WS-7 · Energy

Thank

(1)

Given $m = 500\ kg$: $v = 20\ m/s$.

$$K.E = \frac{1}{2} m v^2 = \frac{1}{2} \times 500 \times (20)^2 = 500 \times \frac{400}{2}$$

$$= 100{,}000\ J$$

(2)

Given $m = 2kg$: $h = 5m$; $g = 9.8\ m/s$

Gravitational Potential energy $= mgh = 2 \times 9.8 \times 5$

$= 98J$

(3)

$u = 15$ m/s

$$H_{max} = \frac{u^2}{2g} = \frac{15 \times 15}{2 \times 9.8}$$

$$= 11.53 \text{ m}$$

(4)

P.E = 200 J ; $m = 10$ kg ; $h = ?$

From $P.E = mgh$

$\Rightarrow 200 = 10 \times 9.8\, h$

$$h = \frac{200}{98} = 2 \text{ m}.$$

(5)

Given $u = 0$; $v = 15$ m/s ; $h = 30$m ; $m = 10$ kg

$$KE = \frac{1}{2} m v^2$$

$$= \frac{1}{2} \times 10 \times (15)^2$$

$$= 5 \times 225$$

$$\Rightarrow 1125 \text{ J}$$

(6)

Given $m = 0.2$ kg ; $u = 30$ m/s

$$K.E = \frac{1}{2} m u^2 = \frac{1}{2} \times 0.2 \times (30)^2 = 0.1 \times 900$$

$$= 90 \text{ J}$$

(7)

$F = 50N \quad ; \quad h = 2m$

$P.E = mgh$

$\Rightarrow 50 \times 2$

$= 100J$

(8)

$m_1 = 3kg \quad ; \quad m_2 = 2kg \quad K.E = 600J$

According to law of conservation of linear momentum $m_1 v_1 = -m_2 v_2$

$\Rightarrow v_1 = -\frac{m_2}{m_1} v_2 \Rightarrow v_2 = -\frac{m_1}{m_2} v_1$

$v_1 = -\frac{2}{3} v_2 \Rightarrow v_2 = \frac{-3}{2} v_1$

$\therefore$ Given $K.E_1 + K.E_2 = 600$

$\Rightarrow \frac{1}{2} m v_1^2 + \frac{1}{2} m_2 v_2^2 = 600$

$\Rightarrow \frac{1}{2} [m_1 v_1^2] + \frac{1}{2} m_2 \left[\frac{m_1}{m_2}\right]^2 v_1^2 = 600$

$\Rightarrow \frac{1}{2} m_1 v_1^2 + \frac{1}{2} \frac{m_1}{m_2} \times m_1 v_1^2 = 600$

$\Rightarrow \frac{1}{2} m_1 v_1^2 \left[1 + \frac{m_1}{m_2}\right] = 600$

$\Rightarrow K.E \left[1 + \frac{3}{2}\right] = 600$

$\Rightarrow K.E \ \frac{5}{2} = 600^{120}$

$K.E = 240 J$

(9)

$m = 200\ gm = 200 \times 10^{-3}\ kg$

$l = 1m \;;\; \theta = 60^\circ \qquad v = \sqrt{2gl(1-\cos\theta)}$

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

$= \frac{1}{2} m \left[\sqrt{2gl(1-\cos\theta)}\right]^2$

$= \frac{1}{2} (0.2)\,(2 \times 9.8 \times 1 (1-\cos 60))$

$\Rightarrow \quad 0.2 \times 9.8 \times \left(1 - \frac{1}{2}\right)$

$\Rightarrow 0.98\ J = 1\ J.$

(10)

According to law of conservation of linear momentum

$$V_{recoil} = -\frac{m_1}{m_2} u.$$

$$= -\frac{m}{M} u.$$

$$\frac{K.E_{bullet}}{K.E_{gun}} = \frac{\frac{1}{2} m u^2}{\frac{1}{2} M V_{rec}^2} = \frac{m u^2}{M \times \left(\frac{m}{M} u\right)^2} \Rightarrow \frac{M}{m}.$$

(17)

Given $m = 12\ kg \;;\; h_1 = 0.3m \;;\; h_2 = 1.5m$

$P.E = mgh_2 = 12 \times 10 \times 1.5 = 180\ J.$

At highest point the final velocity $= 0$.

