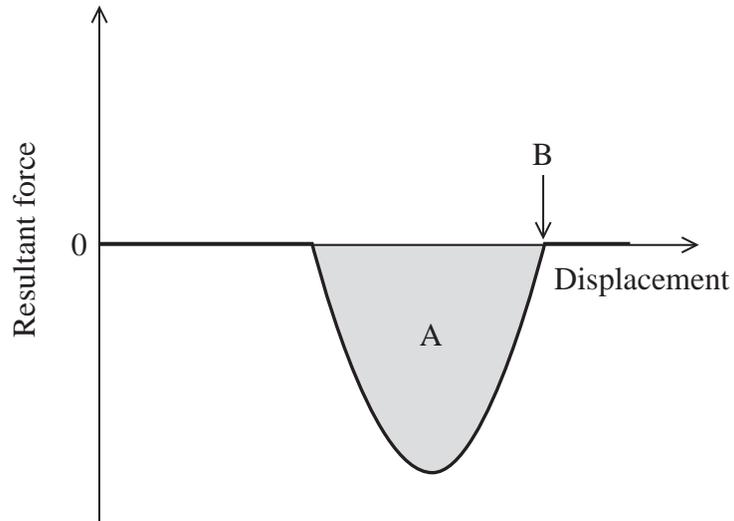


1 (a) A car is moving at constant velocity when the driver applies the brakes.

The graph shows how the resultant force on the car varies with displacement.



(i) State what is represented by the area A. (1)

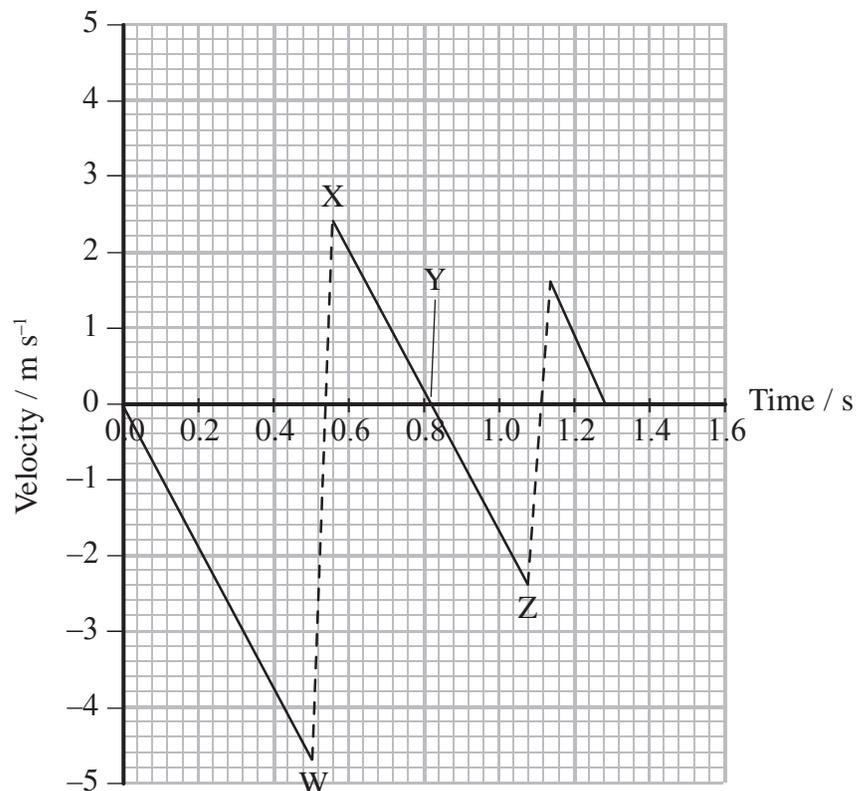
(ii) State the motion of the car at B. (1)

(b) Displacement and velocity are vector quantities.
Define the term vector and give another example of a vector quantity. (2)

Example of a vector quantity

(Total for Question = 4 marks)

- 2 A basketball is dropped vertically onto the horizontal ground and bounces twice before being caught. The graph shows how the velocity of the basketball varies with time.



