Motion Graph Past Paper Questions

Jan 2002 to Jan 2009

Q1 Jan 2002

1 (a) (i) Define acceleration.

.....

(ii) State why acceleration is a vector quantity.

.....

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(2 marks)

(b) State what feature of a velocity-time graph may be used to calculate

(i) acceleration,

.....

(ii) displacement.

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(2 marks)

(c) The graph in **Figure 1** shows how the displacement of a runner from a fixed point, along a straight track, varies with time.

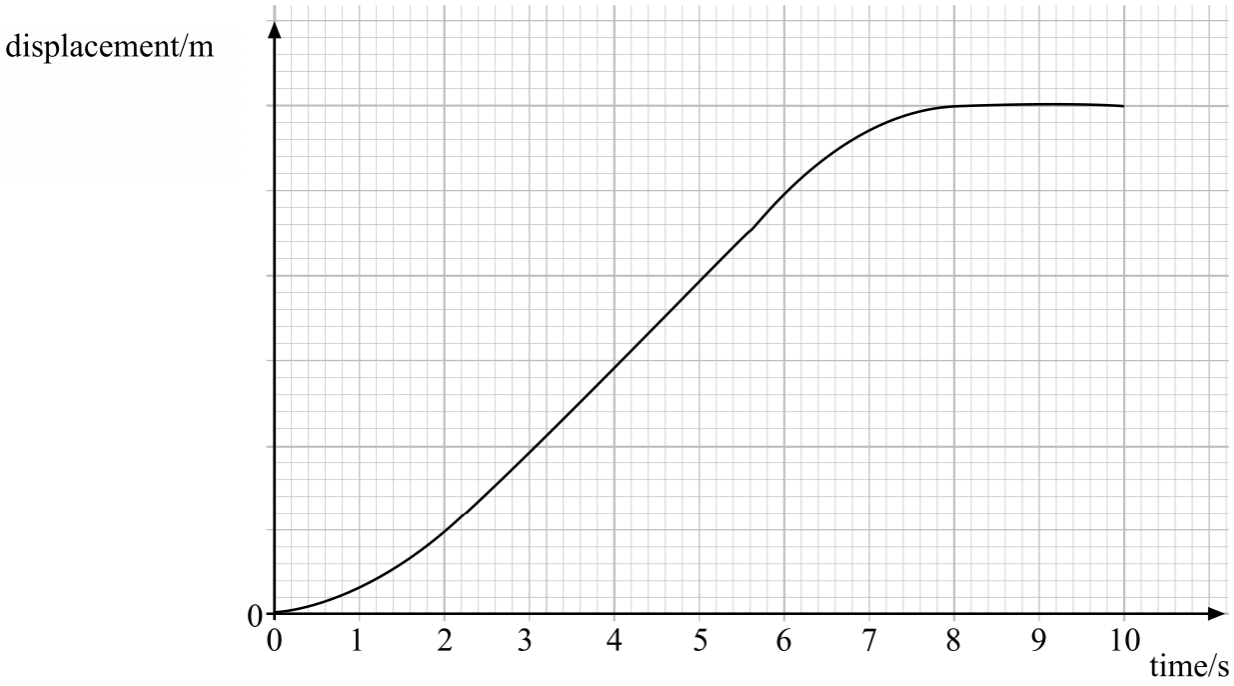


Figure 1

Without calculation, sketch on the grid in **Figure 2** a graph to show how the velocity of the same runner varies over the same period. The time scales are the same on both graphs.

