

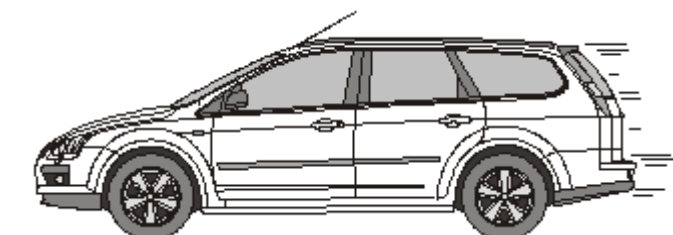
Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

- (a) The diagram shows a car travelling at a speed of 12 m/s along a straight road.



- (i) Calculate the momentum of the car.

Mass of the car = 900 kg

Show clearly how you work out your answer.

Momentum = _____ kg m/s

(2)

- (ii) Momentum has direction.

Draw an arrow on the diagram to show the direction of the car's momentum.

(1)

- (b) The car stops at a set of traffic lights.

How much momentum does the car have when it is stopped at the traffic lights?

Give a reason for your answer.

Q2.

- (a) The diagram shows an athlete at the start of a race. The race is along a straight track.



In the first 2 seconds, the athlete accelerates constantly and reaches a speed of 9 m/s.

- (i) Calculate the acceleration of the athlete.

Show clearly how you work out your answer.

Acceleration = _____

(2)

- (ii) Which **one** of the following is the unit for acceleration?

Draw a ring around your answer.

J/s

m/s

m/s²

Nm

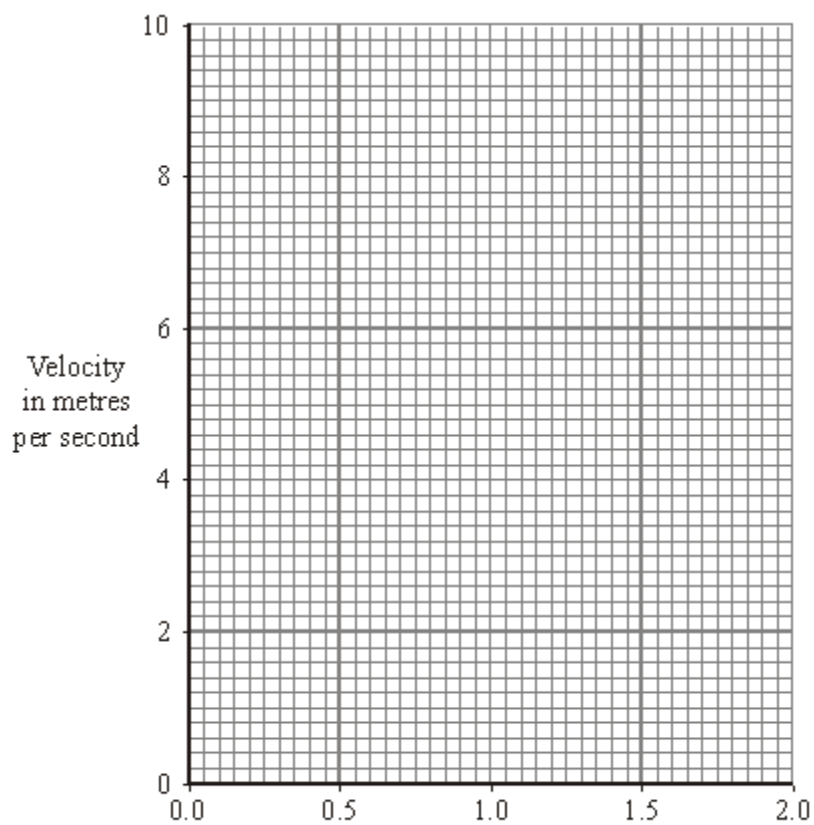
(1)

- (iii) Complete the following sentence.

The velocity of the athlete is the _____ of
the athlete in a given direction.

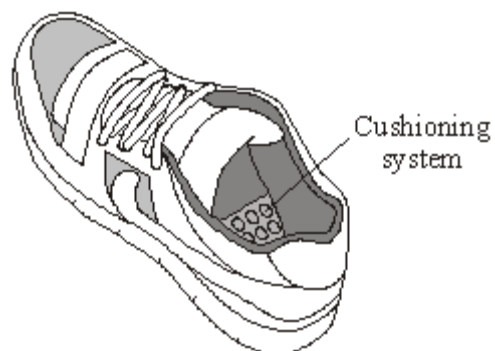
(1)

- (iv) Complete the graph to show how the velocity of the athlete changes during the first 2 seconds of the race.

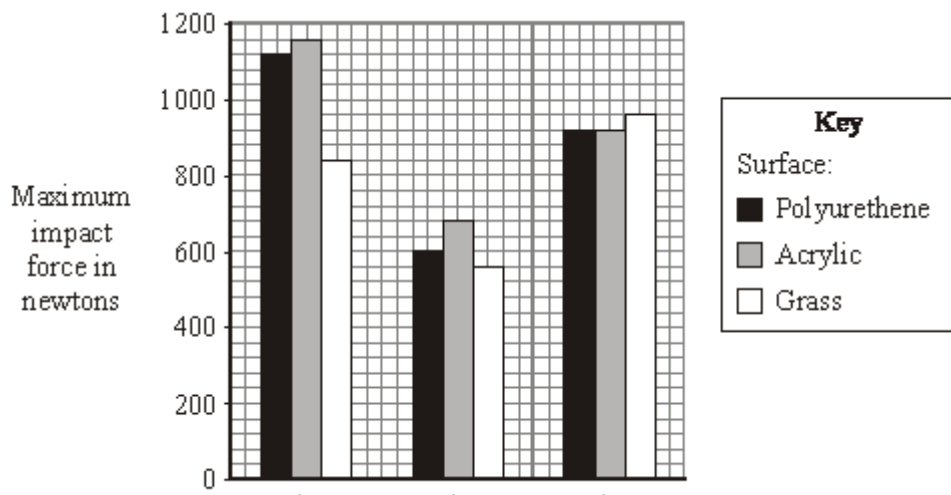


(2)

- (b) Many running shoes have a cushioning system. This reduces the impact force on the athlete as the heel of the running shoe hits the ground.



The bar chart shows the maximum impact force for three different makes of running shoe used on three different types of surface.



- (i) Which **one** of the three makes of running shoe, **A**, **B** or **C**, has the best cushioning system?

Explain the reason for your answer.

(3)

- (ii) The data needed to draw the bar chart was obtained using a robotic athlete fitted with electronic sensors.

Why is this data likely to be more reliable than data obtained using human athletes?

(1)

(Total 10 marks)

Q3.

- (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.

Thrust force



Weight of shuttle, fuel tanks and
booster rockets plus air resistance

- (i) Describe the upward motion of the space shuttle one second after launch.

(1)

- (ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

(1)

- (b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

- (i) Write down the equation that links acceleration, change in velocity and time taken.

(1)

- (ii) Calculate, in m/s^2 , the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

average acceleration = _____ m/s^2

(2)

- (iii) How is the velocity of an object different from the speed of an object?

(1)

(Total 6 marks)