Kinetic energy of object 1 before

$$E_{k1} = \frac{1}{2} m_1 v_1^2$$
$$= \frac{1}{2}(0.0100 \text{ kg})(0.200 \text{ m/s})^2$$
$$= 2.00 \times 10^{-4} \text{ J}$$

Kinetic energy of object 1 after

$$E'_{k1} = \frac{1}{2} m_1 (v'_1)^2$$
$$= \frac{1}{2}(0.0100 \text{ kg})(-0.060 \text{ m/s})^2$$
$$= 1.8 \times 10^{-5} \text{ J}$$

Kinetic energy of object 2 before

$$E_{k2} = \frac{1}{2} m_2 v_2^2$$
$$= \frac{1}{2}(0.0300 \text{ kg})(0)^2$$
$$= 0$$

Kinetic energy of object 2 after

$$E'_{k2} = \frac{1}{2} m_2 (v'_2)^2$$
$$= \frac{1}{2}(0.0300 \text{ kg})(0.0867 \text{ m/s})^2$$
$$= 1.13 \times 10^{-4} \text{ J}$$

Total kinetic energy before collision
$= 2.00 \times 10^{-4}$ J $+ 0$
$= 2.00 \times 10^{-4}$ J

Total kinetic energy after collision is
$= 1.8 \times 10^{-5}$ J $+ 1.13 \times 10^{-4}$ J
$= 1.31 \times 10^{-4}$ J

Mechanical (kinetic) energy lost in collision
$= 2.00 \times 10^{-4}$ J $- 1.31 \times 10^{-4}$ J
$= 6.9 \times 0^{-5}$ J
$\therefore$ collision is inelastic.

c) Most of this energy was converted to thermal energy—some to sound, etc.

Lesson 3—Two Dimensional Interactions

PRACTICE EXERCISES ANSWERS AND SOLUTIONS

1. before collision

$m_1 = 2.0 \times 10^3$ kg
$\vec{v}_1 = 35$ km/h north
$\vec{p}_1 = 7.00 \times 10^4$ kg·km/h north

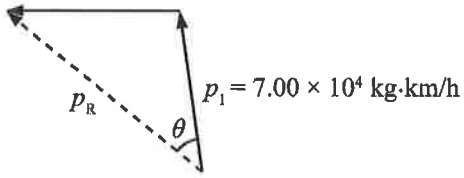
$m_2 = 1.4 \times 10^3$ kg
$\vec{v}_2 = 37.0$ m/s west
$\vec{p}_2 = 28.0$ kg·m/s west

after collision

$m = m_1 + m_2 = 3.4 \times 10^3$ kg
$\vec{v} = ?$
$\vec{p} = ?$

First find out the momentum of the system before collision ($\vec{p}_{sys(before)}$)

$p_2 = 5.18 \times 10^4$ kg·km/h



The magnitude of the resultant momentum is

$$p_R = \sqrt{p_1^2 + p_2^2}$$
$$= \sqrt{(7.00 \times 10^4 \text{ kg·km/h})^2 + (5.18 \times 10^4 \text{ kg·km/h})^2}$$
$$= 8.71 \times 10^4 \text{ kg·km/h}$$

Now, find the direction

$$\tan\theta = \frac{p_2}{p_1}$$
$$= \frac{5.18 \times 10^4 \text{ kg·km/h}}{7.00 \times 10^4 \text{ kg·km/h}}$$
$$= 0.750$$
$$\theta = 36.5°$$

