MOMENTUM AND IMPULSE 04 FEBRUARY 2014

Lesson Description

In this lesson we:

- Define important terms
- Discuss impulse, conservation of momentum and kinetic energy

Summary

Momentum is a vector quantity which is defined as the product of an object's velocity and mass. As an equation: p = mv

Impulse is equal to the change in momentum of an object. Impulse is defined as product of the net force experienced by an object and the time the force is experienced.

The law of conservation of momentum states that the total linear momentum in a closed system remains constant in magnitude and direction during a collision.

$$\Sigma p_{initial} = \Sigma p_{final}$$

Total kinetic energy of a system is conserved during an elastic collision, but not conserved during an inelastic collision.

Test Yourself

Select the most correct answer from the options given. Write down only the correct letter

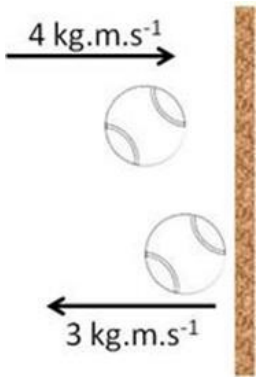
Question 1

The net force acting on an object is equal to the...

A. mass of the object
B. acceleration of the object
C. change in momentum of the object
D. rate of change in momentum of the object

Question 2

A tennis ball strikes a wall horizontally with a momentum of 4kg.m.s^{-1} and rebounds in the opposite direction with a momentum of 3kg.m.s^{-1}. (As shown in the diagram). What is the tennis ball's change in momentum?



A. 1 kg.m.s^{-1} towards the wall
B. 1 kg.m.s^{-1} away from the wall
C. 7 kg.m.s^{-1} towards the wall
D. 7 kg.m.s^{-1} away from the wall

Question 3

Consider the tennis ball striking the wall in question 2. If the ball is in contact with the wall for 0,2 s, what is the net force of the ball on the wall?

A. 5 N towards the wall
B. 5 N away from the wall
C. 35 N towards the wall
D. 35 N away from the wall

Question 4

A ball of mass *m* strikes the ground at a velocity of +*v*. It bounces on the ground and moves upwards at a speed of -½*v*. Which one of the following represents the magnitude of the change in momentum of the ball?

A. -0,5 mv
B. -1,5 mv
C. +0,5 mv
D. +1,5 mv

Question 5

When a passenger airbag inflates in a car during a collision, the chances of serious injury to the passenger is reduced because:

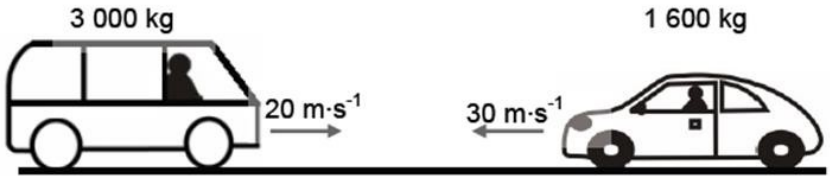
A. the passenger is brought to rest in a shorter period of time
B. the passenger's change in momentum is reduced
C. the net force acting on the passenger is reduced, since the contact time is increased
D. the passenger's change in momentum is increased

Improve your Skills

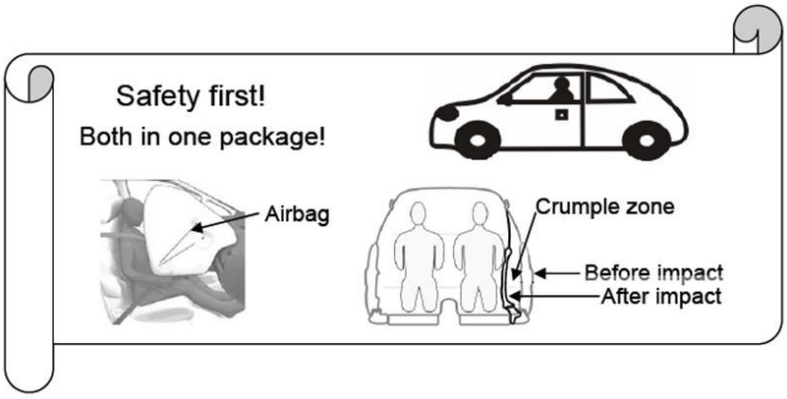
Question 1

(Adapted from Exemplar 2008 Paper 1)

Collisions happen on the roads in our country daily. In one of these collisions, a car of mass 1 600 kg, travelling at a speed of 30 m.s^{-1} to the left, collides head-on with a minibus of mass 3 000 kg, travelling at 20 m.s^{-1} to the right. The two vehicles move together as a unit in a straight line after the collision.



1.1. Calculate the velocity of the two vehicles after the collision.
1.2. Do the necessary calculations to show that the collision was inelastic.
1.3. The billboard below advertises a car from a certain manufacturer.



Use your knowledge of momentum and impulse to justify how the safety features mentioned in the advertisement contribute to the safety of passengers.

Question 2

(Adapted from Final Exam 2009 (1) – Paper 1)

A man of mass 87 kg on roller skates, moving horizontally at constant speed in a straight line, sees a boy of mass 22 kg standing directly in his path. The man grabs the boy and they boy continue in a straight line at 2,4 $m.s^{-1}$.

2.1. Calculate the man's speed just before he grabs the boy. Ignore the effects of friction.
2.2. Is the collision elastic? Use a calculation to support your answer.

Links

Introduction to momentum and impulse	http://www.youtube.com/watch?v=rokrF47SPNA
Introduction to conservation of momentum	http://www.youtube.com/watch?v=yHmzsLIy3x4