DPP – 1 Machines

1. (a) What is a simple machine?

(b) State three functions of a machine. OR

What is the purpose of a machine?

2. (a) Name six simple machines.

(b) Give one practical example of each machine named in (a).

3. What do you understand by the term ideal machine?

4. Explain the term mechanical advantage and state its unit.

5. Define the term velocity ratio and state its unit.

6. Define the term ideal mechanical advantage and state its unit?

7. Define the term efficiency of a machine and state its unit?

8. Prove that efficiency of a machine is the ratio between actual mechanical advantage and velocity ratio.

OR

State the relationship between mechanical advantage velocity ratio and efficiency.

9. Give two reasons, why a machine cannot be 100% efficient.

10. What is a lever?

11. What is the principle of lever?

12. Name and define three classes of levers and give two examples for each kind.

13. How will you determine the order (kind) of a lever?

14. (a) Why the lever of the second order has mechanical advantage more than one?

(b) Why the lever of the third order has mechanical advantage less than one? Give one example of this class of lever.

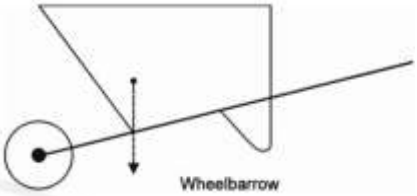
15. To which order do the following levers belong and why?

(i) Railway signal, (ii) a man cutting bread with knife, (iii) a boy writing on a piece of paper, (iv) nut-cracker, (v) handle of water pump, (vi) see-saw, (vii) forceps, (viii) a man rowing a boat, (ix) lock and key, (x) opening of a soda water bottle, (xi) closing a door, (xii) motor car foot brake, (xiii) nail cutter, (xiv) a fishing rod, (xv) a lemon squeezer.

16. Explain why the cutting edges of scissors are made longer as compared to the cutting edges of a metal cutter.

DPP – 2 Machines

1. (a) The diagram shows a wheelbarrow. In the diagram mark fulcrum. Also draw arrows to show the direction of load and effort.

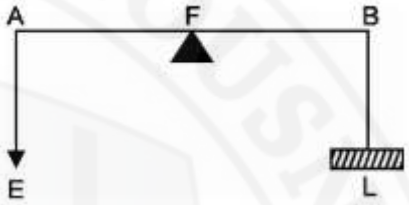


(b) What class of lever is wheelbarrow?

(c) Give one more example of same class of lever.

2. By stating clearly, the position of load (L); effort (E) and fulcrum (F), state the class of levers to which the following belong: (i) Pliers, (ii) Sugar tongs, (iii) Scissors, (iv) Nut-cracker.

3. Diagram shows a weightless lever in equilibrium. Neglect friction at the fulcrum F.



(i) State the principle of moments as applied to above lever.

(ii) Define mechanical advantage and calculate its value for given lever.

(iii)Name the type of lever, which has mechanical advantage greater than one.

4. A pair of scissors and a pair of pliers both belong to the same class of levers. Name the class of lever. Which one has mechanical advantage less than one?

5. (a) Define pulley. By drawing diagram calculate: (1) M.A. , (2) V.R. of single fixed pulley.

(b) Why is single fixed pulley commonly used, in spite of the fact that its mechanical advantage is less than one?

6. (i)A pulley system has a velocity ratio 3. Draw a labelled diagram of the pulley system.

(ii) What is the mechanical advantage of above system?

7. In a single fixed pulley, if the effort moves by the distance x downward by what height is load raised upward.

8. What is a single movable pulley system? What is mechanical advantage in ideal condition?

9. In which direction the force need to be applied, when a single pulley is used with a mechanical advantage greater than 1? Draw the diagram for the arrangement.

10. Show how a single pulley can be used to reduce effort required to overcome a given load. Draw the diagram of the system. Why is it generally more convenient to use two pulleys for this?

