PHYSICS

2020

QUESTIONS

(Two Hours)

Answer to this Paper must be written on the paper provided separately.

*You will **not** be allowed to write during the first **15** minutes.*

This time is to be spent in reading the question paper. The time given at the head of this Paper is the time allowed for writing the answer.

Section I** is compulsory. Attempt **any four** question from **Section II.

The intended marks for questions or parts of questions are given in brackets [].

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

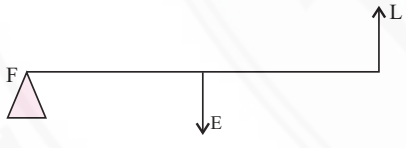
(a) **(i)** *Define moment of force.* [2]

(ii) *Write the relationship between the SI and CGS unit of moment of force.*

(b) *Define a kilowatt hour. How is it related to joule ?* [2]

(c) *A satellite revolves around a planet in a circular orbit. What is the work done by the satellite at any instant ? Give a reason.* [2]

(d) **(i)** *Identify the class of the lever shown in the diagram below :* [2]



(ii) *How is it possible to increase the M. A. of the above lever without increasing its length ?*

(e) *Give one example of each when :* [2]

(i) *Chemical energy changes into electrical energy.*

(ii) *Electrical energy changes into sound energy.*

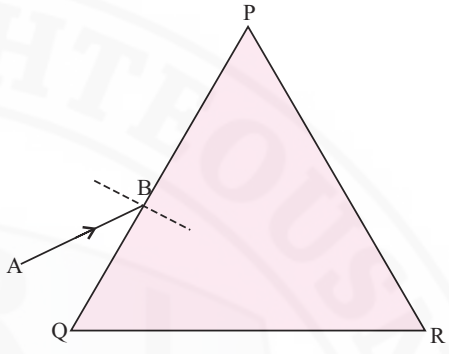
Question 2.

(a) *A crane 'A' lifts a heavy load in 5 seconds, whereas another crane 'B' does the same work in 2 seconds. Compare the power of crane 'A' to that of crane 'B'.* [2]

(b) *A ray of light falls normally on a rectangular glass slab.* [2]

Draw a ray diagram showing the path of the ray till it emerges out of the slab.

(c) *Complete the path of the monochromatic light ray AB incident on the surface PQ of the equilateral glass prism PQR till it emerges out of the prism due to refraction.* [2]



(d) *Where should an object be placed in front of a convex lens in order to get :* [2]

(i) *an enlarged real image*

(ii) *enlarged virtual image ?*

(e) *A pond appears to be 2.7 m deep. If the refractive index of water is $\frac{4}{3}$, find the actual depth of the pond.* [2]

Question 3.

(a) *The wave lengths for the light of red and blue colours are nearly 7.8×10^{-7} m and 4.8×10^{-7} m respectively.* [2]

(i) *Which colour has the greater speed in a vacuum ?*

(ii) *Which colour has a greater speed in glass ?*

(b) *Draw a graph between displacement from mean position and time for a body executing free vibration in a vacuum.* [2]

(c) *A sound wave travelling in water has wavelength 0.4 m.* [2]

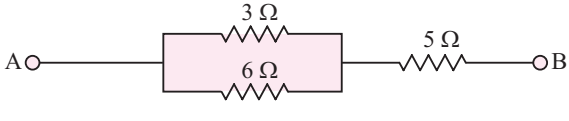
Is this wave audible in air ? (The speed of sound in water = 1400 ms^{-1})

(d) *Why does stone lying in the sun get heated up much more than water lying for the same duration of time ?* [2]

(e) *Why is it not advisable to use a piece of copper wire as fuse wire in an electric circuit ?* [2]

Question 4.

(a) *Calculate the total resistance across AB :* [2]



(b) *Two metallic blocks P and Q having masses in ratio 2 : 1 are supplied with the same amount of heat. If*

their temperatures rise by same degree, compare their specific heat capacities. [2]

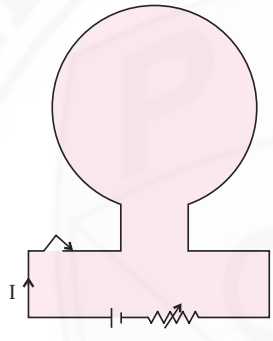
(c) *When a current carrying conductor is placed in a magnetic field, it experiences a mechanical force. What should be the angle between the magnetic field and the length of the conductor so that the force experienced is :* [2]

(i) *Zero*

(ii) *Maximum ?*

(d) *A nucleus* $_{84}X^{202}$ *of an element emits an alpha particle followed by a beta particle. The final nucleus is* $_{a}Y^{b}$. *Find a and b.* [2]

(e) *The diagram below shows a loop of wire carrying current I :* [2]



(i) *What is the magnetic polarity of the loop that faces us ?*

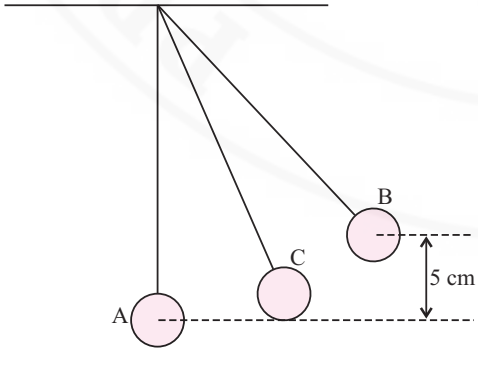
(ii) *With respect to the diagram how can we increase the strength of the magnetic field produced by this loop ?*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) *The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is zero. At the position B the pendulum bob is raised by 5 m.* [3]



(i) *What is the potential energy of the pendulum at the position B ?*

(ii) *What is the total mechanical energy at point C ?*

(iii) *What is the speed of the bob at the position A when released from B ?*

(Take g = 10 ms^{-2} and there is no loss of energy.)

(b) **(i)** *With reference to the direction of action, how does a centripetal force differ from a centrifugal force during uniform circular motion ?* [3]

(ii) *Is centrifugal force the force of reaction of centripetal force ?*

(iii) *Compare the magnitudes of centripetal and centrifugal force.*

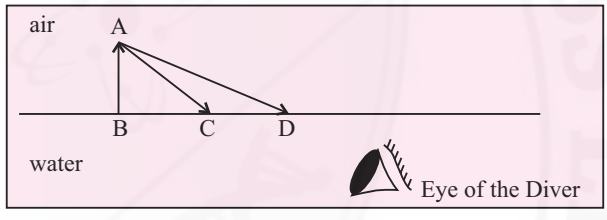
(c) *A block and tackle system of pulleys has velocity ratio 4.* [4]

(i) *Draw a neat, labelled diagram of the system indicating clearly the points of application and direction of load and effort.*

(ii) *What will be its V. R. if the weight of the movable block is doubled ?*

Question 6.

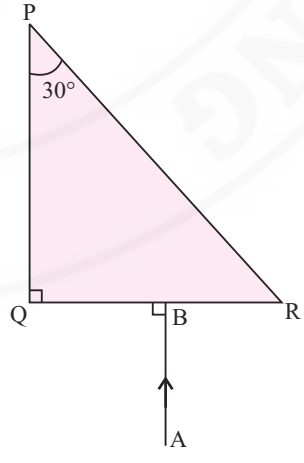
(a) *A diver in water looks obliquely at an object AB in air.* [3]



(i) *Does the object appear taller, shorter or of the same size to the diver ?*

(ii) *Show the path of two rays AC and AD starting from the tip of the object as it travels towards the diver in water and hence obtain the image of the object.*

(b) *Complete the path of the ray AB through the glass prism in PQR till it emerges out of the prism. Given the critical angle of the glass as 42°.* [3]



(c) *A lens of focal length 20 cm forms an inverted image at a distance 60 cm from the lens.* [4]

(i) *Identify the lens.*

(ii) *How far is the lens present in front of the object ?*

(iii) *Calculate the magnification of the image.*

Question 7.

(a) *Give reasons for the following :* [3]

During the day :

(i) *Clouds appear white.*

(ii) *Sky appears blue.*

(b) **(i)** *Name the system which enables us to locate underwater objects by transmitting ultrasonic waves and detecting the reflecting impulse.* [3]

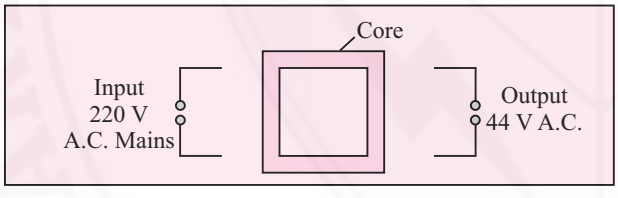
(ii) *What are acoustically measurable quantities related to pitch and loudness ?*

(c) **(i)** *When a tuning fork [vibrating] is held close to ear, one hears a faint hum. The same [vibrating tuning fork] is held such that its stem is in contact with the table surface, then one hears a loud sound. Explain.* [4]

(ii) *A man standing in front of a vertical cliff fires a gun. He hears the echo after 3.5 seconds. On moving closer to the cliff by 84 m, he hears the echo after 3 seconds. Calculate the distance of the cliff from the initial position of the man.*

Question 8.

(a) *The diagram below shows the core of a transformer and its input and output connections.* [3]



(i) *State the material used for the core.*

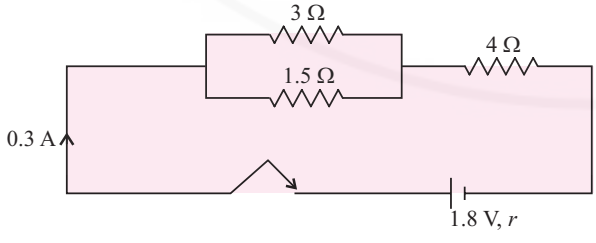
(ii) *Copy and complete the diagram of the transformer by drawing input and output coils.*

(b) **(i)** *What are superconductors ?* [3]

(ii) *Calculate the current drawn by an appliance rated 110 W, 220 V when connected across 220 V supply.*

(iii) *Name a substance whose resistance decreases with the increase in temperature.*

(c)



The diagram above shows three resistors connected across a cell of e.m.f. 1.8 V and internal resistance r. Calculate : [4]

(i) *Current through 3 Ω resistor.*

(ii) *The internal resistance r.*

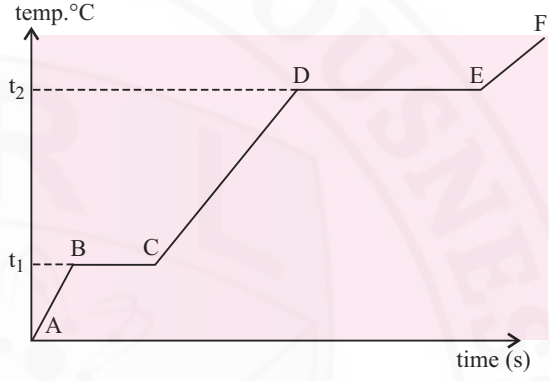
Question 9.

(a) **(i)** *Define heat capacity of a substance.* [3]

(ii) *Write the SI unit of heat capacity.*

(iii) *What is the relationship between heat capacity and specific heat capacity of a substance ?*

(b) *The diagram below shows the change of phases of a substance on a temperature vs time graph on heating the substance at a constant rate.* [3]



(i) *Why is the slope of CD less than slope of AB ?*

(ii) *What is the boiling and melting point of the substance ?*

(c) *A piece of ice of mass 60 g is dropped into 140 g of water at 50°C.* [4]

Calculate the final temperature of water when all the ice has melted.

(Assume no heat is lost to the surrounding)

Specific heat capacity of water = 4.2 $Jg^{-1}k^{-1}$

Specific latent heat of fusion of ice = 336 Jg^{-1}

Question 10.

(a) **(i)** *Draw a neat labeled diagram of a d.c. motor.* [3]

(ii) *Write any one use of a d.c motor.*

(b) (i) *Differentiate between nuclear fusion and nuclear fission.* [3]

(ii) *State one safety precaution in the disposal of nuclear waste.*

(c) *An atomic nucleus A is composed of 84 protons and 128 neutrons. The nucleus A emits an alpha particle and is transformed into a nucleus B.* [4]

(i) *What is the composition of B ?*

(ii) *The nucleus B emits a beta particle and is transformed into a nucleus C. What is the composition of C ?*

(iii) *What is mass number of the nucleus A ?*

(iv) *Does the composition of C change if it emits gamma radiations ?*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** The turning effect of force on the body about an axis is due to the moment of force applied on the body and is equal to the product of the magnitude of the force and the perpendicular distance of the line of action of the force from the axis of rotation.

(ii) $1\ Nm = 10^7$ dyn cm or 1 dyn cm $= 10^{-7}$ Nm.

(b) One kilowatt hour (kWh) is the energy spent or work done by a source of power 1 kW in 1 hour.

$$1\ kWh = 3.6 \times 10^6\ J \text{ or } 3{\cdot}6\ MJ$$

(c) The work done by the satellite at any instant is zero because the force required (centripetal force) to go around the planet is perpendicular to the displacement at any instant of its motion.

(d) **(i)** Class III lever.

(ii) Without increasing the length of the lever, its mechanical advantage can be increased by shifting the effort (E) towards the load (L), *i.e.,* by decreasing the load arm.

(e) **(i)** A dry cell in use.

(ii) Loud speaker.

Answer 2.

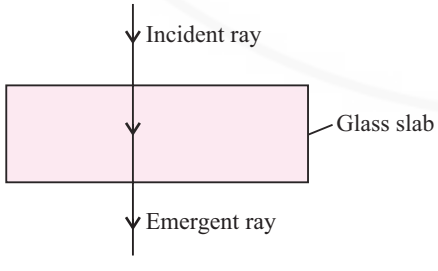
(a) Let the work done in both case be x joule.

Crane A	**Crane B**
$W_1 = x$ Joule	$W_2 = x$ Joule
$t_1 = 5\ s$	$t_2 = 2\ s$
$P_A = \frac{W_1}{t_1} = \frac{x}{5} W$	$P_B = \frac{W_2}{t_2} = \frac{x}{2} W$

$$\therefore \frac{P_A}{P_B} = \frac{x/5}{x/2} = \frac{x}{5} \times \frac{2}{x} = \frac{2}{5}$$

$\therefore$ Power of Crane A : Power of Crane B = 2 : 5

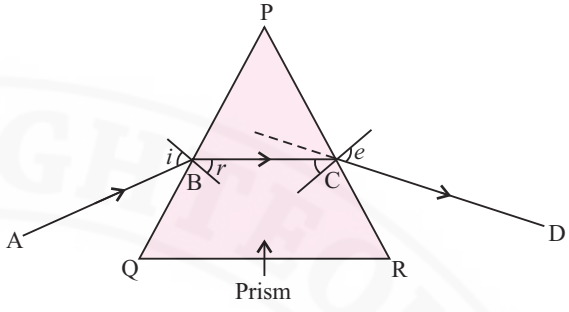
(b)



(c) AB → Incident Ray

BC → Refracted Ray

CD → Emergent Ray.



(d) **(i)** Object must be placed between first focal point (F_1) and the centre of curvature ($2F_1$) of the lens.

(ii) Object must be placed between the first focal point (F_1) and the lens.

(e) Given : Apparent depth = 2.7 m

$$\mu_w = \frac{4}{3}$$

$$\because \quad \mu_w = \frac{\text{Actual depth}}{\text{Apparent depth}}$$

$$\Rightarrow \quad \frac{4}{3} = \frac{\text{Actual depth}}{2.7}$$

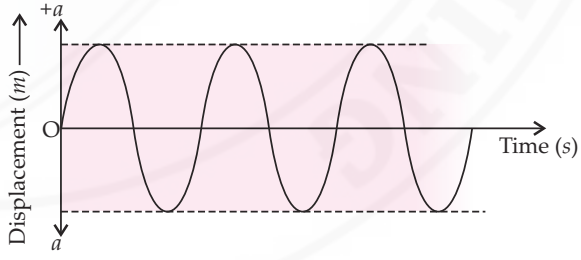
$$\Rightarrow \quad \text{Actual depth} = \frac{4}{3} \times 2.7\ m = 3.6\ m$$

Answer 3.

(a) **(i)** Both colours of light have same speed in vacuum.

(ii) In glass speed of red light is more than that of blue light.

(b)



(c) Given : $\lambda = 0.4$ m

$$V = 1400\ ms^{-1}$$

$$\because \quad V = f\lambda \Rightarrow f = \frac{V}{\lambda} = \frac{1400}{0.4}\ Hz$$

$$= 3500\ Hz$$

$\because$ Frequency remains unchanged in air, the wave is audible in air because 3500 Hz falls in the audible range of frequency.

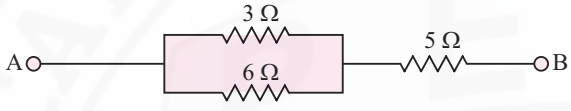
(d) The specific heat capacity of stone is much less than the specific heat capacity of water, hence for the same heat supplied the temperature of stone rises much more than water for the same duration and gets heated up much more.

(e) Copper wire should not be used as a fuse wire because it has high melting point and its specific resistance is much less than a normal fuse wire. (Normal fuse wire should have low melting point and high resistivity)

Answer 4.

(a) Equivalent resistance of 3 Ω and 6 Ω in parallel is,

$$R_1 = \frac{3\times 6}{6+3} = \frac{18}{9} = 2\ \Omega$$



Total resistance across AB is $R_1 + R_2 = (5 + 2) = 7\ \Omega$.

(b) Let specific heat capacity of block P and block Q be C_P and C_Q respectively.

Metallic block P	**Metallic block B**
$m_1 = 2$ m	$m_2 = $ m
$c_1 = C_P$	$c_2 = C_Q$
$\Delta T = \Delta T$	$\Delta T = \Delta T$
$H_1 = m_1 c_1\ \Delta T$	$H_2 = m_2 c_2\ \Delta T$
$= 2m\ C_P\ \Delta T$	$= m\ C_Q\ \Delta T$

$\because \quad H_1 = H_2$

$\Rightarrow\ 2m\ C_P\ \Delta T = mC_Q\ \Delta T$

$$\therefore \quad \frac{C_P}{C_Q} = \frac{m\times\Delta T}{2m\times\Delta T} = \frac{1}{2}$$

$\therefore$ Ratio of specific heat capacities of block P and block Q is 1 : 2.

(c) **(i)** 0°

(ii) 90°

(d) $_{84}X^{202} \longrightarrow {}_{82}Z^{198} + {}_{2}He^{4}$

$_{82}Z^{198} \longrightarrow {}_{83}Y^{198} + {}_{-1}\beta^{0}$

$\therefore a = 83$, and $b = 198$

(e) **(i)** South

(ii) By increasing the strength of the current.

SECTION-II

Answer 5.

(a) **(i)** Given :

$m = 200$ g $= 0.2$ kg, $g = 10\ \text{ms}^{-2}$, $h = 5$ m

$\therefore$ Potential energy (U) $= mgh$

at position B $= 0.2 \times 10 \times 5 = 10$ J

(ii) 10 J $\quad (\because$ K + U = constant)

(iii) At position A, kinetic energy (K) = 10 J

$$\frac{1}{2}mv^2 = 10$$

$$\Rightarrow \frac{1}{2} \times 0.2 \times v^2 = 10$$

$$\Rightarrow \quad v^2 = \frac{10\times 2}{0.2} = 100$$

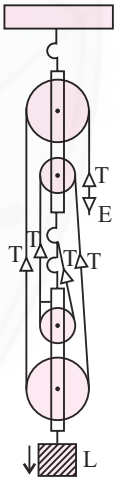
$$\therefore \quad v = \sqrt{100} = 10\ \text{ms}^{-1}$$

(b) **(i)** Centripetal force acts in a direction towards the centre of circular path whereas centrifugal force acts in a direction away from the centre of circular path.

(ii) No, centrifugal force is not the force of reaction of centripetal force because action and reaction do not act on the same body.

(iii) Magnitudes of centripetal and centrifugal forces are in the ratio 1 : 1.

(c) **(i)** Diagram of a block and tackle system having velocity ratio = 4

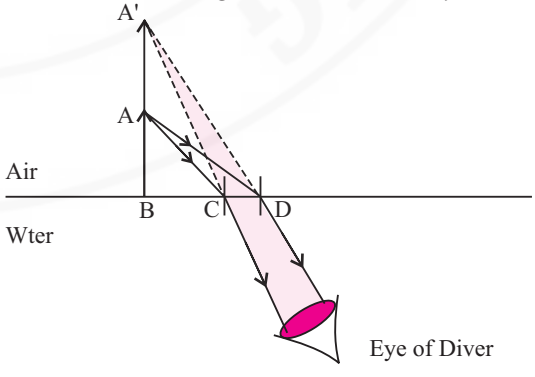


(ii) If weight of movable pulley is doubled there will be no change in the velocity ratio.

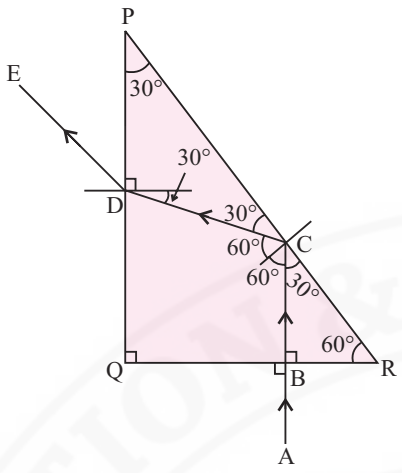
Answer 6.

(a) **(i)** The object will appear taller.

(ii) A'B is the image formed of the object AB.



(b) The path of the ray till it emerges out of the prism is ABCDE.



(c) **(i)** Convex lens

(ii) Given : $f = +20$ cm, $v = +60$ cm

$$\because \quad \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{20} = \frac{1}{60} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{u} = \frac{1}{60} - \frac{1}{20}$$

$$= \frac{1-3}{60} = -\frac{2}{60} = -\frac{1}{30}$$

$$\therefore \quad u = -30 \text{ cm}$$

The lens is at a distance 30 cm in front of the object.

(iii) $m = \frac{v}{u} = \frac{+60}{-30} = -2$ [– ve sign because image is real]

Answer 7.

(a) **(i)** During the day, clouds appear white because they contain dust particles and aggregates of water molecules of size bigger than the wavelength of visible light, hence they scatter all colours of incident white light from the sun to the same extent.

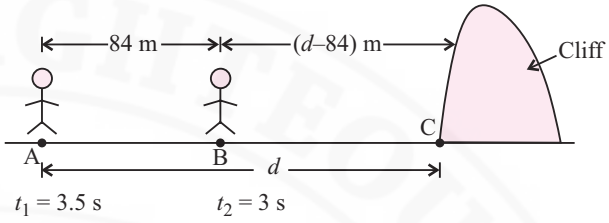
(ii) During the day, sky appears blue because blue (or violet) light due to its short wavelength is scattered more as compared to the red light of long wavelength. Hence, the sky other than the direction of sun appears blue.

(b) **(i)** SONAR or Sound Navigation and Ranging.

(ii) The acoustically measurable quantities related to pitch is frequency or wavelength and for loudness, it is intensity of sound.

(c) **(i)** A tuning fork held close to ear, disturbs a small volume of air and hence, sound heard is faint, when the handle of the vibrating tuning fork is held against table, it sets up forced vibrators in the tabletop. As tabletop has a large surface area, large volume of air is set into vibration transmitting more energy thereby producing loud sound.

(ii) Let the initial position of man from the cliff be d metre



At Position A	At Position B
$d_1 = d$ metre	$d_2 = (d - 84)$ m
$t_1 = 3.5$ s	$t_2 = 3$ s

$$\text{Speed of sound} = \frac{2d}{t}$$

$$\Rightarrow \quad \frac{2d_1}{t_1} = \frac{2d_2}{t_2}$$

$$\Rightarrow \quad \frac{2d}{3.5} = \frac{2(d-84)}{3}$$

$$\Rightarrow \quad 6d = 7d - 588$$

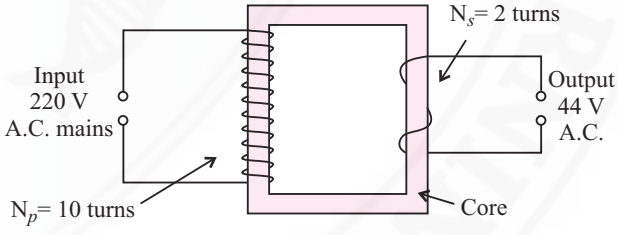
$$\Rightarrow \quad d = 588 \text{ m}$$

$\therefore$ Distance of cliff from initial position of man = 588 m.

Answer 8.

(a) **(i)** The material used for core is laminated soft iron.

(ii)



$$\text{Turns ratio} = \frac{N_s}{N_p} = \frac{E_s}{E_p} = \frac{44}{220} = \frac{1}{5}$$

Hence, number of turns in secondary coil : primary coil is equal to 1 : 5

(b) **(i)** Superconductors are substances of zero resistance at temperature closer to absolute zero.

(ii) P = 110 W V = 220 volt

$$\therefore \quad \text{Current I} = \frac{P}{V} = \frac{110}{220} \text{ A}$$

$$= 0.5 \text{ A}$$

(iii) For semiconductors such as silicon, germanium, or carbon resistance decreases with the increase in temperature.

(c) **(i)** Equivalent resistance of 3Ω and 1.5Ω in parallel,

$$R_1 = \frac{3\times1.5}{3+1.5}\Omega = 1\Omega$$

Potential difference, across R_1

$\Rightarrow$ $V_1 = IR_1$

$= 0.3 \times 1 = 0.3V$

$\therefore$ Current through 3Ω resistor,

$$I_1 = \frac{V_1}{3} = \frac{0.3}{3} = 0.1A$$

(ii) Total external resistance R = 1 + 4 = 5Ω

$\because$ $E = I(R + r)$

$\Rightarrow$ $1.8 = 0.3(5 + r)$

$\Rightarrow$ $\frac{1.8}{0.3} = 5 + r \Rightarrow 6 = 5 + r$

$\therefore$ $r = 6 - 5 = 1\Omega$

Answer 9.

(a) **(i)** Heat capacity of a body is the amount of heat energy required to raise its temperature by 1 Kelvin.

(ii) SI Unit of heat capacity is joule per Kelvin (JK^{-1}).

(iii) Heat capacity = Mass × Specific heat capacity

(b) **(i)** The slope of CD is less than slope of AB because specific heat capacity of liquid phase of same material can be different from that of solid phase of same material.

(ii) Boiling point is t_2°C and melting point is t_1°C.

(c) Let final temperature of water = x°C

Ice	Water
$m_1 = 60$ g	$m_2 = 140$ g
$T_1 = 0$°C	$T_1 = 50$°C
$T_2 = x$°C	$T_2 = x$°C
Rise in temp.	fall in temp.
$(\Delta T) = (x - 0)$°C $= x$°C	$(\Delta T) = (50 - x)$°C

Heat gained by ice = $M_1L + m_1c\Delta T$

$= (60 \times 336 + 60 \times 4.2 \times x)$ J

Heat lost by water = $m_2c\Delta T$

$= 140 \times 4.2 \times (50 - x)$ J

Applying, the principle of mixtures,

$140 \times 4.2 \times (50 - x) = 60 \times 336 + 60 \times 4.2 \times x$

$\Rightarrow$ $4.2(7000 - 140x - 60x) = 60 \times 336$

$\Rightarrow$ $7000 - 200x = \frac{60\times336}{4.2}$

$= \frac{60\times336}{42}\times10$

$= 4800$

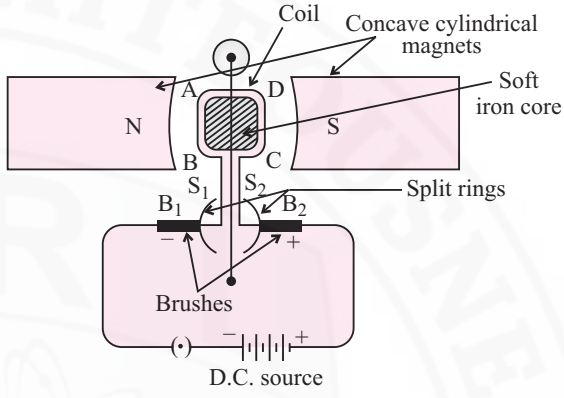
$\Rightarrow$ $200x = 2200$

$\Rightarrow$ $x = 11$°C

$\therefore$ Final temperature of water = 11°C

Answer 10.

(a) **(i)** Diagram of a d.c. motor.



(ii) D.C. motor is used to produce rotational motion by using electricity in devices such as spinning and weaving machines, Fan etc.

(b) **(i)**

Nuclear Fission	Nuclear Fusion
1. In nuclear fission when neutrons are bombarded on a heavy nucleus, it splits in two nearly equal light fragments.	In nuclear fusion, two light nuclei combine to form a heavy nucleus at a very high temperature and high pressure.
2. It can be controlled.	It cannot be controlled.

(ii) For disposal of nuclear waste, they must be first kept in thick casks and then buried in specially constructed deep underground stores and also while handling nuclear waste, we should wear special lined lead aprons and lead gloves.

(c) For nucleus A

Atomic no. (Z) = 84

Mass no. (A) = 84 + 128 = 212

(i) $_{84}A^{212} \xrightarrow{\alpha} {}_{82}B^{208}$ Nucleus B will have 82 protons and (208 – 82) = 126 neutrons.

(ii) $_{82}B^{208} \xrightarrow{\beta} {}_{83}C^{208}$ Nucleus C will have 83 protons and (208 – 83) = 125 neutrons

(iii) Mass number of nucleus, A = 212

(iv) No, the composition of nucleus C does not change due to emission of gamma radiations.

●●

PHYSICS

2019

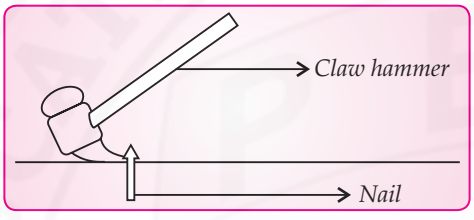
QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) *The diagram below shows a claw hammer used to remove a nail :* **[2]**



(i) *To which class of lever does it belong ?*

(ii) *Give one more example of the **same class** of lever mentioned by you in* **(i)** *for which the **mechanical advantage is greater than one**.*

(b) *Two bodies A and B have masses in the ratio 5 : 1 and their kinetic energies are in the ratio 125 : 9. Find the ratio of their velocities.* **[2]**

(c) **(i)** *Name the physical quantity which is measured in calories.*

(ii) *How is calorie related to the S.I. unit of that quantity ?* **[2]**

(d) **(i)** *Define couple.*

(ii) *State the S.I. unit of moment of couple.* **[2]**

(e) **(i)** *Define critical angle.*

(ii) *State one important factor which affects the critical angle of a given medium.* **[2]**

Question 2.

(a) *An electromagnetic radiation is used for photography in fog.* **[2]**

(i) *Identify the radiation.*

(ii) *Why is this radiation mentioned by you, ideal for this purpose ?*

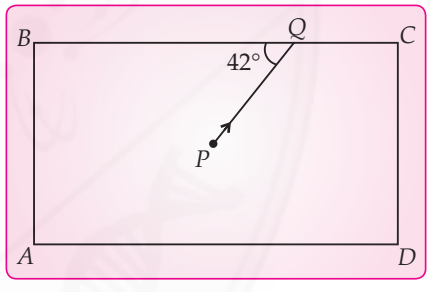
(b) **(i)** *What is the relation between the refractive index of water with respect to air (${}_a\mu_w$) and the refractive index of air with respect to water (${}_w\mu_a$).*

(ii) *If the refractive index of water with respect to air (${}_a\mu_w$) is $\frac{5}{3}$. Calculate the refractive index of air with respect to water (${}_w\mu_a$).* **[2]**

(c) *The specific heat capacity of a substance A is 3,800 $Jkg^{-1}K^{-1}$ and that of a substance B is 400 $Jkg^{-1}K^{-1}$. Which of the two substances is a good conductor of heat ? Give a reason for your answer.* **[2]**

(d) *A man playing a flute is able to produce notes of different frequencies. If he closes the holes near his mouth, will the pitch of the note produced, increase or decrease ? Give a reason.* **[2]**

(e) *The diagram below shows a light source P embedded in a rectangular glass block ABCD of critical angle 42°. Complete the path of the ray PQ till it emerges out of block. [Write necessary angles.]* **[2]**



Question 3.

(a) **(i)** *If the lens is placed in water instead of air, how does its focal length change ?*

(ii) *Which lens, thick or thin has greater focal length ?* **[2]**

(b) *Two waves of the same pitch have amplitudes in the ratio 1 : 3. What will be the ratio of their :* **[2]**

(i) *intensities and*

(ii) *frequencies ?*

(c) *How does an increase in the temperature affect the specific resistance of a :* **[2]**

(i) *Metal and*

(ii) *Semiconductor ?*

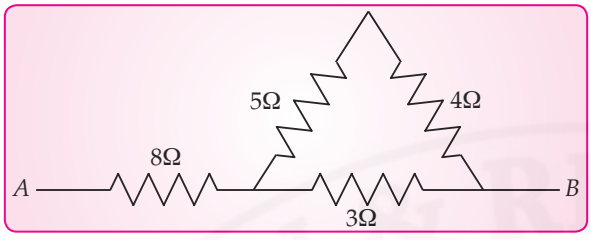
(d) **(i)** *Define resonant vibrations.*

(ii) *Which characteristic of sound, makes it possible to recognize a person by his voice without seeing him ?* **[2]**

(e) *Is it possible for a hydrogen (${}_1^1H$) nucleus to emit an alpha particle ? Give a reason for your answer.* **[2]**

Question 4.

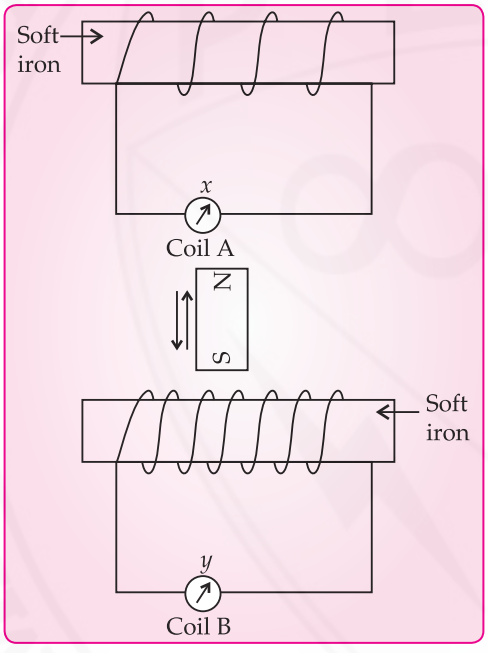
(a) *Calculate the effective resistance across AB :* **[2]**



(b) **(i)** *State whether the specific heat capacity of a substance remains the same when its state changes from solid to liquid.*

(ii) *Give one example to support your answer.* **[2]**

(c) *A magnet kept at the centre of two coils A and B is moved to and fro as shown in the diagram. The two galvanometers show deflection.* **[2]**



*State with **a reason** whether :*

$x > y$

or $x < y$.

[*x and y are magnitudes of deflection*]

(d) **(i)** *Why is a nuclear fusion reaction called a thermo nuclear reaction ?* **[2]**

(ii) *Complete the reaction :*

$^{3}He_{2} + {}^{2}H_{1} \longrightarrow {}^{4}He_{2} + \ldots\ldots + \text{Energy}$

(e) *State two ways to increase the speed of rotation of a D.C. motor.* **[2]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

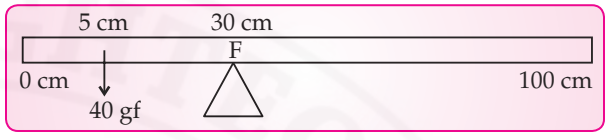
Question 5.

(a) *A body of mass 10 kg is kept at a height of 5 m. It is allowed to fall and reach the ground.* **[3]**

(i) *What is the total mechanical energy possessed by the body at the height of 2 m assuming it is a frictionless medium ?*

(ii) *What is the kinetic energy possessed by the body just before hitting the ground ?* *(Take $g = 10\ m/s^2$.)*

(b) *A uniform meter scale is in equilibrium as shown in the diagram :* **[3]**



(i) *Calculate the weight of the meter scale.*

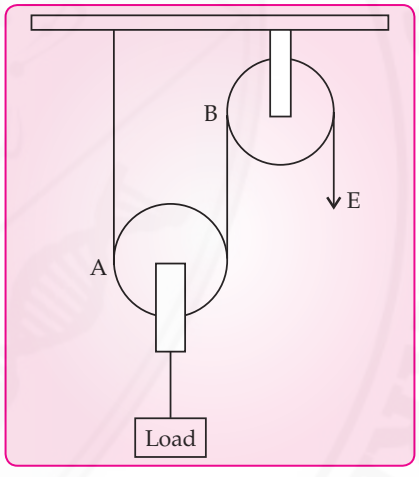
(ii) *Which of the following options is correct to keep the ruler in equilibrium when 40 gf wt is shifted to 0 cm mark ?*

F is shifted towards 0 cm.

Or

F is shifted towards 100 cm.

(c) *The diagram below shows a pulley arrangement :* **[4]**



(i) *Copy the diagram and mark the direction of tension on each strand of the string.*

(ii) *What is the velocity ratio of the arrangement ?*

(iii) *If the tension acting on the string is T, then what is the relationship between T and effort E ?*

(iv) *If the free end of the string moves through a distance x, find the distance by which the load is raised.*

Question 6.

(a) *How does the angle of deviation formed by a prism change with the increase in the angle of incidence ?*

Draw a graph showing the variation in the angle of deviation with the angle of incidence at a prism surface. **[3]**

(b) *A virtual, diminished image is formed when an object is placed between the optical centre and the principal focus of a lens.* **[3]**

(i) *Name the type of lens which forms the above image.*

(ii) *Draw a ray diagram to show the formation of the image with the above stated characteristics.*

(c) *An object is placed at a distance 24 cm in front of a convex lens of focal length 8 cm.* **[4]**

(i) *What is the nature of the image so formed ?*

(ii) *Calculate the distance of the image from the lens.*

(iii) *Calculate the magnification of the image.*

Question 7.

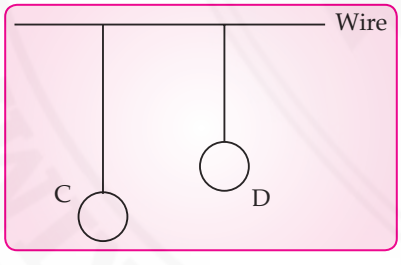
(a) *It is observed that during march-past we hear a base drum distinctly from a distance compared to the side drums.* **[3]**

(i) *Name the characteristic of sound associated with the above observation.*

(ii) *Give a reason for the above observation.*

(b) *A pendulum has a frequency of 4 vibrations per second. An observer starts the pendulum and fires a gun simultaneously. He hears the echo from the cliff after 6 vibrations of the pendulum. If the velocity of sound in air is 340 m/s, find the distance between the cliff and the observer.* **[3]**

(c) *Two pendulums C and D suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating.* **[4]**



(i) *Name the type of oscillation, C will execute.*

(ii) *Name the type of oscillation, D will execute.*

(iii) *If the length of D is made equal to C then what difference will you notice in the oscillations of D ?*

(iv) *What is the name of the phenomenon when the length of D is made equal to C ?*

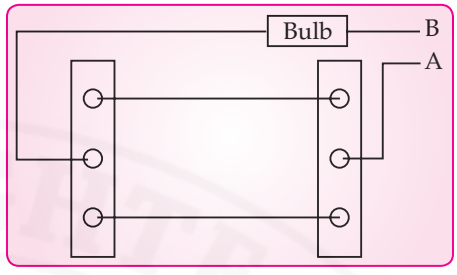
Question 8.

(a) **(i)** *Write one advantage of connecting electrical appliances in parallel combination.*

(ii) *What characteristics should a fuse wire have ?*

(iii) *Which wire in a power circuit is connected to the metallic body of the appliance ?* **[3]**

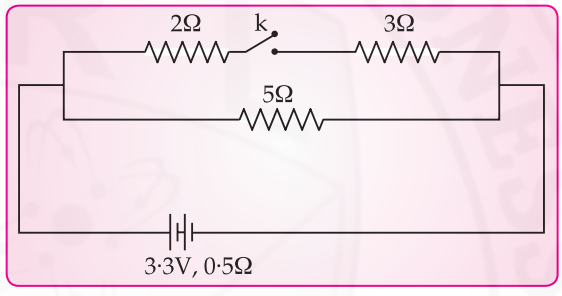
(b) *The diagram below shows a dual control switch circuit connected to a bulb.* **[3]**



(i) *Copy the diagram and complete it so that the bulb is switched ON.*

(ii) *Out of A and B which one is the live wire and which one is the neutral wire ?*

(c)



The diagram above shows a circuit with the key k open. Calculate : **[4]**

(i) *the resistance of the circuit when the key k is open.*

(ii) *the current drawn from the cell when the key k is open.*

(iii) *the resistance of the circuit when the key k is closed.*

(iv) *the current drawn from the cell when the key k is closed.*

Question 9.

(a) **(i)** *Define Calorimetry.*

(ii) *Name the material used for making a Calorimeter.*

(iii) *Why is a Calorimeter made up of thin sheets of the above material answered in* **(ii)** ? **[3]**

(b) *The melting point of naphthalene is 80°C and the room temperature is 30°C. A sample of liquid naphthalene at 100°C is cooled down to the room temperature. Draw a temperature time graph to represent this cooling. In the graph, mark the region which corresponds to the freezing process.* **[3]**

(c) *104 g of water at 30°C is taken in a calorimeter made of copper of mass 42 g. When a certain mass of ice at 0°C is added to it, the final steady temperature of the mixture after the ice has melted, was found to be 10°C. Find the mass of ice added.* [*Specific heat capacity of*

water = 4·2 Jg^{-1} °C^{-1}; Specific latent heat of fusion of ice = 336 Jg^{-1}; Specific heat capacity of copper = 0·4 Jg^{-1}° C^{-1}] **[4]**

Question 10.

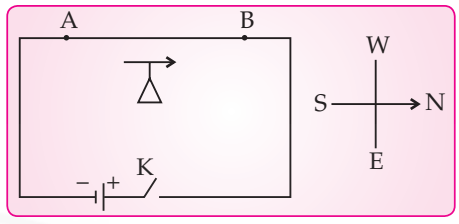
(a) *Draw a neat labelled diagram of an A.C. generator.* **[3]**

(b) **(i)** *Define nuclear fission.*

(ii) *Rewrite and complete the following nuclear reaction by filling in the atomic number of Ba and mass number of Kr :*

$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}_{\cdots}Ba + {}^{\cdots\cdots}_{36}Kr + 3\,{}^{1}_{0}n + Energy$ **[3]**

(c) *The diagram below shows a magnetic needle kept just below the conductor AB which is kept in North-South direction.* **[4]**



(i) *In which direction will the needle deflect when the key is closed ?*

(ii) *Why is the deflection produced ?*

(iii) *What will be the change in the deflection if the magnetic needle is taken just above the conductor AB ?*

(iv) *Name one device which works on this principle.*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** Class first lever.

(ii) Pliers.

(b) Let mass, kinetic energy and velocity of bodies A and B be (m_A, m_B), (k_A, k_B) and (v_A, v_B) respectively.

