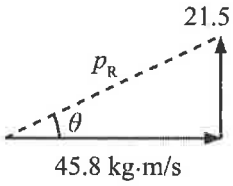
After collision, the 10.0 kg object must have a horizontal component of

105 kg·m/s – 59.2 kg·m/s = 45.8 kg·m/s east

After collision, the 10.0 kg object must have a vertical component of

0 – (–21.5 kg·m/s) = 21.5 kg·m/s north

Now, add 45.8 kg·m/s east and 21.5 kg·m/s north using Pythagoras theorem.



$$p_R = \sqrt{(p_x)^2 + (p_y)^2}$$
$$= \sqrt{(45.8\ \text{kg}\cdot\text{m/s})^2 + (21.5\ \text{kg}\cdot\text{m/s})^2}$$
$$= 50.6\ \text{kg}\cdot\text{m/s}$$

Magnitude of velocity

$$v_2 = \frac{p_2}{m}$$
$$= \frac{50.6\ \text{kg}\cdot\text{m/s}}{10.0\ \text{kg}}$$
$$= 5.1\ \text{m/s}$$

Now find out the direction using

$$\tan\theta = \frac{p_y}{p_x}$$
$$= \frac{21.5\ \text{kg}\cdot\text{m/s}}{45.8\ \text{kg}\cdot\text{m/s}}$$
$$\theta = 25°\ \text{N of E}$$
$$\vec{v}_2 = 5.1\ \text{m/s}\ 25°\ \text{N of E}$$

b)

before collision

(1) (2)

$m_1 = 15.0$ kg $\quad m_2 = 10.0$ kg

$v_1 = 7.0$ m/s $\quad v_2 = 0$

after collision

(1) (2)

$m_1' = 15.0$ kg $\quad m_2' = 10.0$ kg

$v_1' = 4.2$ m/s $\quad v_2' = 5.1$ m/s

Kinetic energy of object 1, before

$$E_{k1} = \frac{1}{2}m_1 v_1^2$$
$$= \frac{1}{2}(15.0\ \text{kg})(7.0\ \text{m/s})^2$$
$$= 3.7\times10^2\ \text{J}$$

Kinetic energy of object 1, after

$$E_{k1}' = \frac{1}{2}m_1\left(v_1'\right)^2$$
$$= \frac{1}{2}(15.0\ \text{kg})(4.2\ \text{m/s})^2$$
$$= 1.3\times10^2\ \text{J}$$

Kinetic energy of object 2, before

$$E_{k2} = \frac{1}{2}m_2 v_2^2$$
$$= \frac{1}{2}(10.0\ \text{kg})(0)^2$$
$$= 0$$

Kinetic energy of object 2, after

$$E_{k2}' = \frac{1}{2}m_2'\left(v_2'\right)^2$$
$$= \frac{1}{2}(10.0\ \text{kg})(5.1\ \text{m/s})^2$$
$$= 1.30\times10^2\ \text{J}$$

Total kinetic energy before collision
$= 3.7\times10^2$ J $+ 0$
$= 3.7\times10^2$ J

Total kinetic energy after collision
$= 1.3\times10^2$ J $+ 1.3\times10^2$ J
$= 2.6\times10^2$ J

Mechanical (kinetic) energy lost in collision is 3.7×10^2 J $- 2.6\times10^2$ J $= 1.1\times10^2$ J,
$\therefore$ collision is inelastic. Kinetic energy was not conserved.

c) Most of the loss in mechanical energy was converted to thermal energy—some to sound, etc.

6. before explosion

○

$m = 3m$
$\vec{v} = 0$
$\vec{p} = 0$

