PUNJAB GROUP OF COLLEGESFAISALABAD

Chapter # 04

Chapter Name ,, Work and Energy

(Short Answers and Numericals)

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Short Answers

CH # 04

(4.1) Ans:-

In above the both cases, there is No displacement in car and person, So the work done will be Zero.

Mathematically,

$$W = Fd\cos\theta$$

In these cases, $\because d = 0$

So, $W = F(0)\cos\theta$

$$\boxed{W = 0}$$

Hence, these two situations are Similar.

(4.2) :- $m = 10\,kg$, $h = 10\,m$, $g = 9.8\,ms^{-2}$

$W = ?$

As,

$$W = Fd\cos\theta$$

$\because F = mg$, $d = h$, $\theta = 0°$

$W = mgh\cos(0°)$ $\quad \because \cos(0°) = 1$

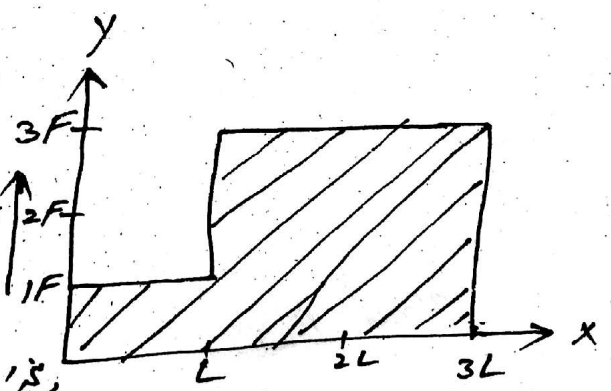
$W = mgh \Rightarrow 10 \times 9.8 \times 10$

$W = 980\,J$

$W = \frac{980}{1000}\,kg \Rightarrow 0.980\,KJ$

(4.3) :-

When a force acts through a distance "L" the force is increased to 3F to cover a further distance of 2L.



The Total work done is,

$W = (F \times L) + (3F \times 2L)$

$W = FL + 6FL$

$\boxed{W = 7FL}$

(4.4) :- Case – I

$m = 50\,kg$, $h = 50\,cm \Rightarrow 50 \times 10^{-2}\,m$

$w = ?$

$w = mgh = 50 \times 9.8 \times 50 \times 10^{-2}$

$w = 245\,J$.

Case – II

$m = 50\,kg$, $S = 2\,m$

$F = 50\,N$, $w = ?$

As, $w = FS$

$w = 50 \times 2$

$w = 100\,J$

Hence, the Ist Case, more work is done.

(4.5) :- Ans:- It means that work has been done on the body by a force of 1N which has lifted the body through a height of 1m. This work is stored in the form of P.E, which is 1J.

An object having 1J P.E means it has ability to do work of 1J.

(4.6) :- The Ist student taken the Refrence point table for Calculating P.E. So according to Ist student

$P.E = mgh_1$

while the IInd student taken the Refrence point the floor (ground) So according to IInd student;

$P.E = mg(h_1 + h_2)$

So, Both the students are correct. But we know that in Calculating P.E

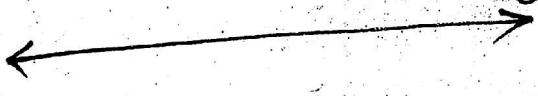
ground is always taken as the point of Reference, So, In fact, the 2nd student is correct.

4.7 :- The atmosphere of the Earth contains a large Number of dust Particles and water vapours. So, when the Rocket enter into the atmosphere and passes through these particles, due to the force of friction, the K.E of rocket is lost in the form of heat. That's why its nose cone becomes very hot.

4.8 (a) Elastic P.E in compressed spring.
(b) Gravitational P.E in water in high dam.
(c) K.E in a moving car.

4.9 :- When the cup was in the hands of the girl, it had gravitational P.E. When the cup is dropped, its P.E converted into K.E. on striking the ground, this energy is converted to sound energy, heat energy and work done in breaking a cup into Pieces.

4.10 :. When a boy throws a stone by a catapult, the stone possesses K.E. On striking the window this energy is converted into sound energy, heat energy and work done in breaking the window into pieces.



