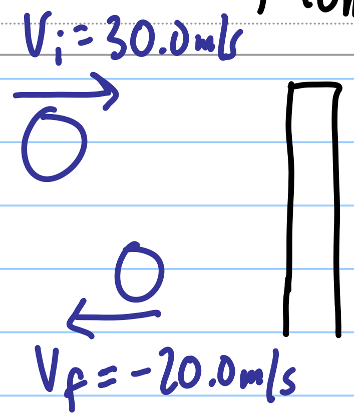
Note Title 09/03/2010

Momentum Review Package

1.)



$$\Delta p = m\Delta v = m(v_f - v_i)$$
$$= (0.080\,kg)(-20.0 - 30.0)\,m/s$$
$$= -4.00\,kg\,m/s$$

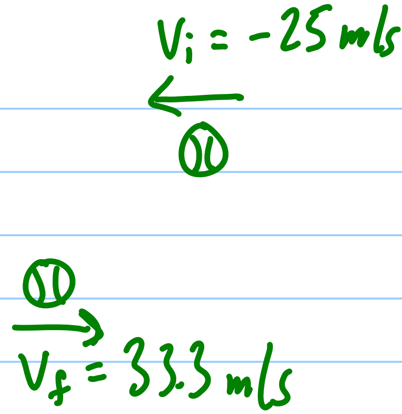
2.) $\Delta p = F_{net} \cdot t = (100.0\,N)(0.020\,s) = 2.0\ N \cdot s$

$\Delta p = m \Delta v$ $\quad$ $\Delta v^{*} = \frac{\Delta p}{m} = \frac{2.0\ N \cdot s}{0.060\,kg} = 33\ m/s$

$* \quad \Delta v = v_f - \overset{0}{\cancel{v_i}}$

$\Delta v = v_f$

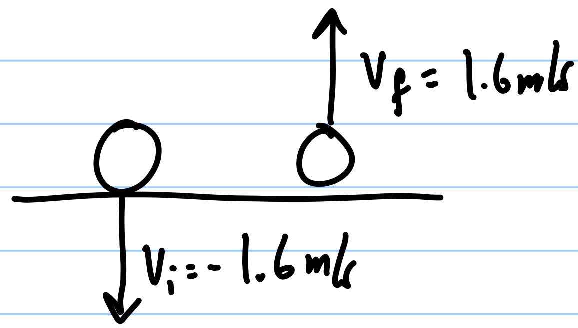
3)



$$\Delta p = m\Delta v = (0.0500\ \text{kg})[33.3 - (-25)]\ \text{m/s}$$

$$= 2.9\ \text{kg m/s}$$

4.)



a) $\Delta p = m\Delta v = m(v_f - v_i)$

$= (0.210\,kg)[1.6-(-1.6)]\,m/s$

$= 0.76\,kg\,m/s$

b) $\Delta p = F_{net} \cdot t$ ← same as ball $= 0.76\,kg\,m/s$

same as ball

c) $\Delta p = F_{net}\, t$ $\quad F_{net} = \frac{\Delta p}{t} = \frac{0.76\,kg\,m/s}{0.11\,s} = 6.9\,N$

5.) a. $\Delta p = m\Delta v = m(v_f - v_i) = (0.220\,kg)(40 - 0)$

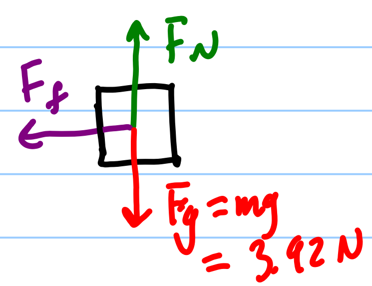
$= 8.8\ kg\,m/s$

b. $\Delta p = F_{net}\,t$ $\quad F_{net} = \frac{\Delta p}{t} = \frac{8.8\ kg\,m/s}{0.013\ s} = 680\,N$

6.) a. $\Delta p = m\Delta v = m(v_f - v_i) = (0.400\,kg)(2.1 - 4.3)\,m/s$

$= -0.88\ kg\,m/s$

b.



