Momentum Quiz 2 Answers

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Momentum Quiz 2

Score: _____/18

1. A football player of mass 82 kg is running due **north** at 7.5 m/s. He collides with another player of mass 65 kg who is running **south** at 8.1 m/s. After the collision, the players stick together. What is the final velocity of both players immediately after the collision (magnitude and direction)? (3 marks)

$\Sigma \vec{p}_i = \Sigma \vec{p}_f$ (0.5)

$m_A \vec{v}_{Ai} + m_B \vec{v}_{Bi} = (m_A + m_B)\vec{v}_f$ (0.5)

$\vec{v}_f = \frac{m_A \vec{v}_{Ai} + m_B \vec{v}_{Bi}}{(m_A + m_B)} = \frac{(82)(7.5) + 65(-8.1)}{82 + 65} = 0.602$ m/s North

(0.5) (0.5) (0.5) (0.5)

2 marks for $v = 7.765$ m/s

Please don't turn in this quiz until you have marked it (the solution key will be sent out on Wednesday)

2. A ~~52~~ .052 kg gram ball is dropped, and hits the ground at 8.2 m/s. After impact, it rebounds upwards at + 6.2 m/s. If the impact takes 0.15 s,

a) What is the impulse on the ball (magnitude and direction)? (2 marks)

$\Delta\vec{p} = m\vec{v}_f - m\vec{v}_i = (.052)(6.2) - (.052)(-8.2)$ (0.5) (0.5)

$\Delta\vec{p} = 0.749 \text{ kg m/s up}$ (0.5) (0.5)

1 mark for 0.104 kg m/s

b) What is the average force of impact (magnitude and direction)? (2 marks)

$\Delta\vec{p} = Ft \rightarrow \vec{F} = \frac{\Delta\vec{p}}{t} = \frac{0.7488}{0.15} = 4.99 \text{ N up}$ (0.5) (0.5) (0.5) (0.5)

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+ = right

3. A 1650 kg car traveling at 11.0 m/s collides with a wall as shown.

The car rebounds off of the wall with a velocity of 1.3 m/s. If the collision lasts for 0.30 s, what is the magnitude of the average force that the wall applies to the car? (2 marks)

$\Delta \vec{p} = \Delta \vec{p}$

$Ft = m\vec{v}_f - m\vec{v}_i$ (0.5)

$F = \frac{m\vec{v}_f - m\vec{v}_i}{t} = \frac{(1650)(-1.3) - 1650(11)}{.3}$ (0.5) (0.5)

$\vec{F} = -67650 \Rightarrow$ **67700 N** (0.5)

4. What will the recoil velocity (**magnitude and direction**) be if a 2.4 kg (A) rifle fires a 0.046 kg (B) bullet with a velocity of 490 m/s due North? (3 marks)

+

$\Sigma \vec{p}_i = \Sigma \vec{p}_f$ (0.5)

$0 = m_A\vec{v}_A + m_B\vec{v}_B$ (0.5)

$v_A = \frac{-m_B v_B}{m_A} = -\frac{(.046)(490)}{2.4} = -9.39 = 9.39$ m/s South (0.5) (0.5) (0.5) (0.5)

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5. When suited up in his hockey gear, George weighs 85.0 kg. He is skating East with a velocity of 14.0 m/s. He collides with Jim who weighs 65 kg and was skating West with a velocity of 8.0 m/s. After the collision, George slides across the ice with a velocity of 4.0 m/s East. What is Jim's velocity after the collision (magnitude and direction)? (3 marks)

$$\Sigma \vec{p}_i = \Sigma \vec{p}_f \quad (0.5)$$

$$m_G \vec{v}_{Gi} + m_J \vec{v}_{Ji} = m_G \vec{v}_{Gf} + m_J \vec{v}_{Jf} \quad (0.5)$$

$$\vec{v}_{Jf} = \frac{m_G \vec{v}_{Gi} + m_J \vec{v}_{Ji} - m_G \vec{v}_{Gf}}{m_J} \quad (0.5)$$

$$\vec{v}_{Jf} = \frac{(85)(14) + (65)(-8) - 85(4)}{65} \quad (0.5)$$

$$\vec{v}_{Jf} = 5.08 \text{ m/s} \quad (0.5) \quad @ \text{ East} \quad (0.5)$$

1.5 out of 3 for v=21 m/s

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A + T

6. An arrow of mass 0.120 kg traveling at 105.0 m/s due west is shot into a target hanging from a rope. The target has a mass of .80 kg and the arrow sticks into the target. Calculate the velocity (**magnitude and direction**) of the target with the arrow immediately after the arrow strikes. (3 marks)

$\Sigma \vec{p}_i = \Sigma \vec{p}_f$ (0.5)

$m_A \vec{v}_{Ai} = (m_A + m_T)\vec{v}_f$ (0.5)

$v_f = \dfrac{m_A \vec{v}_{Ai}}{(m_A + m_T)} = \dfrac{.12(105)}{(.12 + .8)} = 13.7 \text{ m/s}$ West

(0.5) (0.5) (0.5)

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