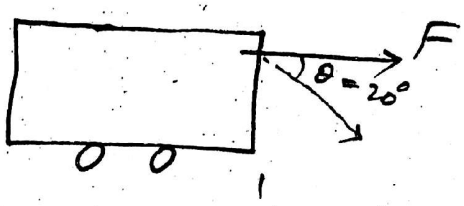
Numericals
CH # 04

4.1 :- Given data,

$F = 40\,N$, $\theta = 20°$

$d = 20\,m$

$w = ?$



$$w = \vec{F} \cdot \vec{d} = Fd\cos\theta$$

$$w = 40 \times 20 \cos 20°$$

$$w = 7.51 \times 10^2\,J$$

4.2 :- Given data,

$m = 3.35 \times 10^{-5}\,kg$

$h = 20\,m$

$w = ?$

Case-I work done due to gravity;

$$w = \vec{F} \cdot \vec{d}$$

$$w = Fd\cos\theta$$

$\because F = mg,\ h = d$

$$w = mgh\cos(0°)$$

$$w = mgh \qquad \because \cos(0°) = 1$$

$$w = (3.35 \times 10^{-5})(9.8)(20)$$

$$w = 0.0328\,J$$

Case-II work done due to Friction :-

$$w = mgh\cos 180°$$

$$w = -mgh$$

$$w = -(3.35 \times 10^{-5})(9.8)(20)$$

$$w = -0.0328\,J$$

4.3 :-

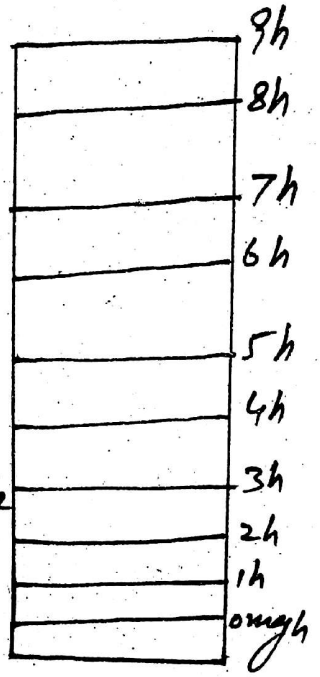
Given data,

$m = 1.5\,kg$

$h = 6\,cm$

$h = 6 \times 10^{-2}\,m$

$w_{Total.} = ??$



As, there is No-work done on the first brick lying flat on the Table. when we place other bricks on it one by one work is done.

$$w = mgh$$

$$w_{Total.} = 0mgh + 1mgh + 2mgh + 3mgh + 4mgh + 5mgh + 6mgh + 7mgh + 8mgh + 9mgh.$$

$$w_{Total.} = 45mgh$$

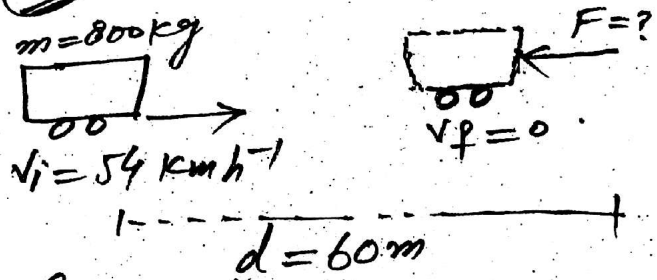
Putting the values;

$W_{Total.} = (45)(1.5)(9.8)(6\times10^{-2})$

$W_{Total.} \Rightarrow 39.69\ J$

$\boxed{W_{Total.} = 40J}$ Ans:-

4.4 :-



Given data;

$m = 800kg$, $v_i = 54\ kmh^{-1}$

$v_i = \frac{54\times1000}{3600}\ ms^{-1} \Rightarrow 15\ ms^{-1}$

$v_f = 0$, $d = 60m$

$F = ?$ $K.E = ?$

As we know,

$F = ma$ ——— (I)

Also,

$2as = v_f^2 - v_i^2$

$2a(60) = (0)^2 - (15)^2$

$a = -\frac{225}{120}$

$a = -1.875\ ms^{-2}$

Putting in eq (I).

$F = (800)(-1.875)$

$F = -1500N$

The -ive sign indicates that the force is retarding.

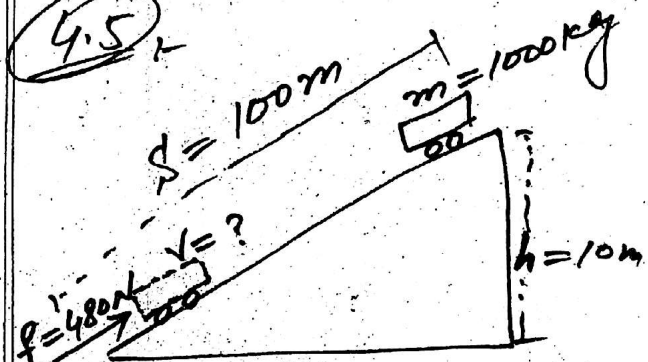
(6) Its Magnitude is;

$\boxed{F = 1500N}$

K.E = ?

The K.E has been used in doing work against the friction.

4.5 :-



Given data;

$m = 1000kg$; $v_i = 0$

$v_f = ?$ $s = 100m$

$f = 480N$, $h = 10m$.

