Question 1

A force of 30 N acts on a body and moves it through a distance of 5 m in the direction of force. Calculate the work done by the force.

Answer

Given:
Force (F) = 30 N
Distance (d) = 5 m
Work done (W) = ?

Work done = Force x distance = 30 N x 5 m = 150 J

So, the work done by the force = 150 J.

Question 2

A man lifts a mass of 20 kg to a height of 2.5 m. Assuming that the force of gravity on 1 kg mass is 10 N, find the work done by the man.

Answer

Given:
Mass (m) = 20 kg
Distance (d) = Height = 2.5 m
Force of gravity on mass of 1 kg = 10 N
Work done (W) = ?

Force (F) = mg = 20 x 10 = 200 N

Work done = Force x distance = 200 x 2.5 = 500 J

So, the work done by the man = 500 J.

Question 3

A body when acted upon by a force of 10 kgf moves to a distance 0.5 m in the direction of force. Find the work done by the force. Take 1 kgf = 10 N.

Answer

Given:
1 kgf = 10 N
10 kgf = 10 x 10 = 100 N
So, Force (F) = 100 N
Distance (d) = 0.5 m
Work done (W) = ?

Work done = Force x distance = 100 x 0.5 = 50 J

So, the work done by the force = 50 J.

Question 4

Two bodies of same masses are placed at height h and 2h. Compare their gravitational potential energy.

Answer

Given:
Mass of first body = Mass of second body = m
Height of first body = h
Height of second body = 2h
g is same for both the bodies.

We know Gravitational potential energy = mgh

Gravitation potential energy of first body (U_1) = mgh

Gravitation potential energy of second body (U_2)= mg2h

On comparing both gravitational potential energy:

$$\frac{U_1}{U_2} = \frac{mgh}{mg2h} = \frac{1}{2}$$

So, gravitational potential energy of first body : gravitational potential energy of second body = 1:2.

Question 5

Find the gravitational potential energy of 2.5 kg mass kept at a height of 15 m above the ground. The force of gravity on mass 1 kg is 10 N.

Answer

Given:
Mass (m) = 2.5 kg
Height (h) = 15 m
Force of gravity on mass 1 kg = 10 N

Gravitational potential energy (U) = mgh = 2.5 x 10 x 15 = 375 J

So, gravitational potential energy = 375 J.

Question 6

The gravitational potential energy stored in a box of weight 150 kgf is 1.5×10^4 J. Find the height of the box. Take 1 kgf = 10 N.

Answer

Given:

Gravitational potential energy (U) = 1.5×10^4 J = 15000 J
Weight = 150 kgf = 150 x 10 = 1500 N
height h = ?

U = mgh

15000 = 1500 x h

$$h = \frac{15000}{1500}$$

h = 10 m

So height of the box = 10 m.

Question 7

The potential energy of a body of mass 0.5 kg increases by 100 J when it is taken to the top of a tower from the ground. If the force of gravity on 1 kg = 10 N, what is the height of the tower?

Answer

Given:
Potential energy (U) = 100 J
Mass (m) = 0.5 kg
Force of gravity on 1 kg mass = 10 N
height (h) = ?

U = mgh

100 = 0.5 x 10 x h

$h = \frac{100}{5}$

h = 20 m

So height of the tower = 20 m.

Question 8

A body of mass 60 kg is moving with a speed 50 m s^{-1}. Find its kinetic energy.

Answer

Given:
Mass (m) = 60 kg
Speed (v) = 50 m s^{-1}
Kinetic energy = ?

Kinetic energy = $\frac{1}{2}$ x mv^2

= $\frac{1}{2}$ x 60 x $(50)^2$

= 30 x 2500

= 75000 J or 7.5 x 10^4 J

So kinetic energy = 7.5 x 10^4 J.

Question 9

A truck of mass 1000 kg increases its speed from 36 km h^{-1} to 72 km h^{-1}. Find the increase in its kinetic energy.

Answer

Given:

Mass (m) = 1000 kg

1 km h^{-1} = $\frac{5}{18}$ m s^{-1}

36 km h^{-1} = $\frac{5}{18}$ x 36 = 10 m s^{-1}

So, initial speed (v_1) = 10 m s^{-1}

1 km h^{-1} = $\frac{5}{18}$ m s^{-1}

72 km h^{-1} = $\frac{5}{18}$ x 72 = 20 m s^{-1}

So, final speed (v_2) = 72 km h^{-1} = 20 m s^{-1}

Increase in its kinetic energy = ?

Increase in kinetic energy = $\frac{1}{2}$ m[$(v_2)^2$ - $(v_1)^2$]

= $\frac{1}{2}$ x 1000 x [$(20)^2$ - $(10)^2$]

= 500 x [400 - 100]

= 500 x 300

= 150000 J or 1.5 x 10^5 J

So increase in kinetic energy = 1.5 x 10^5 J.

Question 10

A car is moving with a speed of 15 km h^{-1} and another identical car is moving with a speed of 30 km h^{-1}. Compare their kinetic energy.

Answer

Speed of first car = 15 km h^{-1}

Speed of second car = 30 km h^{-1}

Mass of both cars = m

Kinetic energy of first car (K_1) = $\frac{1}{2}$ x mv^2

= $\frac{1}{2}$ x m x $(15)^2$

= $\frac{225}{2}$ x m

= 112.5 m J

Kinetic energy of second car (K_2) = $\frac{1}{2}$ x mv^2

= $\frac{1}{2}$ x m x $(30)^2$

= $\frac{900}{2}$ x m

= 450 m J

Comparing the kinetic energy we get:

$$\frac{K_1}{K_2} = \frac{112.5\ m}{450\ m} = \frac{1}{4}$$

So Kinetic energy of first car (K_1) : Kinetic energy of second car (K_2) = 1 : 4.

Question 11

A pump raises water by spending 4×10^5 J of energy in 10 s. Find the power of pump.

Answer

Given:

Work done by pump = Energy spent = 4×10^5 J or 400000 J

time = 10 s

Power = ?

$$\text{Power} = \frac{\text{Work done}}{\text{time taken}}$$

$$= \frac{400000}{10}$$

= 40000 W or 4×10^4 W

So power spent by the pump = 4×10^4 W.

Question 12

It takes 20 s for a girl A to climb up the stairs while girl B takes 15 s for the same job. Compare:

(a) The work done and

(b) The power spent by them.

Answer

(a) Both the girls move the same distance and force is also equal on both. Hence, the work done by both the girls is the same.

∴ Work done by girl A : Work done by girl B = 1 : 1

(b) Power spent = $\frac{\text{Work done}}{\text{time taken}}$

We know,

Work done by girl A = Work done by girl B = W

Power spent by girl A (P_A) = $\frac{W}{20}$

Power spent by girl B (P_B) = $\frac{W}{15}$

Comparing the power spent by girl A and girl B:

$$\frac{P_A}{P_B} = \frac{\frac{W}{20}}{\frac{W}{15}}$$

$$= \frac{15}{20} = \frac{3}{4}$$

∴ Power spent by girl A : Power spent by girl B = 3:4.