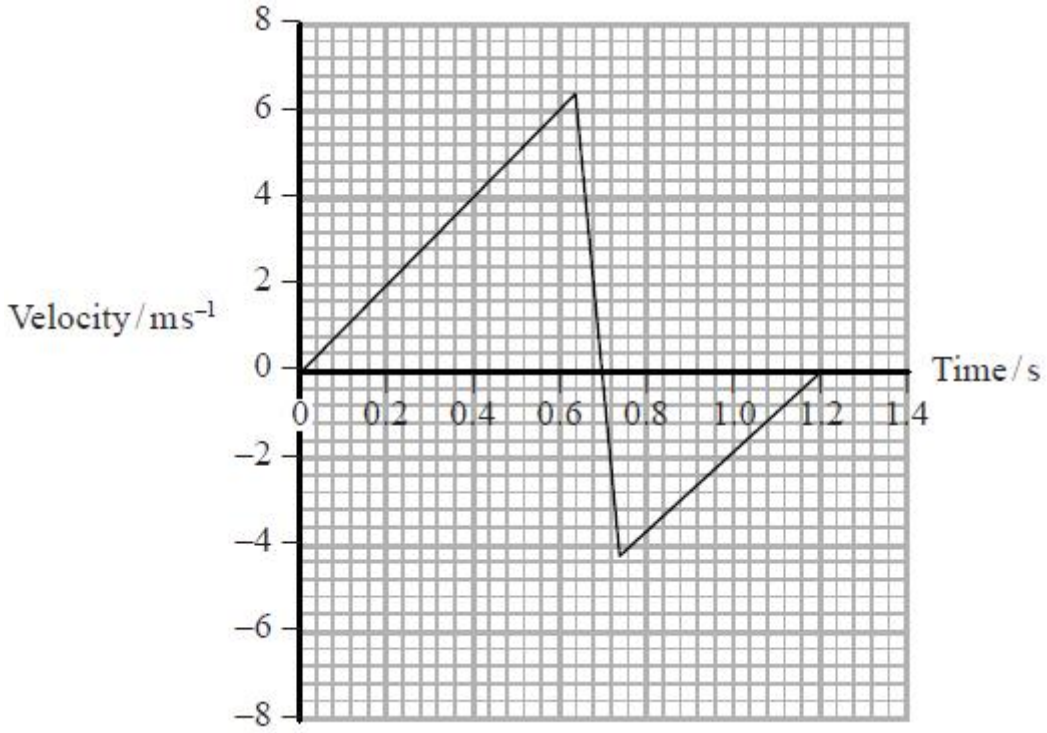
Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A stationary ball is released from a height of 2.0 m onto a hard surface.

The simplified velocity-time graph shows the motion of the ball as it falls and bounces back to its maximum height.



(a) Calculate the maximum height reached by the ball after bouncing.

(2)

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Maximum height = ...

(b) Calculate the decrease in kinetic energy of the ball as it bounces.

mass of ball = 60 g

(2)

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Decrease in kinetic energy = ...

(c) Calculate the resultant force on the ball when it is in contact with the ground.

(3)

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Resultant force = ...

(d) The ball is replaced with one that is softer. It is released from a height of 2.0 m onto the same surface as before. A velocity-time graph is drawn to show the motion of the new ball.

Describe the similarities and differences between the two graphs.

(3)

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(Total for question = 10 marks)

Q2.

The Enterprise is an amusement park ride. Riders sit in cars that are made to rotate in a vertical circle.

The ride starts by moving in a horizontal circle. The speed of rotation increases, and the frame tilts until the ride is rotating vertically as shown.

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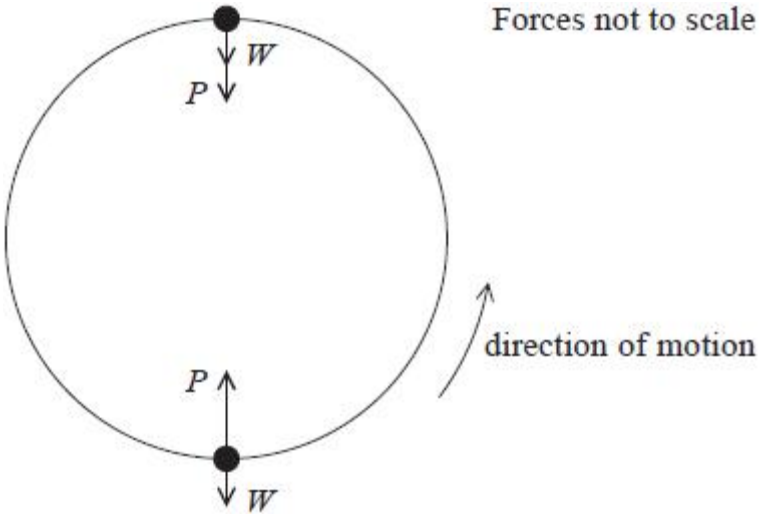
The photograph below shows riders at the top of the vertical circle. The riders are in contact with their seats at all times during the ride.

The diagram shows the weight *W* of a rider and the push *P* from the seat on the rider at the top and bottom of the circular path.



On the website of the amusement park it states

> "The ride is perfectly safe without the need for safety harnesses for the riders. Centrifugal force ensures that the riders remain in their seats at all stages in the ride."

Assess the validity of this statement.

(4)

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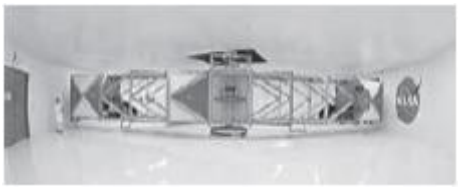
(Total for question = 4 marks)

Q3.

A centrifuge is a machine which rotates.

The United States' space agency, NASA, uses a centrifuge to test whether equipment will operate when experiencing large forces. The equipment to be tested is attached to the end of the frame of the centrifuge, which rotates around a vertical axis at its centre.



(i) Show that the angular velocity of the centrifuge is about 5 rad s^{-1}.

(2)

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(ii) Explain how the centrifuge applies large forces to the equipment under test.

(2)

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(iii) The NASA website says the centrifuge can be used to test whether the equipment can withstand accelerations of up to about 25*g*.

Deduce whether this claim is correct.

(2)

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(Total for question = 6 marks)

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