$\Delta p = F_{net} \cdot t$ $\quad F_{net} = \dfrac{\Delta p}{t} = \dfrac{-0.88\ kg\,m/s}{1.3\ s}$

$= -0.68\ N$

c. $F_{net} = F_f$ $\quad F_f = \mu F_N$ $\quad \mu = \dfrac{F_f}{F_N} = \dfrac{0.68\ N}{3.92\ N}$

$= 0.17$

7.) a. $\Delta p = m\Delta v = m(v_f - v_i) = (0.275\,kg)(13.2 - 15)\,m/s$

$= -0.50\,kg\,m/s$

b. $\Delta p = F_{net} \cdot t$ $\quad F_{net} = \frac{\Delta p}{t} = \frac{-0.50\,kg\,m/s}{1.7\,s} = -0.29\,N$

c. $F_f = \mu F_N$ $\quad \mu = \frac{F_f}{F_N} = \frac{0.29\,N}{2.695\,N} = 0.11$

$F_g = F_N = mg = 2.695\,N$

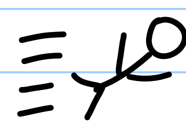
8.) $\Delta p = F_{net} \cdot t = (400.0\,N)(1.3\,s) = 520\,N \cdot s$

$\Delta p = m\Delta v \qquad \Delta v = \frac{\Delta p}{m} = \frac{520\,N \cdot s}{22\,kg} = 23.6\,m/s$

$\Delta v = v_f - v_i \qquad v_f = \Delta v + v_i = 23.6 + (-3.5) = 20.\,m/s$

$v_i = -3.5\,m/s$

backwards



$v_f = ?$

9.) a. $\Delta p = m\Delta v = (55\,kg)(7.5 - 3.0)\,m/s = 250\,kg\,m/s$

b. $\Delta p = F_{net} \cdot t$ $\qquad t = \frac{\Delta p}{F_{net}} = \frac{250\,kg\,m/s}{50\,N} = 5.0\,s$

10.) a. $m\Delta v = F_{net} \cdot t$

$$t = \frac{m\Delta v}{F_{net}} = \frac{(6.00\times10^{4}\,kg)(0-12.0)\,m/s}{-4.00\times10^{3}\,N} = 180\,s$$

b. $F_{net} = ma$

$$a = \frac{F_{net}}{m} = \frac{4.00\times10^{3}\,N}{6.00\times10^{4}\,kg} = 0.0667\,m/s^2$$

$v = 0$
$v_0 = 12.0\,m/s$
$a = -0.0667\,m/s$
$d = ?$
$t = 180\,s$

$$d = \frac{v^2 - v_0^2}{2a} = \frac{0^2 - (12.0)^2}{2(-0.0667)} = 1080\,m$$

11.) a. $v = 0$ $\quad v^2 = v_0^2 + 2ad$

$v_0 = 75\,m/s$

$a = ?$ $\quad a = \dfrac{v^2 - v_0^2}{2d} = \dfrac{0^2 - 75^2}{2(0.80)} = -3516\,m/s^2$

$d = 0.80\,m$

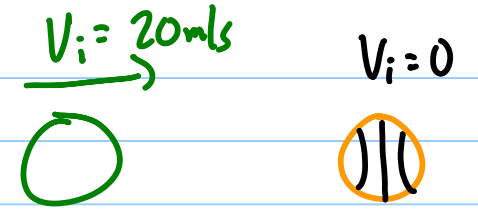
$t =$

b. $v = v_0 + at$ $\quad t = \dfrac{v - v_0}{a} = \dfrac{0 - 75\,m/s}{3516\,m/s^2} = 0.0213\,s$

c. $m\Delta v - F_{net} \cdot t$ $\quad F_{net} = \dfrac{m\Delta v}{t} = \dfrac{(45\,kg)(0-75)}{0.0213} = 1.6 \times 10^5\,N$

d. $F_{net} = ma = (45\,kg)(3516) = 1.6 \times 10^5\,N$

12.)



a. West

b. $\Delta p = F_{net} \cdot t = (100 N)(0.04 s) = 4 N \cdot s$

c. Newton's 3rd Law $\therefore$ $F_{bball} = 100 N$

d. Impulses are equal $\therefore$ $\Delta p_{bball} = 4 N \cdot s$

e. Total momentum is conserved $\therefore$ $\Delta p_{total} = 0$

13.) a. $\Delta p = F_{net} \cdot t = (400.0\,N)(0.50\,s) = 2.0 \times 10^{2}\ N \cdot s$

b. $\Delta p = m \Delta v \qquad \Delta v = \frac{\Delta p}{m} = \frac{-200\ N \cdot s}{90\ kg} = -2.22\ m/s$

$\Delta v = v_f - v_i \qquad v_f = \Delta v + v_i = (-2.22 + 12)\ m/s$

$= 10\ m/s$

c. Impulses are equal and opposite $\therefore$ $\Delta p_{jovo} = 2.0 \times 10^{2}\ N \cdot s$

d. $\Delta p_{total} = 0$

14.) a. $\Delta p = m\Delta v = m(v_f - v_i) = (0.3500\,kg)(50.0 - 14.0)\,m/s$

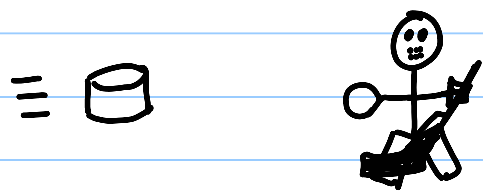
$= 11.5\,kg\,m/s$

b. $\Delta p = F_{net} \cdot t$ $\quad F_{net} = \frac{\Delta p}{t} = \frac{11.5\,kg\,m/s}{0.0100\,s} = 1150\,N$

c. $\Delta p_{stick} = -\Delta p_{puck} = 11.5\,kg\,m/s$ (backwards)

