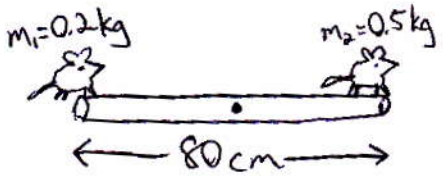
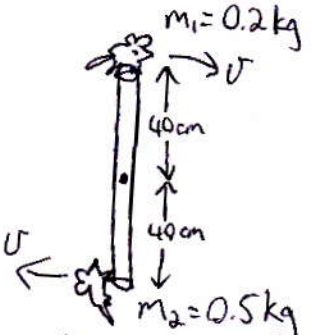
Recitation Week 7

Ch.7 #58





PE initial = 0

KE initial = 0

E initial = 0

E final = 0

PE final = $m_1gh_1 + m_2gh_2$

$= 0.2(9.8)(0.4) + 0.5(9.8)(-0.4) = -1.18\,J$

KE final = $\frac{1}{2}m_1v^2 + \frac{1}{2}m_2v^2 = 1.18\,J$

$\frac{1}{2}(m_1+m_2)v^2 = 1.18\,J$

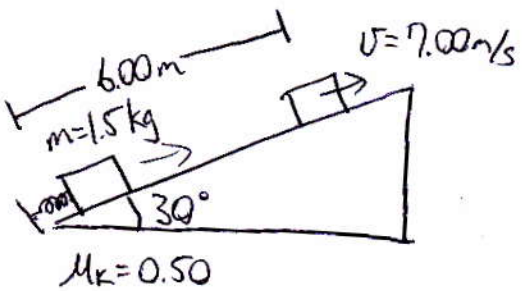
$\frac{1}{2}(0.2+0.5)v^2 = 1.18$

$v^2 = 3.37 \Rightarrow \boxed{v = 1.84\ m/s}$

Ch.7 #73

$\sin 30 = \frac{h}{d} = \frac{h}{6.00}$

$h = 6\sin 30 = 3.00\,m.$



Initial spring PE = final KE + final PE + W_f

$= \frac{1}{2}mv^2 + mgh + F_f \cdot d$

$= \frac{1}{2}mv^2 + mgh + \mu_k mg\cos\theta \cdot d$

$= \frac{1}{2}(1.5)(7)^2 + 1.5(9.8)(3) + 0.5(1.5)(9.8)\cos 30 \cdot 6$

$= 36.75 + 44.1 + 38.19$

$= \boxed{119.04\ J}$

Ch.7 #78

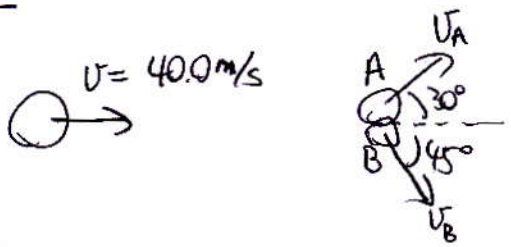
1.3×10^8 J/gallon = efficiency of gasoline

KE of car $= \frac{1}{2}mv^2 = \frac{1}{2}(1500)(37)^2 = 1.03\times10^6$ J

$$\#\text{gallons used} = \frac{KE}{(\text{efficiency of gasoline})\cdot(\text{efficiency of engine})}$$

$$= \frac{1.03\times10^6\ \text{J}}{1.3\times10^8\ \frac{\text{J}}{\text{gallon}}\cdot 0.15} = \boxed{5.3\times10^{-2}\ \text{gallons}}$$