Given : $\dfrac{m_A}{m_B} = \dfrac{5}{1}$

and $\dfrac{k_A}{k_B} = \dfrac{125}{9} \qquad \left[\because k = \dfrac{1}{2}mv^2\right]$

$\Rightarrow \dfrac{\frac{1}{2}m_A(v_A)^2}{\frac{1}{2}m_B(v_B)^2} = \dfrac{125}{9}$

$\Rightarrow \dfrac{m_A}{m_B} \times \left(\dfrac{v_A}{v_B}\right)^2 = \dfrac{125}{9}$

$\Rightarrow \dfrac{5}{1} \times \left(\dfrac{v_A}{v_B}\right)^2 = \dfrac{125}{9}$

$\Rightarrow \left(\dfrac{v_A}{v_B}\right)^2 = \dfrac{125}{9} \times \dfrac{1}{5} = \dfrac{25}{9}$

$\Rightarrow \dfrac{v_A}{v_B} = \sqrt{\dfrac{25}{9}} = \dfrac{5}{3}$

$\therefore \quad v_A : v_B = 5 : 3$

(c) **(i)** Heat energy is measured in calories.

(ii) 1 calorie = 4·186 Joule.

(d) **(i)** Two equal and opposite parallel forces, not acting along the same line forms a couple. A couple is always needed to produce rotation.

(ii) S.I. unit of moment of couple is Newton × metre (Nm).

(e) **(i)** The angle of incidence in the denser medium corresponding to which the angle of refraction in the rarer medium is 90° is called critical angle.

$$\text{Critical angle } (i_c) = \sin^{-1}\left(\frac{1}{\mu}\right)$$

(ii) Critical angle for a given pair of media depends on their refractive indices.

Answer 2.

(a) **(i)** Infrared radiation.

(ii) They have low frequency, the energy associated with them is also low so they do not scatter much and can penetrate appreciably through it.

(b) **(i)** $_a\mu_w = \dfrac{\mu_w}{\mu_a}$

$_w\mu_a = \dfrac{\mu_a}{\mu_w}$

$\therefore \quad _a\mu_w = \dfrac{1}{_w\mu_a}$

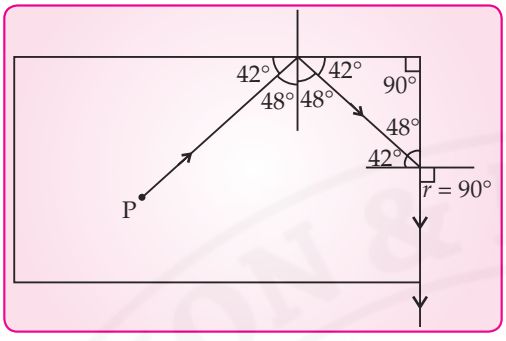
(ii) Given, $_a\mu_w = \dfrac{5}{3}$

$\therefore \quad _w\mu_a = \dfrac{1}{_a\mu_w} = \dfrac{3}{5}$

(c) Substance B with specific heat capacity 400 J kg^{-1} K^{-1} is a good conductor of heat because for the same heat energy and same mass, the rise in temperature of B will be more.

(d) If the man closes the holes in a flute near his mouth a sound of lower frequency note will be produced because the length of vibrating air column increases and the frequency of vibrating air column is inversely proportional to the length of vibrating air column.

(e) The complete ray diagram with necessary angles is as follows :



Answer 3.

(a) **(i)** The focal length of the lens will increase when lens is immersed in water.

(ii) Thin lens will have greater focal length.

(b) **(i)**

$$\frac{A_1}{A_2} = \frac{1}{3}$$

$\because$ Intensity, $I \propto A^2$

$$\therefore \quad \frac{I_1}{I_2} = \frac{1}{9}$$

(ii) Pitch is same $\Rightarrow$ frequency is same.

(c) **(i)** Specific resistance of a metal increases with the increase in temperature.

(ii) Specific resistance of a semiconductor decreases with the increase in temperature.

(d) **(i)** When the frequency of the externally applied periodic force on a body is equal to its natural frequency, the body readily begins, to vibrate with an increased amplitude. Such large amplitude vibrations are called resonant vibrations.

(ii) Quality of sound or Timbre.

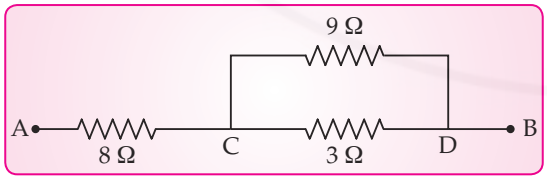
(e) No, it is not possible because an alpha particle ($_2^4He$) consists of two protons and two neutrons.

Answer 4.

(a) Given : 5 Ω and 4 Ω in series

$$\therefore \quad R_1 = (5 + 4)\ \Omega = 9\ \Omega$$

Diagram can be simplified as follows :



Now, 9 Ω and 3 Ω are in parallel.

$$\therefore \quad R_2 = \frac{9 \times 3}{9 + 3} = \frac{27}{12} = \frac{9}{4}\Omega$$

Now, 8 Ω and R_2 are in series

$$\therefore \quad R_3 = 8 + \frac{9}{4} = \frac{41}{4}\Omega = 10{\cdot}25\ \Omega$$

(b) **(i)** No, specific heat capacity of a substance is different in its different phases (states).

(ii) Specific heat capacity of water is 4200 Jkg^{-1} K^{-1} and that of ice is 2100 Jkg^{-1} K^{-1}.

(c) $x < y$ because coil B has more number of turns hence there will be a greater change in magnetic flux linked with the coil B.

(d) **(i)** Nuclear fusion takes place at extremely high temperature and pressure and the two nuclei due to their thermal agitations acquire sufficient kinetic energy so as to overcome the force of repulsion between them when they approach each other, so they get fused. Hence, it is called a thermo nuclear reactions.

(ii) $^3He_2 + {}^2H_1 \longrightarrow {}^4He_2 + \boxed{{}^1H_1}$ + Energy.

(e) **(i)** By increasing the strength of current in the coil.

(ii) By increasing the number of turns in the coil

SECTION-II

Answer 5.

(a) Given : Mass (m) = 10 kg, height (h) = 5 m, g = 10 ms^{-2}, Potential energy (U) = mgh

$$= 10 \times 10 \times 5\ J = 500\ J$$

(i) According to the law of conservation of energy, the sum of kinetic energy (k) and potential energy (U) remains constant when there are no frictional forces.

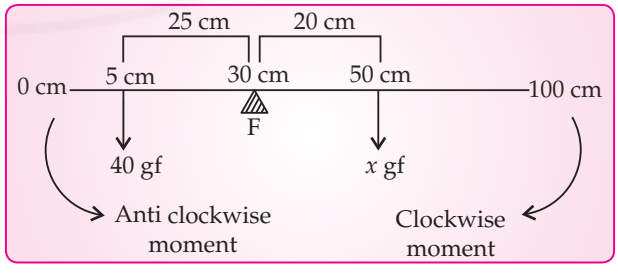
$\therefore$ Total mechanical energy at height of 2 m

= Initial potential energy

= 500 J

(ii) Similarly, according to the law of conservation of energy, the kinetic energy possessed by the body just before touching the ground = 500 J.

(b) **(i)** Let the weight of the meter scale be x gf and it acts at the centre of gravity (*i.e.*, 50 cm mark)



Anticlockwise moment = 40 ×25 gf cm

Clockwise moment = $x \times 20$ gf cm

when the meter scale is balanced,

Clockwise moment = Anticlockwise moment

$\Rightarrow \quad x \times 20 = 40 \times 25$

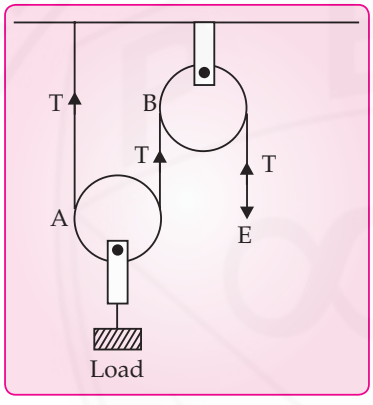
$\Rightarrow \quad x = \frac{40 \times 25}{20}$ gf

$= 50$ gf

$\therefore$ Weight of meter scale is 50 gf.

(ii) F is shifted towards 0 cm.

(c) **(i)** The diagram with direction of tension on each strand is shown below.



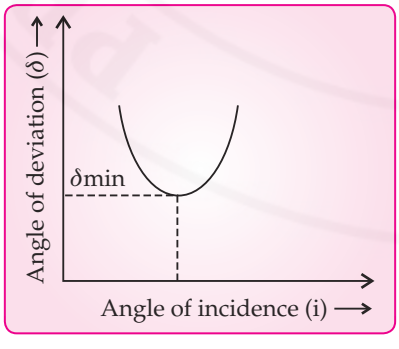
(ii) Velocity ratio = 2

(iii) E = T

(iv) Load is raised by a distance $\frac{x}{2}$.

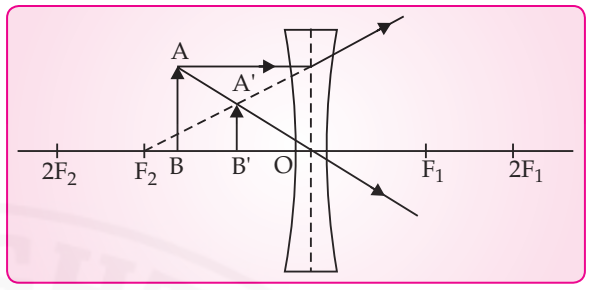
Answer 6.

(a) Experimentally it has been observed that as the angle of incidence increases, the angle of deviation first decreases, reaches to a minimum value for a certain angle of incidence and then an further increasing the angle of incidence, the angle of deviation begins to increase.



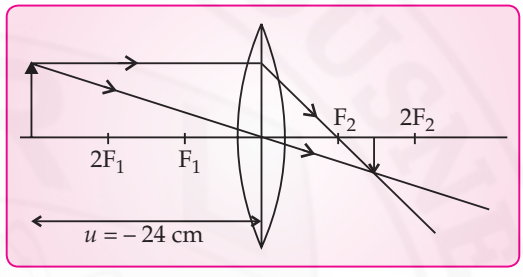
(b) **(i)** A concave lens forms the given image.

(ii) Ray diagram to show the formation of image (A'B') is given below.



(c) **(i)** A real, inverted and diminished image is formed.

(ii) Given : $u = -24$ cm, $f = +8$ cm



From the relation,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{u} + \frac{1}{f}$$

$$= \frac{1}{-24} + \frac{1}{8}$$

$$= \frac{-1+3}{24} = \frac{1}{12}$$

or $v = 12$ cm

Thus, the image is at a distance 12 cm behind the lens.

(iii) Magnification $(m) = \frac{v}{u} = \frac{12}{-24} = -\frac{1}{2}$

Negative sign signifies inverted image.

Answer 7.

(a) **(i)** Loudness

(ii) The sound produced from the base drum is louder than the sound produced by the side drums, hence it can be heard distinctly from a distance as compared to the side drums.

(b) Time taken to complete 4 vibrations = 1 second

Time taken to complete 1 vibration = $\frac{1}{4}$ second

$\therefore$ Time taken to complete 6 vibrations

$$= \frac{1}{4} \times 6 \text{ second}$$

$= 1{\cdot}5$ second

Time (t) = 1·5 s

Velocity (v) = 340 m/s

∴ Distance between the cliff and observer

$$d = \frac{v \times t}{2}$$

$$= \frac{340 \times 1{\cdot}5}{2} \text{ m}$$

$$= 255 \text{ m}$$

(c) **(i)** C will execute free or natural oscillations.

(ii) D will execute forced oscillations.

(iii) The amplitude of oscillations of D will increase and it will oscillate in same phase as that of C.

(iv) Resonance.

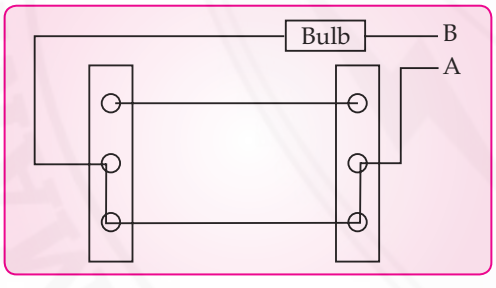
Answer 8.

(a) **(i)** Each appliance gets connected to 220 V supply for its normal working.

(ii) A fuse wire must have low melting point and its specific resistance must be more than that of copper or aluminium.

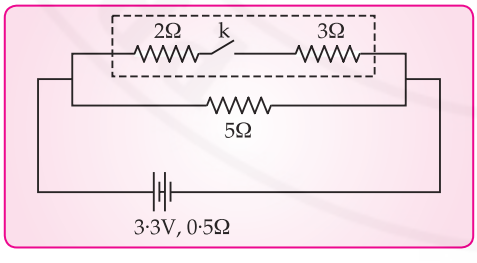
(iii) Earth wire.

(b) **(i)** The diagram below shows the bulb in switched ON mode.



(ii) A is live wire, B is neutral wire.

(c) **(i)** **When the key *k* is open :**



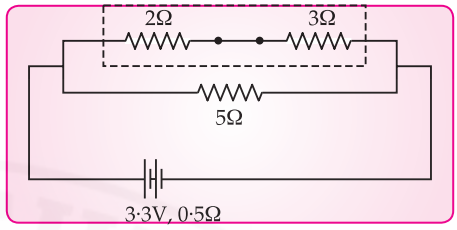
Resistance (R_1) of the circuit = (5 + 0·5) Ω = 5·5 Ω

(ii) Current (I_1) drawn when key *k* is open :

$$I_1 = \frac{V}{R_1} = \frac{3{\cdot}3}{5{\cdot}5.} \text{ A}$$

$$= \frac{3}{5} \text{A} = 0{\cdot}6 \text{ A}$$

(iii) When the key *k* is closed :



2 Ω and 3 Ω are in series and their equivalent resistance = (2 + 3)Ω = 5 Ω

5 Ω and 5 Ω are in parallel

$$\frac{1}{R_P} = \frac{1}{5} + \frac{1}{5} = \frac{1+1}{5} = \frac{2}{5}$$

$$R_P = \frac{5}{2}\Omega = 2{\cdot}5 \ \Omega$$

Resistance of circuit (R_2) when key *k* is closed

$$= (R_P + 0{\cdot}5) \ \Omega$$

$$= (2{\cdot}5 + 0{\cdot}5) \ \Omega$$

$$= 3{\cdot}0 \ \Omega$$

(iv) Current (I_2) drawn when key *k* is closed

$$= \frac{V}{R_2}$$

$$= \frac{3{\cdot}3}{3} \text{ A} = 1{\cdot}1 \text{ A}$$

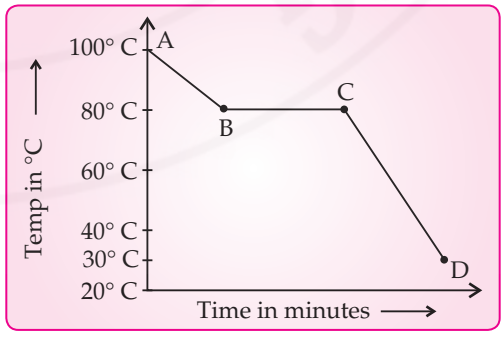
Answer 9.

(a) **(i)** The measurement of the quantity of heat is called calorimetry.

(ii) Copper.

(iii) Calorimeter is made up of thin sheet of copper because copper is a good conductor of heat and so the calorimeter will soon acquire the temperature of its constants and also copper has low specific heat capacity so the heat capacity of the calorimeter remains low and it takes very less amount of heat energy from the contents to acquire its temperature.

(b) BC represents the freezing process in the graph.



(c) Given : m_w = 104 g = T_w = 30°C

m_c = 42 g, T = 10°C

m_i = ?

By calorimetry,

Heat lost = Heat gained

$m_w S_w (T_w - T) + m_c S_c (T_w - T) = m_i \alpha + m_i S_w (T - T_i)$

$\Rightarrow (104)(4{\cdot}2)(30 - 10) + (42)(0{\cdot}4)(30 - 10)$

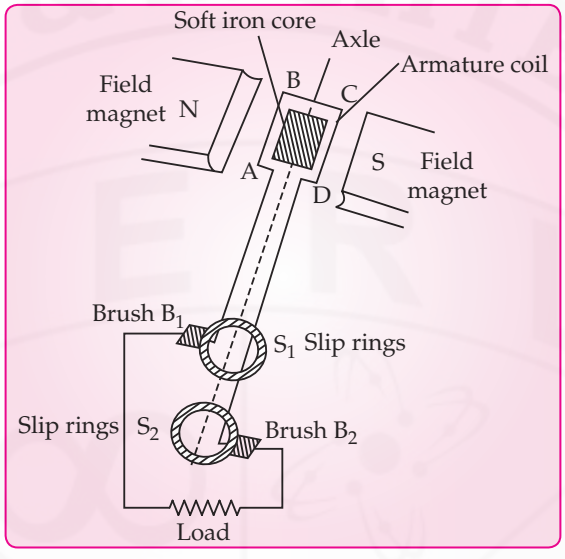
$= m_i(336) + m_i(4{\cdot}2)(10 - 0)$

$\Rightarrow m_i = \dfrac{(104)(4{\cdot}2)(20) + (42)(0{\cdot}4)(20)}{(336 + 42)}$

$m_i = 24$ g

Answer 10.

(a) The diagram of A.C. generator is shown below.



(b) **(i)** Nuclear fission is the process in which a heavy nucleus is splitted into two light nuclei of nearly the same size, by bombarding it with slow neutrons.

(ii) $^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}_{56}Ba + {}^{89}_{36}Kr + 3{}^{1}_{0}n$ + Energy

(c) **(i)** Needle deflects towards the east.

(ii) On passing current in the wire AB, a magnetic field is produced around it and the magnetic needle experiences a torque in this magnetic field, so it deflects to align itself in the direction of magnetic field at that point.

(iii) Needle will deflect towards the west.

(iv) Electric motor.

PHYSICS

2018

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) **(i)** *State and define the S.I. unit of power.* [2]

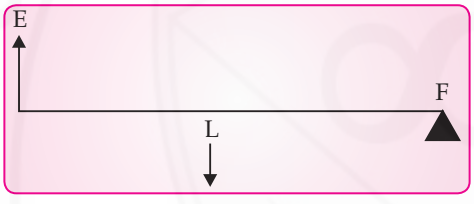
(ii) *How is the unit horse power related to the S.I. unit of power ?*

(b) *State the energy changes in the following cases while in use :* [2]

(i) *An electric iron*

(ii) *A ceiling fan*

(c) *The diagram below shows a lever in use :* [2]



(i) *To which class of levers does it belong ?*

(ii) *Without changing the dimensions of the lever, if the load is shifted towards the fulcrum what happens to the mechanical advantage of the lever ?*

(d) **(i)** *Why is the ratio of the velocities of light of wavelengths 4000 Å and 8000 Å in vacuum 1 : 1 ?* [2]

(ii) *Which of the above wavelengths has a higher frequency ?*

(e) **(i)** *Why is the motion of a body moving with a constant speed around a circular path said to be accelerated ?* [2]

(ii) *Name the unit of physical quantity obtained by the formula* $\frac{2K}{v^2}$.

where K : kinetic energy, v : linear velocity.

Question 2.

(a) *The power of a lens is – 5 D.* [2]

(i) *Find its focal length.*

(ii) *Name the type of lens.*

(b) *State the position of the object in front of a converging lens if :* [2]

(i) *It produces a real and same size image of the object.*

(ii) *It is used as a magnifying lens.*

(c) **(i)** *State the relation between the critical angle and the absolute refractive index of a medium.* [2]

(ii) *Which colour of light has a higher critical angle ? Red light or Green light.*

(d) **(i)** *Define scattering.* [2]

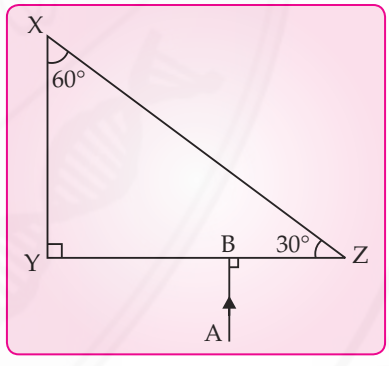
(ii) *The smoke from a fire looks white.*

Which of the following statements is true ?

(1) *Molecules of the smoke are bigger than the wavelength of light.*

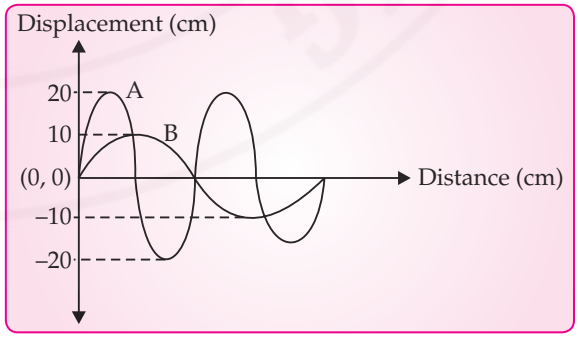
(2) *Molecules of the smoke are smaller than the wavelength of light.*

(e) *The following diagram shows a 60°, 30°, 90° glass prism of critical angle 42°. Copy the diagram and complete the path of incident ray AB emerging out of the prism marking the angle of incidence on each surface.* [2]



Question 3.

(a) *Displacement distance graph of two sound waves A and B, travelling in a medium, are as shown in the diagram below :*



Study the two sound waves and compare their :

(i) *Amplitudes*

(ii) *Wavelengths* [2]

(b) *You have three resistors of values 2 Ω, 3 Ω and 5 Ω. How will you join them so that the total resistance is more than 7 Ω ?* **[2]**

(i) *Draw a diagram for the arrangement.*

(ii) *Calculate the equivalent resistance.*

(c) **(i)** *What do you understand by the term nuclear fusion ?* **[2]**

(ii) *Nuclear power plants use nuclear fission reaction to produce electricity. What is the advantage of producing electricity by fusion reaction ?*

(d) **(i)** *What do you understand by free vibrations of a body ?* **[2]**

(ii) *Why does the amplitude of a vibrating body continuously decrease during damped vibrations ?*

(e) **(i)** *How is the e.m.f. across primary and secondary coils of a transformer related with the number of turns of coil in them ?* **[2]**

(ii) *On which type of current do transformers work ?*

Question 4.

(a) **(i)** *How can a temperature in degree Celsius be converted into S.I. unit of temperature ?*

(ii) *A liquid X has the maximum specific heat capacity and is used as a coolant in car radiators. Name the liquid X.* **[2]**

(b) *A solid metal weighing 150 g melts at its melting point of 800°C by providing heat at the rate of 100 W. The time taken for it to completely melt at the same temperature is 4 min. What is the specific latent heat of fusion of the metal ?* **[2]**

(c) *Identify the following wires used in a household circuit :* **[2]**

(i) *The wire is also called as the phase wire.*

(ii) *The wire is connected to the top terminal of a three pin socket.*

(d) **(i)** *What are isobars ?*

(ii) *Give one example of isobars.* **[2]**

(e) *State any two advantages of electromagnets over permanent magnets.* **[2]**

SECTION-II (40 Marks)

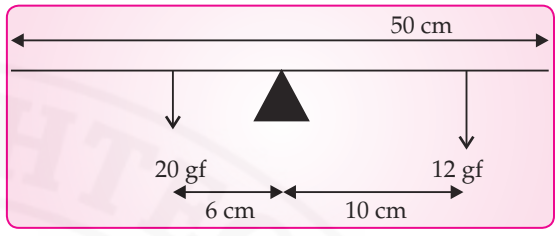
*Attempt any **four** questions from this Section*

Question 5.

(a) **(i)** *Derive a relationship between S.I. and C.G.S. unit of work.*

(ii) *A force acts on a body and displaces it by a distance S in a direction at an angle θ with the direction of force. What should be the value of θ to get the maximum positive work ?* **[3]**

(b) *A half metre rod is pivoted at the centre with two weights of 20 gf and 12 gf suspended at a perpendicular distance of 6 cm and 10 cm from the pivot respectively as shown below :* **[3]**



(i) *Which of the two forces acting on the rigid rod causes clockwise moment ?*

(ii) *Is the rod in equilibrium ?*

(iii) *The direction of 20 kgf* force is reversed. What is the magnitude of the resultant moment of the forces on the rod ?*

* **Mark is an error by the Council. We suggest you to use 'gf' instead of 'kgf'.**

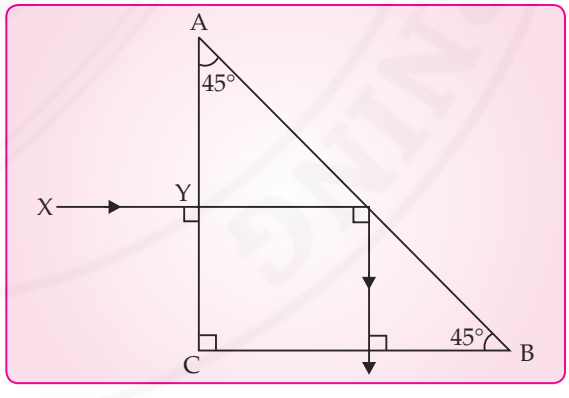
(c) **(i)** *Draw a diagram to show a block and tackle pulley system having a velocity ratio of 3 marking the direction of load (L), effort (E) and tension (T).*

(ii) *The pulley system drawn lifts a load of 150 N when an effort of 60 N is applied. Find its mechanical advantage.*

(iii) *Is the above pulley system an ideal machine or not ?* **[4]**

Question 6.

(a) *A ray of light XY passes through a right angled isosceles prism as shown below :* **[3]**

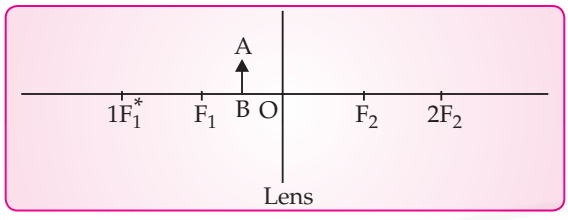


(i) *What is the angle through which the incident ray deviates and emerges out of the prism ?*

(ii) *Name the instrument where this action of prism is put into use.*

(iii) *Which prism surface will behave as a mirror ?*

(b) *An object AB is placed between O and F_1 on the principal axis of a converging lens as shown in the diagram.*



* **Mark is an error by the Council. We suggest you to use '$2F_1$' instead of '$1F_1$'.**

Copy the diagram and by using three standard rays starting from point A, obtain an image of the object AB. **[3]**

(c) *An object is placed at a distance of 12 cm from a convex lens of focal length 8 cm. Find :* **[4]**

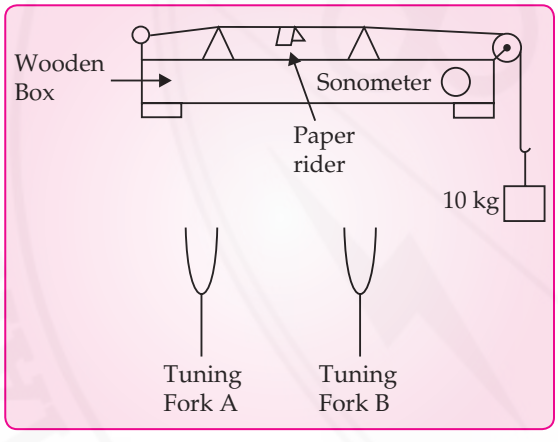
(i) *the position of the image*

(ii) *nature of the image*

Question 7.

(a) *Draw the diagram of a right angled isosceles prism which is used to make an inverted image erect.* **[3]**

(b)



The diagram above shows a wire stretched over a sonometer. Stems of two vibrating tuning forks A and B are touched to the wooden box of the sonometer. It is observed that the paper rider (a small piece of paper folded at the centre) present on the wire flies off when the stem of vibrating tuning fork B is touched to the wooden box but the paper just vibrates when the stem of vibrating tuning fork A is touched to the wooden box.

(i) *Name the phenomenon when the paper rider just vibrates.*

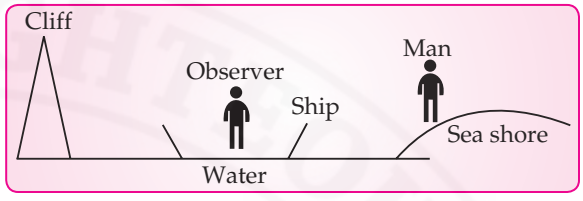
(ii) *Name the phenomenon when the paper rider flies off.*

(iii) *Why does the paper rider fly off when the stem of tuning fork B is touched to the box ?* **[3]**

(c) *A person is standing at the sea shore. An observer on the ship which is anchored in between a vertical cliff and the person on the shore fires a gun. The person on the shore hears two sounds, 2 seconds and 3 seconds after seeing the smoke of the fired gun. If the speed of sound in the air is 320 ms^{-1}, then calculate :*

(i) *The distance between the observer on the ship and the person on the shore.*

(ii) *The distance between the cliff and the observer on the ship.* **[4]**

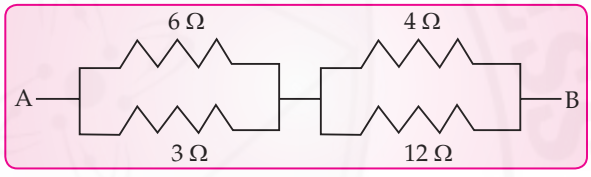


Question 8.

(a) **(i)** *A fuse is rated 8 A. Can it be used with an electrical appliance rated 5 kW, 200 V ? Give a reason.*

(ii) *Name two safety devices which are connected to the live wire of a household electric circuit.* **[3]**

(b) **(i)** *Find the equivalent resistance between A and B.*



(ii) *State whether the resistivity of a wire changes with the change in the thickness of the wire.* **[3]**

(c) *An electric iron is rated 220 V, 2 kW.* **[4]**

(i) *If the iron is used for 2 h daily find the cost of running it for one week if it costs ₹ 4·25 per kWh.*

(ii) *Why is the fuse absolutely necessary in a power circuit ?*

Question 9.

(a) **(i)** *Heat supplied to a solid changes it into liquid. What is this change in phase called ?*

(ii) *During the phase change does the average kinetic energy of the molecules of the substance increase ?*

(iii) *What is the energy absorbed during the phase change called ?* **[3]**

(b) **(i)** *State two differences between 'Heat Capacity' and 'Specific Heat Capacity'.*

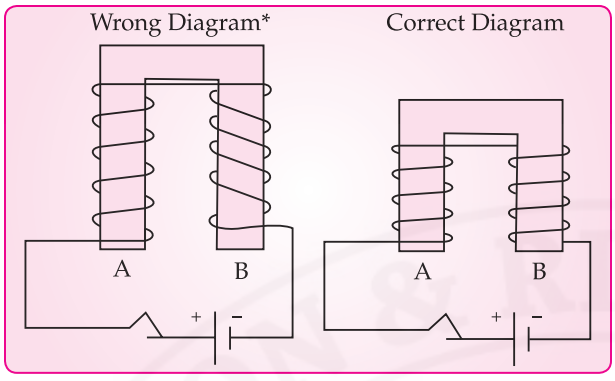
(ii) *Give a mathematical relation between Heat Capacity and Specific Heat Capacity.* **[3]**

(c) *The temperature of 170 g of water at 50°C is lowered to 5°C by adding certain amount of ice to it. Find the mass of ice added.*

Given : Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$ and Specific latent heat of ice = 336000 J kg^{-1}. **[4]**

Question 10.

(a) *The diagram shows a coil wound around a U shape soft iron bar AB.*



* **Mark is an error by the Council. We suggest you to use 'Correct Diagram' instead of 'Wrong Diagram'.**

(i) *What is the polarity induced at the ends A and B when the switch is pressed ?*

(ii) *Suggest one way to strengthen the magnetic field in the electromagnet.*

(iii) *What will be the polarities at A and B if the direction of current is reversed in the circuit ?* **[3]**

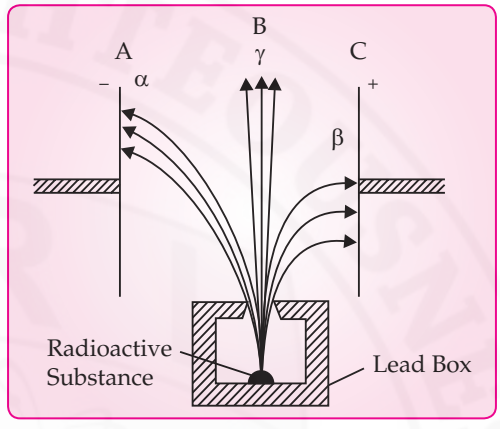
(b) *The ore of uranium found in nature contains* $_{92}U^{238}$ *and* $_{92}U^{235}$*. Although both the isotopes are fissionable, it is found out experimentally that one of the two isotopes is more easily fissionable.*

(i) *Name the isotope of uranium which is easily fissionable.*

(ii) *Give a reason for your answer.*

(iii) *Write a nuclear reaction when Uranium 238 emits an alpha particle to form a Thorium (Th) nucleus.* **[3]**

(c) *Radiations given out from a source when subjected to an electric field in a direction perpendicular to their path are shown below in the diagram. The arrows show the path of the radiation A, B and C. Answer the following questions in terms of A, B and C.* **[4]**



(i) *Name the radiation B which is unaffected by the electrostatic field.*

(ii) *Why does the radiation C deflect more than A ?*

(iii) *Which among the three causes the least biological damage externally ?*

(iv) *Name the radiation which is used in carbon dating.*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** The S.I. unit of power is watt (W).

If 1 joule of work is done in 1 second, the power spent is said to be 1 watt.

(ii) 1 H.P. = 746 W / 750 W

(b) **(i)** Electrical energy changes to heat energy.

(ii) Electrical energy changes to mechanical energy.

(c) **(i)** The load 'L' is in between effort 'E' and fulcrum 'F', so it is a class II lever.

(ii) If load is shifted towards the fulcrum, keeping the dimensions of the lever same, the load arm decreases.

Since, Mechanical advantage of a lever

$$= \frac{\text{Effect arm}}{\text{Load arm}}$$

Hence, the mechanical advantage increases.

(d) **(i)** In vacuum, the velocity of light is always constant *i.e.*, 3×10^8 ms^{-1} and it does not depend on wavelength or frequency.

(ii) We know that,

$$c = \lambda\nu$$

or $$\nu = \frac{c}{\lambda}$$

$$\therefore \quad \nu \propto \frac{1}{\lambda} \quad \text{(As } c \text{ is always constant)}$$

Hence, lower wavelength *i.e.*, 4000 Å has higher frequency.

(e) **(i)** The motion of a body moving with a constant speed around a circular path is accelerated due to continuous change in its direction at each point of circular path. Hence the velocity of the body changes continuously.

(ii) $$\frac{2K}{v^2} = \frac{2 \times \frac{1}{2}mv^2}{v^2} = m$$

Hence, the physical quantity obtained is mass and its unit is kilogram (kg)/*g*/any unit of mass.

Answer 2.

(a) **(i)** Given : P = – 5 D

We know that, $$f = \frac{1}{P}$$

$$\Rightarrow \quad f = \frac{1}{-5}\ \text{m}$$

$$= -0{\cdot}2\ \text{m} = -20\ \text{cm}$$

(ii) The negative power indicates that the lens is a concave lens/diverging lens.

(b) **(i)** The object is placed on the principal axis at a distance equal to twice the focal length of the lens (or At $2F_1$).

(ii) The object is placed between the first principal focal point (F_1) and the optical centre of lens.

(c) **(i)** $$\mu = \frac{1}{\sin C} = \text{cosec}\ C$$

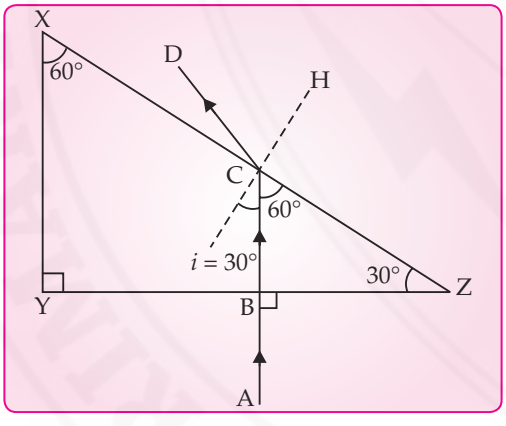
where 'μ' is the absolute refractive index of medium and 'C' is the critical angle.

(ii) Critical angle increases with the increase in wavelength of light, hence, red light having longer wavelength than green light has a higher critical angle.

(d) **(i)** The process of absorption and then re-emission of light energy without changing it's wavelength is called scattering of light.

(ii) Molecules of the smoke are bigger than the wavelength of light is the correct statement.

(e) CD is the emergent ray as shown in the figure. Angle of incidence on the surface YZ is 0° and on surface XZ is 30°.



Answer 3.

(a) **For wave A :** Amplitude (a_1) = 20 cm, Wavelength (λ_1) = λ cm (say)

For wave B : Amplitude (a_2) = 10 cm, Wavelength (λ_2) = 2λ cm

(i) $$\frac{a_1}{a_2} = \frac{20}{10} = \frac{2}{1}$$

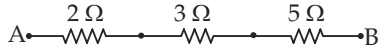
The amplitude of wave A is two times of the amplitude of wave B.

(ii) $$\frac{\lambda_1}{\lambda_2} = \frac{\lambda}{2\lambda} = \frac{1}{2}$$

The wavelength of wave A is half of the wavelength of wave B.

(b) 2 Ω, 3 Ω and 5 Ω have to be joined in series to obtain the total resistance more than 7 Ω.

(i)



(ii) $$R_{eq.} = (2 + 3 + 5)\ \Omega = 10\ \Omega$$

(c) **(i)** Nuclear fusion is the process in which two light nuclei combine to form a heavy and more stable nucleus. In this process, huge amount of energy is released.

(ii) Nuclear fusion is not possible at ordinary temperature and ordinary pressure, but the advantage of fusion reaction over fission reaction is that the fusionable substance is not radioactive, so it does not give out any harmful radiations and the disposal of its waste is not difficult.

(d) **(i)** The periodic vibrations of a body in the absence of any external periodic force on it, are called free (or natural) vibrations.

(ii) The amplitude of a vibrating body continuously decreases during damped vibrations because of the frictional (resistive) force due to the surrounding medium causes the energy loss.

(e) **(i)** E.m.f. & the number of coil are directly proportional to each other.

$$\frac{E_s}{E_p} = \frac{N_s}{N_p}$$

where E_s and E_p are the e.m.f. across the secondary and the primary coils respectively.

N_s and N_p are the number of turns in the secondary and primary coils respectively.

(ii) A transformer works on alternating current (A.C.).

Answer 4.

(a) **(i)** The S.I. unit of temperature is Kelvin (K).

To convert temperature in degree Celsius to Kelvin, 273·15 is added to degree Celsius.

$$T\ (K) = °C + 273{\cdot}15$$

(ii) The liquid 'X' is water because water has highest specific heat capacity.

(b) Given : m = 150 g, Power (P) = 100 W, Time (t) = 4 minute = 4 × 60 = 240 s

Heat energy supplied to melt the metal

$$= P \times t$$

$$= 100 \times 240\ \text{joule}$$

Heat energy required by the metal to melt

$$= mL$$

$$= 150 \times L\ \text{joule}$$

If there is no exchange of heat energy with the surrounding, then

$150 \times L = 100 \times 240$

or $L = \frac{100 \times 240}{150}$

$= 160 \text{ J g}^{-1}$.

(c) **(i)** Live wire.

(ii) Earth wire.

(d) **(i)** Isobars are atoms of different elements which have the same mass number A, but different atomic number Z.

(ii) $^{14}_{6}C$ and $^{14}_{7}N$ are isobars.

(e) The advantages of electromagnets over permanent magnets are :

(i) The strength of magnetic field of an electromagnet can easily be changed by changing the magnitude of current or the number of windings in its solenoid.

(ii) The polarity of the electromagnet can be reversed easily by reversing the direction of current in its solenoid.

SECTION-II

Answer 5.

(a) **(i)** The S.I. unit of work is joule (J) and C.G.S. unit is erg.

1 joule = 1 newton × 1 metre

$= 10^5$ dyne × 100 cm

$= 10^7$ dyne cm

($\because$ 1 dyne cm = 1 erg)

$= 10^7$ erg

or $1 \text{ J} = 10^7$ erg

(ii) We know that,

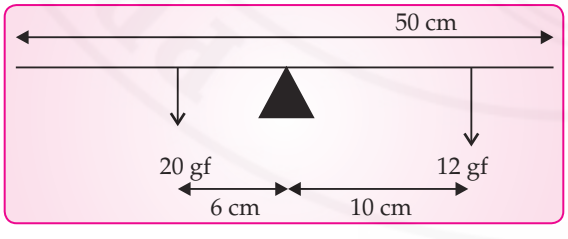
$W = FS \cos \theta$

For maximum positive work, cos θ should be maximum.

Maximum value of cos θ = 1

$\therefore \quad \theta = 0°$.

(b) **(i)** The force of 12 gf causes a clockwise moment.



(ii) Clockwise moment

= 12 × 10 gf cm = 120 gf cm

Anti-clockwise moment

= 20 × 6 = 120 gf cm

$\because$ Clockwise moment

= Anti-clockwise moment

$\therefore$ Yes, the rod is in equilibrium.

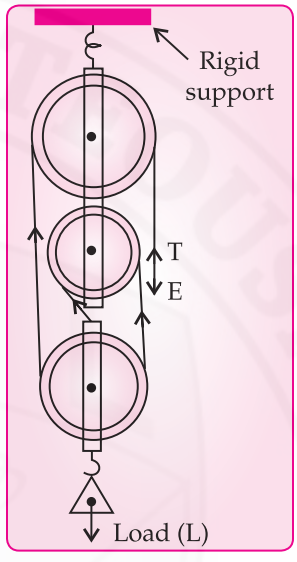
(iii) If the direction of 20 gf force is reversed, it will also create a clockwise moment.

$\therefore$ Resultant moment

= (120 + 120) gf cm (clockwise)

= 240 gf cm

(c) **(i)** The diagram is shown below :



(ii) M.A. $= \frac{\text{Load}}{\text{Effort}} = \frac{150}{60} = 2{\cdot}5$

(iii) No, the pulley system is not ideal because M.A. < V.R.

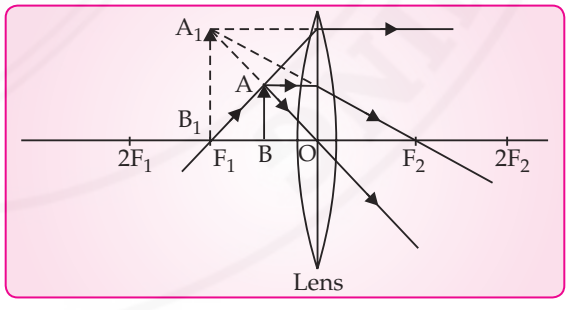
Answer 6.

(a) **(i)** The angle through which the incident ray deviates and emerges out of the prism is 90°.

(ii) Refracting Periscope.

(iii) The surface AB of the prism behaves as a mirror.

(b) A_1B_1 is the image formed.



(c) **(i)** Given : Object distance (u) = – 12 cm

Focal length (f) = + 8 cm (convex lens)

Using the relation,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

or $$\frac{1}{v} - \frac{1}{(-12)} = \frac{1}{8}$$

or $\frac{1}{v}+\frac{1}{12}=\frac{1}{8}$

or $\frac{1}{v}=\frac{1}{8}-\frac{1}{12}=\frac{3-2}{24}=\frac{1}{24}$

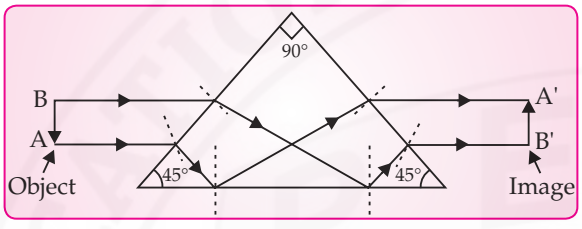
or $v = +24$ cm

Therefore, the image is formed at a distance of 24 cm behind the lens (or on the other side).

