2.3 Linear Motion
2.4 Angular Motion
2.5 Projectile Motion
2.6 Fluid Mechanics

Mark Scheme

1. Which of the following can be defined as 'the shortest route in a straight line between the starting and finishing positions'? **(1 mark)**

A) Velocity
B) Acceleration
C) Displacement
D) Momentum

Mark One - C

2. Impulse is the time it takes for a force to be applied to an object or body. What is the correct equation for impulse? **(1 mark)**

A) Impulse = force x time
B) Impulse = force x speed
C) Impulse = force x acceleration
D) Impulse = force ÷ time

Mark One - A

3. The image to the right shows a performer taking part in the long jump.

Identify and explain two external forces acting on the long jumper as they are in the air. **(4 marks)**

Force 1:

Mark One – Air Resistance

Mark Two – This acts in the opposite direction to the travel of the long jumper

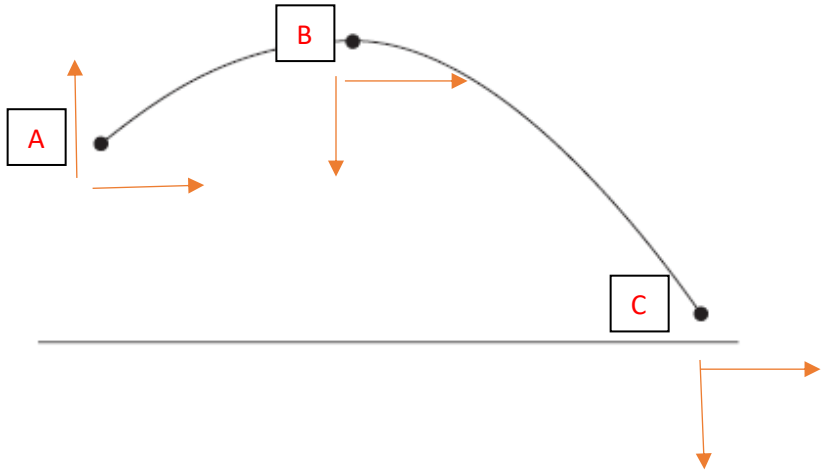
Force 2:

Mark One – Gravity

Mark Two – This will be pulling the jumper down towards the sandpit

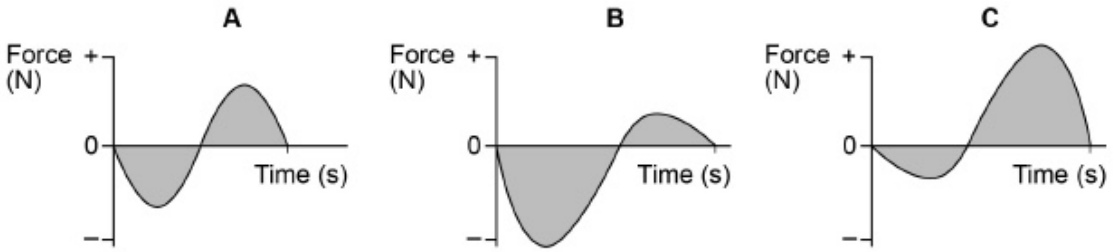
Accept Other Appropriate Answers

4. The figure below shows the flight of a shot put. Label the diagram to show the changing horizontal and vertical vectors at A, B and C.. **(3 marks)**



3 marks given for having horizontal and vertical vectors correct as shown by the arrows in the image

5. The graphs below show three impulse graphs of a sprinter at different stages of a 100m race. **(3 marks)**



Identify which impulse graph represents the start, middle and end of the race. For each graph, justify your reason.

Mark One - The start of the race is represented by graph C. This graph shows a large positive impulse which represents the acceleration taking place

Mark Two - The middle of the race is represented by graph A. This graph shows an equal balance of positive and negative impulse, which represents a constant speed taking place

Mark Three - The end of the race is is represented by graph B. This graph shows a large negative impulse which represents slowing down/deceleration

6. A figure skater must be able to spin at different speeds during a routine. Explain what is meant by angular motion and evaluate how a figure skater will change their angular velocity during a performance. **(8 marks)**

A01 – 2 A02 – 3 A03 – 3

A01 – Knowledge of angular motion e.g.

- Angular motion is movement that takes place around an axis or fixed point
- **Torque** is an important part of angular motion. This refers to the force created that turns the body around an axis.

A02 – Explanation of angular motion e.g.

- A skater must look to change their moment of inertia in order to change their angular motion and angular velocity
- Inertia means that an object remains in its existing state of rest or motion unless it is acted upon by an external force.
- Increasing speed of rotation comes from a decreasing moment of inertia

A03 – Evaluation of how a skater will change their angular velocity during a performance e.g.

- Angular Momentum = Moment of Inertia x Angular Velocity
- To slow down angular motion, a performer must increase their moment of inertia
- This is achieved by opening out their limbs and their body
- This is achieved by tucking their body/bringing their arms together
- To increase angular motion, a performer must decrease their moment of inertia

Accept other appropriate answers

7. The image to the right shows a track cyclist. Explain the forces acting on the cyclist and evaluate how the cyclist can maximise their speed. Consider Bernouli's principle of lift in your answer. **(15 marks)**

A01 – 4 A02 – 5 A03 – 6

A01 – Knowledge of forces acting on a cyclist e.g.

- Drag
- Surface drag
- Form drag
- Air resistance
- Gravity

A02 – Examples/explanation of forces acting on a cyclist e.g.

- Drag – This acts in opposite to motion and will slow something (or someone) down. Drag comes in two forms.
- Surface Drag refers to friction. For example the friction created when the cyclists tyres meet the track
- Form drag refers to streamlining. For example cyclists get in a low position to maximise their form drag and increase their speed
- Air resistance works in the opposite direction to the cyclist and can slow them down. Maximising streamlining can reduce the effects of air resistance
- Gravity pulls the cyclist to the centre of the Earth, reducing their linear motion

A03 – Evaluation of how a cyclist can maximise their speed and analysis of Bernouli's principle e.g.

- A cyclist can maximise their speed by focussing on reducing the effects of surface drag and maximising the effects of form drag (streamlining)
- The cyclists clothing and helmet will benefit form drag, as will their low position on the bike and positioning of their handlebars
- The Benouli principle explains how lift force and downward lift force can occur when air travels over an object
- A track cyclist will get into a low streamlined position on their bike and will also wear a streamlined helmet that is optimal for speed. Therefore air will the travel slowly above the cyclist, causing high pressure.
- Meanwhile the air travels quicker against the cyclist, creating low pressure. Pressure moves from high to low, allowing the cyclist to keep speed, particularly whilst cornering

Accept other appropriate answers