Momentum

Question Paper

Course	CIE IGCSE Physics
Section	1. Motion, Forces & Energy
Topic	Momentum
Difficulty	Medium

Time Allowed 50

Score /41

Percentage /100

Question 1

Extended tier only

A tennis player is practicing by hitting a ball many times against a wall. The ball hits the wall 20 times in 60 s.

The average change in momentum for each collision with the wall is 4.2 kg m/s.

Calculate the average force that the ball exerts on the wall.

[3 marks]

Question 2a

Extended tier only

The velocity of an object of mass m increases from u to v.

State, in terms of m, u and v, the change of momentum of the object.

[1 mark]

Question 2b

Extended tier only

In a game of tennis, a player hits a stationary ball with his racquet.

(i) The racquet is in contact with the ball for 6.0 ms. The average force on the ball during this time is 400 N.

Calculate the impulse on the tennis ball.

impulse = ...[2]

(ii) The mass of the ball is 0.056 kg.

Calculate the speed with which the ball leaves the racquet.

speed = ...[2]

(iii) State the energy transfer that takes place:

1. as the ball changes shape during the contact between the racquet and the ball

2. as the ball leaves the racquet.

[2]

[6 marks]

Question 3a

Extended tier only

Complete Fig. 2.1 by writing in the right-hand column the name of the quantity given by the product in the left-hand column.

product	quantity
mass × acceleration	
force × time	

Fig. 2.1

[2 marks]

Question 3b

Extended tier only

Fig. 2.2 shows a man hitting a ball with a golf club.

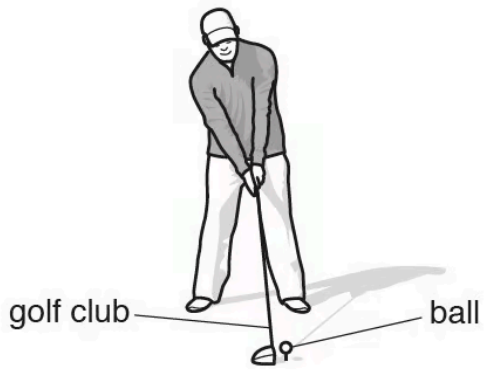

Fig. 2.2

The ball has a mass of 0.046 kg. The golf club is in contact with the ball for 5.0×10^{-4} s and the ball leaves the golf club at a speed of 65 m/s.

(i) Calculate:

1. the momentum of the ball as it leaves the golf club

momentum = ...[2]

2. the average resultant force acting on the ball while it is in contact with the golf club.

average force = ...[2]

(ii) While the golf club is in contact with the ball, the ball becomes compressed and changes shape.

Name the energy store being filled whilst the ball is in contact with the golf club.

[1]

[5 marks]

Question 4a

Extended tier only

Fig. 3.1 shows a shooting competition, where air rifles fire soft metal pellets at distant targets.

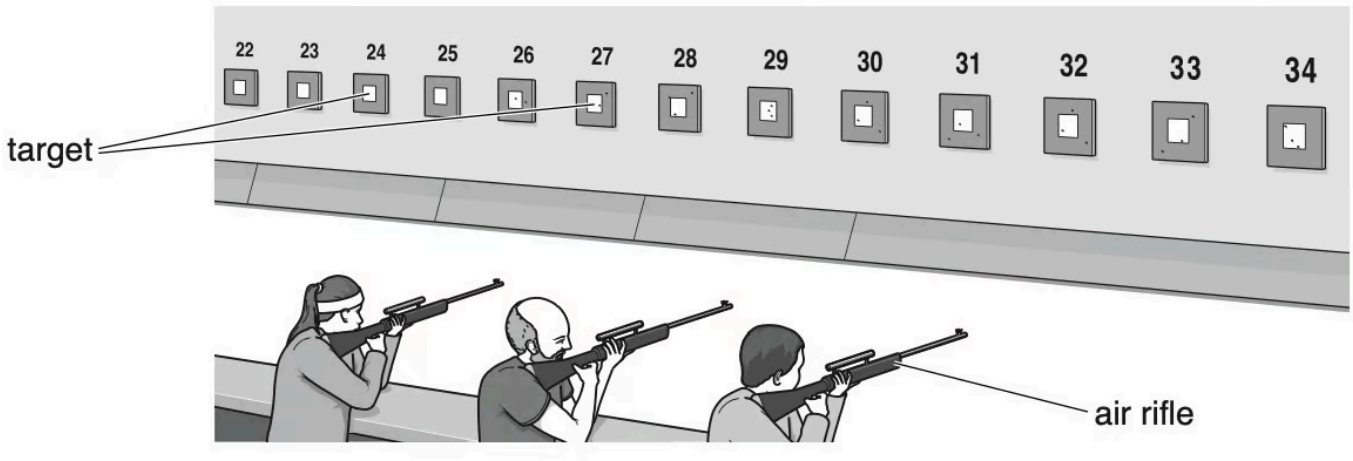

Fig. 3.1

When an air rifle is fired, it exerts an impulse of 0.019 N s on the pellet.

Define *impulse*.

[1 mark]

Question 4b

Extended tier only

The pellet has a mass of 1.1×10^{-4} kg.

Determine:

(i) the speed with which the pellet leaves the rifle

speed = ... [2]

(ii) the kinetic energy of the pellet as it leaves the rifle.

kinetic energy = ... [3]

[5 marks]

Question 4c

The pellet melts when it strikes the target.

Describe how the molecular structure of the liquid metal differs from that of the solid metal.

[3 marks]

Question 5a

Extended tier only

State the equation for impulse in terms of the velocity of an object. Define the variables used.

[2 marks]

Question 5b

Extended tier only

In a game of croquet, a player hits a ball which was initially at rest with a mallet.

The mallet has mass of 1.36 kg.

(i) The mallet is in contact with the ball for 11 ms. The average force on the ball during this time is 200 N.

Calculate the impulse on the croquet ball.

impulse = ...[3]

(ii) The mass of the ball is 0.450 kg.

Calculate the speed with which the ball leaves the mallet.

speed = ...[2]

[5 marks]

Question 5c

Extended tier only

Calculate the velocity of the mallet at the moment it hit the ball.

[3 marks]

Question 5d

State the energy transfer that takes place:

(i) As the ball changes shape during the contact between the mallet and the ball.

[2]

(ii) As the ball leaves the mallet.

[1]

[5 marks]