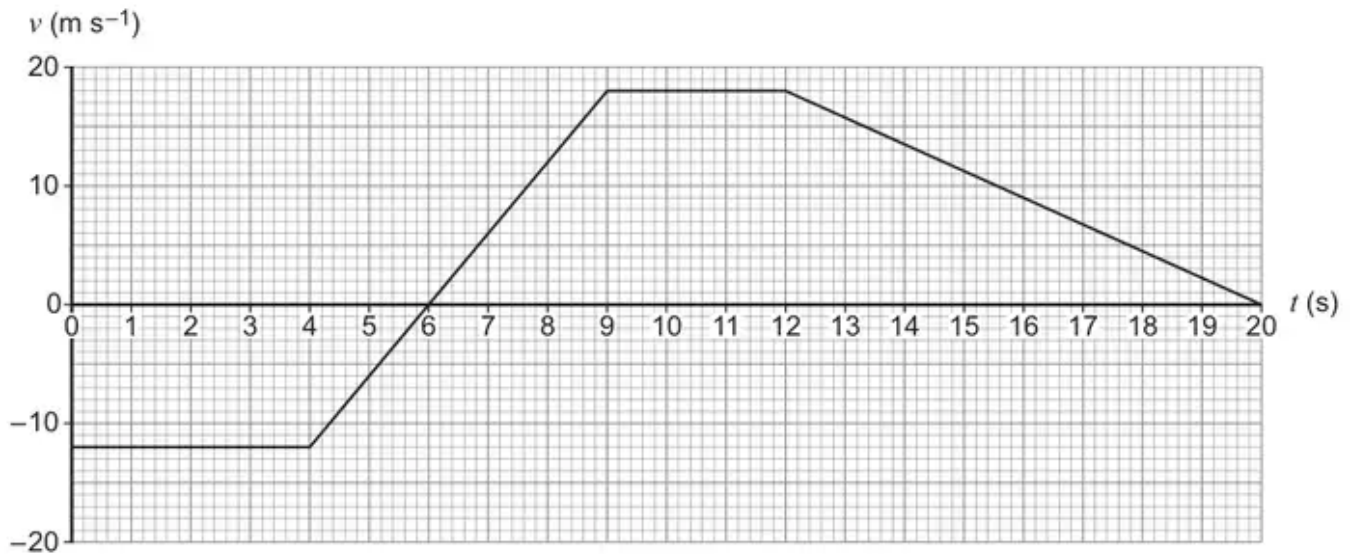


QQQ – Mechanics Year 1 – Chapter 9 – Time-Series Graphs (Version 2)

Total Marks: 24

(24 = Platinum, 22 = Gold, 19 = Silver, 16 = Bronze)

1. The diagram below shows a velocity-time graph for a particle moving with velocity $v \text{ m s}^{-1}$ at time t seconds.



Which statement is correct?

Tick (✓) **one** box.

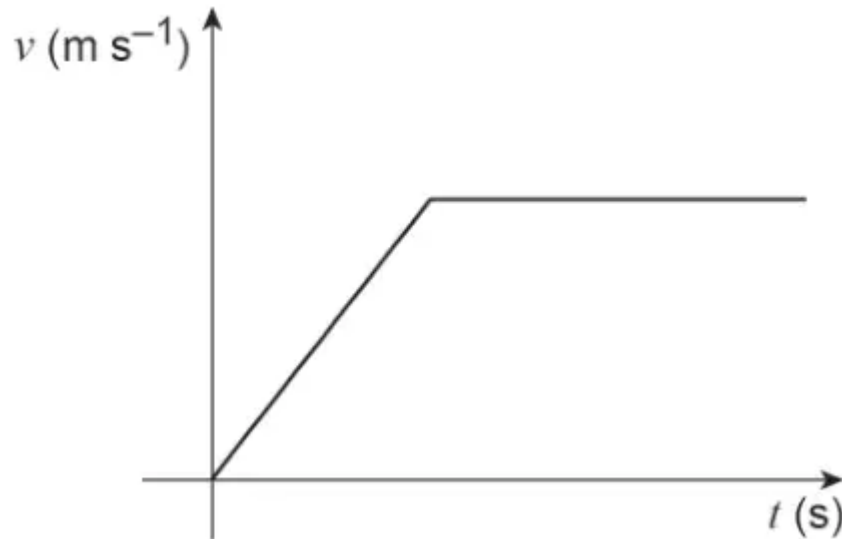
[1 mark]

