4. a) before collision

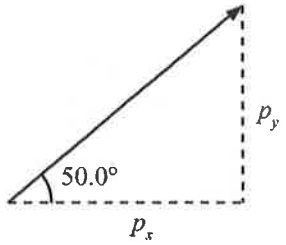
$m_1 = 50.0$ kg $\quad m_2 = 60.0$ kg
$\vec{v}_1 = ?$ $\quad \vec{v}_2 = 0$
$\vec{p}_1 = ?$ $\quad \vec{p}_2 = 0$

before collision

$m_1 = 50.0$ kg
$\vec{v}_1' = 6.00$ m/s 50.0° N of E
$\vec{p}_1' = 300$ kg·m/s
50.0° N of E

$m_2 = 60.0$ kg
$\vec{v}_2' = 6.30$ m/s 38.0° S of E
$\vec{p}_2' = 378$ kg·m/s 38.0° S of E

Find horizontal and vertical components of 300 kg·m/s 50.0° N of E



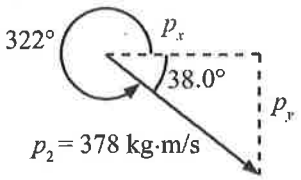
To solve this problem consider east and north direction as positive

$\vec{p}_{1x}' = p_{1x}' \cos\theta$
$= (300 \text{ kg}\cdot\text{m/s})(\cos 50.0°)$
$= 193 \text{ kg}\cdot\text{m/s}$

$\vec{p}_{1y}' = p_1' \sin\theta$
$= (300 \text{ kg}\cdot\text{m/s})(\sin 50.0°)$
$= 230 \text{ kg}\cdot\text{m/s}$

Find horizontal and vertical components of 378 kg·m/s 38.0° S of E

38.0° S of E = 322° heading counter clockwise from positive x-axis



$\vec{p}_{2x}' = p_2' \cos\theta$
$= (378 \text{ kg}\cdot\text{m/s})(\cos 322°)$
$= 298 \text{ kg}\cdot\text{m/s}$

$\vec{p}_{2y}' = p_2' \sin\theta$
$= (378 \text{ kg}\cdot\text{m/s})(\sin 322°)$
$= -233 \text{ kg}\cdot\text{m/s}$

Do the vector addition for the components of the momentum

$\sum \vec{p}_x' = \vec{p}_{1x}' + \vec{p}_{2x}'$
$= 193 \text{ kg}\cdot\text{m/s} + 298 \text{ kg}\cdot\text{m/s}$
$= 491 \text{ kg}\cdot\text{m/s}$

$\sum \vec{p}_y' = \vec{p}_{1y}' + \vec{p}_{2y}'$
$= 230 \text{ kg}\cdot\text{m/s} + (-233 \text{ kg}\cdot\text{km/s})$
$= -3.00 \text{ kg}\cdot\text{m/s}$

Now add $\sum p_x$ and $\sum p_y$ using Pythagoras theorem, to find out the magnitude of the resultant momentum.

$p_R = \sqrt{(p_x)^2 + (p_y)^2}$
$= \sqrt{(491 \text{ kg}\cdot\text{m/s})^2 + (3.00 \text{ kg}\cdot\text{m/s})^2}$
$= 491 \text{ kg}\cdot\text{m/s}$

$\tan\theta = \dfrac{p_y}{p_x}$
$= \dfrac{3.00 \text{ kg}\cdot\text{m/s}}{491 \text{ kg}\cdot\text{m/s}}$
$\theta = 0.35°$
$\doteq 0°$

$\vec{p}_{sys(after)} = \vec{p}_R = 491 \text{ kg}\cdot\text{m/s}$ east
$\vec{p}_{sys(after)} = \vec{p}_{sys(before)} = \vec{p}_1$

$\vec{p}_1 = m_1 \vec{v}_1$
$\vec{v}_1 = \dfrac{\vec{p}}{m}$
$= \dfrac{491 \text{ kg}\cdot\text{m/s east}}{50.0 \text{ kg}}$
$= 9.82$ m/s east

