# Motion Graphs

## Question Paper

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|---|---|
| **Level** | International A Level |
| **Subject** | Physics |
| **Exam Board** | Edexcel |
| **Topic** | Mechanics |
| **Sub Topic** | Motion Graphs |
| **Booklet** | Question Paper |

**Time Allowed:** **54 minutes**

**Score:** **/45**

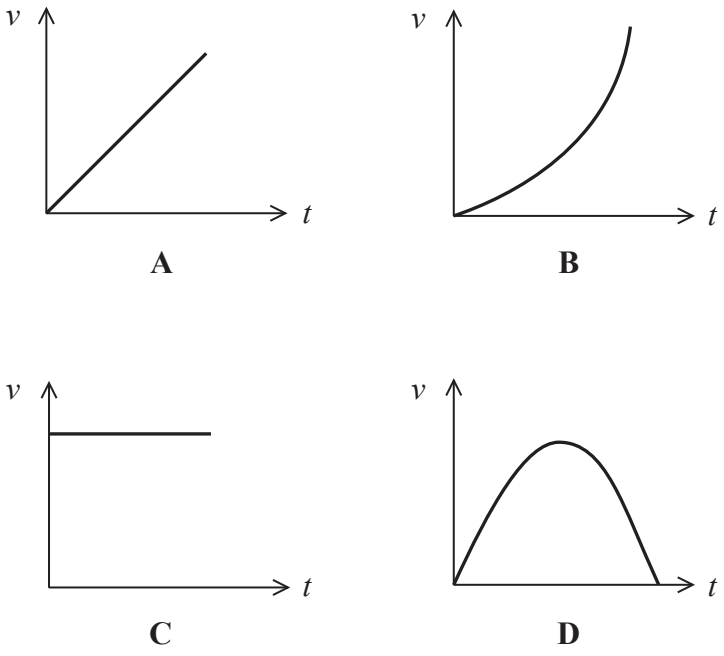
**Percentage:** **/100**

**Grade Boundaries:**

| A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

**1** A moving object has uniform, non-zero acceleration.

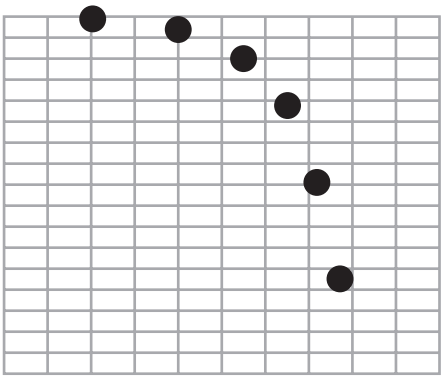
Which velocity-time graph correctly shows this?




- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

**(Total for Question 1 = 1 mark)**

**2** The diagram is taken from a multiflash photograph of an object falling in a vertical plane.



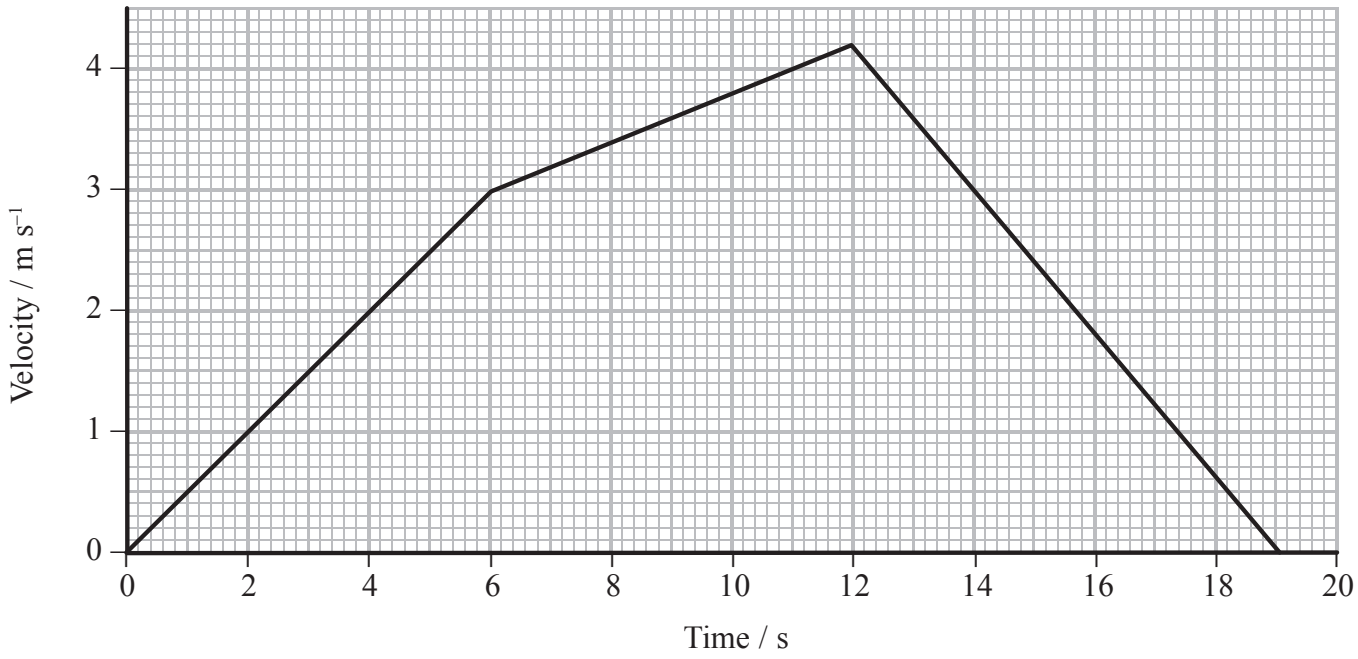
Select the row of the table that correctly describes the horizontal velocity and the vertical velocity of the object.

| | Horizontal velocity | Vertical velocity |
|---|---|---|
| ☒ **A** | decreasing | increasing |
| ☒ **B** | decreasing | no change |
| ☒ **C** | no change | increasing |
| ☒ **D** | no change | no change |

**(Total for Question 2 = 1 mark)**

**Questions 3 and 4 refer to the graph below.**

The velocity-time graph for an object is shown.




**3** The initial acceleration of the object is

☒ **A** 0.40 m s$^{-2}$

☒ **B** 0.50 m s$^{-2}$

☒ **C** 2.0 m s$^{-2}$

☒ **D** 9.0 m s$^{-2}$

**(Total for Question 3 = 1 mark)**

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**4** The displacement of the object during the time of deceleration is

☒ **A** 29 m

☒ **B** –29 m

☒ **C** 15 m

☒ **D** –15 m

**(Total for Question 4 = 1 mark)**

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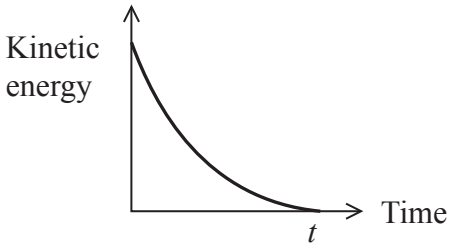
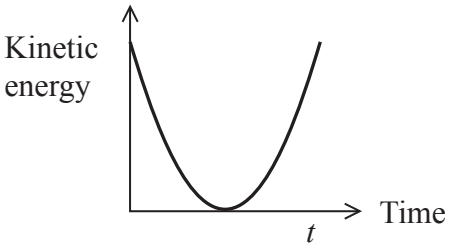
**5** A ball is thrown vertically upwards. It reaches a maximum height, moves downwards and is caught by the thrower at a time *t*.

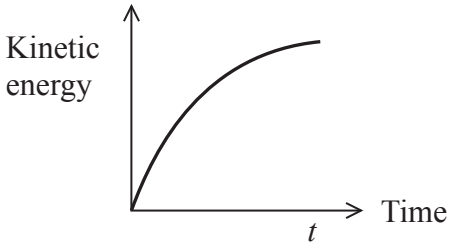
Which of the following is the kinetic energy-time graph for the ball?



