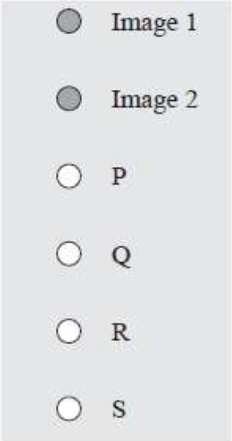
Q1.

A student used a falling sphere to determine the acceleration of free fall.

A camera produced images of the sphere at constant time intervals as it fell.

The positions of the sphere in the first two images are shown. Image 1 shows the sphere's position at the instant it was released.



Which of the positions P, Q, R or S will the sphere be at in Image 3?

(1)

- **A** P
- **B** Q
- **C** R
- **D** S

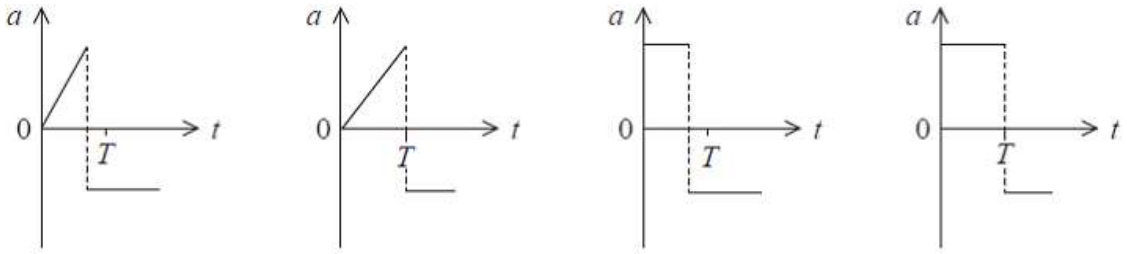
(Total for question = 1 mark)

Q2.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A model rocket is launched and moves vertically upwards while still burning fuel to give a constant upwards thrust. The fuel runs out, and the rocket reaches the maximum height at time *T* before falling back to the ground.

Which of the following graphs could show how the acceleration α of the rocket varies with time *t*, if the decrease in mass as the fuel burns is neglected?

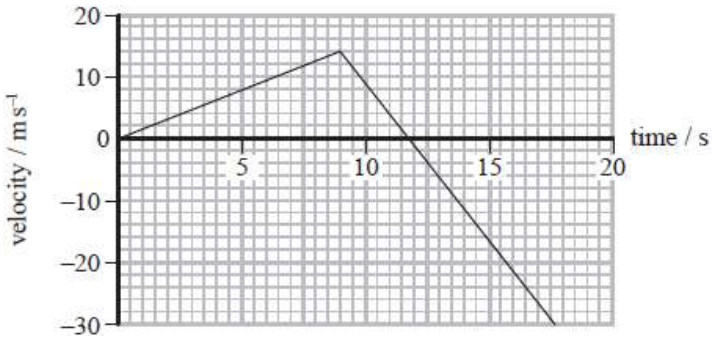


☒ **A** ☒ **B** ☒ **C** ☒ **D**

(Total for question = 1 mark)

Q3.

The graph shows how the velocity of an object varies with time.



Describe how the acceleration of the object varies with time.
Your answer should include calculations.

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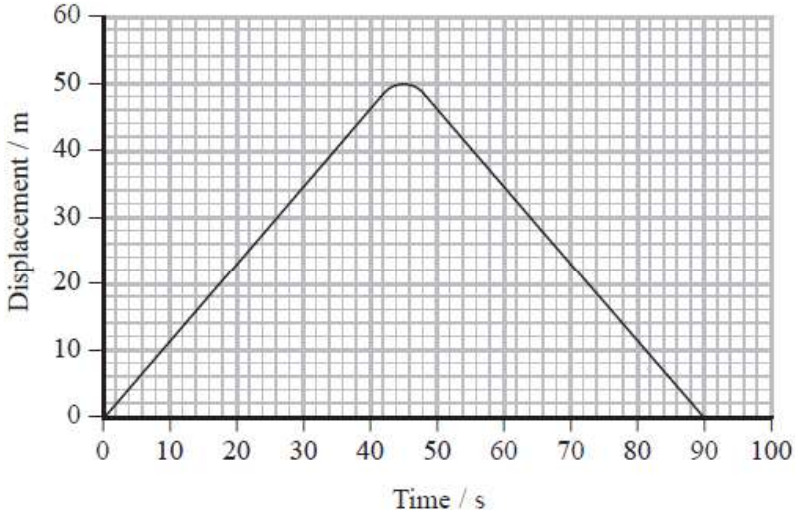
(Total for question = 3 marks)

Q4.

A swimmer swims a 100 m race. A simplified displacement-time graph for the swimmer is shown.



(a) Draw a corresponding velocity-time graph for the motion of the swimmer on the axes below.

Show all working in the space below.

