title **Auxiliar #9** subject date

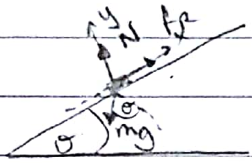
P1. $v_i = V \rightarrow E_i = \frac{1}{2} m V^2$

$v_f = \alpha V \rightarrow E_f = \frac{1}{2} m \alpha^2 V^2$

$$\Delta E = E_f - E_i = \frac{1}{2} m V^2 (\alpha^2 - 1)$$

$$\Delta E = W \Rightarrow f_R \cdot L = \frac{1}{2} m V^2 (\alpha^2 - 1)$$

$$\mu N L = \frac{1}{2} m V^2 (\alpha^2 - 1)$$



$y)\ N - mg\cos(\theta) = 0$

$\Rightarrow N = mg\cos(\theta)$

$$\mu \cancel{m} g \cos(\theta) L = \frac{1}{2} \cancel{m} V^2 (\alpha^2 - 1)$$

$$\mu g \cos(\theta) L = \frac{V^2}{2} (\alpha^2 - 1)$$

$$\boxed{\mu = \frac{V^2(\alpha^2 - 1)}{2g\cos(\theta) L}} \Rightarrow L = \frac{V^2(\alpha^2 - 1)}{2g\cos(\theta)\mu}$$

$$mgh = \frac{1}{2} m V^2 + \frac{L}{2} f_R$$

$$\cancel{m} g L \sin(\theta) = \frac{1}{2} \cancel{m} V^2 + \frac{L}{2} \cancel{m} g \cos(\theta) \mu$$

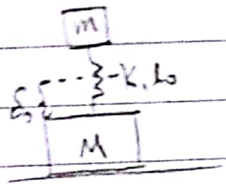
$$gL\left(\sin(\theta) - \frac{\cos(\theta)}{2}\mu\right) = \frac{1}{2} V^2$$

$$\frac{\cancel{V^2}(\alpha^2 - 1)}{\cancel{2}\cos(\theta)\mu}\left(\sin(\theta) - \frac{\cos(\theta)}{2}\mu\right) = \frac{1}{\cancel{2}}\cancel{V^2}$$

$$(\alpha^2 - 1)\left(\frac{tg(\theta)}{\mu} - \frac{1}{2}\right) = 1$$

$$\frac{tg(\theta)}{\mu} = \frac{1}{\alpha^2 - 1} + \frac{1}{2} \Rightarrow \mu = \frac{tg(\theta)}{\frac{1}{\alpha^2 - 1} + \frac{1}{2}}$$

P2.



$$E_i = \delta_0 mg + \frac{1}{2}k(\delta_0 - l_0)^2$$
$$E_f = x_f mg + \frac{1}{2}k(x_f - l_0)^2$$

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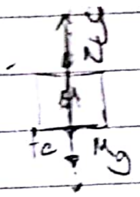


$$y\rfloor \; -Mg - f_e + \cancel{N}^{\,0} = 0$$
$$-Mg + k(x_f - l_0) = 0$$
$$\boxed{x_f = \frac{Mg}{k} + l_0}$$

$$\delta_0 mg + \frac{1}{2}k(\delta_0 - l_0)^2 = \left(\frac{Mg}{k} + l_0\right)mg + \frac{1}{2}k\left(\frac{Mg}{k}\right)^2$$

$$\delta_0 mg + \frac{1}{2}k(\delta_0^2 - 2\delta_0 l_0 + l_0^2) = \left(\frac{Mg}{k} + l_0\right)mg + \frac{M^2g^2}{2k}$$

$$\delta_0^2 + \delta_0\left(\frac{2mg}{k} - 2l_0\right) - \left(\frac{Mg}{k} + l_0\right)\frac{2mg}{k} - \frac{M^2g^2}{k^2} + l_0^2 = 0$$

$$\delta_0 = \frac{-\left(\frac{2mg}{k} - \cancel{2}l_0\right) \pm \sqrt{\left(\frac{2mg}{k} - 2l_0\right)^2 - 4\left(l_0^2 - \frac{M^2g^2}{k^2} - \frac{2mg}{k}\left(\frac{Mg}{k} + l_0\right)\right)}}{\cancel{2}}$$

