CHAPTER SIX

WORK, ENERGY AND MACHINES:

Introduction:

- Work is done when an applied force moves through a distance, in the direction of the force.

- In science work is only done if there is movement of the applied force.

- For this reason, a man pulling a track does work, but a man who carries a load and stands at a place does no work.

- Work **=** Force **x** distance **or** work **=** mgh,

Where m **=** mass of the object.

g **=** acceleration due to gravity.

h **=** height of the object above the ground.

(Q1) Find the work done when a force of 20N, pulls a block through a distance of 5m.

Soln:

Force **=**20N.

Distance **=** 5m.

Work done **=** Force **x** distance.

Work done **=** 20 **x** 5 = 100J.

(Q2) Calculate the work done when a force of 2.5N moves through a distance of 4m.

.

.

Soln:

Force **=** 2.5N.

Distance **=** 4m.

Work done **=** Force **x** distance **=** 2.5 **x** 4 = 10J.

NB: If the weight or mass is given in kg, it must be changed into force by multiplying by **'g'** or the acceleration due to gravity **i.e** 10m/s^2.

(Q3) Calculate the work done when a body of mass 5kg moves through a distance of 10m.

Soln:

Mass **=** 5kg.

Force **=** 5 **x** 10 **=** 50N.

Distance **=** 10m.

Work **=** Force **x** distance

= 50 **x** 10 **=** 500J.

(Q4) Calculate the work done when a body of weight 0.5kg, moves through a distance of 20m.

Soln:

Weight **=** 0.5kg.

Force **=** 0.5 **x** 10 **=** 5N.

Distance **=** 20m.

Work done **=** Force **x** distance **=** 5 **x** 20 **=** 100J.

NB: If weight is given in grams, it must first be converted to kg by dividing by **1000.**

(Q5) A body of mass 400g moves through a distance of 20m. Find the work done

Mass = 400g = 400/1000 = 0.4kg.

Force = 0.4 **x** 10 = 4N.

Work done = Force **x** distance

= 4 **x** 20 = 80J.

(Q6) A table of mass 6000g is moved through a distance of 4m. Calculate the work done.

Soln:

Mass = 6000g = 6000/1000 = 6kg.

Since force = mass **x** 'g,'

then force = 6 **x** 10 = 60N.

Distance = 4m.

Work done = Force **x** distance

= 60 **x** 4 = 240J.

NB: If the distance is given in **cm**, we must change it into metres by dividing by **100.**

(Q7) A block of mass 5kg moves through a distance of 300cm. Calculate the work done.

Soln:

Mass = 5kg.

Force = 5 **x** 10 = 50N.

Distance = 300cm = 300/100 = 3m.

Work done = force **x** distance

= 50 **x** 3 = 150J.

(Q8) The distance moved by a force of 50N is 800cm. Find the work done.

Soln:

Distance = 800cm = 800/100 = 8m.

Force = 50N.

Work done = Force **x** distance

= 50 **x** 8 = 400J.

(Q9) A body of mass 600g moved through a distance of 200cm. Find the work done.

Soln:

Mass = 600g = 600/1000= 0.6kg.

Force = 0.6 **x** 10 = 6N.

Distance = 200cm = 200/100 = 2m.

Work done = Force **x** distance = 6 **x** 2 = 12J.

(Q10) Find the distance travelled by a force of 50N, if it does a work of 200J.

Soln:

Force = 50N.

Work done = 200J.

Distance = ?

Since work done = force **x** distance,

then200 = 50 **x** distance, and dividing through using 50 =>

200/50 = 50 **x** distance/50 =>

distance = 4m.

(Q11) Find the distance moved by a force of 10N, if it did work of 50J.

Force = 10N.

Work done = 50J.

Distance =?

Since work done = force **x** distance, then

50 = 10 **x** distance, and dividing through using 10 =>

50/10 = 10 **x** distance/10,

=>5 = distance, =>

distance = 5m.

(Q12) Find the distance travelled by a body of weight 5kg, if the work done = 200J.

Soln

Weight = 5kg.

Force = 5 **x** 10 = 50N.

Work done = 200J.

Distance =?

Since work = force **x** distance,

then 200 = 50**x** distance.

200/50 = 50 **x** distance/50.

Distance = 4m.

(Q13) Calculate the distance moved by a body of mass 7000g, if the work done is 3500J.

Soln:

Mass **=** 7000g **=** 7000/1000 **=** 7kg.

Force **=** 7 **x** 10 **=** 70N.

Since work done **=** force **x** distance,

then 3500 **=** 70 **x** distance,

=>3500/70 **=** 70 **x** distance/70,

=> distance **=** 50m.

NB: When force is divided by acceleration due to gravity **i.e.** 'g' or 10m/s^2, we get weight.

(Q14) A body moved a distance of 10m and did a work of value 4000J. Calculate

(a) the force.
(b) the weight.

Soln

(a) Distance **=** 10m.

Work done **=** 4000J.

Since work done **=** force **x** distance, then

4000 **=** force **x** 10, =>

4000/10 **=** force **x** 10/10,

=> force **=** 400N.

(b) Weight **=** force/'g' **=** 400/10 **=** 40,

=> weight **=** 40kg.

(Q15) Calculate the work done by man of mass 70kg, if he climbs a tree 5m high.

[Take g = 10m/s^2]

Soln

Mass = 70kg.

Force = 70 **x** 10 = 700N.

Distance = 5m.

Since work done = force **x** distance,

then work done = 700 **x** 5 = 3500J.

(Q16) A man of weight 500g climbs a mountain, which is 20m high. Calculate the work done.

Soln:

Weight = 500g = 500/1000 = 0.5kg.

Force = 0.5 **x** 10 = 5N.

Distance = 20m.

Work done = force **x** distance

= 5 **x** 20 = 100J.

(Q17) A man of 500g is moved up a pole which is 700cm long. Find the work done

Soln:

Weight = 500g = 500/1000 = 0.5kg.

Force = 0.5 **x** 10 = 5N.

Distance = 700cm = 700/100 = 7m.

Work done = force **x** distance = 5 **x** 7 = 35J.

(Q18) A simple machine is used to lift a load through a height of 5.0m. If the force exerted by the machine is 200N, calculate the work done by the machine.

Soln:

Distance **=** 5.0m **=** 5m.

Force **=** 200N.

Work done **=** Force **x** Distance

= 200 **x** 5 **=** 1000J.

(Q19) Calculate the work done by a man of mass 65kg, if he climbs a ladder which is 4m high.

Soln:

Force **=** 65 **x** 10 **=** 650N.

Distance moved **=** 4m.

Work done **=** 650 **x** 4 **=** 2600J.

NB: If the weight or the mass is given in Newtons, then it is force.

We must therefore not multiply it by 'g' or acceleration due to gravity.