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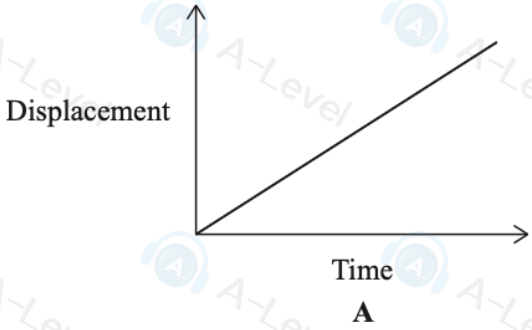
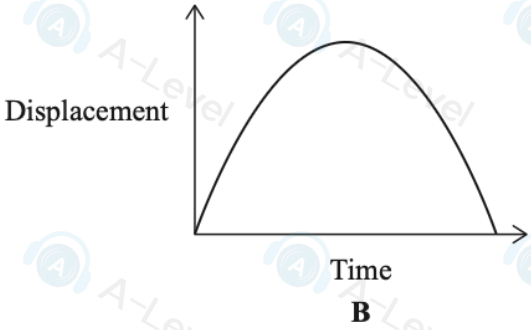
6: An object has a constant non-zero acceleration.

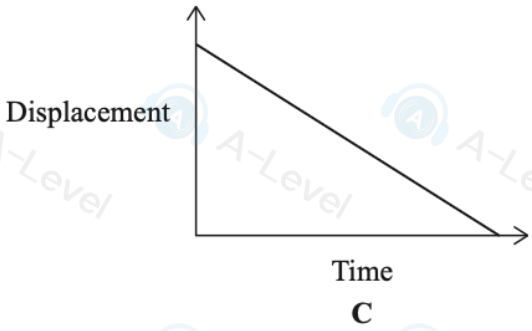
Which of the following displacement-time graphs could represent the motion of the object?



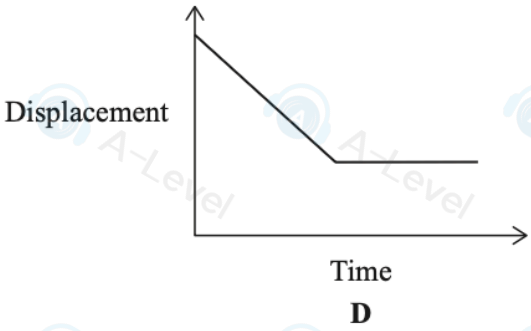
A



B



C



D

☒ **A**

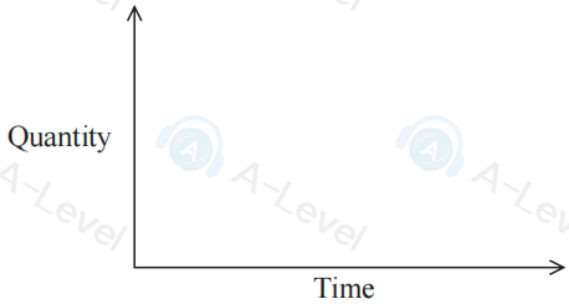
☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

1 Graphs can be used to represent the motion of an object.

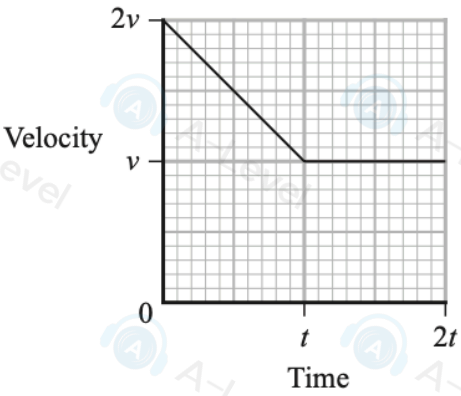


Which row in the table gives a quantity plotted on the y-axis and the corresponding quantity represented by the gradient of the graph?

	Quantity plotted on y-axis	Gradient of graph
☒ **A**	displacement	acceleration
☒ **B**	velocity	acceleration
☒ **C**	acceleration	velocity
☒ **D**	acceleration	displacement

(Total for Question 1 = 1 mark)

8 The velocity-time graph for a train journey is shown.



Which of the following expressions gives the distance travelled by the train in time $2t$?