(ii) The image is real, inverted and magnified.

Answer 7.

(a) The diagram is shown below :



(b) **(i)** Forced vibration.

(ii) Resonance.

(iii) The paper rider flies off when the stem of the tuning fork B is touched to the box because the frequency of vibration of tuning fork B is equal to the natural frequency of vibration of the stretched wire holding the paper rider and resonance occurs.

(c) **(i)** The person on the shore hears the first direct sound after 2 s from the observer.

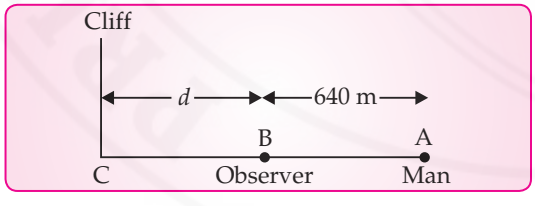
∴ Distance between observer on ship and man on shore

$= v \times t_1$

$= 320 \times 2 = 640$ m

(ii) Let the distance between the cliff and the observer be d metre.

Therefore, the second sound heard by the man on the shore travels a total distance of



$(d + d + 640)$ m $= (2d + 640)$ m

Time taken, $t_2 = 3$ s

∴ Speed of sound

$= \frac{\text{Total distance travelled}}{\text{Time taken}}$

or $320 = \frac{2d+640}{3}$

or $960 = 2d + 640$

or $2d = 960 - 640 = 320$

∴ $d = \frac{320}{2} = 160$ m

Answer 8.

(a) **(i)** Given : Power (P) = 5 kW = 5000 W, V = 200 volt

∴ Current (I) $= \frac{P}{V}$

$= \frac{5000}{200} = 25$ A

The 8 A fuse cannot be used with the above appliance because it draws a current of 25 A and the fuse will blow off.

(ii) (1) Fuse, (2) Switch.

(b) **(i)** 6 Ω and 3 Ω resistances are connected in parallel.

∴ $\frac{1}{R_1}=\frac{1}{6}+\frac{1}{3}$

$=\frac{1+2}{6}=\frac{3}{6}=\frac{1}{2}$

or $R_1 = 2\ \Omega$

4 Ω and 12 Ω resistances are connected in parallel.

∴ $\frac{1}{R_2}=\frac{1}{4}+\frac{1}{12}$

$=\frac{3+1}{12}=\frac{4}{12}=\frac{1}{3}$

or $R_2 = 3\ \Omega$

Now, R_1 and R_2 are connected in series.

∴ Equivalent resistance between A and B = (2 + 3) Ω = 5 Ω.

(ii) Resistivity of a substance is its characteristic property and it does not change with the change in the thickness of the wire.

(c) **(i)** Electrical energy consumed daily

= Power × Time = 2 kW × 2 h = 4 kWh

Electrical energy consumed in one week

= 4 kWh × 7 = 28 kWh

∴ Total cost for running it for one week

= ₹ 4·25 × 28 = ₹ 119

(ii) Fuse is necessary in power circuits to limit threats to human life and property damage due to excessive current or faulty appliance that may get connected to the power circuit.

Answer 9.

(a) **(i)** The change from solid state to a liquid state at a constant temperature is called melting.

(ii) Since, temperature remains constant during change of phase, the average kinetic energy does not change.

(iii) The energy absorbed during phase change is called latent heat of fusion.

(b) **(i)** Difference between heat capacity and specific heat capacity :

Heat Capacity	Specific Heat Capacity
1. It is the amount of heat energy required to raise the temperature of entire body by 1°C.	1. It is the amount of heat energy required to raise the temperature of unit mass of body by 1°C.
2. Its S.I. unit is JK^{-1}.	2. Its S.I. unit is $Jkg^{-1}K^{-1}$.

(ii) Heat capacity of a body

= Mass of the body × Specific heat capacity

or $C' = m \times c$

$$c = \frac{C'}{m}$$

(c) Given :

For hot body :

170 g water at 50°C changes to water at 5°C.

$m = 170\text{ g} = \frac{170}{1000}$ kg, $c = 4200\text{ J kg}^{-1}\text{ °C}^{-1}$,

$\Delta T = (50 - 5)°C = 45°C$

∴ Heat lost by water

$= mc\Delta T$

$= \frac{170}{1000} \times 4200 \times 45$ J

$= 32130$ J

For cold body :

Let mass of ice be x kg.

x kg ice at 0°C changes to water at 5°C.

Mass $(m) = x$ kg, $L = 336000\text{ J kg}^{-1}$,

$c = 4200\text{ J kg}^{-1}\text{°C}^{-1}$, $\Delta T = (5 - 0)°C = 5°C$

∴ Heat gained by ice

$= mL + mc\Delta T$

$= (x \times 336000 + x \times 4200 \times 5)$ J

$= (336000\,x + 21000\,x)$ J

$= 357000\,x$ J.

When no heat energy is lost to the surroundings,

Heat gained = Heat lost

or $357000\,x = 32130$

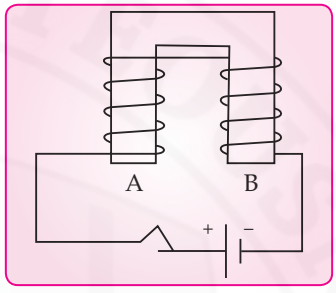
$\therefore\quad x = \frac{32130}{357000}$ kg

$= 0{\cdot}09$ kg $= 90$ g.

∴ Mass of ice added = 90 g.

Answer 10.

(a) **(i)** Polarity induced at end A is south pole (S) and at end B is north pole (N).



(ii) The strength of magnetic field can be increased by increasing the magnitude of current or by increasing the number of windings in the electromagnet.

(iii) If direction of current is reversed, the polarities at A and B will also be reversed. End A will become north pole (N) and end B will become south pole (S).

(b) **(i)** $_{92}U^{235}$ is more easily fissionable than $_{92}U^{238}$.

(ii) Fission of $_{92}U^{238}$ is possible only by fast neutrons whereas the fission of $_{92}U^{235}$ can be achieved even by slow neutrons.

(iii) $_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_{2}He^{4}$ [$_{2}He^{4}$ is an alpha particle]

(c) **(i)** γ - radiation.

(ii) The deflection of radiation C (or β-particle) is more than that of radiation A (or α-particle) because β-particles have less mass than α-particles.

(iii) Radiation A (or α-radiations) causes least biological damage.

(iv) The radiation which is used in carbon dating is radiation C (or β-radiation).

●●

PHYSICS

2017

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) *A brass ball is hanging from a stiff cotton thread. Draw a neat labelled diagram showing the forces acting on the brass ball and the cotton thread.*** [2]

(b) *The distance between two bodies is doubled. How is the magnitude of gravitational force between them affected ?*** [2]

(c) *Why is a jack screw provided with a long arm ?* [2]

(d) *If the power of a motor be 100 kW, at what speed can it raise a load of 50,000 N ?* [2]

(e) *Which class of lever will always have M.A. > 1 and why ?* [2]

Question 2.

(a) *Define heat capacity and state its S.I. unit.* [2]

(b) *Why is the base of a cooking pan generally made thick ?* [2]

(c) *A solid of mass 50 g at 150°C is placed in 100 g of water at 11°C, when the final temperature recorded is 20°C. Find the specific heat capacity of the solid.* [2]

(Specific heat capacity of water = 4·2 J/g°C)

(d) *How is the refractive index of a material related to :*

(i) *real and apparent depth ?*

(ii) *velocity of light in vacuum or air and the velocity of light in a given medium ?* [2]

(e) *State the conditions required for total internal reflection of light to take place.* [2]

Question 3.

(a) *Draw a ray diagram to show the refraction of a monochromatic ray through a prism when it suffers minimum deviation.* [2]

(b) *The human ear can detect continuous sounds in the frequency range from 20 Hz to 20000 Hz. Assuming that the speed of sound in air is 330 ms^{-1} for all frequencies, calculate the wavelengths corresponding to the given extreme frequencies of the audible range.* [2]

(c) *An enemy plane is at a distance of 300 km from a radar. In how much time the radar will be able to detect the plane ? Take velocity of radio waves as 3×10^8 ms^{-1}.* [2]

(d) *How is the frequency of a stretched string related to :*

(i) *its length ?*

(ii) *its tension ?* [2]

(e) *Define specific resistance and state its S.I. unit.* [2]

Question 4.

(a) *An electric bulb of resistance 500 Ω, draws a current of 0·4 A. Calculate the power of the bulb and the potential difference at its end.* [2]

(b) *State two causes of energy loss in a transformer.* [2]

(c) *State two characteristics of a good thermion emitter.*** [2]

(d) *State two factors upon which the rate of emission of thermions depends.*** [2]

(e) *When does the nucleus of an atom tend to be radioactive ?* [2]

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) *A uniform half metre rule balances horizontally on a knife edge at 29 cm mark when a weight of 20 gf is suspended from one end.* [3]

(i) *Draw a diagram of the arrangement.*

(ii) *What is the weight of the half metre rule ?*

(b) **(i)** *A boy uses a single fixed pulley to lift a load of 50 kgf to some height. Another boy uses a single movable pulley to lift the same load to the same height. Compare the effort applied by them. Give a reason to support your answer.*

(ii) *How does uniform circular motion differ from uniform linear motion ?*

(iii) *Name the process used for producing electricity using nuclear energy.* [3]

(c) *A pulley system with V.R. = 4 is used to lift a load of 175 kgf through a vertical height of 15 m. The effort required is 50 kgf in the downward direction. (g = 10 N kg^{-1})*

Calculate :

(i) *Distance moved by the effort.*

(ii) *Work done by the effort.*

(iii) *M.A. of the pulley system.*

(iv) *Efficiency of the pulley system.* [4]

** Answer is not given due to change in the present syllabus.

Question 6.

(a) **(i)** *How is the transference of heat energy by radiation prevented in a calorimeter ?*

(ii) *You have a choice of three metals A, B and C, of specific heat capacities 900 $Jkg^{-1}{}^{o}C^{-1}$, 380 $Jkg^{-1}{}^{o}C^{-1}$ and 460 $Jkg^{-1}{}^{o}C^{-1}$ respectively, to make a calorimeter. Which material will you select ? Justify your answer.* **[3]**

(b) *Calculate the mass of ice needed to cool 150 g of water contained in a calorimeter of mass 50 g at 32°C such that the final temperature is 5°C.*

Specific heat capacity of calorimeter = 0·4 J/g°C

Specific heat capacity of water = 4·2 J/g°C

Latent heat capacity of ice = 330 J/g. **[3]**

(c) **(i)** *Name the radiations which are absorbed by greenhouse gases in the earth's atmosphere.*

(ii) *A radiation X is focused by a particular device on the bulb of a thermometer and mercury in the thermometer shows a rapid increase. Name the radiation X.*

(iii) *Name two factors on which the heat energy liberated by a body depends.* **[4]**

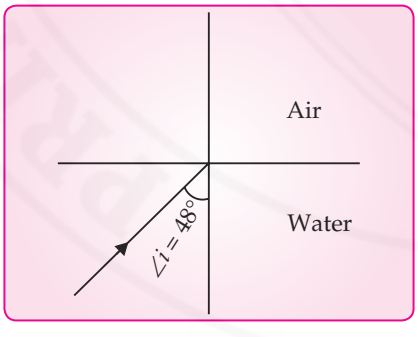
Question 7.

(a) *A lens forms an upright and diminished image of an object when the object is placed at the focal point of the given lens.*

(i) *Name the lens.*

(ii) *Draw a ray diagram to show the image formation.* **[3]**

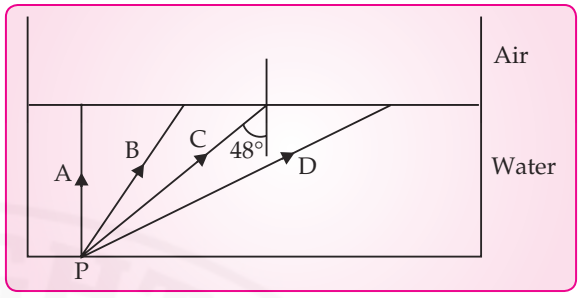
(b) *A ray of light travels from water to air as shown in the diagram given below :*



(i) *Copy the diagram and complete the path of the ray. Given the critical angle for water is 48°.*

(ii) *State the condition so that total internal reflection occurs in the above diagram.* **[3]**

(c) *The diagram below shows a point source P inside a water container. Four rays A, B, C, D starting from the source P are shown up to the water surface.* **[4]**



(i) *Show in the diagram the path of these rays after striking the water surface. The critical angle for water air surface is 48°.*

(ii) *Name the phenomenon which the rays B and D exhibit.*

Question 8.

(a) *Name the factor that determines :*

(i) *Loudness of the sound heard.*

(ii) *Quality of the note.*

(iii) *Pitch of the note.* **[3]**

(b) **(i)** *What are damped vibrations ?*

(ii) *Give one example of damped vibrations.*

(iii) *Name the phenomenon that causes a loud sound when the stem of a vibrating tuning fork is kept pressed on the surface of a table.* **[3]**

(c) **(i)** *A wire of length 80 cm has a frequency of 256 Hz. Calculate the length of a similar wire under similar tension, which will have frequency 1024 Hz.*

(ii) *A certain sound has a frequency of 256 hertz and a wavelength of 1·3 m.*

(1) *Calculate the speed with which this sound travels.*

(2) *What difference would be felt by a listener between the above sound and another sound travelling at the same speed, but of wavelength 2·6 m ?* **[4]**

Question 9.

(a) **(i)** *Name the colour code of the wire which is connected to the metallic body of an appliance.*

(ii) *Draw the diagram of a dual control switch when the appliance is switched 'ON'.* **[3]**

(b) **(i)** *Which particles are responsible for current in conductors ?*

(ii) *To which wire of a cable in a power circuit should the metal case of a geyser be connected ?*

(iii) *To which wire should the fuse be connected ?* **[3]**

(c) **(i)** *Explain the meaning of the statement 'current rating of a fuse is 5 A'.*

(ii) *In the transmission of power the voltage of power generated at the generating stations is stepped up from 11 kV to 132 kV before it is transmitted. Why ?* **[4]**

Question 10.[**]

(a) *Answer the following questions based on a hot cathode ray tube.*

(i) *Name the charged particles.*

(ii) *State the approximate voltage used to heat the filament.*

(iii) *What will happen to the beam when it passes through the electric field ?* **[3]**

(b) *State three factors on which the rate of emission of electrons from a metal surface depends.* **[3]**

(c) **(i)** *What are free electrons ?*

(ii) *Why do they not leave the metal surface on their own ?*

(iii) *How can they be made to leave the metal surface ? (State any two ways).* **[4]**

ANSWERS

SECTION-I

Answer 1.

(c) A jack screw is provided with a long arm to increase the perpendicular distance of the point of application of force from the axis of rotation, so that we can apply a small force to rotate the jack to lift the heavy load.

(d) Given : Power = 100 kW = 100×10^3 W = 10^5 W

Force (Weight) = 50,000 N = 5×10^4 N

Since, Power = Force × Average speed

$$\therefore \quad \text{Average speed} = \frac{\text{Power}}{\text{Force}}$$

$$= \frac{10^5}{5 \times 10^4} \text{ ms}^{-1}$$

$$= \frac{10 \times 10^4}{5 \times 10^4} \text{ ms}^{-1} = 2 \text{ ms}^{-1}$$

Therefore, at a speed of 2 ms^{-1} the motor can raise a load of 50,000 N.

(e) A class II lever will always have M.A. > 1, because the load lies between the fulcrum and the effort. Hence, the effort arm is always longer than the load arm.

Since, $\text{M.A.} = \frac{\text{Effort arm}}{\text{Load arm}}$

and Effort arm > Load arm

$\therefore$ M.A. > 1

Answer 2.

(a) The amount of heat energy needed to raise the temperature of a body by 1°C (or 1 K) is called the heat capacity or thermal capacity of the body. Its S.I. unit is JK^{-1}.

(b) The base of a cooking pan is made thick to increase its heat capacity so that it gets heated slowly and imparts sufficient heat energy at a slow rate to the food for its cooking. It also helps to keep the cooked food warm for a long time.

(c) Given : For solid (Hot body) : m_1 = 50 g, T_1 = 150°C, T = 20°C

Fall in temperature of solid,

$$\Delta T_1 = (150 - 20)^\circ C$$

$$= 130^\circ C$$

c_1 = ?

For water (Cold body) : m_2 = 100 g, T_2 = 11°C, T = 20°C

Rise in temperature of water,

$$\Delta T_2 = (20 - 11)^\circ C$$

$$= 9^\circ C$$

$$c_2 = 4{\cdot}2 \text{ Jg}^{-1}{}^\circ\text{C}^{-1}$$

Heat lost by hot body

$$= m_1 c_1 \Delta T_1$$

$$= 50 \times c_1 \times 130 \text{ joule}$$

Heat gained by cold body

$$= m_2 c_2 \Delta T_2$$

$$= 100 \times 4{\cdot}2 \times 9 \text{ joule}$$

From the principle of calorimetry, if the system is fully insulated, then,

Heat lost by hot body = Heat gained by cold body

or $50 \times c_1 \times 130 = 100 \times 4{\cdot}2 \times 9$

or $c_1 = \frac{100 \times 4{\cdot}2 \times 9}{50 \times 130} \text{ Jg}^{-1}{}^\circ\text{C}^{-1}$

$= 0{\cdot}58 \text{ Jg}^{-1}{}^\circ\text{C}^{-1}$

(d) Let μ be the refractive index of the material.

(i) $\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$

(ii) $\mu = \frac{\text{Speed of light in vacuum or air } (c)}{\text{Speed of light in medium } (v)}$

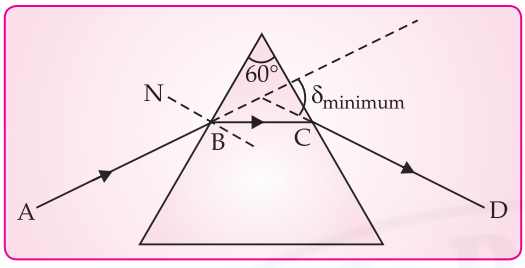
(e) **1.** The light must travel from a denser to a rarer medium.

2. The angle of incidence must be greater than the critical angle for the given pair of media.

Answer 3.

(a) For minimum deviation, refracted ray (BC) must be parallel to the base of the prism.

[**] Answer is not given due to change in the present syllabus.



(b) For the lower extreme frequency of audible range :

Frequency (f_1) = 20 Hz

Speed of sound in air (v) = 330 ms^{-1}

$\therefore$ Wavelength (λ_1) = $\frac{v}{f_1}$

= $\frac{330}{20}$ m = 16·5 m

For the upper extreme frequency of audible range :

Frequency (f_2) = 20,000 Hz

Speed of sound in air (v) = 330 ms^{-1}

$\therefore$ Wavelength (λ_2) = $\frac{v}{f_2}$

= $\frac{330}{20,000}$ m

= 0·0165 m

(c) Given : Distance (d) = 300 km = 300×10^3 m

= 3×10^5 m

Velocity (v) of radio waves = 3×10^8 ms^{-1}

Time taken by radar to detect the plane,

$$t = \frac{2d}{v} = \frac{2 \times 3 \times 10^5}{3 \times 10^8} s$$

$= 2 \times 10^{-3}$ s

(d) **(i)** The frequency of vibration of a stretched string is inversely proportional to its length, $\left(f \propto \frac{1}{l}\right)$.

(ii) The frequency of vibration of a stretched string is directly proportional to the square root of the tension applied on the string, $\left(f \propto \sqrt{T}\right)$.

(e) The specific resistance of a material is the resistance of a wire of that material of unit length and unit area of cross-section.

Its S.I. unit is ohm-metre (Ω m).

Answer 4.

(a) Given : Resistance (R) = 500 Ω, Current (I) = 0·4 A

Power (P) = I^2R

= $(0·4)^2 \times 500$ W = 80 W

Potential difference at its ends (V)

= IR

= 0·4 × 500 V = 200 V

(b) The two causes of energy loss in a transformer are :

(i) Energy loss due to induced (or eddy) currents in the core.

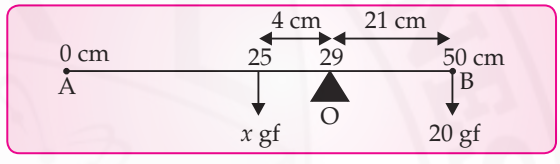
(ii) Energy loss due to heat produced in coils (copper loss).

(e) The nucleus of an atom becomes radioactive if the nucleus is large (*i.e.*, atomic number > 82) or if the number of neutrons is much more than the number of protons as compared to a normal stable atom.

SECTION-II

Answer 5.

(a) **(i)** Let the weight of the half metre rule be x gf and it acts at the 25 cm mark (centre of gravity).



(ii) Anti-clockwise moment (ACWM)

= $x \times 4$ gf cm

Clockwise moment (CWM)

= 20 × 21 gf cm

In equilibrium,

ACWM = CWM

or $x \times 4 = 20 \times 21$

$\therefore$ $x = \frac{20 \times 21}{4}$ gf = 105 gf

The weight of the half metre rule is 105 gf.

(b) **(i)** For single fixed pulley,

Load (L) = 50 kgf

Mechanical Advantage (M.A.) = 1

Since, M.A. = $\frac{\text{Load}}{\text{Effort}}$

$\therefore$ Effort (E_1) applied

= $\frac{\text{Load}}{\text{M.A.}} = \frac{50}{1}$ = 50 kgf

For a single movable pulley,

L = 50 kgf

M.A. = 2

$\therefore$ Effort (E_2) applied

= $\frac{\text{Load}}{\text{M.A.}} = \frac{50}{2}$ = 25 kgf

Ratio of effort applied,

$E_1 : E_2 = 50 : 25 = 2 : 1$

(ii) In uniform linear motion, the speed and velocity are constant and acceleration is zero, whereas in a uniform circular motion, the velocity is variable (even though speed is uniform), so, it is an accelerated motion.

(iii) Electricity is produced using nuclear energy by carrying out controlled chain reaction of nuclear fission in a nuclear reactor.

(c) Given : Velocity Ratio (V.R.) = 4

Load (L) = 175 kgf

= 175 × 10 N = 1750 N

Displacement of load (d_2)

= 15 m

∴ Effort (E) = 50 kgf

= 50 × 10 N = 500 N

g = 10 N kg^{-1}.

(i) V.R. = $\frac{\text{Distance moved by effort } (d_E)}{\text{Distance moved by load } (d_L)}$

or $4 = \frac{d_E}{15}$

∴ Distance moved by effort (d_E)

= 4 × 15 m = 60 m

(ii) Work done by the effort

= E × d_E

= 500 × 60 J = 30000 J

(iii) M.A. = $\frac{L}{E} = \frac{1750}{500} = 3.5$

(iv) Efficiency (η) = $\frac{\text{M.A.}}{\text{V.R.}} \times 100\%$

= $\frac{3{\cdot}5}{4} \times 100\% = 87.5\%$

Answer 6.

(a) **(i)** The outer and the inner surfaces of a calorimeter are highly polished to prevent the transfer of heat by radiation.

(ii) The metal B of specific heat capacity 380 J kg^{-1} °C^{-1} should be used because it will take the least amount of heat from the contents to attain the temperature of the contents.

(b) Heat energy imparted by calorimeter and water contained in it in cooling from 32°C to 5°C is used in melting ice and then raising the temperature of melted ice from 0°C to 5°C.

For cold body : Ice at 0°C to water at 5°C.

Heat gained = $mL + mc\Delta T$

= $m \times 330 + m \times 4{\cdot}2 \times (5 - 0)$

= $330\,m + m \times 4{\cdot}2 \times 5$

= $330\,m + 21\,m$

= $351m$ joule.

For hot body : (Water + Calorimeter) at 32°C to 5°C.

Heat lost = $m_1c_1\Delta T_1 + m_2c_2\,\Delta T_2$

= $150 \times 4{\cdot}2 \times (32 - 5) + 50 \times 0{\cdot}4 \times (32 - 5)$

= $150 \times 4{\cdot}2 \times 27 + 50 \times 0{\cdot}4 \times 27$

= 17010 + 540 = 17550 joule.

From the principle of calorimetry, if the system is fully insulated then,

Heat gained by cold body

= Heat lost by hot body

351 m = 17550

or $m = \frac{17550}{351}$ g

= 50 g.

∴ The mass of ice needed = 50 g.

(c) **(i)** The radiations absorbed by the green house gases are infra-red radiations of long wavelength.

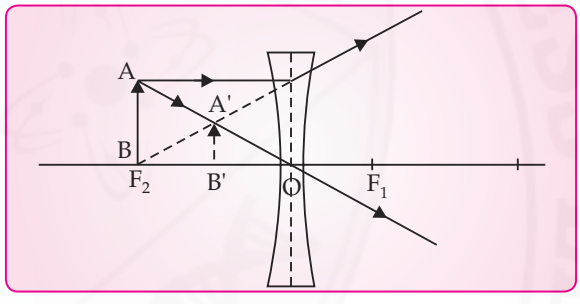
(ii) The radiation X is infra-red radiation.

(iii) The heat energy liberated by a body depends on mass, specific heat capacity and change in temperature of the body.

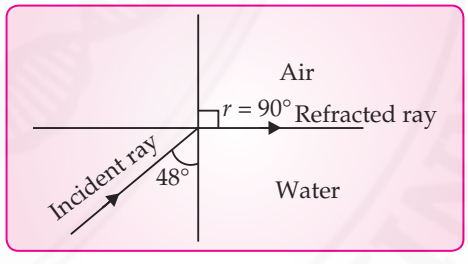
Answer 7.

(a) **(i)** Concave lens.

(ii)

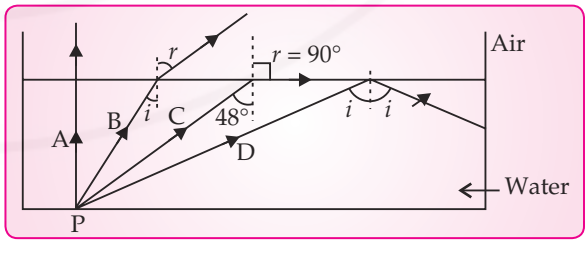


(b) **(i)**



(ii) For total internal reflection to occur in the above diagram, the angle of incidence must be greater than 48°.

(c) **(i)**



(ii) The ray B exhibits the phenomenon of refraction.

The ray D exhibits the phenomenon of total internal reflection.

Answer 8.

(a) **(i)** Amplitude.

(ii) Waveform.

(iii) Frequency.

(b) **(i)** The periodic vibrations of decreasing amplitude in the presence of resistive force are called damped vibrations.

(ii) A tuning fork when stroked on a rubber pad, executes damped vibrations in air.

(iii) Forced vibrations.

(c) **(i)** Given : $f_1 = 256$ Hz, $l_1 = 80$ cm, $f_2 = 1024$ Hz, $l_2 = ?$

Since, $f \propto \frac{1}{l}$

$\therefore \quad fl = \text{constant}$

or $\quad f_1 l_1 = f_2 l_2$

or $\quad 256 \times 80 = 1024 \times l_2$

$\therefore \quad l_2 = \frac{256 \times 80}{1024}$ cm

$= 20$ cm

The length of wire which will have frequency 1024 Hz under similar conditions is 20 cm.

(ii) Given : $f = 256$ hertz, $\lambda = 1{\cdot}3$ m

(1) Speed of sound (v)

$= f\lambda$

$= 256 \times 1{\cdot}3 \text{ ms}^{-1}$

$= 332{\cdot}8 \text{ ms}^{-1}$

(2) Given : $v = 332{\cdot}8 \text{ ms}^{-1}$, $\lambda = 2{\cdot}6$ m

$\therefore \quad$ Frequency, $f = \frac{v}{\lambda}$

$= \frac{332{\cdot}8}{2{\cdot}6}$

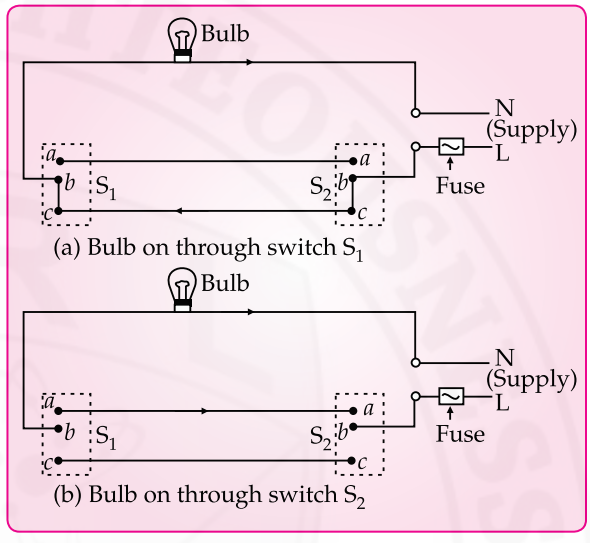
$= 128$ hertz.

The second sound of wavelength 2·6 m will have low pitch and sound will be flat compared to the fixed sound of wavelength 1·3 m.

Answer 9.

(a) **(i)** The colour code of the earth wire is green or yellow.

(ii)



(b) **(i)** Free electrons

(ii) Earth wire

(iii) Live wire

(c) **(i)** The current rating of a fuse is 5 A means that if current exceeds 5 A in the circuit, the fuse wire will melt.

(ii) The voltage is stepped up from 11 kV to 132 kV to minimise the loss of energy in the form of heat in the live wires used for transmission.

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PHYSICS

2016

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) **(i)** *Give an example of a non contact force which is always of attractive nature.***

(ii) *How does the magnitude of this non contact force on the two bodies depend on the distance of separation between them ?*** [2]

(b) *A boy weighing 40 kgf climbs up a stair of 30 steps each 20 cm high in 4 minutes and a girl weighing 30 kgf does the same in 3 minutes. Compare :*

(i) *The work done by them.*

(ii) *The power developed by them.* [2]

(c) *With reference to the terms Mechanical Advantage, Velocity Ratio and efficiency of a machine, name and define the term that will not change for a machine of a given design.* [2]

(d) *Calculate the mass of ice required to lower the temperature of 300 g of water at 40°C to water at 0°C.*

(Specific latent heat of ice = 336 J/g, Specific heat capacity of water = 4·2 J/g°C) [2]

(e) *What do you understand by the following statements :* [2]

(i) *The heat capacity of the body is 60 JK^{-1}.*

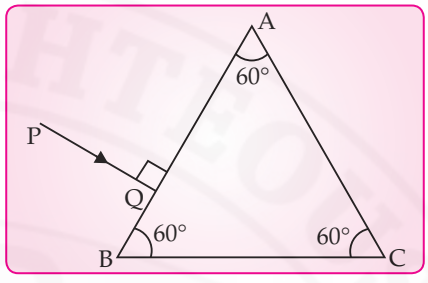
(ii) *The specific heat capacity of lead is 130 $Jkg^{-1}K^{-1}$.*

Question 2.

(a) *State two factors upon which the heat absorbed by a body depends.* [2]

(b) *A boy uses blue colour of light to find the refractive index of glass. He then repeats the experiment using red colour of light. Will the refractive index be the same or different in the two cases ? Give a reason to support your answer.* [2]

(c) *Copy the diagram given below and complete the path of light ray till it emerges out of the prism. The critical angle of glass is 42°. In your diagram mark the angles wherever necessary.* [2]



(d) *State the dependence of angle of deviation :* [2]

(i) *On the refractive index of the material of the prism.*

(ii) *On the wavelength of light.*

(e) *The ratio of amplitude of two waves is 3 : 4. What is the ratio of their :* [2]

(i) *loudness ?*

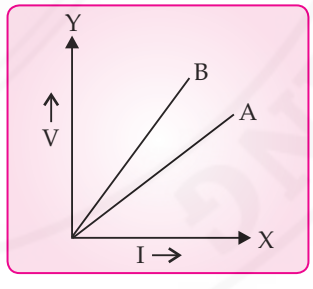
(ii) *frequencies ?*

Question 3.

(a) *State two ways by which the frequency of transverse vibrations of a stretched string can be increased.* [2]

(b) *What is meant by noise pollution ? Name one source of sound causing noise pollution.* [2]

(c) *The V-I graph for a series combination and for a parallel combination of two resistors is shown in the figure below. Which of the two A or B, represents the parallel combination ? Give a reason for your answer.* [2]



(d) *A music system draws a current of 400 mA when connected to a 12 V battery.*

(i) *What is the resistance of the music system ?*

(ii) *The music system is left playing for several hours and finally the battery voltage drops and the music system stops playing when the current drops to 320 mA. At what battery voltage does the music system stop playing ?* [2]

(e) *Calculate the quantity of heat produced in a 20 Ω resistor carrying 2.5 A current in 5 minutes.* [2]

** Answer is not given due to change in the present syllabus.

Question 4.

(a) *State the characteristics required of a good thermion emitter.*** [2]

(b) *An element* $_{Z}S^{A}$ *decays to* $_{85}R^{222}$ *after emitting* 2α *particles and* 1β *particle. Find the atomic number and atomic mass of the element S.* [2]

(c) *A radioactive substance is oxidized. Will there be any change in the nature of its radioactivity ? Give a reason for your answer.* [2]

(d) *State the characteristics required in a material to be used as an effective fuse wire.* [2]

(e) *Which coil of a step up transformer is made thicker and why ?* [2]

SECTION-II (40 Marks)

Attempt any ***four*** *questions from this Section*

Question 5.

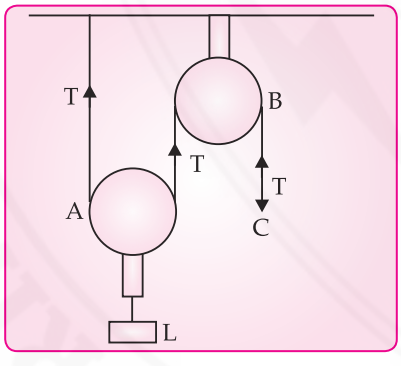
(a) *A stone of mass 'm' is rotated in a circular path with a uniform speed by tying a strong string with the help of your hand. Answer the following questions :* [3]

(i) *Is the stone moving with a uniform or variable speed ?*

(ii) *Is the stone moving with a uniform acceleration ? In which direction does the acceleration act ?*

(iii) *What kind of force acts on the hand and state its direction ?*

(b) *From the diagram given below, answer the questions that follow :* [3]



(i) *What kind of pulleys are A and B ?*

(ii) *State the purpose of pulley B.*

(iii) *What effort has to be applied at C to just raise the load L = 20 kgf ?*

(Neglect the weight of pulley A and friction)

(c) **(i)** *An effort is applied on the bigger wheel of a gear having 32 teeth. It is used to turn a wheel of 8 teeth. Where is it used ?***

(ii) *A pulley system has three pulleys. A load of 120 N is overcome by applying an effort of 50 N. Calculate the Mechanical Advantage and Efficiency of this system.* [4]

** Answer is not given due to change in the present syllabus.

Question 6.

(a) **(i)** *What is the principle of method of mixtures ?*

(ii) *What is the other name given to it ?*

(iii) *Name the law on which the principle is based.* [3]

(b) *Some ice is heated at a constant rate, and its temperature is recorded after every few seconds, till steam is formed at 100°C. Draw a temperature time graph to represent the change. Label the two phase changes in your graph.* [3]

(c) *A copper vessel of mass 100 g contains 150 g of water at 50°C. How much ice is needed to cool to 5°C ?*

Given :

Specific heat capacity of copper = $0{\cdot}4\ Jg^{-1}\ °C^{-1}$

Specific heat capacity of water = $4{\cdot}2\ Jg^{-1}\ °C^{-1}$

Specific latent heat of fusion of ice = $336\ Jg^{-1}$ [4]

Question 7.

(a) **(i)** *Write a relationship between angle of incidence and angle of refraction for a given pair of media.*

(ii) *When a ray of light enters from one medium to another having different optical densities, it bends. Why does this phenomenon occur ?*

(iii) *Write one condition where it does not bend when entering a medium of different optical density.* [3]

(b) *A lens produces a virtual image between the object and the lens.*

(i) *Name the lens.*

(ii) *Draw a ray diagram to show the formation of this image.* [3]

(c) *What do you understand by the term 'Scattering of light' ? Which colour of white light is scattered the least and why ?* [4]

Question 8.

(a) **(i)** *Name the waves used for echo depth sounding.*

(ii) *Give one reason for their use for the above purpose.*

(iii) *Why are the waves mentioned by you not audible to us ?* [3]

(b) **(i)** *What is an echo ?*

(ii) *State two conditions for an echo to take place.* [3]

(c) **(i)** *Name the phenomenon involved in tuning a radio set to a particular station.*

(ii) *Define the phenomenon named by you in part* (i) *above.*

(iii) *What do you understand by loudness of sound ?*

(iv) *In which units is the loudness of sound measured ?* [4]

Question 9.

(a) **(i)** *Which particles are responsible for current in conductors ?*

(ii) *To which wire of a cable in a power circuit should the metal case of a geyser be connected ?*

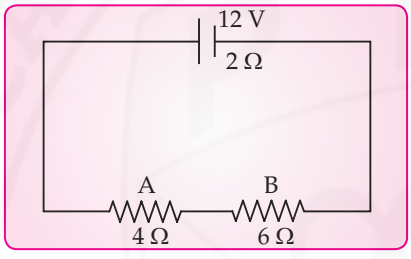
(iii) *To which wire should the fuse be connected ?* **[3]**

(b) **(i)** *Name the transformer used in the power transmitting station of a power plant.*

(ii) *What type of current is transmitted from the power station ?*

(iii) *At what voltage is this current available to our household ?* **[3]**

(c) *A battery of emf 12 V and internal resistance 2 Ω is connected with two resistors A and B of resistance 4 Ω and 6 Ω respectively joined in series.*



Find : **[4]**

(i) *Current in the circuit.*

(ii) *The terminal voltage of the cell.*

(iii) *The potential difference across 6 Ω resistor.*

(iv) *Electrical energy spent per minute in 4 Ω resistor.*

Question 10.

(a) *Arrange α, β and γ rays in ascending order with respect to their* **[3]**

(i) *Penetrating power*

(ii) *Ionising power*

(iii) *Biological effect.*

(b) **(i)** *In a cathode ray tube what is the function of anode ?***

(ii) *State the energy conversion taking place in a cathode ray tube.***

(iii) *Write one use of cathode ray tube.*** **[3]**

(c) **(i)** *Represent the change in the nucleus of radioactive element when a β particle is emitted.*

(ii) *What is the name given to elements with same mass number and different atomic number ?*

(iii) *Under which conditions does the nucleus of an atom tend to be radioactive ?* **[4]**

ANSWERS

SECTION-I

Answer 1.

(b) **(i)** Weight of a boy (F_1)

$= 40$ kgf

Distance covered (d) $= 30 \times \frac{20}{100} = 6$ m

Work done by boy (W_1)

$= F_1 d$

$= 40 \times 9{\cdot}8 \times 6$

$(\because 1 \text{ kgf} = g = 9{\cdot}8 \text{ N})$

$= 2352$ J

Weight of a girl (F_2)

$= 30$ kgf

Work done by girl (W_2)

$= F_2 d$

$= 30 \times 9{\cdot}8 \times 6$

$= 1764$ J

On comparing work done by them, we get

$$\frac{W_1}{W_2} = \frac{2352 \text{ J}}{1764 \text{ J}} = \frac{4}{3}$$

(ii) Time taken by a boy (t_1)

$= 4$ min

$= 4 \times 60 = 240$ sec

Power developed by boy (P_1)

$$= \frac{W_1}{t_1} = \frac{2352}{240}$$

$= 9{\cdot}8$ W

Time taken by a girl (t_2)

$= 3$ min

$= 3 \times 60 = 180$ sec

Power developed by girl (P_2)

$$= \frac{W_2}{t_2} = \frac{1764}{180}$$

$= 9{\cdot}8$ W

On comparing power developed by them, we get

$$\frac{P_1}{P_2} = \frac{9{\cdot}8 \text{ W}}{9{\cdot}8 \text{ W}} = 1 : 1.$$

(c) Velocity ratio will not change for a machine of a given design and it can be defined as the ratio of the displacement of the effort to the displacement of the load (in the same given time).

(d) Mass of water = 300 g

Specific heat of water = 4·2 J/g °C

Specific heat of ice = 336 J/g

Fall in temperature, $\theta_F = 40 - 0 = 40°C$

Heat gained by ice

= Heat lost by water

** Answer is not given due to change in the present syllabus.

$\therefore$ Mass of ice × Specific heat of ice

= Mass of water × Specific heat of water × Fall in temperature

$$\text{Mass of ice} = \frac{\text{Mass of water} \times \text{Specific heat of water} \times \theta_F}{\text{Specific heat of ice}}$$

$$= \frac{300 \times 4{\cdot}2 \times 40}{336} = 150 \text{ g}$$

(e) **(i)** The heat capacity of the body is 60 JK^{-1}. This means that the amount of heat energy required to raise the body's temperature by 1 K without going through a change of state is 60 J.

(ii) The specific heat capacity of lead is 130 $Jkg^{-1}K^{-1}$. This means that the amount of heat energy needed to raise the temperature of 1 kg of lead through 1 K is 130 J.

Answer 2.

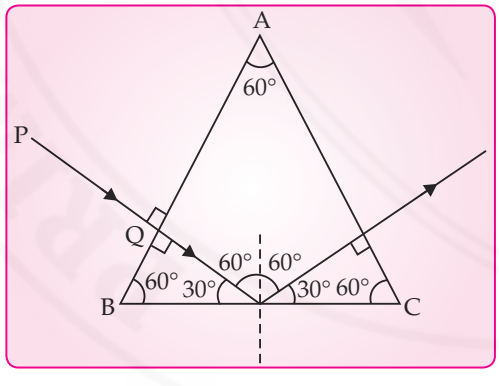
(a) Two factors upon which the heat absorbed by a body depends are :

1. the change in the temperature of the body.

2. the mass of the body.

(b) The index of refraction is a function of the wavelength of the light. The wavelength of red light is longer than the wavelength of blue light. Therefore, blue light bends more when it passes from air to glass. As the angle of deviation in both cases will be different, the refractive index will also be different. It will be more in case of blue light than in red light.

(c)



(d) **(i)** If the refractive index of the material increases, the angle of deviation also increases.

(ii) Lesser the wavelength of light, greater is the angle of deviation.

(e) It is given that the ratio of amplitude of two waves is 3 : 4.

(i) As loudness is directly proportional to the square of the amplitude. So, the ratio of the two waves' loudness is 9 : 16.

(ii) As frequency does not depend upon amplitude. So, the ratio of frequency of the two waves is 1 : 1.

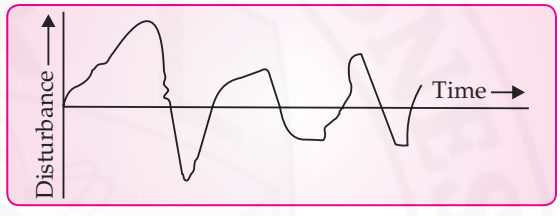
Answer 3.

(a) The frequency of transverse vibrations of a stretched string can be increased :

1. by increasing the tension in the string.

2. by decreasing the length of the vibrating string.

(b) A noise is a non-periodic (or irregular) disturbance with sudden changes of amplitude and lacking a sense of continuity. It is discordant and unpleasant to the ear. Usually all the sounds of level above 120 dB are termed as noise.



Noise pollution can be defined as the unwanted, unpleasant or disagreeable sound that causes discomfort to living beings.

The sound produced by heavy means of transport causes noise pollution.

(c) Since the straight line A is less steeper than B, so the straight line A represents small resistance. In a parallel combination, the equivalent resistance is less than in series combination. So, A represents the parallel combination.

