Name:_____ Date:_____ Class:_____

AP Physics 1 Collisions Practice

1. A 3.00 kg mud ball has a perfectly inelastic collision with a second mud ball that is initially at rest. The composite system moves with a speed equal to one-third the original speed of the 3.00 kg mud ball. What is the mass of the second mud ball? ***6.00 kg***
2. A 15.0 g toy car moving to the right at 20.0 cm/s has an elastic head-on collision with a 20.0 g toy car moving in the opposite direction at 30.0 cm/s. After colliding, the 15.0 g car moves with a velocity of 37.1 cm/s to the left. Find the velocity of the 20.0 g car after the collision. ***12.8 cm/s to the right***
3. An 82-kg male and a 48-kg female pair figure skating team are gliding across the ice at 7.4 m/s, preparing for a throw jump maneuver. The male skater tosses the female skater forward with a speed of 8.6 m/s. Determine the speed of the male skater immediately after the throw. ***6.7 m/s***
4. A 70.9-kg boy and a 43.2-kg girl, both wearing skates face each other at rest on a skating rink. The boy pushes the girl, sending her eastward with a speed of 4.64 m/s. Neglecting friction, determine the subsequent velocity of the boy. ***2.83 m/s west***
5. A 1550 kg car moving south at 10.0 m/s collides with a 2250 kg car moving north. The cars stick together and move as a unit after the collision at a velocity of 5.22 m/s to the north. Find the velocity of the 2250 kg car before the collision. ***15.7 m/s north***
6. Anna Litical and Noah Formula are doing a cart and brick lab. They drop a brick on a 2.6 kg cart moving at 28.2 cm/s. After the collision, the dropped brick and cart are moving together with a velocity of 15.7 cm/s. Determine the mass of the dropped brick. ***2.1 kg***
7. A 75 kg student stands in the middle of a frozen pond having a radius of 5.0 m. He is unable to get to the other side because of a lack of friction between his shoes and the ice. To overcome this difficulty, he throws his 2.6 kg physics book horizontally toward the north shore at a speed of 5.0 m/s. How long does it take him to reach the south shore? ***29 s***
8. Rex (m=86 kg) and Tex (92 kg) board the bumper cars at the local carnival. Rex is moving at a full speed of 2.05 m/s when he rear-ends Tex who is at rest in his path. Tex and his 125-kg car lunge forward at 1.40 m/s. Determine the post-collision speed of Rex and his 125-kg car. ***0.61 m/s***
9. A 200 g arrow moving horizontally collides inelastically with a 500 g apple, initially at rest on top of a 1.2 m tall post. If the arrow and apple move together a horizontal distance of 2.6 m from the base of the post as it falls, what is the initial velocity of the arrow before it strikes the apple? ***18.4 m/s***
10. A 125 g arrow moving horizontally at a speed of 12 m/s collides inelastically with a 375 g pendulum bob initially at rest. What will be the peak height of the arrow and pendulum after the collision? ***0.46 m***

Collisions Practice

①

$$p_0 = p_f \qquad v_f = \frac{v_{1_0}}{3}$$

$$m_1 v_{1_0} + m_2 v_{2_0}^{0} = (m_1 + m_2) v_f$$

$$3 \cdot (3\,kg) v_{1_0} = (3\,kg + m_2)\left(\frac{v_{1_0}}{3}\right) \cdot 3$$

$$9\,kg = (3\,kg) + m_2$$

$$m_2 = 6\,kg$$

②

$$p_0 = p_f$$

$$m_1 v_{1_0} + m_2 v_{2_0} = m_1 v_{1_f} + m_2 v_{2_f}$$

$$(15\,g)(20\,cm/s) + (20\,g)(-30\,cm/s) = (15\,g)(-37.1\,cm/s) + (20\,g) v_{2_f}$$

$$-300\,g \cdot cm/s = -556.5\,g \cdot cm/s + (20\,g) v_{2_f}$$

$$v_{2_f} = 12.83\,cm/s$$

③

$$p_0 = p_f$$

$$(m_1 + m_2) v_0 = m_1 v_{1_f} + m_2 v_{2_f}$$

$$(82\,kg + 48\,kg)(7.4\,m/s) = (48\,kg)(8.6\,m/s) + (82\,kg) v_{2_f}$$

$$962\,kg \cdot m/s = 412.8\,kg \cdot m/s + (82\,kg) v_{2_f}$$

$$v_{2_f} = 6.7\,m/s$$

④

$$p_0 = p_f$$

$$0 = m_1 v_{1_f} + m_2 v_{2_f}$$

$$0 = (70.9\,kg) v_{1_f} + (43.2\,kg)(4.64\,m/s)$$

$$v_{1_f} = -2.83\,m/s$$

(5)

$$p_0 = p_f$$

$$m_1 v_{1_0} + m_2 v_{2_0} = (m_1 + m_2) v_f$$

$$(1550\ kg)(-10\ m/s) + (2250\ kg) v_{2_0} = (1550\ kg + 2250\ kg)(5.22\ m/s)$$

$$v_{2_0} = 15.7\ m/s$$

(6)

$$p_{0_x} = p_{f_x}$$

$$m_1 v_{1_{0_x}} + m_2 v_{2_{0_x}} = (m_1 + m_2) v_{f_x}$$

$$(2.6\ kg)(28.2\ cm/s) + 0 = (2.6\ kg + m_2)(15.7\ cm/s)$$

$$m_2 = 2.07\ kg$$

(7)

$$p_0 = p_f$$

$$0 = m_1 v_{1_0} + m_2 v_{2_0}$$

$$0 = (2.6\ kg)(5\ m/s) + (75\ kg) v_{2_0}$$

$$v_{2_0} = -0.173\ m/s$$

$$v = \frac{\Delta x}{t}$$

$$0.173\ m/s = \frac{5.0\ m}{t}$$

$$t = 28.85\ s$$

(8)

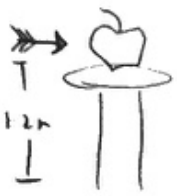
$$p_0 = p_f$$

$$m_1 v_{1_0} + m_2 v_{2_0} = m_1 v_{1_f} + m_2 v_{2_f}$$

$$(125\ kg)(2.05\ m/s) + 0 = (131\ kg)(1.4\ m/s) + (125\ kg) v_{2_f}$$

$$v_{2_f} = 0.58\ m/s$$

(9)



$$P_0 = P_f$$

$$m_1 v_{1_0} + m_2 v_{2_0} = (m_1 + m_2) v_f$$

$$(200\,g) v_{1_0} + 0 = (200\,g + 500\,g)(5.31\ m/s)$$

$$v_{1_0} = 18.57\ m/s$$

x	y
$\Delta x = 2.6m$	$\Delta y = 1.2m$
$v_x = \frac{\Delta x}{t}$	$v_{y_0} = 0$
$v_x = \frac{2.6m}{.49s}$	$a = g$
$v_x = 5.31\ m/s$	$t = ?$
	$\Delta y = v_{y_0} t + \frac{1}{2} g t^2$
	$1.2m = \frac{1}{2} g t^2$
	$t = 0.49s$

(10)

$$P_0 = P_f$$

$$m_1 v_{1_0} + m_2 v_{2_0} = (m_1 + m_2) v_f$$

$$(125\,g)(12\ m/s) + 0 = (125\,g + 375\,g) v_f$$

$$v_f = 3\ m/s$$

$$K_0 = U_{SL}$$

$$\frac{1}{2} m v_0^2 = mgh$$

$$\frac{1}{2}(3\ m/s)^2 = gh$$

$$h = 0.46\ m$$