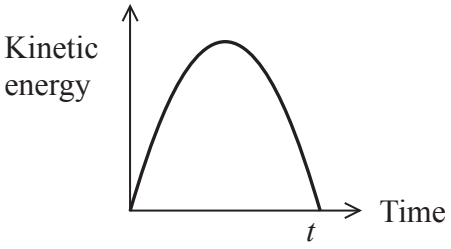

**A**




**B**




**C**




**D**

☒ **A**

☒ **B**

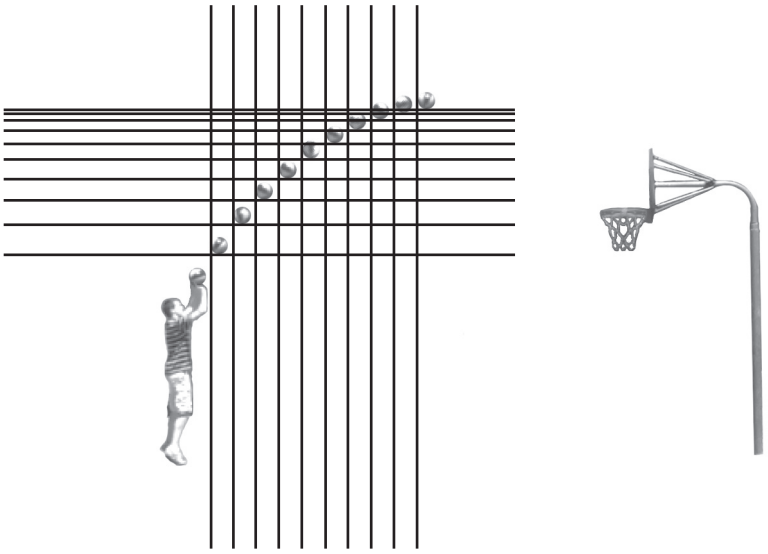
☒ **C**

☒ **D**

**(Total for Question 5 = 1 mark)**

**6** A basketball is thrown towards a basket. The position of the ball at equal time intervals is shown in the photograph.

Vertical and horizontal lines have been added to the photograph to help identify the ball's horizontal and vertical position.



Suggest a reason for each of the following observations:

(a) the vertical lines are evenly spaced,

**(1)**

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(b) the horizontal lines become closer together.

**(1)**

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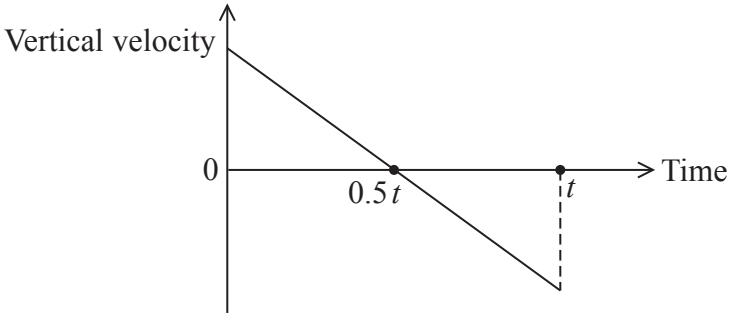
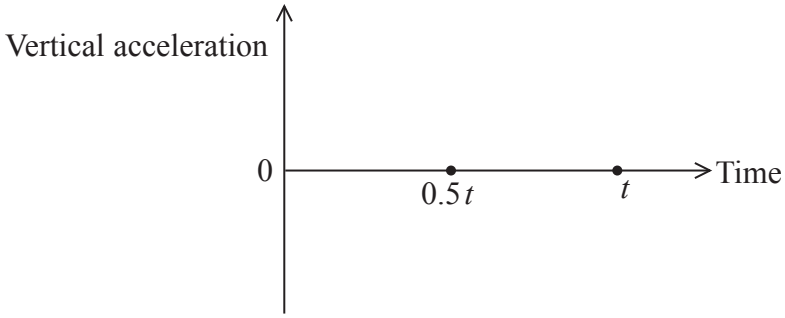
**(Total for Question 6 = 2 marks)**

**7** A cricket ball is hit and travels across a field where it is caught at a time $t$. A graph of vertical velocity against time is shown.