L Task

Jee main level

① K.E = 400 J ; v = 10 m/s

From $K.E = \frac{1}{2} m v^2$

$\Rightarrow 400 J = \frac{1}{2} \times m \times 10^2$

$\Rightarrow 800 = m \times 100$

$\Rightarrow m = 80 kg \rightarrow C$

② Given P.E = 150,000 J

i.e $mgh = 150,000 J$

Loss of P.E = gain of K.E

$-150000 = \frac{1}{2} m v^2$

$\Rightarrow v^2 = \frac{2 \times 150,000}{100} = 3000$

$\Rightarrow v = \sqrt{3000} = 54.77 m/s \rightarrow D$

③ Given $m = 0.2 kg$: $h = 10 m$.

Loss of Potential energy = gain in kinetic energy

$-K.E = mgh$

$= 0.2 \times 10 \times 10$

$= 20 J$ (or) $19.6 J \rightarrow A$.

(4)

Given $m = 500\,kg$: $u = 50\,m/s$

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

$$= \frac{1}{2} \times 500 \times (50)^2$$

$$= \frac{1}{2} \times 500 \times 2500$$

$$= 625000 \rightarrow A.$$

(5)

Given $u = 0$; $h = 30m$: $m = 10\,kg$

Potential energy at maximum height

$$= mgh$$

$$= 10 \times 30 \times 9.8$$

$$\rightarrow 2940\,J \rightarrow A$$

(6)

Weight $mg = 1000\,N$: $h = 5\,m$

Gravitational Potential Energy $= mgh$

$$= 1000 \times 9.8 \times 5$$

$$\rightarrow 4900\,J$$

If $g = 10$ Then $P.E = 5000\,J \rightarrow A$

(7)

Given $m = 1200\ kg$; $V = 25\ m/s$

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

$= \frac{1}{2} \times 1200 \times (25)^2$

$= 600 \times 625$

$= 37,5000\ J \rightarrow A$

(8)

Given $h = 10m$.

also $P.E = K.E$

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

$\Rightarrow v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 10}$

$= \sqrt{196} = 14\ m/s$ - B

(9)

At maximum height 'h' $T.E = P.E + K.E$

$= mgh + 0$

$T.E = mgh.$

at a height $\frac{3h}{4}$; $P.E = mg\left(\frac{3h}{4}\right) = \frac{3}{4} mgh$

$K.E = T.E - P.E = mgh - \frac{3}{4} mgh$

$= \frac{1}{4} mgh$

$\therefore \frac{K.E}{P.E} = \frac{\frac{1}{4} mgh}{\frac{3}{4} mgh} = \frac{1}{3}$ $\rightarrow B$

(10)

$\frac{P.E}{K.E} = \frac{5}{2}$ Given $h = 400m$; $v = ?$

$\therefore \frac{mgh}{\frac{1}{2}mv^2} = \frac{5}{2}$ $\Rightarrow v^2 = \frac{2}{5} \times 2gh$

$\Rightarrow 2gh = \frac{5}{2}v^2$ $= \frac{2}{5} \times 2 \times 10 \times 400$

$= 3200$

$\therefore v = \sqrt{3200} = 10 \times 5.6$

$= 56 \text{ m/s} \Rightarrow A$

Advanced

(9)

Given

$m = 5 \text{ kg}$ $P = 10 \text{ kgm/s}$ $\Rightarrow mu = 10$

$F = 0.2 \text{ N}$ $t = 10 \text{ sec}$ $u = \frac{10}{m} = 2 \text{ m/s}$

From Newton's 2nd law $F = \frac{dP}{dt}$

$dP = F \times dt = 0.2 \times 10 = 2 \text{ kgm/s}$

From $a = \frac{F}{m} = \frac{0.2}{5} = 0.04 \text{ m/s}^2$

From $v = u + at$

$= 2 + 0.04 \times 10$

$v = 2.4 \text{ m/s}$

Increase in $K.E = \frac{1}{2}m(v^2 - u^2)$

$= \frac{1}{2} \times 5 [v+u][v-u]$

$= \frac{1}{2} \times 5 [2.4+2][2.4-2]$

$= \frac{1}{2} \times 5 \times 4.4 \times 0.4$ (0.2)

$= 4.4 \text{ J}$