☒ **A** $4vt$

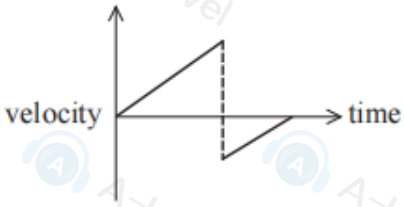
☒ **B** $5vt$

☒ **C** $\frac{3vt}{2}$

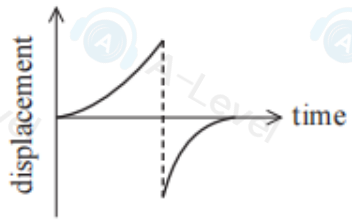
☒ **D** $\frac{5vt}{2}$

(Total for Question 8 = 1 mark)

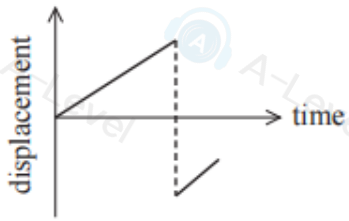
The velocity-time graph for the motion of a ball is shown.



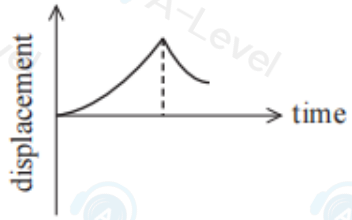
10 Which of the following graphs of displacement against time could represent the motion of the ball?



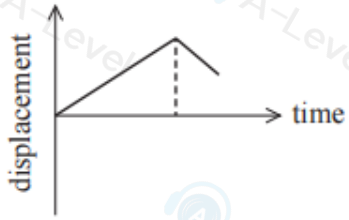
A



B



C



D

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

(Total for Question 10 = 1 mark)

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7 A student drops a ball and measures the time taken for the ball to reach the ground. He repeats this for different heights.

He uses a graphical method to determine a value for g, the acceleration of free fall.

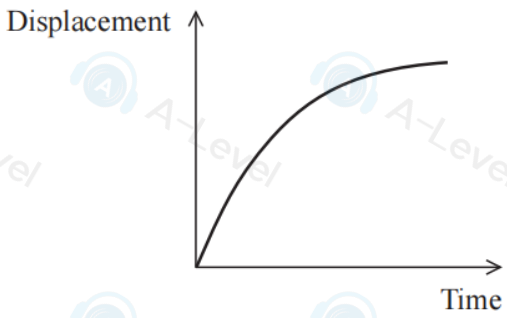
He plots height on the y-axis of his graph.

Which row of the table is correct for the student's graph?

	Quantity plotted on x-axis	Gradient of graph
☒ **A**	time	$\frac{1}{g}$
☒ **B**	time	g
☒ **C**	$(\text{time})^2$	$\frac{g}{2}$
☒ **D**	$(\text{time})^2$	$2g$

(Total for Question 7 = 1 mark)

7 A displacement-time graph for the motion of an object is shown.



Which of the following statements is correct?

☒ **A** There is a decreasing resultant force acting on the object in the direction of the motion.

☒ **B** There is an increasing resultant force acting on the object in the direction of the motion.

☒ **C** There is a resultant force acting on the object opposite to the direction of motion.

☒ **D** There is no resultant force acting on the object.

(Total for Question 7 = 1 mark)

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7 A ball bearing falls vertically from rest through a distance of 50 cm in a time of 0.32 s.

Which expression gives the acceleration of the ball bearing in $m\,s^{-2}$?

☒ **A** $1 \div 0.32^2$

☒ **B** $0.5 \div 0.32$

☒ **C** $100 \div 0.32^2$

☒ **D** $50 \div 0.32$

(Total for Question 7 = 1 mark)

Questions 8 and 9 refer to the information below.

A ball is dropped and is caught after the first bounce.

8 The ball takes 1.6 s to reach the ground.

From what height was the ball dropped?