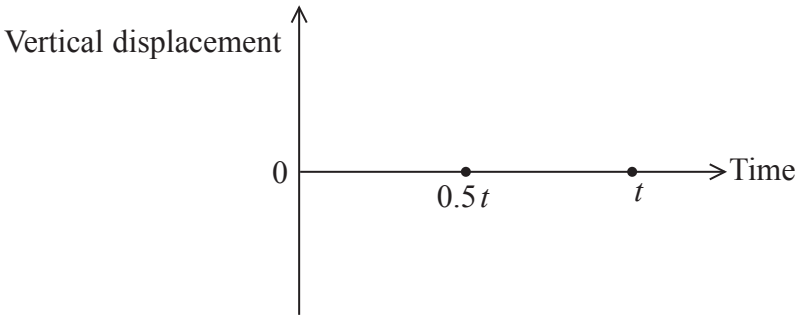

(a) On the axes below, sketch the corresponding graph of vertical acceleration against time for the motion of the cricket ball.

**(2)**




(b) On the axes below, sketch the corresponding graph of vertical displacement against time for the motion of the cricket ball.

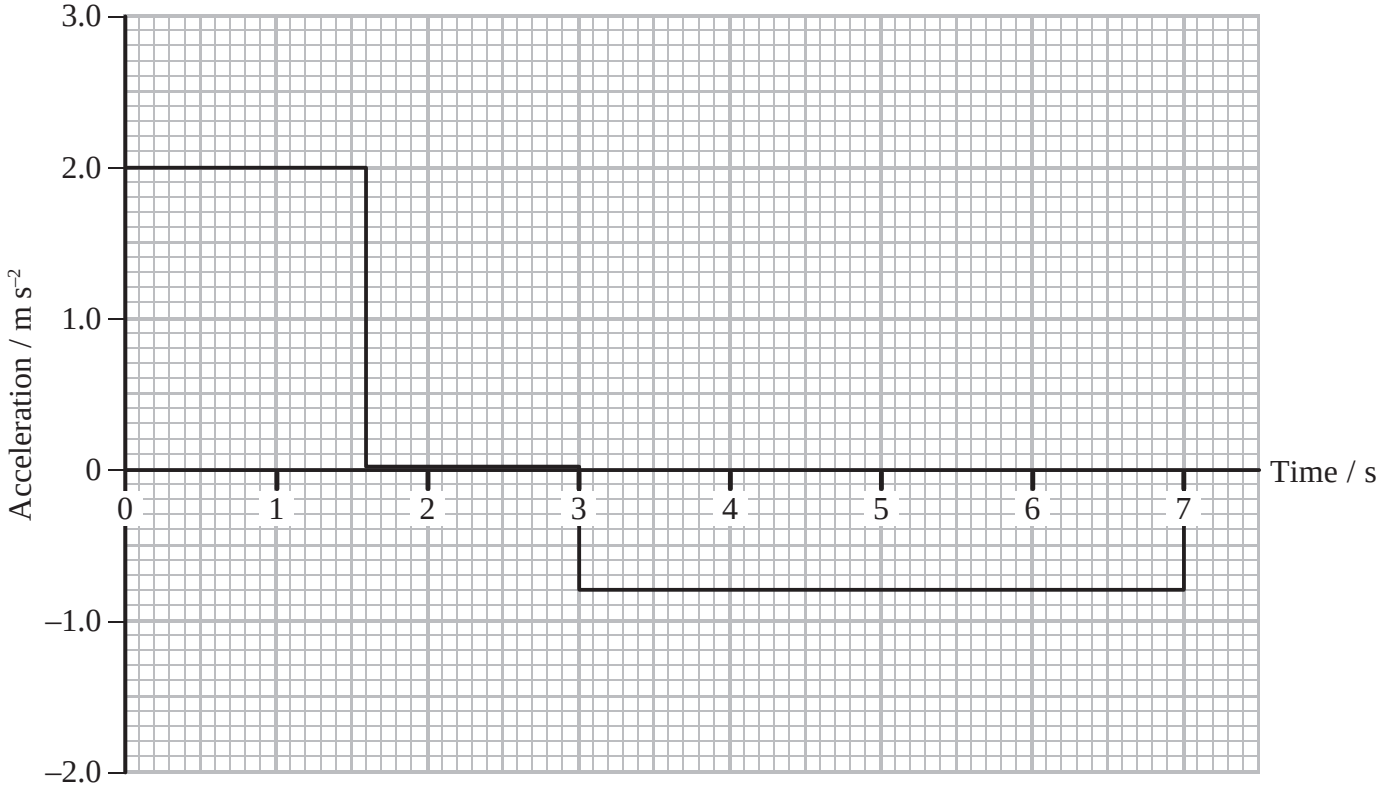
