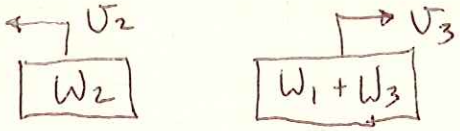
PROB. 14-4

$W_1 = 180^{LB}$, $W_2 = 120^{LB}$, $W_3 = 300^{LB}$,

RELATIVE VELOCITY $= 16 \frac{ft}{s}$

a) FIND v_{BOAT} IF WOMAN DIVES FIRST



$$m\bar{v} = \sum m_i \vec{v}_i$$

$$0 = \left(\frac{W_2}{g}\right)\vec{v}_2 + \left(\frac{W_1}{g} + \frac{W_3}{g}\right)\vec{v}_3$$

$$0 = W_2(-v_2)\hat{i} + (W_1 + W_3)(v_3)\hat{i}$$

$$\vec{v}_2 = \vec{v}_3 + \vec{v}_{2/3}, \quad (-v_2)\hat{i} = (v_3)\hat{i} + (-16)\hat{i}$$

$$v_2 = 16 - v_3$$

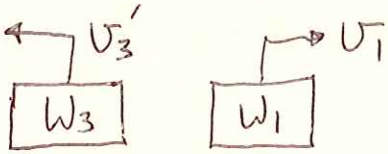
$$0 = W_2[-(16 - v_3)] + (W_1 + W_3)v_3$$

$$0 = -16W_2 + W_2 v_3 + (W_1 + W_3)v_3$$

$$v_3(W_1 + W_2 + W_3) = 16W_2$$

$$v_3 = \frac{16W_2}{(W_1 + W_2 + W_3)} = \frac{16(120)}{(180 + 120 + 300)} = 3.2 \frac{ft}{s} \rightarrow$$

MAN DIVES SECOND:



$$\left(\frac{W_1}{g} + \frac{W_3}{g}\right)\vec{v}_3 = \left(\frac{W_1}{g}\right)\vec{v}_1 + \left(\frac{W_3}{g}\right)\vec{v}_3'$$

$$(W_1 + W_3)(v_3)\hat{i} = (W_1)(v_1)\hat{i} + (W_3)(-v_3')\hat{i}$$

PROB. 14-4 CONT.

$$\vec{v}_1 = \vec{v}_3' + \vec{v}_{1/3}' \;:\; (v_1)\hat{i} = (-v_3')\hat{i} + (16)\hat{i}$$

$$v_1 = 16 - v_3'$$

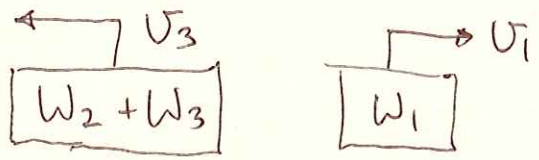
$$(W_1 + W_3)v_3 = W_1(16 - v_3') - W_3 v_3'$$

$$-(W_1 + W_3)v_3' = (W_1 + W_3)v_3 - 16W_1$$

$$v_3' = \frac{16W_1 - (W_1 + W_3)v_3}{(W_1 + W_3)}$$

$$v_3' = \frac{16(180) - (180 + 300)(3.2)}{(180 + 300)} = 2.8 \ \frac{ft}{s} \leftarrow$$

b) MAN DIVES FIRST:



$$0 = \left(\frac{W_2}{g} + \frac{W_3}{g}\right)\vec{v}_3 + \left(\frac{W_1}{g}\right)\vec{v}_1$$

$$0 = (W_2 + W_3)(-v_3)\hat{i} + (W_1)(v_1)\hat{i}$$

$$\vec{v}_1 = \vec{v}_3 + \vec{v}_{1/3} \;:\; (v_1)\hat{i} = (-v_3)\hat{i} + (16)\hat{i}$$

$$v_1 = 16 - v_3$$

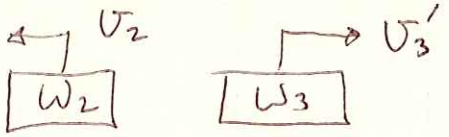
$$0 = (W_2 + W_3)(-v_3) + W_1(16 - v_3)$$

$$0 = -(W_1 + W_2 + W_3)v_3 + 16W_1$$

PROB. 14-4 CONT.

$$v_3 = \frac{16 W_1}{(W_1 + W_2 + W_3)} = \frac{16(180)}{(180 + 120 + 300)} = 4.8 \frac{ft}{s} \leftarrow$$

WOMAN DIVES SECOND:



$$\left(\frac{W_2}{g} + \frac{W_3}{g}\right)\vec{v}_3 = \left(\frac{W_2}{g}\right)\vec{v}_2 + \left(\frac{W_3}{g}\right)\vec{v}_3'$$

$$(W_2 + W_3)(-v_3)\hat{i} = (W_2)(-v_2)\hat{i} + (W_3)(v_3')\hat{i}$$

$$-(W_2 + W_3)v_3 = -W_2 v_2 + W_3 v_3'$$

$$\vec{v}_2 = \vec{v}_3' + \vec{v}_{2/3'} : \quad (-v_2)\hat{i} = (v_3')\hat{i} + (-16)\hat{i}$$

$$v_2 = 16 - v_3'$$

$$-(W_2 + W_3)v_3 = -W_2(16 - v_3') + W_3 v_3'$$

$$16 W_2 - (W_2 + W_3)v_3 = (W_3 + W_2)v_3'$$

$$v_3' = \frac{16 W_2 - (W_2 + W_3)v_3}{(W_2 + W_3)}$$

$$v_3' = \frac{16(120) - (120 + 300)(4.8)}{(300 + 120)} = -0.2286 \frac{ft}{s} \leftarrow$$