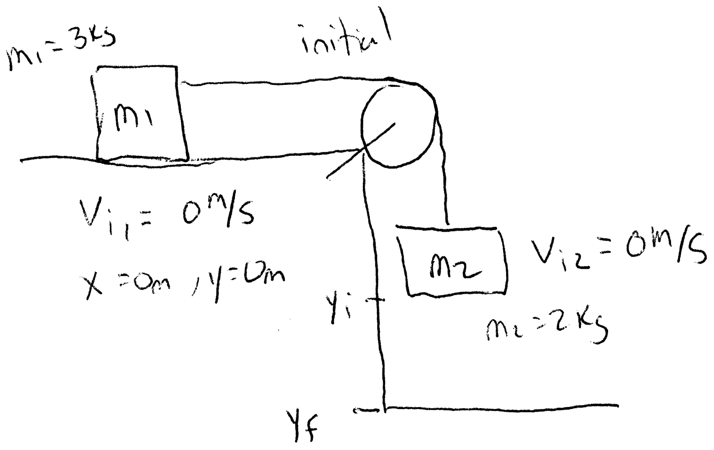
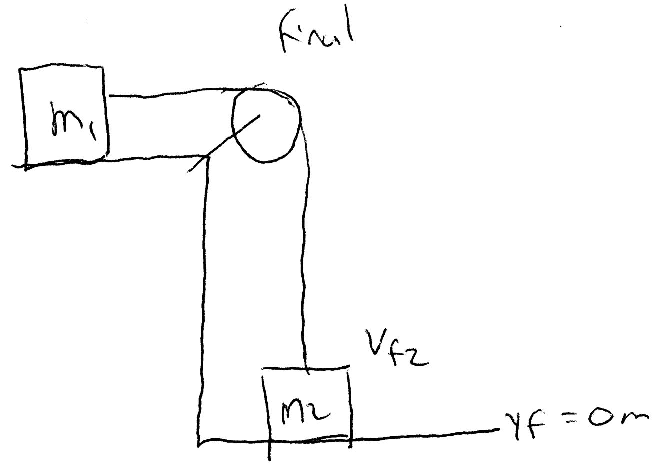
Exam 3 practice

Ch. 11 50





$\Delta y = y_f - y_i = -1.50 m$

note: $V_{f1} = V_{f2} = V_f$

a) no friction, so mechanical energy is conserved.

$$K_i + U_{gi} = K_f + U_{gf}$$

$$\cancel{\tfrac{1}{2} m_1 v_{i1}^2}^{\,0} + \cancel{\tfrac{1}{2} m_2 v_{2i}^2}^{\,0} + m_2 g y_i = \tfrac{1}{2} m_1 v_f^2 + \tfrac{1}{2} m_2 v_f^2 + \cancel{m_2 g y_f}^{\,0}$$

$$\text{or} \quad V_f = \sqrt{\frac{2 m_2 g y_i}{m_1 + m_2}} = \left[\frac{2(2kg)(10 m/s^2)(1.5m)}{5 kg}\right]^{1/2}$$

$$\boxed{= 3.5 m/s}$$

b) $\mu = 0.15$

now we can't ignore ΔE_{th} = W done by friction

$= (f)(\Delta x) = (\mu m_1 g)(\Delta x)$

$= (.15)(3kg)(10 m/s^2)(1.5m)$

$= 6.75 J$

so conservation of energy is.

$$K_{1f} + K_{2f} + U_{2f} + \Delta E_{th} = K_{1i} + K_{2i} + U_{2i}$$

note: $U_{1i} = U_{1f}$ so $\Delta U_1 = 0$

$$\frac{1}{2}m_1v_{1f}^2 + \frac{1}{2}m_2v_{2f}^2 + mgy_f + \Delta E_{th} = m_2gy_{2i}$$

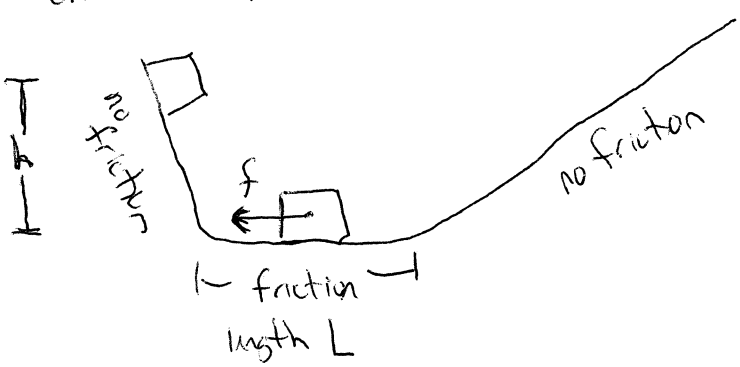
or $$v_f = \sqrt{\left(\frac{2}{m_1+m_2}\right)\left[m_2g(y_i) - \Delta E_{th}\right]}$$

$$= \sqrt{\left(\frac{2}{5\,kg}\right)\left[(2\,kg)(10\,m/s^2)(1.5\,m) - 6.75\,J\right]}$$

$$\boxed{= 3.0\,m/s}$$

slower than part 'a' because friction took mechanical energy from system

ch. 11 #57



a) here, mechanical energy is conserved!

