DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 5

Topic :- WORK ENERGY AND POWER

1 **(b)**

$P =$ constant

$\Rightarrow Fv = P \; [\because P =$ force $\times$ velocity$]$

$\Rightarrow Ma \times v = P \;\; [\because F = Ma]$

$\Rightarrow va = \frac{P}{M}$

$\Rightarrow v \times \frac{vdv}{ds} = \frac{P}{M} \;\; \left[\because a = \frac{vdv}{ds}\right]$

$\Rightarrow \int_0^v v^2 dv = \int_0^s \frac{P}{M} ds$

[Assuming at $t = 0$ it starts from rest, *ie*, from $s = 0$]

$\Rightarrow \frac{v^3}{3} = \frac{P}{M} s$

$\Rightarrow v = \left(\frac{3P}{M}\right)^{1/3} \times s^{1/3}$

$\Rightarrow \frac{ds}{dt} = ks^{1/3} \left[k = \left(\frac{3P}{M}\right)^{1/3}\right]$

$\Rightarrow \int_0^s \frac{ds}{s^{1/3}} = \int_0^t kdt$

$\Rightarrow \frac{s^{2/3}}{2/3} = kt$

$\therefore \; s = \left(\frac{2}{3}k\right)^{3/2} \times t^{3/2}$

$\Rightarrow s \propto t^{3/2}$

2 **(d)**

Let m be the mass of the block, h the height from which it is dropped, and x the compression o the spring. Since, energy is conserved, so

Final gravitational potential energy

= final spring potential energy

or $mg(h + x) = \frac{1}{2}kx^2$

or $mg(h + x) + \frac{1}{2}kx^2 = 0$

or $kx^2 - 2mg(h + x) = 0$

$kx^2 - 2mgx - 2mgh = 0$

This is a quadratic equation for x. Its solution is

$$x = \frac{mg \pm \sqrt{(mg)^2 + 2mghk}}{k}$$

Now, $mg = 2 \times 9.8 = 19.6$ N

and $hk = 0.40 \times 1960 = 784$ N

$$\therefore \quad x = \frac{19.6 \pm \sqrt{(19.6)^2 + 2(19.6)(784)}}{1960}$$

$= 0.10$ m or -0.080 m

Since, x must be positive (a compression) we accept the positive solution and reject the negative solution. Hence, $x = 0.10$ m

3 **(a)**

When two bodies of same mass makes head on elastic collision, and then they interchange their velocities.

So, after collision first body starts to move with velocity v.

4 **(d)**

Energy supplied $= \frac{1}{2}mv^2 = \frac{1}{2}(0.5)14^2 = 49$ J

Energy stored $= mgh = 0.5 \times 9.8 \times 8 = 39.2$ J

$\therefore$ Energy dissipated $= 49 - 39.2 = 9.8$ J

5 **(d)**

$$P = \frac{mgh}{t}$$

$\frac{M}{t} =$ mass of water fall per second

$$= \frac{P}{gh} = \frac{1 \times 10^6}{10 \times 10} = 10^4 \text{ kg s}^{-1}$$

6 **(d)**

$$F = -\frac{\partial U}{\partial x}\hat{\mathbf{i}} - \frac{\partial U}{\partial y}\hat{\mathbf{j}} = 7\hat{\mathbf{i}} - 24\hat{\mathbf{j}}$$

$\therefore \quad a_x = \frac{F_x}{m} = \frac{7}{5} = 1.4$ ms^{-2} along positive x-axis

$$a_y = \frac{F_y}{m} = -\frac{24}{5}$$

$= 4.8$ms^{-2} along negative y-axis

$\therefore \; v_x = a_x t = 1.4 \times 2$

$= 2.8$ ms^{-2}

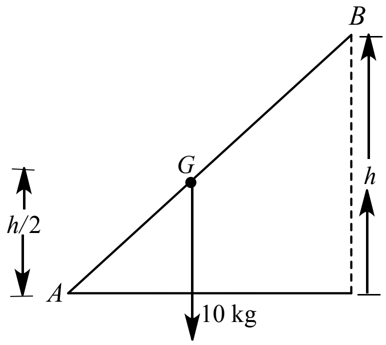
and $v_y = 4.8 \times 2 = 9.6$ ms^{-1}

$\therefore \; v = \sqrt{v_x^2 + v_y^2} = 10$ ms^{-1}

7 **(b)**

Work done=$\frac{mg\text{h}}{2}$

$\therefore\ 100 = \frac{10 \times 10 \times h}{2}$



Or $\text{h} = 2.0m$

8 **(c)**

$E = \frac{p^2}{2m}$ or $E \propto p^2$

or $\frac{E_1}{E_2} = \left(\frac{p_1}{p_2}\right)^2 = \left(\frac{p_1}{2p_2}\right)^2 = \frac{1}{2}$ or $E_2 = 4E_1$

