3.2 Distance-Time and Velocity-Time Graphs: 30-minute Pack

Total Marks

EDEXCEL 4PH1 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Describe the motion of a vehicle shown on a distance-time graph that is a curve with increasing gradient for the first 5 s, then a straight horizontal line for the next 5 s, and finally a straight line returning to the origin over 5 s. Use words describing speed and direction.

(Total for Question 1 is 2 marks)

2 A car travels with constant speed. On a distance-time graph its line is straight and passes through (2 s, 10 m) and (6 s, 34 m). Calculate the speed of the car in m/s.

(Total for Question 2 is 2 marks)

3 Read off from a velocity-time graph a vehicle that travels at 12 m/s from t = 0 s to t = 4 s, then decelerates linearly to 0 m/s at t = 8 s. Determine the acceleration during the deceleration phase, in m/s^2.

(Total for Question 3 is 3 marks)

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4 On a velocity-time graph a cyclist travels at -2 m/s (negative sign indicates towards the origin) for 5 s, then reverses direction and accelerates to +6 m/s over 4 s. Calculate the change in velocity and the average acceleration during the 4 s interval. Give units.

(Total for Question 4 is 3 marks)

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5 A velocity-time graph shows a car moving at 10 m/s for 6 s, then accelerating uniformly to 22 m/s over the next 4 s. Calculate the distance travelled during the acceleration interval (from t = 6 s to t = 10 s) using the area under the velocity-time graph. Give your answer in metres.

(Total for Question 5 is 4 marks)

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6 A lorry is shown on a velocity-time graph as follows: accelerates uniformly from 0 to 8 m/s in 4 s, continues at 8 m/s for 6 s, then decelerates uniformly to 2 m/s in 2 s.

(a) Calculate the acceleration during the initial 4 s (from 0 to 8 m/s). Give units. **(2)**

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(b) Calculate the distance covered during the whole 12 s journey by using the areas under the velocity-time graph. Give units. **(2)**

.....

(Total for Question 6 is 4 marks)

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7 A velocity-time graph shows a toy train moving at 3 m/s for 4 s, then accelerating uniformly to 9 m/s over 3 s, then maintaining 9 m/s for 5 s.

(a) Calculate the acceleration during the 3 s interval (from 3 m/s to 9 m/s). Show working and include units. **(1)**

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(b) Calculate the distance covered in the whole 12 s. Show working and include units. **(2)**

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(Total for Question 7 is 3 marks)

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8 A vehicle is driven so that its velocity-time graph between t = 0 and t = 9 s is as follows: from 0 to 3 s constant at 0 m/s (stationary), from 3 to 6 s accelerates uniformly to 15 m/s, from 6 to 9 s decelerates uniformly to 6 m/s. Calculate the total displacement from t = 3 s to t = 9 s using areas under the velocity-time graph. Give your answer in metres.

(Total for Question 8 is 3 marks)

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9 A runner completes a two-stage journey shown on a velocity-time graph: first stage, constant speed 4 m/s for 10 s; second stage, accelerates uniformly to 12 m/s over 5 s. Calculate the total distance run during the whole 15 s interval by using areas under the velocity-time graph. Show steps and give units.

(Total for Question 9 is 4 marks)

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Mark scheme · 3.2 Distance-Time and Velocity-Time Graphs: 30-minute Pack

Question 1

states first period is speeding up (increasing speed) away from origin	**B1**
states second period is stationary (not moving, constant distance from the origin), then final period is returning to origin meaning moving back towards start and covering decreasing distance	**B1**

Answer: From 0-5 s the vehicle is accelerating and increasing its speed away from the origin. From 5-10 s it is stationary, staying at the same distance from the origin. From 10-15 s it moves back towards the origin, its distance from the origin decreasing until it reaches the origin.

Question 2

uses gradient = change in distance / change in time = (34 - 10)/(6 - 2)	**M1**
gives 6 m/s cao	**A1**

Answer: 6 m/s

Question 3

uses gradient = change in velocity / change in time = (0 - 12)/(8 - 4)	**M1**
gives acceleration = -3.0 m/s^2 cao	**A1**
states negative sign means deceleration or slowing down	**B1**

Answer: -3.0 m/s^2 (deceleration of 3.0 m/s^2)

Question 4

calculates change in velocity = final - initial = 6 - (-2) = 8 m/s	**M1**
uses acceleration = change in velocity / time = 8 / 4	**M1**
gives acceleration = 2.0 m/s^2 cao and labels change in velocity 8 m/s	**A1**

Answer: Change in velocity = 8 m/s; average acceleration = 2.0 m/s^2

Question 5

recognises area under v-t graph for the interval is a trapezium and uses area = (sum of parallel sides)/2 x height	**M1**
substitutes velocities and time: area = (10 + 22)/2 x 4	**M1**
evaluates area = 64 m cao	**A1**
states unit m with final answer	**B1**

Answer: 64 m

Question 6

(a) uses gradient = change in velocity / change in time = (8 - 0)/4	**M1**
(a) gives acceleration = 2.0 m/s^2 cao	**A1**

(a) Answer: 2.0 m/s^2

(b) splits into triangle 0-4 s, rectangle 4-10 s, trapezium 10-12 s or equivalent and calculates areas	**M1**
(b) evaluates total distance = 16 + 48 + 10 = 74 m cao	**A1**

(b) Answer: 74 m

Question 7

(a) gives acceleration = (9 - 3)/3 = 2.0 m/s^2 cao	**A1**

(a) Answer: 2.0 m/s^2

(b) calculates areas for sections: rectangle 0-4 s = 3 x 4, trapezium 4-7 s = (3 + 9)/2 x 3, rectangle 7-12 s = 9 x 5	**M1**
(b) adds values: 12 + 18 + 45 = 75 m cao	**A1**

(b) Answer: 75 m

Question 8

splits into trapezium 3-6 s with velocities 0 to 15 and time 3, and trapezium 6-9 s with velocities 15 to 6 and time 3, or uses triangle+rectangle forms	**M1**
calculates areas: 3-6 s area = (0 + 15)/2 x 3 = 22.5 m; 6-9 s area = (15 + 6)/2 x 3 = 31.5 m	**M1**
gives total displacement = 54.0 m cao	**A1**

Answer: 54.0 m

Question 9

calculates distance in stage 1 as area of rectangle = 4 x 10	**M1**
recognises stage 2 area is trapezium or triangle+rectangle and uses area = (4 + 12)/2 x 5	**M1**
evaluates stage 1 = 40 m and stage 2 = 40 m cao	**A1**
gives total = 80 m with unit	**B1**

Answer: 80 m

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