

Graphs - Displacement-Time & Velocity-Time

Question Paper 4

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Kinematics of motion in a straight line
Sub Topic	Graphs - displacement-time & velocity-time
Booklet	Question Paper 4

Time Allowed: 60 minutes

Score: /50

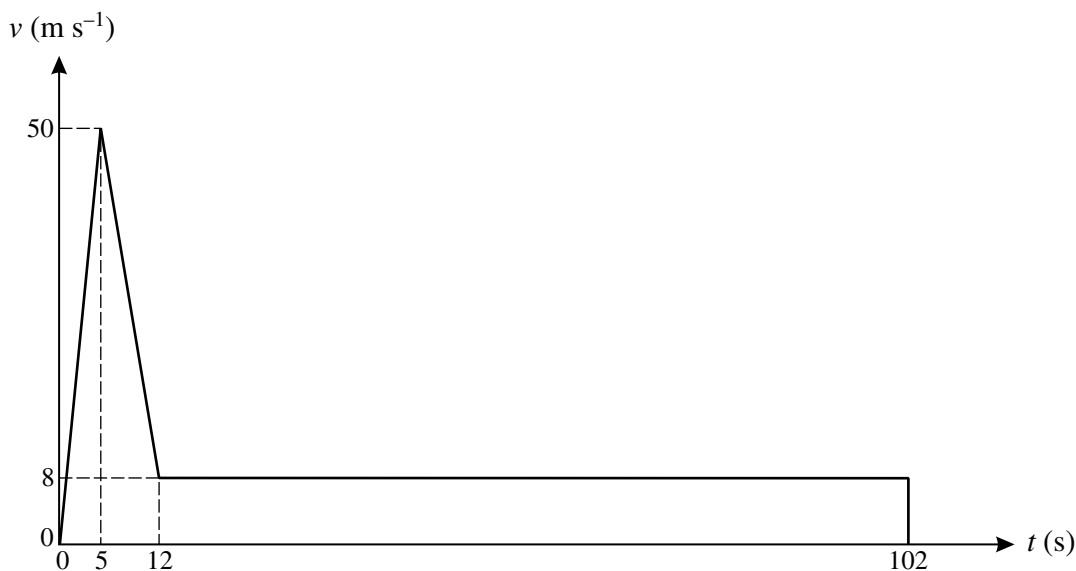
Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 A train starts from rest at a station A and travels in a straight line to station B , where it comes to rest. The train moves with constant acceleration 0.025 m s^{-2} for the first 600 s , with constant speed for the next 2600 s , and finally with constant deceleration 0.0375 m s^{-2} .
- (i) Find the total time taken for the train to travel from A to B . [4]
- (ii) Sketch the velocity-time graph for the journey and find the distance AB . [3]
- (iii) The speed of the train t seconds after leaving A is 7.5 m s^{-1} . State the possible values of t . [1]

2



The velocity-time graph shown models the motion of a parachutist falling vertically. There are four stages in the motion:

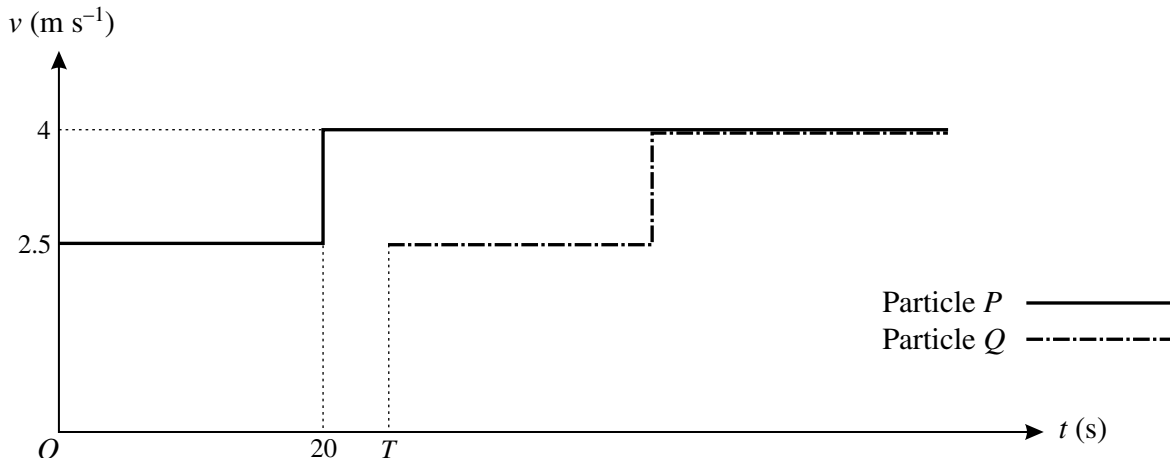
- falling freely with the parachute closed,
- decelerating at a constant rate with the parachute open,
- falling with constant speed with the parachute open,
- coming to rest instantaneously on hitting the ground.

- (i) Show that the total distance fallen is 1048 m . [2]

The weight of the parachutist is 850 N .