11. Give reasons for the following: (i) In a single fixed pulley, the velocity ratio is always more than the mechanical advantage. (ii) The efficiency of a pulley is always less than 100%. (iii) In case of block and tackle arrangement, the mechanical advantage increases with the increase in number of pulleys.

DPP – 3 Machines

1. In operating a water pump, a resistance of 480 N is overcome by an effort of 72N. If the distance of fulcrum from the point where resistance acts is 0.2 m, find the distance of fulcrum from where the effort acts.

2. A uniform plank of sea-saw is 5 m long and supported at its centre. A boy weighing 40 kg, sits at a distance of 1.5 m from one end of see-saw. Where must a girl weighing 25 kg sit on the other end of see-saw, so as to balance the weight of boy.

3. A crow bar of length 120 cm has its fulcrum situated at a distance of 20 cm from load. Calculate mechanical advantage of crow bar.

4. A handle of a nut cracker is 16 cm long and a nut is placed 2 cm from its hinge. If a force of 4 kgf is applied at the end of handle to crack it, what weight, if simply placed on the nut, will crack it?

5. An effort of 50 kgf is applied at the end of lever of second order, which supports a load of 750 kgf, such that load is at a distance of 0.1 m from hinge. Find the length of lever.

6. A machine displaces a load of 125 kgf through a distance of 0.30 m, when an effort of 12.5 kgf acts through a distance of 4.0 m. Calculate:

(i) velocity ratio,

(ii) mechanical advantage,

(iii) % age efficiency of machine.

7. Calculate:

(i) velocity ratio,

(ii) mechanical advantage,

(iii) % age efficiency of a machine, which overcomes a resistance of 800 N through a distance of 0.12 m, when an effort of 160 N acts through a distance of 0.72 m.

8. An effort of 500 N is applied through a distance of 0.50 m on a machine, whose efficiency is 90%, such that resistance is overcome through a distance of 0.04 m. Calculate:

(i) V.R,

(ii) M.A,

(iii) resistance overcome by machine.

9. A crow bar of length 2.0 m is used as a machine, to lift a box of 100 kgf by placing a fulcrum at a distance of 0.1 m from the box. Calculate:

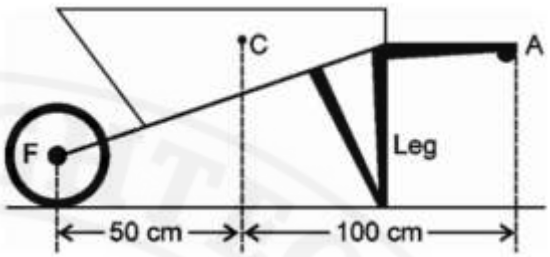
(i) velocity ratio,

(ii) mechanical advantage,

(iii) effort required. What assumption has been made, in solving this problem?

10. A person is carrying a load of 25 kgf, suspended from a wooden staff, such that load projects 8 cm from shoulder. Where must the person apply an effort of 7.5 kgf, so as to balance the staff?

11. Figure shows a wheelbarrow with C as centre of gravity, such that its leg is in contact with ground.



(i) What is the direction of force acting at C? Name the force.

(ii) What is the direction of minimum force acting at A to keep the leg off the ground? What is the force called?

(iii) The weight of wheel borrow is 15 kgf and it holds 60 kgf of sand. Calculate the minimum force to keep the leg off the ground?

12. A 4 m long rod of negligible weight is to be balanced about a point 125 cm from one end. A load of 18 kgf is suspended at a point 60 cm from the support on the shorter arm.

(i) A weight W is placed 250 cm from the support on the longer arm. Find W.

(ii) If W = 5 kgf, where it must be kept to balance the rod?

(iii) To which class of lever does it belong?

13. A pair of scissors has its blades 15 cm long, while its handles 7.5 cm long. What is its mechanical advantage?

14. A force of 5 kgf is required to cut a metal sheet. A shears used for cutting the metal sheet has its blade 5 cm long, while the handle is 10 cm long. What effort is needed to cut the sheet?