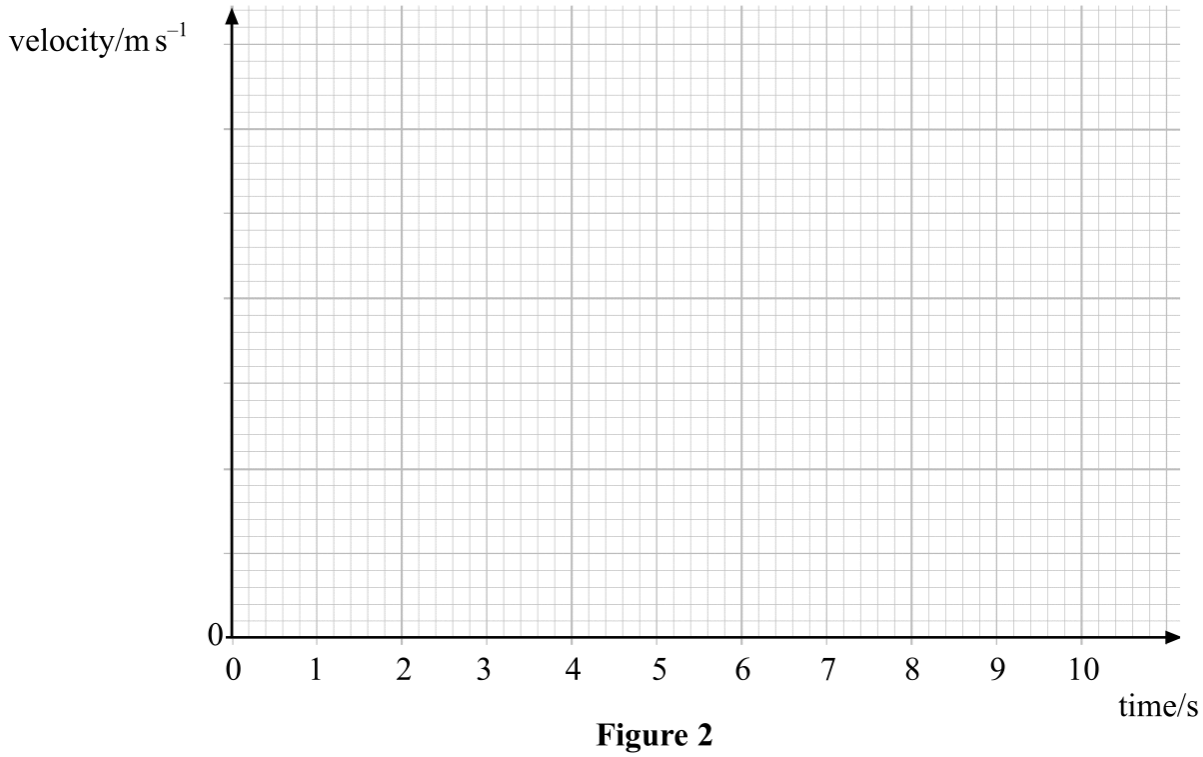
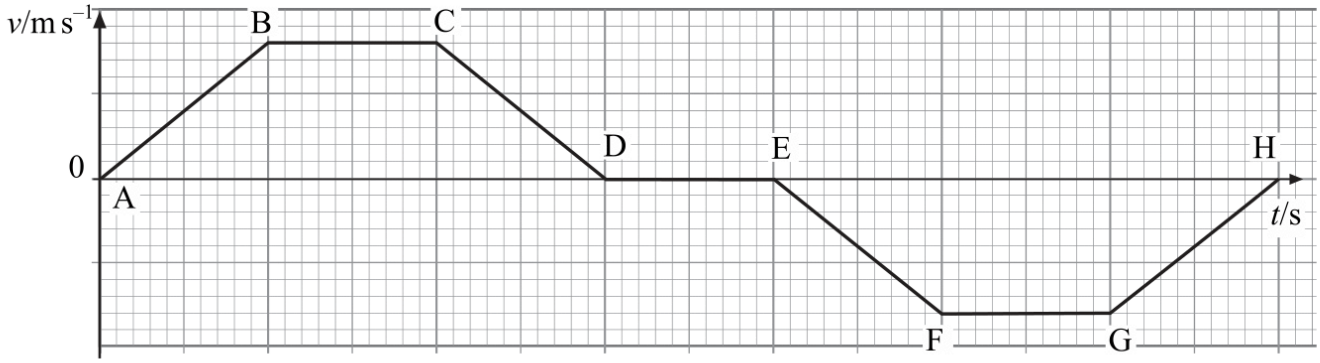


Figure 2

(4 marks)

1 The graph below shows how the velocity of a toy train moving in a straight line varies over a period of time.

Q1 Jun 2002



(a) Describe the motion of the train in the following regions of the graph.

AB .....

BC .....

CD .....

DE .....

EF .....

(5 marks)

(b) What feature of the graph represents the displacement of the train?

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(1 mark)

(c) Explain, with reference to the graph, why the distance travelled by the train is different from its displacement.