(d) Current (I) = 400 mA

$= 400 \times 10^{-3}$ A

Voltage (V) = 12 V

(i) $V = IR$

$\therefore$ Resistance $(R) = \frac{V}{I} = \frac{12}{400 \times 10^{-3}} = 30\ \Omega$

(ii) $R = 30\ \Omega$

$I = 320 \text{ mA} = 320 \times 10^{-3}$ A

$V = IR = 320 \times 10^{-3} \times 30 = 9{\cdot}6$ V

(e) Current (I) = 2·5 A

Resistance = 20 Ω

Time (t) = 5 min = 5 × 60 sec

= 300 sec

Quantity of heat produced (H)

$= I^2Rt$

$= (2{\cdot}5)^2 \times 20 \times 300$

= 37500 J = 37·5 kJ

Answer 4.

(b) $S_Z^A \xrightarrow{2\alpha} X_{Z-4}^{A-8} \xrightarrow{\beta} R_{Z-4+1}^{A-8}$

Given : $R_{Z-3}^{A-8} = R_{85}^{222}$

$\therefore$ $Z - 3 = 85$; $A - 8 = 222$

$\Rightarrow$ $Z = 88$; $A = 230$

$\therefore$ Atomic number of S = 88

Atomic mass of S = 230

(c) When a radioactive substance is oxidized, there will be no change in the nature of its radioactivity. This is because radioactivity is a property of the nucleus and the nucleus of a substance does not get changed if it gets oxidized. (Oxidation is a chemical change involving only the extra nuclear electrons.)

(d) Characteristics required in a material to be used as an effective fuse wire are :

(i) high resistivity **(ii)** low melting point.

(e) In step up transformer, the primary coil carries more current than the secondary coil. So, to withstand high currents, and to reduce the energy loss the primary coil of transformer should be made thicker.

SECTION-II

Answer 5.

(a) **(i)** The stone is moving with a uniform speed.

(ii) Yes, the stone is moving with a uniform acceleration, acting radially inward.

(iii) The force which acts on the hand is the centrifugal force. Its direction is opposite to the centripetal force *i.e.*, away from the centre.

(b) **(i)** A is a single movable pulley.

B is a single fixed pulley.

(ii) It is quite difficult to apply effort in the upward direction, if no fixed pulley B is used. The fixed pulley changes the direction of effort from upwards to downwards, making the application of the effort more convenient and easier.

(iii) Given, $L = 20$ kgf

Effort = ?

In equilibrium,

$L = 2T$

At C, Effort (E) = T

$$\text{Effort needed} = \frac{L}{2} = \frac{20}{2} = 10 \text{ kgf.}$$

(c) **(ii)** Mechanical advantage (M.A.)

$$= \frac{\text{Load}}{\text{Effort}} = \frac{120}{50} = 2{\cdot}4$$

$$\text{Efficiency} = \frac{\text{M.A.}}{\text{V.R.}} \times 100\%$$

Since, Velocity ratio (V.R.)

= Number of pulleys = 3

$\therefore$ $\text{Efficiency} = \frac{2{\cdot}4}{3} \times 100 = 80\%$

Answer 6.

(a) **(i)** According to the principle of mixtures, when a hot body is mixed with a cold body, heat energy passes from the hot body to the cold body, till both the bodies attain the same temperature.

If no heat energy is lost to the surroundings *i.e.*, the system is perfectly insulated then

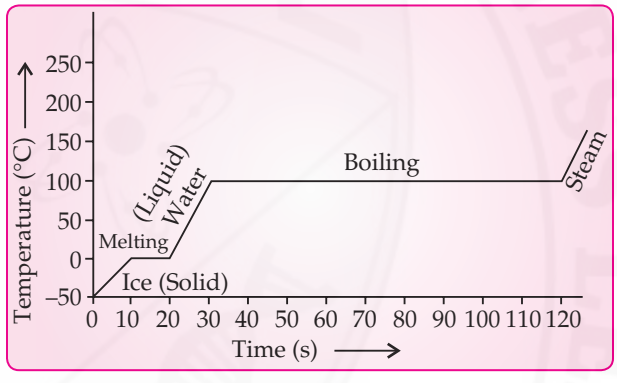
Heat energy lost by the hot body

= Heat energy gained by cold body.

(ii) Principle of calorimetry.

(iii) It is based on the law of conservation of energy.

(b)



(c) Heat energy imparted by vessel

$= 100 \times 0{\cdot}4 \times (50 - 5)$

$= 1800$ J

Heat energy imparted by water

$= 150 \times 4{\cdot}2 \times (50 - 5)$

$= 28350$ J

Let m gram of ice be used.

Heat energy taken by ice to melt

$= m \times 336$ J

Heat energy taken by the melted ice to raise its temperature from 0°C to 5°C

$= m \times 4{\cdot}2 \times (5 - 0) = 21m$ J

By law of conservation of energy,

Heat energy imparted by vessel and water

= Heat energy taken by ice and melted ice

i.e., $1800 + 28350 = 336m + 21m$

or $30150 = 357m$

$\therefore$ $m = \frac{30150}{375} = 84{\cdot}45$ g

Thus, 84·45 g of ice is used.

Answer 7.

(a) **(i)** The ratio of the sine of the angle of incidence i to the sine of the angle of refraction r is constant for a given pair of media. This constant is called refractive index.

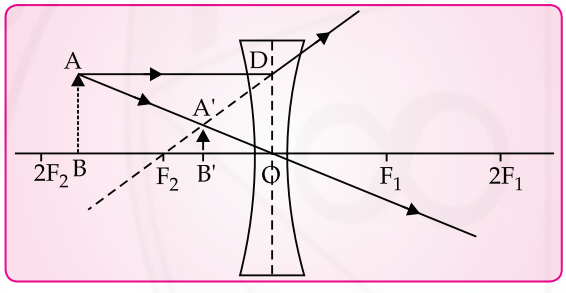
$$\Rightarrow \quad \frac{\sin i}{\sin r} = {}_1\mu_2 \text{ or } {}_1n_2$$

(ii) When a ray of light passes from one medium to another medium, its direction (or path) changes because of change in speed of light while travelling from one medium to another.

(iii) The ray of light which is incident normally on the surface separating the two media, passes undeviated (does not bend). Thus, if angle of incidence $\angle i = 0°$, then angle of refraction $\angle r = 0°$. The deviation of the ray is zero.

(b) **(i)** Concave lens.

(ii)



(c) Scattering of light is the process of absorption and then re-emission of light energy in many different directions, without changing its wave length.

The colour of white light which scattered the least is red. This is because red colour has the longest wavelength 8000 Å and lowest frequency $3{\cdot}75 \times 10^{14}$ Hz.

Answer 8.

(a) **(i)** Ultrasonic waves.

(ii) The ultrasonic waves are used because they can travel undeviated through a long distance.

(iii) The ultrasonic waves are not audible to us because they have frequency of more than audible range of frequency 20000 Hz.

(b) **(i)** The clear and distinct sound heard after reflection from a distant obstacle (cliff, wall etc.) after the original sound has ceased, is called an echo.

(ii) Conditions for an echo to take place are :

1. The minimum distance between the source of sound and the reflector in air must be 17 m. It is different in different medium depending upon the speed of sound in that medium.

2. The size of the reflector must be large enough as compared to the wavelength of sound wave.

(c) **(i)** Resonance.

(ii) When the frequency of an externally applied periodic force on a body is equal to its natural frequency, the body readily begins to vibrate with an increased amplitude. This phenomenon is known as resonance.

(iii) Loudness is the property by virtue of which a loud sound can be distinguished from a faint one, both having the same pitch and quality.

(iv) The unit of loudness is decibel (dB).

Answer 9.

(a) **(i)** Electrons **(ii)** Earth wire

(iii) Live wire

(b) **(i)** Step up transformer

(ii) Alternating current

(iii) 220 V

(c) **(i)** Total resistance $= 4 + 6 + 2 = 12\ \Omega$

$$I = \frac{\text{Emf}}{\text{Total resistance}}$$

$$= \frac{12}{12} = 1 \text{ A}$$

(ii) $V = E - Ir$

$= 12 - (1 \times 2) = 10$ V

(iii) $V = IR = 1 \times 6 = 6$ V

(iv) Electrical energy spent

$= I^2Rt$

$= 1 \times 1 \times 4 \times 60 = 240$ J.

Answer 10.

(a) **(i)** $\alpha < \beta < \gamma$ **(ii)** $\gamma < \beta < \alpha$

(iii) $\alpha < \beta < \gamma$

(c) **(i)** In emitting a β-particle, the number of nucleons in the nucleus remains same, but the number of neutrons is decreased by one and the number of protons is increased by one.

$$\underset{\text{(Parent nucleus)}}{{}^{A}_{Z}P} \longrightarrow \underset{\text{(daughter nucleus)}}{{}^{A}_{Z+1}Q} + \underset{\text{(β-particle)}}{{}^{0}_{-1}e}$$

(ii) Isobars

(iii) When the number of neutrons is 1·3 to 1·5 times the number of protons in the nucleus of an atom, nucleus has more mass or nucleus has excess energy under such condition it tends to be radioactive.

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PHYSICS

2015

QUESTIONS

SECTION-I (40 Marks)

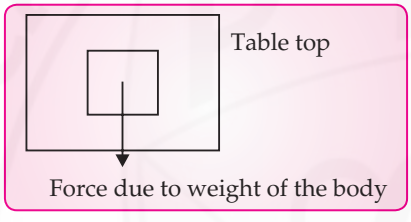
*Attempt **all** questions from this Section*

Question 1.

(a) *When a body is placed on a table top, it exerts a force equal to its weight downwards on the table top but does not move or fall.***

(i) *Name the force exerted by the table top.*

(ii) *What is the direction of the force?* [2]



(b) **(i)** *Name one factor that affects the lateral displacement of light as it passes through a rectangular glass slab.*

(ii) *On reversing the direction of the current in a wire, the magnetic field produced by it gets……* [2]

(c) **(i)** *On what factor does the position of the centre of gravity of a body depend ?*

(ii) *What is the S.I. unit of the moment of force ?* [2]

(d) *Name the factors affecting the turning effect of a body.* [2]

(e) **(i)** *Define equilibrium.*

(ii) *In a beam balance when the beam is balanced in a horizontal position, it is in……equilibrium.* [2]

Question 2.

(a) *How is work done by a force measured when the force :* [2]

(i) *is in the direction of displacement.*

(ii) *is at an angle to the direction of displacement.*

(b) *State the energy changes in the following while in use :* [2]

(i) *Burning of a candle.*

(ii) *A steam engine.*

(c) **(i)** *A scissor is a……multiplier.*

(ii) *1 kWh = ……J.* [2]

(d) *Explain the motion of a planet around the sun in a circular path.* [2]

(e) *Rajan exerts a force of 150 N in pulling a cart at a constant speed of 10 m/s. Calculate the power exerted.* [2]

** Answer is not given due to change in the present syllabus.

Question 3.

(a) **(i)** *Give the expression for mechanical advantage of an inclined plane in terms of the length of an inclined plane.***

(ii) *Name a common device where a gear train is used.*** [2]

(b) *The speed of light in glass is 2×10^5 km/s. What is the refractive index of glass ?* [2]

(c) **(i)** *Draw a graph between displacement and the time for a body executing free vibrations.*

(ii) *Where can a body execute free vibrations ?* [2]

(d) **(i)** *What happens to the resistivity of semiconductors with the increase of temperature ?*

(ii) *For a fuse, higher the current rating……is the fuse wire.* [2]

(e) **(i)** *Name the high energetic invisible electromagnetic waves which help in the study of the structure of crystals.*

(ii) *State an additional use of the waves mentioned in part (e) (i).* [2]

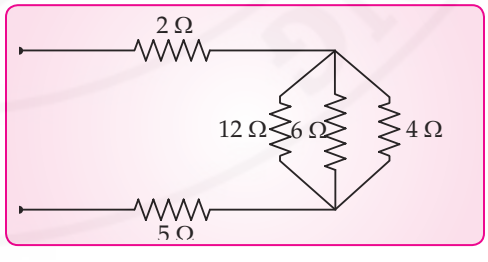
Question 4.

(a) *Rishi is surprised when he sees water boiling at 115°C in a container. Give reasons as to why water can boil at the above temperature.* [2]

(b) **(i)** *Why does a current carrying, freely suspended solenoid rest along a particular direction ?*

(ii) *State the direction in which it rests.* [2]

(c) *Find the equivalent resistance between points A and B.* [2]



(d) *Give two similarities between an A.C. generator and a D.C. motor.* [2]

(e) **(i)** *Why is a cathode ray tube evacuated to a low pressure ?***

(ii) *What happens if the negative potential is changed on a grid ?*** [2]

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) *Draw a simplified diagram of a lemon crusher, indicating direction of load and effort.* [2]

(b) **(i)** *Name the physical quantity measured in terms of horse power.*

(ii) *A nut is opened by a wrench of length 20 cm. If the least force required is 2 N, find the moment of force needed to loosen the nut.*

(iii) *Explain briefly why the work done by a fielder when he takes a catch in a cricket match is negative.* [4]

(c) *A block and tackle system has V.R. = 5.*

(i) *Draw a neat labelled diagram of a system indicating the direction of its load and effort.*

(ii) *Rohan exerts a pull of 150 kgf. What is the maximum load he can raise with this pulley system if its efficiency = 75% ?* [4]

Question 6.

(a) **(i)** *Where should an object be placed so that a real and inverted image of the same size as the object is obtained using a convex lens ?*

(ii) *Draw a ray diagram to show the formation of the image as specified in the part a (i).* [3]

(b) **(i)** *Why does the Sun appear red at sunrise ?*

(ii) *Name the subjective property of light related to its wavelength.* [3]

(c) *Jatin puts a pencil into a glass container having water and is surprised to see the pencil in a different state.* [4]

(i) *What change is observed in the appearance of the pencil ?*

(ii) *Name the phenomenon responsible for the change.*

(iii) *Draw a ray diagram showing how the eye sees the pencil.*

Question 7.

(a) **(i)** *State the safe limit of sound level in terms of decibel for human hearing.*

(ii) *Name the characteristic of sound in relation to its waveform.* [2]

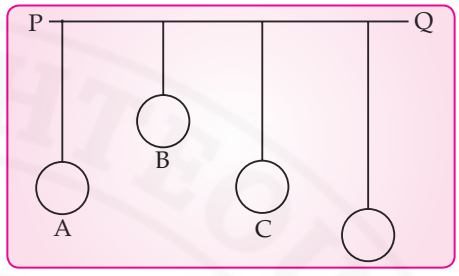
(b) *A person standing between two vertical cliffs and 480 m from the nearest cliff shouts. He hears the first echo after 3 s and the second echo 2 s later.*

Calculate :

(i) *The speed of sound.*

(ii) *The distance of the other cliff from the person.* [3]

(c) *In the diagram below, A, B, C, D are four pendulums suspended from the same elastic string PQ. The length of A and C are equal to each other while the length of pendulum B is smaller than that of D. Pendulum A is set into a mode of vibrations.*



(i) *Name the type of vibrations taking place in pendulums B and D ?*

(ii) *What is the state of pendulum C ?*

(iii) *State the reason for the type of vibrations in pendulums B and C.* [5]

Question 8.

(a) **(i)** *Name the device used to increase the voltage at a generating station.*

(ii) *At what frequency is A.C. supplied to residential houses ?*

(iii) *Name the wire in a household electrical circuit to which the switch is connected.* [3]

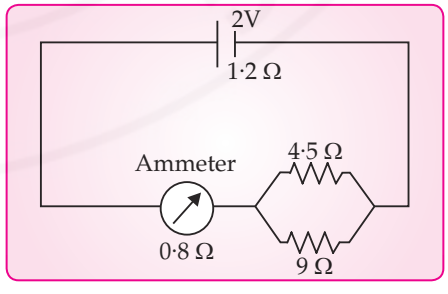
(b) *The relationship between the potential difference and the current in a conductor is stated in the form of a law.* [3]

(i) *Name the law.*

(ii) *What does the slope of V-I graph for a conductor represent ?*

(iii) *Name the material used for making the connecting wire.*

(c) *A cell of emf 2 V and internal resistance 1·2 Ω is connected with an ammeter of resistance 0·8 Ω and two resistors of 4·5 Ω and 9 Ω as shown in the diagram below :*



(i) *What would be the reading on the Ammeter ?*

(ii) *What is the potential difference across the terminals of the cell ?* [4]

Question 9.

(a) **(i)** *Name a gas caused by the Greenhouse effect.***

(ii) *Which property of water makes it an effective coolant ?* **[2]**

(b) **(i)** *Water in lakes and ponds do not freeze at once in cold countries. Give a reason in support of your answer.*

(ii) *What is the principle of Calorimetry ?*

(iii) *Name the law on which this principle is based.*

(iv) *State the effect of an increase of impurities on the melting point of ice.* **[4]**

(c) *A refrigerator converts 100 g of water at 20°C to ice at – 10°C in 35 minutes.*

Calculate the average rate of heat extraction in terms of watts.

Given : Specific heat capacity of ice = 2·1 J g^{-1} °C^{-1}

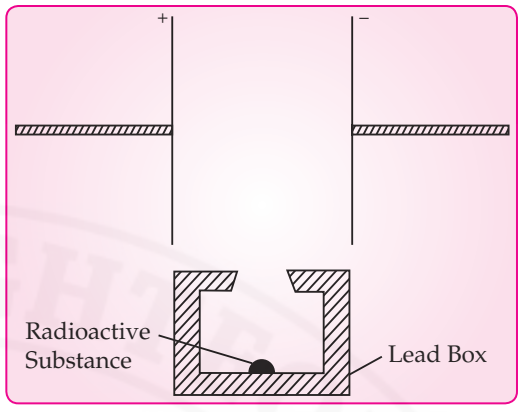
Specific heat capacity of water = 4·2 J g^{-1} °C^{-1}

Specific Latent heat of fusion of ice = 336 J g^{-1} **[4]**

Question 10.

(a) **(i)** *What is thermionic emission ?***

(ii) *Name the unit in which the work function of a metal is expressed.*** **[2]**



(b) **(i)** *Complete the diagram as given above by drawing the deflection of radioactive radiations in an electric field.*

(ii) *State any two precautions to be taken while handling radioactive substances.* **[5]**

(c) *An atomic nucleus A is composed of 84 protons and 128 neutrons.* **[3]**

(i) *The nucleus A emits an alpha particle and is transformed into nucleus B. What is the composition of nucleus B ?*

(ii) *The nucleus B emits a beta particle and is transformed into a nucleus C. What is the composition of nucleus C ?*

(iii) *Does the composition of nucleus C change if it emits gamma radiations ?*

ANSWERS

SECTION-I

Answer 1.

(b) **(i)** The thickness of glass slab affects the lateral displacement of light as it passes through a rectangular glass slab.

(ii) Reversed in direction.

(c) **(i)** The position of the centre of gravity of a body depends on its shape, *i.e.,* the distribution of mass in it.

(ii) The S.I. unit of moment of force is newton metre (Nm).

(d) The factors affecting the turning effects of a body are:

1. the magnitude of force applied.

2. the perpendicular distance of the line of action of force from the axis of rotation.

(e) **(i)** When a number of forces acting on a body produce no change in its state of rest or of motion, then the body is said to be in equilibrium.

(ii) Static

** Answer is not given due to change in the present syllabus.

Answer 2.

(a) **(i)** Work done is given by the product of the force (F) and the displacement (*d*) in the direction of the force.

i.e., Work done = F × *d*

(ii) Work done is measured by the product of the force (F) and the component of displacement (*d*) in the direction of the force.

i.e., Work done = F × *d* cos θ

where θ is the angle which the displacement makes with the direction of the force.

(b) **(i)** Chemical energy to the light and heat energy.

(ii) Chemical to heat energy to mechanical energy.

(c) **(i)** Force

(ii) 3.6×10^6

(d) The motion of a planet around the sun in a circular path is due to the centripetal force which is provided by the gravitational force of attraction on the planet by the sun.

(e) Power exerted = Force × Average speed
= 150 × 10
= 1500 W

Answer 3.

(b) Given,

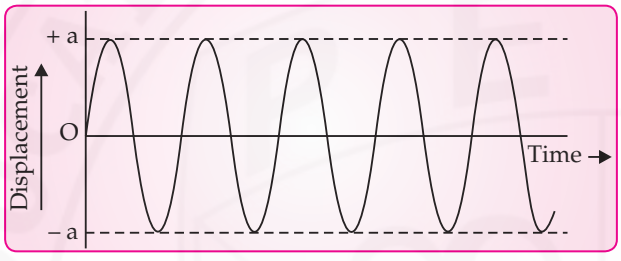
Speed of light in glass $= 2 \times 10^5$ km/s
$= 2 \times 10^5 \times 10^3$ m/s
$= 2 \times 10^8$ m/s

Refractive index of glass

$$= \frac{\text{Speed of light in vacuum}}{\text{Speed of light in glass}}$$

$$= \frac{3 \times 10^8}{2 \times 10^8} = 1{\cdot}5$$

(c) (i)



(ii) A body can execute free vibrations in vacuum because the presence of any medium offers some resistance, as a result of which the amplitude of vibrations does not remain constant.

(d) (i) The resistivity of semiconductors decreases with increase in temperature.

(ii) Thicker

(e) (i) X-rays

(ii) They are used for the detection of fracture in bones.

Answer 4.

(a) Water boils at higher temperature because of the increase in pressure or the presence of some impurity. More the impurity or pressure, more will be the boiling point.

(b) (i) This is because the current carrying freely suspended solenoid behaves like a bar magnet.

(ii) It rests in the geographic North-South direction.

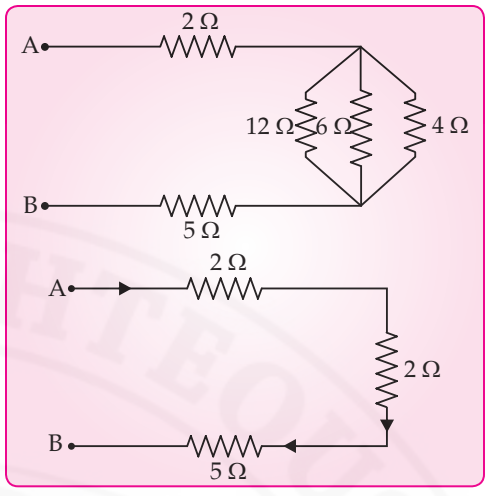
(c) Three resistances 12 Ω, 6 Ω and 4 Ω are connected in parallel.

∴ The equivalent resistance in parallel is given by

$$\frac{1}{R_p} = \frac{1}{12} + \frac{1}{6} + \frac{1}{4}$$

$$\frac{1}{R_p} = \frac{1+2+3}{12}$$

$$R_p = \frac{12}{(1+2+3)} = 2\ \Omega$$



Now, 2 Ω, R_p and 5 Ω are in series.

Thus, the equivalent resistance between A and B = 2 Ω + 2 Ω + 5 Ω = 9 Ω.

(d) Similarities between A.C. generator and D.C. motor are :

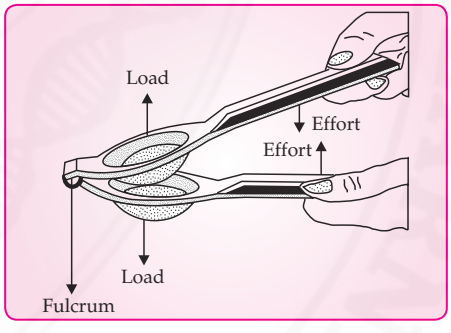
(i) armature coil rotates in a magnetic field.

(ii) the external circuit is connected to two carbon brushes.

SECTION-II

Answer 5.

(a)



(b) (i) The physical quantity is power.

1 H.P. = 746 W

(ii) Given : Distance = 20 cm

$$= \frac{20}{100} = 0{\cdot}2 \text{ m}$$

Force = 2 N

Moment of the force
= Force × Distance
= 2 × 0·2 Nm = 0·4 Nm

(iii) Here, the fielder uses a force to oppose the motion of the ball.

Thus, θ = 180°

We know,

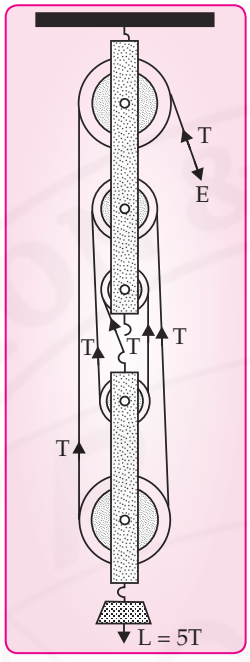
work done = force (F) × displacement (d) × cos 180°

$= -F \times d$

$(\because \cos 180° = -1)$

Thus, work done is negative.

(c) (i)



(ii) Efficiency = 75%

V.R. = 5

$$\text{Efficiency} = \frac{\text{M.A.}}{\text{V.R.}}$$

Thus, $\frac{75}{100} = \frac{\text{M.A.}}{5}$

Or M.A. = 3·75

Now, $\text{M.A.} = \frac{\text{Load}}{\text{Effort}}$

$3{\cdot}75 = \frac{\text{Load}}{150}$

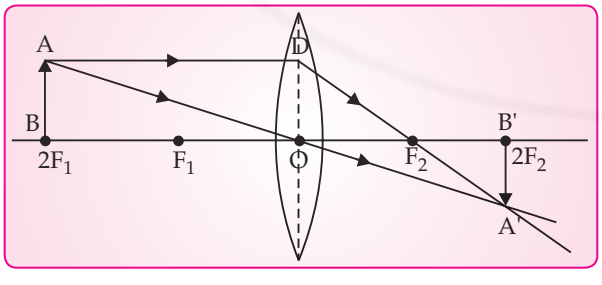
Thus, Load = 3·75 × 150

= 562·5 kgf.

Answer 6.

(a) (i) The object must be placed on the principal axis of a convex lens at a distance twice the focal length of the lens *i.e.*, at $2F_1$.

(ii)



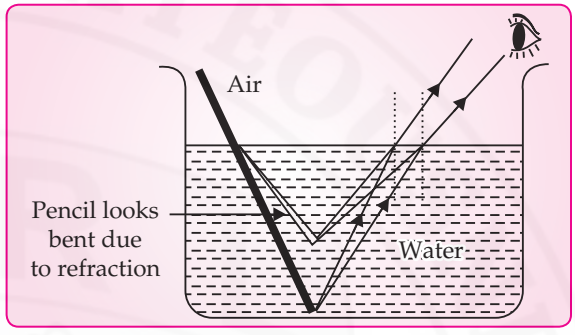
(b) (i) At sunrise, light from the sun has to travel a very long distance to reach the observer on earth. The light while travelling from sun loses blue light due to scattering while the red light is scattered very little because of its long wavelength. So the sun looks red during sunrise.

(ii) Colour of light.

(c) (i) He sees that the pencil appears to be bent.

(ii) Refraction of light

(iii)



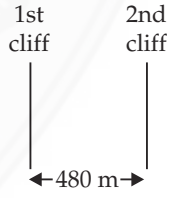
Answer 7.

(a) (i) The safe limit of sound level for human hearing is in the range of 0 to 80 dB.

(ii) The characteristic of sound in relation to its waveform is quality or timbre.

(b) The first echo is heard from the nearest cliff.

The total distance travelled by sound to reach the first cliff and then come back = 2 × 480 m = 960 m, Time taken = 3 second



(i) Speed of sound $= \frac{\text{Total distance travelled}}{\text{Time taken}}$

$= \frac{960}{3}$ m/s

= 320 m/s

(ii) Time taken for the second echo

= (3 + 2) second

= 5 second

Distance of the second cliff from the observer

$= \frac{(\text{speed} \times \text{time})}{2}$

$= \frac{(320 \times 5)}{2} = 800$ m

(c) (i) Forced vibration

(ii) Pendulum C is in a state of resonance with Pendulum A. Also they are in the same phase.

(iii) This is because the time period of pendulum B is different from that of C (since length of the pendulums B and C are different).

Answer 8.

(a) **(i)** Step up Transformer

(ii) 50 hertz

(iii) Live wire

(b) **(i)** Ohm's law

(ii) The slope of the graph represent resistance of the conductor.

(iii) Copper

(c) The resistance of 4·5 Ω and 9 Ω are connected in parallel.

∴ Equivalent resistance,

$$R_1 = \frac{(4{\cdot}5 \times 9)}{(4{\cdot}5 + 9)} = \frac{40{\cdot}5}{13{\cdot}5} = 3\ \Omega$$

Total resistance in the circuit (R)

$$= 1{\cdot}2 + 0{\cdot}8 + 3 = 5\ \Omega$$

(i) Reading of the ammeter

= Current in the circuit (I)

$$= \frac{\text{Total e.m.f. (E)}}{\text{Total resistance (R)}}$$

$$= \frac{2}{5} = 0{\cdot}4 \text{ ampere}$$

(ii) Potential difference across the terminals of the cell (V)

= Total p.d. in the external circuit

$= E - Ir$

$= 2 - (0{\cdot}4 \times 1{\cdot}2)$

$= 2 - 0{\cdot}48 = 1{\cdot}52$ volts

Answer 9.

(a) **(ii)** High specific heat capacity (4200 $Jkg^{-1}K^{-1}$) of water makes it an effective coolant.

(b) **(i)** This is because of high specific latent heat of fusion of ice (equal to 336000 J/kg). So to freeze water, a large quantity of heat has to be taken out from water to freeze it.

(ii) The principle of calorimetry states that heat energy lost by a hot body is equal to the heat energy gained by the cold body, provided no heat is lost to the surrounding.

(iii) It is based on the law of conservation of energy.

(iv) The melting point of ice decreases with the increase in impurities in it.

(c) Heat lost by water when the refrigerator converts 100 g of water at 20°C to water at 0°C

= mass of water × specific heat capacity of water × fall in temperature

$= 100 \times 4{\cdot}2 \times (20 - 0) = 8400$ J

Heat energy extracted to convert 100 g of water at 0°C to ice at 0°C

= mass of water × specific latent heat of fusion of ice $= 100 \times 336 = 33600$ J

Heat energy extracted to convert 100 g of ice at 0°C to ice at –10°C

= mass of ice × specific heat capacity of ice × fall in temperature

$= 100 \times 2{\cdot}1 \times [0 - (-10)] = 100 \times 2{\cdot}1 \times 10 = 2100$ J

Total heat extracted = 8400 + 33600 + 2100

= 44100 J

Let the average rate of extraction of heat be P watt.

Energy extracted by the refrigerator in t seconds

$= P \times t$

Thus, $P \times t = 44100$ J

or $P \times 35 \times 60 = 44100$

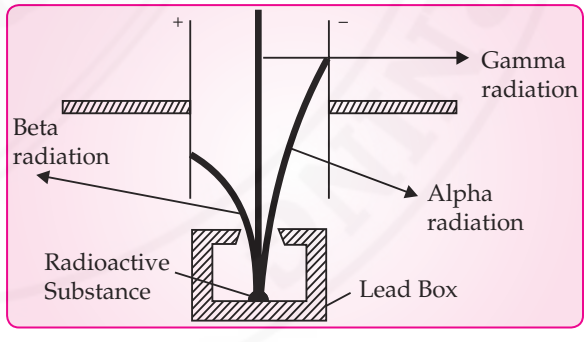
(∵ 35 minute = 35 × 60 second)

∴ $P = \frac{44100}{35 \times 60}$

= 21 watt

Answer 10.

(b) **(i)**



(ii) Two precautions to be taken while handling radioactive substances are :

1. Special lead lined aprons and lead gloves should be used.

2. The radioactive materials should be handled with long lead tongs.

(c) **(i)** Atomic number of A = Number of protons

= 84

Number of neutrons in A = Mass number of A
– Atomic number of A

Thus, Mass number of A
= Number of neutrons in A + Atomic number of A
= 128 + 84
= 212

When an alpha particle is emitted,
Atomic number of B = Atomic number of A – 2
= 84 – 2 = 82

Thus, Number of protons in B
= Number of electrons in B
= Atomic number
= 82

Mass number of B = 212 – 4
= 208

Number of neutrons in B
= Mass number of B – Atomic number of B
= 208 – 82
= 126

$$^{212}_{84}A \longrightarrow {}^{4}_{2}He + {}^{208}_{82}B$$

(ii) Atomic number of C is one more than the mass number of B due to beta emission *i.e.*, 82 + 1 = 83, whereas mass number remains the same *i.e.*, 208.

$$^{208}_{82}B \longrightarrow e^{0}_{-1} + {}^{208}_{83}C$$

So, Number of electrons in C
= Number of protons in C
= Atomic number
= 83

Number of neutrons
= Mass number of C – Atomic number of C
= 208 – 83 = 125

(iii) If C emits gamma radiation, then there is no change in the composition of C.

PHYSICS

2014

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) *A force is applied on (i) a non-rigid body and (ii) a rigid body. How does the effect of the force differ in the above two cases ?*** [2]

(b) *A metallic ball is hanging by a string from a fixed support. Draw a neat labelled diagram showing the forces acting on the ball and the string.*** [2]

(c) **(i)** *What is the weight of a body placed at the centre of the earth ?*

(ii) *What is the principle of an ideal machine ?* [2]

(d) *Is it possible to have an accelerated motion with a constant speed ? Explain.* [2]

(e) **(i)** *When does a force do work ?*

(ii) *What is the work done by the moon when it revolves around the earth ?* [2]

Question 2.

(a) *Calculate the change in the Kinetic energy of a moving body if its velocity is reduced to 1/3rd of the initial velocity.* [2]

(b) *State the energy changes in the following devices while in use :* [2]

(i) *A loud speaker*

(ii) *A glowing electric bulb*

(c) **(i)** *What is nuclear energy ?*

(ii) *Name the process used for producing electricity using nuclear energy.* [2]

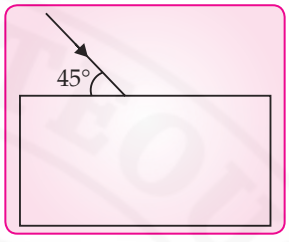
(d) *State one important advantage and disadvantage each of using nuclear energy for producing electricity.* [2]

(e) **(i)** *The conversion of part of the energy into an undesirable form is called……*

(ii) *For a given height h, …… the length l of the inclined plane, lesser will be the effort required.*** [2]

Question 3.

(a) *Draw the diagram given below and clearly show the path taken by the emergent ray :* [2]



(b) **(i)** *What is consumed using different electrical appliances, for which electricity bills are paid ?*

(ii) *Name a common device that uses electro-magnets.* [2]

(c) **(i)** *A ray of light passes from water to air. How does the speed of light change ?*

(ii) *Which colour of light travels fastest in any medium except air ?* [2]

(d) *Name the factors affecting the critical angle for the pair of media.* [2]

(e) **(i)** *Name a prism required for obtaining a spectrum of ultraviolet light.*

(ii) *Name the radiations which can be detected by a thermopile.* [2]

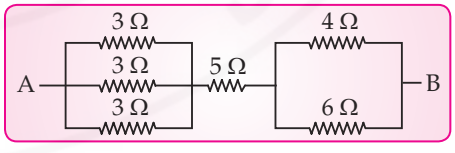
Question 4.

(a) *Why is the colour red used as a sign of danger ?* [2]

(b) **(i)** *What are mechanical waves ?*

(ii) *Name one property of waves that do not change when the wave passes from one medium to another.* [2]

(c) *Find the equivalent resistance between points A and B.*



[2]

(d) *50 g of metal piece at 27°C requires 2400 J of heat energy so as to attain a temperature of 327°C. Calculate the specific heat capacity of the metal.* [2]

(e) *An electrons emitter must have ……work function and ……melting point.*** [2]

** Answer is not given due to change in the present syllabus.

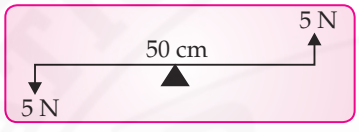
SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) **(i)** *A man having a box on his head, climbs up a slope and another man having an identical box walks the same distance on a levelled road. Who does more work against the force of gravity and why ?*

(ii) *Two forces each of 5 N act vertically upwards and downwards respectively on the two ends of a uniform metre rule which is placed at its mid-point as shown in the diagram. Determine the magnitude of the resultant moment of these forces about the midpoint.* **[4]**



(b) **(i)** *A body is thrown vertically upwards. Its velocity keeps on decreasing. What happens to its kinetic energy as its velocity becomes zero ?*

(ii) *Draw a diagram to show how a single pulley can be used so as to have its ideal M.A. = 2.* **[3]**

(c) *Derive a relationship between mechanical advantage, velocity ratio and efficiency of a machine.* **[3]**

Question 6.

(a) **(i)** *Light passes through a rectangular glass slab and through a triangular glass prism. In what way does the direction of the two emergent beams differ and why ?*

(ii) *Ranbir claims to have obtained an image twice the size of the object with a concave lens. Is he correct ? Give a reason for your answer.* **[4]**

(b) *A lens forms an erect, magnified and virtual image of an object.*

(i) *Name the lens.*

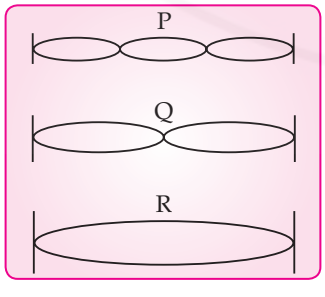
(ii) *Draw a labelled ray diagram to show the image formation.* **[3]**

(c) **(i)** *Define the power of a lens.*

(ii) *The lens mentioned in 6 (b) above is of focal length 25 cm. Calculate the power of the lens.* **[3]**

Question 7.

(a) *The adjacent diagram shows three different modes of vibrations P, Q and R of the same string.*



(i) *Which vibration will produce a louder sound and why ?*

(ii) *The sound of which string will have maximum shrillness ?*

(iii) *State the ratio of wavelengths of P and R.* **[4]**

(b) *A type of electromagnetic wave has wavelength 50 Å.*

(i) *Name the wave.*

(ii) *What is the speed of the wave in vacuum ?*

(iii) *State one use of this type of wave.* **[3]**

(c) **(i)** *State one important property of waves used for echo depth sounding.*

(ii) *A radar sends a signal to an aircraft at a distance of 30 km away and receives it back after 2×10^{-4} second. What is the speed of the signal ?* **[3]**

Question 8.

(a) *Two resistors of 4 Ω and 6 Ω are connected in parallel to a cell to draw 0·5 A current from the cell.*

(i) *Draw a labelled circuit diagram showing the above arrangement.*

(ii) *Calculate the current in each resistor.* **[4]**

(b) **(i)** *What is an Ohmic resistor ?*

(ii) *Two copper wires are of the same length, but one is thicker than the other.*

(1) *Which wire will have more resistance ?*

(2) *Which wire will have more specific resistance ?* **[3]**

(c) **(i)** *Two sets A and B, of three bulbs each, are glowing in two separate rooms. When one of the bulbs in set A is fused, the other two bulbs also cease to glow. But in set B, when one bulb fuses, the other two bulbs continue to glow. Explain why this phenomenon occurs.*

(ii) *Why do we prefer arrangements of Set B for house circuiting ?* **[3]**

Question 9.

(a) *Heat energy is supplied at a constant rate to 100 g of ice at 0°C. The ice is converted into water at 0°C in 2 minutes. How much time will be required to raise the temperature of water from 0°C to 20°C ?*

[Given : sp. heat capacity of water 4·2 $g^{-1}°C^{-1}$, sp. latent heat of ice = 336 Jg^{-1}] **[4]**

(b) *Specific heat capacity of substance A is 3·8 J g^{-1} K^{-1} whereas the specific heat capacity of substance B is 0·4 J g^{-1} K^{-1}.*

(i) *Which of the two is a good conductor of heat ?*

(ii) *How is one led to the above conclusion ?*

(iii) *If substances A and B are liquids then which one would be more useful in car radiators ?* **[3]**

(c) **(i)** *State any two measures to minimize the impact of global warming.***

(ii) *What is the Greenhouse effect ?*** **[3]**

** Answer is not given due to change in the present syllabus.

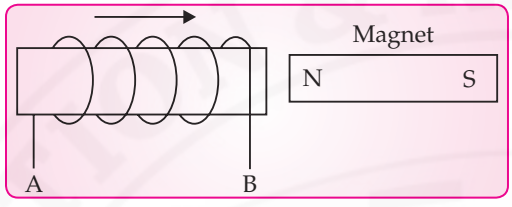
Question 10.

(a) **(i)** *Name two factors on which the magnitude of an induced e.m.f. in the secondary coil depends.*

(ii) *In the following diagram an arrow shows the motion of the coil towards the bar magnet.*

(1) *State in which direction the current flows, A to B or B to A ?*

(2) *Name the law used to come to the conclusion.*



[4]

(b) *A nucleus $_{11}Na^{24}$ emits a beta particle to change into Magnesium (Mg).*

(i) *Write the symbolic equation for the process.*

(ii) *What are numbers 24 and 11 called ?*

(iii) *What is the general name $^{24}_{12}Mg$ with respect to $^{24}_{11}Na$?* **[3]**

(c) *In a cathode ray tube state :*

(i) *the purpose of covering cathode by thorium and carbon.*

(ii) *the purpose of the fluorescent screen.*

(iii) *How is it possible to increase the rate of emission of electrons.* **[3]**

ANSWERS

SECTION-I

Answer 1.

(c) **(i)** The weight of a body placed at the centre of the earth is zero as

$$g = 0$$

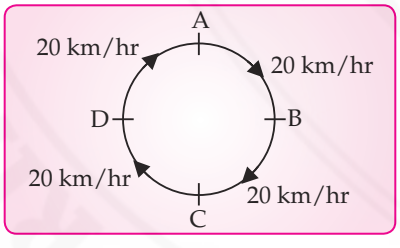
$$\therefore \quad W = mg = 0$$

(ii) An ideal machine works on the principle that work input = work output and has 100% efficiency as there is no energy loss.

Or

Work done by the machine = Work done on the machine.

(d) Yes, it is possible to have accelerated motion with constant speed.



For example, in uniform circular motion, the magnitude of speed is constant but direction of motion changes so that acceleration is produced.

(e) **(i)** Work is said to be done when the applied force produces displacement in the direction of the force.

Work done = Force × Displacement

(ii) Work done is zero by the moon, as there is no displacement since it is moving in a circular path.

Answer 2.

(a) Let a body of mass 'm' kg is moving with velocity 'v' m/s. The initial kinetic energy is given by

$$\text{K.E}_i = \frac{1}{2}mv^2$$

Now, the velocity is reduced to $\frac{1}{3}^{\text{rd}}$ of the initial velocity. The final kinetic energy is given by

$$\text{K.E}_f = \frac{1}{2}m\left(\frac{v}{3}\right)^2$$

$$= \frac{1}{9}\left(\frac{1}{2}mv^2\right) = \frac{1}{9}\text{K.E}_i$$

So, K.E. becomes $\frac{1}{9}^{\text{th}}$ of its initial K.E.

(b) **(i)** **Loud speaker :** Electrical energy to sound energy.

(ii) **Glowing electric bulb :** Electrical energy to heat and light energy.

(c) **(i)** Nuclear energy is the energy released by the atom's nucleus during a nuclear reaction.

(ii) Nuclear fission.

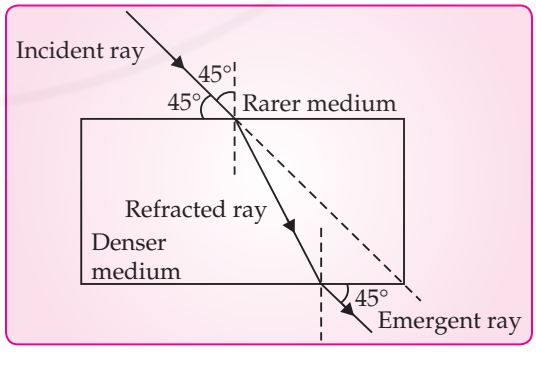
(d)

Advantage	Disadvantage
Tremendous amount of electrical energy can be produced by using a very small amount of nuclear fuel.	The nuclear waste produced by it is the source of harmful radiations and also causes environmental pollution.