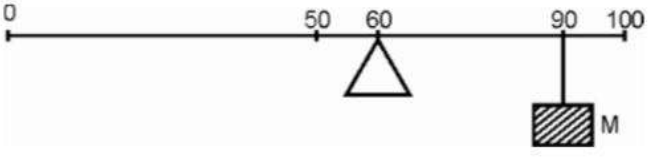
15. Diagram shows a lever in use.

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

(ii) If AB = 1 m, AF = 0.4 m, find its mechanical advantage.

(iii) Calculate the value of E.

16. Figure below shows a uniform metre scale kept in equilibrium, when supported at 60 cm mark and mass M is suspended from the 90 cm mark. State with reason, whether the weight of scale is greater, less than or equal to the mass M.



DPP – 4 Machines

1. A pulley system has velocity ratio 3 and an efficiency of 80%. Calculate:

(i) Mechanical advantage of system

(ii) Value of effort required to raise a load of 300 N.

2. A pulley system has five pulleys in all and is 90% efficient. Calculate:

(i) mechanical advantage,

(ii) effort required to lift a load of 1000 N,

(iii) resistance due to movable parts of machine and friction.

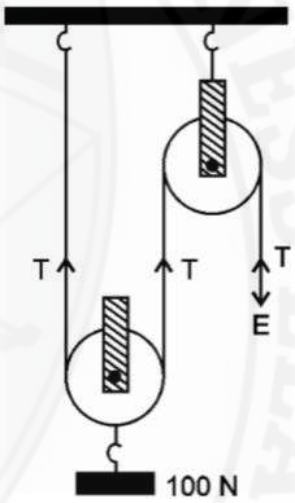
3. A pulley system has four pulleys in all and is 80% efficient. Calculate:

(i) mechanical advantage,

(ii) load lifted by an effort of 1400 N,

(iii) resistance of movable parts of machine.

4. Diagram shows a pulley arrangement.



(i) Copy the diagram, and mark direction of force due to tension acting on the movable pulley.

(ii) What is the purpose of fixed pulley?

(iii) If tension is T newtons, deduce the relation between T and E.

(iv) Calculate the velocity ratio of the arrangement.

(v) Assuming the efficiency to be 100%, what is the mechanical advantage?

(vi) Calculate effort E.

(vii) State two factors that will reduce efficiency of arrangement.

5. A pulley system can lift a load of 1200 N by an effort of 250 N. If the resistance due to weight of movable parts and friction is 300 N, calculate:

(i) Mechanical advantage,

(ii) Velocity ratio,

(iii) Total number of pulleys in system,

(iv) Efficiency of system.

6. An effort of 240 N overcomes a useful load of 1000 N, when applied on the block and tackle system of pulleys, such that weight of movable blocks and friction etc. is 200 N. Calculate:

(i) mechanical advantage,

(ii) velocity ratio,

(iii) total number of pulleys in system,

(iv) efficiency of system.

7. A woman draws water from a well using fixed pulley. The mass of bucket and water together is 6 kg. The force applied by the woman is 70 N. Calculate mechanical advantage.[Take g = 10 ms^{-2}]

8. A fixed pulley is driven by 100 kg mass falling at a rate of 8.0 m in 4 s. It lifts a load of 500 kgf. Calculate the power input to the pulley taking force of gravity on 1 kg = 10 N. If the efficiency of pulley is 75%, find the height to which load is raised in 4.0 s.

9. In a block and tackle system consisting of 3 pulleys, a load of 75 kgf is raised by an effort of 25 kgf. Find the mechanical advantage, velocity ratio and efficiency.

10. A block and tackle system has 5 pulleys. If an effort of 1000 N is needed to raise a load of 4500 N. Calculate:

(i) mechanical advantage,

(ii) velocity ratio and

(iii) efficiency of the system.

11. A block and tackle system has velocity ratio 3. A man can exert a pull of 200 kgf. What is the maximum load he can raise with this pulley system, if its efficiency is 60%?