Honors Physics practice problems 02-11-11

1) $M_B = 20\,kg$
$\vec{V}_{Bi} = +7.25\,\frac{m}{s}$
$M_S = 60\,kg$
$\vec{V}_{Si} = -6.05\,\frac{m}{s}$
$\vec{V}_f = $ ____ $\frac{m}{s}$

$M_B\vec{V}_{Bi} + M_S\vec{V}_{Si} = M_T\vec{V}_f$

$\vec{V}_f = \frac{M_B\vec{V}_{Bi} + M_S\vec{V}_{Si}}{M_T}$

$= \frac{20\,kg(7.25\,\frac{m}{s}) + 60\,kg(-6.05\,\frac{m}{s})}{20\,kg + 60\,kg}$

a) $\boxed{\vec{V}_f = 2.72\,\frac{m}{s},\ left}$

+ right
− left

$\vec{\Delta P} = M_B(\vec{V}_{Bf} - \vec{V}_{Bi})$
$= 20\,kg(-2.72\,\frac{m}{s} - 7.2$

b) $\boxed{\Delta P = -199\,\frac{kg\,m}{s}}$

2) $M_1 = 95\,kg$
$\vec{V}_{1i} = +8.2\,\frac{m}{s}$
$M_2 = 70\,kg$
$\vec{V}_{2i} = +4.3\,\frac{m}{s}$
$\vec{V}_f = $ ____ $\frac{m}{s}$

$M_1\vec{V}_{1i} + M_2\vec{V}_{2i} = M_T\vec{V}_f$

$\vec{V}_f = \frac{M_1\vec{V}_{1i} + M_2\vec{V}_{2i}}{M_T}$

$= \frac{95\,kg(+8.2\,\frac{m}{s}) + 70\,kg(+4.3\,\frac{m}{s})}{95\,kg + 70\,kg}$

a) $\boxed{\vec{V}_f = 6.55\,\frac{m}{s},\ East}$

+ East
− west

$\vec{J}_{12} = M_1(\vec{V}_{1f} - \vec{V}_{1i})$
$= 95\,kg(6.55\,\frac{m}{s} - 8.2$

b) $\boxed{\vec{J}_{12} = -157\,\frac{kg\,m}{s}}$

3) $M_M = 2000\,kg$
$V_{Mi} = +20\,\frac{m}{s}$
$M_S = $ ____ kg
$V_{Si} = 0\,\frac{m}{s}$
$V_f = +11\,\frac{m}{s}$

$M_M\vec{V}_{Mi} + M_S\cancel{\vec{V}_{Si}}^{0} = (M_M + M_S)\vec{V}_f$

$M_S\vec{V}_f = M_M\vec{V}_{Mi} - M_M\vec{V}_{Mf}$

$M_S = \frac{M_M\vec{V}_{Mi} - M_M\vec{V}_{Mf}}{\vec{V}_f}$

$= \frac{2000\,kg(20\,\frac{m}{s}) - 2000\,kg(11\,\frac{m}{s})}{11\,\frac{m}{s}}$

a) $\boxed{M_S = 1640\,kg}$

$\Delta K_M = K_{Mf} - K_{Mi}$
$= \frac{1}{2}M_M(V_{Mf}^2 - V_{Mi}^2)$
$= \frac{1}{2}(2000\,kg)((11\,\frac{m}{s})^2 - (20\,\frac{m}{s})^2)$

b) $\boxed{\Delta K_M = -2.79\times10^5\,J}$

$\Delta K_S = K_{Sf} - K_{Si}$
$= \frac{1}{2}M_S(V_{Sf}^2 - V_{Si}^2)$
$= \frac{1}{2}(1640\,kg)((11\,\frac{m}{s})^2 - (0\,\frac{m}{s})^2)$

c) $\boxed{\Delta K_S = +9.92\times10^4\,J}$

4) $M_J = 150\,g$
$V_{Ji} = +10\,\frac{m}{s}$
$M_B = 625\,g$
$V_{Bi} = +30\,\frac{m}{s}$
$V_{Bf} = +22.3\,\frac{m}{s}$
$V_{Jf} = $ ____ $\frac{m}{s}$

$M_J\vec{V}_{Ji} + M_B\vec{V}_{Bi} = M_J\vec{V}_{Jf} + M_B\vec{V}_{Bf}$

$\vec{V}_{Jf} = \frac{M_J\vec{V}_{Ji} + M_B\vec{V}_{Bi} - M_B\vec{V}_{Bf}}{M_J}$

$= \frac{150\,g(10\,\frac{m}{s}) + 625\,g(30\,\frac{m}{s}) - 625\,g(22.3\,\frac{m}{s})}{150\,g}$

a) $\boxed{\vec{V}_{Jf} = 42.1\,\frac{m}{s}}$

+ North
− South

$\vec{F}_{BJ}\Delta t = M_B\Delta\vec{V}_B$

$\vec{F}_{BJ} = \frac{M_B(\vec{V}_{Bf} - \vec{V}_{Bi})}{\Delta t}$

$= 0.625\,kg(22.3\,\frac{m}{s} - 30\,\frac{m}{s}$

b) $\boxed{\vec{F}_{BJ} = -4.81\,N}$
that is, south

+ right
- left

5) $m_R = 15\,g$

$\vec{v}_{Ri} = +5.6\ \frac{m}{s}$

$m_B = 165\,g$

$\vec{v}_{Bi} = -4.2\ \frac{m}{s}$

$\vec{v}_{Bf} = -2.57\ \frac{m}{s}$

$\vec{v}_{Rf} =$ ___ $\frac{m}{s}$ ___

$m_R\vec{v}_{Ri} + m_B\vec{v}_{Bi} = m_R\vec{v}_{Rf} + m_B\vec{v}_{Bf}$

$$\vec{v}_{Rf} = \frac{m_R\vec{v}_{Ri} + m_B\vec{v}_{Bi} - m_B\vec{v}_{Bf}}{m_R}$$

$$= \frac{15\,g\left(5.6\ \frac{m}{s}\right) + 165\,g\left(-4.2\ \frac{m}{s}\right) - 165\,g\left(-2.57\ \frac{m}{s}\right)}{15\,g}$$

$\boxed{\vec{v}_{Rf} = -12.3\ \frac{m}{s}}$

that is, left

6) $m_B = 7.27\,kg$

$\vec{v}_{Bi} = +8.5\ \frac{m}{s}$

$m_p =$ ___ kg

$\vec{v}_{pi} = 0\ \frac{m}{s}$

$\vec{v}_{Bf} = +5.54\ \frac{m}{s}$

$\vec{v}_{pf} = +14\ \frac{m}{s}$

$m_B\vec{v}_{Bi} + m_p\cancel{\vec{v}_{pi}}^{0} = m_B\vec{v}_{Bf} + m_p\vec{v}_{pf}$

$$m_p = \frac{m_B\vec{v}_{Bi} - m_B\vec{v}_{Bf}}{\vec{v}_{pf}}$$

$$= \frac{7.27\,kg\left(8.5\ \frac{m}{s}\right) - 7.27\,kg\left(5.54\ \frac{m}{s}\right)}{14\ \frac{m}{s}}$$

$\boxed{m_p = 1.54\,kg}$