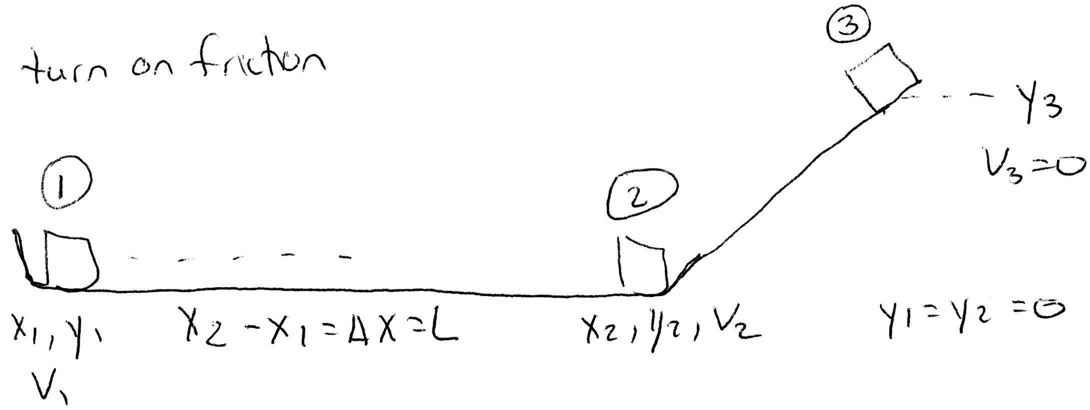
$$E_{top} = E_{bottom}$$

$$K_{top} + U_{top} = K_{bottom} + U_{bottom}$$

$$\frac{1}{2}\cancel{m}v_t^2 + \cancel{m}gh = \frac{1}{2}\cancel{m}v_b^2 + mg(0)$$

$$v_b = \sqrt{2gh}$$

b) now turn on fricton



E at 1 − W = E at 2 = E at 3 so

$$K_3 + U_{g3} + \Delta E_{th} = K_1 + U_{g1} + \cancel{W_{ext}}$$ (no external forces)

↑ $V_3 = 0$, so $K_3 = 0$

$$mgy_3 + \mu_K mgL = \frac{1}{2} m V_1^2 + \cancel{mgy_1}^{\,0}$$

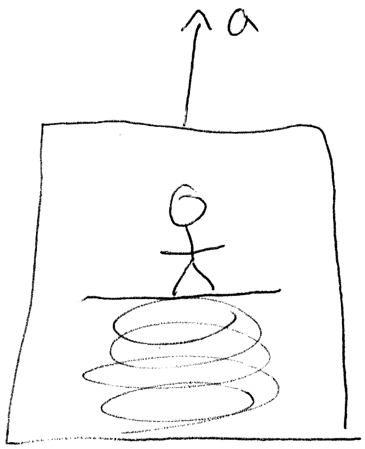
but $V_1^2 = 2gh$

$$\cancel{mg}y_3 = \cancel{mg}h - \mu_K \cancel{mg}L$$ or

$$\boxed{y_3 = h - \mu_K L}$$

ch 10

18)



[Force of spring on student]