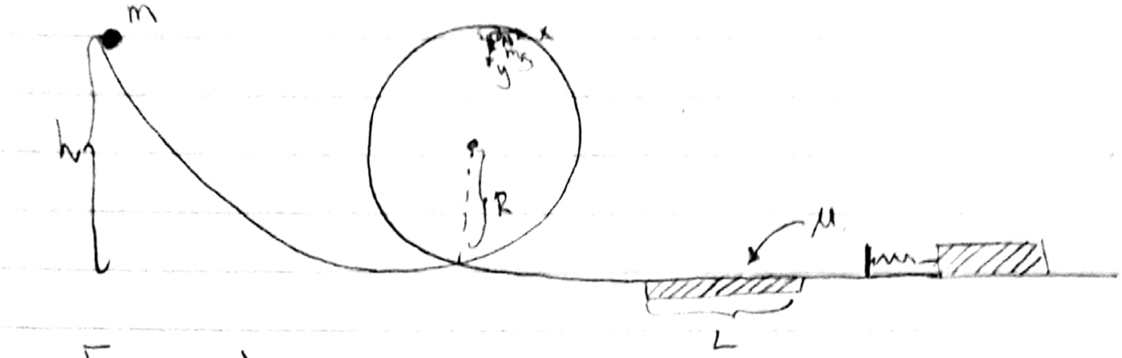
$$= \left(l_0 - \frac{mg}{k}\right) \pm \sqrt{\frac{m^2g^2}{k^2} - 2\cancel{\frac{mgl_0}{k}} + \cancel{l_0^2} - \cancel{l_0^2} + \frac{M^2g^2}{k^2} + \frac{2mMg^2}{k^2} + \cancel{\frac{2mgl_0}{k}}}$$

$$= \left(l_0 - \frac{mg}{k}\right) \pm \sqrt{\frac{g^2}{k^2}(m^2 + 2mM + M^2)}$$

$$= l_0 - \frac{mg}{k} \pm \frac{g}{k}(M+m)$$

- $\delta_{01} = l_0 - \cancel{\frac{mg}{k}} + \frac{Mg}{k} + \cancel{\frac{mg}{k}} = l_0 + \frac{Mg}{k}$
- $\delta_{02} = l_0 - \frac{Mg}{k} - \frac{2mg}{k}$

$P_3.$



$$E_i = mgh$$
$$E_f = 2mgR + \frac{1}{2}mv^2$$

$$\cancel{m}g + \cancel{N}^{0} = \frac{\cancel{m}\cdot v^2}{R}$$

$$\boxed{v = \sqrt{gR}}$$

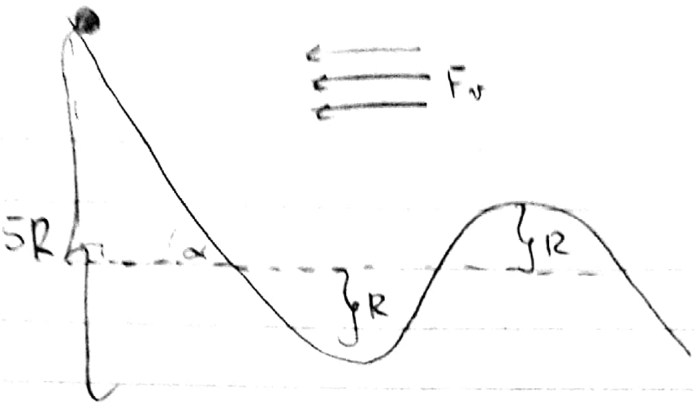
$$E_f = 2mgR + \frac{1}{2}mgR = \frac{5}{2}mgR$$

$$\boxed{h = \frac{5}{2}R}$$

$$\frac{3}{2}L\mu m\cancel{g} = \frac{5}{2}m\cancel{g}R \Rightarrow L = \frac{5}{3}\frac{R}{\mu}$$

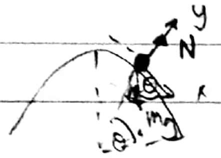
$$E_f = \frac{1}{2}k\Delta^2 = \frac{5}{2}mgR - \frac{5}{3}\frac{R}{\cancel{\mu}}\cdot\cancel{\mu}\cdot mg$$
$$\frac{1}{2}k\Delta^2 = \frac{5}{6}mgR$$
$$\boxed{\Delta = \sqrt{\frac{5}{3}\frac{mgR}{k}}}$$

P4. (a)



$$F_v \cos(\alpha) \cdot \frac{3R}{\sin(\alpha)} = W$$

$$= \frac{3F_vR}{tg(\alpha)}$$



$$\cancel{N}^{\,0} - \cancel{m}g\sin(\theta) = -\frac{\cancel{m}v^2}{R}$$

$$\frac{mv^2}{2} + mg(R + R\sin(\theta)) = 5mgR$$

$$\frac{v^2}{2} + gR(1+\sin(\theta)) = 5gR - \frac{3F_vR}{tg(\alpha)m}$$

$$v^2 = 8gR - 2gR\sin(\theta) - \frac{6F_vR}{tg(\alpha)m}$$

$$g\sin(\theta) = 8g - 2g\sin(\alpha) - \frac{6F_v\cancel{R}}{m\,tg(\alpha)}$$

$$\sin(\theta) = \frac{8}{3} - \frac{2F_v\cancel{R}}{gm\,tg(\alpha)}$$

$$\frac{8}{3} - \frac{2F_v}{mg\,tg(\alpha)} > 0$$

$$\frac{8}{3} > \frac{2F_v}{mg\,tg(\alpha)}$$

$$tg(\alpha) > \frac{3F_v}{4mg}$$

$$\frac{8}{3} - \frac{2F_v}{mg\,tg(\alpha)} < 1$$

$$\frac{2F_v}{mg\,tg(\alpha)} > \frac{5}{3}$$

$$tg(\alpha) < \frac{6F_v}{5mg}$$

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