# Equations of Motion and Motion Graph Questions

1. The diagram is a velocity-time graph for an electron.
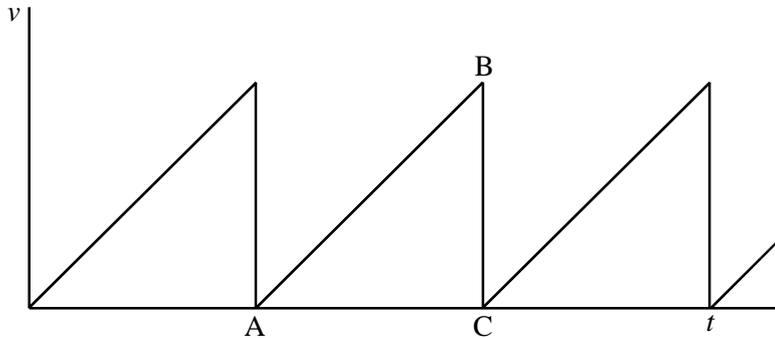
Describe carefully the motion represented by lines AB and BC.

AB: ....

....

BC: ....

....

(2)

The graph is a much simplified model of how an electron moves along a wire carrying a current.
Explain what causes the motion represented by AB and BC.

AB: ....

....

BC: ....

....

(2)

Explain the term *drift velocity* and indicate its value on the graph above.

....

....

(2)

With reference to the behaviour of the electron, explain why the wire gets warm.

....

....

(1)
(Total 7 marks)

2. The diagram shows a velocity-time graph for a ball bouncing vertically on a hard surface. The ball was dropped at $t = 0$ s.
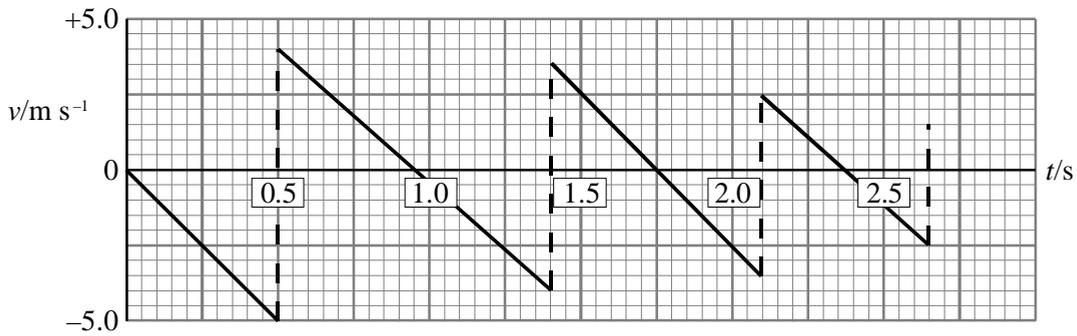
At what time does the graph show the ball in contact with the ground for the third time?

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(1)

The downward sloping lines on the graph are straight and parallel with each other. Why?

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(2)

Show that the height from which the ball was dropped is about 1.2 m.

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....

(2)

Sketch a displacement-time curve on the axes below for the first second of the motion.
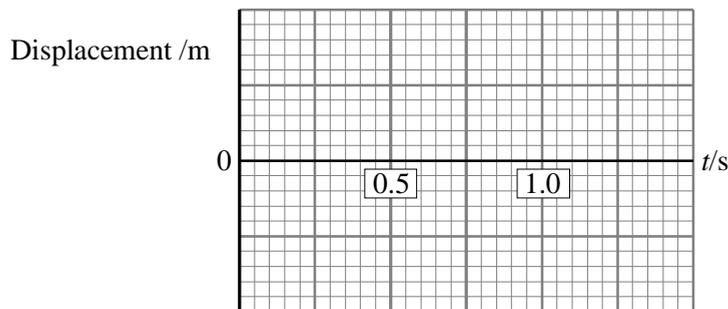
(3)

What is the displacement of the ball when it finally comes to rest?