$m = 60\,kg$

$K = 2500\,N/m$

(ΣF_y): $\vec{F}_{s\,on\,s} - F_G = ma_y$

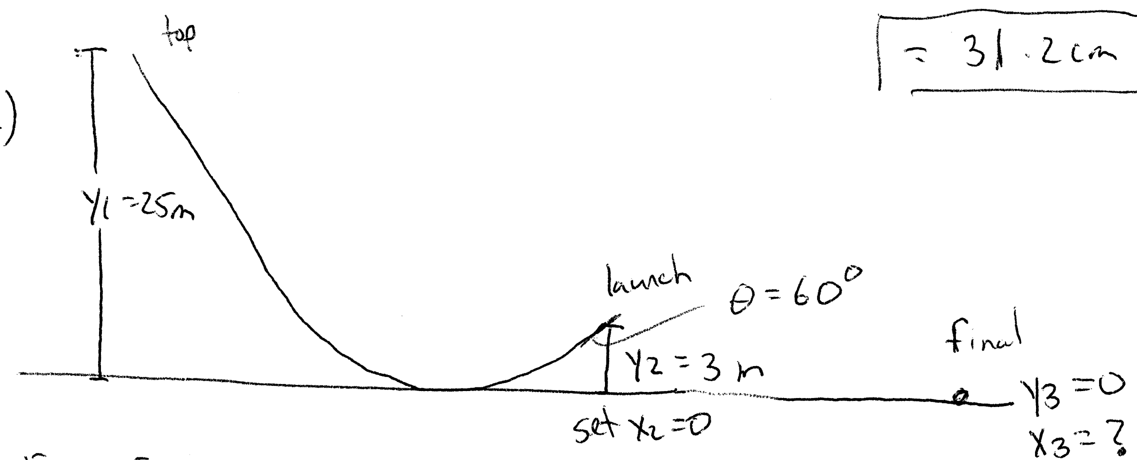
$F_{s\,on\,s} = ma_y + F_G$ but $F_{s\,on\,s} = K\Delta y$

so $\Delta y = \dfrac{ma_y + F_G}{K} = \dfrac{m(a_y + g)}{K} = \dfrac{(60\,kg)(3\,m/s^2 + 10\,m/s^2)}{2500\,N/m}$

$= .312\,m$

$\boxed{= 31.2\,cm}$

49)



$E_{top} = E_{launch}$

$\cancel{K_T}^{0} + U_T = K_L + U_L$

$\cancel{m}gy_1 = \frac{1}{2}\cancel{m}V_L^2 + \cancel{m}gy_2$

or $V_L = \sqrt{2g(y_1 - y_2)}$

now it's a projectile motion problem!!!

$y_3 = y_2 + V_{2y}\Delta t + \frac{1}{2}a_y(\Delta t)^2$

and $X_3 = \cancel{X_2}^{0} + V_{2x}\Delta t + \cancel{\frac{1}{2}a_x}^{0}(\Delta t)^2$

$V_{2y} = V_L \sin\theta$

$a_y = -g$

solve for Δt (need to use quadratic equation)

$V_{2x} = V_L \cos\theta$

solve for X_3

Ch. 10

#58) Skip this. Don't spend a lot of time on relative motion . . .

Ch. 9

45) $p_i = 0$ $\qquad\qquad$ $p_f = 0$

$m_1 \qquad m_2 = 7m_1$

$\Delta x_1 = ? \qquad \Delta x_2 = 8.2\,m$

$\mu_1 = \mu_2 = \mu$

friction causes both particles to accelerate (i.e. $v_f = 0$)

Use cons. of momentum

$$0 = m_1 v_{1f} + m_2 v_{2f}$$

$$= m_1 (v_{1f} + 7 v_{2f})$$

or $v_{1f} = -7 v_{2f}$ *

and $v_{2f} = -\frac{1}{7} v_{1f}$

$$f_k = \mu_k N$$
$$= \mu m_2 g$$

$$(\Sigma F_x): \; -\mu \cancel{m_2} g = \cancel{m_2} a_2$$

$$\boxed{a_2 = -\mu g}$$

$$v_{f2}^2 = v_{i2}^2 + 2a\Delta x_2$$

here: v_{i2} = velocity of m_2 right after explosion; v_{f2} = velocity of m_2 AFTER coming to rest. (note: v_{i2} is the same as v_{2f} in the cons. of momentum equation)

$$v_{i2}^2 = v_{f2}^2 - 2a\Delta x_2$$

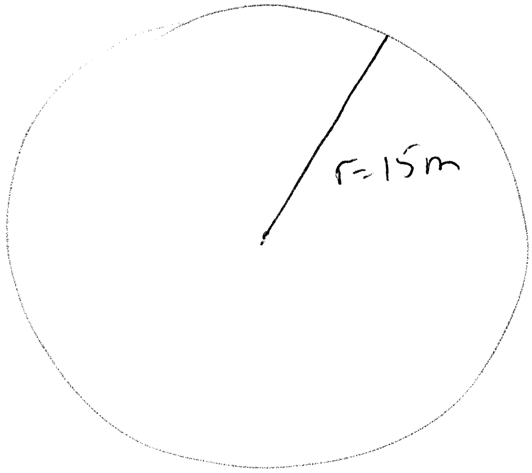
or $$v_{i2} = \sqrt{-2a\Delta x_2}$$
$$= \sqrt{-2(-\mu g)\Delta x_2}$$
$$= \sqrt{2(\mu)(10)(8.2)}$$
$$= 12.8\sqrt{\mu}\ \text{m/s}$$ right after explosion

plug into *

$$\boxed{\begin{aligned} v_{1f} &= -7 v_{2f} \\ &= -7(12.8)\sqrt{\mu} \\ &= -89.6\sqrt{\mu}\ \text{m/s} \end{aligned}}$$