- The particle was stationary for $9 \leq t \leq 12$
- The particle was decelerating for $12 \leq t \leq 20$
- The particle had a displacement of zero when $t = 6$
- The particle's speed when $t = 4$ was -12 m s^{-1}

(Total 1 marks)

2. A car starting from rest moves forward in a straight line.

The motion of the car is modelled by the velocity–time graph below:



One of the following assumptions about the motion of the car is implied by the graph.

Identify this assumption.

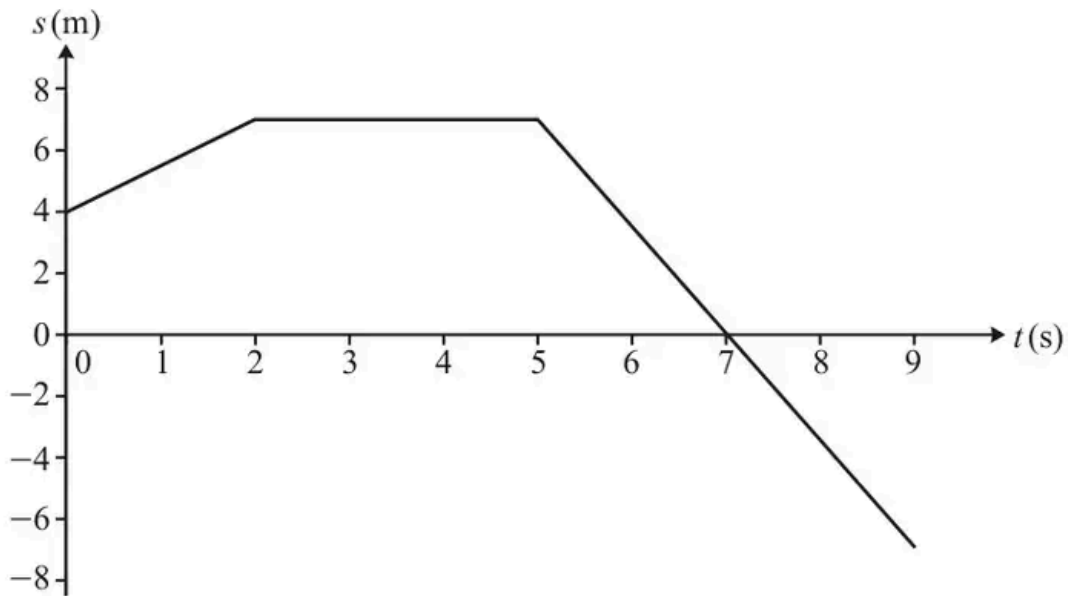
[1 mark]

Tick (✓) **one** box.

- The car never accelerates.
- The acceleration of the car is always positive.
- The acceleration of the car can change instantaneously.
- The acceleration of the car is never constant.

(Total 1 marks)

3. The graph shows displacement s m against time t s for a model of the motion of a bead moving along a straight wire. The points $(0, 4)$, $(2, 7)$, $(5, 7)$ and $(9, -7)$ are the endpoints of the line segments.