$FS = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$(480)(100) = \frac{1}{2}mv_f^2 - \frac{1}{2}m(0)^2$

$48000 = \frac{1}{2}(1000)v_f^2$

$\frac{48000}{500} = v_f^2$

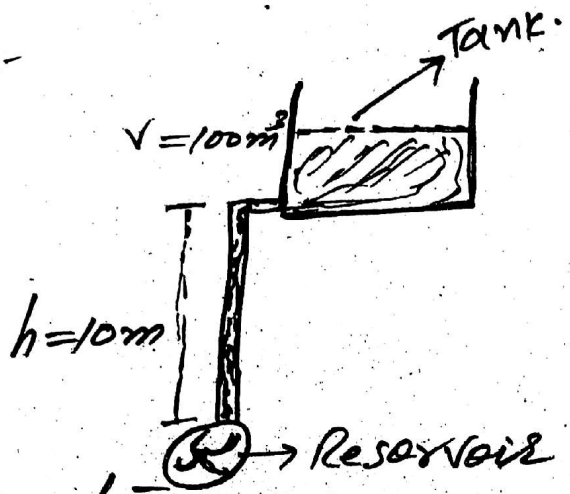
$96 = v_f^2$

$\sqrt{v_f^2} = \sqrt{96}$

$v_f = 9.79\ ms^{-1}$

$\boxed{v_f \cong 10\ ms^{-1}}$

4.6 :-



Given data;

$V = 100 m^3$, $h = 10 m$

$\rho = 1000 kg m^{-3}$, $t = 20 min.$

$g = 9.8 m s^{-2}$ $t = 20 \times 60 = 1200 s$

P.E = ? P = ?

As we know,

$P.E = mgh$ — (I)

$\rho = \frac{m}{V}$

$m = \rho \times V$

$m = 1000 kg m^{-3} \times 100 m^3$

$m = 10^5 kg$ put in (I).

$P.E = 10^5 \times 9.8 \times 10$

$\boxed{P.E = 9.8 \times 10^6 J}$

Also we know,

$P = \frac{w}{t} = \frac{P.E}{t}$

$P = \frac{9.8 \times 10^6}{1200}$

$P = 8166.6 watt$

$P = 8.166 \times 10^3 W$

$\because 10^3 = Kilo$

$\boxed{P = 8.2 KW}$

4.7 :-

Given data,

$F = 400 N$

$V = 80 km h^{-1} = \frac{80 \times 1000}{3600}$

$V = 22.22 m s^{-1}$

P = ?

As we know,

$P = \vec{F} \cdot \vec{V}$

$P = FV \cos\theta$

$\because \theta = 0°$ because the force and velocity have same direction mean parallel.

$P = (400)(22.22)\cos(0°)$

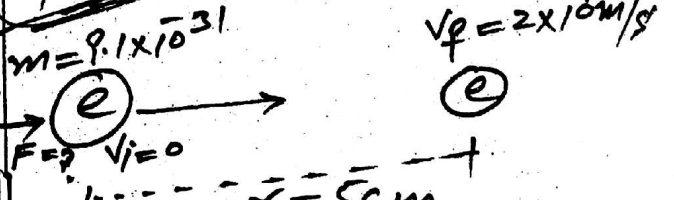
$\because \cos(0°) = 1$

$P = 8888 watt$

$P = 8.88 \times 10^3 W$

$\boxed{P = 8.9 KW}$

4.8 :-



Given data,

$m = 9.1 \times 10^{-31} kg$, $V_i = 0$

$V_f = 2 \times 10^7 m s^{-1}$, $d = 5 cm$

$F = ?$, $d = 5 \times 10^{-2} m$

As we know that

$$Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$F(5\times10^{-5}) = \frac{1}{2}(9.1\times10^{-31})(2\times10^{7})^2 - 0$$

$$F = \frac{(9.1\times10^{-31})(2\times10^{7})^2}{2(5\times10^{-5})}$$

$$\boxed{F = 3.6\times10^{-15}\ N}$$

(4.9) Given data;

$w = mg = 750\ N$

$h_1 = 10\ m,\ h_2 = 5\ m$

$v = ?$

$h = h_1 - h_2 = 10 - 5 = 5\ m$

As we know that,

Loss of P.E = Gain in K.E

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

$$v^2 = 2gh$$

$$\sqrt{v^2} = \sqrt{2gh}$$

$$v = \sqrt{2gh}$$

Putting the values.

$$v = \sqrt{2\times9.8\times5}$$

$$v = \sqrt{98}$$

$$v = 9.89\ ms^{-1}$$

$$\boxed{v = 9.9\ ms^{-1}}$$

Best of Luck