

IGCSE Physics Worksheet

Topic: Momentum and Impulse

Reading Passage:

Momentum is a measure of how difficult it is to stop a moving object. It depends on both the mass and the velocity of the object. The momentum p of an object is defined as $p = m v$. Momentum is a vector quantity, meaning it has both magnitude and direction. In a closed system, the total momentum before a collision equals the total momentum after the collision. This is known as the principle of conservation of momentum. Impulse describes how a force changes the momentum of an object. When a force acts on an object for a certain amount of time, the momentum changes. Impulse $F \Delta t$ is equal to the change in momentum: $F \Delta t = \Delta p$. This relationship explains why safety features such as airbags, crumple zones, and padded surfaces reduce injuries. They increase the time over which the force acts, reducing the force experienced by the passengers.

Questions:

Section A:

1. Define momentum.
2. State the equation for impulse.
3. Explain why momentum is described as a vector quantity.
4. What does the principle of conservation of momentum state?

Section B:

5. A 1.2 kg ball is moving at 8 m/s. (a) Calculate its momentum. (b) If it is brought to rest in 0.4 s, calculate the impulse acting on it.
6. A 900 kg car is travelling at 20 m/s. It collides with a stationary 600 kg car. After the collision, both cars move together. (a) Calculate the total momentum before the collision. (b) Calculate their combined velocity after the collision.

Section C:

7. Explain how airbags reduce injuries during a collision, using the idea of impulse and momentum.

Answer Key:

Section A:

1. Momentum is the product of an object's mass and velocity.
2. $F \Delta t = \Delta p$.
3. Momentum is a vector because it depends on velocity, which has direction.
4. The total momentum of a closed system remains constant before and after a collision.

Section B:

5(a) $p = 1.2 * 8 = 9.6 \text{ kg m/s}$.

5(b) $\Delta p = -9.6 \text{ Ns}$.

6(a) $p = 900 * 20 = 18,000 \text{ kg m/s}$.

6(b) $v = 18,000 / 1500 = 12 \text{ m/s}$.

Section C:

7. Airbags increase the stopping time, reducing the force experienced, because $F \Delta t = \Delta p$.