- (a) Suggest why the downward sloping lines are all parallel. (1)
- (b) (i) State the reason for the upwardly sloping dotted lines. (1)
- (ii) Describe how the gradient of the dotted lines would change if the basketball was not fully inflated. (1)

(c) Calculate the initial height through which the basketball fell.

(2)

Height =

(d) (i) Show that the kinetic energy of the basketball at X is about 1 J.

mass of ball = 0.4 kg

(2)

(ii) Hence calculate the height of the basketball at Y.

(2)

Height =

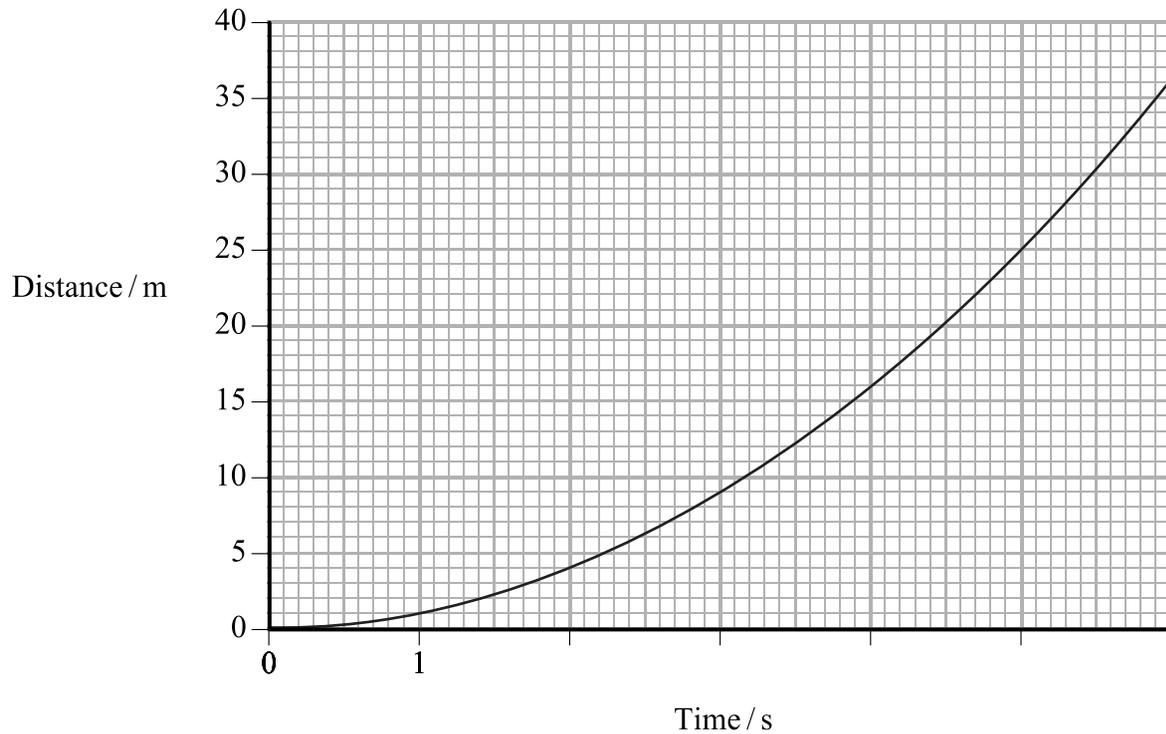
(e) The velocity of the basketball on impact at W is greater than the velocity on impact at Z.

State a reason for the difference in velocities at W and Z.

(1)

(Total for Question = 10 marks)

3 The graph shows how displacement varies with time for an object which starts from rest with constant acceleration.



(a) Use the distance-time graph to determine the speed of the object at a time of 4.0 s.