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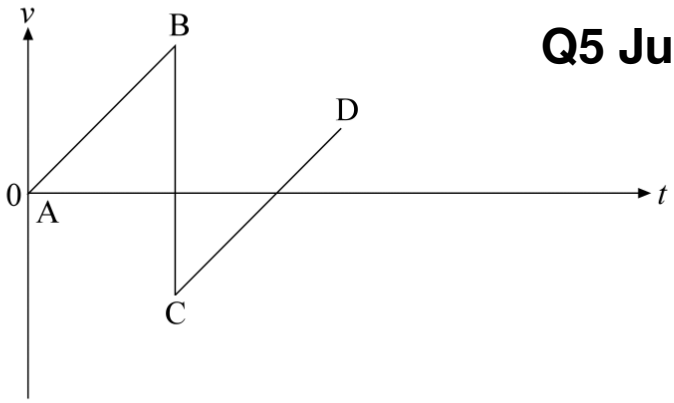
(2 marks)

5 The diagram shows the velocity-time graph for a vertically bouncing ball, which is released above the ground at A and strikes the floor at B. The effects of air resistance have been neglected.



Q5 Jun 2003

(a) (i) What does the gradient of a velocity-time graph represent?

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(ii) Explain why the gradient of the line CD is the same as line AB.

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(iii) What does the area between the line AB and the time axis represent?

.....

(iv) State why the velocity at C is negative.

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.....

(v) State why the speed at C is less than the speed at B.

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.....

.....

(5 marks)

(b) The ball has a mass of 0.15 kg and is dropped from an initial height of 1.2 m. After impact the ball rebounds to a height of 0.75 m.

Calculate

(i) the speed of the ball immediately before impact,

.....

.....

(ii) the speed of the ball immediately after impact,

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(iii) the change in momentum of the ball as a result of the impact,

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(iv) the magnitude of the resultant average force acting on the ball during impact if it is in contact with the floor for 0.10 s.

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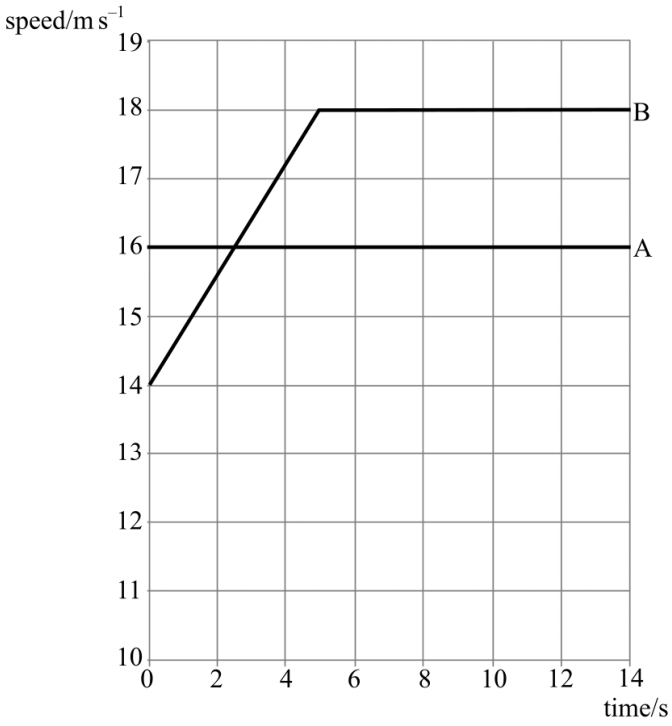
(8 marks)

4 The graph represents the motion of two cars, A and B, as they move along a straight, horizontal road.



Q4 Jan 2005

(a) Describe the motion of each car as shown on the graph.

(i) car A: .....

.....

(ii) car B: .....

.....

(3 marks)

(b) Calculate the distance travelled by each car during the first 5.0 s.

(i) car A: .....

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(ii) car B: .....

.....

