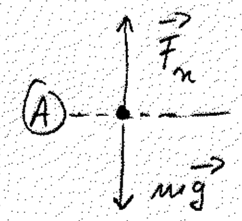
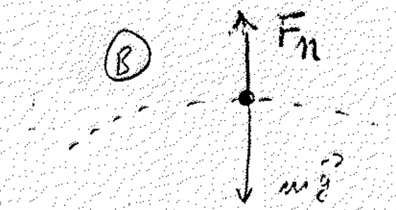
II) A)





Multiple Choice:

1. A
2. C
3. A
4. B
5. E

B) Apply $\Sigma \vec{F} = m\vec{a}$ to B

$$-F_n - mg = -m\frac{v_B^2}{R}$$

$$F_n = m\frac{v_B^2}{R} - mg \quad = 0$$

$$\Rightarrow \quad \underline{\underline{v_B = \sqrt{gR}}}$$

C) $E_A = E_B$

$$mgh_A = \underbrace{\frac{m}{2}v_B^2}_{\frac{m}{2}(gR)} + mg(2R) + \underbrace{W_f}_{0.3\,mgh_A}$$

$$\Rightarrow 0.7\,gh_A = \frac{1}{2}gR + 2gR = \frac{5}{2}gR$$

$$\Rightarrow \quad R = \frac{2}{5}\,0.7\,h_A = (0.28)(1.5\,m) = \underline{0.42\,m}$$

D) $E_B = E_C$

$E_B = E_A - 0.3\,mgh_A = 0.7\,mgh_A$

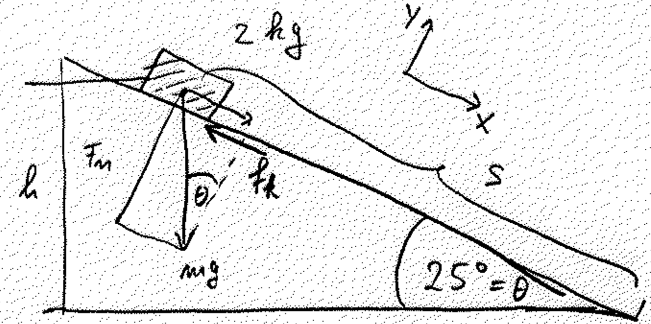
$0.7\,mgh_A =$

$= \frac{m}{2}v_C^2 + mgh_C$

$\Rightarrow v_C = \sqrt{2g(0.7h_A -}$

$= \underline{4.08\,\frac{m}{s}}$

III)



A) No friction ($f_k = 0$): $\sum \vec{F} = m\,\vec{a}$

$$\Rightarrow \; mg \sin\theta = m\, a_x^0$$

$$\Rightarrow \; \underline{a_x^0 = g \sin\theta}$$

With friction: $mg \sin\theta - f_k = m\, a_x$

$$f_k = \mu_k F_n$$

$$= \mu_k\, mg \cos\theta$$

$$\Rightarrow \; \underline{g \sin\theta - \mu_k g \cos\theta = a_x}$$

B) Calculate μ_k: $\mu_k = \dfrac{g \sin\theta - a_x}{g \cos\theta} = \tan\theta - \dfrac{a_x}{g \cos\theta}$

$s = \dfrac{a_x}{2} t^2$ No friction: $s = \dfrac{a_x^0}{2} t^2 = \dfrac{g \sin\theta}{2} t^2,\; t =$

$$= \frac{(9.81 \frac{m}{s^2}) \sin 25°}{2} (5s)^2$$

$$= \underline{51.82\ m}$$

With friction:

$$a_x = \frac{2s}{t^2} = \frac{2 \times 51.82\ m}{(15\ s)^2} = \underline{0.46\ \frac{m}{s^2}}$$

$$\Rightarrow \; \mu_k = \tan 25° - \frac{0.46 \frac{m}{s^2}}{\ldots} = \underline{\underline{0.41}}$$