Ch. 8

40)



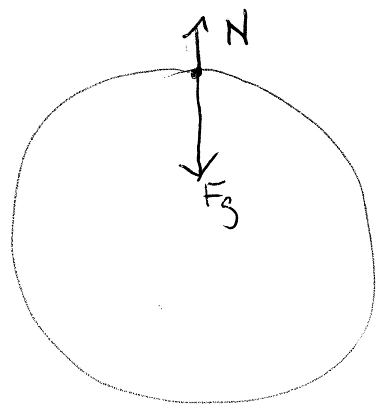
Δt for 1 rev = 25 s

a) $\Delta s = v\Delta t$ or

$$v = \frac{\Delta s}{\Delta t} = \frac{2\pi r}{\Delta t} = \frac{2\pi(\cancel{15}^{3})}{\cancel{25}_{5}} = \frac{6\pi}{5}\ m/s = \boxed{3.8\ m/s}$$

$$a = \frac{v^2}{r} = \frac{(3.8\ m/s)^2}{15\ m} = \boxed{.96\ m/s^2}$$

b)



(ΣF_r): $F_g - N = ma_r$

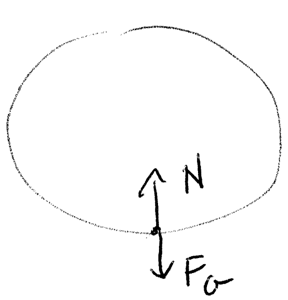
$N = F_g - ma_r$

$= mg - m(.96\ m/s^2)$

$= m\cdot(9.04)\ N$

so $\frac{w_T}{F_o} = \frac{\cancel{m}(9.04)\ N}{\cancel{m}\ g} = .90$ apparent weight is decreased

c)



(ΣF_r): $N - F_o = \frac{mv^2}{r}$ or

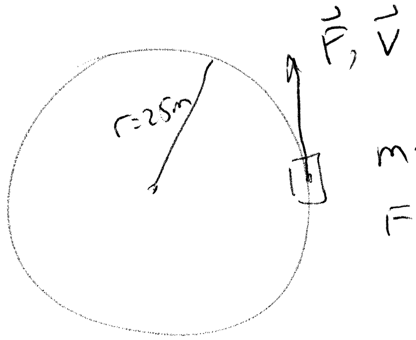
$N = F_o + \frac{mv^2}{r}$ apparent weight is increased.

$= m(10.96)$

$\frac{w_b}{F_o} = \frac{10.96}{10} = 1.1$

Ch. 8

50)



$m = 1500\,kg$

$F = 1000\,N$

a) @ $t = 10s$, car has both tangential & radial acceleration

a_T = constant!

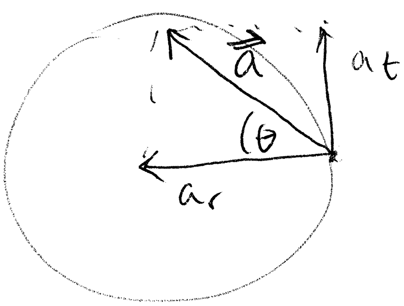
$F = m a_T$ or $a_T = \frac{F}{m} = \frac{1000\,N}{1500\,kg} = \frac{2}{3}\,m/s^2 = \underline{.67\,m/s^2}$

speed @ 10s is ...

$v_f = v_o + at$

$= \left(\frac{2}{3}\,m/s^2\right)(10s) = \frac{20}{3}\,m/s = 6.67\,m/s$

@ 10s, $a_r = \frac{v^2}{r} = \frac{\left(\frac{20}{3}\right)^2}{25} = \frac{(20)(20)}{(9)(25)} = \frac{16}{9}\,m/s^2$



$\tan\theta = \frac{a_t}{a_r}$ or

$\theta = \tan^{-1} \frac{\frac{2}{3}}{\frac{16}{9}}$

$= \tan^{-1}(3/8) = \boxed{21^\circ}$

Ch. 8

50) cont...

car slides when static friction can no longer provide the centripetal force.

(ΣF_r): $f_{s_{max}} = \mu_s N = \mu_s mg$

(ΣF_r): $f_{s_{max}} = \frac{mv^2}{r}$

$\mu_s \cancel{m} g = \frac{\cancel{m} v^2}{r}$ or

$v = \sqrt{\mu_s r g}$ here $\mu_s = 1.0$

$= \sqrt{25(10\,m/s^2)} = \underline{15.8\ m/s}$

how long to reach that speed?

$V_f = \cancel{V_0} + at$

$\Delta t = \frac{V_f}{a} = \frac{15.8\,m/s}{.67\,m/s^2} = \boxed{23.6\,s}$