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(4 marks)

(c) At time t = 0, the two cars are level. Explain why car A is at its maximum distance ahead of B at t = 2.5 s

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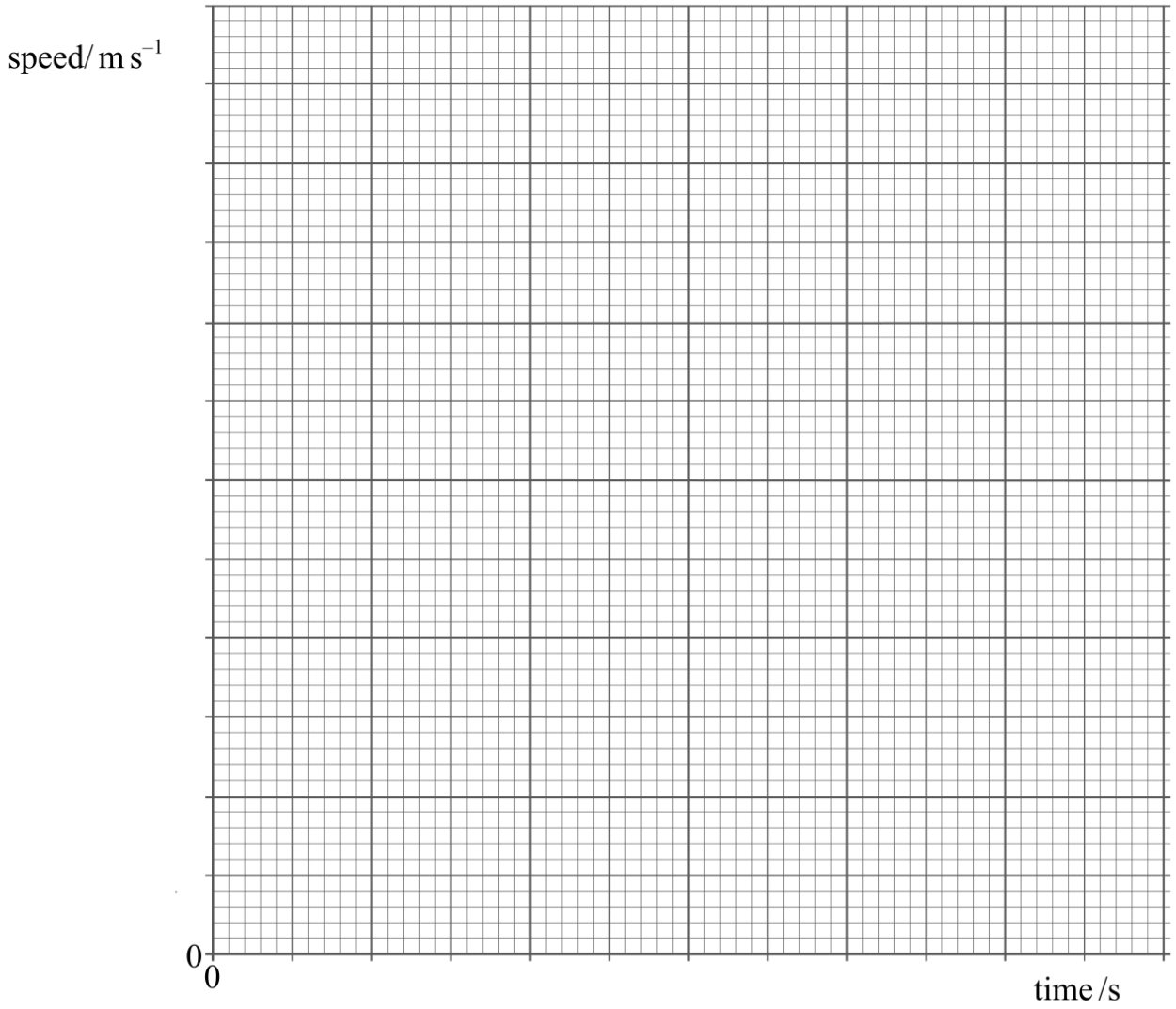
(3 marks)

1 A car accelerates from rest to a speed of 26 m s^{-1}. The table shows how the speed of the car varies over the first 30 seconds of motion.

time/ s	0	5.0	10.0	15.0	20.0	25.0	30.0
speed/ m s^{-1}	0	16.5	22.5	24.5	25.5	26.0	26.0

(a) Draw a graph of speed against time on the grid provided. **Q1 Jan 2006**



(3 marks)

(b) Calculate the average acceleration of the car over the first 25 s.

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(2 marks)

(c) Use your graph to estimate the distance travelled by the car in the first 25 s.

