Pg 178 - 180: #28, 29, 32, 33

28) - need to find speed of block just after collision

$$K_i = U_{g_f} = \frac{1}{2}(m)\vec{v}_i^2 = mgh \Rightarrow \vec{v}_i = \sqrt{\frac{\cancel{m}gh}{\frac{1}{2}\cancel{m}}}$$

$$\rightarrow \vec{v}_i = \sqrt{2(10 m/s^2)(.120m} = 1.55 m/s$$

* now use conservation of $\vec{p}$ to solve rest

$$(m_{bullet} \cdot \vec{v}_{i\,bullet}) + (\cancel{m_{block} \cdot \vec{v}_{i\,block}}) = (m_{bullet} \cdot \vec{v}_{f\,bullet}) + (m_{block} \cdot \vec{v}_{f\,block})$$

$$\vec{v}_{i\,bullet} = \frac{(m_{bullet} \cdot \vec{v}_{f\,bullet}) + (m_{block} \cdot \vec{v}_{f\,block})}{m_{bullet}}$$

$$\rightarrow \vec{v}_{i\,bullet} = \frac{(.007kg \cdot 200 m/s) + (1.5kg \cdot 1.55 m/s)}{(.007kg)}$$

$$\vec{v}_{i\,bullet} = 532.14 m/s$$

29.) Use conservation of $\vec{p}$ first

$$(m_{bullet} \cdot \vec{v}_{i\,bullet}) + (m_{ball} \cdot \vec{v}_{i\,ball}) = (m_{bullet} + m_{ball})\,\vec{v}_{f\,bullet\,\&\,ball}$$

$$\hookrightarrow \frac{(m_{bullet} \cdot \vec{v}_{i\,bullet})}{(m_{bullet} + m_{ball})} = \vec{v}_{f\,bullet\,\&\,ball}$$

$$\hookrightarrow \frac{(.030kg \cdot 200m/s)}{(.030kg + .15kg)} = \vec{v}_{f\,bullet\,ball} = 33.3m/s$$

* now use conservation of energy to find max height

$$\frac{1}{2}(m_{bullet\,\&\,ball})\,\vec{v}_i^{\,2} = (m_{bullet\,\&\,ball})\,g\,h$$

$$\hookrightarrow \frac{\frac{1}{2}(m)\,\vec{v}_i^{\,2}}{mg} = h = \frac{\frac{1}{2}(33.3m/s)^2}{10m/s^2}$$

$$h = 55.4m$$

32) a)

$$(m_{1200} \cdot \vec{v}_{i}) + (m_{900} \cdot \vec{v}_{i}) = (m_{1200} \cdot \vec{v}_{F}) + (m_{900} \cdot \vec{v}_{F})$$

$$\frac{(m_{1200} \cdot \vec{v}_{i}) + (m_{900} \cdot \vec{v}_{i}) - (m_{1200} \cdot \vec{v}_{F})}{m_{900}}$$

$$\frac{(1200\,kg \cdot +25.0\,m/s) + (900\,kg \cdot +20.0\,m/s) - (1200\,kg \cdot +18.0\,m/s)}{900\,kg} = \vec{v}_{F}$$

$$\vec{v}_{F\ 900\,kg\ truck} = +20.9\,m/s$$

b) $KE_{lost} = K_i - K_F$

$$K_{lost} = \left(\tfrac{1}{2} m \vec{v}_{i}^{2}{}_{truck} + \tfrac{1}{2} m \vec{v}_{i}^{2}{}_{car}\right) - \left(\tfrac{1}{2} m \vec{v}_{i}^{2}{}_{truck} + \tfrac{1}{2} m \vec{v}_{i}^{2}{}_{car}\right)$$

$$\left(\tfrac{1}{2}(900\,kg)(+20.0\,m/s)^2 + \tfrac{1}{2}(1250\,kg)(+25.0\,m/s)^2\right) -$$

$$\left(\tfrac{1}{2}(900\,kg)(+20.9\,m/s)^2 + \tfrac{1}{2}(1250\,kg)(+18.0\,m/s)^2\right)$$

33) start w/ conservation of energy to solve for speed of block + bullet just after impact

$\rightarrow K_{\text{block + bullet}} = U_s$

$\rightarrow \frac{1}{2}(m_{\text{block + bullet}})(\vec{v}_i)^2 = \frac{1}{2}kx^2$

$\rightarrow \vec{v}_i = \sqrt{\frac{kx^2}{m_{\text{mass total}}}} = \sqrt{\frac{(150\,N/m)(.80m)^2}{.112\,kg}}$

$\vec{v}_i$ bullet + block = 29.3 m/s

$\rightarrow$ is $\vec{v}_F$ in cons of $\vec{p}$

* now use conservation of $\vec{p}$

$(m_{\text{bullet}} \cdot \vec{v}_i) + (m_{\text{block}} \cdot \vec{v}_i) = (m_{tot} \cdot \vec{v}_F)$

$\rightarrow \vec{v}_i = \frac{m_{tot} \cdot \vec{v}_F}{\text{mass bullet}}$

$\rightarrow \vec{v}_i = \frac{.112\,kg \cdot 29.3\,m/s}{.012\,kg} = 273\,m/s$