(3)

Speed =

(b) Calculate the acceleration.

(2)

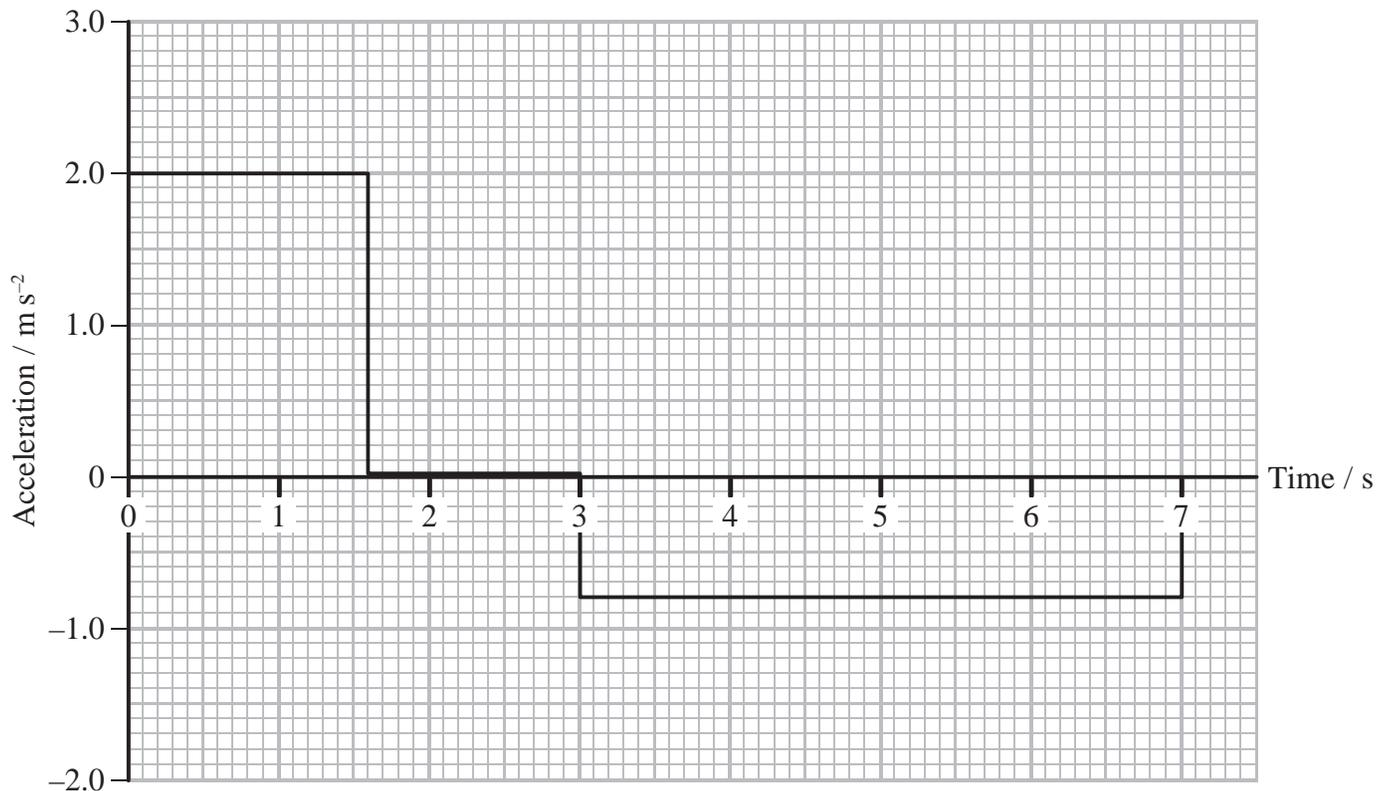
Acceleration =

(Total for Question = 5 marks)

- 4 The toy aeroplane in the photograph has a spring mechanism connected to the wheels. When the aeroplane is pulled backwards, the wheels rotate backwards and a spring is compressed. When the aeroplane is released, the force from the spring propels the aeroplane forwards.



