99. (a) No, only if masses are the same.

(b) In the same direction.

100. First, calculate the velocity of both objects right after the collision from momentum conservation.

\[(1.0 \text{ kg})(10 \text{ m/s}) + (2.0 \text{ kg})(0) = (1.0 \text{ kg} + 2.0 \text{ kg})v, \quad \rightarrow \quad v = 3.33 \text{ m/s}.\]

From the conservation of energy, \(\frac{1}{2}m(3.33 \text{ m/s})^2 = m(9.80 \text{ m/s}^2)h, \quad \rightarrow \quad h = 0.566 \text{ m}.\)

So \(x = \frac{0.566 \text{ m}}{\sin 37^\circ} = 0.94 \text{ m}.\)

101. First find the velocity of the combination (truck and car) right after collision.

\[m_1 = 1500 \text{ kg}, \quad m_2 = 1200 \text{ kg}, \quad v_{10} = 25 \text{ m/s}, \quad v_{20} = 0 \text{ m/s}, \quad v_1 = v_2 = v = ?\]

\[P_e = P. \quad \rightarrow \quad m_1 v_{10} + m_2 v_{20} = m_1 v_1 + m_2 v_2 = (m_1 + m_2)v.\]

So \(v = \frac{m_1 v_{10} + m_2 v_{20}}{m_1 + m_2} = \frac{(1500 \text{ kg})(25 \text{ m/s}) + (0)}{1500 \text{ kg} + 1200 \text{ kg}} = 13.9 \text{ m/s}.\)

\(K_e = \frac{1}{2}(1500 \text{ kg})(25 \text{ m/s})^2 + \frac{1}{2}(1200 \text{ kg})(0)^2 = 4.69 \times 10^5 \text{ J};\)

\(K = \frac{1}{2}(1500 \text{ kg})(13.9 \text{ m/s})^2 + \frac{1}{2}(1200 \text{ kg})(13.9 \text{ m/s})^2 = 2.61 \times 10^5 \text{ J}.\)

The kinetic energy lost is \(K_e - K = 2.1 \times 10^5 \text{ J}.\)

102. (a) \(p_x = p_x = (0.50 \text{ kg})(3.3 \text{ m/s}) = 1.65 \text{ kg m/s}.\)

\(p = \sqrt{(1.65 \text{ kg m/s})^2 + (1.65 \text{ kg m/s})^2} = 2.3 \text{ kg m/s},\)

\(\theta = \tan^{-1} \frac{1.65}{1.65} = 45^\circ \text{ below the } -x \text{ axis}.\)

(b) No; the same as in (a). A collision does not have to occur; momentum would be the same.

103. From momentum conservation \(P_e = P\) (note \(m_1 = m_2 = m\):

\[m_1 v_{10} + m_2 v_{20} = m_1 v_1 + m_2 v_2, \quad \text{so} \quad v_1 + v_2 = v_{10} + v_{20};\]  

Eq. (1)

also from the result of Exercise 6.81(a) \(v_2 - v_1 = -(v_{20} - v_{10}).\) 

Eq. (2)

Eq. (1) + Eq. (2) gives \(2v_2 = 2v_{10}\) so \(v_2 = v_{10} = 2.0 \text{ m/s}\)

and \(v_1 = v_{10} + v_{20} - v_2 = 2.0 \text{ m/s} + (-2.0 \text{ m/s}) = -2.0 \text{ m/s},\)

where \(v_{20} = -2.0 \text{ m/s}\) is because the balls are “approaching each other.”

Therefore, the speeds are \(v_1 = v_2 = 2.0 \text{ m/s}.\)