☒ **A** 7.8 m

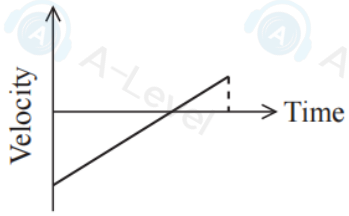
☒ **B** 13 m

☒ **C** 16 m

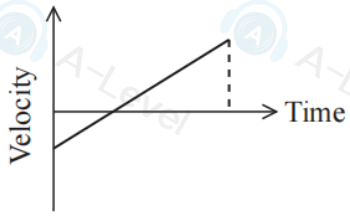
☒ **D** 25 m

(Total for Question 8 = 1 mark)

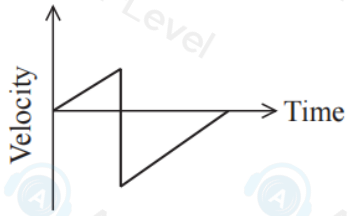
9 Which of the following is the velocity-time graph for the motion of the ball?



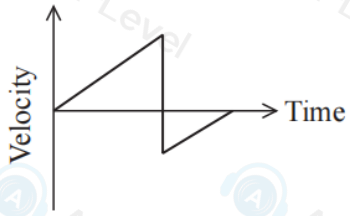
A



B



C



D

☒ **A**

☒ **B**

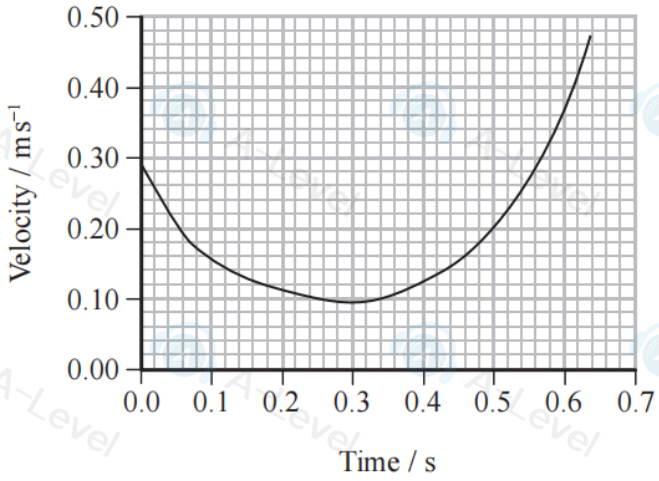
☒ **C**

☒ **D**

(Total for Question 9 = 1 mark)

13 A ball bearing moves across a horizontal bench towards a magnet as shown.

The velocity-time graph for the horizontal motion of the ball bearing up to the point of contact with the magnet is shown.



(a) Explain the shape of the graph.

(3)

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(b) Calculate the maximum acceleration of the ball bearing.

(3)

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.....