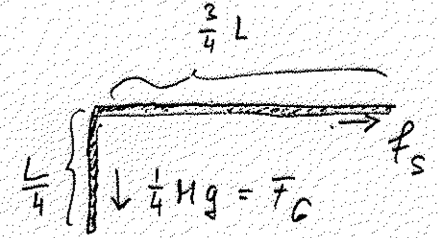
c) $W_f = F_n \cdot s$

$= \mu_k (m\, g \cos\theta)\, s$

$= (0.41)\left(2\,kg \times 9.81\,\frac{m}{s^2} \times \cos 25^\circ\right)(51.82\,m)$

$= \underline{377.8\ Nm}$

IV) A.)



$$f_s = \mu_s \underset{\left(\frac{3}{4}M \cdot g\right)}{\underset{\parallel}{F_m}} = \mu_s \cdot \frac{3}{4} M g$$

$$F_G = \frac{1}{4} M g$$

$$f_s = F_G \Rightarrow \mu_s \frac{3}{4} M g = \frac{1}{4} M g \Rightarrow \underline{\underline{\mu_s = \frac{1}{3}}}$$

B.) $\lambda = \frac{M}{L} \Rightarrow m(y) = \lambda \cdot y \qquad 0 \leq y \leq \frac{L}{4}$

$$dW = F(y)\,dy$$
$$= \overset{\sim}{\overline{m(y)\,g}}\;dy$$
$$dW = \lambda\left(\frac{L}{4} - y\right) g\,dy$$

c.) $$W = \int_0^{L/4} \lambda\left(\frac{L}{4} - y\right) g\,dy = \lambda g \left\{\frac{L^2}{16} - \frac{L^2}{32}\right\}$$
$$= \frac{\lambda g L^2}{32}$$

V)

A.) $\vec{F} = Q\,\vec{E}$

$\quad\; \overset{\shortparallel}{F_x\,\hat{i}} \qquad \overset{\shortparallel}{E_x\,\hat{i}}$ only x component

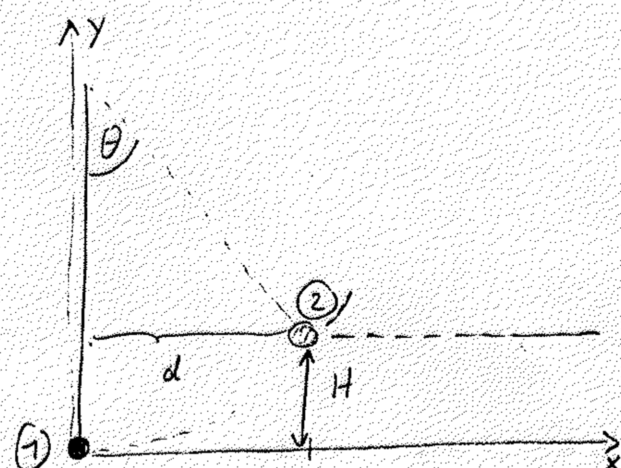
$$F_x = Q\,E_x$$

$$F_x = -\frac{dU_x}{dx} \Rightarrow dU_x = -F_x\,dx = -Q\,E_x\,dx$$

$$\Rightarrow \underline{U_x = -Q E_x\,x + Const}$$

B.) Zero

C.)



$E_{kin} = 0\,,\; U_{Grav} = mgH$

$U_{El} = U_x(d) = -QE$

$y = 0 : U_{Grav} = 0$

$x = 0 : U_{El} = 0 \Rightarrow \underline{U_x(0) = 0 = Const}$

Conservation of energy : $E_{ng_1} = E_{ng_2}$

$$\underbrace{\phantom{E_{ng_1}}}_{\overset{\shortparallel}{0}} = U_{Grav} + U_{El}$$

$$= mgH - Q\,E_x\,d$$

$$\Rightarrow \boxed{\frac{H}{d} = \frac{Q\,E_x}{mg}}$$