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?

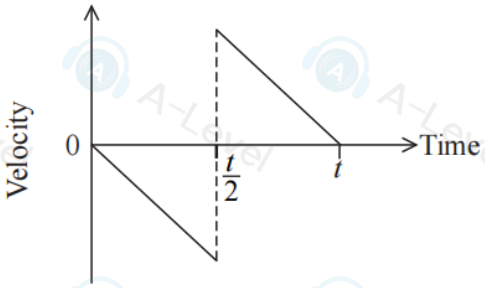
- ☒ **A** 7.8 m
- ☒ **B** 13 m
- ☒ **C** 16 m
- ☒ **D** 25 m

(Total for Question 8 = 1 mark)

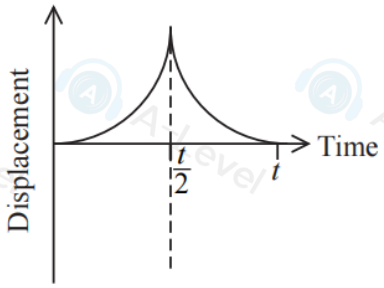
DO NOT WRITE IN THIS AREA

7 A ball is dropped, bounces once at time $\frac{t}{2}$ and is then caught at time t.

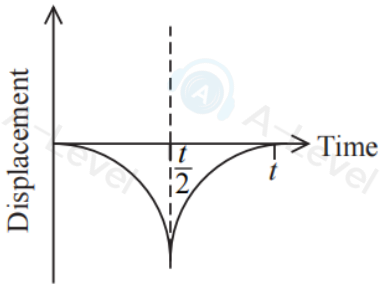
The velocity-time graph for the motion of the ball is shown.



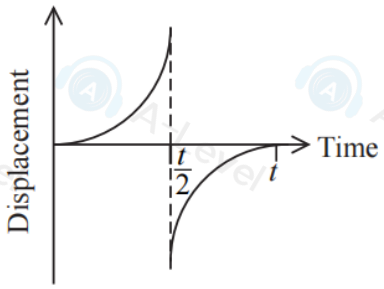
Assuming that the initial displacement of the ball is 0, which is the correct displacement-time graph for the motion of the ball?



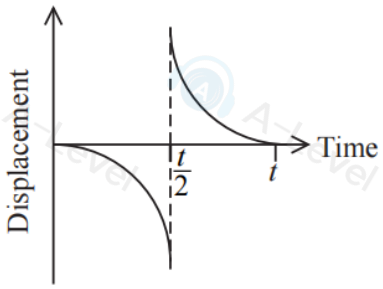
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(Total for Question 7 = 1 mark)

8 A ball is thrown vertically upwards with a velocity of $+3.0\,\text{m s}^{-1}$.

Which of the following is the acceleration of the ball at its maximum height?

A $0\,\text{m s}^{-2}$

B $-3.0\,\text{m s}^{-2}$

C $+9.8\,\text{m s}^{-2}$

D $-9.8\,\text{m s}^{-2}$

(Total for Question 8 = 1 mark)

DO NOT WRITE IN THIS AREA

6 A ball is travelling horizontally at a speed of $7.0\,m\,s^{-1}$. The ball hits a vertical wall and rebounds along its initial path at a speed of $5.0\,m\,s^{-1}$.
The ball has an acceleration of $300\,m\,s^{-2}$ while in contact with the wall.

Which of the following expressions gives the time of contact t between the ball and the wall?

☒ **A** $t = \dfrac{-5-7}{-300}$

☒ **B** $t = \dfrac{5-7}{-300}$

☒ **C** $t = \dfrac{-5-7}{300}$

☒ **D** $t = \dfrac{5-7}{300}$

(Total for Question 6 = 1 mark)

2 Which of the following statements describes the gravitational field strength acting on a body at a point?

☒ **A** gravitational force per unit length

☒ **B** gravitational force per unit mass

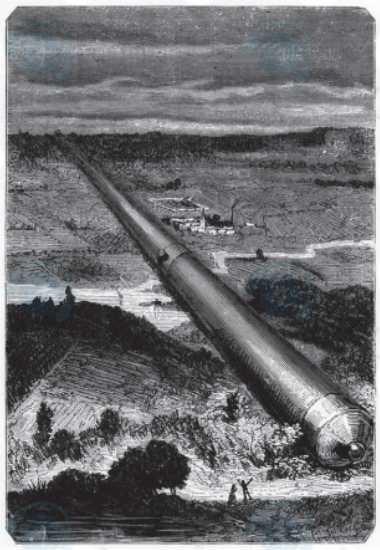
☒ **C** gravitational potential energy per unit length

☒ **D** gravitational potential energy per unit mass

(Total for Question 2 = 1 mark)

DO NOT WRITE IN THIS AR

15 In 1865, in his book 'From the Earth to the Moon', the writer Jules Verne wrote about sending men to the Moon. In order to escape the Earth's gravitational field, Verne proposed firing a capsule from a cannon of length 220 m, as shown in this illustration from the book.



(a) The velocity of the capsule at the end of the cannon was estimated to be 11 km s^{-1}.

(i) Calculate the acceleration of the capsule through the cannon.

(3)

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Acceleration = ...

(ii) It can be assumed that only 50% of the energy supplied by the gunpowder in the cannon would have been transferred to the capsule.

Determine the mass of gunpowder that would have been required to obtain a maximum speed of 11 km s^{-1}.

(4)

mass of capsule = 1500 kg
energy released from gunpowder = 3 MJ kg^{-1}

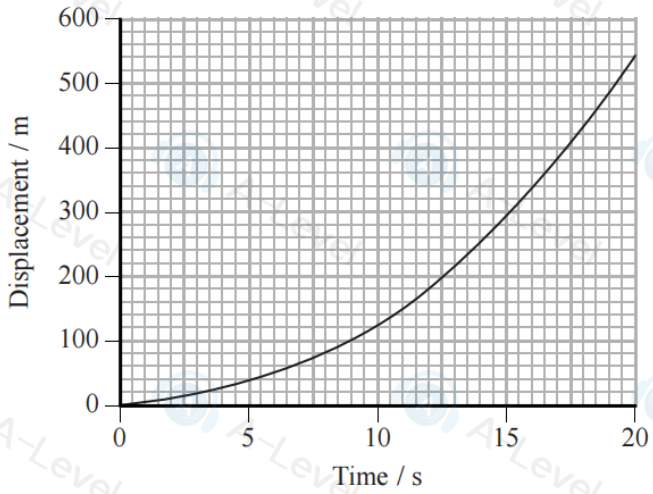
Mass of gunpowder = ...

*(b) In order to land safely on the surface of the Moon, Verne suggested that gases could be ejected from the capsule to reduce its speed.

Explain how ejecting gases from the capsule could reduce its speed. Your answer should include reference to Newton's laws of motion.

(5)

15 The graph shows how the displacement of a racing car along a straight track varies with time.



(a) A student used the graph to calculate the velocity of the car at 15 s.

The student wrote:

Velocity = displacement / time
= 300/15
= 20 m s^{-1}

State why this value is incorrect and calculate the correct velocity at 15 s.

(3)

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.....

.....

.....

Velocity of the car at 15 s = ...

(b) The gradient of the graph continued to increase as the car travelled along the track. After 20 s the rate of increase of the gradient began to decrease.

Explain why the rate of increase of the gradient decreased.

(2)

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(Total for Question 15 = 5 marks)