

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)

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

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

$$\vec{v}_f = \frac{m_A \vec{v}_{Ai} + m_B \vec{v}_{Bi}}{(m_A + m_B)} = \frac{(82)(7.5) + 65(-8.1)}{82 + 65} = 0.602 \text{ m/s} \quad (0.5)$$

North
(0.5)

2 marks for $v = 7.765 \text{ m/s}$

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~~ ⁻ 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)

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

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

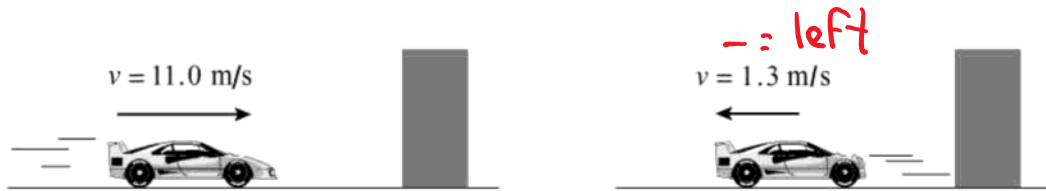
1 mark for 0.104 kg m/s

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

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

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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)

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

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

$$F = \frac{m\vec{v}_f - m\vec{v}_i}{t} = \frac{(1650)(-1.3) - 1650(11)}{0.3} \quad (0.5)$$

$$\vec{F} = -67650 = \boxed{67700 \text{ N}} \quad (0.5)$$

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

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

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

$$v_A = \frac{-m_B v_B}{m_A} = \frac{-(0.046)(490)}{2.4} = -9.39 = 9.39 \text{ m/s South} \quad (0.5) \quad (0.5) \quad (0.5)$$

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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)

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

$$m_G \vec{v}_{G_i} + m_J \vec{v}_{J_i} = m_G \vec{v}_{G_f} + m_J \vec{v}_{J_f} \quad (0.5)$$

$$\vec{v}_{J_f} = \frac{m_G \vec{v}_{G_i} + m_J \vec{v}_{J_i} - m_G \vec{v}_{G_f}}{m_J} \quad (0.5)$$

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

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

1.5 out of 3 for v=21 m/s

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6. An ^A arrow of mass 0.120 kg traveling at ⁺ 105.0 m/s due west is shot into a target ^T 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)

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

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

$$\vec{v}_f = \frac{m_A \vec{v}_{A_i}}{(m_A + m_T)} = \frac{.12(105)}{(.12 + .8)} = 13.7 \text{ m/s West} \quad (0.5)$$

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