Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

(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/s^2** **Nm**

(1)

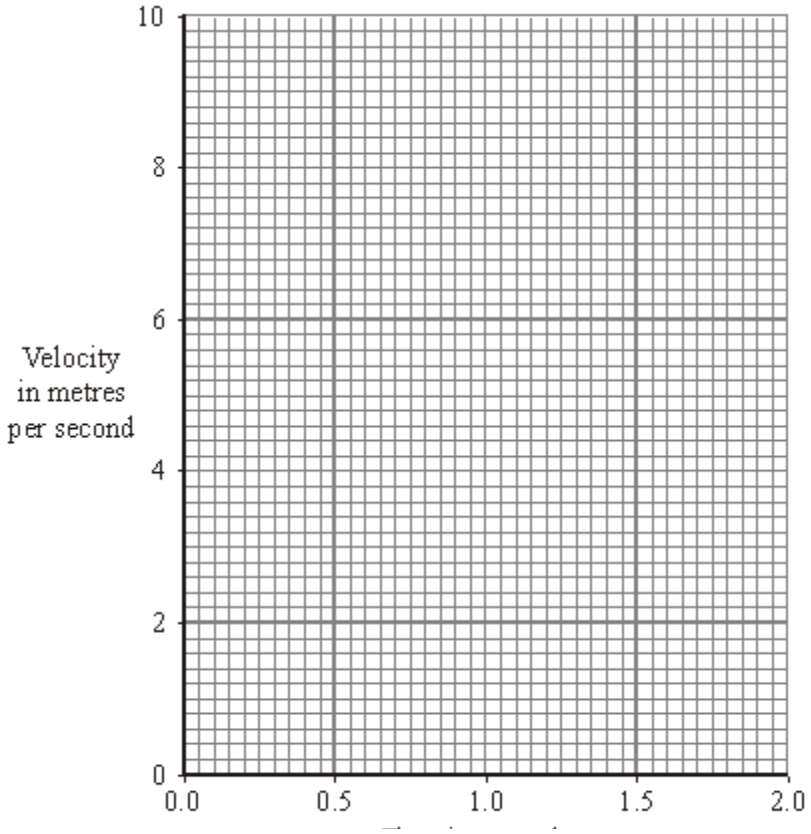
(iii) Complete the following sentence.

The velocity of the athlete is the _____ of

the athlete in a given direction.

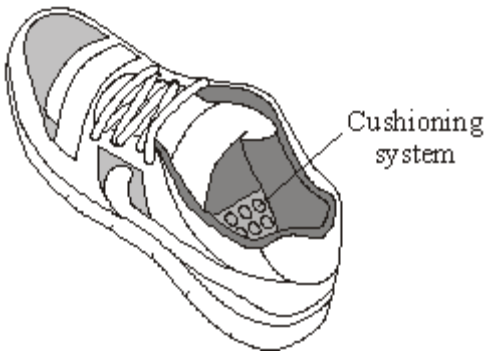
(1)

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

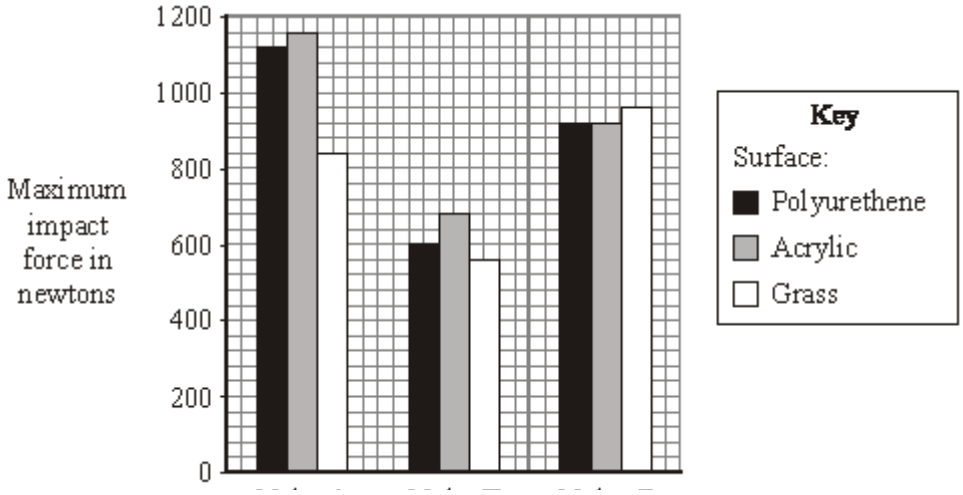


(2)

(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?

_____

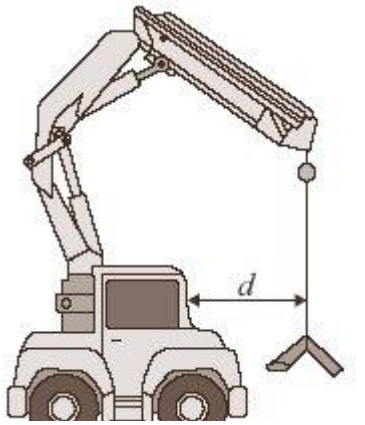
_____

(1)

(Total 10 marks)

Q2.