**(2)**




**(Total for Question 7 = 4 marks)**

**8** 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 $s^{-1}$.

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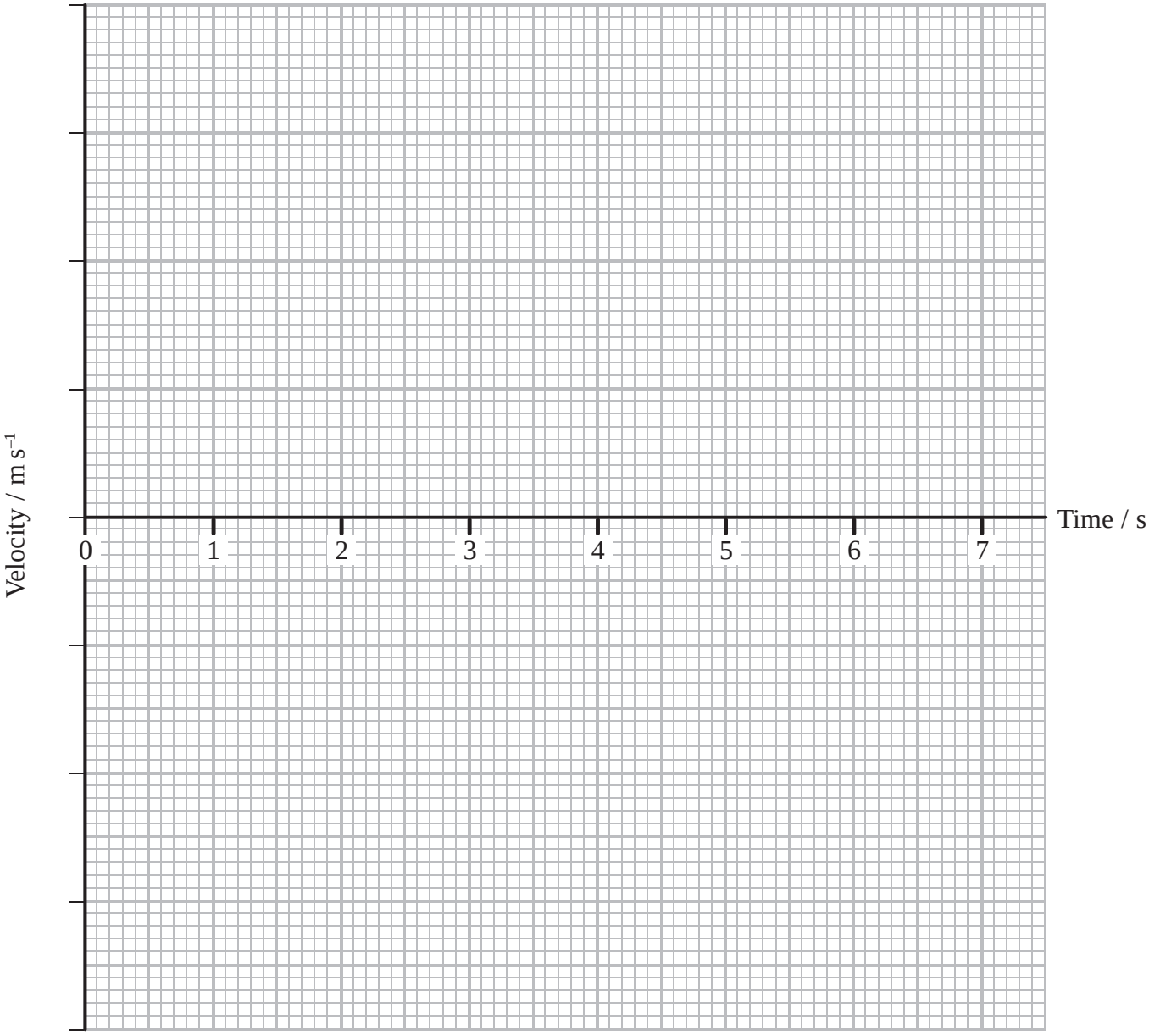
(b) On the axes below draw the corresponding velocity-time graph for the aeroplane.

**(3)**




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

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Total distance travelled = .....