Collisions

1.) **Before** | **After**



$m_1 = 0.250\,kg$ $\quad m_2 = 80.0\,kg$ $\quad m_T = 80.250\,kg$

$v_{1i} = 40.0\,m/s$ $\quad v_{2i} = 0$ $\quad v_f = ?$

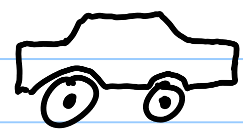
$$m_1 v_{1i} + m_2 \cancel{v_{2i}}^{\,0} = m_T v_f$$

$$m_1 v_{1i} = m_T v_f$$

$$v_f = \frac{m_1 v_{1i}}{m_T} = \frac{(0.250)(40.0)}{80.250} = \boxed{0.125\ m/s}$$

2.)

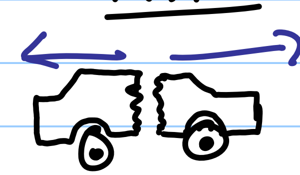
Before



$m_t = 1200\ kg$

$V_i = 0$

After



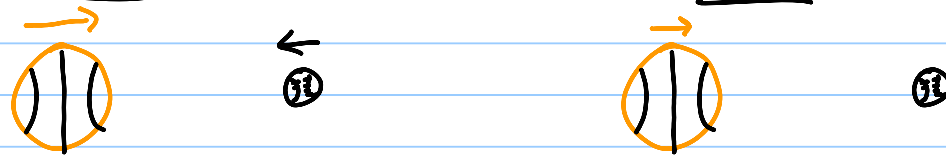
$m_1 = 450\ kg \quad m_2 = 750\ kg$

$V_{1f} = -22\ m/s \quad V_{2f} = ?$

$m_t \cancel{V_i}^{\,0} = m_1 V_{1f} + m_2 V_{2f}$

$$V_{2f} = \frac{-m_1 V_{1f}}{m_2} = \frac{-(450\ kg)(-22\ m/s)}{750\ kg} = 13\ m/s$$

3) Before After



a.

$m_1 = 0.650\ kg$ $m_2 = 0.190\ kg$ $m_1 = 0.650$ $m_2 = 0.190$

$v_{1i} = 6.3\ m/s$ $v_{2i} = -2.8\ m/s$ $v_{1f} = 1.3$ $v_{2f} = ?$

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

$$v_{2f} = \frac{m_1 v_{1i} + m_2 v_{2i} - m_1 v_{1f}}{m_2} = \frac{(0.650)(6.3) + (0.190)(-2.8) - (0.650)(1.3)}{0.190}$$

$$= 14\ m/s \text{ (right)}$$

b. $\Delta p = m\Delta v = m(v_f - v_i) = (0.650)(1.3 - 6.3)$

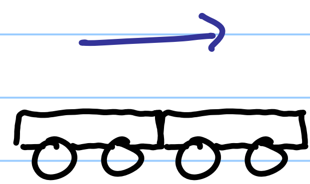
$$= -3.25\ kg\ m/s$$

c. $\Delta p = m\Delta v = m(v_f - v_i) = (0.190)(14 - 2.8)$

$$= 3.25\ kg\ m/s$$

4.)

Before



$m_T = 5.0\ kg$

$V_i = 2.0\ m/s$

After

$m_1 = 2.5$ $\quad$ $m_2 = 2.5\ kg$

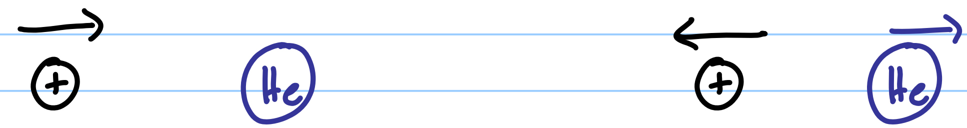
$V_{1f} = ?$ $\quad$ $V_{2f} = 4.0\ m/s$

$$m_T V_i = m_1 V_{1f} + m_2 V_{2f}$$

$$V_{1f} = \frac{m_T V_i - m_2 V_{2f}}{m_1} = \frac{(5.0)(2.0) - (2.5)(4.0)}{2.5}$$

$$= 0\ m/s$$

5.) Before After



a. $m_1 = 1.67\times10^{-27}$ $m_2 = ?$ $m_1 = 1.67\times10^{-27}$ m_2 ?