So, increase is 300%

9 **(a)**

Mass of fragments are as 2 : 3

Total mass $= 20kg$

$\therefore$ Larger fragment $= 12kg$

$\therefore$ Smaller fragment $= 8\ kg$

Momentum is conserved

$\therefore 8 \times 6 = 12 \times v \Rightarrow v = 4 =$ velocity of larger fragment

$\therefore$ Kinetic energy $= \frac{1}{2}mv^2 = \frac{1}{2} \times 12 \times (4)^2 = 96\ J$

10 **(c)**

$\frac{1}{2}m_1u_1^2 - \frac{1}{2}m_1v_1^2 = \frac{75}{100} \times \frac{1}{2}m_1u_1^2$

Or $u_1^2 - v_1^2 = \frac{3}{4}u_1^2$

or $v_1 = \frac{1}{2}u_1$ ....(i)

Now $v_1 = \frac{(m_2 - m_1)u_1}{(m_1 + m_2)}$....(ii)

Thus, $\frac{1}{2}u_1 = \frac{(m_2 - m_1)u_1}{(m_1 + m_2)}$

or $m_2 = 3m_1 = 3m$

11 **(b)**

The linear momentum of exploding part will remain conserved.

Applying conservation of linear momentum, We write,

$m_1u_1 = m_2u_2$

Here,$m_1 = 18$kg,$m_2 = 12$kg

$u_1 = 6ms^{-1}$,$u_2 = ?$

$\therefore 18 \times 6 = 12\ u_2$

$\Rightarrow u_2 = \frac{18 \times 6}{12}\ \ 9ms^{-1}$

Thus, kinetic energy of 12 kg mass

$k_2 = \frac{1}{2} m_2 u_2^2$

$= \frac{1}{2} \times 12 \times (9)^2$

$=6 \times 81$

$=486$ J

12 **(b)**

Force constant of a spring

$k = \frac{F}{x} = \frac{mg}{x} = \frac{1 \times 10}{2 \times 10^{-2}} \Rightarrow k = 500\ N/m$

Increment in the length $= 60 - 50 = 10\ cm$

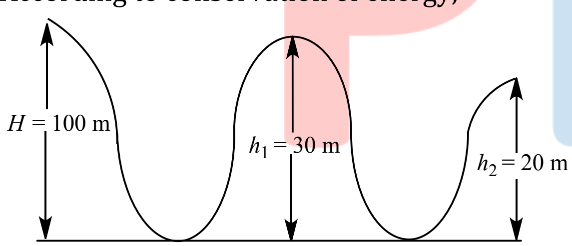
$U = \frac{1}{2} kx^2 = \frac{1}{2} 500(10 \times 10^{-2})^2 = 2.5\ J$

13 **(c)**

There is no displacement

14 **(a)**

According to conservation of energy,



$mgH = \frac{1}{2} mv^2 + mgh_2$

Or $\quad mg(H - h_2) = \frac{1}{2} mv^2$

Or $v = \sqrt{2g(100 - 20)}$

Or v$=\sqrt{2 \times 10 \times 80} = 40ms^{-1}$

15 **(a)**

$U = \frac{1}{2} ks^2 = 10$ J

$U' = \frac{1}{2} k(s + s)^2 = 4\left(\frac{1}{2} ks^2\right) = 40$ J

$W = U' - U = 40 - 10 = 30$ J

16 **(a)**

$s=\frac{1}{3}t^2$

$v=\frac{ds}{dt}=\frac{2}{3}t, a=\frac{d^2s}{dt^2}=\frac{2}{3}$

$F=ma=3\times\frac{2}{3}=2$ N

$W= 2\times\frac{1}{3}t^2$

At $t=2$ s,

$W=2\times\frac{1}{3}\times2\times2=\frac{8}{3}$ J

17 **(b)**

$W=\frac{1}{2}kx^2$

If both wires are stretched through same distance then

$W\propto k$. As $k_2=2k_1$ so $W_2=2W_1$

18 **(a)**

Work done = area under curve and displacement axis

$=1\times10-1\times10+1\times10=10\,J$

19 **(b)**

Total mechanical energy= mgh

As, $\frac{\text{KE}}{\text{PE}}=\frac{2}{1}$

$\text{KE}=\frac{2}{3}\text{mgh}$

and $\text{PE}=\frac{1}{3}mg\text{h}$

Height from the ground at this instant,

$\text{h}'=\frac{\text{h}}{3}$ *and speed of particle at this instant,*

$v=\sqrt{2g(\text{h - h}')}$

$=\sqrt{2g\left(\frac{2h}{3}\right)}$

$=2\sqrt{\frac{g\text{h}}{3}}$

20 **(a)**

$U=-\int Fdx=-\int kx\,dx=-k\frac{x^2}{2}$

This is the equation of parabola symmetric to U axis in negative direction

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	D	A	D	D	D	B	C	A	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	B	C	A	A	A	B	A	B	A