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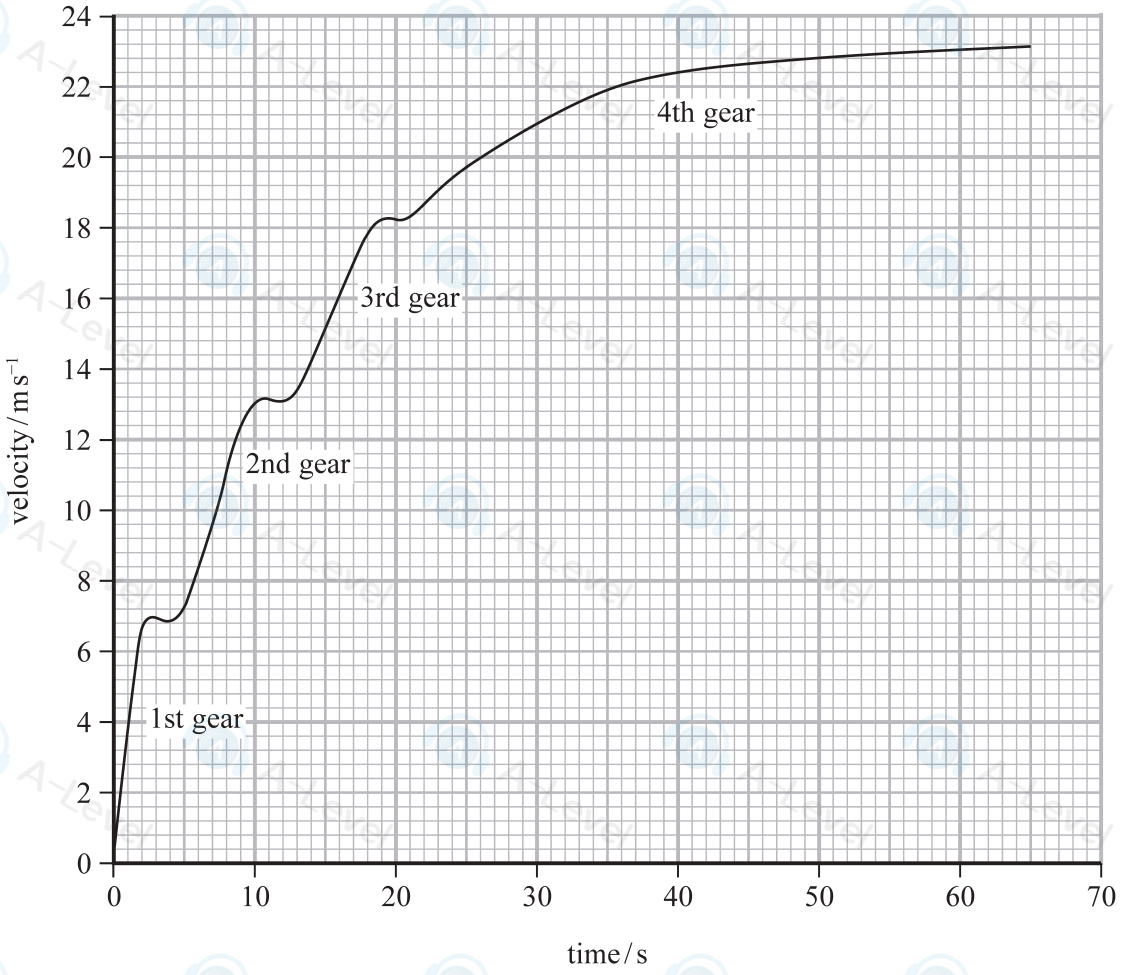
Maximum acceleration = ...

17 The velocity-time graph for a car for the first part of a journey is shown.



(a) As the velocity of the car increased, the driver changed gear. Each change in gear produced a small decrease in velocity.

(i) State how the graph shows that in 3rd gear the car has a smaller acceleration than in 1st gear.

(1)

.....

.....

(ii) Determine the average acceleration when the car is accelerating in 2nd gear.

(2)

Average acceleration in 2nd gear = ...

(iii) The equation that links the power P of a car engine to the forward force F on the car and the velocity v of the car is

$$P = Fv$$

Comment on the magnitude of F when the car is in higher gears, assuming P remains constant.

(2)

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(b) The manufacturer of a different car gives the following information.

Gear	Maximum velocity / m s^{-1}	Maximum acceleration / m s^{-2}
1st	18	2.9
2nd	32	1.2
3rd	46	0.83
4th	74	0.72

(i) Calculate the minimum time taken for the car to accelerate from rest to 60 miles per hour. You may assume that the time taken to change gears is negligible.

1 mile = 1600 m

(4)

Time = ...

(ii) Explain why there will be a maximum speed at which the car can travel.

(3)

(Total for Question 17 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS
TOTAL FOR PAPER = 80 MARKS