....

(1)
(Total 9 marks)

3. A ball is dropped from a high window onto a concrete floor. The velocity–time graph for part of its motion is shown.
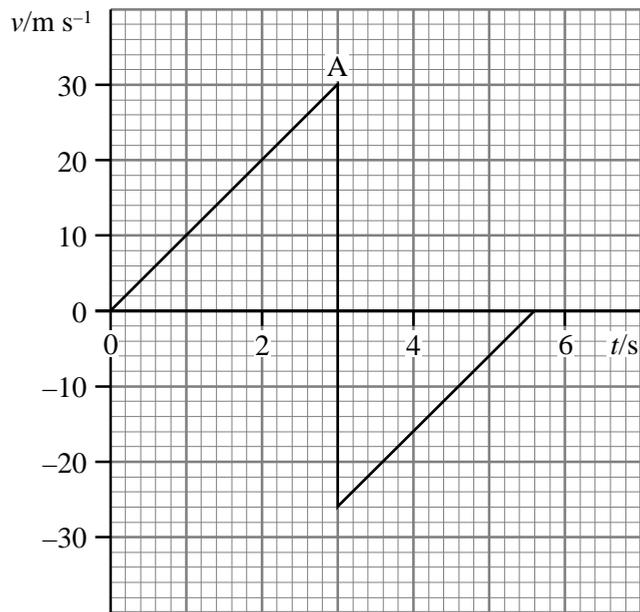
Calculate the gradient from the origin to A.

....

....

Gradient = ...

Comment on the significance of your answer.

....

(3)

What happened to the ball at point A?

....

(1)

Calculate the height of the window above the ground.

....

....

....

Height = ...

(3)
(Total 7 marks)

4. The graph shows the variation of velocity with time for a body moving in a straight line.

v/m s^{-1}
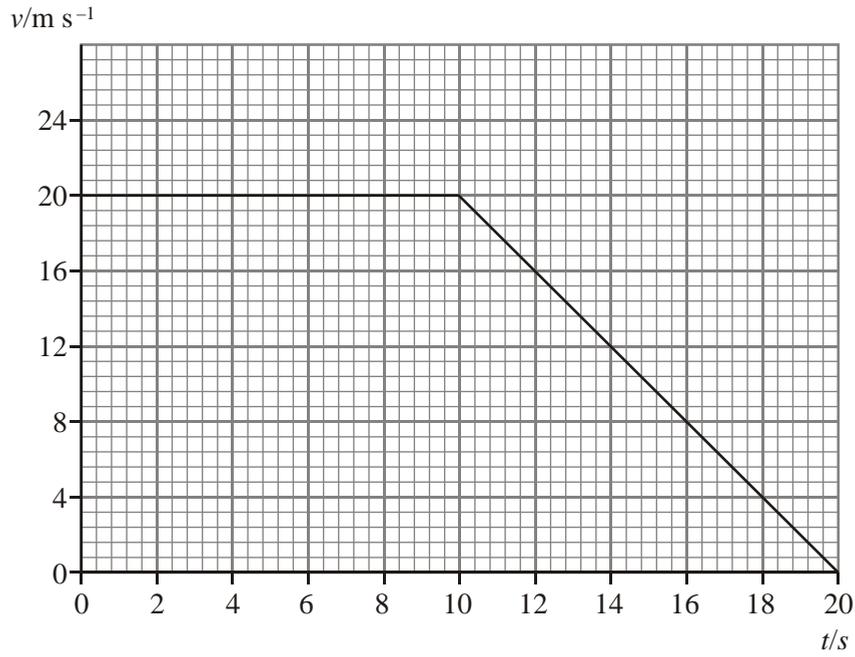

Calculate

(i) the total distance travelled,

....

....

Distance = ...

(ii) the average speed over the 20 seconds.

