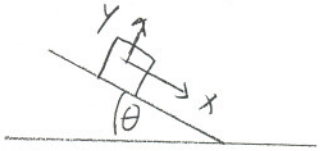
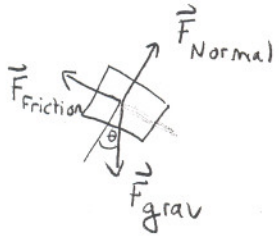
Homework #5

1) Bose on plane, $\theta = 23.5°$; friction coeff. $\mu_K = 0.17$

a) 

Forces acting on bose: 

Forces in x-direction: $\sum F_x = F_{Friction} + F_{grav,x}$

$= -\mu_k F_{Normal} + m g \sin\theta$ (*)

Normal force (y): $\sum F_y \stackrel{!}{=} 0 = F_{grav,y} + F_{Normal} \Rightarrow F_{Normal} = -F_{grav,y}$

$= m g \cos\theta$

$\Rightarrow$ (*) $\sum F_x = -\mu_k m g \cos\theta + m g \sin\theta \stackrel{N II}{=} m a$

$\Rightarrow \quad a = -\mu_k g \cos\theta + g \sin\theta = g(\sin\theta - \mu_k \cos\theta) = 0.24\, g$

$= 2.38 \frac{m}{s^2}$

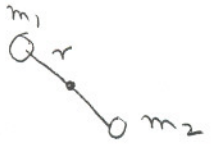
b) $v_{final}^2 = v_{initial}^2 + 2 a \Delta x$; $\Delta x = 8.80\ m$

$\Rightarrow v_{final} = \underline{6.47 \frac{m}{s}}$

2) Roller coaster: Must have $F_{grav} = +F_{centripetal}$

or $\quad g = a_{centripetal} = \frac{v^2}{r}$

$\Rightarrow \quad v = \sqrt{rg} = \underline{8.5 \frac{m}{s}}$

3) 

$r = 0.78\,m$ $\quad T = 3s$ $\quad \frac{2\pi r}{v} = T \Rightarrow v = \frac{2\pi(0.78\,m)}{3s} = 1.63\,\frac{m}{s}$

$\Rightarrow a = \frac{v^2}{r} = 3.42\,\frac{m}{s^2} \Rightarrow F = ma = \underline{205\,N}$

4) Acceleration on Venus: $g_{Venus} = G\frac{M_{Venus}}{r^2_{Venus}} = \underline{8.86\,\frac{m}{s^2}}$

5) Spaceshuttle: $h = 570\,km$ $\quad r = r_{Earth} + h = 6380 + 570\,km$

Circular orbit: $F_{centripetal} = F_{grav} \Rightarrow a = \frac{v^2}{r} = \frac{MG}{r^2} \Rightarrow v = \sqrt{\frac{MG}{r}}$

$= \underline{7580\,\frac{m}{s}}$

6) $m = 56\,kg$ woman in elevator going $v = const. = 4.0\,\frac{m}{s}$

a) $F_N - F_{grav} = ma \Rightarrow F_N = mg = \underline{549\,N} \triangleq 56\,kg$

b) Same as a) 56 kg

c) $F_N - F_{grav} = ma \Rightarrow m = m\left(1 + \frac{a}{g}\right) = (1+0.35)\,56\,kg = \underline{75.6\,kg}$

d) $F = m(g-a) = \underline{357\,N} \triangleq \underline{36.4\,kg}$

e) 0 kg, no force: $F = m(g-a) = m(g-g) = 0$