(e) **(i)** Dissipation of energy.

Answer 3.

(a)



(b) **(i)** Electrical energy in kWh which is commercially known as unit.

$1\ \text{kWh} = 1\ \text{kW} \times 1\ \text{hr}$

$= 1$ unit of electricity

(ii) Electromagnets are used in electric bell, door alarm, electric motor, etc.

(c) **(i)** When light passes from water to air *i.e.*, from denser to rarer medium, its speed increases.

(ii) Red light travels fastest.

(d) Factors affecting the critical angle :

1. Wavelength of light.

2. Temperature (on changing the temperature of medium, its refractive index changes).

(e) **(i)** Quartz prism

(ii) Infra-red radiations.

Answer 4.

(a) Red colour is used as a sign of danger due to its longest wavelength and lesser deviation (scattering). Therefore, it can reach to a longer distance.

(b) **(i)** Mechanical waves are waves which requires medium for their propagation.

E.g.– sound waves

(ii) Property of wave that does not change when it passes from one medium to another is frequency.

(c) $\frac{1}{R_1} = \left(\frac{1}{3} + \frac{1}{3} + \frac{1}{3}\right)$

$\Rightarrow \frac{1}{R_1} = 1$

$\Rightarrow R_1 = 1\ \Omega$

$R_2 = 5\ \Omega$

$\frac{1}{R_3} = \frac{1}{4} + \frac{1}{6} = \frac{10}{24}$

$\Rightarrow R_3 = \frac{24}{10}\ \Omega$

Now, these resistances are connected in series.

$\therefore$ Equivalent resistance between A and B is

$R_{eq.} = R_1 + R_2 + R_3$

$= 1 + 5 + \frac{24}{10}$

$R_{eq.} = 8{\cdot}4\ \Omega$

(d) Given, $m = 50\ \text{g or } \frac{50}{1000}\text{kg}$

$Q = 2400\ \text{J}$

$T_1 = 27°\text{C}$

$T_2 = 327°\text{C}$

We know, $Q = mc\Delta t$

or $c = \frac{Q}{m\,\Delta t}$

$= \frac{2400}{\frac{50}{1000} \times (327 - 27)}$

$(\because\ \Delta t°\text{C} = \Delta t\text{K})$

$= \frac{2400}{\frac{5}{100} \times 300}$

$= \frac{2400}{15} = 160\ \text{Jkg}^{-1}\ \text{K}^{-1}$

SECTION-II

Answer 5.

(a) **(i)** Man having a box on his head who climbs up a slope does more work against the force of gravity because he has more potential energy by virtue of his position *i.e.*, height.

As, P.E. = Work done = F × S

$= mg \times h$

(ii) The two forces each of 5 N form a couple.

$\therefore$ Moment of the couple

= Either force × Perpendicular distance between the two forces

$= 5 \times 1$

= 5 Nm (anti-clockwise)

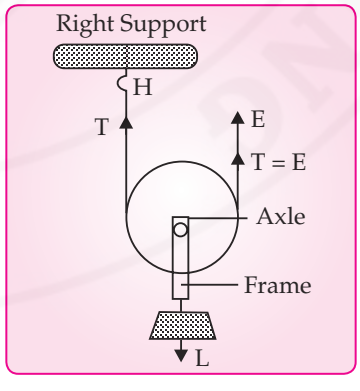
(b) **(i)** K.E. completely changes to P.E. (K.E. becomes zero).

(ii) Load, L = T + T = 2T

And Effort, E = T

Now, $\text{M.A.} = \frac{\text{Load}}{\text{Effort}}$

$\therefore\ \text{M.A.} = \frac{2T}{T} = 2$



(c) $\text{M.A.} = \frac{\text{Load}}{\text{Effort}}$

$\text{V.R.} = \frac{\text{Displacement of the effort}}{\text{Displacement of the load}}$

$$\text{Efficiency, } \eta = \frac{\text{Work output}}{\text{Work input}}$$

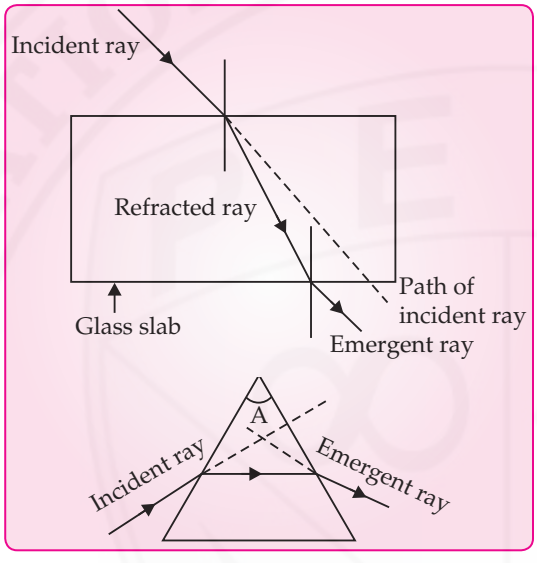
$$\eta = \frac{L \times d_{load}}{E \times d_{effort}}$$

$$\eta = \text{M.A.} \times \frac{1}{\text{V.R.}}$$

$$\eta = \frac{\text{M.A.}}{\text{V.R.}}$$

Answer 6.

(a) (i)

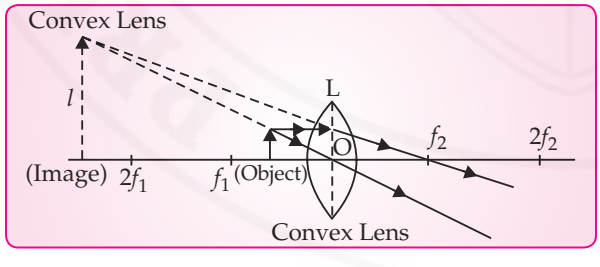


In a glass slab, the emergent ray is laterally displaced because the two refracting surfaces are parallel to each other whereas in case of prism, the emergent ray is deviated because two refracting surfaces are inclined at an angle A.

(ii) No, he is not correct because concave lens always forms virtual, erect and diminished image.

(b) (i) Convex lens.

(ii)



(c) (i) Power of a lens is defined as the measure of deviation produced in the path of light when it passes through the lens.

Or

The power of a lens is defined as the reciprocal of its focal length in metres. The S.I. unit of power is dioptre (D).

Power of lens (in D)

$$= \frac{1}{\text{Focal length (in metre)}}$$

(ii) Given : $f = 25 \text{ cm} = 0{\cdot}25 \text{ m}$

$$P = \frac{1}{f(\text{in m})}$$

$$P = \frac{1}{0{\cdot}25} = +4 \text{ D}$$

Answer 7.

(a) (i) Vibration R, as its amplitude is high.

(ii) Sound of string 'P' will have maximum shrillness as its frequency is maximum.

(iii) Let the frequency of the principal note in vibration R be f.

Then, the frequency of vibration P is $3f$.

$\therefore \quad f_R = f$ and $f_P = 3f$

$\Rightarrow \quad f_R : f_P = 1 : 3$

But $\quad f \propto \frac{1}{\lambda}$

So, $\quad \frac{\lambda_P}{\lambda_R} = \frac{f_R}{f_P} = \frac{1}{3}$

$\therefore \quad \lambda_P : \lambda_R = 1 : 3$

(b) (i) X-rays.

(ii) Speed of the wave in vacuum is 3×10^8 m/s.

(iii) X-rays are used for determining fracture of bones, hidden objects in customs at airports.

(c) (i) An important property of such type of waves is that they travel undeviated through long distances.

(ii) $\quad \text{Speed, } v = \frac{2d}{t}$

$\Rightarrow \quad v = \frac{2 \times 30 \times 10^3}{2 \times 10^{-4}}$

$\Rightarrow \quad v = \frac{30 \times 10^3}{10^{-4}}$

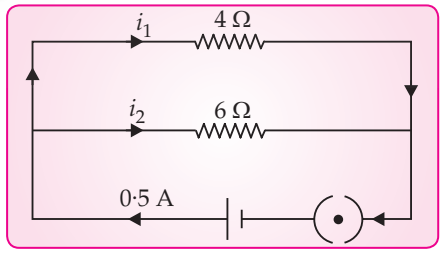
$\Rightarrow \quad v = 3 \times 10^4 \times 10^4$

$\therefore$ Speed of the signal,

$v = 3 \times 10^8$ m/s

Answer 8.

(a) (i)



(ii) $\frac{1}{R} = \frac{1}{4} + \frac{1}{6}$

$R = 2{\cdot}4\ \Omega$

Now, $V = IR$

$V = 0{\cdot}5 \times 2{\cdot}4 = 1{\cdot}2\ V$

$i_1 = \frac{V}{R_1} = \frac{1{\cdot}2}{4} = 0{\cdot}3\ A$

$i_2 = \frac{1.2}{6} = 0{\cdot}2\ A$

(b) **(i)** An ohmic resistor is a resistor which obeys ohm's law. Examples are all metallic conductors such as silver, aluminium, copper, etc.

(ii) **(1)** Thinner wire will have more resistance because the resistance is inversely proportional to the area of cross-section.

(2) Specific resistance of both wire is same because specific resistance depends on the nature of the material which is same in both cases.

(c) **(i)** In set A, bulbs are in series so if one gets fused, others are also affected.

In set B, bulbs are in parallel so if one goes off, others continue to glow.

(ii) For house circuiting, we use the set B arrangement *i.e.*, all the appliances are connected in parallel because in this arrangement, each appliance operates at the same voltage and works independently without being affected whether the other appliance is switched on or off.

Answer 9.

(a) Given,

Mass of ice, $m = 100\ g = 0{\cdot}1\ kg$

Heat energy required to raise the temperature of water from 0°C to 20°C,

$Q = mc\Delta t$

$= 0{\cdot}1\ kg \times 4200\ Jkg^{-1}{}^{o}C^{-1} \times 20°C$

$= 420 \times 20 = 8400\ J$

Heat energy required for conversion of ice into water at 0°C $= mL$

$= 0{\cdot}1\ kg \times 336000\ J/kg$

$= 33600\ J$

Now, Power, $P = \frac{W}{t}$

$P = \frac{33600}{120}$

$= \frac{3360}{12} = 280\ W$

Also, $P \times t' = Q$

$t' = \frac{Q}{P}$

$= \frac{8400}{280} = 30\ sec.$

(b) Specific heat capacity of A is $3{\cdot}8\ Jg^{-1}\ K^{-1}$.

Specific heat capacity of B is $0{\cdot}4\ Jg^{-1}\ K^{-1}$.

(i) 'B' is a good conductor of heat.

(ii) The specific heat capacity of B is lower than A. This means that less heat is required to raise the temperature of 1 g of B by 1 K than the heat required for A.

(iii) 'A' will be preferred as it absorbs large amount of heat energy without raising its own temperature much as its specific heat capacity is high.

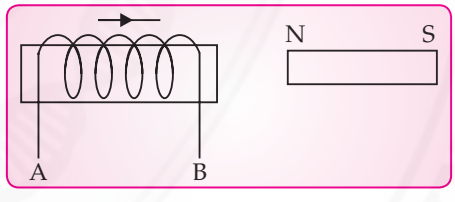
Answer 10.

(a) **(i)** Magnitude of induced e.m.f. depends on

1. the magnitude of e.m.f. applied in the primary coil.

2. the number of turns in the coil.

(ii) **1.**



Current flows from A to B as the coil moves towards the magnet and induced e.m.f. always opposes the motion.

2. Lenz's law

(b) **(i)** $_{11}Na^{24} \longrightarrow {}_{12}Mg^{24} + {}_{-1}e^{0} + energy$

(ii) 24 is the mass number (number of protons and neutrons).

11 is the atomic number (number of protons).

(iii) Isobars.

PHYSICS

2013

QUESTIONS

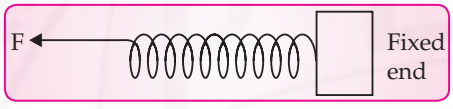
SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) *Give any two effects of a force on a non-rigid body.*** [2]

(b) *One end of a spring is kept fixed while the other end is stretched by a force as shown in the diagram.***



(i) *Copy the diagram and mark on it the direction of the restoring force.*

(ii) *Name one instrument which works on the above principle.* [2]

(c) **(i)** *Where is the centre of gravity of a uniform ring situated ?*

(ii) *'The position of the centre of gravity of a body remains unchanged even when the body is deformed.' State whether the statement is true or false.* [2]

(d) *A force is applied on a body of mass 20 kg moving with a velocity of 40 ms^{-1}. The body attains a velocity of 50 ms^{-1} in 2 second. Calculate the work done by the body.* [2]

(e) *A type of single pulley is very often used as a machine even though it does not give any gain in mechanical advantage.*

(i) *Name the type of pulley used.*

(ii) *For what purpose is such a pulley used ?* [2]

Question 2.

(a) **(i)** *In what way does an 'Ideal machine' differ from a 'Practical machine' ?*

(ii) *Can a simple machine act as a force multiplier and a speed multiplier at the same time ?* [2]

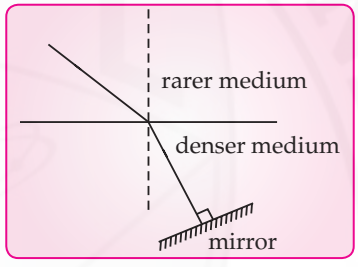
(b) *A girl of mass 35 kg climbs up from the first floor of a building at a height 4 m above the ground to the third floor at a height 12 m above the ground. What will be the increase in her gravitational potential energy ? [g = 10 ms^{-2}]* [2]

(c) *Which class of lever found in the human body is being used by a boy :*

(i) *when he holds a load on the palm of his hand.*

(ii) *when he raises the weight of his body on his toes ?* [2]

(d) *A ray of light is moving from a rarer medium to a denser medium and strikes a plane mirror placed at 90° to the direction of the ray as shown in the diagram.*



(i) *Copy the diagram and mark arrows to show the path of the ray of light after it is reflected from the mirror.*

(ii) *Name the principle you have used to mark the arrows to show the direction of the ray.* [2]

(e) **(i)** *The refractive index of glass with respect to air is 1·5. What is the value of the refractive index of air with respect to glass ?*

(ii) *A ray of light is incident as a normal ray on the surface of separation of two different mediums. What is the value of the angle of incidence in this case ?* [2]

Question 3.

(a) *A bucket kept under a running tap is getting filled with water. A person sitting at a distance is able to get an idea when the bucket is about to be filled.*

(i) *What change takes place in the sound to give this idea ?*

(ii) *What causes the change in the sound ?* [2]

(b) *A sound made on the surface of a lake takes 3 s to reach a boatman.*

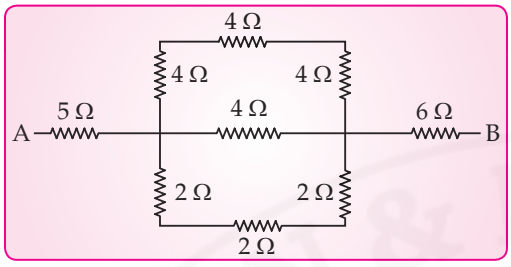
How much time will it take to reach a diver inside the water at the same depth ?

Velocity of sound in air = 330 ms^{-1}

Velocity of sound in water = 1450 ms^{-1} [2]

** Answer is not given due to change in the present syllabus.

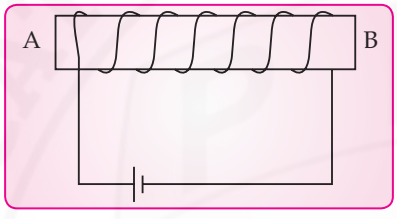
(c) *Calculate the equivalent resistance between the points A and B for the following combination of resistors :* **[2]**



(d) *You have been provided with a solenoid AB.*

(i) *What is the polarity at end A ?*

(ii) *Give one advantage of an electromagnet over a permanent magnet.* **[2]**



(e) **(i)** *Name the device used to protect the electric circuits from overloading and short circuits.*

(ii) *On what effect of electricity does the above device work ?* **[2]**

Question 4.

(a) *Define the term 'Heat capacity' and state its S.I. unit.* **[2]**

(b) *What is meant by Global Warming ?*** **[2]**

(c) *How much heat energy is released when 5 g of water at 20°C changes to ice at 0°C ?*

[Specific heat capacity of water = 4·2 J $g^{-1}°C^{-1}$

Specific latent heat of fusion of ice = 336 J g^{-1}] **[2]**

(d) *Which of the radioactive radiations :*

(i) *can cause severe genetical disorders.*

(ii) *are deflected by an electric field ?* **[2]**

(e) *A radioactive nucleus undergoes a series of decays according to the sequence*

$$X \xrightarrow{\beta} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\alpha} X_3.$$

If the mass number and atomic number of X_3 are 172 and 69 respectively, what is the mass number and atomic number of X ? **[2]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) **(i)** *With reference to their direction of action, how does a centripetal force differ from a centrifugal force ?*

(ii) *State the principle of conservation of energy.*

(iii) *Name the form of energy which a body may possess even when it is not in motion.* **[3]**

(b) *A coolie is pushing a box weighing 1500 N up an inclined plane 7·5 m long on to a platform, 2·5 m above the ground.***

(i) *Calculate the mechanical advantage of the inclined plane.*

(ii) *Calculate the effort applied by the coolie.*

(iii) *In actual practice, the coolie needs to apply more effort than what is calculated. Give one reason why you think the coolie needs to apply more effort.* **[3]**

(c) *A block and tackle system of pulleys has a velocity ratio 4.*

(i) *Draw a labelled diagram of the system indicating clearly the points of application and directions of load and effort.*

(ii) *What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system ?* **[4]**

Question 6.

(a) *Name the radiations :*

(i) *that are used for photography at night.*

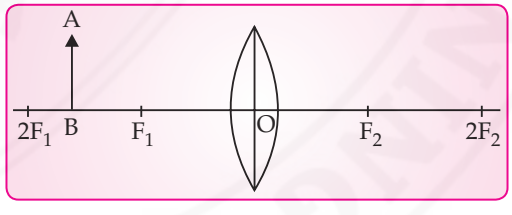
(ii) *used for detection of fracture in bones.*

(iii) *whose wavelength range is from 100 Å to 4000 Å (or 10 nm to 400 nm).* **[3]**

(b) **(i)** *Can the absolute refractive index of a medium be less than one ?*

(ii) *A coin placed at the bottom of a beaker appears to be raised by 4·0 cm. If the refractive index of water is 4/3, find the depth of the water in the beaker.* **[3]**

(c) *An object AB is placed between $2F_1$ and F_1 on the principal axis of a convex lens as shown in the diagram :*



Copy the diagram and using three rays starting from point A, obtain the image of the object formed by the lens. **[4]**

Question 7.

(a) **(i)** *What is the principle on which SONAR is based ?*

(ii) *An observer stands at a certain distance away from a cliff and produces a loud sound. He hears the echo of the sound after 1·8 s. Calculate the distance between the cliff and the observer if the velocity of sound in air is 340 ms^{-1}.* **[3]**

** Answer is not given due to change in the present syllabus.

(b) *A vibrating tuning fork is placed over the mouth of a burette filled with water. The tap of the burette is opened and the water level gradually starts falling. It is found that the sound from the tuning fork becomes very loud for a particular length of the water column.*

(i) *Name the phenomenon taking place when this happens.*

(ii) *Why does the sound become very loud for this length of the water column ?* **[3]**

(c) **(i)** *What is meant by the terms (1) amplitude (2) frequency, of a wave ?*

(ii) *Explain why stringed musical instruments, like the guitar, are provided with a hollow box.* **[4]**

Question 8.

(a) **(i)** *It is observed that the temperature of the surroundings starts falling when the ice in a frozen lake starts melting. Give a reason for the observation.*

(ii) *How is the heat capacity of the body related to its specific heat capacity ?* **[3]**

(b) **(i)** *Why does a bottle of soft drink cool faster when surrounded by ice cubes than by ice cold water, both at 0°C ?*

(ii) *A certain amount of heat Q will warm 1 g of material X by 3°C and 1 g of material Y by 4°C. Which material has a higher specific heat capacity ?* **[3]**

(c) *A calorimeter of mass 50 g and specific heat capacity 0·42 J g^{-1} $°C^{-1}$ contains some mass of water at 20°C. A metal piece of mass 20 g at 100°C is dropped into the calorimeter. After stirring, the final temperature of the mixture is found to be 22°C. Find the mass of water used in the calorimeter.*

[specific heat capacity of the metal piece = 0·3 J g^{-1} $°C^{-1}$
specific heat capacity of water = 4·2 J g^{-1} $°C^{-1}$] **[4]**

Question 9.

(a) **(i)** *State Ohm's law.*

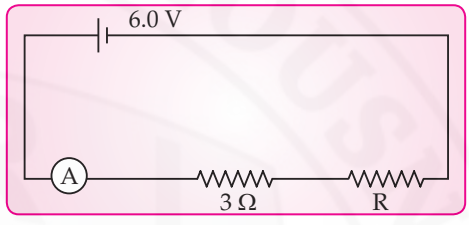
(ii) *A metal wire of resistance 6 Ω is stretched so that its length is increased to twice its original length. Calculate its new resistance.* **[3]**

(b) **(i)** *An electrical gadget can give an electric shock to its user under certain circumstances. Mention any two of these circumstances.*

(ii) *What preventive measure provided in a gadget can protect a person from an electric shock ?* **[3]**

(c) *The figure shows a circuit.*

When the circuit is switched on, the ammeter reads 0·5 A.



(i) *Calculate the value of the unknown resistor R.*

(ii) Calculate the charge passing through the 3 Ω resistor in 120 s.

(iii) *Calculate the power dissipated in the 3 Ω resistor.* **[4]**

Question 10.

(a) *Name the three main parts of a Cathode Ray Tube.*** **[3]**

(b) **(i)** *What is meant by Radioactivity ?*

(ii) *What is meant by nuclear waste ?*

(iii) *Suggest one effective way for the safe disposal of nuclear waste.* **[3]**

(c) **(i)** *Draw a simple labelled diagram of a d.c. electric motor.*

(ii) *What is the function of the split rings in a d.c. motor ?*

(iii) *State one advantage of a.c. over d.c.* **[4]**

ANSWERS

SECTION-I

Answer 1.

(c) **(i)** Centre of gravity of a uniform ring is at its geometric centre.

(ii) False.

(d) Work done, $W = \frac{1}{2} m (v_2^2 - v_1^2)$

$= \frac{1}{2} \times 20 (50^2 - 40^2)$

$= 9000$ J

(e) **(i)** Single fixed pulley.

(ii) Single fixed pulley is used to change the direction of effort applied.

Answer 2.

(a) **(i)** Ideal machine has 100% efficiency *i.e.*, work done on the machine is equal to the work done by the machine while a practical machine is not 100% efficient due to the energy loss in friction etc.

(ii) No, it will either be acting as a speed multiplier or a force multiplier.

(b) Increase in gravitational potential energy

$= mg (h_2 - h_1)$

$= 35 \times 10 (12 - 4)$

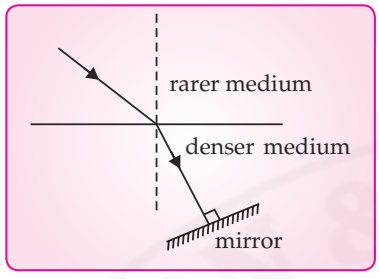
$= 350 \times 8 = 2800$ J

** Answer is not given due to change in the present syllabus.

(c) **(i)** Class III lever.

(ii) Class II lever.

(d) **(i)**



(ii) Principle of reversibility of light.

(e) **(i)** $_{a}\mu_{g} = 1{\cdot}5$

$$_{g}\mu_{a} = \frac{1}{_{a}\mu_{g}}$$

$$= \frac{1}{1{\cdot}5} = 0{\cdot}666 = 0{\cdot}67$$

(ii) $\angle i = 0°$

Answer 3.

(a) **(i)** As the bucket is filled, the sound becomes shriller due to decrease in length of air column and increase in frequency.

(ii) The change in sound takes place due to change in frequency of sound due to decrease in the length of the air column.

(b) Given, depth *i.e.*, distance is same in both the cases.

Now, $s = \frac{d}{t}$

$\Rightarrow$ $330 = \frac{d}{3}$

$\Rightarrow$ $d = 990$ m

Now for the diver inside water

$$s' = \frac{d}{t'}$$

or $$t' = \frac{d}{s'} = \frac{990}{1450}$$

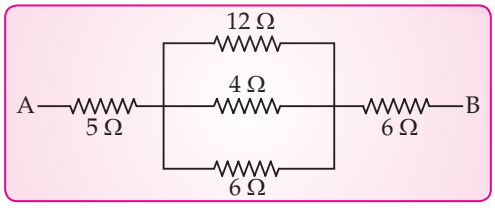
$\therefore$ $t' = 0{\cdot}682$ sec.

(c) In the given circuit, 4 Ω, 4 Ω and 4 Ω in series gives $R_1 = 4 + 4 + 4 = 12$ Ω

and 2 Ω, 2 Ω and 2 Ω in series gives

$R_2 = 2 + 2 + 2 = 6$ Ω.

Now, $R_1 = 12$ Ω, $R_2 = 6$ Ω and $R_3 = 4$ Ω are in parallel.



The equivalent resistance R′ is given by

$$\frac{1}{R'} = \frac{1}{12} + \frac{1}{4} + \frac{1}{6}$$

$$= \frac{1+3+2}{12} = \frac{6}{12}$$

$$\frac{1}{R'} = \frac{1}{2}$$

$$R' = 2\ \Omega$$

Total resistance = 5 + 2 + 6 = 13 Ω.

(d) **(i)** North pole.

(ii) The strength of the magnetic field of an electromagnet can be changed according to its use and it will be a magnet till the time current passes through it whereas, the strength of permanent magnet can not be increased and can not be magnetized and demagnetized in an instance.

(e) **(i)** Fuse.

(ii) Heating effect of electric current.

Answer 4.

(a) **Heat capacity :** Heat capacity of the body is the amount of heat energy required to raise its temperature by 1°C or 1 K.

The S.I. unit of heat capacity is joule per kelvin (JK^{-1}).

(c) Heat energy required

$= mc\Delta t + mL$

$= 5 \times 4{\cdot}2 \times (20 - 0) + 5 \times 336$

$= 420 + 1680 = 2100$ J

(d) **(i)** γ-radiations.

(ii) α and β radiations are deflected by an electric field.

(e)

$$^{A}_{Z}X \xrightarrow{\beta} {}^{A}_{Z+1}X_1 \xrightarrow{\alpha} {}^{A-4}_{Z+1-2}X_2 \xrightarrow{\alpha} {}^{A-4-4}_{Z+1-2-2}X_3$$

Given, Atomic number of $X_3 = 69$

Mass number of $X_3 = 172$

$\therefore$ $A - 8 = 172 \Rightarrow A = 180$

And $Z - 3 = 69 \Rightarrow Z = 72$

SECTION-II

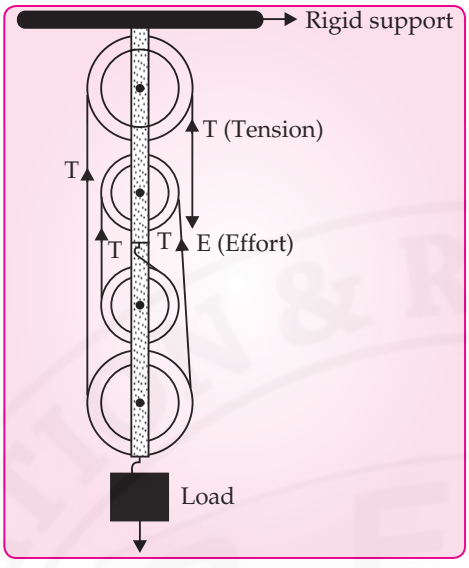
Answer 5.

(a) **(i)** Direction of centripetal force is towards the centre of the circle whereas centrifugal force is directed radially outwards.

(ii) **Principle of conservation of energy :** It states that energy can neither be created nor be destroyed but can be transformed from one form to another form. The total sum of energy in the universe always remains the same.

(iii) Potential energy.

(c) **(i)**



(ii) M.A. = V.R. = 4, for an ideal pulley system.

Answer 6.

(a) **(i)** Infrared radiations.

(ii) X-rays.

(iii) UV radiations.

(b) **(i)** No, the absolute refractive index of a medium cannot be less than one because speed of light in any medium is always less than that of in vacuum.

(ii) Let Real depth = x

Refractive Index,

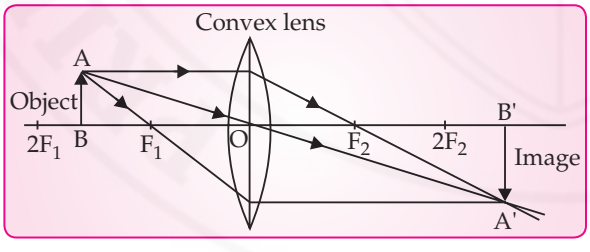
$$\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$$

$$\Rightarrow \quad \frac{4}{3} = \frac{x}{x-4}$$

$$\Rightarrow \quad 4x - 16 = 3x$$

$$\therefore \quad x = 16 \text{ cm.}$$

(c)



Answer 7.

(a) **(i)** SONAR is based on the principle of reflection of sound *i.e.*, echo.

(ii) Here, $s = \frac{2d}{t}$

$$\Rightarrow \quad 2d = s \times t$$

$$\Rightarrow \quad d = \frac{340 \times 1{\cdot}8}{2}$$

$$\therefore \quad d = 306 \text{ m.}$$

(b) **(i)** Resonance.

(ii) The frequency of the tuning fork and the natural frequency of the vibrating air column become equal. The air column vibrates with larger amplitude thus producing a loud sound.

(c) **(i)** **1. Amplitude :** Maximum displacement of the vibrating particle on either side of the mean position is called amplitude.

2. Frequency : Number of oscillations completed by the wave in one second is called frequency.

(ii) When the strings vibrate, the air column inside the box is set into forced vibrations. Since the sound box has a large area, it sets a large volume of air into vibration of the same frequency as that of the string, thereby producing resonance.

Answer 8.

(a) **(i)** Temperature of the surroundings starts falling when the ice starts melting because every 1 gm of ice requires 336 J to convert it into water at 0°C so it extracts a great amount of heat from the atmosphere.

(ii) Heat capacity $= \frac{\Delta\theta}{\Delta T} = \frac{mc\Delta T}{\Delta T} = mc$

i.e., Heat capacity = mass × specific heat capacity

(b) **(i)** Bottles of soft drink cools faster when surrounded by ice cubes because every 1 g of ice on melting requires 336 J. So, it extracts a large amount of heat from the bottle hence, they cool faster.

(ii) Specific heat capacity,

$$c = \frac{\text{Heat taken}}{\text{Mass} \times \text{Rise in temperature}}$$

$$\therefore \quad c_X = \frac{Q}{1 \times 3} \text{ and } c_Y = \frac{Q}{1 \times 4}$$

$$\therefore \quad c_X > c_Y$$

Hence, X has higher specific heat capacity.

(c) Heat given = Heat taken

let mass of water used be m, then

$$mc\Delta T = m'c'\Delta t + m_1c_1\Delta t$$

$$\Rightarrow \quad 20 \times 0{\cdot}3 \times (100 - 22) = 50 \times 0{\cdot}42 \times (22 - 20) + m \times 4{\cdot}2 \times (22 - 20)$$

$$\Rightarrow \quad 468 = 42 + 8{\cdot}4\, m$$

$$\Rightarrow \quad 8{\cdot}4\, m = 426$$

$$\therefore \quad m = 50{\cdot}71 \text{ g.}$$

Answer 9.

(a) (i) Ohm's law : It states that the current flowing in a conductor is directly proportional to the potential difference across its ends provided the physical conditions and the temperature of the conductor remains constant *i.e.*, $V \propto I$ or $V = IR$

where R is a constant called resistance of conductor.

(ii) $R' = n^2R$

$= 2^2 \times 6 = 24\ \Omega.$

(b) (i) 1. When the live wire comes in contact with the wet hand of the user.

2. Due to short circuit in the electrical gadget.

(ii) Earthing can protect a person from electric shock.

(c) (i) We know, $V = IR'$

$\Rightarrow \quad 6 = 0{\cdot}5 \times R'$

$\Rightarrow \quad R' = 12\ \Omega$

$\because \quad R' = 3 + R$

$\Rightarrow \quad 12 = 3 + R$

$\therefore \quad R = 9\ \Omega$

(ii) Charge, $q = It$

$\Rightarrow \quad q = 0{\cdot}5 \times 120 = 60$ coulomb

(iii) Power dissipation,

$P = I^2R$

$P = 0{\cdot}5^2 \times 3 = 0{\cdot}75$ W.

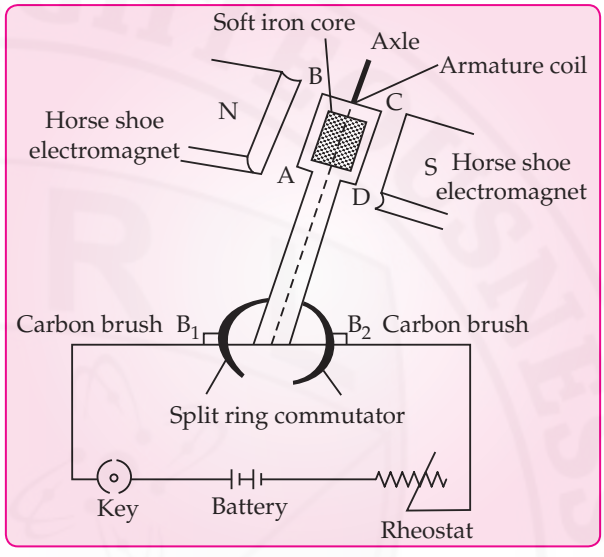
Answer 10.

(b) (i) Radioactivity : The process of spontaneous emission of α, β and γ radiations from the nuclei of atoms during their decay is known as radioactivity.

(ii) After disintegration, the radioactive material finally converts into lead and still it holds some radioactivity. This is called nuclear waste.

(iii) Delay and decay method is the effective way for the safe disposal of nuclear waste.

(c) (i)



(ii) The split ring acts as a commutator in a d.c. motor. With the split ring, the direction of current through the coil is reversed after every half rotation of coil and thus the direction of couple rotating the coil remains unchanged and the coil continues to rotate in the same direction.

(iii) Advantage of a.c. over d.c. is that it is able to travel long distance without much power loss.

PHYSICS

2012

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) **(i)** *Define 1 kgf.***

(ii) *How is it related to the S.I. unit of force ?*** [2]

(b) **(i)** *What are non-contact forces ?***

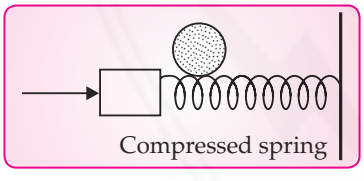
(ii) *How does the distance of separation between two bodies affect the magnitude of the non-contact force between them ?*** [2]

(c) *A boy of mass 30 kg is sitting at a distance of 2 m from the middle of a see-saw. Where should a boy of mass 40 kg sit so as to balance the see-saw ?* [2]

(d) **(i)** *What is meant by the term 'moment of force' ?*

(ii) *If the moment of force is assigned a negative sign then will the turning tendency of the force be clockwise or anti-clockwise ?* [2]

(e) *A ball is placed on a compressed spring. When the spring is released, the ball is observed to fly away.*



(i) *What form of energy does the compressed spring possess ?*

(ii) *Why does the ball fly away ?* [2]

Question 2.

(a) **(i)** *State the energy conversion taking place in a solar cell.***

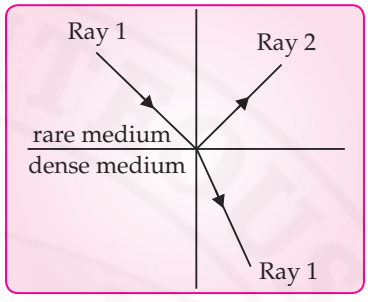
(ii) *Give one disadvantages of using a solar cell.*** [2]

(b) *A body of mass 0·2 kg falls from a height of 10 m to a height of 6 m above the ground. Find the loss in potential energy taking place in the body.*

[g = 10 ms^{-2}] [2]

(c) **(i)** *Define the term refractive index of a medium in terms of velocity of light.*

(ii) *A ray of light moves from a rare medium to a dense medium as shown in the diagram below. Write down the number of the ray which represents the partially reflected ray.* [2]



(d) *You are provided with a printed piece of paper. Using this paper how will you differentiate between a convex lens and a concave lens ?* [2]

(e) *A ray of light incident at an angle of incidence 'i' passes through an equilateral glass prism such that the refracted ray inside the prism is parallel to its base and emerges from the prism at an angle of emergence 'e'.*

(i) *How is the angle of emergence 'e' related to the angle of incidence 'i'?*

(ii) *What can you say about the value of the angle of deviation in such a situation ?* [2]

Question 3.

(a) **(i)** *What is meant by 'Dispersion of light' ?*

(ii) *In the atmosphere which colour of light gets scattered the least ?* [2]

(b) *Which characteristics of sound will change if there is a change in*

(i) *its amplitude* **(ii)** *its waveform.* [2]

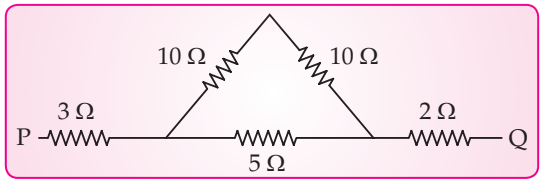
(c) **(i)** *Name one factor which affects the frequency of sound emitted due to vibrations in an air column.*

(ii) *Name the unit used for measuring the sound level.* [2]

(d) *An electrical appliance is rated at 1000 KVA, 220 V. If the appliance is operated for 2 hours, calculate the energy consumed by the appliance in :*

(i) *kWh* **(ii)** *joule* [2]

(e) *Calculate the equivalent resistance between P and Q from the following diagram :* [2]



** Answer is not given due to change in the present syllabus.

Question 4.

(a) **(i)** *What is an a.c. generator or Dynamo used for ?*

(ii) *Name the principle on which it works.* **[2]**

(b) *Differentiate between heat capacity and specific heat capacity.* **[2]**

(c) *A hot solid of mass 60 g at 100°C is placed in 150 g of water at 20°C. The final steady temperature recorded is 25°C. Calculate the specific heat capacity of the solid. [Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$]* **[2]**

(d) **(i)** *What is the value of the speed of gamma radiations in air or vacuum ?*

(ii) *Name a material which exhibits fluorescence when cathode rays fall on it.*** **[2]**

(e) *Give any two important sources of background radiation.* **[2]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) **(i)** *Which of the following remains constant in uniform circular motion. Speed or Velocity or both ?*

(ii) *Name the force required for uniform circular motion. State its direction.* **[3]**

(b) **(i)** *State the class of levers and the relative positions of load (L), effort (E) and fulcrum (F) in each of the following cases.*

(1) *A bottle opener* **(2)** *Sugar tongs.*

(ii) *Why is less effort needed to lift a load over an inclined plane as compared to lifting the load directly ?*** **[3]**

(c) **(i)** *A moving body weighing 400 N possesses 500 J of kinetic energy. Calculate the velocity with which the body is moving. ($g = 10\ ms^{-2}$)*

(ii) *Under what condition will a set of gears produce :* **

(1) *a gain in speed*

(2) *a gain in torque.* **[4]**

Question 6.

(a) **(i)** *What is meant by the term 'critical angle' ?*

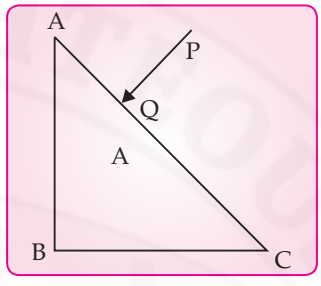
(ii) *How is it related to the refractive index of the medium ?*

(iii) *Does the depth of a tank of water appear to change or remain the same when viewed normally from above ?* **[3]**

(b) *A ray of light PQ is incident normally on the hypotenuse of a right angled prism ABC as shown in the diagram given below :*

(i) *Copy the diagram and complete the path of the ray PQ till it emerges from the prism.*

(ii) *What is the value of the angle of deviation of the ray ?*



(iii) *Name an instrument where this action of the prism is used.* **[3]**

(c) *A converging lens is used to obtain an image of an object placed in front of it. The inverted image is formed between F_2 and $2F_2$ of the lens.*

(i) *Where is the object placed ?*

(ii) *Draw a ray diagram to illustrate the formation of the image obtained.* **[4]**

Question 7.

(a) **(i)** *What is meant by Resonance ?*

(ii) *State two ways in which Resonance differs from Forced vibrations.* **[3]**

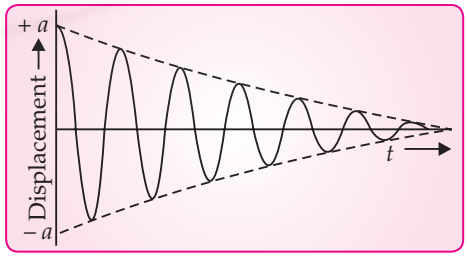
(b) **(i)** *A man standing between two cliffs produces a sound and hears two successive echoes at intervals of 3 s and 4 s respectively. Calculate the distance between the two cliffs.*

The speed of sound in the air is 330 ms^{-1}.

(ii) *Why will an echo not be heard when the distance between the source of sound and the reflecting surface is 10 m ?* **[3]**

(c) *The diagram below shows the displacement-time graph for a vibrating body.*

(i) *Name the type of vibrations produced by the vibrating body.*



** Answer is not given due to change in the present syllabus.

(ii) *Give one example of a body producing such vibrations.*

(iii) *Why is the amplitude of the wave gradually decreasing ?*

(iv) *What will happen to the vibrations of the body after some time ?* **[4]**

Question 8.

(a) **(i)** *A cell is sending current in an external circuit. How does the terminal voltage compare with the e.m.f. of the cell ?*

(ii) *What is the purpose of using a fuse in an electrical circuit ?*

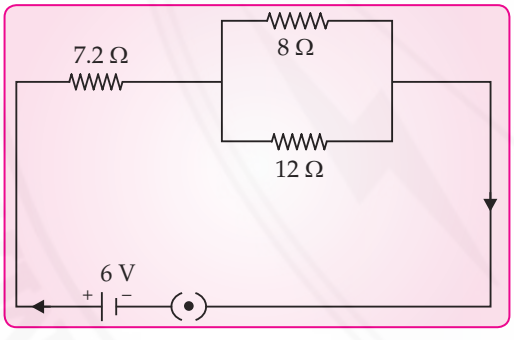
(iii) *What are the characteristic properties of fuse wire ?* **[3]**

(b) **(i)** *Write an expression for the electrical energy spent in the flow of current through an electrical appliances in terms of I, R and t.*

(ii) *At what voltage is the alternating current supplied to our houses ?*

(iii) *How should the electric lamps in a building be connected ?* **[3]**

(c) *Three resistors are connected to a 6 V battery as shown in the figure given below :*



Calculate : **[4]**

(i) *the equivalent resistance of the circuit.*

(ii) *total current in the circuit.*

(iii) *potential difference across the 7·2 Ω resistor.*

Question 9.**

(a) **(i)** *Write an expression for the heat energy liberated by a hot body.*

(ii) *Some heat is provided to a body to raise its temperature by 25°C. What will be the corresponding rise in temperature of the body as shown on the Kelvin scale ?*

(iii) *What happens to the average kinetic energy of the molecules as ice melts at 0°C ?* **[3]**

(b) *A piece of ice at 0°C is heated at a constant rate and its temperature recorded at regular intervals till steam is formed at 100°C. Draw a temperature-time graph to represent the change in phase. Label the different parts of your graph.* **[3]**

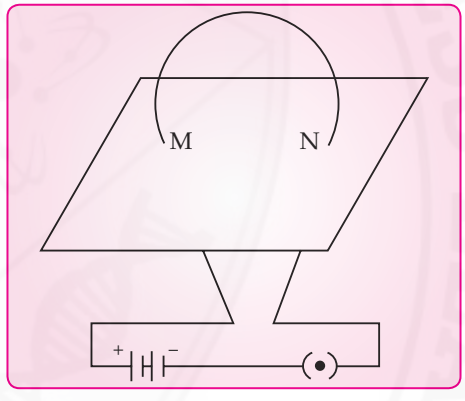
(c) *40 g of ice at 0°C is used to bring down the temperature of a certain mass of water at 60°C to 10°C. Find the mass of water used.*

[Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$]

[Specific latent heat of fusion of ice = 336 × 10^3 J kg^{-1}] **[4]**

Question 10.

