PROB. 14-17

$m_A = 1500\ kg$, $m_H = 3000\ kg$, $\vec{r}_0 = (1200)\hat{k}\ m$

AT $t = 240\ s$ EARLIER, $\vec{r}_H = (-8400)\hat{i} + (1200)\hat{k}\ m$

$\vec{r}_A = (-16{,}000)\hat{i} + (12{,}000)\hat{j} + (1200)\hat{k}\ m$

$m_1 = 1000\ kg$, $m_2 = 2000\ kg$, $\vec{r}_1 = (500)\hat{i} + (-100)\hat{j}\ m$

$\vec{r}_2 = (600)\hat{i} + (-500)\hat{j}\ m$

FIND $\vec{r}_A$ AFTER IMPACT

MASS CENTER G:

$$m\bar{r} = m_A\vec{r}_A + m_1\vec{r}_1 + m_2\vec{r}_2$$

$$(m_A + m_H)\bar{r} = m_A\vec{r}_A + m_1\vec{r}_1 + m_2\vec{r}_2$$

FIND $\bar{r}$ AFTER IMPACT: ASSUME UNIFORM MOTION IN X-Y PLANE

$$\bar{r} = \bar{v}_0 \cdot t$$

FIND $\bar{v}_0$: CONSERVE MOMENTUM PRIOR TO IMPACT

$$m\bar{v}_0 = m_A\vec{v}_{A0} + m_H\vec{v}_{H0}$$

$$\bar{v}_0 = \left(\frac{1}{m_A + m_H}\right)(m_A\vec{v}_{A0} + m_H\vec{v}_{H0})$$

PRIOR TO IMPACT, ASSUME UNIFORM VELOCITY

~~$\bar{r} = \vec{v} \cdot t$, $\vec{v} = \frac{1}{t}\bar{r} = \left(\frac{1}{240}\right)$~~

$$\vec{r} = \vec{r}_0 + \vec{v}t$$

PROB. 14-17 CONT.

$$\vec{v}_{AO} = \frac{1}{t}(\vec{r}_A - \vec{r}_{AO}) = \left(\frac{1}{240}\right)\left[(1200)\hat{k} - \{(-16{,}000)\hat{i} + (12{,}000)\hat{j} + (1200)\hat{k}\}\right]$$

$$\vec{v}_{AO} = (66.67)\hat{i} + (-50)\hat{j} \ \frac{m}{s}$$

$$\vec{v}_{HO} = \left(\frac{1}{240}\right)\left[(1200)\hat{k} - \{(-8400)\hat{i} + (1200)\hat{k}\}\right]$$

$$\vec{v}_{HO} = (35)\hat{i} \ \frac{m}{s}$$

$$\vec{v}_o = \left(\frac{1}{4500\ kg}\right)\{(1500\ kg)\left[(66.67)\hat{i} + (-50)\hat{j}\right] + (3000\ kg)(35)\hat{i}\}$$

$$\vec{v}_o = (45.56)\hat{i} + (-16.67)\hat{j} \ \frac{m}{s}$$

$$\vec{r} = \left[(45.56)\hat{i} + (-16.67)\hat{j}\right] \cdot t$$

FIND t: VERTICAL MOTION

$$z_o = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2z_o}{g}} = \sqrt{\frac{2(1200)}{(9.81)}} = 15.64^s$$

$$\vec{r} = (15.64^s)\left[(45.56)\hat{i} + (-16.67)\hat{j}\right]$$

$$\vec{r} = (712.6)\hat{i} + (-260.7)\hat{j} \qquad (z=0)$$

$$\vec{r}_A = \left(\frac{1}{1500}\right)\{(1500+3000)\left[(712.6)\hat{i} + (-260.7)\hat{j}\right] - (1000)\left[(500)\hat{i} + (-100)\hat{j}\right] - (2000)\left[(600)\hat{i} + (-500)\hat{j}\right]\}$$

$$\boxed{\vec{r}_A = (1004)\hat{i} + (-48.73)\hat{j}\ m}$$