PROB. 14-7

$M_A = 240$ kg, $M_B = 260$ kg, $M_C = 235$ kg

$\vec{U}_{AO} = (2)\hat{\imath}$ $\frac{m}{s}$, $\vec{U}_{CO} = (-1.5)\hat{\imath}$ $\frac{m}{s}$, $\vec{U}_{BO} = 0$, $e = 0.8$

a) A AND C HIT B AT THE SAME TIME

FIND U_{AF}, U_{BF}, U_{CF}

$m\vec{U} = \sum m_i \vec{U}_i$

$M_A \vec{U}_{AO} + M_B \overset{0}{\vec{U}_{BO}} + M_C \vec{U}_{CO} = M_A \vec{U}_{AF} + M_B \vec{U}_{BF} + M_C \vec{U}_{CF}$

$(240)(2) + (235)(-1.5) = 240\, U_{AF} + 260\, U_{BF} + 235\, U_{CF}$

$240\, U_{AF} + 260\, U_{BF} + 235\, U_{CF} = 127.5$

$U_{BF} - U_{AF} = e\left(U_{AO} - \overset{0}{U_{BO}}\right)$

$U_{BF} = U_{AF} + (0.8)(2) = U_{AF} + 1.6$

$U_{BF} - U_{CF} = e\left(U_{CO} - \overset{0}{U_{BO}}\right)$

$U_{CF} = U_{BF} + 1.2 = \left(U_{AF} + 1.6\right) + 1.2 = U_{AF} + 2.8$

$240\, U_{AF} + 260\left(U_{AF} + 1.6\right) + 235\left(U_{AF} + 2.8\right) = 127.5$

$U_{AF} = -1.288 \frac{m}{s}$ ←

$U_{BF} = (-1.288) + 1.6 = 0.3122 \frac{m}{s}$ →

$U_{CF} = (0.3122) + 1.2 = 1.512 \frac{m}{s}$ →

b) FIND VELOCITIES IF A HITS B BEFORE C DOES

A HITS B:

PROB. 14-7 CONT.

$$M_A \bar{U}_{AO} = M_A \bar{U}_{AF} + M_B \bar{U}_{BF}$$

$$(240)(2) = (240)\bar{U}_{AF} + (260)\bar{U}_{BF}$$

$$240\,\bar{U}_{AF} + 260\,\bar{U}_{BF} = 480$$

$$\bar{U}_{BF} - \bar{U}_{AF} = e\left(\bar{U}_{AO} - \cancel{\bar{U}_{BO}}^{0}\right)$$

$$\bar{U}_{BF} = \bar{U}_{AF} + (0.8)(2) = \bar{U}_{AF} + 1.6$$

$$240\,\bar{U}_{AF} + 260\left(\bar{U}_{AF} + 1.6\right) = 480$$
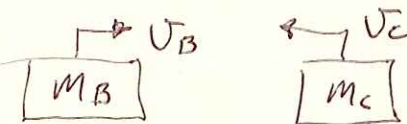
$$\boxed{\bar{U}_{AF} = 0.128\ \tfrac{m}{s} \longrightarrow}$$

$$\bar{U}_{BF} = (0.128) + 1.6 \boxed{= 1.728\ \tfrac{m}{s} \longrightarrow}$$

B HITS C:

$$M_B \bar{U}_{BO} + M_C \bar{U}_{CO} = M_B \bar{U}_{BF} + M_C \bar{U}_{CF}$$

$$(260)(1.728) + (235)(-1.5) = (260)\bar{U}_{BF} + (235)\bar{U}_{CF}$$

$$260\,\bar{U}_{BF} + 235\,\bar{U}_{CF} = 96.78$$

$$\bar{U}_{BF} - \bar{U}_{CF} = e\left(\bar{U}_{CO} - \bar{U}_{BO}\right)$$

$$\bar{U}_{BF} = \bar{U}_{CF} + 0.8\left[(-1.5) - (1.728)\right]$$

$$\bar{U}_{BF} = \bar{U}_{CF} - 2.582$$

$$260\left(\bar{U}_{CF} - 2.582\right) + 235\,\bar{U}_{CF} = 96.78$$

$$\boxed{\bar{U}_{CF} = 1.552\ \tfrac{m}{s} \longrightarrow}$$

$$\bar{U}_{BF} = (1.552) - 2.582 \boxed{= -1.03\ \tfrac{m}{s} \longleftarrow}$$

PROB. 14-7 CONT.

B HITS A AGAIN:
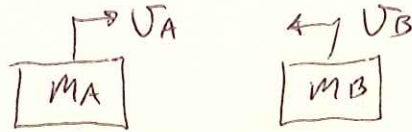
$$M_A U_{AO} + M_B U_{BO} = M_A U_{AF} + M_B U_{BF}$$

$$(240)(0.128) + (260)(-1.03) = (240) U_{AF} + (260) U_{BF}$$

$$240 U_{AF} + 260 U_{BF} = -237.1$$

$$U_{BF} - U_{AF} = e(U_{AO} - U_{BO})$$

$$U_{BF} = U_{AF} + (0.8)[(0.128) - (-1.03)] = U_{AF} + 0.9264$$

$$240 U_{AF} + 260(U_{AF} + 0.9264) = -237.1$$

$$\boxed{U_{AF} = -0.9559 \frac{m}{s}} \leftarrow$$

$$U_{BF} = (-0.9559) + 0.9264 \boxed{= -0.02953 \frac{m}{s}} \leftarrow$$

NO MORE COLLISIONS