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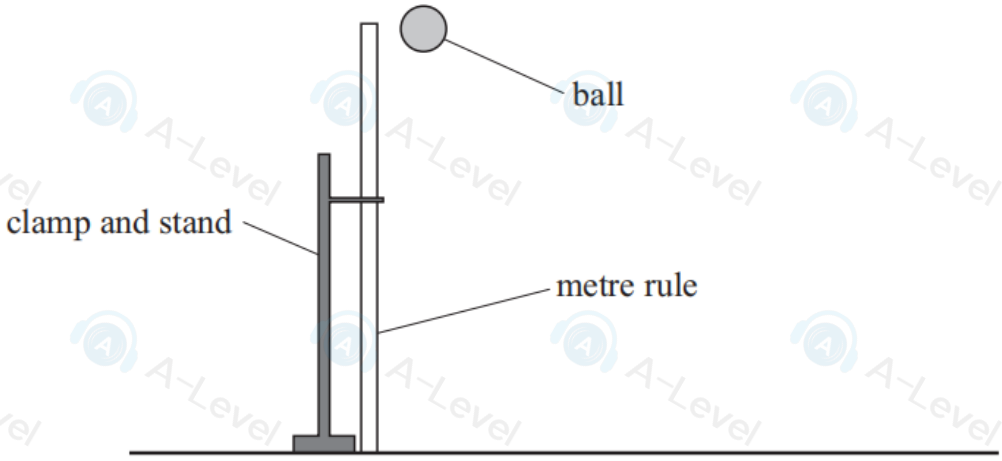
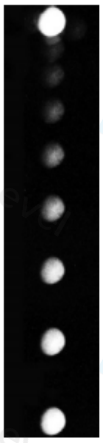
14 A student clamped a metre rule so that it was vertical. She dropped a ball from rest near the top of the metre rule, as shown.



A strobe emits flashes of light. The time interval between flashes is constant.

The student photographed the falling ball using strobe lighting. The ball can be seen at different heights in the photograph, as shown.



(Source: © sciencephotos/Alamy Stock Photo)

For each flash of light, the student determined the distance fallen by the ball.

(a) She took one photograph using a strobe app on a mobile phone.
She took a second photograph using a laboratory strobe.

The time interval between flashes was the same for the strobe app and for the laboratory strobe. Each flash of light from the laboratory strobe has a smaller duration than each flash from the mobile phone.

Explain how the smaller duration of each flash from the laboratory strobe affected the uncertainty in the measurement of the distance fallen.

(2)

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.....

(b) The student recorded the distances s fallen by the ball and corresponding values of the time t.

(i) Explain why a graph of s against t^2 gives a straight line.

(2)

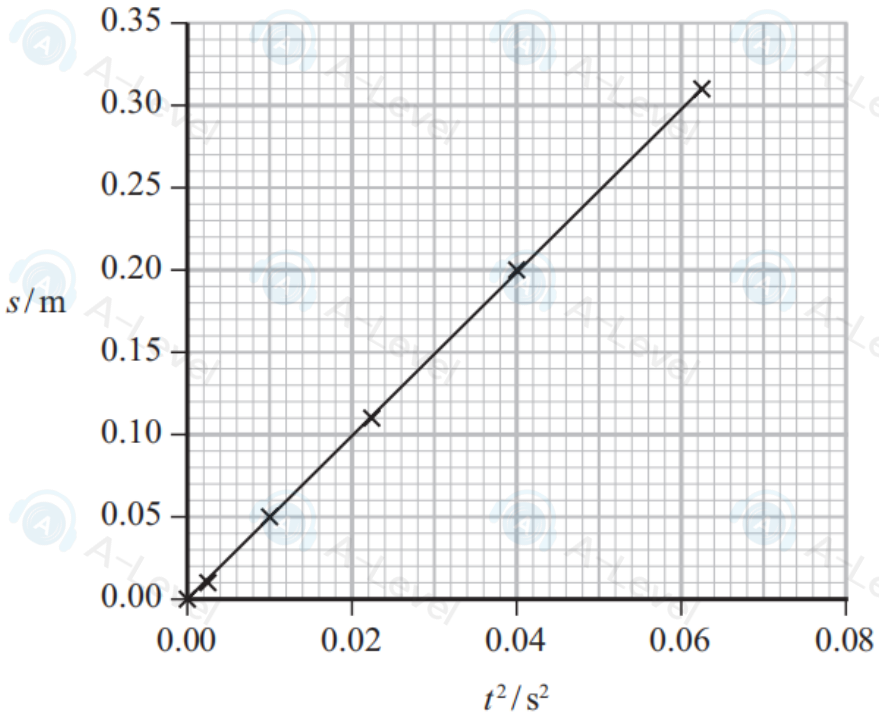
.....

.....

.....

.....

(ii) The student plotted a graph of s against t^2, as shown.



Determine the acceleration of free fall, g, using the student's graph.

(2)

.....

.....

.....

.....

g = ...

(Total for Question 14 = 6 marks)

12 Two students carry out experiments to measure the acceleration of free fall. In each experiment a ball bearing is dropped through a known distance and the time taken is measured.

