

PROB. 14-1

$$m_1 = 15 \text{ kg}, m_2 = 20 \text{ kg}, m_3 = 25 \text{ kg}, \vec{v}_{3,i} = 0,$$

$$\vec{v}_{1,i} = (3) \hat{i} \frac{\text{m}}{\text{s}}, \vec{v}_{2,i} = (2) \hat{i} \frac{\text{m}}{\text{s}}, \text{ FIND } \vec{v}'$$

a)  $m_1$  FIRST,  $m_2$  SECOND

CONSERVATION OF LINEAR MOMENTUM:

$$\vec{L} = \sum m_i \vec{v}_i = \text{CONSTANT}$$

THROW  $m_1$  FIRST:

$$(\sum m \vec{v})_i = (\sum m \vec{v})_f$$

$$m_1 \vec{v}_{1,i} + m_3 \vec{v}_{3,i} = m_1 \vec{v}_{1,f} + m_3 \vec{v}_{3,f}$$

$$\vec{v}_{1,f} = \vec{v}_{3,f} = \vec{v}$$

$$\vec{v} = \frac{m_1 \vec{v}_{1,i}}{(m_1 + m_3)} = \frac{(15 \text{ kg})(3 \frac{\text{m}}{\text{s}}) \hat{i}}{(15 + 25 \text{ kg})} = (1.125) \hat{i} \frac{\text{m}}{\text{s}}$$

THROW  $m_2$  SECOND:

$$(\sum m \vec{v})_i = (\sum m \vec{v})_f$$

$$(m_1 + m_3) \vec{v} + m_2 \vec{v}_{2,i} = (m_1 + m_2 + m_3) \vec{v}'$$

$$\vec{v}' = \frac{(m_1 + m_3) \vec{v} + m_2 \vec{v}_{2,i}}{(m_1 + m_2 + m_3)}$$

$$\vec{v}' = \frac{(15 + 25 \text{ kg})(1.125 \frac{\text{m}}{\text{s}}) \hat{i} + (20 \text{ kg})(2.0 \frac{\text{m}}{\text{s}}) \hat{i}}{(15 + 20 + 25 \text{ kg})} = (1.417) \hat{i} \frac{\text{m}}{\text{s}}$$

PROB. 14-1 CONT.

b)  $m_2$  FIRST,  $m_1$  SECOND

THROW  $m_2$  FIRST:

$$(\sum m \vec{U})_i = (\sum m \vec{U})_f$$

$$m_2 \vec{U}_{2,i} + m_3 \vec{U}_{3,i} = (m_2 + m_3) \vec{U}$$

$$\vec{U} = \frac{m_2 \vec{U}_{2,i}}{(m_2 + m_3)} = \frac{(20 \text{ kg})(2 \frac{\text{m}}{\text{s}}) \hat{L}}{(20 + 25 \text{ kg})} = (0.8889) \hat{L} \frac{\text{m}}{\text{s}}$$

THROW  $m_1$  SECOND:

$$(\sum m \vec{U})_i = (\sum m \vec{U})_f$$

$$(m_2 + m_3) \vec{U} + m_1 \vec{U}_{1,i} = (m_1 + m_2 + m_3) \vec{U}'$$

$$\vec{U}' = \frac{(m_2 + m_3) \vec{U} + m_1 \vec{U}_{1,i}}{(m_1 + m_2 + m_3)}$$

$$\vec{U}' = \frac{(20 + 25 \text{ kg})(0.8889 \frac{\text{m}}{\text{s}}) \hat{L} + (15 \text{ kg})(3 \frac{\text{m}}{\text{s}}) \hat{L}}{(15 + 20 + 25 \text{ kg})}$$

$$\vec{U}' = (1.417) \hat{L} \frac{\text{m}}{\text{s}}$$