(a) *The diagram below shows a current carrying loop or a circular coil passing through a sheet of cardboard at the points M and N. The sheet of cardboard is sprinkled uniformly with iron filings.*



(i) *Copy the diagram and draw an arrow on the circular coil to show the direction of current flowing through it.*

(ii) *Draw the pattern of arrangement of the iron filings when current is passed through the loop.* **[3]**

(b) **(i)** *Draw a simplified labelled diagram of a hot cathode ray tube.***

(ii) *Name a common device where a hot cathode ray tube is used.*** **[3]**

(c) *A certain nucleus X has a mass number 14 and atomic number 6. The nucleus X changes to* $_7Y^{14}$ *after the loss of a particle.*

(i) *Name the particle emitted.*

(ii) *Represent this change in the form of an equation.*

(iii) *A radioactive substance is oxidized. What change would you expect to take place in the nature of its radioactivity ? Give a reason for your answer.* **[4]**

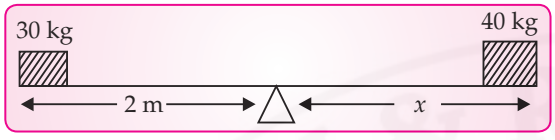
** Answer is not given due to change in the present syllabus.

ANSWERS

SECTION-I

Answer 1.

(c)



By principle of moments,

$$30 \times 2 = x \times 40$$

or $$x = \frac{30 \times 2}{40} = 1{\cdot}5 \text{ m}$$

So, the other boy should sit at a distance of 1·5 m from the mean position.

(d) **(i)** **Moment of force :** It is equal to the product of the magnitude of the force and the perpendicular distance of the line of action of force from the axis of rotation.

(ii) If moment of force is assigned a negative value, it means turning tendency of force is in clockwise direction.

(e) **(i)** The Compressed spring possess potential energy.

(ii) Potential energy of the spring is imparted to the ball in the form of kinetic energy.

Answer 2.

(b) Given, Mass = 0·2 kg

Height, h = 10 m to 6 m

Loss in Potential Energy

$$= mg\,(h_1 - h_2)$$
$$= 0{\cdot}2 \times 10 \times (10 - 6) = 8 \text{ J}$$

(c) **(i)** **Refractive Index :** It is defined as the ratio of velocity of light in medium 1 to the velocity of light in medium 2.

(ii) Ray 2 shows partially reflected ray.

(d) First we place the lens on a piece of printed paper. Then we lift it slowly. If the words of the printed paper, seen through the lens becomes bigger or magnified then it is convex lens otherwise concave lens.

(e) **(i)** Angle of emergence $\angle e$

= Angle of incidence $\angle i$

(ii) Angle of deviation becomes minimum in this situation.

Answer 3.

(a) **(i)** **Dispersion of light :** When a beam of white light falls on a prism, it splits into the rays of constituent colours. This is known as dispersion of light.

(ii) In atmosphere, red colour scatters the least because of its long wavelength.

(b) **(i)** If there is a change in amplitude of sound then its loudness will change.

(ii) If there is a change in waveform of sound then its quality will change.

(c) **(i)** Length of the air column.

(ii) Decibel.

(d) Given : V = 220 volt, P = 1000 kVA,

Time = 2 hrs

(i) Energy consumed $= Pt$

$= 2000$ kWh

(ii) We know, 1 kWh $= 3{\cdot}6 \times 10^6$ J

So, 2000 kWh $= 2000 \times 3{\cdot}6 \times 10^6$ J

$= 7{\cdot}2 \times 10^9$ J

(e) In the given circuit, two 10 Ω resistances are in series.

$\therefore$ $R_S = 10\ \Omega + 10\ \Omega = 20\ \Omega$.

Now, 20 Ω and 5 Ω resistances are in parallel.

$\therefore$ $$\frac{1}{R_p} = \frac{1}{20} + \frac{1}{5}$$

$$\frac{1}{R_P} = \frac{1+4}{20} = \frac{5}{20}$$

$$R_P = 4\ \Omega$$

The equivalent resistance between P and Q is given by

$$R = 3 + 4 + 2 = 9\ \Omega$$

Answer 4.

(a) **(i)** An a.c. generator is used for producing alternating current.

(ii) It works on the principle of electromagnetic induction.

(b) Refer to Gurukul Solved Paper Physics 2018,. Answer 9(b)(i).

(c) Given :

Mass of hot solid, m_1= 60 g at 100°C

Mass of water, m_2 = 150 g at 20°C

Final temperature = 25°C

By principle of calorimetry,

Heat given = Heat taken

$\Rightarrow$ $m_1 c_1 \Delta t_1 = m_2 c_2 \Delta t_2$

$\Rightarrow$ $60 \times c \times (100 - 25) = 150 \times 4{\cdot}2 \times (25 - 20)$

$\therefore$ Required specific heat capacity,

$$c = 0{\cdot}7 \text{ J g}^{-1} \text{ °C}^{-1}$$

(d) **(i)** Speed of γ radiation = 3×10^8 m/s in air or vacuum.

(e) Two sources of background radiations are :

1. The radioactive substances such as potassium (K-40), Carbon (C-14) and radium present inside our body.

2. Cosmic rays, solar radiations coming from outer space and naturally occuring radioactive elements such as radon-222 etc.

SECTION-II

Answer 5.

(a) **(i)** In uniform circular motion, speed remains constant.

(ii) Force required for uniform circular motion is centripetal force. It is always directed along the radius of the circular path *i.e.*, towards the centre of the circle.

(b) **(i)** **(1) A bottle opener :** It is a class II lever. Here the load (L) is in between the effort (E) and the fulcrum (F).

(2) Sugar tongs : It is a class III lever. Here the effort (E) is in between the fulcrum (F) and the load (L).

(c) **(i)** Given : Weight = 400 N

$$W = mg$$

$$400 = m \times 10$$

$$m = 40 \text{ kg}$$

Now, Kinetic Energy

$$= \frac{1}{2} mv^2$$

$$500 = \frac{1}{2} \times 40 \times v^2$$

$$v = 5 \text{ m/s}$$

Answer 6.

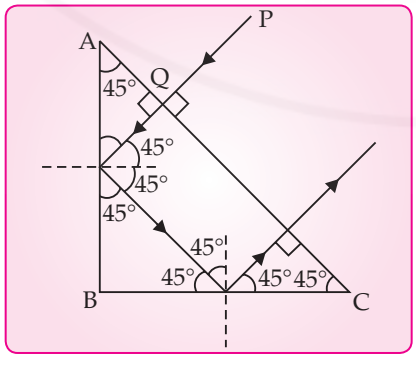
(a) **(i)** **Critical angle :** It is the angle of incidence in the denser medium corresponding to which the angle of refraction in the rarer medium is 90°.

(ii) $$n = \frac{1}{\sin i_c}$$

where, n = refractive index, i_c = critical angle.

(iii) Depth of the tank remains the same when viewed normally from above.

(b) **(i)**

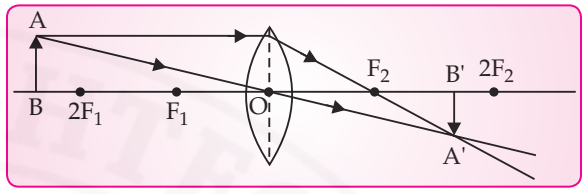


(ii) Angle of deviation of the ray = 180°.

(iii) Prism binoculars.

(c) **(i)** Object is beyond $2F_1$.

(ii)



Answer 7.

(a) **(i)** **Resonance :** When the frequency of an externally applied periodic force on a body is equal to the natural frequency of the body, the body vibrates with increased amplitude thus producing a loud sound. This phenomenon is called resonance.

(ii) **1.** In resonance, it is necessary that frequency of externally applied force should be equal to natural frequency of the body whereas, it is not necessary for forced vibrations.

2. In forced vibrations, the amplitude of oscillations is small whereas, in resonance, the amplitude of vibration is large.

(b) **(i)** First echo is heard from the nearest cliff so let its distance be d_1.

$\therefore$ Speed of sound

$$= \frac{\text{Total distance travelled, } 2d_1}{\text{Time taken, } t_1}$$

$$\therefore \quad d_1 = \frac{v \times t_1}{2} = \frac{330 \times 3}{2} = 495 \text{ m}$$

and second echo is heard from farther cliff so let its distance be d_2.

$$\therefore \quad d_2 = \frac{v \times t_2}{2} = \frac{330 \times 4}{2} = 660 \text{ m}$$

$\therefore$ Total distance = 660 + 495 = 1155 m.

(ii) Echo will not be heard because to hear an echo, the minimum distance between the source and the reflecting surface should be 17 m.

(c) **(i)** The diagram shows damped vibrations.

(ii) A tuning fork vibrating in air.

(iii) The amplitude of the wave decreases due to energy loss against frictional force which the surrounding medium exerts on the vibrating body.

(iv) After some time the amplitude gradually decreases and finally the body stops vibrating.

Answer 8.

(a) **(i)** E.m.f. of a cell is greater than terminal voltage.

(ii) Fuse is a safety device which is used to limit the current in an electric circuit.

(iii) Characteristic properties of a fuse wire :

1. It is made up of an alloy of lead and tin.

2. It has high resistivity and low melting point.

(b) **(i)** Electrical energy = I^2Rt.

(ii) 220 volt.

(iii) Electric lamps should be connected in parallel.

(c) **(i)** In the given circuit, 8 Ω and 12 Ω are connected in parallel.

$$\therefore \quad \frac{1}{R_1} = \frac{1}{8} + \frac{1}{12} = \frac{3+2}{24} = \frac{5}{24}$$

$$R_1 = 4{\cdot}8 \text{ ohm.}$$

Total resistance = 4·8 + 7·2 = 12 ohm

(ii) $V = IR$

$\Rightarrow \quad 6 = I \times 12$

$\Rightarrow \quad I = 0{\cdot}5$ A

(iii) $V = IR = 0{\cdot}5 \times 7{\cdot}2 = 3{\cdot}6$ V.

Answer 9.

(a) **(i)** Expression for the heat energy liberated by hot body = $mc\Delta T$

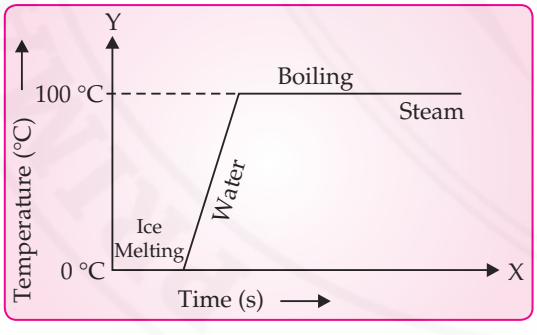
i.e., $H = mc\Delta T$

where m is the mass, c is the specific heat capacity and ΔT is the change in temperature.

(ii) Temperature rise of the body on the Kelvin scale will be 25 K.

(iii) Average K.E. of the molecules remain the same.

(b)



(c) Let mass of water used = m g

By principle of calorimetry,

Heat given = Heat taken

$$m_1c_1\Delta t_1 = mL + m_2c_2\Delta t_2$$

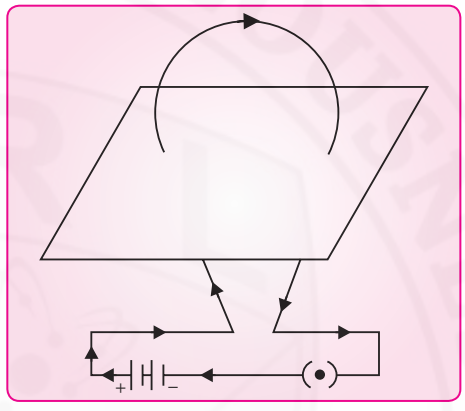
or $\quad m \times 4{\cdot}2 \times (60 - 10) = 40 \times 336 + 40 \times 4{\cdot}2 \times (10 - 0)$

or $\quad m \times 4{\cdot}2 \times 50 = 40 \times 336 + 1680$

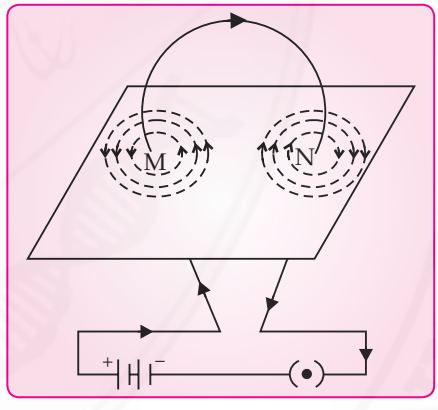
$\therefore \quad m = 72$ g

Answer 10.

(a) **(i)**



(ii)



(c) **(i)** Particle emitted is β-particle.

(ii) ${}^{14}_{6}X \rightarrow {}^{14}_{7}Y + {}^{0}_{-1}e$.

(iii) Radioactivity is a nuclear phenomenon. Hence, oxidation has no effect on the nucleus of the substance.

●●

PHYSICS

2011

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section*

Question 1.

(a) **(i)** *Define one newton.*

(ii) *Write the relation between S. I. unit and C.G.S. unit of force.*** [2]

(b) *Where does the position of centre of gravity lie for :* [2]

(i) *a circular lamina* **(ii)** *a triangular lamina ?*

(c) *A man can open a nut by applying a force of 150 N by using a lever handle of length 0·4 m. What should be the length of the handle if he is able to open it by applying a force of 60 N ?* [2]

(d) *Name a machine which can be used to :* [2]

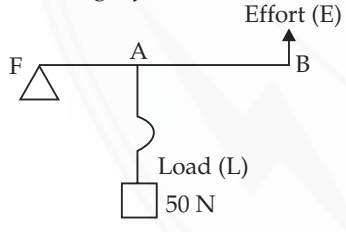
(i) *multiply force*

(ii) *change the direction of force applied.*

(e) *The diagram below shows a lever in use.*

(i) *To which class of lever does it belong ?*

(ii) *If FA = 40 cm, AB = 60 cm, then find the mechanical advantage of the lever.* [2]



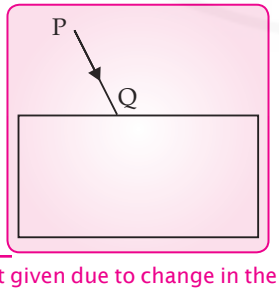
Question 2.

(a) *A ball of mass 200 g falls from a height of 5 m. What will be its kinetic energy when it just reaches the ground ? ($g = 9{\cdot}8\ m\ s^{-2}$)* [2]

(b) *In the diagram below, PQ is a ray of light incident on a rectangular glass block.*

(i) *Copy the diagram and complete the path of the ray of light through the glass block. In your diagram, mark the angle of incidence by letter 'i' and the angle of emergence by the letter 'e'.*

(ii) *How are the angles 'i' and 'e' related to each other ?* [2]

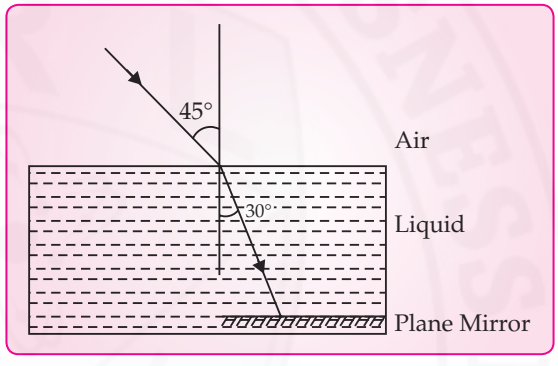


** Answer is not given due to change in the present syllabus.

(c) *A ray of monochromatic light enters a liquid from air as shown in the diagram given below :*

(i) *Copy the diagram and show in the diagram the path of the ray of light after it strikes the mirror and reenters the medium of air.*

(ii) *Mark in your diagram the two angles on the surface of separation when the ray of light moves out from the liquid to air.* [2]



(d) **(i)** *When does a ray of light falling on a lens pass through it undeviated ?*

(ii) *Which lens can produce a real and inverted image of an object ?* [2]

(e) **(i)** *How is the refractive index of a medium related to its real depth and apparent depth ?*

(ii) *Which characteristic property of light is responsible for the blue colour of the sky ?* [2]

Question 3.

(a) *When acoustic resonance takes place, a loud sound is heard. Why does this happen ? Explain.* [2]

(b) **(i)** *Three musical instruments give out notes at the frequencies listed below. Flute : 400 Hz; Guitar : 200 Hz; Trumpet : 500 Hz. Which one of these has the highest pitch ?*

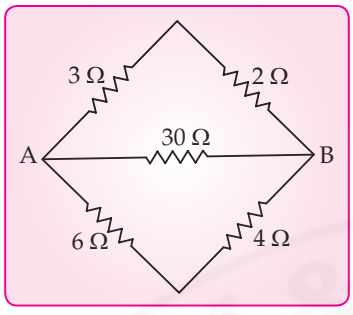
(ii) *With which of the following frequencies does a tuning fork of 256 Hz resonate : 288 Hz, 314 Hz, 333 Hz, 512 Hz ?* [2]

(c) *Two bulbs are marked 100 W, 220 V and 60 W, 110 V. Calculate the ratio of their resistances.* [2]

(d) **(i)** *What is the colour code for the insulation on the earth wire ?*

(ii) *Write an expression for calculating electrical power in terms of current and resistance.* [2]

(e) *Calculate the equivalent resistance between A and B from the following diagram :* [2]



Question 4.

(a) *Differentiate between heat and temperature.* **[2]**

(b) **(i)** *Define Calorimetry.*

(ii) *What is meant by Energy degradation ?*** **[2]**

(c) *200 g of hot water at 80°C is added to 300 g of cold water at 10°C. Calculate the final temperature of the mixture of water. Consider the heat taken by the container to be negligible. [specific heat capacity of water is 4200 J kg^{-1} $°C^{-1}$]* **[2]**

(d) *Fill in the blanks in the following sentences with appropriate words :*

(i) *During the emission of a beta particle, the …… number remains the same.*

(ii) *The minimum amount of energy required to emit an electron from a metal surface is called ……* **[2]**

(e) *A mixture of radioactive substances gives off three types of radiations :*

(i) *Name the radiation which travels with the speed of light.*

(ii) *Name the radiation which has the highest ionizing power.* **[2]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 5.

(a) **(i)** *What is meant by an ideal machine ?*

(ii) *Write a relationship between the mechanical advantage (M. A.) and velocity ratio (V. R.) of an ideal machine.*

(iii) *A coolie carrying a load on his head and moving on a frictionless horizontal platform does no work. Explain the reason why.* **[3]**

(b) *Draw a diagram to show the energy changes in an oscillating simple pendulum. Indicate in your diagram how the total mechanical energy in it remains constant during the oscillation.* **[3]**

(c) *A uniform metre scale can be balanced at the 70·0 cm mark when a mass of 0·05 kg is hung from the 94·0 cm mark.* **[4]**

(i) *Draw a diagram of the arrangement.*

(ii) *Find the mass of the metre scale.*

** Answer is not given due to change in the present syllabus.

Question 6.

(a) **(i)** *State the laws of refraction of light.*

(ii) *Write a relation between the angle of incidence (i), angle of emergence (e), angle of prism (A) and angle of deviation (d) for a ray of light passing through an equilateral prism.* **[3]**

(b) **(i)** *Suggest one way, in each case, by which we can detect the presence of :*

(1) *Infra-red radiations*

(2) *Ultraviolet radiations*

(ii) *Give one use of Infra-red radiations.* **[3]**

(c) *An object is placed in front of a lens between its optical centre and the focus and forms a virtual, erect and diminished image.*

(i) *Name the lens which formed this image.*

(ii) *Draw a ray diagram to show the formation of the image with the above stated characteristics.* **[4]**

Question 7.

(a) **(i)** *Name the type of waves which are used for sound ranging.*

(ii) *Why are these waves mentioned in (i) above, not audible to us ?*

(iii) *Give one use of sound ranging.* **[3]**

(b) *A man standing 25 m away from a wall produces a sound and receives the reflected sound.*

(i) *Calculate the time after which he receives the reflected sound if the speed of sound in air is 350 ms^{-1}.*

(ii) *Will the man be able to hear a distinct echo ? Give a reason for your answer.* **[3]**

(c) **(i)** *Name two safety devices which are connected to the live wire of a household electrical circuit.*

(ii) *Give one important function of each of these two devices.* **[4]**

Question 8.

(a) **(i)** *Draw a graph of Potential difference (V) versus Current (I) for an ohmic resistor.*

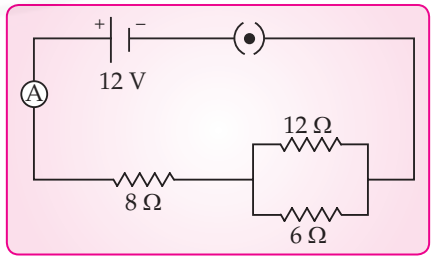
(ii) *How can you find the resistance of the resistor from this graph ?*

(iii) *What is a non-ohmic resistor ?* **[3]**

(b) **(i)** *An electric bulb is marked 100 W, 250 V. What information does this convey ?*

(ii) *How much current will the bulb draw if connected to a 250 V supply?* **[3]**

(c) *Three resistors are connected to a 12 V battery as shown in the figure given below :*



(i) *What is the current through the 8 ohm resistor ?*

(ii) *What is the potential difference across the parallel combination of 6 ohm and 12 ohm resistor ?*

(iii) *What is the current through the 6 ohm resistor ?* **[4]**

Question 9.

(a) **(i)** *Explain why the weather becomes very cold after a hail storm.*

(ii) *What happens to the heat supplied to a substance when the heat supplied causes no change in the temperature of the substance ?* **[3]**

(b) **(i)** *When 1 g of ice at 0°C melts to form 1 g of water at 0°C then, is the latent heat absorbed by the ice or given out by it ?*

(ii) *Give one example where high specific heat capacity of water is used as a heat reservoir.*

(iii) *Give one example where high specific heat capacity of water is used for cooling purposes.* **[3]**

(c) *250 g of water at 30°C is present in a copper vessel of mass 50 g. Calculate the mass of ice required to bring down the temperature of the vessel and its contents to 5°C.*

Specific latent heat of fusion of ice = 336×10^3 J kg^{-1}

Specific heat capacity of copper vessel = 400 J kg^{-1} $°C^{-1}$

Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$. **[4]**

Question 10.

(a) **(i)** *State two properties which a substance should possess when used as a thermionic emitter.***

(ii) *When an alpha particle gains two electrons it becomes neutral and becomes an atom of an element which is a rare gas. What is the name of this rare gas ?* **[3]**

(b) **(i)** *Define radioactivity.*

(ii) *What happens inside the nucleus that causes the emission of beta particle ?*

(iii) *Express the above change in the form of an equation.* **[3]**

(c) **(i)** *Name a device which is commonly used to convert an electrical signal into a visual signal.***

(ii) *The nucleus* $^{202}_{84}X$ *emits an alpha particle and forms the nucleus Y. Represent this change in the form of an equation.*

(iii) *What changes will take place in the mass number and atomic number of the nucleus Y if it emits gamma radiations ?* **[4]**

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** **One Newton :** If a body of mass 1 kg moves with an acceleration of $1 m/s^2$ then force acting on the body is said to be one newton.

(b) **(i)** Circular lamina – Centre of the lamina.

(ii) Triangular lamina – Point of intersection of medians.

(c) Given, $F_1 = 150$ N, $l_1 = 0{\cdot}4$ m, $F_2 = 60$ N, $l_2 = ?$

$\because$ Force × Perpendicular distance = Constant

$F_1 \times l_1 = F_2 \times l_2$

or $150 \times 0{\cdot}4 = 60 \times l_2$

$\therefore$ $l_2 = 1$ m

(d) **(i)** Nut cracker.

(ii) Single fixed pulley.

(e) **(i)** Class II lever.

(ii) We know,

$$L \times L.A. = E \times E.A.$$

$$M.A. = \frac{L}{E} = \frac{E.A.}{L.A.} = \frac{100}{40} = 2{\cdot}5$$

Answer 2.

(a) Given : $m = 200$ g, $h = 5$ m

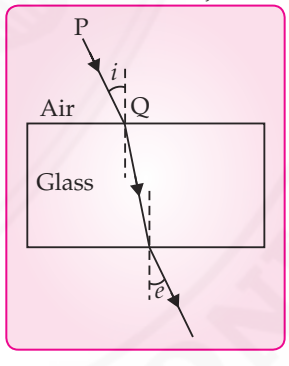
When the ball reaches the ground, then

P.E. = K.E.

$\therefore$ $K.E. = mgh = \frac{200}{1000} \times 9{\cdot}8 \times 5$

$= 9{\cdot}8$ joule

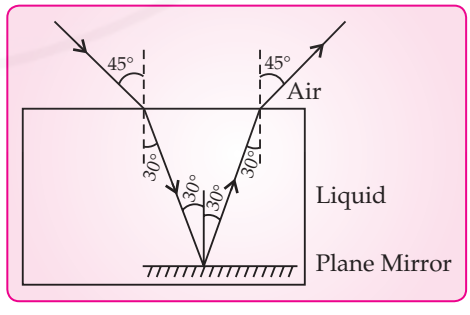
(b) **(i)**



(ii) When the incident ray is undergoing minimum deviation, the angle of incidence is equal to angle of emergence, *i.e.*,

$\angle i = \angle e$

(c) **(i)**



** Answer is not given due to change in the present syllabus.

(ii) Angles are marked in the diagram.

(d) **(i)** A ray of light falling on the lens passes through it undeviated when it passes through optical centre of the lens.

(ii) Convex lens.

(e) **(i)** Refractive index = $\frac{\text{Real Depth}}{\text{Apparent Depth}}$

(ii) Scattering of light.

Answer 3.

(a) When acoustic resonance takes place, a loud sound is heard. This is because the natural frequency of the vibrating body becomes equal to the frequency of external applied force due to which amplitude becomes large and hence loud sound is heard.

(b) **(i)** Trumpet (500 Hz) will have the highest pitch.

(ii) Tuning fork will resonate with 512 Hz.

(c) Given :

Ist Bulb	IInd Bulb
$P_1 = 100$ W	$P_2 = 60$ W
$V_1 = 220$ V	$V_2 = 110$ V

We know, $P = \frac{V^2}{R}$

or $R = \frac{V^2}{P}$

$\therefore \quad \frac{R_1}{R_2} = \frac{\frac{V_1^2}{P_1}}{\frac{V_2^2}{P_2}}$

$= \frac{V_1^2 \times P_2}{P_1 \times V_2^2}$

$= \frac{(220)^2 \times 60}{100 \times (110)^2}$

$= \frac{12}{5}$

$R_1 : R_2 = 12 : 5$

(d) **(i)** The colour code for the insulation of earth wire is green or yellow.

(ii) Electrical power in terms of current and resistance is

$P = I^2R.$

(e)

$\frac{1}{R} = \frac{1}{5} + \frac{1}{30} + \frac{1}{10}$

$\frac{1}{R} = \frac{6+1+3}{30}$

$R = \frac{30}{10}$

$= 3\ \Omega$

Answer 4.

(a)

Heat	Temperature
1. It is a form of energy.	1. It is the sensation of hotness and coldness.
2. Unit of heat is joule.	2. Unit of temperature is °C or kelvin.

(b) **(i)** **Calorimetry :** Measurement of quantity of heat exchanged is called calorimetry.

(c) Given : Mass of hot water $m = 200$ g

Temperature = 80°C

Mass of cold water,

$m = 300$ g

Temperature = 10°C

Let the final temperature of mixture = θ.

By the principle of calorimetry,

Heat given = Heat taken

$200 \times c \times (80 - \theta) = 300 \times c \times (\theta - 10)$

or $200 \times 80 - 200\ \theta = 300\ \theta - 300 \times 10$

or $16000 - 200\ \theta = 300\ \theta - 3000$

or $19000 = 500\ \theta$

$\therefore \quad \theta = 38°C$

(d) **(i)** During the emission of a beta particle, the mass number remains the same.

(ii) The minimum amount of energy required to emit an electron from a metal surface is called work function.

(e) **(i)** γ-rays.

(ii) α-particles.

SECTION-II

Answer 5.

(a) **(i)** **Ideal Machine :** It is a machine in which work done on the machine is equal to the work done by the machine.

(ii) We know

Efficiency (η)

$= \frac{\text{Mechanical Advantage (M.A.)}}{\text{Velocity Ratio (V.R.)}}$

And for an ideal machine

$\eta = 1$

So, M.A. = V.R.

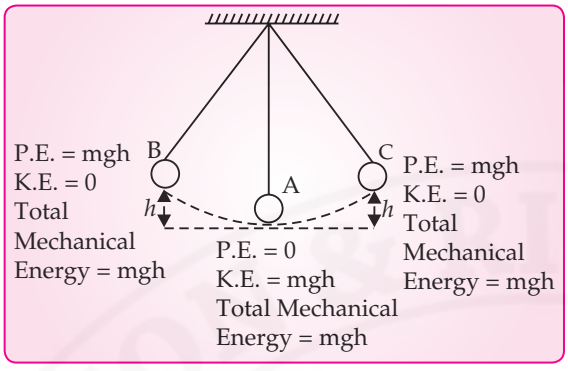
(iii) We know $W = F\,d \cos\theta.$

Since force is normal to displacement, so $\theta = 90°$

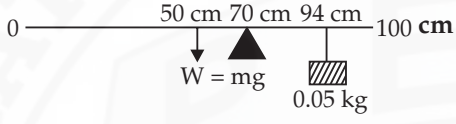
Hence work done,

$W = Fd \cos 90° = 0.$

(b)



(c) **(i)** Diagram of the given arrangement is shown below :



(ii) As the given meter scale is a uniform scale. So its centre of gravity lies at its centre, *i.e.*, 50 cm. Let mass of meter scale be m kg.

By principle of moments,

$$m_1x_1 = m_2x_2$$

or $$m \times (70 - 50) = 0{\cdot}05 \times (94 - 70)$$

$$\therefore \quad m = \frac{0{\cdot}05 \times 24}{20}$$

$$= 0{\cdot}06 \text{ kg}$$

$$= 60 \text{ g}$$

Answer 6.

(a) **(i)** Laws of refraction of light :

(1) The incident ray, refracted ray and normal at the point of incidence all lie in the same plane.

(2) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant for a given pair of media and is known as refractive index of medium 2 with respect to medium 1.

It is generally represented by the Greek letter ${}_1\mu_2$.

$$\boxed{{}_1\mu_2 = \frac{\sin i}{\sin r}}$$

(ii) $i + e = A + d$.

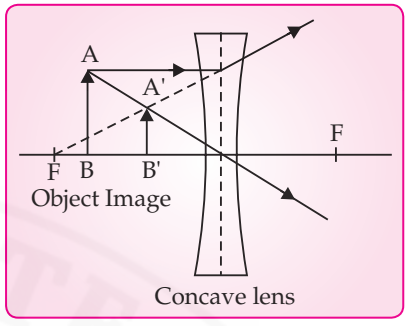
(b) **(i)** **(1) Infra-red radiations :** These are detected by a thermopile.

(2) Ultraviolet radiation : When a silver chloride solution is taken in a test tube and is passed from red to violet light no change is seen. But beyond the violet end, the solution first turns violet and then it turns dark brown.

(ii) Infrared radiations are used in remote control of television.

(c) **(i)** Concave lens.

(ii)



Answer 7.

(a) **(i)** Ultrasonic waves.

(ii) These waves are not audible to us because the frequency lies beyond the limits of audibility (20 Hz - 20000 Hz).

(iii) These are used in determining the depth of a sea.

(b) **(i)** We know that, $v = \frac{2d}{t}$

Here, $d = 25$ m

$v = 350$ m/s

$$\Rightarrow \quad 350 = \frac{50}{t}$$

$$\therefore \quad t = \frac{1}{7} \text{ sec}$$

$$= 0{\cdot}14 \text{ sec.}$$

(ii) Echo will be heard because the conditions required for the formulation of echo are fulfilled *i.e.*, the distance is more than 17 *m* and time period is more than 0·1 *second*.

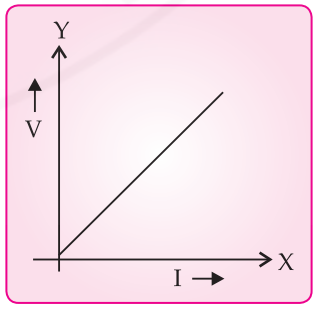
(c) **(i)** 1. Switch 2. Fuse.

(ii) **1. Functions of Switch :** It is an on-off device which is used to either connect or disconnect an electric appliance in a circuit. It is connected in the live wire.

2. Function of Fuse : It is used to limit the current in the electric circuit.

Answer 8.

(a) **(i)**



(ii) We can find resistance by finding the slope of the graph.

(iii) Non-ohmic Resistor : This is a resistor which does not obey Ohm's Law. V-I graph for non-ohmic resistor is not a straight line.

(b) (i) Given : 100 W, 250 V.

Information :

1. It conveys that when the bulb is connected to a 250 V supply it consumes 100 J of energy in 1 second or 100 W power.

2. It will work at its maximum capacity at 250 V.

(ii) Given : V = 250 V, I = ?

We know, $P = VI$

$\Rightarrow \quad 100 = 250 \times I$

$\therefore \quad I = \frac{100}{250} = 0{\cdot}4$ A.

(c) (i) 6 ohm and 12 ohm resistances are connected in parallel.

So, $\frac{1}{R_1} = \frac{1}{6} + \frac{1}{12} = \frac{2+1}{12} = \frac{3}{12}$

$\Rightarrow \quad \frac{1}{R_1} = \frac{1}{4}$

$\Rightarrow \quad R_1 = 4$ ohm

$\therefore$ Total Resistance, R = 8 + 4 = 12 ohm

Now, $V = IR$

$\Rightarrow \quad 12 = I \times 12$

$\therefore \quad I = 1$ A

(ii) $V' = IR_1 = 1 \times 4 = 4$ V

(iii) $V' = I_1 R'$

$\Rightarrow \quad 4 = I_1 \times 6$

$\therefore \quad I_1 = \frac{4}{6} = 0{\cdot}67$ A

Answer 9.

(a) (i) It becomes very cold after the hail storm because ice begins to melt by absorbing heat energy from the surroundings. This decreases the temperature of the surroundings which leads to the cooling of atmosphere.

(ii) This heat supplied is used in the change of state. This heat is known as latent heat.

(b) (i) Latent heat is absorbed by the melting ice.

(ii) Water is used as heat reservoir in cold countries for preservation of juice bottle to avoid them freezing.

(iii) In car radiators.

(c) Given :

Mass of water = 250 g

Temperature of water = 30°C

Mass of vessel = 50 g

Final temperature = 5°C

Let mass of ice = m g

By the principle of calorimetry,

Heat given = Heat taken

or $250 \times 4{\cdot}2 \times (30 - 5) + 50 \times 0{\cdot}4 \times (30 - 5)$

$= m \times 336 + m \times 4{\cdot}2 \times 5$

or $26250 + 500 = 336m + 21m$

or $26750 = 357m$

$\therefore \quad m = 74{\cdot}9$ g

Answer 10.

(a) (ii) Helium gas.

(b) (i) Radioactivity : It is the process of spontaneous emission of α, β and γ radiations from the nuclei of atoms during their decay.

(ii) In an unstable nucleus, number of neutrons are more than number of protons. In such a case, a neutron may change to a proton to achieve stability by emitting an electron called beta particle.

(iii) $_0n^1 \rightarrow {}_1P^1 + {}_{-1}e^0$

↓ ↓

Proton β - particle

(c) (ii) $_{84}X^{202} \rightarrow {}_{82}Y^{198} + {}_2He^4$.

(iii) No change in mass number and atomic number when γ radiations are emitted out.

●●

CHEMISTRY

2020

QUESTIONS

(Two Hours)

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during the first ***15*** *minutes.*

This time is to be spent in reading the question paper. The time given at the head of this Paper is the time allowed for writing the answers.

Section I *is compulsory. Attempt any four questions from* ***Section II.***

The intended marks for questions or parts of questions are given in brackets [].

SECTION-I (40 Marks)

Attempt ***all*** *questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* **[5]**

(i) *The element with highest ionization potential, is :*

(A) *Hydrogen* (B) *Caesium*

(C) *Radon* (D) *Helium*

(ii) *The inert electrode used in the electrolysis of acidified water, is :*

(A) *Nickel* (B) *Platinum*

(C) *Copper* (D) *Silver*

(iii) *A compound with low boiling point, is :*

(A) *Sodium chloride*

(B) *Calcium chloride*

(C) *Potassium chloride*

(D) *Carbon tetrachloride*

(iv) *The acid which can produce carbon from cane sugar, is :*

(A) *Concentrated Hydrochloric acid*

(B) *Concentrated Nitric acid*

(C) *Concentrated Sulphuric acid*

(D) *Concentrated Acetic acid*

(v) *The organic compound having a triple carbon-carbon covalent bond, is :*

(A) C_3H_4 (B) C_3H_6

(C) C_3H_8 (D) C_4H_{10}

(b) *State one relevant observation for each of the following reactions :* **[5]**

(i) *Action of concentrated nitric acid on copper.*

(ii) *Addition of excess ammonium hydroxide into copper sulphate solution.*

(iii) *A piece of sodium metal is put into ethanol at room temperature.*

(iv) *Zinc carbonate is heated strongly.*

(v) *Sulphide ore is added to a tank containing oil and water, and then stirred or agitated with air.*

(c) *Write a balanced chemical equation for each of the following reactions :* **[5]**

(i) *Reaction of carbon powder and concentrated nitric acid.*

(ii) *Reaction of excess ammonia with chlorine.*

(iii) *Reaction of lead nitrate solution with ammonium hydroxide.*

(iv) *Producing ethane from bromo ethane using Zn/Cu couple in alcohol*

(v) *Complete combustion of ethane.*

(d) **(i)** *Draw the structural formula for each of the following :* **[5]**

1. *2, 2 dimethyl pentane*

2. *Methanol*

3. *Iso propane*

(ii) *Write the IUPAC name for the following compounds :*

1. *Acetaldehyde*

2. *Acetylene*

(e) *State one relevant reason for each of the following :* **[5]**

(i) *Graphite anode is preferred to platinum in the electrolysis of molten lead bromide.*

(ii) *Soda lime is preferred to sodium hydroxide in the laboratory preparation of methane.*

(iii) *Hydrated copper sulphate crystals turn white on heating.*

(iv) *Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle.*

(v) *Hydrogen chloride gas fumes in moist air.*

(f) *Calculate :* **[5]**

(i) *The amount of each reactant required to produce 750 ml of carbon dioxide, when two volumes of carbon monoxide combine with one volume of oxygen to produce two volumes of carbon dioxide :*

$$2CO + O_2 \rightarrow 2CO_2$$

(ii) *The volume occupied by 80 g of carbon dioxide at STP.*

(iii) *Calculate the number of molecules in 4.4 gm of CO_2.*

[Atomic mass of C = 12, O = 16]

(iv) *State the law associated in question no. (f) (i) above.*

(g) *Give one word or a phrase for the following statements :* **[5]**

(i) *The chemical bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.*

(ii) *Electrode used as cathode in electrorefining of impure copper.*

(iii) *The substance prepared by adding other metals to a base metal in appropriate proportions to obtain certain desirable properties.*

(iv) *The tendency of an atom to attract electrons to itself when combined in a compound.*

(v) *The reaction in which carboxylic acid reacts with alcohol in the presence of conc. H_2SO_4 to form a substance having a fruity smell.*

(h) *Fill in the blanks from the choices given in brackets :* **[5]**

(i) *The polar covalent compound in gaseous state that does not conduct electricity is .....*

(carbon tetra chloride, ammonia, methane)

(ii) *A salt prepared by displacement reaction is .....*

(ferric chloride, ferrous chloride, silver chloride)

(iii) *The number of moles in 11 gm of nitrogen gas is .....*

(0.39, 0.49, 0.29) [atomic mass of N = 14]

(iv) *An alkali which completely dissociates into ions is ..... (ammonium hydroxide, calcium hydroxide, lithium hydroxide)*

(v) *An alloy used to make statues is .....*

(bronze, brass, fuse metal)

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) *The following table represent the elements and the atomic number :* **[3]**

With reference to this, answer the following using only the alphabets given in the table.

Element	*Atomic number*
P	*13*
Q	*7*
R	*10*

(i) *Which element combines with hydrogen to form a basic gas ?*

(ii) *Which element has an electron affinity zero ?*

(iii) *Name the element, which forms an ionic compound with chlorine.*

(b) *Draw the electron dot diagram for the compounds given below. Represent the electrons by (.) and (x) in the diagram :* **[3]**

[Atomic No. Ca = 20, O = 8, Cl = 17, H = 1]

(i) *Calcium oxide*

(ii) *Chlorine molecule*

(iii) *Water molecule*

(c) *Choose the correct word which refers to the process of electrolysis from A to E, to match the description (i) to (iv) :* **[4]**

A : Oxidation B : Cathode C : Anode

D : An electrolyte E : Reduction

(i) *Conducts electricity in aqueous or in molten state.*

(ii) *Loss of electron takes place at anode.*

(iii) *A reducing electrode.*

(iv) *Electrode connected to the positive end or terminal of the battery.*

Question 3.

(a) *Baeyer's process is used to concentrate bauxite ore to alumina. :* **[3]**

Give balanced chemical equations for the reaction taking place for its conversion from bauxite to alumina.

(b) *Complete the following by selecting the correct option from the choices given :* **[3]**

(i) *pH of acetic acid is greater than dilute sulphuric acid. So acetic acid contains ..... concentration of H^+ ions. (greater, same, low)*

(ii) *The indicator which does not change colour on passage of HCl gas is ..... (methyl orange, moist blue litmus, phenolphthalein)*

(iii) *The acid which cannot act as an oxidizing agent is .....(conc. H_2SO_4, conc. HNO_3, conc. HCl)*

(c) *Match the gases given in column I to the identification of the gases mentioned in column II :* **[4]**

Column I	*Column II*
(i) Hydrogen sulphide	*A. Turns acidified potassium dichromate solution green.*
(ii) Nitric oxide	*B. Turns lime water milky.*
(iii) Carbon dioxide	*C. Turns reddish brown when it reacts with oxygen.*
(iv) Sulphur dioxide	*D. Turns moist lead acetate paper silvery black.*

Question 4.

(a) *Differentiate between the following pairs based on the information given in the brackets :* **[3]**

(i) *Conductor and electrolyte (conducting particles)*

(ii) *Cations and anions (formation from an atom)*

(iii) *Acid and Alkali (formation of type of ions)*

(b) *Draw the structures of isomers of pentane.* **[3]**

(c) *Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction :* **[4]**

(i) *Give the balanced chemical equation for the reaction with suitable conditions(s) if any.*

(ii) *Why is concentrated sulphuric acid used instead of concentrated nitric acid ?*

(iii) *How is the gas collected ?*

(iv) *Name the drying agent not used for drying the gas.*

Question 5.