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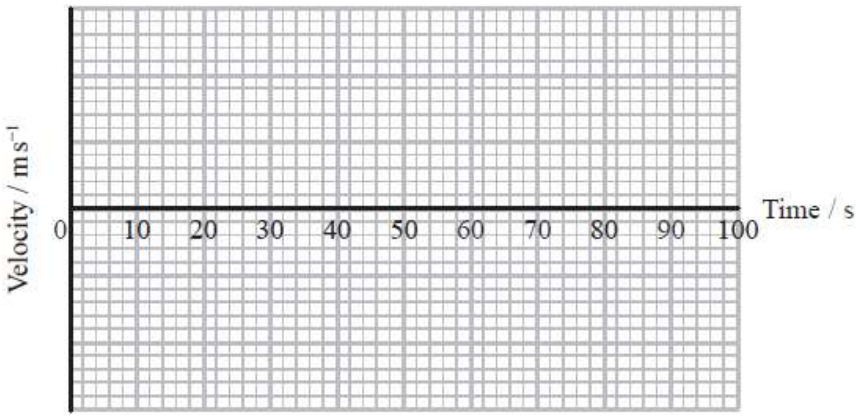
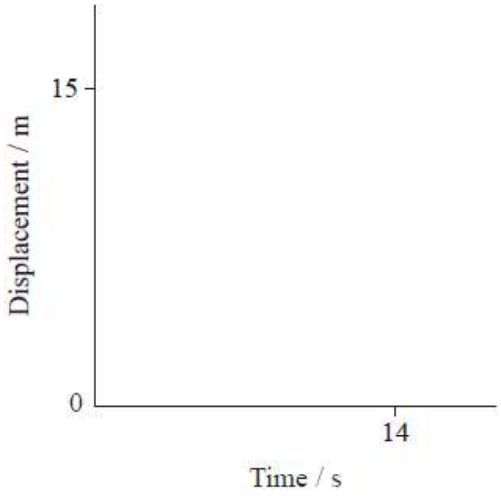


(b) To increase her initial speed, the swimmer began the race by gliding underwater for 15 m and then began to use her arms and legs. This was not represented on the simplified displacement-time graph.

(i) Sketch onto the axes below to show the actual variation of displacement with time for the first 15 m of the race.

(2)



(ii) Explain one other way in which the motion of the swimmer has been simplified when drawing the displacement-time graph.

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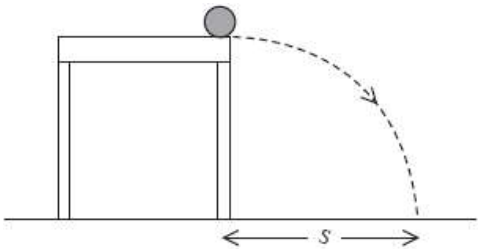
(Total for question = 8 marks)

Q5.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A ball rolls off a table with a horizontal velocity of 1.2 m s^{-1}. The ball takes 0.9 s to reach the ground and lands a distance *s* from the table as shown.



Which of the following expressions could be used to determine the value of *s* in metres?

☐ **A** $\frac{1.2^2}{2 \times 9.81}$

☐ **B** 1.2×0.9

☐ **C** $\frac{1}{2} \times 9.81 \times 0.9^2$

☐ **D** $(1.2 \times 0.9) + (\frac{1}{2} \times 9.81 \times 0.9^2)$

(Total for question = 1 mark)

Q6.

A ball is thrown vertically upwards.

Which row of the table correctly describes the magnitude of the initial acceleration of the ball and the magnitude of the acceleration when it is at its maximum height?

	Initial acceleration	Acceleration at maximum height
☒ **A**	0	$9.81\,ms^{-2}$
☒ **B**	$9.81\,ms^{-2}$	0
☒ **C**	$9.81\,ms^{-2}$	$9.81\,ms^{-2}$
☒ **D**	0	0

(Total for question = 1 mark)

Q7.

The photograph shows an area of land where golfers can practise their golf shots.
Distances are marked out along the land in front of where the golfer stands, to measure the distance travelled by the ball.

Two levels are available. If the lower level is used, the ball lands at the same height from which it was hit. If the higher level is used, this enables the ball to be hit further.

Source: www.golfnews.co.uk

(a) A ball is given an initial velocity of 33 m s^{-1} at an angle of 28° to the horizontal.

When hit from the lower level, this ball travels a horizontal distance of 92 m before landing. Use of the higher level increases the horizontal distance travelled before landing by 10 m.

Deduce whether an upper level at a height of 4.5 m would be sufficient to produce this increase. You should ignore air resistance.

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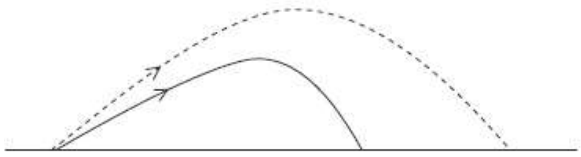
* (b) Your answer to part (a) did not consider the effect of air resistance.

The trajectories of the motion of the golf ball with air resistance and without air resistance are shown.



Explain the differences between the two paths.

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(Total for question = 11 marks)