....

....

Average speed = ...
(Total 4 marks)

5. A lorry is travelling at 25 m s^{-1} down a mountain road when the driver discovers that the brakes have failed. She notices that an escape lane covered with sand is ahead and stops her lorry by steering it on to the sand.

Sand

Escape lane
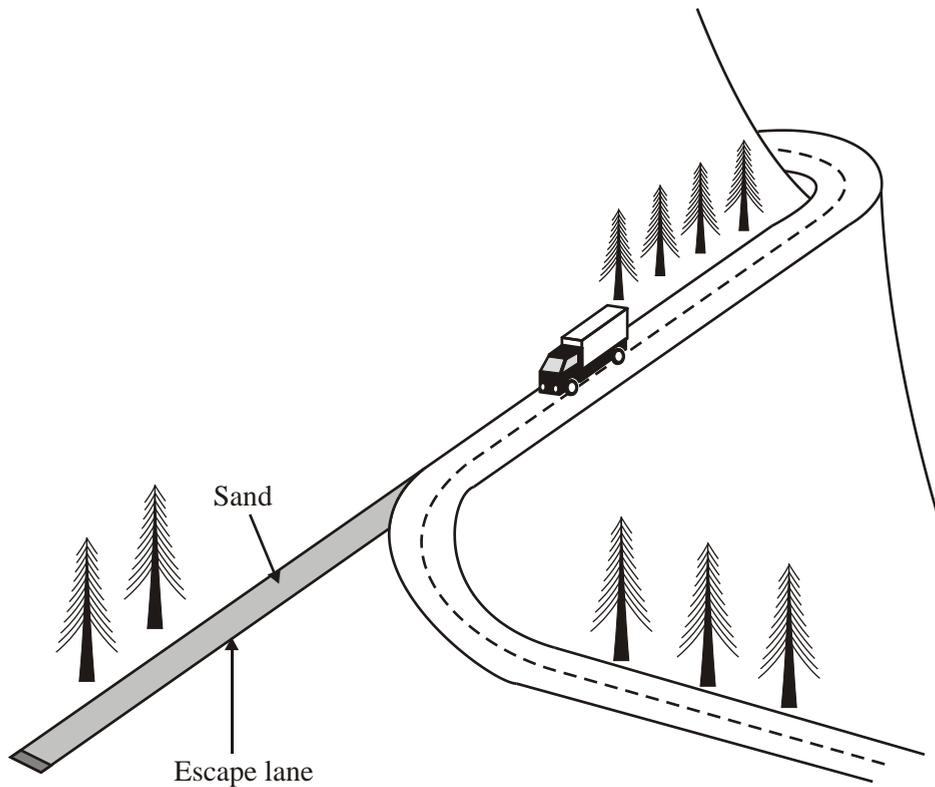
The lorry is brought to a halt in 40 m. Calculate the average deceleration of the lorry.

....

....

....

Average deceleration =...........................

(3)

Suggest how the depth of the sand affects the stopping distance. Justify your answer.

....

....

....

(1)
(Total 4 marks)

6. Two cars, A and B, are travelling along the outside lane of a motorway at a speed of
30.0 m s^{-1}. They are a distance d apart.

30.0 m s^{-1} 30.0 m s^{-1}

B   A

$\leftarrow$ d $\longrightarrow$
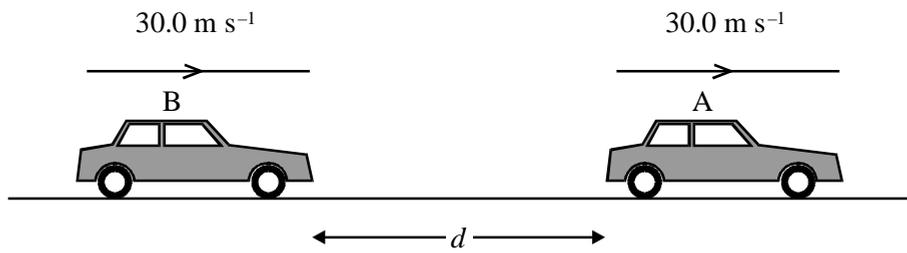
The driver of car A sees a slower vehicle move out in front of him, and brakes hard until his
speed has fallen to 22.0 m s^{-1}. The driver of car B sees car A brake and, after a reaction time of
0.900 s, brakes with the same constant deceleration as A.

