Physics 11 "Please, Sir: May I Have Some More Mentum?" Name: KEY

1. Steve brags that he can use his head to stop a hammer with a momentum of 100 N·s in only 0.042 s. What force will be applied to his head?

$F_{NET} = \frac{\Delta p}{\Delta t} = \frac{p' - p}{t} = \frac{0 - 100}{0.042} =$

−2380 N

2. What is the momentum of a 2.5 kg bag of wet leather thrown at 20 m/s?

$p = mv = (2.5\,kg)(20\,m/s) =$

50 kg m/s

3. What is the impulse on a cart that is exerted by a force of 46 N for 3.5 s?

$F_{NET} \cdot \Delta t = (46\,N)(3.5\,s) =$

161 N·s

4. An object travelling at 400 m/s has a momentum of 4.5 kg · m/s. What is its mass?

$m = \frac{p}{v} = \frac{4.5\,kg\,\frac{m}{s}}{400\,\frac{m}{s}} = 0.01125\,kg$ OR

$1.125 \times 10^{-3}\,kg$ OR **11.3 g**

5. A billiard ball moving at (−) 2.5 m/s hits the cushion and bounces back with a velocity of (+) 2.0 m/s. The mass of the billiard ball is 0.50 kg.

a) What is the change in momentum of the billiard ball?

$\Delta p = m\Delta v$

$= m(v' - v) = 0.50\,kg\,(2.0 - (-2.5))\,\frac{m}{s} =$

2.25 kg · m/s [AWAY FROM CUSHION]

b) What is the magnitude and direction of the impulse exerted on the ball by the cushion?

SAME AS IN (a)

c) If the force of the cushion on the ball acts for 0.020 s, what is the magnitude **and** direction of this force?

$$F_{NET} = \frac{\Delta p}{\Delta t} = \frac{2.25\ N\cdot s}{0.020\ \ s} = 112.5\ \ N$$

113 N

d) What is the ball's acceleration?

$$a = \frac{F_{NET}}{m} = \frac{112.5\ N}{0.50\ kg} = 225\ \frac{m}{s^2}$$

$225\ \frac{m}{s^2}$

6. A 10000 kg railway car travelling at a speed of 20 m/s strikes an identical car at rest. If the cars lock together as a result of their collision, what is their common speed afterwards?

$$m_1v_1 + \cancel{m_2v_2}_{0} = (m_1+m_2)v'$$

$$v' = \frac{m_1v_1}{m_1+m_2} = \frac{10000(20)}{20000} = 10\frac{m}{s}$$

$10\ \frac{m}{s}$

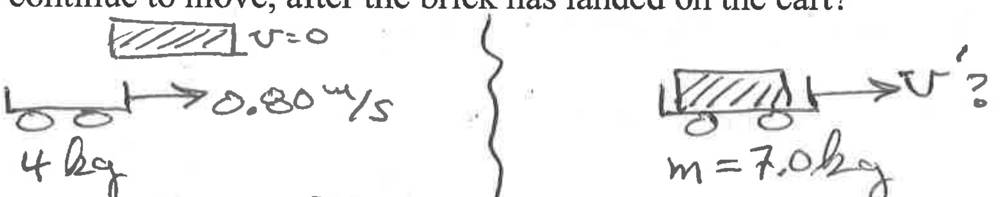
7. Calculate the recoil velocity of a 4.0 kg gun which shoots a 0.050 kg bullet at a speed of 280 m/s.

$$0 = m_1v_1 + m_2v_2$$

$$v_1 = \frac{-m_2v_2}{m_1} = \frac{-(0.050)(280)}{4.0} = -3.5\ \frac{m}{s}$$

$-3.5\ \frac{m}{s}$

8. A 3.0 kg brick is dropped vertically onto a 4.0 kg cart, which is moving across a level floor at 0.80 m/s. With what velocity do the cart and brick continue to move, after the brick has landed on the cart?



$$m_1v_1 + \cancel{m_2v_2}^{0} = m'v'$$

$$v' = \frac{m_1v_1}{m'}$$

$$= \frac{4(0.80)}{7} = 0.457$$

$0.46\ \frac{m}{s}$

9. A steel ball of mass 1.2 kg travelling at a speed of 2.5 m/s makes a head-on collision with a smaller steel ball of mass 0.8 kg which is originally stationary. If the smaller ball moves on with a speed of 3.1 m/s, what is the final velocity of the 1.2 kg steel ball?

$v_1 = 2.5$ $\quad v_2 = 0$ $\quad v_1'$ $\quad v_2' = 3.1\ \frac{m}{s}$

$$m_1 v_1 + \cancel{m_2 v_2} = m_1 v_1' + m_2 v_2'$$

$$v_1' = \frac{m_1 v_1 - m_2 v_2'}{m_1} = \frac{1.2(2.5) - 0.8(3.1)}{1.2} =$$

$0.43\ \frac{m}{s}$

10. A block of cheese of 5.5 kg is at rest on a frictionless surface. A bowling ball of mass 1.2 kg is thrown into the block of cheese (where it remains). If the velocity of the thrown ball is 20 m/s, what will be the velocity of the cheese and ball after the collision?

20 $\quad v'$

$$m_1 v_1 + 0 = (m_1 + m_2) v'$$

$$v' = \frac{m_1 v_1}{m_1 + m_2} = \frac{1.2(20)}{(1.2 + 5.5)} = \frac{24}{6.7} = 3.58$$

$3.58\ \frac{m}{s}$

11. A ball of mass 8.0 kg, rolling along at 5.5 m/s, comes into contact with a ball of mass 3.0 kg, which was at rest. After impact, the 3.0 kg ball moves away twice as fast as the 8.0 kg ball, both travelling in the same direction.

What was the velocity of the 8 kg ball after the collision?

8 $\quad 5.5$ $\quad$ 3 $\quad 0$ $\quad$ 8 $\quad v_1'$ $\quad$ 3 $\quad v_2' = 2v_1'$

$$m_1 v_1 + 0 = m_1 v_1' + m_2 2v_1'$$

$$8(5.5) = 8v_1' + 3 \cdot 2 v_1'$$

$$44 = 14 v_1'$$

$$\therefore v_1' = \frac{44}{14} = 3.14\ \frac{m}{s}$$

$3.14\ \frac{m}{s}$