PROB. 14-16

$W = 30^{LB}$, $\vec{v}_0 = (120)\hat{i}\ \frac{ft}{s}$, PASSES THROUGH THE ORIGIN AT $t=0$, $W_A = 12^{LB}$, $W_B = 18^{LB}$, AT $t = 3^s$, $\vec{r}_A = (300)\hat{i} + (24)\hat{j} + (-48)\hat{k}$ ft

FIND $\vec{r}_B$. ASSUME $a_y = -g = -32.2\ \frac{ft}{s^2}$

NEGLECT AIR RESISTANCE.

THE MASS CENTER MOVES AS IF IT HAD NOT EXPLODED:

$$m\bar{r} = \sum m_i \vec{r}_i = m_A \vec{r}_A + m_B \vec{r}_B$$

$$\left(\frac{W}{g}\right)\bar{r} = \left(\frac{W_A}{g}\right)\vec{r}_A + \left(\frac{W_B}{g}\right)\vec{r}_B$$

$$W\bar{r} = W_A \vec{r}_A + W_B \vec{r}_B$$

FOR UNIFORMLY ACCELERATED MOTION,

$$X = X_0 + v_0 t + \tfrac{1}{2} a t^2 \qquad \text{EQN. } (11.7)$$

$$\bar{r} = \bar{r}_0 + \bar{v}_0 \cdot t + \tfrac{1}{2}\bar{a}\cdot t^2$$

$$\bar{r} = (120)\hat{i}\cdot(3^s) + \tfrac{1}{2}(-32.2)\hat{j}\cdot(3^s)^2$$

$$\bar{r} = (360)\hat{i} + (-144.9)\hat{j} \text{ ft}$$

$$(30^{LB})\left[(360)\hat{i} + (-144.9)\hat{j}\right] = (12)\left[(300)\hat{i} + (24)\hat{j} + (-48)\hat{k}\right] + (18)\left[(r_{Bx})\hat{i} + (r_{By})\hat{j} + (r_{Bz})\hat{k}\right]$$

X-DIRECTION: $(30)(360) = (12)(300) + (18)(r_{Bx})$

$$r_{Bx} = 400 \text{ ft}$$

PROB. 14-16 CONT.

Y-DIRECTION: $(30)(-144.9) = (12)(24) + (18)(r_{By})$

$r_{By} = -257.5$ ft

Z-DIRECTION: $0 = (12)(-48) + (18)(r_{Bz})$

$r_{Bz} = 32$ ft

$$\boxed{\vec{r}_B = (400)\hat{i} + (-257.5)\hat{j} + (32)\hat{k} \text{ ft}}$$

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