DPP – 3

SOLUTION

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1. $W = \frac{-k}{2}[9-1]$

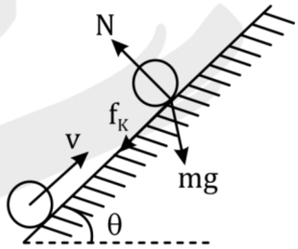
$W = -4k$ Joule

2. $w_g + w_N + w_f = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

$mg\sin\theta l + (-\mu mg\cos\theta)l = \frac{1}{2}mv^2$

$v = \sqrt{2g(\sin\theta - \mu\cos\theta)l}$

3. $w_N + w_g + w_f = k_f - k_i$



$-mg\sin\theta \cdot d + 0 - \mu mg\cos\theta \cdot d = -\frac{1}{2}mu_0^2$

$d = \frac{v_0^2}{2g(\sin\theta + \mu\cos\ \theta)}$

4. $w_g + w_N + w_f = \frac{1}{2}mv^2 - 0$

$mg\frac{l}{2} + 0 + 0 = \frac{1}{2}mv^2$

$v = \sqrt{gl}$

5. In first case (A)

$w_A = mg$ [vertical displacement]

$= mgr$

In Case (B)

$w_B = mg$ [vertical displacement]

$= mg(R - r)$

In case (c)

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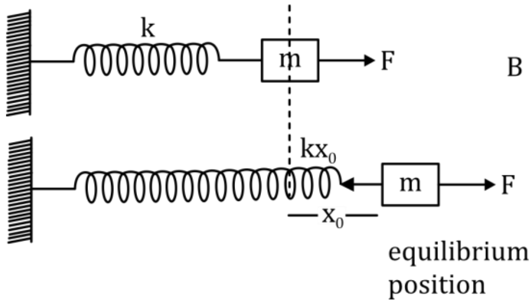
$w_c = mg[S_{vertical}] \quad \Rightarrow \quad = mgh.$

6. $kx_0 = F$

$x_0 = \frac{F}{k}$



but it gain same speed & move extra x_0

$\Rightarrow$ maximum extension $= \frac{2F}{k}$

7. Store Potential Energy

$= \frac{1}{2}kx_0^2 = \frac{1}{2}mv_{max}^2$

$\frac{1}{2}k\left[\frac{F}{k}\right]^2 = \frac{1}{2}mv_{max}^2$

$\frac{F^2}{km} = v_{max}^2$

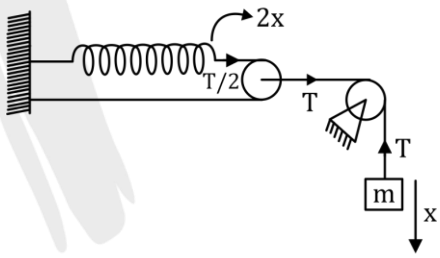
$v_{max} = \frac{F}{\sqrt{km}}$

8. Work done on the spring is store in form of spring potential Energy.

$\frac{T}{2} \cdot 2x = \frac{1}{2}k(2x)^2$

$\frac{mg}{2} \cdot 2x = \frac{1}{2}k \times 4x^2$

$\frac{mg}{2k} = x$

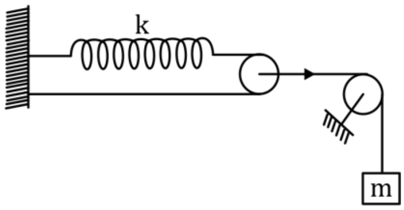


9. If block will go 2x height down then strech of x will take place in spring.

By energy conservation

$2x\ mg = \frac{1}{2}kx^2$

$x = \frac{4mg}{k}$



Total displacement of block is 2x

$\therefore 2x = \dfrac{8mg}{k}$

10. $\rightarrow$ Total elongation in spring will be 2x. because after x-elongation; block will gain some speed, so that speed will give x elongation.

$2kx = \mu_0 mg$ ____(1)

$\because F = kx$ ____(2)

from (1) and (2)

$2F = \mu_0 mg$

$F = \frac{\mu_0 mg}{2}$

11. Suppose length of each spring is l

$\cos\ 37^\circ = \dfrac{h}{l} \Rightarrow l = \dfrac{h}{\cos\ 37^\circ} = \dfrac{5h}{4}$

extention in spring $x = l - h = \frac{5h}{4} - h$

$x = h/4$

conservation of mechanical energy

$U_i + k_i = U_f + K_f$

$U_i = K_f \qquad \because k_i = 0, U_f = 0$

$\dfrac{1}{2}Kx^2 + \dfrac{1}{2}kx^2 = \dfrac{1}{2}mv^2$

$kx^2 = \dfrac{1}{2}mv^2$

$\frac{2kx^2}{m} = v^2$

$v = x\sqrt{\frac{2k}{m}} = \frac{h}{4}\sqrt{\frac{2\times1000}{5}} = \frac{h}{4}\times 20 \quad \Rightarrow \quad 5h$

$v = 5h\ m/s$