- (ii) Find the upward force on the parachutist due to the parachute, during the second stage. [5]

3



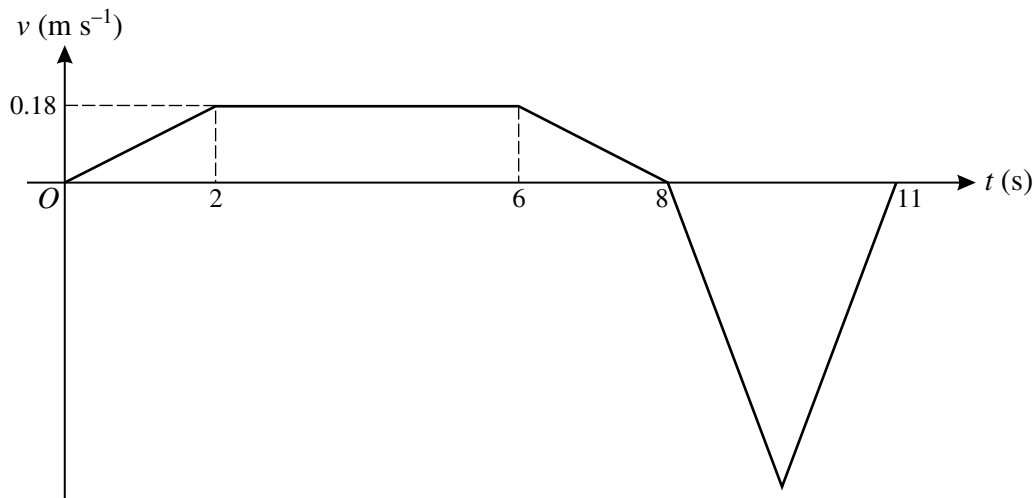
The diagram shows the velocity-time graphs for the motion of two particles P and Q , which travel in the same direction along a straight line. P and Q both start at the same point X on the line, but Q starts to move T s later than P . Each particle moves with speed 2.5 m s^{-1} for the first 20 s of its motion. The speed of each particle changes instantaneously to 4 m s^{-1} after it has been moving for 20 s and the particle continues at this speed.

- (i) Make a rough copy of the diagram and shade the region whose area represents the displacement of P from X at the instant when Q starts. [1]

It is given that P has travelled 70 m at the instant when Q starts.

- (ii) Find the value of T . [2]
- (iii) Find the distance between P and Q when Q 's speed reaches 4 m s^{-1} . [2]
- (iv) Sketch a single diagram showing the displacement-time graphs for both P and Q , with values shown on the t -axis at which the speed of either particle changes. [2]

4



The diagram shows the velocity-time graph for the motion of a machine's cutting tool. The graph consists of five straight line segments. The tool moves forward for 8 s while cutting and then takes 3 s to return to its starting position. Find

- (i) the acceleration of the tool during the first 2 s of the motion, [1]
- (ii) the distance the tool moves forward while cutting, [2]
- (iii) the greatest speed of the tool during the return to its starting position. [2]

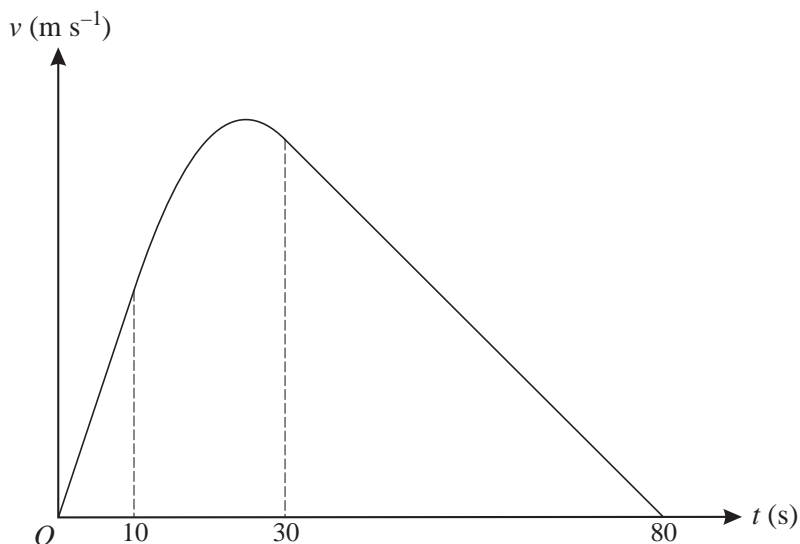
5 A ball moves on the horizontal surface of a billiards table with deceleration of constant magnitude $d \text{ m s}^{-2}$. The ball starts at A with speed 1.4 m s^{-1} and reaches the edge of the table at B , 1.2 s later, with speed 1.1 m s^{-1} .

- (i) Find the distance AB and the value of d . [3]

AB is at right angles to the edge of the table containing B . The table has a low wall along each of its edges and the ball rebounds from the wall at B and moves directly towards A . The ball comes to rest at C where the distance BC is 2 m.

- (ii) Find the speed with which the ball starts to move towards A and the time taken for the ball to travel from B to C . [3]
- (iii) Sketch a velocity-time graph for the motion of the ball, from the time the ball leaves A until it comes to rest at C , showing on the axes the values of the velocity and the time when the ball is at A , at B and at C . [2]

6



An object P travels from A to B in a time of 80 s. The diagram shows the graph of v against t , where $v \text{ m s}^{-1}$ is the velocity of P at time t s after leaving A . The graph consists of straight line segments for the intervals $0 \leq t \leq 10$ and $30 \leq t \leq 80$, and a curved section whose equation is $v = -0.01t^2 + 0.5t - 1$ for $10 \leq t \leq 30$. Find

(i) the maximum velocity of P , [4]

(ii) the distance AB . [9]