Ch.8 #28



$p = mv$

$P_0 = P_f$

a) $P_{Ay} = -P_{By}$

$m_A v_{Ay} = -m_B v_{By}$

$v_{Ay} = -v_{By}$

$v_A \sin 30 = -v_B \sin(-45)$

$v_A = 1.41 v_B$

$P_{Ax} + P_{Bx} = P_{A0}$

$m_A v_{Ax} + m_B v_{Bx} = m_A v$

$v_A \cos 30 + v_B \cos(-45) = 40$

$1.41 v_B \cos 30 + v_B \cos 45 = 40$

$v_B(1.41\cos 30 + \cos 45) = 40$

$\boxed{v_B = 20.7\ \text{m/s}}$

$\boxed{v_A = 1.41 v_B = 29.2\ \text{m/s}}$

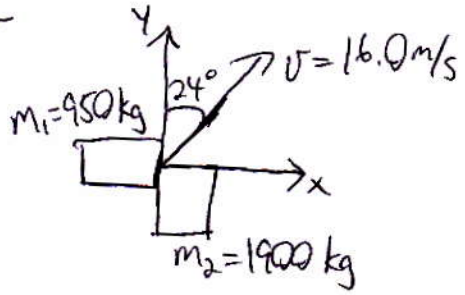
b) $E_0 = \frac{1}{2}m_A v^2$

$E_f = \frac{1}{2}m_A v_A^2 + \frac{1}{2}m_B v_B^2$

$$\frac{E\ \text{dissipated}}{E_0} = \frac{E_0 - E_f}{E_0} = \frac{\frac{1}{2}m_A v^2 - \frac{1}{2}m_A v_A^2 - \frac{1}{2}m_B v_B^2}{\frac{1}{2}m_A v^2} = \frac{v^2 - v_A^2 - v_B^2}{v^2} = \frac{40^2 - 20.7^2 - 29.2^2}{40^2}$$

$$\boxed{= 0.2}$$

Ch.8 #37



All momentum in x-direction comes from subcompact (m_1).
All momentum in y-direction comes from truck (m_2).

$$P_y = m_{tot} v_y = (m_1+m_2) v \cos 24$$
$$= (950+1900)(16)\cos 24$$
$$= 4.17 \times 10^4 \text{ kg m/s}$$
$$P_y = m_2 v_{20} = 4.17 \times 10^4 \text{ kg m/s}$$
$$1900 v_{20} = 4.17 \times 10^4$$
$$\boxed{v_{20} = 21.9 \text{ m/s}}$$

$$P_x = m_{tot} v_x = (m_1+m_2) v \sin 24$$
$$= (950+1900)(16)\sin 24$$
$$= 1.85 \times 10^4 \text{ kg m/s}$$
$$P_x = m_1 v_{10} = 1.85 \times 10^4 \text{ kg m/s}$$
$$950 v_{10} = 1.85 \times 10^4$$
$$\boxed{v_{10} = 19.5 \text{ m/s}}$$

Ch.8 #39

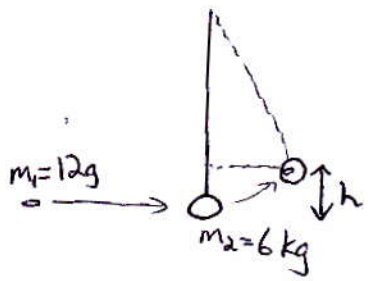
b) $E_0 = \frac{1}{2} m_1 v_1^2 \qquad v_1 = 380 \text{ m/s}$

$$= \tfrac{1}{2}(0.012)(380)^2$$
$$= \boxed{866.4 \text{ J}}$$

a) $E_f = m_{tot} g h = \frac{1}{2} m v^2$

[redacted]

$$m_1 v_1 = (m_1+m_2) v$$
$$0.012(380) = (0.012+6) v$$
$$v = 0.76 \text{ m/s}$$
$$mgh = \tfrac{1}{2} m v^2$$
$$h = \frac{\frac{1}{2}v^2}{g} = \frac{\frac{1}{2}(0.76)^2}{9.8} = \boxed{0.029 \text{ m}}$$



c) $\frac{1}{2} m v^2 = \frac{1}{2}(6.012)(0.76)^2$

$$= \boxed{1.74 \text{ J}}$$

Ch.8 #63

a) Impulse = Δp $\quad m = 0.04\ kg$

$v^2 = 2a\Delta x$

$v^2 = 2(9.8)(2.00m)$

$v^2 = 39.2$

$v = 6.26\ m/s$ $\longleftrightarrow$ opposite directions. $v_{up} = 5.6\ m/s$

$v_{up}^2 = 2a\Delta x$

$v_{up}^2 = 2(9.8)(1.6m)$

$v_{up}^2 = 31.36$

Impulse $= \Delta p = mv - mv_{up} = 0.04(6.26 - (-5.6)) = \boxed{0.47\ Ns}$

b) $t = 2 \times 10^{-3}\ s.$

$F \cdot t = \text{Impulse}$

$F(2 \times 10^{-3}) = 0.47$

$\boxed{F = 235\ N}$