The diagram shows a small mobile crane. It is used on a building site.



The distance, d, is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	**Maximum safe distance, *d*, in metres (m)**
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

(a) What is the relationship between the load and the maximum safe distance?

_____

_____

_____

(2)

(b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, *d*, of 2.0 metres.

Is the driver correct?

Explain your answer.

_____

_____

_____

_____

(2)

(c) What is the danger if the driver does not follow the safety instructions?

_____

_____

(1)

(d) How should the data in the table have been obtained?

Put a tick (✓) in the box next to your answer.

average results from an opinion poll of mobile crane drivers ☐

copied from a handbook for a similar crane ☐

results of experiments on a model mobile crane ☐

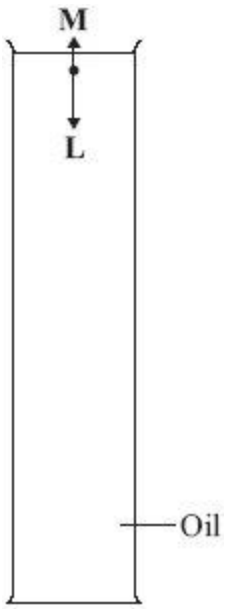
results of experiments on this mobile crane ☐

(1)

(Total 6 marks)

Q3.

(a) The diagram shows a steel ball-bearing falling through a tube of oil.
The forces, **L** and **M**, act on the ball-bearing.

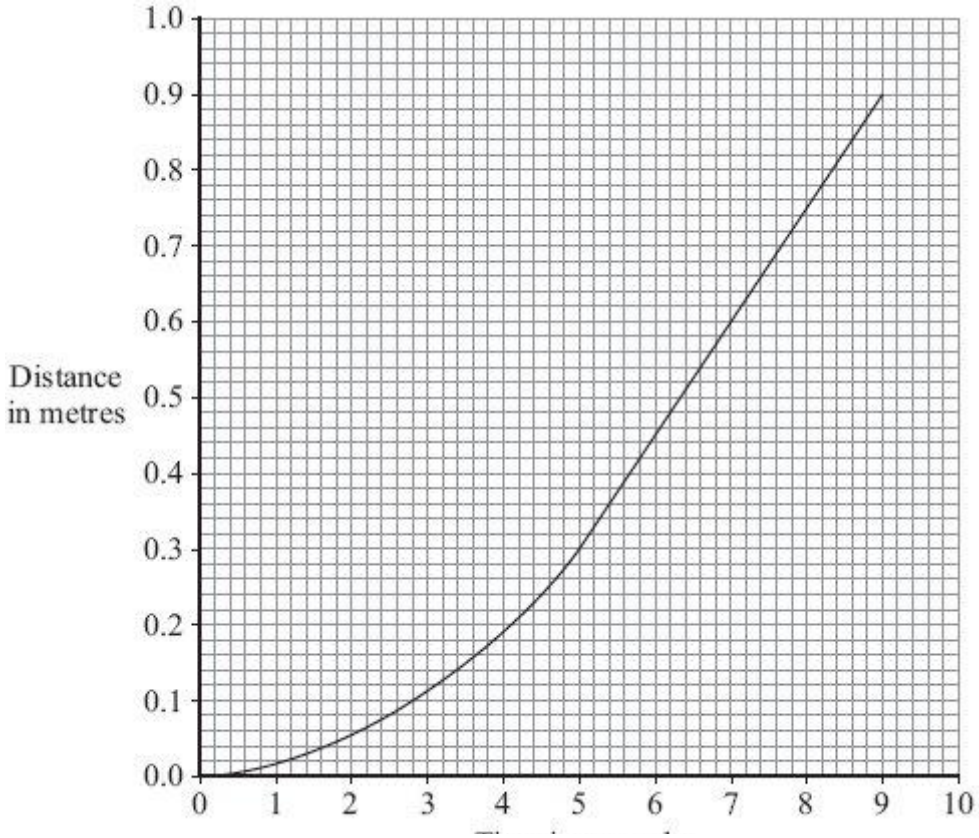


What causes force **L**?

_____

(1)

(b) The distance – time graph represents the motion of the ball-bearing as it falls through the oil.



(i) Explain, in terms of the forces, **L** and **M**, why the ball-bearing accelerates at first but then falls at constant speed.

_____

_____

_____

_____

_____

_____

(3)

(ii) What name is given to the constant speed reached by the falling ball-bearing?

_____

(1)

(iii) Calculate the constant speed reached by the ball-bearing.
Show clearly how you use the graph to work out your answer.

_____

_____

_____

Speed = _____ m/s

(2)

(Total 7 marks)