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

mass of aeroplane = 0.12 kg

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Maximum kinetic energy = .....

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

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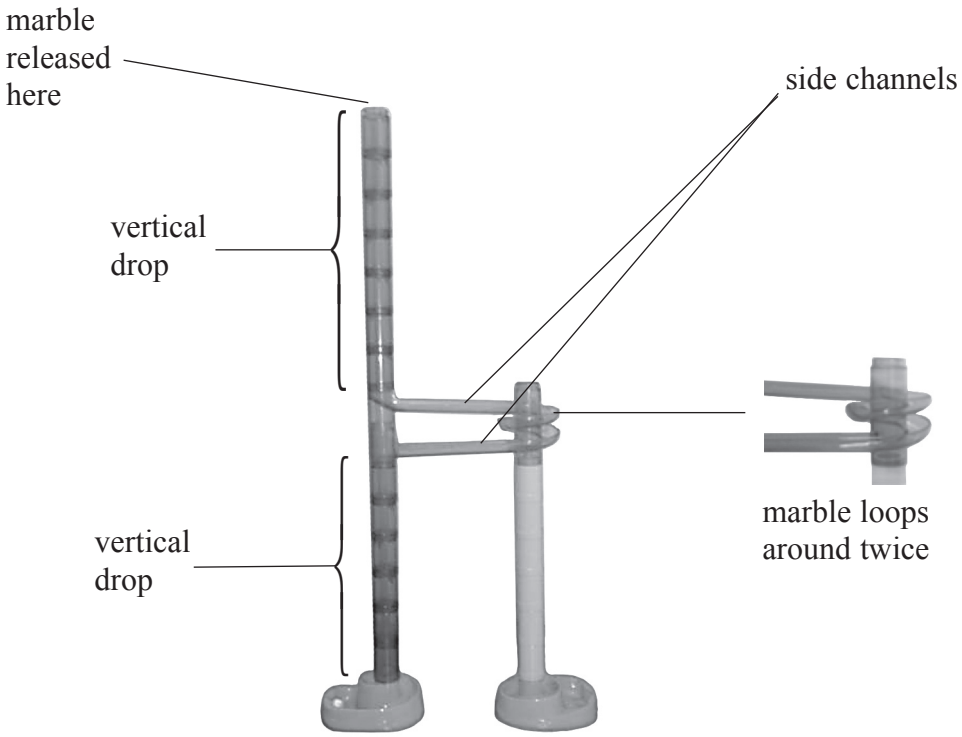
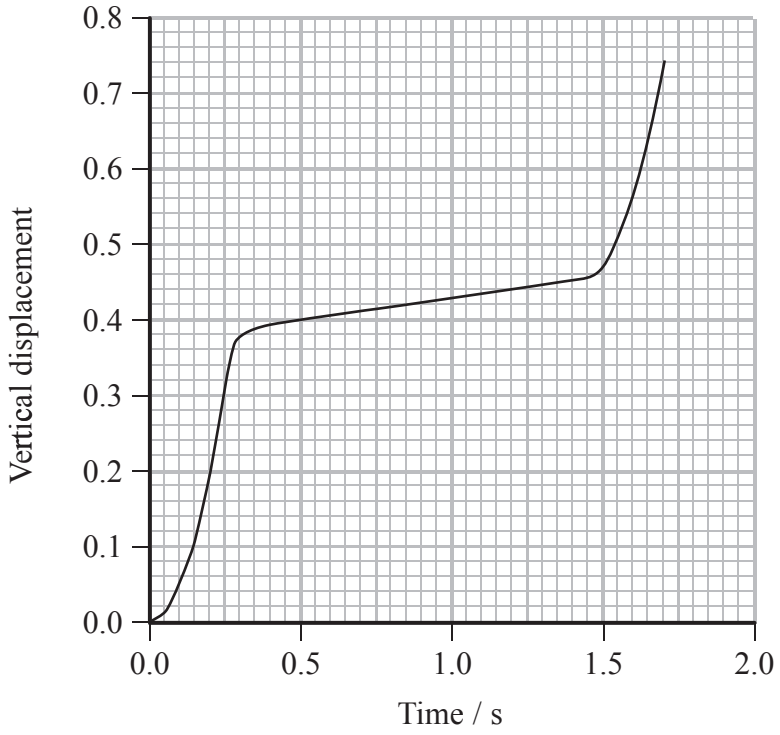
Mean power developed = .....