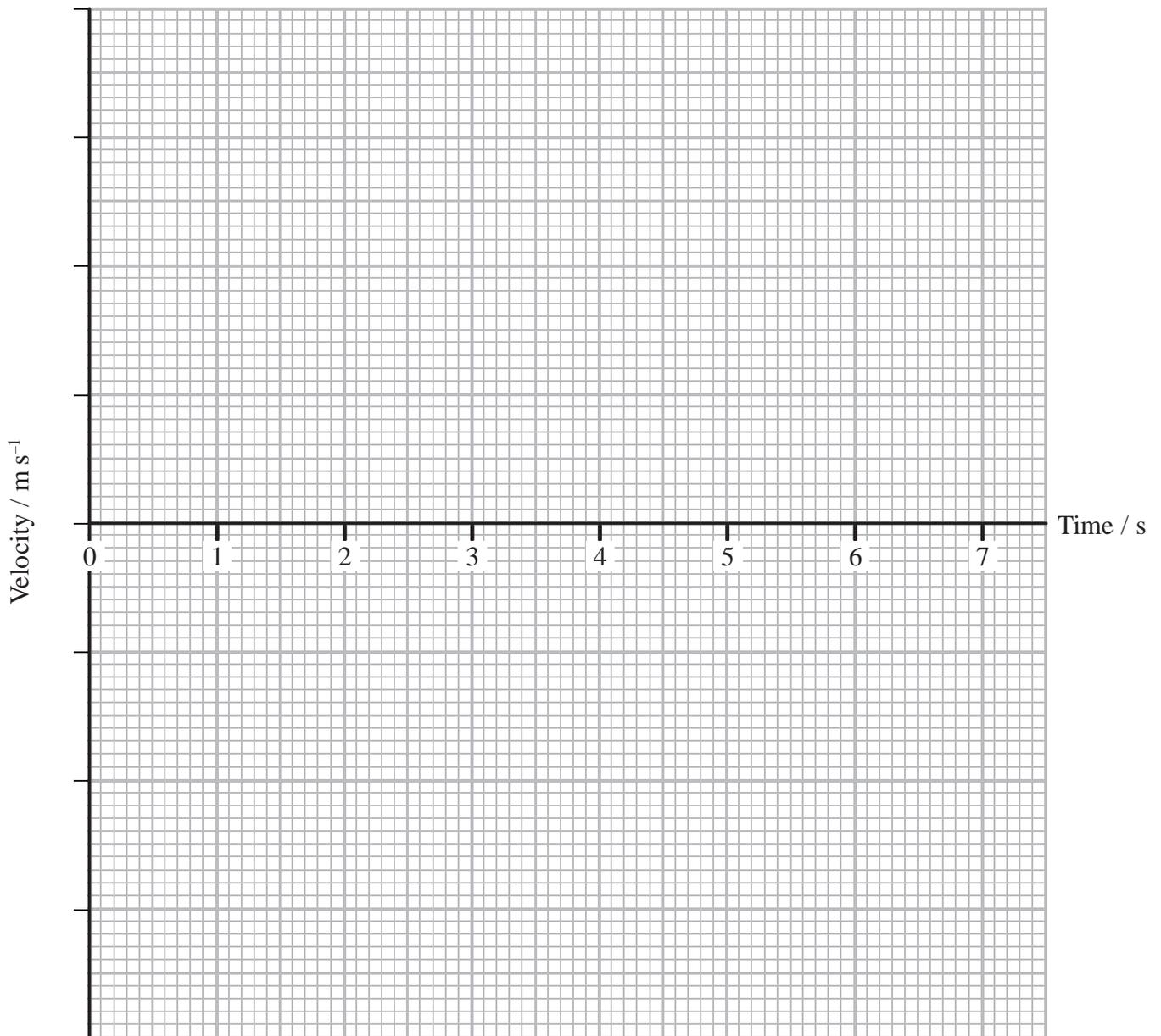
The aeroplane is pulled backwards, released and then moves forward in a straight line along a flat surface. The simplified acceleration-time graph for the forward motion of the aeroplane is shown.



