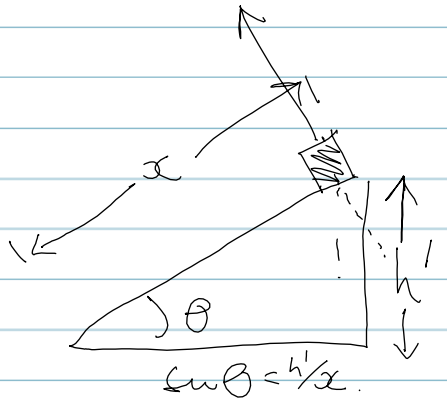
Work & Energy

1. a) $E_S = \frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$$v = \sqrt{\frac{kx^2}{m}} = \underline{14.1 \text{ m/s}}$$



Total energy at lowest point $= \frac{1}{2}kx^2 + mgh$

Energy gained moving up slope:

— $\underline{F_f}$ up slope $= \mu_k F_N = \mu_k mg\cos\theta$

— Wd up slope $= f_f x = \mu_k mg \frac{\cos\theta}{\sin\theta} h'$

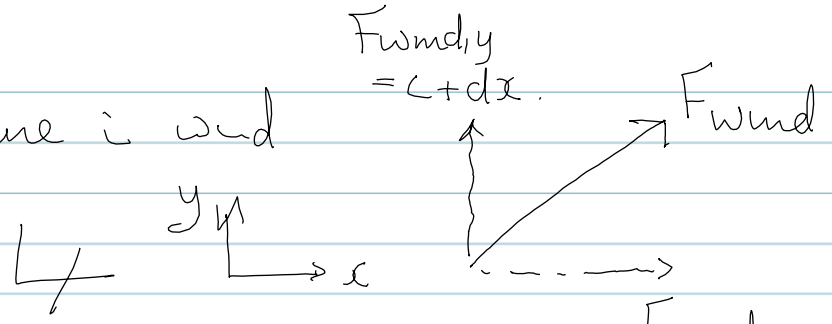
$$= \frac{\mu_k mg h'}{\tan\theta}$$

Energy up slope $= mgh' + \frac{\mu_k mg h'}{\tan\theta}$

Equate, solve for h'

$$h' = \frac{\frac{1}{2}kx^2 + mgh}{mg\left(1 + \mu_k/\tan\theta\right)} = \boxed{16 \text{ m}}$$

2 Plane is wind



$F_{wind,x} = a + bx$

$$Wd = \int \vec{F} \cdot dx = \int_0^x a + bx = ax + \frac{bx^2}{2}$$

3 KE lost = wd by air friction.

$$Wd = \int_0^\infty F\,dx = \int_0^\infty be^{-cx}$$

$$= \left[-\frac{b}{c} e^{-cx} \right]_0^\infty$$

$$= 0 - -b/c = b/c.$$