The diagram below shows velocity-time graphs for car A (solid line) and car B (broken line).
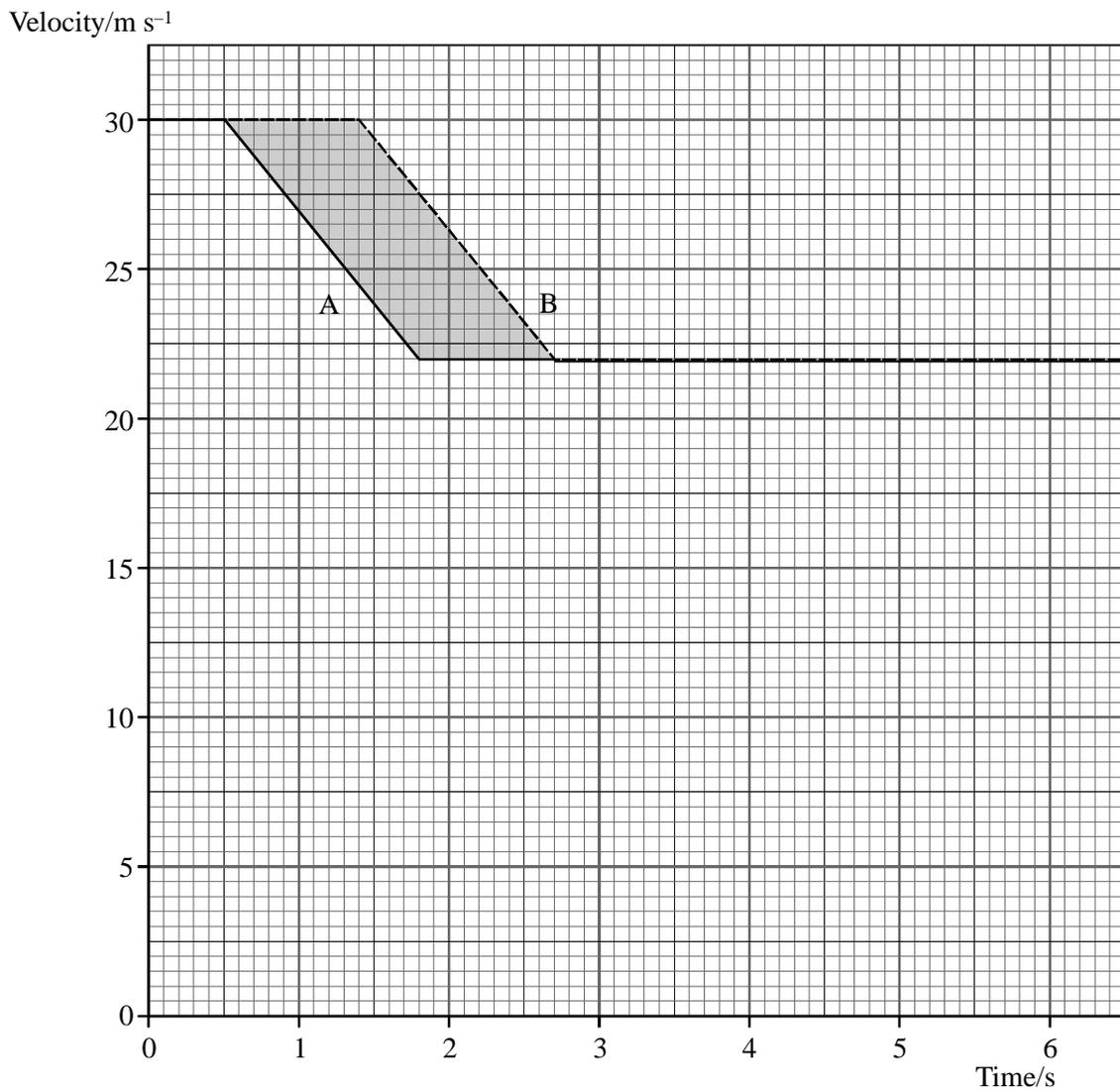
Velocity/m s^{-1}

