

$$= 1039 \text{ J}$$

WS-7. Energy

Task

①

Given

$$m = 500 \text{ kg} \quad : \quad v = 20 \text{ m/s}$$

$$\begin{aligned} \text{K.E} &= \frac{1}{2} m v^2 = \frac{1}{2} \times 500 \times (20)^2 = 500 \times \frac{400}{2} \\ &= 100,000 \text{ J} \end{aligned}$$

②

Given

$$m = 2 \text{ kg}; \quad h = 5 \text{ m}; \quad g = 9.8 \text{ m/s}^2$$

$$\begin{aligned} \text{Gravitational Potential Energy} &= mgh = 2 \times 9.8 \times 5 \\ &= 98 \text{ J} \end{aligned}$$

$$\Rightarrow V_2 = 0 \text{ J}$$



③

$$u = 15 \text{ m/s}$$

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

$$= 14.53 \text{ m}$$

$$F = 50 \text{ N}$$

④

$$P.E = 200 \text{ J} ; m = 10 \text{ kg} ; h = ?$$

$$\text{From } P.E = mgh$$

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

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

⑤

$$\text{Given } u = 0 ; v = 15 \text{ m/s} ; h = 30 \text{ m} ; m = 10 \text{ kg}$$

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

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

$$= 5 \times 225$$

$$= 1225 \text{ J}$$

⑥

$$\text{Given } m = 0.2 \text{ kg} ; u = 30 \text{ m/s}$$

$$K.E = \frac{1}{2} m u^2 = \frac{1}{2} \times 0.2 \times (30)^2 = 0.1 \times 900 = 90 \text{ J}$$



④

$$F = 50 \text{ N} ; h = 2 \text{ m}$$

$$P \cdot F = mg \cdot h$$

$$\Rightarrow 50 \times 2 \\ = 100 \text{ J}$$

⑤

$$m_1 = 3 \text{ kg} ; m_2 = 2 \text{ kg} \quad K \cdot E = 600 \text{ J}$$

According to law of conservation of mean

momentum

$$m_1 v_1 = -m_2 v_2$$

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

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

$$\therefore \text{Given } K \cdot E_1 + K \cdot E_2 = 600$$

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

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

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

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

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

$$\Rightarrow K \cdot E \cdot \frac{5}{2} = 600$$

$$K \cdot E = 240 \text{ J}$$

(9)

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

$$l = 1 \text{ m}; \quad \theta = 60^\circ$$

$$u = \sqrt{2gl(1 - \cos\theta)}$$

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

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

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

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

$$= 0.98 \text{ J} = 1 \text{ J}$$

(10)

According to law of conservation of linear momentum

$$v_{\text{recoil}} = - \frac{m_1}{m_2} u$$

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

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

(11)

$$\text{Given } m = 12 \text{ kg}; \quad h_1 = 0.3 \text{ m}; \quad h_2 = 1.5 \text{ m}$$

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

At highest point the final velocity = 0.

$$K.E = 400 \text{ J}; \quad v = 10 \text{ m/s}$$

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

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

$$\Rightarrow 8000 = m \times 100$$

$$\Rightarrow m = 80 \text{ kg} \rightarrow c$$

2

$$\text{Given } P.E = 150,000 \text{ J}$$

$$\text{ie) } mgh = 150,000 \text{ J}$$

$$\text{Loss of } P.E = \text{gain of } K.E$$

$$150,000 = \frac{1}{2} m v^2$$

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

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

3

$$\text{Given } m = 0.2 \text{ kg}; \quad h = 10 \text{ m.}$$

$$\text{Loss of Potential energy} = \text{gain in kinetic energy}$$

$$K.E = mgh$$

$$= 0.2 \times 10 \times 10$$

$$= 20 \text{ J (or) } 19.6 \text{ J} \rightarrow A$$

(4)

Given $m = 500 \text{ kg}$; $u = 50 \text{ m/s}$

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

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

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

$$= 625000 \rightarrow A.$$

(5)

Given $u = 0$; $h = 30 \text{ m}$; $m = 10 \text{ kg}$

Potential energy at maximum height

$$= m g h$$

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

$$= 2940 \text{ J} \rightarrow A.$$

(6)

Weight $mg = 1000 \text{ N}$; $h = 5 \text{ m}$

Gravitational Potential Energy $= m g h$

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

$$= 49000 \text{ J}$$

If $g = 10$

Then

$$P.E = 50000 \text{ J} \rightarrow A$$



(7)

Given $m = 1200 \text{ kg}$, $v = 25 \text{ m/s}$

$$\therefore k \cdot E = \frac{1}{2} m v^2$$

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

$$= 600 \times 625$$

$$= 37,5000 \text{ J} \rightarrow A$$

(8)

Given

$$h = 10 \text{ m}$$

$$\text{also } P \cdot E = k \cdot E$$

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

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

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

(9)

At maximum height 'h' $T \cdot E = P \cdot E + k \cdot E$

$$= mgh + 0$$

$$T \cdot E = mgh$$

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

$$k \cdot E = T \cdot E - P \cdot E = mgh - \frac{3}{4} mgh$$

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

$$\therefore \frac{k \cdot E}{P \cdot E} = \frac{\frac{1}{4} mgh}{\frac{3}{4} mgh} = \frac{1}{3} \rightarrow B$$



(10)

$$\frac{P.E}{K.E} = \frac{5}{2}$$

Given $h = 400 \text{ m}$; $v = ?$

$$\therefore \frac{mgh}{\frac{1}{2}mv^2} = \frac{5}{2}$$

$$\therefore 2gh = \frac{5}{2}v^2$$

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

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

$$= 3200$$

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

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

(9)

Advanced

Given

$$m = 5 \text{ kg}$$

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

$$F = 0.2 \text{ N}$$

$$t = 10 \text{ sec}$$

$$u = \frac{10}{m} = 2 \text{ m/s}$$

From

Newton's

2nd law

$$F = \frac{dp}{dt}$$

$$dp = F \times dt = 0.2 \times 10 = 2 \text{ kg m/s}$$

From

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

From

$$v = u + at$$

$$= 2 + 0.04 \times 10$$

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

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

$$= \frac{1}{2} \times 5 (v+u)(v-u)$$

$$= \frac{1}{2} \times 5 (2.4+2)(2.4-2)$$

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