$V_{1i} = 1.00\times10^{7}\,m/s$ $V_{2i} = 0$ $V_{1f} = -6.00\times10^{6}\,m/s$ $V_{2f} = 4.00\times10^{6}\,m/s$

$$m_1V_{1i} + \cancelto{0}{m_2V_{2i}} = m_1V_{1f} + m_2V_{2f}$$

$$m_2 = \frac{m_1V_{1i} - m_1V_{1f}}{V_{2f}} = \frac{(1.67\times10^{-27})(1.00\times10^{7}) - (1.67\times10^{-27})(-6.00\times10^{6})}{4.00\times10^{6}}$$

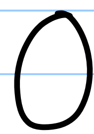
$$= 6.68\times10^{-27}\,Kg$$

b. $\Delta p = m\Delta v = (1.67\times10^{-27})(-6.00\times10^{6} - 1.00\times10^{7})$

$= -2.67\times10^{-20}\,kgm/s$

6.)

Before



$m_T = ?$

$v_f = 0$

After

$m_1 = 0.120\ kg \quad m_2 = ?$

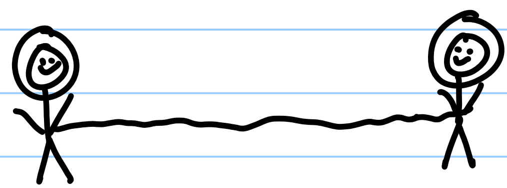
$v_{1f} = -6.0\ m/s \quad v_{2f} = 8.0\ m/s$

$$\cancel{m_T v_f}^{\,0} = m_1 v_{1f} + m_2 v_{2f}$$

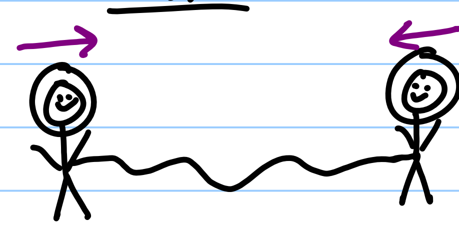
$$m_2 = -\frac{m_1 v_{1f}}{v_{2f}} = -\frac{(0.120)(-6.0)}{8.0} = 0.090\ kg$$

7.)

Before



After



$m_1 = 60.0$ $\quad m_2 = 42.0$ $\quad m_1 = 60.0$ $\quad m_2 = 42.0$

$v_{1i} = 0$ $\quad v_{2i} = 0$ $\quad v_{1f} = 0.40$ m/s $\quad v_{2f} = ?$

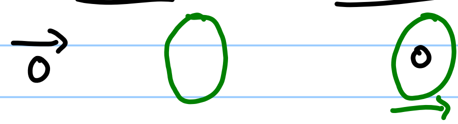
$$\cancel{m_1 v_{1i}}^{\,0} + \cancel{m_2 v_{2i}}^{\,0} = m_1 v_{1f} + m_2 v_{2f}$$

$$v_{2f} = \frac{-m_1 v_{1f}}{m_2} = -\frac{(60.0)(0.40)}{42.0} = -0.57 \text{ m/s}$$

or

0.57 m/s towards Thelma

8.) a. Before After



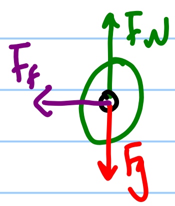
$m_1 = 0.075\,kg$ $m_2 = 3.1\,kg$ $m_T = 3.175\,kg$

$V_{1i} = 70.0\,m/s$ $V_{2i} = 0$ $V_f = ?$

$$m_1 V_{1i} + \cancel{m_2 V_{2i}}^{\,0} = m_T V_f$$

$$V_f = \frac{m_1 V_{1i}}{m_T} = \frac{(0.075\,kg)(70.0\,m/s)}{3.175\,kg} = 1.7\,m/s$$

b.



$$F_N = F_g = mg = (3.175)(9.80)$$

$$= 31.15\,N$$

$$F_f = \mu F_N = (0.25)(31.15) = 7.779\,N$$

$$F_{net} = F_f = ma \qquad a = \frac{F_f}{m} = \frac{7.779}{3.175} = 2.45\,m/s^2$$

$V = 0$

$V_0 = 1.7\,m/s$

$a = -2.45\,m/s^2$

$d = ?$

$t =$

$$\cancel{V^2}^{\,0} = V_0^2 + 2ad$$

$$d = \frac{-V_0^2}{2a} = \frac{-(1.7)^2}{2(-2.45)} = \boxed{0.56\,m}$$