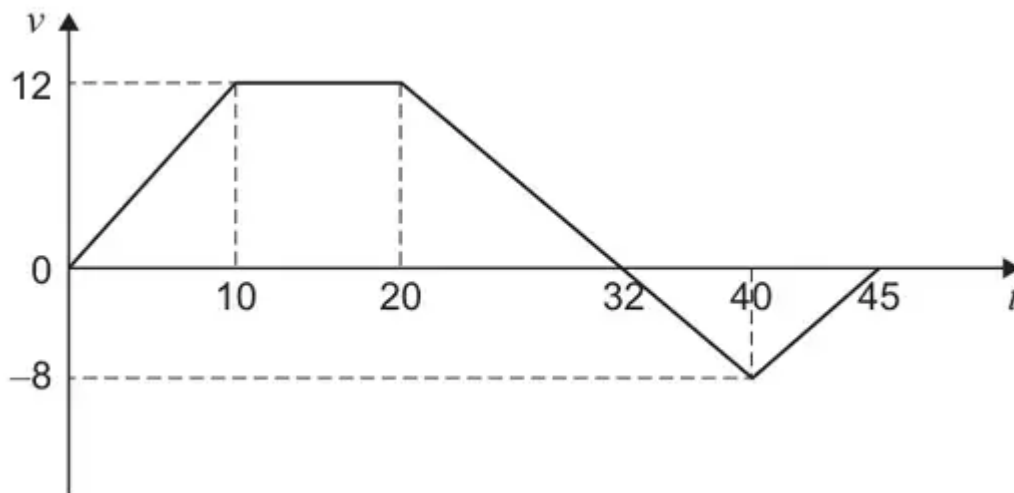


- (a) Find an expression for the displacement of the bead for $0 \leq t \leq 2$. [2]
- (b) Sketch the velocity-time graph for this model. [2]
- (c) Explain why the model may not be suitable at $t = 2$ and $t = 5$. [1]

(Total 5 marks)

4. A car, initially at rest, is driven along a straight horizontal road.

The graph below is a simple model of how the car's velocity, v metres per second, changes with respect to time, t seconds.

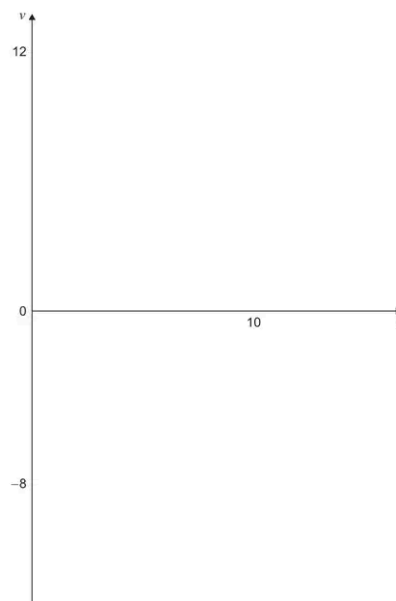


(a) Find the displacement of the car when $t = 45$ [3 marks]

(b) Shona says:

“This model is too simple. It is unrealistic to assume that the car will instantaneously change its acceleration.”

On the axes below sketch a graph, for the first 10 seconds of the journey, which would represent a more realistic model. [2 marks]



(Total 5 marks)

5. A child is running up and down a path. A simplified model of the child's motion is as follows:

- he first runs north for 5 s at 4 m s^{-1} ;
- he then suddenly stops and waits for 8 s;
- finally he runs in the opposite direction for 7 s at 3.5 m s^{-1} .

(a) Taking north to be the positive direction, sketch a velocity-time graph for this model of the child's motion. [2]

Using this model,

(b) calculate the total distance travelled by the child, [2]

(c) find his final displacement from his original position. [1]

(Total 5 marks)

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6. A train travels along a straight horizontal track between two stations, A and B .

In a model of the motion, the train starts from rest at A and moves with constant acceleration 0.3 m s^{-2} for 80 s.

The train then moves at constant velocity before it moves with a constant deceleration of 0.5 m s^{-2} , coming to rest at B .

- (a) For this model of the motion of the train between A and B ,
- (i) state the value of the constant velocity of the train,
 - (ii) state the time for which the train is decelerating,
 - (iii) sketch a velocity-time graph. (3)

The total distance between the two stations is 4800 m.

(b) Using the model, find the total time taken by the train to travel from A to B . (3)

(c) Suggest one improvement that could be made to the model of the motion of the train from A to B in order to make the model more realistic. (1)

(Total 7 marks)

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