



DPP - 4

Work power energy

$$1. \quad -\frac{1}{2}kx^2 = \frac{1}{2}m\left(\frac{v}{2}\right)^2 - \frac{1}{2}mv^2$$

$$k = \frac{3mv^2}{4x^2}$$

$$= \frac{6E}{4} \frac{1}{(25 \times 10^{-2})^2}$$

$$k = 24E$$

$$\therefore [n = 24]$$

$$2. \quad mg\left(h + \frac{h}{2}\right) = \frac{1}{2}k\left(\frac{h}{2}\right)^2$$

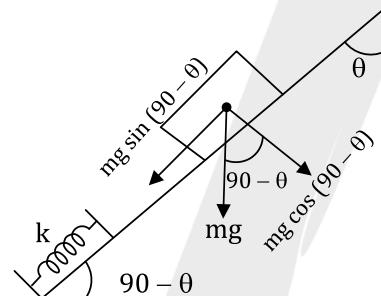
$$\frac{3mgh}{2} = \frac{1}{2} \frac{Kh^2}{4}$$

$$12mg = Kh$$

$$K = \frac{12 \times 0.1 \times 10}{0.10} =$$

$$[K = 120 \text{ Nm}^{-1}]$$

$$3. \quad kx = mgsin(90 - \theta)$$



$$x = \frac{mg \cos \theta}{k}$$

compare with condition given in question

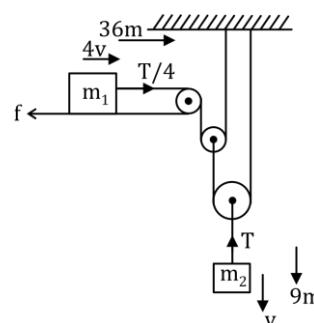
$$\frac{nmg \cos \theta}{4k} = \frac{mg \cos \theta}{k}$$

$$n = 4$$

$$4. \quad w_{\text{Total}} = k_f - k_i$$

$\Rightarrow (w_T)_{\text{net}}$ on block (1) & (2) is zero

$$-\mu_1 mg \times 36 + m_2 g \times 9 = \frac{1}{2}m_1(4v)^2 + \frac{1}{2}m_2v^2 - 0$$





⇒ After Solving this

$$v = 4 \text{ m/s}$$

So velocity of $m_1 = 4v$

$$= 16 \text{ m/s}$$

5. Energy conservation

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

$$x = \sqrt{\frac{2m}{k}} \cdot v$$

$$x = \left(\sqrt{\frac{2 \times 250}{2 \times 1000}} \right) v$$

$$x = \frac{v}{2}$$

6. $KE = \frac{1}{2}mu^2$ (Initial condition)

$$90 = \frac{1}{2} \times \frac{200}{1000} u^2$$

$$u = 30 \text{ m/sec}$$

After 1 second

$$40 = \frac{1}{2} \times \frac{200}{1000} \cdot V^2$$

$$V^2 = 400$$

$$V = 20 \text{ m/s.}$$

i.e. velocity is decreasing

$$\text{retardation (a)} = \frac{20 - 30}{1} = -10 \text{ m/sec}^2$$

$$v^2 = u^2 + 2as.$$



$$0 = (30)^2 + 2(-10)S.$$

$$S = \frac{900}{20}$$

$$S = 45 \text{ meter}$$

7. $l_1 + l_2 = l \cdot (\text{Total length of spring})$

and $l_1 = nl_2$ (given)

$$nl_2 + l_2 = l \quad \text{---(1)}$$

$$l_2 = \frac{l}{n+1} \quad \text{---(2)}$$

$$l_1 = l - l_2 = l - \frac{l}{n+1}$$

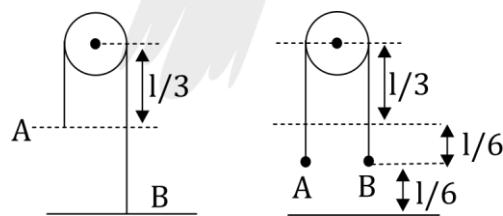
$$= \frac{ln+l-l}{n+1}$$

$$l_1 = \frac{nl}{n+1}$$

$$\text{as } k \propto \frac{1}{l} \Rightarrow k_1 l_1 = k_2 l_2$$

$$\frac{k_1 nl}{n+1} = \frac{k_2 l}{n+1} \Rightarrow \frac{k_1}{k_2} = \frac{1}{n}$$

8. final saturation of spring ↓



initial saturation of chain

$$\text{work done} = \left(\frac{m}{6}\right) \left(\frac{l}{6}\right) g = \frac{mlg}{36}$$

If $\frac{1}{6}$ length is going up mean corresponding mass will be $\frac{m}{6}$.

9. $dm = \frac{m}{l} dl$

and $dl = R d\theta$

So $dm = \frac{m}{l} R d\theta$.

$PE = dmgh$

$$du = -\frac{m}{L} R d\theta \times g(R - R \cos \theta)$$

$$du = -\frac{m}{L} R^2 g(1 - \cos \theta) d\theta.$$

$$u = \int_0^{1/R} -\frac{mR^2g}{L} (1 - \cos \theta) d\theta$$

$$u = \frac{-mgR^2}{L} (\theta - \sin \theta)_0^{1/R}$$

$$u = \frac{mgR^2}{L} \left[\sin \frac{1}{R} - \frac{1}{R} \right]$$

10. expansion is x_0 and further expansion let P

energy conservation

$$\frac{1}{2}k(P + x_0)^2 = \frac{1}{2}kx^2 + mg(P + 2x_0)$$

$$\therefore kx_0 = mg$$

$$\frac{1}{2}K(P + x_0)^2 = \frac{1}{2}kx_0^2 + kx(P + 2x_0)$$

$$P = 2x_0$$

11. By energy conservation

work done by boy = store energy in spring = $\frac{1}{2}kx^2$

