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TENDER HEART HIGH SCHOOL, SEC-33 B, CHD.
Subject:- PHYSICS ; TEACHER:- CHARANJEET KAUR
CLASS-X
NUMERICALS CHAPTER-2(b)
WORK POWER AND ENERGY

(1) mass of Body A = mass of Body B = m
height of Body A ; $h_A = h$
" " B ; $h_B = 2h$

Ratio of their gravitational P.E is $\frac{mgh_A}{mgh_B} = \frac{\cancel{m}g\cancel{h}}{\cancel{m}g(2\cancel{h})}$

$\Rightarrow \frac{1}{2}$ or 1:2

" " " " 1:2

(2) m = 1kg, h = 5m, g = 10m/s^2
gravitational P.E = mgh = 1×5×10 = 50 J
Now K.E of the mass when it falls and hits the ground is 50J (∵ when mass hits the ground its P.E is converted into K.E)

(3) m = 300 kg, g = 9.8 N kg^{-1}, gravitational P.E = 29400 J
gravitational P.E = mgh
29400 = 300×9.8×h
$10 = \frac{29400}{300 \times 9.8} = h$
$\boxed{h = 10m}$

(4) m = 10kg, h_1 = 20m, h_2 = 8m, g = 10m/s^2
(i) Loss in P.E = $mgh_1 - mgh_2 = mg(h_1 - h_2)$ = 10×10×12
= 1200 J

(ii) Total Energy at any instant = ?
At height 20m; P.E = mgh = 10×10×20 = 2000 J
" " ; K.E = 0 (Body is at rest)
So Total Energy = K.E + P.E = 2000 J + 0 = 2000 J

(6) $m = 50\,kgf$, $h_1 = 3m$, $h_2 = 9m$

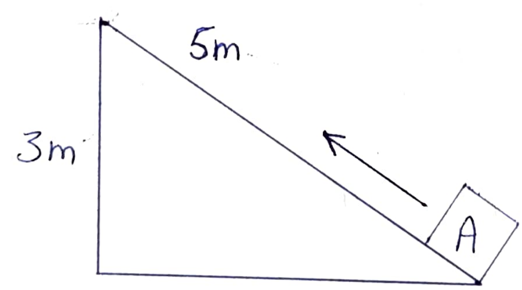
Increase in Potential Energy $= mg(h_2 - h_1)$
$= 50 \times 10\,(9-3)$
$= 50 \times 10 \times 6\,J$
$= 3000\,J$

(8) $m = 50\,kg$, $h = 15m$, $g = 9.8\,m/s^2$

(i) work done by the man $= mgh = 50 \times 9.8 \times 15 = 7350\,J$

(ii) Increase in P.E = ?
As the man climbs the ladder
So man's initial height is $= 0$ (before climbing)
" final " " $= 15m$ (After ")
So, therefore Increase in P.E $= mg(15-0)$
$= 50 \times 9.8 \times 15 = 7350\,J$ Ans

(9)



$F = 100N$, $S = 5m$

(i) work done by the force F; in moving the block A, 5m along the slope is
$W = FS\cos 0°$ (Along the slope as F S are same direction)
$W = FS$
$W = 100 \times 5$
$\boxed{W = 500\,J}$

(ii) P.E gained by the Block = ?
As block is moved through a vertical height of 3m
So P.E gained $= mgh = 100 \times 3 = 300\,J$
($\because F = mg = 100N$)

(iii) The difference in work done by the force and the increase in P.E of the block is $= 200\,J$ ($\because 500J - 300J = 200J$)

$\therefore$ In moving this block through the slope, some energy is used in work done against the friction which is lost in the form of heat energy.

(11) $K.E = \frac{1}{2}mv^2 \Rightarrow K_1$

$K_2 = K.E$ for speed halved $= \frac{1}{2}m\left(\frac{v}{2}\right)^2$ $\quad [\because v' = \frac{1}{2}v]$

$= \frac{1}{2}\frac{mv^2}{4}$

$= \frac{1}{4}\cdot\frac{1}{2}mv^2$

$\boxed{K_2 \Rightarrow \frac{1}{4}\cdot K_1}$

So new K.E becomes one fourth of K_1

(12) mass of Body 1 = mass of Body 2 = m

velocity of Body 1 = v

" " " 2 = $2v$

$\because$ mass of the bodies are same $\therefore K.E \propto v^2$

$\therefore K_1 = v^2 = v^2$

$K_2 = (2v)^2 = 4v^2$

or $\frac{K_1}{K_2} = \frac{\cancel{v^2}}{4\cancel{v^2}} = \frac{1}{4}$

or $\boxed{K_1 : K_2 = 1:4}$

(13) one car running with speed = 15 Km/hr

Another Car " " " = $45 kmh^{-1}$

K.E is directly proportional to v^2 if mass is same then:

$K_1 = v_1^2 = (15)^2$ $\quad$ or $\frac{K_1}{K_2} = \left(\frac{\cancel{15}\,1}{\cancel{45}\,3}\right)^2$

$K_2 = v_2^2 = (45)^2$ $\quad$ $\frac{K_1}{K_2} = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$

or $\boxed{K_1 : K_2 = 1:9}$

(17) $m = 10kg$, $v = 20 m/s$

$m' = 2 \times 10 = 20 kg$

$v' = \frac{1}{2} \times \cancel{20}^{10} = 10 m/s$

Initial K.E $= \frac{1}{2}mv^2 = \frac{1}{2} \times \cancel{10}^{5} \times (20)^2 = 5 \times 400 = 2000 J$

final K.E $= \frac{1}{2}m'v'^2 = \frac{1}{2} \times 20 \times (10)^2 = \frac{1}{\cancel{2}} \times \cancel{20}^{10} \times 10 \times 10 = 1000 J$

(19) $m = 60 kg$, $p = 3000 \ kg m^{-1}$,

(i) $K.E = \frac{p^2}{2m}$ $[\because p^2 = 2mK]$ as K is K.E So $K = \frac{p^2}{2m}$

$K.E = \frac{\cancel{3000}^{\cancel{1500}\,750} \times \cancel{3000}}{\cancel{2} \times \cancel{60}}$

$K.E = 75000 = 75 \times 10^3 = 7.5 \times 10^4 J$ or

(ii) Speed of body $(v) = ?$

$K.E = \frac{1}{2}mv^2$

$75000 = \frac{1}{2} \times 60 \times v^2$

$\frac{\cancel{2} \times \cancel{75000}^{2500}}{\cancel{60}_{3}} = v^2$

$v^2 = 2500$

$v = \sqrt{2500} = 50 m/s$ Ans

(20) $m = 50g = \frac{50}{1000} kg$ $50 \times 10^{-3} kg$

$p = 5 kg m s^{-1}$

Workdone = K.E (to give momentum to body)

$K = \frac{p^2}{2m}$ $(\because p^2 = 2mK$, $\frac{p^2}{2m} = K)$

$K = \frac{5 \times 5}{2 \times 50 \times 10^{-3}} = \frac{\cancel{5} \times \cancel{5} \times 10^3}{2 \times \cancel{50}_{2}} = \frac{1}{4} \times 10^3 = 0.25 \times 10^3 = 250 J$ Ans

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Q(21) (a) work done by the man carrying the box for 5 minutes;

= zero (∵ he is stationary not covering any displacement

(b) If he runs carrying the box with a speed of 3 m/s to catch the bus:–

So work done = K.E of man

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

$= \frac{1}{2} \times 20kg \times (3)^2 = \frac{1}{\cancel{2}} \times \cancel{20}^{10} \times 3 \times 3$

$= 90J$

(c) If he raises the box by 0.5m;

P.E gained by him is $mgh = 20 \times 10 \times 0.5$

$= \frac{20 \times 10 \times 5}{\cancel{10}}$ $(g = 10ms^{-2})$

$\boxed{P.E = 100J}$

Q(22) bullet mass = $50g = \frac{50}{1000} = 5 \times 10^{-2} kg$, $v = 500 m/s$.

(a) K.E of the bullet $= \frac{1}{\cancel{2}} \times 5 \times 10^{-2} \times \cancel{500}^{250} \times 500$

$= \frac{5 \times 250 \times 5\cancel{00}}{\cancel{10^2}}$

$K.E = 6250J$

(b) Average retarding force offered by the target (F) = ?

as work done by the bullet = K.E of the bullet

work done = Force × displacement

$6250 = F \times 0.1m$

[displacement = 10cm) $= \frac{10}{100} = 0.1m$

$\frac{6250}{0.1} = F$

[bullet covered 0.1cm displacement in target)

$\boxed{F = 62500N}$

23 $m = 0.5 kg$

$v = 2 m/s$

P.E of the spring during compression = K.E of moving trolley.

$\therefore K.E = \frac{1}{2} \times m \times v^2 = \frac{1}{\cancel{2}} \times 0.5 \times \cancel{2} \times 2$

$K.E = 1 J$

or P.E of spring = 1 J Ans

finish

α —— α —— α —— α —— α —— α ——