- (a) Show that the maximum velocity of the aeroplane is about 3 m s⁻¹.

(2)

(b) On the axes below draw the corresponding velocity-time graph for the aeroplane. (3)



(c) Calculate the total distance travelled by the aeroplane after release. (3)

Total distance travelled =

(d) (i) Calculate the maximum kinetic energy of the aeroplane.

mass of aeroplane = 0.12 kg

(2)

Maximum kinetic energy =

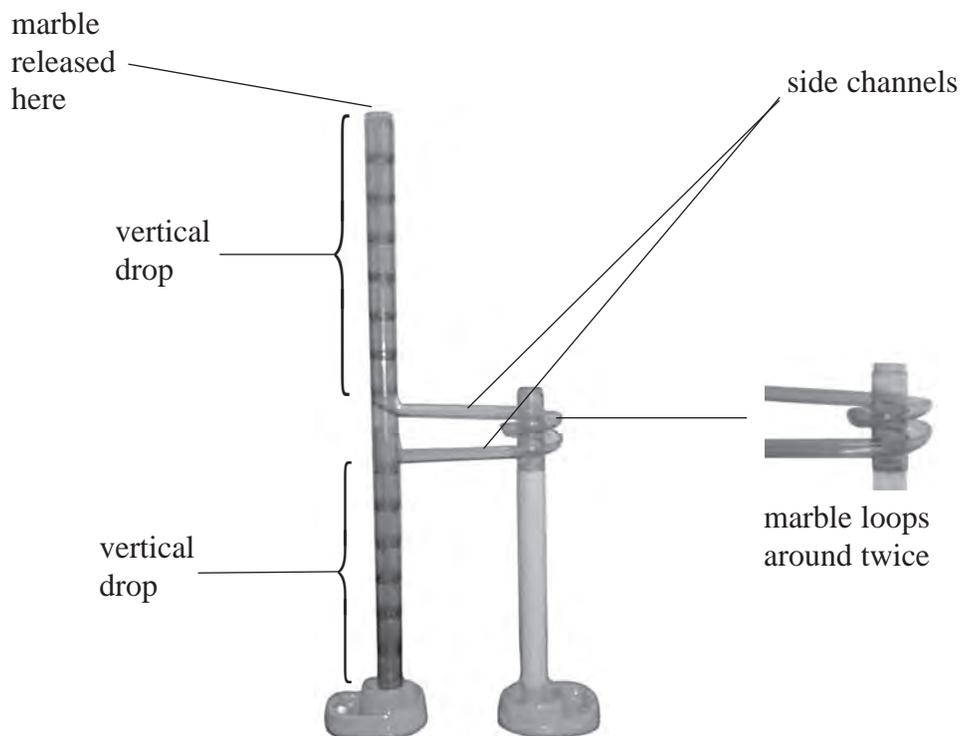
(ii) Calculate the mean power developed by the spring mechanism during the period of acceleration.

(2)