**(Total for Question 8 = 12 marks)**

**9** 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.



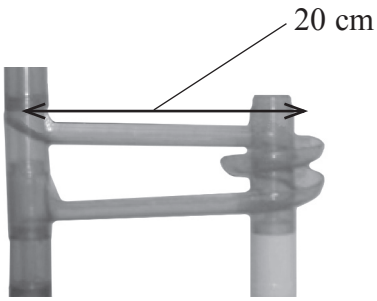
(a) (i) While the marble is in the side channels its speed remains constant.

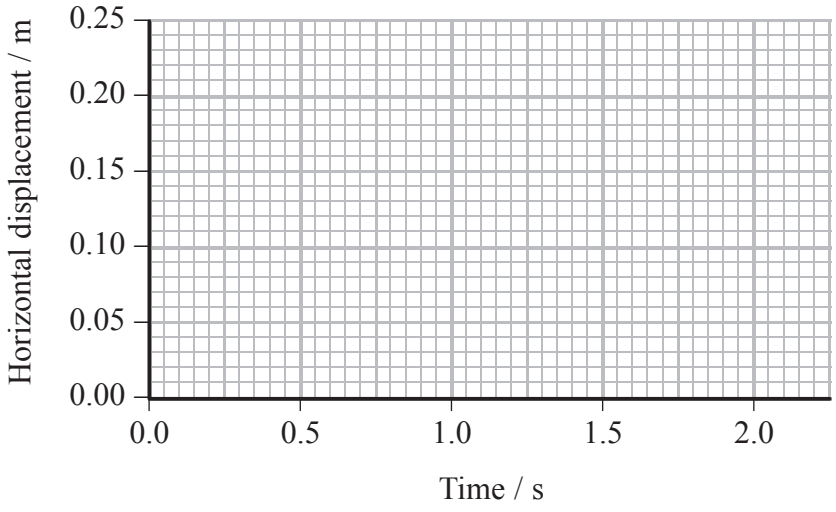
Use the graph to show that the vertical velocity is about 0.06 m $s^{-1}$.

**(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 marble.

**(1)**

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

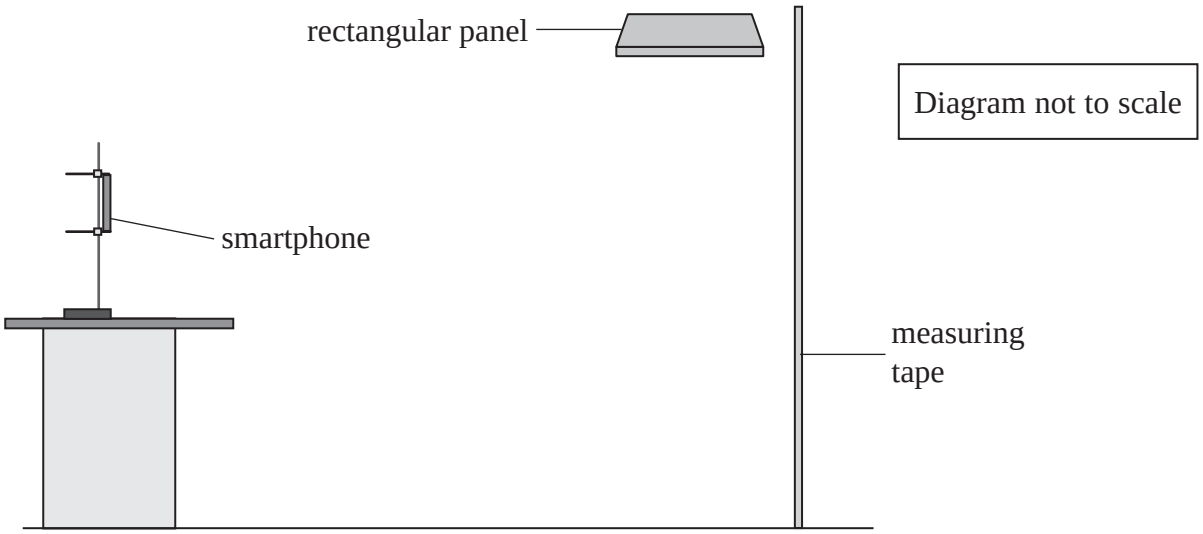
Explain the advantages of using the digital video camera compared with a rule and stopwatch to obtain the data.