(a) *Distinguish between the following pairs of compounds using a reagent as a chemical test :* **[3]**

(i) *Calcium nitrate and Zinc nitrate solution.*

(ii) *Ammonium sulphate crystals and Sodium sulphate crystals.*

(iii) *Magnesium chloride and Magnesium nitrate solution.*

(b) *Calculate the percentage of* **:** **[3]**

(i) *Fluorine*

(ii) *Sodium and*

(iii) *Aluminium*

in sodium aluminium fluoride [Na_3AlF_6], to the nearest whole number. [Atomic Mass : Na = 23, Al = 27, F = 19]

(c) **(i)** *State the volume occupied by 40 gm of methane at STP, if its vapour density (V.D.) is 8.* **[4]**

(i) *Calculate the number of moles present in 160 gm of NaOH.*

[Atomic Mass : Na = 23, H = 1, O = 16]

Question 6.

(a) *Identify the salts* ***P***, ***Q***, ***R*** *from the following observations* **[3]**

(i) *Salt* ***P*** *has light bluish green colour. On heating, it produces a black coloured residue. Salt* ***P*** *produces brisk effervescence with dil. HCl and the gas evolved turns lime water milky, but no action with acidified potassium dichromate solution.*

(ii) *Salt* ***Q*** *is white in colour. On strong heating, it produces buff yellow residue and liberates reddish brown gas. Solution of salt* ***Q*** *produces chalky white insoluble precipitate with excess of ammonium hydroxide.*

(iii) *Salt* ***R*** *is black in colour. On reacting with concentrated HCl, it liberates a pungent greenish yellow gas which turns moist starch iodide paper blue black.*

(b) *Identify the substance underlined in each of the following :* **[3]**

(i) *The electrode that increases in mass during the electro-refining of silver.*

(ii) *The acid that is a dehydrating as well as a drying agent.*

(iii) *The catalyst used to oxidize ammonia into nitric oxide.*

(c) *Copy and complete the following paragraph using the options given in brackets :* **[4]**

Alkenes are a homologous series of (i) ..... (saturated / unsaturated) hydrocarbons characterised by the general formula (ii) ..... (C_nH_{2n+2}/ C_nH_{2n}). Alkenes undergo (iii) ..... (addition/ substitution) reactions and also undergo (iv) ..... (hydrogenation / dehydrogenation) to form alkanes.

Question 7.

(a) *Write balanced chemical equations, for the preparation of the given salts :* **[3]**

(i) to (iii) by using the methods A to C respectively :

A : Neutralization B : Precipitation C : Titration

(i) *Copper sulphate*

(ii) *Zinc carbonate*

(iii) *Ammonium sulphate*

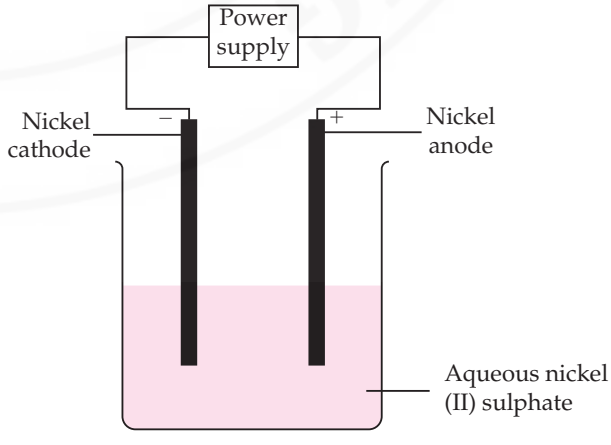
(b) *Name the following elements :* **[3]**

(i) *An alkaline earth metal present in group 2 and period 3.*

(ii) *A trivalent metal used to make light tools.*

(iii) *A monovalent non-metal present in fluorspar.*

(c) *An aqueous solution of nickel (II) sulphate was electrolyzed using nickel electrodes. Observe the diagram and answer the questions that follow :* **[4]**



(i) *What do you observe at the* ***cathode*** *and* ***anode*** *respectively ?*
(ii) *Name the cation that remains as a spectator ion in the solution.*
(iii) *Which equation for the reaction at the anode is correct ?*

1. $Ni \rightarrow Ni^{2+} + 2e^-$
2. $Ni + 2e^- \rightarrow Ni^{2+}$
3. $Ni^{2+} \rightarrow Ni + 2e^-$
4. $Ni^{2+} + 2e^- \rightarrow Ni$

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (D) Helium
(ii) (B) Platinum
(iii) (D) Carbon tetrachloride
(iv) (C) Concentrated Sulphuric acid
(v) (A) C_3H_4

(b) **(i)** Action of concentrated nitric acid on copper :
Reddish brown fumes of NO_2 are produced when copper reacts with conc. nitric acid :

$$Cu\ (s) + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$$

(ii) Addition of excess ammonium hydroxide into copper sulphate solution leads to formation of a deep blue coloured solution.
When ammonium hydroxide is added in the solution of copper sulphate drop-wise, a pale blue precipitate of copper hydroxide is obtained. The equation for this follows :

$$CuSO_4 + 2NH_4OH \rightarrow Cu(OH)_2 + (NH_4)_2SO_4 + 4H_2O$$

When ammonium hydroxide is added in excess, the precipitate dissolves and gives a deep blue solution of tetraammine copper (II) sulphate. The equation for this follows :

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \rightarrow [Cu(NH_3)_4]SO_4 + H_2O$$

Hence, the product formed is a complex named as tetraammine copper (II) sulphate.
(iii) When a piece of sodium metal is put into ethanol at room temperature hydrogen gas is produced which can be identified by a pop sound and it extinguishes a burning splinter.

$$\underset{\text{Sodium}}{2Na(s)} + \underset{\text{Ethanol}}{2C_2H_5OH(l)} \rightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa(l)} + \underset{\text{Hydrogen}}{H_2(g)}$$

(iv) White coloured zinc carbonate is heated strongly to give pale yellow zinc oxide and carbon dioxide gas which extinguishes wooden splinter.

$$ZnCO_3 \rightarrow ZnO + CO_2\uparrow$$

(v) Sulphide ore is added to a tank containing oil and water and then stirred or agitated with air to generate a froth. This is known as froth floatation where the sulphide ore particles are preferentially wetted by oil while gangue particles are preferentially wetted by water. A mixture of water and pine oil is taken in the tank. The powdered Sulphide ore is dropped in. Compressed air is blown in through the agitator. The agitator is rotated several times. Froth containing ore starts rising up.

(c) **(i)** Carbon powder reacts with concentrated nitric acid to give carbon dioxide, nitrogen dioxide and water.

$$C(s) + 4HNO_3(l) \rightarrow CO_2(g) + 4NO_2(g) + 2H_2O(l)$$

(ii) Excess of ammonia reacts with chlorine to give nitrogen and ammonium chloride.

$$8NH_3(g) + 3Cl_2(g) \rightarrow N_2(g) + \underset{\text{Solid white fog}}{6NH_4Cl}$$

(iii) Lead nitrate solution reacts with ammonium hydroxide to give lead hydroxide and ammonium nitrate.

$$Pb(NO_3)_2 + 2NH_4OH \rightarrow Pb(OH)_2 + 2NH_4NO_3$$

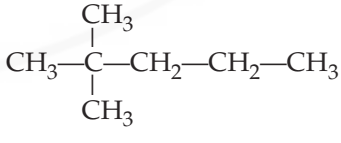
(iv) Production of ethane from bromoethane using Zn/Cu couple in ethanol gives H_2 gas for the reaction.

$$\underset{\text{Bromoethane}}{C_2H_5Br} + H_2 \xrightarrow{Zn/Cu,\ C_2H_5OH} \underset{\text{Ethane}}{C_2H_6} + HBr$$

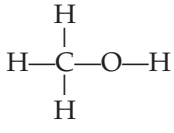
(v) Complete combustion of ethane gives carbon dioxide and water.

$$\underset{\text{Ethane}}{2C_2H_6} + \underset{\text{Oxygen}}{7O_2} \longrightarrow \underset{\text{Carbon dioxide}}{4CO_2} + \underset{\text{Water}}{6H_2O}$$

(d) **(i) 1.** 2, 2-Dimethyl pentane



2. Methanol



3. Isopropane

$$H_3C—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}—CH_3$$

(ii) 1. IUPAC name of acetaldehyde (CH_3CHO) is Ethanal.

2. IUPAC name of acetylene ($HC \equiv CH$) is Ethyne.

(e) **(i)** Graphite anode is preferred in the electrolysis of molten lead bromide, because graphite remains unaffected by the reactive bromine vapours which are released at the anode.

(ii) Soda lime is preferred to sodium hydroxide in the laboratory preparation for methane because Sodium hydroxide is deliquescent and absorbs water from atmosphere.

$$CH_3COONa \xrightarrow{NaOH/CaO} CH_4 + Na_2CO_3$$

(iii) Hydrated copper sulphate crystals turn white on heating due to the loss of water molecules upon heating.

$$CuSO_4 . 5H_2O \underset{\text{add } H_2O}{\overset{\Delta}{\rightleftharpoons}} CuSO_4 + 5H_2O$$

(iv) Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle because Nitric acid has tendency to decompose slowly in presence of sunlight and produce nitrogen dioxide gas, which is reddish brown in colour. This liberated NO_2 gas dissolves in nitric acid and gives it a yellowish colour.

$$4HNO_3 \rightarrow 4NO_2 + 2H_2O + O_2$$

(v) Hydrogen chloride gas fumes in moist air because it is highly soluble in water and when it comes in contact with air containing water droplets it dissolves in water and forms mist, which appears as white fumes.

(f) **(i)** $2CO + O_2 \rightarrow 2CO_2$

Here, 2 moles of CO react with 1 mole of O_2

At STP, 1 mole of any ideal gas takes up 22.4 L.

So, 44.8 L of CO reacts with 22.4 L of O_2 to give 44.8 L of CO_2.

So, 750 ml of CO_2 production will need 750 ml of CO and 375 ml of O_2

(ii) Molecular weight of CO_2 = 44 g

So, weight of one mole CO_2 gas is 44 g

Or, 44 g of CO_2 occupies 22.4 L at STP

$\therefore$ 80 g will occupy $\frac{22.4}{44} \times 80$

$= 40.72$ L

or $= 40720$ mL

(iii) Weight of one mole CO_2 gas is 44 g

Or, 44 g CO_2 contains 6.02×10^{23} CO_2 molecules.

So, 4.4 g of CO_2 will contain 6.023×10^{22} CO_2 molecules.

(iv) Gay Lussac's law of combining volumes of gases is associated here and it states that : "When gases react, they do so in volumes which bears a simple whole number ratio to one another and to the volumes of the products, if gaseous, provided the temperature and pressure of the reacting gases and their products remain constant".

(g) **(i)** Covalent bond

(ii) Pure (thin block) of copper

(iii) Alloys

(iv) Electronegativity

(v) Esterification

(h) **(i)** ammonia

(ii) ferric chloride

(iii) 0.39

(iv) calcium hydroxide

(v) bronze

SECTION-II

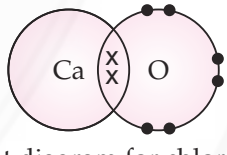
Answers 2.

(a) **(i)** Q (QH_3 is the basic gas) with Z = 7

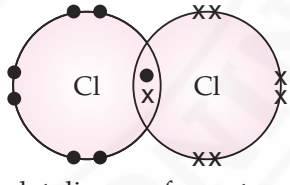
(ii) R with Z = 10

(iii) P with Z = 18

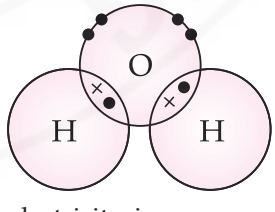
(b) **(i)** Electron dot diagram for Calcium oxide



(ii) Electron dot diagram for chlorine molecule



(iii) Electron dot diagram for water molecule



(c) **(i)** Conducts electricity in aqueous or in molten state – D: An electrolyte

(ii) Loss of electron takes place at anode – A: Oxidation

(iii) A reducing electrode – B: Cathode

(iv) Electrode connected to the positive end or terminal of the battery – C: Anode

Answers 3.

(a) Chemical reactions related to Baeyer's process for the conversion from bauxite to alumina:

1. $Al_2O_3.2H_2O(s) + 2NaOH \xrightarrow{150° - 200° C} 2NaAlO_2 + H_2O$

2. $NaAlO_2 + 2H_2O \xrightarrow{50° - 60° C} Al(OH)_3 + NaOH$

3. $2Al(OH)_3 \xrightarrow[\text{Alumina}]{\text{Heat}} Al_2O_3 + 3H_2O$

(b) **(i)** low **(ii)** phenolphthalein
(iii) conc. HCl

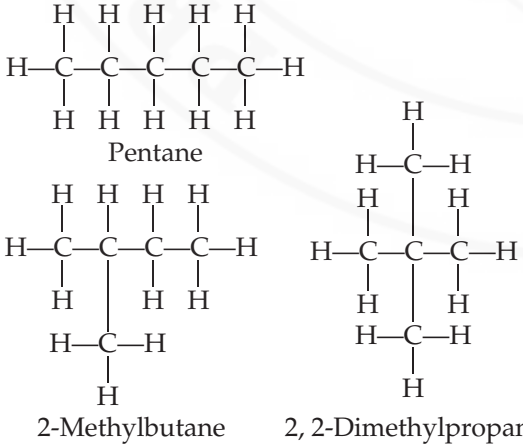
(c)

Column I	Column II
(i) Hydrogen sulphide	D. Turns moist lead acetate paper silvery black.
(ii) Nitric oxide	C. Turns reddish brown when reacts with oxygen.
(iii) Carbon dioxide	B. Turns lime water milky.
(iv) Sulphur dioxide	A. Turns acidified potassium dichromate solution green.

Answers 4.

(a) **(i)** Conductor has electrons as the conduction particles whereas ions are the conducting species in electrolyte.
(ii) Cations are formed when a neutral atom loses electrons whereas anions are formed when a neutral atom gains electron.
(iii) An acid dissociates to furnish H^+ ions and the conjugate base which is negatively charged and a base dissociates to give OH^- ions and a conjugate acid which is positively charged.

(b) Structures of isomers of pentane are as follows :



Pentane | 2-Methylbutane | 2, 2-Dimethylpropane

Structural isomers of C_5H_{12}

(c) **(i) 1.** $NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{below 200°C}]{\text{Heated}} NaHSO_4 + HCl\uparrow$

2. $2NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{above 200°C}]{\text{Heated}} Na_2SO_4 + 2HCl\uparrow$

(ii) Concentrated nitric acid is not used for preparation of HCl gas as it is very strong oxidising agent and will end up oxidising HCl gas.

(iii) HCl is collected by the upward displacement of air.

(iv) Calcium oxide.

Answers 5.

(a) **(i)** Calcium nitrate and Zinc nitrate solutions can be distinguish by reacting with ammonium hydroxide solution :

1. On adding ammonium hydroxide gelatinous white precipitates of zinc hydroxide are formed.

$Zn(NO_3)_2 + 2NH_4OH \longrightarrow Zn(OH)_2 + 2NH_4NO_3$

2. On adding excess of ammonium hydroxide, the precipitates dissolve forming a soluble complex.

$Zn(NO)_2 + 2NH_4NO_3 \longrightarrow 2NH_4OH + [Zn(NH_3)_4](NO_3)_2 + 4H_2O$

No visible reaction occurs when we add calcium nitrate to ammonium hydroxide.

$CaNO_3 + NH_4OH \longrightarrow$ No reaction

(ii) Ammonium sulphate crystals give pungent colourless gas Ammonia (NH_3) when heated. When NH_3 gas comes in contact with a glass rod dipped in HCl white fumes of NH_4Cl are produced. Sodium sulphate crystals do no undergo the above reaction sequence, hence can be differentiated from ammonium sulphate crystals.

(iii) Magnesium chloride reacts with silver nitrate solution to give precipitate of silver chloride, whereas magnesium nitrate does not react with silver nitrate solution to give a precipitate.

$MgCl_2\,(aq) + 2AgNO_3\,(aq) \longrightarrow Mg(NO_3)_2\,(aq) + 2AgCl\,(s)\downarrow$

$MgNO_3 + AgNO_3 \longrightarrow$ No reaction

(b) Molecular weight of Na_3AlF_6

$3 \times 23 + 27 + 6 \times 19 = 210$

Now,

(i) Percentage of fluorine $= \frac{(6\times19)}{210} \times 100$

$= 54.2\%$

(ii) Percentage of sodium = $\frac{(3\times23)}{210}\times100$

$= 32.8\ \%$

(iii) Percentage of aluminium = $\frac{27}{210}\times100$

$= 12.8\ \%$

(c) **(i)** Molecular weight = 2 × Vapour density at STP

In case of methane, substituting the given information –

Molecular weight = 2 × 8

= 16

Molecular weight of methane = 16 which means 16 g of methane occupy 22.4 L volume at STP.

So, 40 g of methane will occupy = $\frac{22.4}{16}\times40$

= 56 L

(ii) Number of moles

$= \frac{\text{Given weight of substance}}{\text{Molecular weight of substance}}$

Molecular weight of NaOH = 23 + 16 + 1

= 40

No. of moles = $\frac{160}{40} = 4$

There are 4 moles of NaOH in 160 g of NaOH

Answers 6.

(a) **(i)** P is Copper carbonate.

$CuCO_3(s) \rightarrow CuO(s)$

Copper II carbonate → Copper (II) oxide

Bluish green → Black

$+ CO_2(g)$

+ Carbon dioxide(g)

$CuCO_3 + HCl \rightarrow CuCl_2 + CO_2 + H_2O$

(P) Effervescence

$CuCO_3 + K_2Cr_2O_7 \rightarrow$ No reaction

(ii) The salt Q is Lead nitrate

$2Pb(NO_3)_2(s) \xrightarrow{\text{heat}} 2PbO(s) + 4NO_{2(g)} + O_2(g)$

Lead nitrate (Q), Colourless → Lead monoxide, Yellow → Nitrogen dioxide, Reddish brown → Oxygen

When reacted with ammonium hydroxide solution it gives a chalky white precipitate of lead hydroxide :

$Pb(NO_3)_2 + 2NH_4OH \rightarrow 2NH_4NO_3 + Pb(OH)_2\downarrow$

(Q) Chalky white ppt.

(iii) The salt R is MnO_2, which is black in colour and reacts with HCl to give Cl_2 gas

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

Chlorine gas is pungent and greenish yellow in colour. The chlorine gas oxidises some of the iodide ions in the starch iodide paper to create iodine diatomic molecules. These molecules react with the iodide ions and the starch to form a charge-transfer complex of blue colour.

(b) **(i)** Cathode

(ii) Conc. H_2SO_4

(iii) Platinum Rhodium catalyst in Ostwald's process.

(c) **(i)** unsaturated

(ii) C_nH_{2n}

(iii) addition

(iv) hydrogenation

Answers 7.

(a) **(i)** Copper sulphate by neutralization

$Cu(OH)_2 + H_2SO_4 \rightarrow CuSO_4\downarrow + 2H_2O$

Copper hydroxide + Sulphuric acid → Copper sulphate

(ii) Zinc carbonate by precipitation

$Zn(NO_3)_2\,(aq) + 2NaCO_3 \rightarrow Zn(CO_3)_2 + 2NaNO_3\,(aq)$

Zinc nitrate (aq) + Sodium carbonate → Zinc carbonate

(iii) Ammonium sulphate can be prepared by titration of NH_3 solution with dil. H_2SO_4 solution.

$2NH_4OH\,(aq) + H_2SO_4\,(aq) \rightarrow (NH_4)_2SO_4 + 2H_2O\,(l)$

White powder

(b) **(i)** Magnesium or Mg

(ii) Aluminium or Al

(iii) Fluorine or F

(c) **(i)** At cathode reduction takes place and deposition of Ni takes place as Ni^{2+} ions from solution convert to Ni metal.

$Ni^{2+} + 2e^- \rightarrow Ni$

At anode oxidation takes place and Ni metal converts to Ni^{2+} ions.

$Ni \rightarrow Ni^{2+} + 2e^-$

(ii) H^+ is the spectator cation.

(iii) **1.** $Ni \rightarrow Ni^{2+} + 2e^-$

CHEMISTRY

2019

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* [5]

(i) *An electrolyte which completely dissociates into ions is :*

(A) Alcohol *(B) Carbonic acid*
(C) Sucrose *(D) Sodium hydroxide*

(ii) *The most electronegative element from the following elements is :*

(A) Magnesium *(B) Chlorine*
(C) Aluminium *(D) Sulphur*

(iii) *The reason for using aluminium in the alloy duralumin is :*

(A) Aluminium is brittle.
(B) Aluminium gives strength.
(C) Aluminium brings lightness.
(D) Aluminium lowers melting point.

(iv) *The drying agent used to dry HCl gas is :*

(A) Conc. H_2SO_4 *(B) ZnO*
(C) Al_2O_3 *(D) CaO*

(v) *A hydrocarbon which is a greenhouse gas is :*

(A) Acetylene *(B) Ethylene*
(C) Ethane *(D) Methane*

(b) *Fill in the blanks with the choices given in brackets :* [5]

(i) *Conversion of ethanol to ethene by the action of concentrated sulphuric acid is an example of ..... . (dehydration/dehydrogenation/ dehydrohalogenation)*

(ii) *When sodium chloride is heated with concentrated sulphuric acid below 200°C, one of the products formed is ..... . (sodium bisulphate/sodium sulphate/ chlorine)*

(iii) *Ammonia reacts with excess chlorine to form ..... . (nitrogen/nitrogen trichloride/ammonium chloride)*

(iv) *Substitution reaction are characteristic reactions of ..... . (alkynes/alkenes/alkanes)*

(v) *In period 3, the most metallic element is ..... . (Sodium / magnesium / aluminium)*

(c) *Write a balanced chemical equation for each of the following reactions :* [5]

(i) *Reduction of copper (II) oxide by hydrogen.*

(ii) *Action of dilute sulphuric acid on sodium hydroxide.*

(iii) *Action of dilute sulphuric acid on zinc sulphide.*

(iv) *Ammonium hydroxide is added to ferrous sulphate solution.*

(v) *Chlorine gas is reacted with ethene.*

(d) *State one observation for each of the following :* [5]

(i) *Concentrated nitric acid is reacted with sulphur.*

(ii) *Ammonia gas is passed over heated copper (II) oxide.*

(iii) *Copper sulphate solution is electrolysed using copper electrodes.*

(iv) *A small piece of zinc is added to dilute hydrochloric acid.*

(v) *Lead nitrate is heated strongly in a test tube.*

(e) **(i)** *Calculate :* [5]

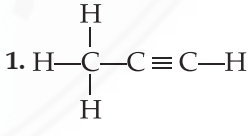
1. *The number of moles in 12g of oxygen gas.*
[O = 16]

2. *The weight of 10^{22} atoms of carbon.*
[C = 12, Avogadro's No. = 6×10^{23}]

(ii) *Molecular formula of a compound is $C_6H_{18}O_3$. Find its empirical formula.*

(f) **(i)** *Give the IUPAC name of the following organic compounds :* [5]

1.



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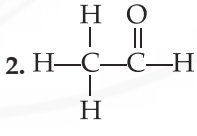


(ii) *What is the special feature of the structure of ethyne ?*

(iii) *Name the saturated hydrocarbon containing two carbon atoms.*

(iv) *Give the structural formula of acetic acid.*

(g) *Give the appropriate term defined by the statements given below :* [5]

(i) *The formula that represents the simplest ratio of the various elements present in one molecule of the compound.*

(ii) *The substance that releases hydronium ion as the only positive ion when dissolved in water.*

(iii) *The tendency of an atom to attract electrons towards itself when combined in a covalent compound.*

(iv) *The process by which certain ores, specially carbonates are converted to oxide in the absence of air.*

(v) *The covalent bond in which the electrons are shared equally between the combining atoms.*

(h) *Arrange the following according to the instructions given in brackets :* **[5]**

(i) *K, Pb, Ca, Zn. (In the increasing order of the reactivity)*

(ii) *Mg^{2+}, Cu^{2+}, Na^{+}, H^{+} (In the order of preferential discharge at the cathode)*

(iii) *Li, K, Na, H (In the decreasing order of their ionization potential)*

(iv) *F, B, N, O (In the increasing order of electron affinity)*

(v) *Ethane, methane, ethene, ethyne. (In the increasing order of the molecular weight) [H = 1, C = 12]*

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) *Draw the electron dot structure of :* **[3]**

(i) *Nitrogen molecule [N = 7]*

(ii) *Sodium chloride [Na = 1, Cl =17]*

(iii) *Ammonium ion [N = 7, H = 1]*

(b) *The pH values of three solution, A, B and C are given in the table. Answer the following questions :* **[3]**

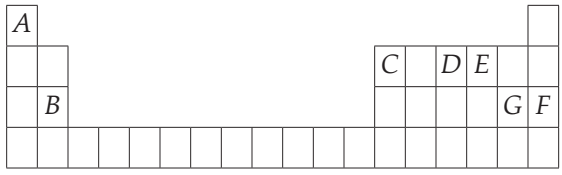
Solution	*pH value*
A	*12*
B	*2*
C	*7*

(i) *Which solution will have no effect on litmus solution ?*

(ii) *Which solution will liberate CO_2 when reacted with sodium carbonate ?*

(iii) *Which solution will turn red litmus solution blue ?*

(c) *Study the extract of the Periodic Table given below and answer the questions that follow. Give the alphabet corresponding to the elements in question. DO NOT repeat an element.* **[4]**



(i) *Which element forms electrovalent compound with G ?*

(ii) *The ion of which element will migrate towards the cathode during electrolysis ?*

(iii) *Which non-metallic element has the valency of 2 ?*

(iv) *Which is an inert gas ?*

Question 3.

(a) *Name the particles present in :* **[3]**

(i) *Strong electrolyte*

(ii) *Non-electrolyte*

(iii) *Weak electrolyte*

(b) *Distinguish between the following pairs of compounds using the reagent given in the bracket.* **[3]**

(i) *Manganese dioxide and copper (II) oxide. (using concentrated HCl)*

(ii) *Ferrous sulphate solution and ferric sulphate solution. (using sodium hydroxide solution)*

(iii) *Dilute hydrochloric acid and dilute sulphuric acid. (using lead nitrate solution)*

(c) *Choose the method of preparation of the following salts, from the methods given in the list.* **[4]**

[List : A. Neutralization B. Precipitation C. Direct combination D. Substitution]

(i) *Lead chloride*

(ii) *Iron (II) sulphate*

(iii) *Sodium nitrate*

(iv) *Iron (III) chloride*

Question 4.

(a) *Complete the following equations :* **[3]**

(i) *$S + conc.\ HNO_3 \rightarrow$*

(ii) *$C + conc.\ H_2SO_4 \rightarrow$*

(iii) *$Cu + dil.\ HNO_3 \rightarrow$*

(b) *Write a balanced chemical equation for the preparation of* **[3]**

(i) *Ethene from bromoethane.*

(ii) *Ethyne using calcium carbide.*

(iii) *Methane from sodium acetate.*

(c) *Name the following organic compounds :* **[4]**

(i) *The compound with 3 carbon atoms functional group is a carboxyl.*

(ii) *The first homologue whose general formula is C_nH_{2n}.*

(iii) *The compound that reacts with acetic acid to form ethyl ethanoate.*

(iv) *The compound formed by complete chlorination of ethyne.*

Question 5.

(a) *Give the chemical formula of :* **[6]**

(i) *Bauxite*

(ii) *Cryolite*

(iii) *Sodium aluminate.*

(b) *Answer the following question based on the extraction of aluminium from alumina by* ***Hall-Heroult's Process :*** **[3]**

(i) *What is the function of cryolite used along with alumina as the electrolyte ?*

(ii) *Why is powdered coke sprinkled on top of the electrolyte ?*

(iii) *Name the electrode, from which aluminium is collected.*

(c) *Match the alloys given in column I to the uses given in column II.* **[4]**

COLUMN I	COLUMN II
(i) Duralumin	A. Electrical fuse
(ii) Solder	B. Surgical instrument
(iii) Brass	C. Aircraft body
(iv) Stainless Steel	D. Decorative articles

Question 6.

(a) *Identify the substances underlined.* **[3]**

(i) *The <u>catalyst</u> used to oxidise ammonia.*

(ii) *The <u>organic compound</u> which when solidified, forms an ice like mass.*

(iii) *The <u>dilute acid</u> which is an oxidizing agent.*

(b) *Copper sulphate solution reacts with sodium hydroxide solution to form a precipitate of copper hydroxide according to the equation :* **[3]**

$$2NaOH + CuSO_4 \rightarrow Na_2SO_4 + Cu(OH)_2 \downarrow$$

(i) *What mass of copper hydroxide is precipitated by using 200 gm of sodium hydroxide ?*

[H = 1, O = 16, Na = 23, S = 32, Cu = 64]

(ii) *What is the colour of the precipitate formed ?*

(c) *Find the* ***empirical formula*** *and the* ***molecular formula*** *of an organic compound from the data given below :* **[4]**

C = 75.92%, H = 6.32% and N = 17.76%

The vapour density of the compound is 39.5

[C = 12, H = 1, N = 14]

Question 7.

(a) *Name the gas evolved in each of the following cases :* **[3]**

(i) *Alumina undergoes electrolytic reduction.*

(ii) *Ethene undergoes hydrogenation reaction.*

(iii) *Ammonia reacts with heated copper oxide.*

(b) *Study the flow chart given and give balanced equations to represent the reactions A, B and C :*

$$Mg_3N_2 \xrightarrow{A} NH_3 \underset{C}{\overset{B}{\rightleftharpoons}} NH_4Cl$$

[3]

(c) *Copy and complete the following table which refers to the industrial method for the preparation of ammonia and sulphuric acid.* **[4]**

Name of the compound	Name of the process	Catalytic equation (with the catalyst)
Ammonia	(i).....	(ii).....
Sulphuric acid	(iii).....	(iv).....

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (D) sodium hydroxide

(ii) (B) Chlorine

(iii) (C) Aluminium brings lightness

(iv) (A) Conc. H_2SO_4

(v) (D) Methane

(b) **(i)** dehydration

(ii) sodium bisulphate or sodium hydrogen Sulphate

(iii) ammonium chloride

(iv) Alkanes

(v) Sodium

(c) **(i)** Reduction of copper (II) oxide by hydrogen-

$$CuO\ (s) + H_2\ (g) \rightarrow Cu\ (s) + H_2O\ (g)$$

(ii) Action of dilute sulphuric acid on sodium hydroxide-

$$H_2SO_4\ (aq) + 2NaOH\ (aq) \rightarrow Na_2SO_4\ (aq) + 2H_2O\ (l)$$

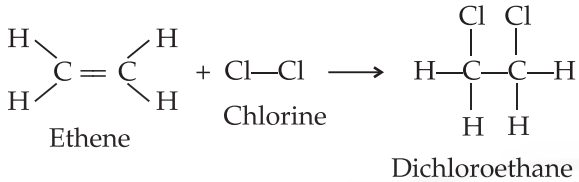
(iii) Action of dilute sulphuric acid on zinc sulphide-

$$ZnS + H_2SO_4 \rightarrow ZnSO_4 + H_2S\uparrow$$

(iv) Ammonium hydroxide is added to ferrous sulphate solution –

$$FeSO_4 + 2NH_4OH \rightarrow (NH_4)_2SO_4 + Fe(OH)_2$$

(v) Chlorine gas is reacted with ethene :



(d) **(i)** Concentrated nitric acid is reacted with sulphur to give reddish brown nitrogen oxide gas.

$$6HNO_3(Conc.) + S\ (s) \rightarrow H_2SO_4\ (g) + 6NO_2\uparrow(g) + 2H_2O\ (l)$$

(ii) When ammonia gas is passed over heated copper (II) oxide, reddish brown copper metal is obtained and black CuO is used up.

$$2NH_3 + 3CuO \xrightarrow{\text{Heat}} 3Cu + 3H_2O + N_2$$

(iii) Copper sulphate solution is electrolysed using copper electrodes and the cathode increases in size due to deposition of copper metal, whereas the copper anode gets thin due to loss of copper metal into the solution as Cu^{2+} ions.

The electrolytic solution contains following ions-

$$CuSO_4(s) + H_2O \rightarrow Cu^{2+}(aq) + SO_4^{2-}(aq) + H^+(aq) + OH^-(aq)$$

At cathode-

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu\ (s)$$

At anode made up of copper –

$$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$$

(iv) A small piece of zinc is added to dilute hydrochloric acid to give bubbles in solution due to evolution of hydrogen gas.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2\ (s) + H_2\ (g)\uparrow$$

(v) Lead nitrate is heated strongly in a test tube to give a cracking sound and a reddish brown gas (NO_2).

$$2Pb(NO_3)_2\ (s) \xrightarrow{\text{Heat}} 2PbO + 4NO_2\uparrow + O_2(g)$$

Reddish brown gas is evolued.

(e) **(i) 1.** The number of moles in 12 g of oxygen gas can be calculated as below-

Given atomic mass of oxygen is 16 g,

Hence molar mass of O_2 gas = 16 × 2 = 32 g

That is, 32 g oxygen gas has one molecule of O_2 molecules.

Therefore, 12 g of oxygen gas would contain = (1/32) × 12 = 0.375 moles

2. The weight of 10^{22} atoms of carbon can be calculated as follows –

Given – atomic weight of carbon = 12, and Avogadro's number = 6.023×10^{23}

Weight of one mole of carbon is 12 g,

Weight of 6.023×10^{23} carbon atoms is 12 g

Hence, weight of 10^{22} carbon atoms is $(12\ g/6.023 \times 10^{23}) \times 10^{22} = 0.199 \approx 0.2\ g$

(ii) Empirical formula can be obtained by dividing the number of atoms in molecule by the smallest number in the molecular formula –

Given molecular formula – $C_6H_{18}O_3$

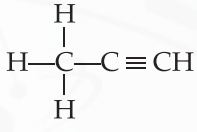
Smallest number in formula is 3

Dividing all the atoms by 3,

Empirical formula comes to be – C_2H_6O

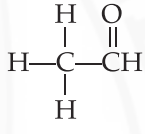
(f) **(i)** IUPAC name-

1.



Propyne

2.

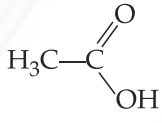


Ethanal

(ii) Special feature of ethyne structure is that ethyne (C_2H_2) contains a triple bond between the two carbon atoms and it is linear in shape due to *sp* hybridisation in carbon atoms.

(iii) The saturated hydrocarbon containing two carbon atoms is Ethane, C_2H_6.

(iv) The structural formula of acetic acid is –



Ethanoic acid (acetic acid)

(g) **(i)** The formula that represents the simplest ratio of various elements present in one molecule of a compound is known as **Empirical formula.**

(ii) The substance that releases hydronium ion as the only positive ion when dissolved in water is **protic acid**.

(iii) The tendency of an atom to attract electrons towards itself when combined in a covalent compound is known as **electronegativity.**

(iv) The process by which certain ores, specially carbonates, are converted to oxides in absence of air is known as **calcination.**

(v) The covalent bond in which the electrons are shared equally between the combining atoms is known as **Non-polar covalent bond.**

(h) **(i)** The given elements can be arranged in increasing order of reactivity as follows –

$$Pb < Zn < Ca < K$$

(ii) In the order of preferential discharge at the cathode –

$$Na^+ > Mg^{2+} > H^+ > Cu^{2+}$$

(iii) In the decreasing order of their ionization potential-

$$H > Li > Na > K$$

(iv) In the increasing order of electron affinity –

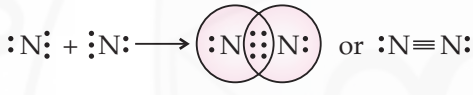
$$B < N < O < F$$

(v) In the increasing order of molecular weight – Methane (CH_4) < ethyne (C_2H_2) < ethene (C_2H_4) < ethane (C_2H_6)

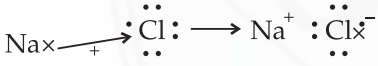
SECTION-II

Answers 2.

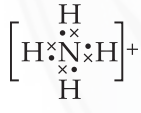
(a) **(i)** Electron dot structure of nitrogen molecule –



(ii) Electron dot structure of Sodium chloride –



(iii) Electron dot structure of Ammonium ion –



(b) **(i)** Solution C would have no effect on litmus solution as its pH is 7 and hence it is neutral.

(ii) Solution B would liberate CO_2 when reacted with sodium carbonate as it is acidic solution and has pH 2.

(iii) Solution A would turn red litmus solution blue as it is basic in nature and has pH 12.

(c) **(i)** A would form electrovalent compound with G.

(ii) B ion would travel to cathode during electrolysis.

(iii) E has valency of 2.

(iv) F is an inert gas.

Answers 3.

(a) **(i)** The particles present in strong electrolyte are molecules which easily and completely dissociate into ions. Example: Strong electrolyte such as NaCl which dissociates strongly into Na^+ and Cl^- ions.

(ii) The particles present in non-electrolyte are molecules which do not dissociate into ions. Example: Non-electrolyte such as urea. NH_2CONH_2 which do not dissociate.

(iii) The particles present in weak electrolyte are both molecules and ions which dissociate into ions to a very less extent. Example: CH_3COOH which dissociates feebly into CH_3COO^- and H^+ ions.

(b) **(i)** Manganese dioxide reacts with concentrated hydrochloric acid to give chlorine gas, which is greenish yellow in colour, whereas copper (II) oxide reacts with concentrated hydrochloric acid to give $CuCl_2$, but no chlorine gas is evolved.

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2\uparrow + 2H_2O$$

(ii) A reddish precipitate of Iron(III) hydroxide is obtained when ferric sulphate reacts with sodium hydroxide solution, whereas dirty green precipitate is obtained when ferrous sulphate is mixed with sodium hydroxide.

$$Fe_2(SO_4)_3\,(aq) + 6NaOH\,(aq) \rightarrow 2Fe(OH)_3\,(s) + 3Na_2SO_4\,(aq)$$

(iii) Lead nitrate reacts with dilute HCl to form the insoluble salt lead chloride, which appears as the white precipitate. The insoluble lead chloride reacts with excess Cl^- ions (of HCl) to form a soluble complex, the tetrachloroplumbate(II) ion,

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2\downarrow + 2HNO_3$$

$$PbCl_2 + 2HCl \rightarrow [PbCl_4]^{2-} + 2H^+(aq)$$

Soluble

Lead nitrate solution reacts with H_2SO_4 to give lead sulphate precipitate, which does not dissolve further in sulphuric acid solution.

$$Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4\downarrow + HNO_3$$

(c) **(i)** (B) Lead chloride can be prepared by precipitation.

$$Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$$

(ii) (D) Iron (II) Sulphate can be prepared by substitution.

(iii) (A) Sodium nitrate can be prepared by Neutralization.

$$2HNO_3 + Na_2CO_3 \rightarrow 2\,NaNO_3 + H_2O + CO_2$$

(iv) (C) Iron (III) chloride can be prepared by direct combination.

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

Answers 4.

(a) **(i)** $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$

(ii) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

(iii) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(b) **(i)** Ethene from bromoethane

$H_2CBr\text{-}CH_3 + KOH \rightarrow H_2C{=}CH_2 + KBr + H_2O$

Bromoethane — Ethene

(ii) Ethyne using calcium carbide

$CaC_2 + 2H_2O \rightarrow HC \equiv CH + Ca(OH)_2$

Calcium Carbide — Ethyne

(iii) Methane from sodium acetate

$CH_3COONa + NaOH \xrightarrow[CaO]{\Delta} CH_4 + Na_2CO_3$

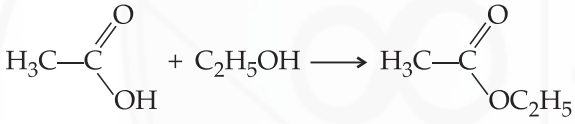
Sodium acetate — Sodium Hydroxide — Methane — Sodium carbonate

(c) **(i)** The compound with three carbon atoms whose functional group is carboxyl-

Propanoic acid, CH_3CH_2COOH

(ii) The first homologue whose general formula is C_nH_{2n} is C_2H_4 that is Ethene.

(iii) The compound that reacts with acetic acid to form ethyl ethanoate is ethanol-



Ethanoic acid (acetic acid) — Ethyl ethanoate

(iv) The compound formed by complete chlorination of ethyne is tetrachloroethane, $C_2H_2Cl_4$.

Answers 5.

(a) **(i)** The chemical formula of Bauxite is $Al_2O_3.2H_2O$ [where, $O < x < 1$]

(ii) The chemical formula of Cryolite is Na_3AlF_6.

(iii) The chemical formula of Sodium aluminate is $NaAlO_2$.

(b) **(i)** Cryolite (Na_3AlF_6) is mixed with alumina to bring down the melting point of electrolyte mixture and to increase its electrical conductivity.

(ii) The electrolytic mixture is sprinkled with coke to prevent the anode's oxidation by the oxygen evolved.

(iii) Aluminium is collected at cathode which is carbon lining covering the inside portion of vessel.

(c) **(i)** Duralumin – C. Aircraft body

(ii) Solder – A. Electrical fuse

(iii) Brass – D. Decorative articles

(iv) Stainless steel – B. Surgical instruments

Answers 6.

(a) **(i)** Platinum

(ii) Acetic acid or ethanoic acid CH_3COOH

(iii) Dilute nitric acid or HNO_3

(b) **(i)** The given equation is

$2NaOH + CuSO_4 \rightarrow Na_2SO_4 + Cu(OH)_2\downarrow$

Molecular weight of NaOH, Sodium hydroxide = 23 + 16 + 1 = 40

Molecular weight of $Cu(OH)_2$, Copper hydroxide = 64 + 16 + 1 + 16 + 1 = 98

2 × 40 = 80 g of NaOH is used to precipitate 98 g of $Cu(OH)_2$

Hence, 200 g of NaOH will be used to precipitate (98/80) 200 g of $Cu(OH)_2$ = 245 g of $Cu(OH)_2$

So, 245 g of copper hydroxide would be prepared using 200 g of sodium hydroxide.

(ii) The precipitate of copper hydroxide is bluish green solid or Pale blue solid.

(c) Given : C=75.92%, H = 6.32% and N = 17.76%

Let us assume that the weight of compound is 100 g. So, in that 100 g C is 75.92 g, H is 6.32 g and N is 17.76 g.

Now, lets calculate the moles of each element present in the compound-

75.92 g C × (1 mol C/12 g C) = 6.32

6.32 g H × (1 mol H/1 g H) = 6.32

17.76 g N × (1 mol N/14 g N) = 1.26

Next, dividing all the mole numbers by the smallest among them, which is 1.26. This division yields –

5 mol C, 5 mol H and 1 mol N

So, the compound has the empirical formula – C_5H_5N.

Now, we know that

Molecular mass of a gas = 2 × vapour density of the gas

= 2 × 39.5

= 79

So, Molecular mass of the given compound is 79.

Empirical formula mass = (12 × 5) + (1 × 5) + (14 × 1) = 79

As, Empirical formula mass = Molecular mass

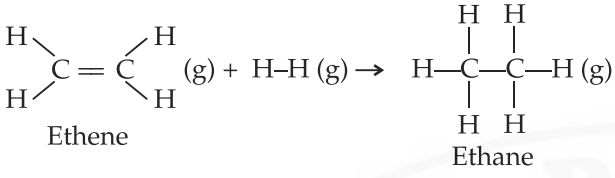
So, in this case Empirical formula = Molecular formula = C_5H_5N.

Answers 7.

(a) (i) Oxygen gas (O_2) is evolved when alumina undergoes electrolysis.