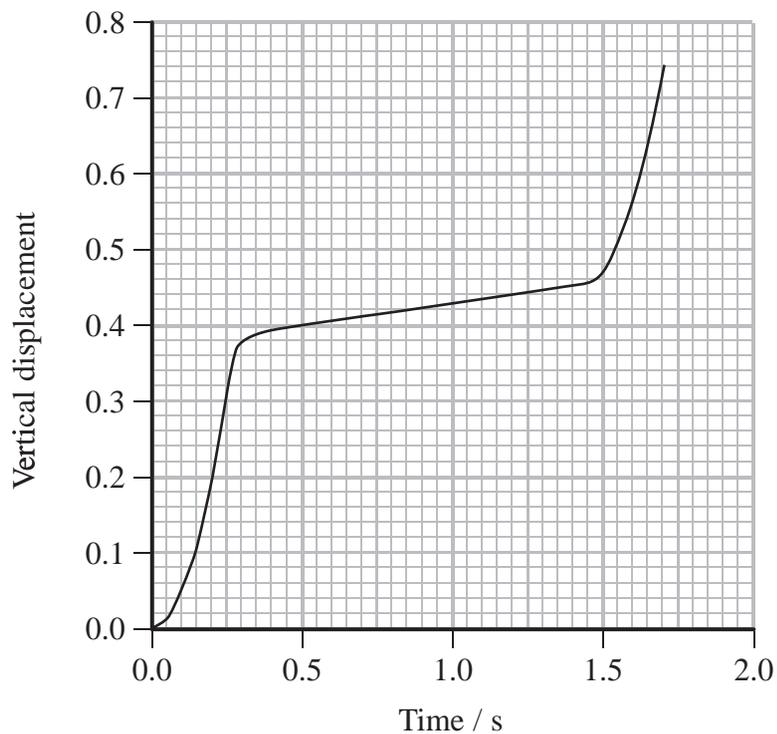
Mean power developed =

(Total for Question = 12 marks)

5 The photograph shows a marble game.



A marble was released and its motion was recorded using a digital video camera. The data was uploaded to a computer and then analysed using a motion capture programme. The following vertical displacement-time graph was obtained.



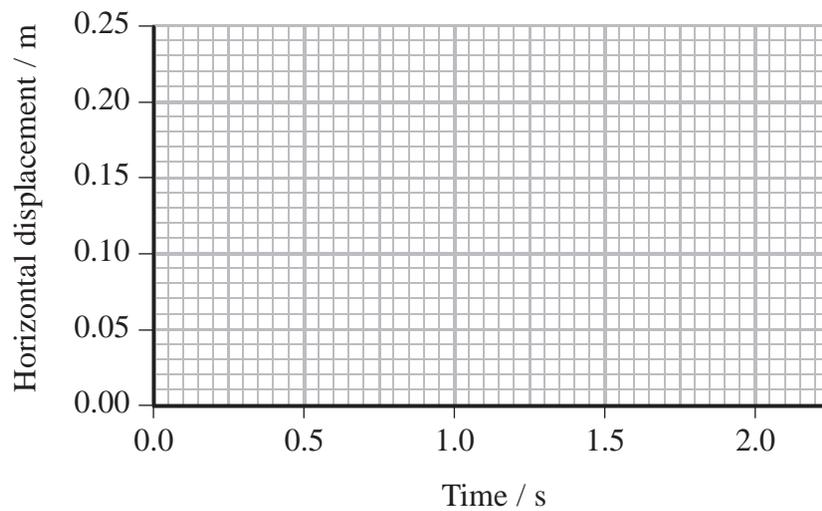
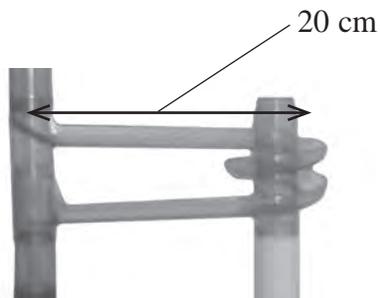
(a) (i) While the marble is in the side channels its speed remains constant.

Use the graph to show that the vertical velocity is about 0.06 m s^{-1} .

(2)

(ii) On the axis below sketch the displacement-time graph for the horizontal displacement of the marble.

(4)



(iii) State the average horizontal velocity of the ma

(1)

(b) Measurements of the displacement of the marble and time taken could have been made using a rule and stopwatch.

Explain the advantages of using the digital video camera compared with a rule and stopwatch to obtain the data.

(3)

(Total for Question = 10 marks)