**(3)**

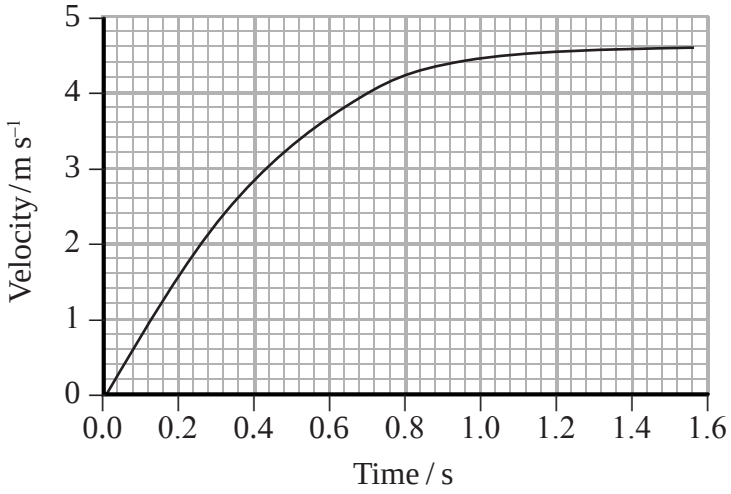
**(Total for Question 9 = 10 marks)**

**10** A student investigated the motion of a small rectangular panel. The panel was held above the floor next to a measuring tape.

The panel was released and, using a video camera on a smartphone, its motion as it fell to the floor was recorded. Using the position of the panel at regular time intervals the velocity of the panel was obtained.




The velocity-time graph shows the motion of the panel until it reaches the floor.




(a) Show that the panel was dropped from a height of approximately 5 m.

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(b) (i) Use the graph to calculate the maximum acceleration of the panel.

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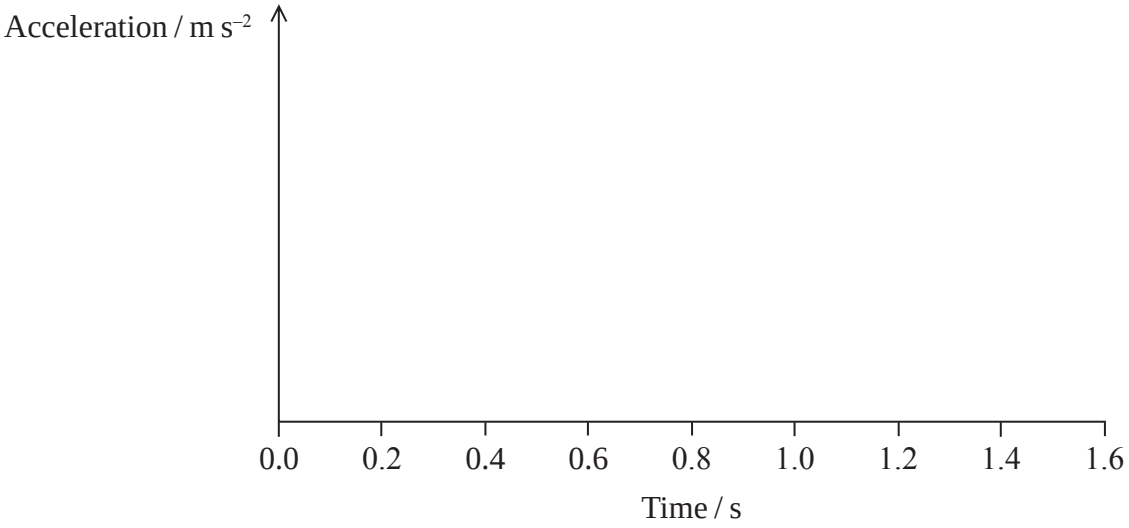
Maximum acceleration = .....

(ii) Without further calculation sketch an acceleration-time graph for the panel on the axes below.

**(4)**




(c) Explain how the student can check the reliability of these results.

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**(Total for Question 10 = 12 marks)**