Find the deceleration of the cars whilst they are braking.

....

....

....

....

Deceleration = ...

(3)

What does the area under a velocity-time graph represent?

....

(1)

Determine the shaded area.

....

....

....

Area = ...

(2)

State the minimum value of the initial separation d if the cars are not to collide.
Explain how you arrived at your answer.

....

....

....

(2)

Suppose that, instead of only slowing down to 22.0 m s^{-1}, the cars had to stop. Add lines to the grid above to show the velocity–time graphs in this case. (Assume that the cars come to rest with the same constant deceleration as before.)

(1)

Explain why a collision is now more likely.

....

....

....

....

(2)
(Total 11 marks)

7. An athlete runs a 100 m race. The idealised graph below shows how the athlete's velocity v changes with time t for a 100 m sprint.
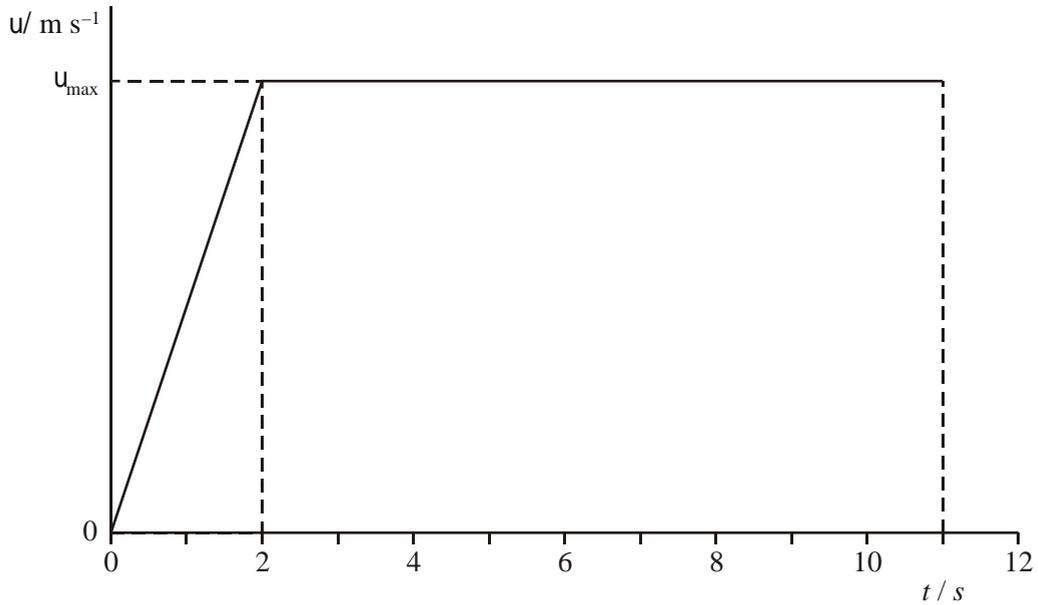
By considering the area under the graph, calculate the maximum velocity v_{max} of the athlete.

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Maximum velocity = ...

(3)

Using the axes below, sketch a graph showing how the acceleration of this athlete changes with time during this race. Mark any significant values on the axes.

(4)
(Total 7 marks)