Student A drops the ball bearing and starts a stopwatch. He stops the stopwatch when he sees the ball bearing reach the ground. The stopwatch measures to the nearest 0.01 s.

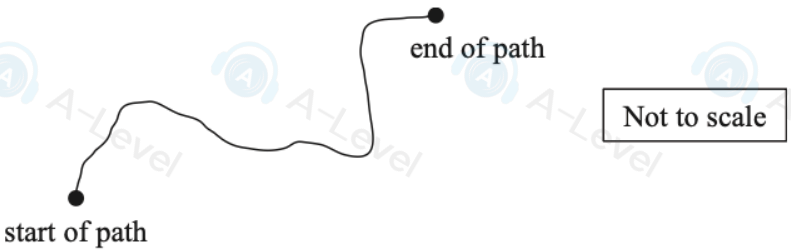
Student B uses an electronic system that releases the ball bearing and simultaneously starts a timer. The timer stops automatically when the ball bearing reaches a sensor. The timer measures to the nearest 0.001 s.

State and explain two reasons why the method used by Student B is better for this experiment.

(4)

(Total for Question 12 = 4 marks)

12: A person rides a bicycle along the path shown.

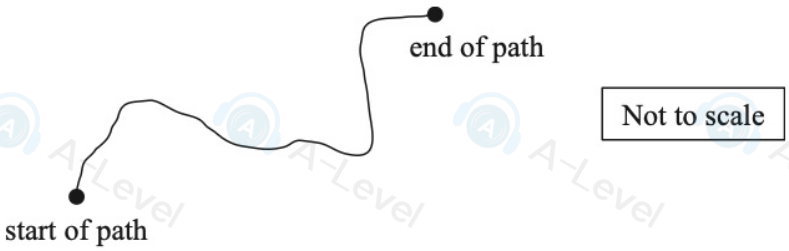


(a) At the end of the path, the magnitude of the displacement from the start is less than the distance travelled by the person.

Describe why the displacement is less than the distance travelled by the person.

(2)

12: A person rides a bicycle along the path shown.



(a) At the end of the path, the magnitude of the displacement from the start is less than the distance travelled by the person.

Describe why the displacement is less than the distance travelled by the person.

(2)

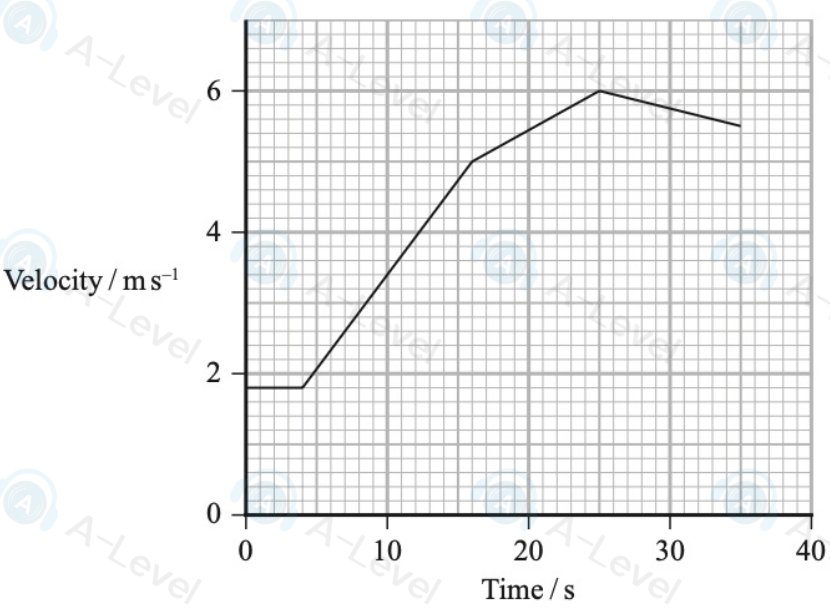
.....

.....

.....

.....

(b) The velocity-time graph for part of the bicycle ride is shown.



Determine the maximum acceleration of the person on the bicycle.

(3)

.....

.....

.....

.....

.....

Maximum acceleration = ...

(Total for Question 12 = 5 marks)