$Al_2O_3 \rightleftharpoons 2Al^{3+} + 3O^{2-}$

(ii) Ethane gas (C_2H_6) is evolved when ethene undergoes hydrogenation reaction.



Ethene Ethane

(iii) Nitrogen gas (N_2) is evolved when ammonia is treated with copper oxide.

$$2NH_3 + 3CuO \xrightarrow{\Delta} 3\,Cu + 3H_2O + N_2$$

Ammonia Nitrogen gas

(b) The flow chart can be completed as follows-

$$Mg_3N_2 \xrightarrow{H_2O(A)} NH_3 \underset{Ca(OH)_2(C)}{\overset{HCl(B)}{\rightleftharpoons}} NH_4Cl$$

The full reactions are as follows-

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$

(A)

$$NH_3 + HCl \rightarrow NH_4Cl$$

(B)

$$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + 2H_2O + CaCl_2$$

(C)

(c) Details of industrial processes-

Name of the compound	Name of the process	Catalytic equation (with the catalyst)
Ammonia	(i) Haber's Process	(ii) $N_2(g) + 3H_2(g) \underset{K_2O + Al_2O_3}{\overset{\text{Iron oxide}}{\rightleftharpoons}} 2\,NH_3\,(g)$ Ammonia
Sulphuric acid	(iii) Contact process	(iv) $2SO_2 + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$ $\xrightarrow{H_2SO_4} H_2S_2O_7$ Oleum

CHEMISTRY

2018

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Choose the correct answer from the options given below :* [5]

(i) *The salt solution which does not react with ammonium hydroxide is :*

(A) Calcium nitrate (B) Zinc nitrate

(C) Lead nitrate (D) Copper nitrate

(ii) *The organic compound which undergoes substitution reaction is :*

(A) C_2H_2 (B) C_2H_4

(C) $C_{10}H_{18}$ (D) C_2H_6

(iii) *The electrolysis of acidified water is an example of :*

(A) Reduction (B) Oxidation

(C) Redox reaction (D) Synthesis

(iv) *The IUPAC name of dimethyl ether is :*

(A) Ethoxy methane (B) Methoxy methane

(C) Methoxy ethane (D) Ethoxy ethane

(v) *The catalyst used in the Contact Process is :*

(A) Copper (B) Iron

(C) Vanadium pentoxide (D) Manganese dioxide

(b) *Give **one word** or a **phrase** for the following statements :* [5]

(i) *The energy released when an electron is added to a neutral gaseous isolated atom to form a negatively charged ion.*

(ii) *Process of formation of ions from molecules which are not in ionic state.*

(iii) *The tendency of an element to form chains of identical atoms.*

(iv) *The property by which certain hydrated salts, when left exposed to atmosphere, lose their water of crystallization and crumble into powder.*

(v) *The process by which sulphide ore is concentrated.*

(c) *Write a balanced chemical equation for each of the following :* [5]

(i) *Action of concentrated sulphuric acid on carbon.*

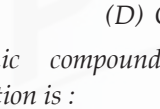
(ii) *Reaction of sodium hydroxide solution with iron (III) chloride solution.*

(iii) *Action of heat on aluminium hydroxide.*

(iv) *Reaction of zinc with potassium hydroxide solution.*

(v) *Action of dilute hydrochloric acid on magnesium sulphite.*

(d) **(i)** *Give the IUPAC name for each of the following :*

(1) 

(2) 

(3) 

(ii) *Write the structural formula of the two isomers of butane.*

(e) *State one relevant observation for each of the following reactions :* [5]

(i) *Lead nitrate solution is treated with sodium hydroxide solution drop wise till it is in excess.*

(ii) *At the anode, when molten lead bromide is electrolyzed using graphite electrodes.*

(iii) *Lead nitrate solution is mixed with dilute hydrochloric acid and heated.*

(iv) *Anhydrous calcium chloride is exposed to air for some time.*

(v) *Barium chloride solution is slowly added to sodium sulphate solution.*

(f) *Give a reason for each of the following :* [5]

(i) *Ionic compounds have a high melting point.*

(ii) *Inert gases do not form ions.*

(iii) *Ionisation potential increases across a period, from left to right.*

(iv) *Alkali metals are good reducing agents.*

(v) *Conductivity of dilute hydrochloric acid is greater than that of acetic acid.*

(g) *Name the gas that is produced in each of the following cases :* **[5]**

(i) *Sulphur is oxidized by concentrated nitric acid.*

(ii) *Action of dilute hydrochloric acid on sodium sulphide.*

(iii) *Action of cold and dilute nitric acid on copper.*

(iv) *At the anode during the electrolysis of acidified water.*

(v) *Reaction of ethanol and sodium.*

(h) *Fill up the blanks with the correct choice given in brackets :* **[5]**

(i) *Ionic or electrovalent compounds do not conduct electricity in their _____ state.*

(fused/solid)

(ii) *Electrolysis of aqueous sodium chloride solution will form _____ at the cathode.*

(hydrogen gas/sodium metal)

(iii) *Dry hydrogen chloride gas can be collected by_____ displacement of air.*

(downward/upward)

(iv) *The most common ore of iron is_____ .*

(calamine/haematite)

(v) *The salt prepared by the method of direct combination is _____*

(iron (II) chloride/iron (III) chloride).

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section*

Question 2.

(a) **(i)** *What do you understand by a lone pair of electrons ?* **[3]**

(ii) *Draw the electron dot diagram of hydronium ion. (H =1; O = 8)*

(b) *In Period 3 of the Periodic Table, element **B** is placed to the left of element **A**. On the basis of this information, choose the correct word from the brackets to complete the following statements :* **[3]**

(i) *The element **B** would have (lower/higher) metallic character than **A**.*

(ii) *The element **A** would probably have (lesser/higher) electron affinity than **B**.*

(iii) *The element **A** would have (greater/smaller) atomic size than **B**.*

(c) *Copy and complete the following table which refers to the conversion of ions to neutral particles :* **[4]**

Conversion	*Ionic Equation*	*Oxidation/ Reduction*
Chloride ion to chlorine molecule	*(i) _____*	*(ii) _____*
Lead (II) ion to lead	*(iii) _____*	*(iv) _____*

Question 3.

(a) *(i) Write the balanced chemical equation to prepare ammonia gas in the laboratory by using an alkali.* **[3]**

(ii) State why concentrated sulphuric acid is not used for drying ammonia gas.

(iii) *Why is ammonia gas not collected over water ?*

(b) **(i)** *Name the acid used for the preparation of hydrogen chloride gas in the laboratory. Why is this particular acid preferred to other acids ?* **[3]**

(ii) *Write the balanced chemical equation for the laboratory preparation of hydrogen chloride gas.*

(c) *For the preparation of hydrochloric acid in the laboratory :* **[2]**

(i) *Why is direct absorption of hydrogen chloride gas in water not feasible ?*

(ii) *What arrangement is done to dissolve hydrogen chloride gas in water ?*

(d) *For the electro-refining of copper :* **[2]**

(i) *What is the cathode made up of ?*

(ii) *Write the reaction that takes place at the anode.*

Question 4.

(a) *The percentage composition of a gas is :* **[2]**

Nitrogen 82.35%, Hydrogen 17.64%.

Find the empirical formula of the gas.

[N = 14, H = 1]

(b) *Aluminium carbide reacts with water according to the following equation :* **[4]**

$$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$$

(i) *What mass of aluminium hydroxide is formed from 12 g of aluminium carbide ?*

(ii) *What volume of methane at S.T.P. is obtained from 12 g of aluminium carbide ?*

[Relative molecular weight of Al_4C_3 = 144; $Al(OH)_3$ = 78]

(c) **(i)** *If 150 cc of gas A contains X molecules, how many molecules of gas B will be present in 75 cc of B ?* **[2]**

The gases A and B are under the same conditions of temperature and pressure.

(ii) *Name the law on which the above problem is based.*

(d) *Name the main component of the following alloys :* **[2]**

(i) *Brass*

(ii) *Duralumin*

Question 5.

(a) *Complete the following table which relates to the homologous series of hydrocarbons :* **[6]**

General formula	*IUPAC name of the homologous series*	*Characteristic bond type*	*IUPAC name of the first member of the series*
C_nH_{2n-2}	(A)	(B)	(C) .....
C_nH_{2n+2}	(D)	(E)	(F) .....

(b) **(i)** *Name the most common ore of the metal aluminium from which the metal is extracted. Write the chemical formula of the ore.*

(ii) *Name the process by which impure ore of aluminium gets purified by using concentrated solution of an alkali.*

(iii) *Write the equation for the formation of aluminium at the cathode during the electrolysis of alumina.* **[4]**

Question 6.

(a) *A compound* ***X*** *(having vinegar like smell) when treated with ethanol in the presence of the acid* ***Z****, gives a compound* ***Y*** *which has a fruity smell. The reaction is :*

$$C_2H_5OH + X \xrightarrow{Z} Y + H_2O$$

(i) *Identify* ***Y*** *and* ***Z****.*

(ii) *Write the structural formula of* ***X****.*

(iii) *Name the above reaction.* **[4]**

(b) *Ethane burns in oxygen to form CO_2 and H_2O according to the equation :*

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

If 1250 cc of oxygen is burnt with 300 cc of ethane. Calculate :

(i) *the volume of CO_2 formed.*

(ii) *the volume of unused O_2.* **[4]**

(c) *Three solutions P, Q and R have pH value of 3.5, 5.2 and 12.2 respectively. Which one of these is a :*

(i) *Weak acid ?*

(ii) *Strong alkali ?* **[2]**

Question 7.

(a) *Give a chemical test to distinguish between the following pairs of chemicals :*

(i) *Lead nitrate solution and zinc nitrate solution.*

(ii) *Sodium chloride solution and sodium nitrate solution.* **[4]**

(b) *Write a balanced equation for the preparation of each of the following salts :*

(i) *Copper sulphate from copper carbonate.*

(ii) *Zinc carbonate from zinc sulphate.* **[2]**

(c) **(i)** *What is the type of salt formed when the reactants are heated at a suitable temperature for the preparation of nitric acid ?*

(ii) *State why for the preparation of nitric acid, the complete apparatus is made up of glass.* **[2]**

(d) *Which property of sulphuric acid is shown by the reaction of concentrated sulphuric acid with :*

(i) *Ethanol ?*

(ii) *Carbon ?* **[2]**

ANSWERS

SECTION-I

Answers 1.

(a) **(i)** (A) Calcium nitrate

(ii) (D) C_2H_6 [As saturated hydrocarbons undergo substitution reaction.]

(iii) (C) Redox reaction

(iv) (B) Methoxy methane

(v) (C) Vanadium pentoxide

(b) **(i)** Electron affinity

(ii) Ionization

(iii) Catenation

(iv) Efflorescence or Efflorescent

(v) Froth floatation method

(c) **(i)** $C + 2H_2SO_4$ (conc.) $\rightarrow CO_2 + 2SO_2 + 2H_2O$

(ii) $FeCl_3 + 3NaOH \rightarrow \underset{\text{Iron (III) hydroxide}}{Fe(OH)_3} + 3NaCl$

(iii) Aluminium hydroxide on heating decomposes into aluminium oxide along with water.

$$2Al(OH)_3 \rightarrow \underset{\text{Aluminium oxide}}{Al_2O_3} + 3H_2O$$

(iv) Zinc reacts with potassium hydroxide solution to form potassium zincate

$$Zn + 2KOH \rightarrow \underset{\text{Potassium Zincate}}{K_2ZnO_2} + H_2$$

(v) Magnesium sulphite reacts with dilute hydrochloric acid to give magnesium chloride :

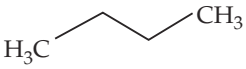
$$MgSO_3 + 2HCl \rightarrow MgCl_2 + H_2O + SO_2\uparrow$$

(d) **(i)** (1) Methanal

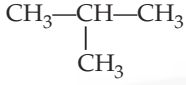
(2) Propan-1-ol

(3) But-2-ene

(ii)



n-Butane



Iso-Butane

(e) **(i)** On dropwise addition of sodium hydroxide solution to lead nitrate solution it first gives a white precipitate and then on adding excess of sodium hydroxide solution, a clear solution is obtained due to formation of sodium plumbate (Na_2PbO_2) which is colourless and soluble.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 (\downarrow) + 2NaNO_3$$

$$Pb(OH)_2 + 2NaOH \text{ (Excess)} \longrightarrow Na_2PbO_2$$

(ii) At the anode, when lead bromide is electrolyzed using graphite electrodes following reaction occurs at the anode during electrolysis and red brown vapours are evolved at anode.

$$2Br^- - 2e^- \rightarrow 2Br$$

$$2Br \rightarrow Br_2(\uparrow)$$

(iii) Lead nitrate solution is mixed with dilute hydrochloric acid and heated to give lead chloride and nitric acid :

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2 \downarrow + 2HNO_3$$

Lead chloride is a white precipitate solution in warm water but on heating colourless solution is observed.

(iv) Anhydrous calcium chloride is exposed to air for some time and it absorbs moisture from air as it has a strong affinity for water.

$$CaCl_2 + 2H_2O \rightarrow Ca(OH)_2 + 2HCl$$

(v) Barium chloride solution is slowly added to sodium sulphate solution to obtain white precipitate of barium sulphate :

$$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

(f) **(i)** Ionic compounds have high melting points because the ionic bonds are formed by transfer of electrons which are held by strong electrostatic force of attraction and require a great deal of energy to break the bond.

(ii) Inert gases do not form ions because their outermost shell is complete and they have a stable electronic configuration.

(iii) Ionisation potential increases across a period from left to right because size of atom decreases and effective nuclear charge increases per electron, hence making it difficult to remove electron.

(iv) Alkali metals are good reducing agents because alkali metals have ns^1 outer electron configuration and they achieve the nearest stable configuration by losing one electron, hence they have a great tendency to loose electrons or get oxidized therefore, they are good reducing agents.

(v) Conductivity of dilute hydrochloric acid is greater than that of acetic acid because hydrochloric acid is a strong acid and it dissociates completely in aqueous solution to form H^+ and Cl^- ions (a higher concentration of ions). Acetic acid, on the other hand, is a weak acid and it partially dissociates forming H^+ and CH_3COO^- ions (concentration of ions is low).

(g) **(i)** H_2SO_4 and NO_2 are produced when sulphur reacts with conc. HNO_3.

$$S + 6HNO_3(conc.) \rightarrow H_2SO_4 + 6NO_2\uparrow + 2H_2O$$

(ii) Hydrogen sulphide (H_2S) gas is produced when dilute hydrochloric acid reacts with sodium sulphide.

$$Na_2S(aq) + 2HCl(aq) \rightarrow H_2S(g) + 2NaCl(aq)$$

(iii) NO gas is evolved when cold and dilute nitric acid reacts with copper.

$$3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq)\uparrow + 2NO(g) \downarrow + 4H_2O(l)$$

(iv) Oxygen is evolved at the anode during the electrolysis of acidified water.

$$OH^- - 1e^- \rightarrow OH$$

$$4OH \rightarrow 2H_2O + O_2\uparrow$$

(v) Hydrogen gas is produced during the reaction of ethanol and sodium.

$$C_2H_5OH + Na \rightarrow C_2H_5ONa + \frac{1}{2} H_2(g)\uparrow$$

(h) **(i)** solid

(ii) hydrogen gas

(iii) upward (HCl gas is heavy than air)

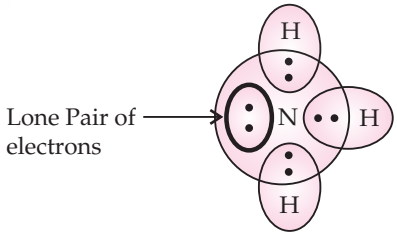
(iv) haematite

(v) iron (III) chloride

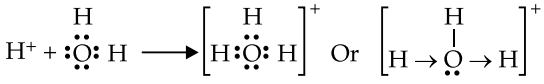
SECTION-II

Answers 2.

(a) **(i)** A lone pair is an electron pair in the outermost shell of an atom that is not shared or bonded to another atom. Below is the example of lone pair on nitrogen atom of ammonia molecule (NH_3).



(ii) Electron dot diagram of hydronium ion :



(b) **(i)** The element **B** would have *higher* metallic character than element **A.**

(ii) The element **A** would have probably *higher* electron affinity than element **B**.

(iii) The element **A** would have *smaller* atomic size than element **B.**

(c)

Conversion	Ionic Equation	Oxidation/ Reduction
Chloride ion to chlorine molecule	(i) $Cl^- - e^- \rightarrow \frac{1}{2} Cl_2(g)$	(ii) Oxidation
Lead(II) ion to lead	(iii) $Pb^{2+} + 2e^- \rightarrow Pb(s)$	(iv) Reduction

Answers 3.

(a) **(i)** Preparation of NH_3 gas using alkali can be done by reacting ammonium sulphate with sodium hydroxide.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4$$

(ii) Concentrated sulphuric acid is not used for drying ammonia gas because concentrated sulphuric acid (H_2SO_4) being acidic in nature reacts with basic ammonia gas to give ammonium sulphate [$(NH_4)_2SO_4$].

(iii) Ammonia gas is not collected over water because it has a high solubility in water and it dissolves in water to give a basic solution.

$$NH_3(g) + H_2O(l) \longrightarrow NH_4^+(aq) + OH^-(aq)$$

(b) **(i)** Conc. sulphuric acid is used for preparation of hydrogen chloride gas in laboratory. This is preferred over other acids because of the following reasons :

1. It has low volatility than HCl gas (so that the produced HCl gas is collected easily).

2. It has dehydrating properties, so the HCl gas produced can be effectively dehydrated to remove traces of water.

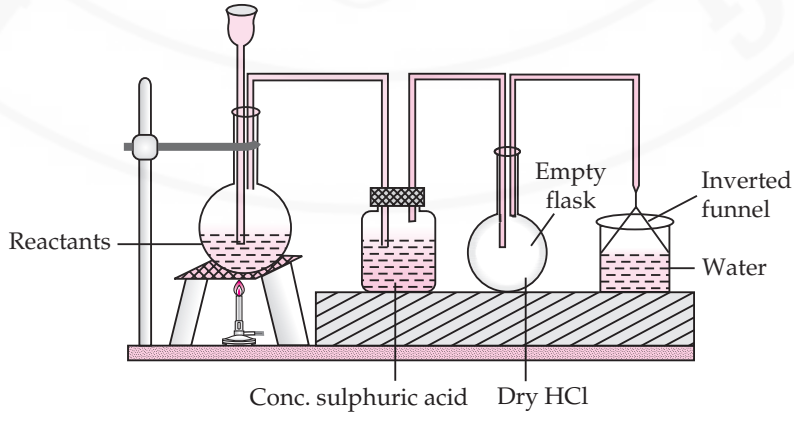
(ii) Laboratory preparation of hydrogen chloride gas can be done by heating NaCl with concentrated sulphuric acid :

$$NaCl + H_2SO_4 \xrightarrow{420\ K\ or\ 200^\circ C} \underset{\text{Sodium hydrosulphate}}{NaHSO_4} + HCl(\uparrow)$$

(conc.)

(c) **(i)** Hydrogen chloride gas is not directly absorbed in water because hydrogen chloride gas is higly soluble in water and causes back suction.

(ii) Hydrogen chloride gas is produced by reacting sodium chloride and sulphuric acid in a reaction vessel, the outlet from the vessel containing hydrogen chloride gas is put into another vessel containing sulphuric acid which helps to obtain dry hydrogen chloride gas. The dry gas then reaches to the vessel containing water through an empty vessel (this empty vessel is kept for accommodation of any back suction of water during absorption of hydrogen chloride gas in water). After travelling the empty vessel, hydrogen chloride gas is introduced to the vessel containing water through a pipe fitted with a funnel at the end and over the water vessel, this ensures maximum surface area for hydrochloric acid gas absorption in water.



(d) **(i)** For electro-refining of copper the cathode is made up of a strip of pure copper metal.

(ii) The reaction taking place at anode (made up of impure copper) is :

$$Cu - 2e^- \longrightarrow Cu^{2+}$$

Answers 4.

(a) Nitrogen : 82.35% and Hydrogen : 17.64%

Element	N	H
Percentage	82.35	17.64
Relative Ratio	82.35/14 = 5.88	17.64/1 = 17.64
Simple Ratio	$\frac{5.88}{5.88} = 1$	$\frac{17.64}{5.88} = 3$

So, the empirical formula of the gas would be NH_3.

(b) **(i)** $Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$

One mole of Al_4C_3 gives 4 moles of $Al(OH)_3$.

i.e., 144 g of Al_4C_3 gives 4×78 g of $Al(OH)_3$

So, 12 g of Al_4C_3 gives $\frac{312 \times 12}{144}$ g of $Al(OH)_3$

$= 26$ g of $Al(OH)_3$.

(ii) One mole of Al_4C_3 gives 3 moles of methane

12 g of Al_4C_3 gives $\frac{48 \times 12}{144}$ g of $CH_4 = 4$ g

Now, 16 g of methane has volume 22.4 L (at STP, the volume of one mole of any gas is 22.4 L)

4 g of methane would occupy 5.6 L.

So, 5.6 L of methane would be obtained from 12 g of Al_4C_3.

(c) **(i)** There will be X/2 molecules of gas B in 75 cc volume.

(ii) The above problem is based on Avogadro's law, which states that :

'Equal volumes of all gases under similar conditions of temperature and pressure contain the same number of molecules.'

(d) **(i)** Main components of brass are copper and zinc.

(ii) Main components of duralumin are aluminium (95%), copper (4%), manganese (0.5%) and magnesium (0.5%).

Answers 5.

(a)

General formula	IUPAC names of the homologous series	Characteristic bond type	IUPAC name of the first member of the series
C_nH_{2n-2}	(A) Alkyne	(B) Triple covalent bond —C ≡ C—	(C) Ethyne
C_nH_{2n+2}	(D) Alkane	(E) Single covalent bond —C—C—	(F) Methane

(b) **(i)** Most common ore of aluminium metal is bauxite, $Al_2O_3.2H_2O$.

(ii) The process by which impure ore of aluminium gets purified by using concentrated solution of an alkali is known as 'Baeyer's process'.

$$Al_2O_3.\ 2H_2O + 2NaOH \rightarrow 2NaAlO_2 + 3H_2O$$

(iii) During electrolysis of alumina, the cathode reaction is :

$$Al^{3+}\ (melt) + 3e^- \rightarrow Al\ (Pure\ Al)$$

Answers 6.

(a) **(i)** Compound X is acetic acid (CH_3COOH) as it has vinegar like smell. Compound Y is a ester *i.e.*, $CH_3COOC_2H_5$ ethyl ethanoate.

Z is a protic acid for example HCl (aq) or conc. H_2SO_4.

(ii) The structural formula of X is CH_3COOH acetic acid.

(iii) The above reaction is known as 'Esterification' reaction.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Acetic acid}}{CH_3COOH} \xrightarrow[\text{Esterification}]{H_3O^+} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5}$$

(b) The given equation is :

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

(i) So, according to above equation, 2 V (volumes) of ethane reacts to give 4 V of carbon dioxide. So, 300 cc of ethane would give 600 cc of carbon dioxide.

(ii) Also, 2 V (volumes) of ethane reacts with 7 V of oxygen.

300 cc of ethane is 2 V, so oxygen required for 300 cc of ethane is

$$\frac{300 \times 7}{2} = 1050 \text{ cc}$$

The remaining oxygen would be :

1250 cc – 1050 cc = 200 cc

(c) **(i)** Solution Q is a weak acid as its pH is 5.2

(ii) Solution R is a strong alkali as its pH is 12.2.

Answers 7.

(a) **(i)** Add aqueous hydrochloric acid solution to the solution of lead nitrate and solution of zinc nitrate prepared separately. The solution of lead nitrate would give a white precipitate of $PbCl_2$ whereas there would be no precipitate formed with zinc nitrate solution.

$$Pb^{2+} + 2\,Cl^- \rightarrow PbCl_2(\downarrow)$$

$$Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2(\downarrow) + 2HNO_3$$

$$Zn(NO_3)_2 + 2HCl \rightarrow ZnCl_2 + 2HNO_3$$

(ii) Add aqueous solution of silver nitrate ($AgNO_3$) to the solution of sodium chloride and solution of sodium nitrate prepared separately. The solution of sodium chloride would give a white precipitate of AgCl whereas there would be no precipitate only colourless solution is formed with sodium nitrate solution.

(b) **(i)** Preparation of copper sulphate from copper carbonate can be done by reacting copper carbonate with sulphuric acid.

$$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + CO_2\uparrow + H_2O$$

(ii) Zinc carbonate from zinc sulphate can be prepared by reacting zinc sulphate with sodium carbonate.

$$ZnSO_4 + Na_2CO_3 \rightarrow ZnCO_3 + Na_2SO_4$$

(c) **(i)** Sodium sulphate is formed if the reactants (sulphuric acid and sodium nitrate) for the preparation of nitric acid are heated above 200°C. The sodium sulphate formed deposits as a hard crust and is difficult to remove.

$$NaNO_3 + NaHSO_4 \xrightarrow{200^\circ C} Na_2SO_4 + HNO_3$$

(ii) All glass apparatus should be used while preparing nitric acid as the nitric acid vapours are highly corrosive and they corrode the cork or rubber fittings used in the apparatus.

(d) **(i)** Reaction of concentrated sulphuric acid with ethanol leads to formation of ethene, which shows that it is dehydrating in nature.

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[\text{Dehydration}]{H_2SO_4} \underset{\text{Ethene}}{C_2H_4} + H_2O$$

(ii) Reaction of concentrated sulphuric acid with carbon shows its oxidizing nature, where it oxidizes carbon to carbon dioxide.

$$C + 2H_2SO_4 \rightarrow CO_2 + 2H_2O + 2SO_2$$

CHEMISTRY

2017

QUESTIONS

SECTION-I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Fill in the blanks with the choices given in brackets.* [5]

(i) *The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion is called _____.*

(electron affinity, ionisation potential, electronegativity)

(ii) *The compound that does not have a lone pair of electrons is _____ .*

(water, ammonia, carbon tetra chloride).

(iii) *When a metallic oxide is dissolved in water, the solution formed has a high concentration of _____ ions.* *(H^+, H_3O^+, OH^-).*

(iv) *Potassium sulphite on reacting with hydrochloric acid releases _____ gas.*

(Cl_2, SO_2, H_2S).

(v) *The compound formed when ethene reacts with hydrogen is _____ .* *(CH_4, C_2H_6, C_3H_8).*

(b) *Choose the correct answer from the options given below :* [5]

(i) *A chloride which forms a precipitate that is soluble in excess of ammonium hydroxide, is :*

(A) Calcium chloride *(B) Ferrous chloride*
(C) Ferric chloride *(D) Copper chloride*

(ii) *If the molecular formula of an organic compound is $C_{10}H_{18}$ it is :*

(A) alkene *(B) alkane*
(C) alkyne *(D) not a hydrocarbon*

(iii) *Which of the following is a common characteristic of a covalent compound ?*

(A) high melting point
(B) consists of molecules
(C) always soluble in water
(D) conducts electricity when it is in the molten state

(iv) *To increase the pH value of neutral solution, we should add :*

(A) an acid *(B) an acid salt*
(C) an alkali *(D) a salt*

(v) *Anhydrous iron (III) chloride is prepared by :*

(A) direct combination
(B) simple displacement
(C) decomposition
(D) neutralization

(c) *Identify the substance underlined, in each of the following cases :* [5]

(i) *Cation that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide.*

(ii) *The electrolyte used for electroplating an article with silver.*

(iii) *The particles present in a liquid such as kerosene, that is a non-electrolyte.*

(iv) *An organic compound containing —COOH functional group.*

(v) *A solid formed by reaction of two gases, one of which is acidic and the other basic in nature.*

(d) *Write a balanced chemical equation for each of the following :* [5]

(i) *Action of cold and dilute nitric acid on copper.*

(ii) *Reaction of ammonia with heated copper oxide.*

(iii) *Preparation of methane from iodomethane.*

(iv) *Action of concentrated sulphuric acid on sulphur.*

(v) *Laboratory preparation of ammonia from ammonium chloride.*

(e) *State one relevant observation for each of the following reactions :* [5]

(i) *Addition of ethyl alcohol to acetic acid in the presence of concentrated sulphuric acid.*

(ii) *Action of dilute hydrochloric acid on iron (II) sulphide.*

(iii) *Action of sodium hydroxide solution on ferrous sulphate solution.*

(iv) *Burning of ammonia in air.*

(v) *Action of concentrated sulphuric acid on hydrate copper sulphate.*

(f) **(i)** *Draw the structural formula for each of the following :*

1. 2, 3-dimethyl butane

2. diethyl ether

3. propanoic acid

(ii) *From the list of terms given, choose the most appropriate term to match the given description.*

(calcination, roasting, pulverisation, smelting).

1. Crushing of the ore into a fine powder.

2. Heating of the ore in the absence of air to a high temperature. **[5]**

(g) **(i)** *Calculate the number of gram atoms in 4.6 grams of sodium (Na = 23).*

(ii) *Calculate the percentage of water of crystalization in $CuSO_4.5H_2O$*

(H = 1, O = 16, S = 32, Cu = 64)

(iii) *A compound of X and Y has the empirical formula XY_2. Its vapour density is equal to its empirical formula weight. Determine its molecular formula.* **[5]**

(h) *Match the atomic number 2, 4, 8, 15 and 19 with each of the following :*

(i) *A solid non-metal belonging to the third period.*

(ii) *A metal of valency 1.*

(iii) *A gaseous element with valency 2.*

(iv) *An element belonging to Group 2.*

(v) *A rare gas.* **[5]**

SECTION-II (40 Marks)

*Attempt any **four** questions from this Section.*

Question 2.

(a) *Arrange the following as per the instruction given in the brackets :* **[4]**

(i) *He, Ar, Ne (Increasing order of the number of electron shells)*

(ii) *Na, Li, K (Increasing Ionisation Energy)*

(iii) *F, Cl, Br (Increasing electronegativity)*

(iv) *Na, K, Li (Increasing atomic size)*

(b) *State the type of Bonding in the following molecules :* **[2]**

(i) *Water* **(ii)** *Calcium oxide*

(c) *Answer the following questions :* **[2]**

(i) *How will you distinguish between ammonium hydroxide and sodium hydroxide using copper sulphate solution ?*

(ii) *How will you distinguish between dilute hydrochloric acid and dilute sulphuric acid using lead nitrate solution ?*

(d) *Identify the salts P and Q from the observations given below :* **[2]**

(i) *On performing the flame test salt P produces a lilac coloured flame and its solution gives a white precipitate with silver nitrate solution, which is soluble in Ammonium hydroxide solution.*

(ii) *When dilute HCl is added to salt Q, a brisk effervescence is produced and the gas turns lime water milky.*

When NH_4OH solution is added to the above mixture (after adding dilute HCl), it produces a white precipitate which is soluble in excess NH_4OH solution.

Question 3.

(a) *Draw an electron dot diagram to show the formation of each of the following compounds :* **[4]**

(i) *Methane*

(ii) *Magnesium Chloride*

[H = 1, C = 6, Mg = 12, Cl = 17]

(b) *State the observations at the anode and at the cathode during the electrolysis of :* **[4]**

(i) *fused lead bromide using graphite electrodes.*

(ii) *copper sulphate solution using copper electrodes.*

(c) *Select the ion in each case, that would get selectively discharged from the aqueous mixture of the ions listed below :* **[2]**

(i) *SO_4^{2-}, NO_3^- and OH^-*

(ii) *Pb^{2+}, Ag^+ and Cu^{2+}*

Question 4.

(a) *Certain blank spaces are left in the following table and these are labelled as A, B, C, D and E. Identify each of them :* **[5]**

	Lab preparation of	*Reactants used*	*Products formed*	*Drying agent*	*Method of collection*
(i)	*HCl gas*	*$NaCl + H_2SO_4$*	*A*	*conc. H_2SO_4*	*B*
(ii)	*NH_3 gas*	*C*	*$Mg(OH)_2 + NH_3$*	*D*	*E*

(b) *Write balanced chemical equations to show :* **[3]**

(i) *The oxidizing action of conc. Sulphuric acid on Carbon.*

(ii) *The behavior of H_2SO_4 as an acid when it reacts with magnesium.*

(iii) *The dehydrating property of conc. Sulphuric acid with sugar.*

(c) *Write balanced chemical equations to show how SO_3 is converted to sulphuric acid in the contact process.* **[2]**

Question 5.

(a) **(i)** *Propane burns in air according to the following equation :*

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O.$$ **[4]**

What volume of propane is consumed on using 1000 cm^3 of air, considering only 20% of air contains oxygen ?

(ii) *The mass of 11.2 litre of a certain gas at S.T.P. is 24 g. Find the gram molecular mass of the gas.*

(b) *A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :* **[4]**

(i) *Find the number of moles of hydrogen present.*

(ii) *What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure ? (H = 1, C = 12, O = 16)*

(iii) *If the number of molecules of hydrogen in the cylinder is X, calculate the number of CO_2 molecules in the cylinder under the same conditions of temperature and pressure.*

(iv) *State the law that helped you to arrive at the above result.*

(c) *Write a balanced chemical equation for the preparation of each of the following salts :* **[2]**

(i) *Copper carbonate*

(ii) *Ammonium sulphate crystals*

Question 6.

(a) *Give a balanced chemical equation for each of the following :* **[4]**

(i) *Action of conc. nitric acid on sulphur.*

(ii) *Catalytic oxidation of ammonia.*

(iii) *Laboratory preparation of nitric acid.*

(iv) *Reaction of ammonia with nitric acid.*

(b) *Identify the term or substance based on the descriptions given below :* **[4]**

(i) *Ice like crystals formed on cooling an organic acid sufficiently.*

(ii) *Hydrocarbon containing a triple bond used for welding purposes.*

(iii) *The property by virtue of which the compound has the same molecular formula but different structural formulae.*

(iv) *The compound formed where two alkyl groups are linked by* $-\overset{\overset{O}{\|}}{C}-$ *group.*

(c) *Give a balanced chemical equation for each of the following :* **[3]**

(i) *Preparation of ethane from sodium propionate.*

(ii) *Action of alcoholic KOH on bromoethane.*

Question 7.

(a) *Name the following :* **[4]**

(i) *The process of coating of iron with zinc.*

(ii) *An alloy of lead and tin that is used in electrical circuits.*

(iii) *An ore of zinc containing its sulphide.*

(iv) *A metal oxide that can be reduced by hydrogen.*

(b) *Answer the following questions with respect to the electrolytic process in the extraction of aluminium :* **[3]**

(i) *Identify the components of the electrolyte other than pure alumina and the role played by each.*

(ii) *Explain why powdered coke is sprinkled over the electrolytic mixture.*

(c) *Complete the following by selecting the correct option from the choices given :* **[3]**

(i) *The metal which does not react with water or dilute H_2SO_4 but reacts with concentrated H_2SO_4 is————. (Al/Cu/Zn/Fe)*

(ii) *The metal whose oxide, which is amphoteric, is reduced to metal by carbon reduction————. (Fe/Mg/Pb/Al)*

(iii) *The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is————. (Al/Na/Mg/K)*

ANSWERS

SECTION-I

Answer 1.

(a) **(i)** The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion is called **ionisation potential**.

(ii) The compound that does not have a lone pair of electron is **carbon tetrachloride.**

(iii) When a metallic oxide is dissolved in water, the solution formed has a high concentration of **OH^-** ions.

(iv) Potassium sulphite on reacting with hydrochloric acid releases **SO_2** gas.

(v) The compound formed when ethene reacts with hydrogen is **C_2H_6**.

(b) **(i)** (D) Copper chloride

(ii) (C) Alkyne

(iii) (B) Consists of molecules

(iv) (C) An alkali

(v) (A) Direct combination

(c) **(i)** **Cation** that does not form a precipitate with ammonium hydroxide but forms one with sodium hydroxide — **Ca^{2+}**

(ii) The **electrolyte** used for electroplating an article with silver — **Solution of sodium argentocyanide** *i.e.*, **Na[Ag(CN)$_2$]**

(iii) The **particles** present in a liquid such as kerosene, that is a non-electrolyte — **Free Molecules**

(iv) An **organic compound** containing — COOH functional group — **Carboxylic acid**

(v) A **solid** formed by reaction of two gases, one of which is acidic and the other basic in nature — **Ammonium chloride** (NH_4Cl) (formed by combining vapours of ammonia with hydrogen chloride gas)

(d) **(i)** Copper reacts with cold and dilute nitric acid to form copper nitrate, water and nitric oxide.

$$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO\uparrow$$

Copper — Nitric acid — Copper nitrate — Nitric oxide

(ii) $3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$

Copper oxide — Ammonia

(iii) $CH_3I + 2H \xrightarrow[\text{Alcohol}]{Zn/Cu} CH_4 + HI$

Methane

(iv) $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

(v) $2NH_4Cl + Ca(OH)_2 \xrightarrow{Heat} CaCl_2 + 2NH_3 + 2H_2O$

(e) **(i)** Ethanoic or acetic acid reacts with ethanol in the presence of concentrated sulphuric acid to produce the ester, ethyl ethanoate having a fruity smell and turns blue litmus paper red.

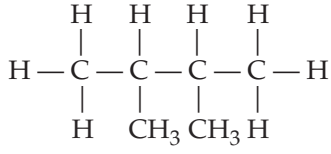
(ii) Iron sulphide reacts with hydrochloric acid, releasing a highly toxic gas hydrogen sulphide having rotten egg smell and turns blue litmus paper red.

(iii) A dirty green precipitate of ferrous hydroxide is formed which is insoluble in excess of NaOH solution.

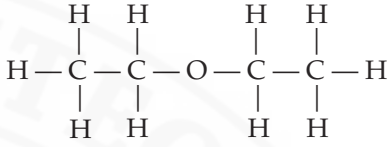
(iv) Ammonia burns in air to form greenish-yellow vapours of nitric oxide.

(v) The blue crystals are changed into white powder as water is removed. Concentrated sulphuric acid takes away the water molecules and the copper sulphate becomes anhydrous.

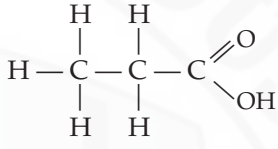
(f) **(i)** **1.** 2, 3-dimethyl butane



2. Diethyl ether



3. Propanoic acid



(ii) **1.** Pulverisation

2. Calcination

(g) **(i)** 1 g atom is the mass of 1 mole of monoatomic element.

1 mole of Na is equal to 23 g atom of Na.

23 g of Na = 1 mole of Na

4.6 g of Na = $4.6 \times 1/23 = 0.2$ mole

So, number of gram atoms

$= 0.2 \times 6.022 \times 10^{23}$ atoms

$= 1.204 \times 10^{23}$ atoms

(ii) Molar mass of $CuSO_4.5H_2O$

$= [64 + 32 + (16 \times 4) + 5(2 \times 1 + 16)]$

$= 250$

Mass of water of crystallisation

$= 5(2 \times 1 + 16) = 90$

$\therefore$ Percentage of water of crystallisation

$$= \frac{90}{250} \times 100 = 36\%$$

(iii) Molecular weight = 2 × Vapour density

= 2 × Empirical formula weight

(Given, Vapour density

= empirical formula weight)

Also,

Molecular Weight = Empirical formula weight × n

Therefore, 2 × Empirical formula weight

= Empirical formula weight × n

$n = 2$

Now, Molecular Formula

= (Empirical Formula) × n

$= (XY_2)_2$

$= X_2Y_4$

(h) **(i)** Z = 15 **(ii)** Z = 19
(iii) Z = 8 **(iv)** Z = 4
(v) Z = 2

SECTION-II

Answer 2.

(a) **(i)** He < Ne < Ar **(ii)** K < Na < Li
(iii) Br < Cl < F **(iv)** Li < Na < K

(b) **(i)** Covalent bonding
(ii) Ionic or electrovalent bonding

(c) **(i)** When ammonium hydroxide solution is added drop by drop to copper sulphate solution, a pale blue or bluish white precipitate is formed which is soluble in excess of ammonium hydroxide and a deep blue or inky blue solution is formed with excess of ammonium hydroxide.

$$CuSO_4 + 2NH_4OH \rightarrow Cu(OH)_2 \downarrow + (NH_4)_2SO_4$$

$$Cu(OH)_2 + 4NH_4OH \rightarrow [Cu(NH_3)_4](OH)_2 + 4H_2O$$

Copper solution forms a blue precipitate with sodium hydroxide solution. It is insoluble in excess of NaOH.

$$\underset{\text{Copper sulphate}}{CuSO_4} + \underset{\text{Sodium hydroxide}}{2NaOH} \rightarrow \underset{\text{Copper hydroxide}}{Cu(OH)_2} + \underset{\text{Sodium sulphate}}{Na_2SO_4}$$

(ii) On adding lead nitrate to both acids, we will get a white precipitate. On heating the solution, the one whose precipitate will redissolve will be dil. HCl and the one with insoluble precipitate will be dil. H_2SO_4.

Actually on adding lead nitrate to HCl, $PbCl_2$ precipitates out and on heating the solution it redissolves. But in case of H_2SO_4, $PbSO_4$ is formed which is insoluble even on heating it and white in colour.

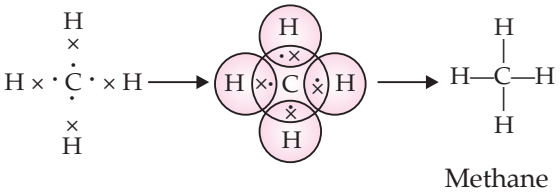
$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{2HCl} \longrightarrow PbCl_2 + 2HNO_3$$

$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{H_2SO_4} \longrightarrow PbSO_4 + 2HNO_3$$

(d) **(i)** Potassium chloride **(ii)** Zinc carbonate

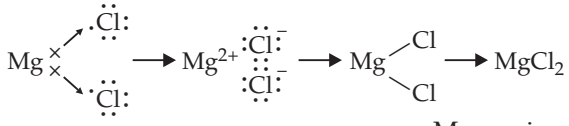
Answer 3.

(a) **(i)**



Methane

(ii) Magnesium chloride



Magnesium chloride

(b) **(i)** At anode, the Br^- ion gives up electrons. Red brown bromine gas bubbles can be seen. At cathode, the Pb^{2+} ion accepts electrons. The electrolysis of lead bromide using graphite electrodes produces lead metal at the cathode as silvery grey deposits and bromine gas at the anode.

At the cathode : $Pb^{2+} + 2e^- \rightarrow Pb$

At the anode : $2Br^- - 2e^- \rightarrow 2Br$

$2Br \rightarrow Br_2\uparrow$

(ii) At the cathode, Cu^{2+} ions are discharged and deposited on the cathode. At the anode, however, copper ions go into solution in preference to the discharge of either OH^- or SO_4^{2-} ions. As the electrolysis continues, the cathode increases in thickness by reddish brown deposit of copper while the anode slowly dissolves away.

At the cathode : $Cu^{2+} + 2e^- \rightarrow Cu$

At the anode : $Cu - 2e^- \rightarrow Cu^{2+}$

(c) **(i)** OH^- ions **(ii)** Ag^+ ions

Answer 4.

(a) **(i)** **(A)** $NaHSO_4 + HCl$
(B) Upward displacement of air
(ii) **(C)** $Mg_3N_2 + H_2O$
(D) CaO
(E) Downward displacement of air.

(b) **(i)** $C + 2H_2SO_4 \longrightarrow CO_2\uparrow + 2SO_2\uparrow + 2H_2O$

(ii) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2\uparrow$

(iii) $C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O$
(Cane sugar)

(c) **1.** Conversion of sulphur trioxide into sulphuric acid :

$$\underset{\text{Sulphur trioxide}}{SO_3} + \underset{\text{(conc.)}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

2. Dilution of oleum :

$$\underset{\text{Oleum}}{H_2S_2O_7} + H_2O \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$