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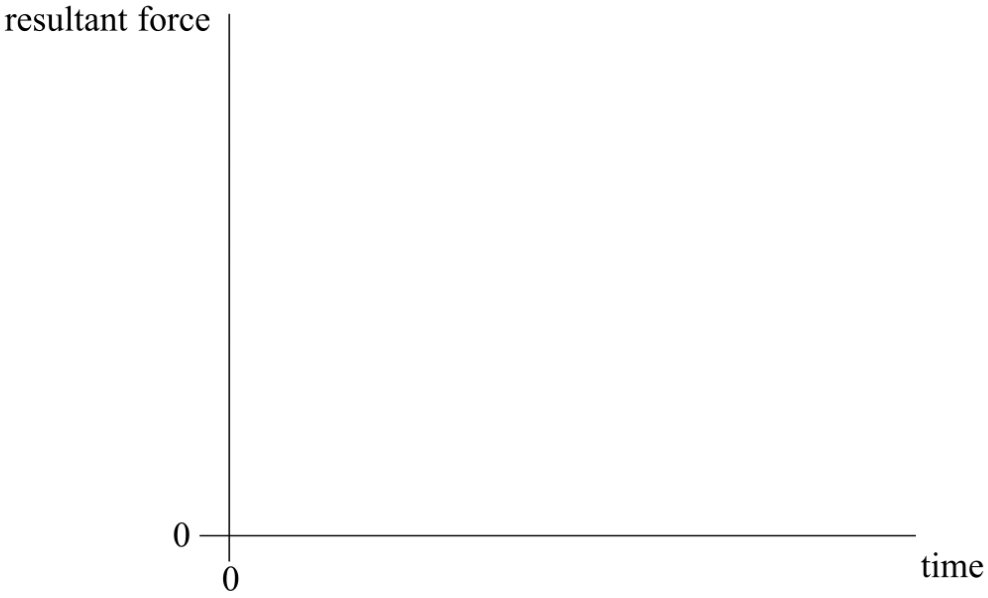
(2 marks)

(d) Using the axes below, sketch a graph to show how the resultant force acting on the car varies over the first 30 s of motion.



(2 marks)

(e) Explain the shape of the graph you have sketched in part (d), with reference to the graph you plotted in part (a).

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(2 marks)

6 A supertanker of mass 4.0×10^8 kg, cruising at an initial speed of $4.5\ \text{m s}^{-1}$, takes one hour to come to rest.

(a) Assuming that the force slowing the tanker down is constant, calculate

(i) the deceleration of the tanker, **Q6 Jun 2006**

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.....

(ii) the distance travelled by the tanker while slowing to a stop.

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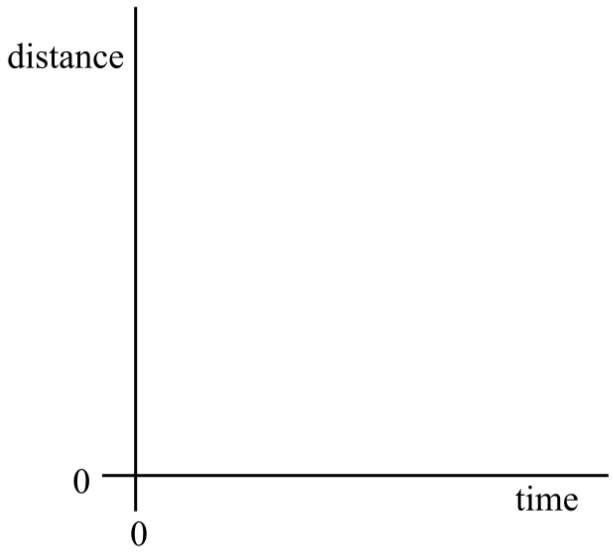
(4 marks)

(b) Sketch, using the axes below, a distance-time graph representing the motion of the tanker until it stops.



(2 marks)

(c) Explain the shape of the graph you have sketched in part (b).

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(2 marks)

2 (a) A cheetah accelerating uniformly from rest reaches a speed of 29 m s^{-1} in 2.0 s and then maintains this speed for 15 s. Calculate

Q2 Jan 2007

(i) its acceleration,

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(ii) the distance it travels while accelerating,

.....

.....

(iii) the distance it travels while it is moving at constant speed.

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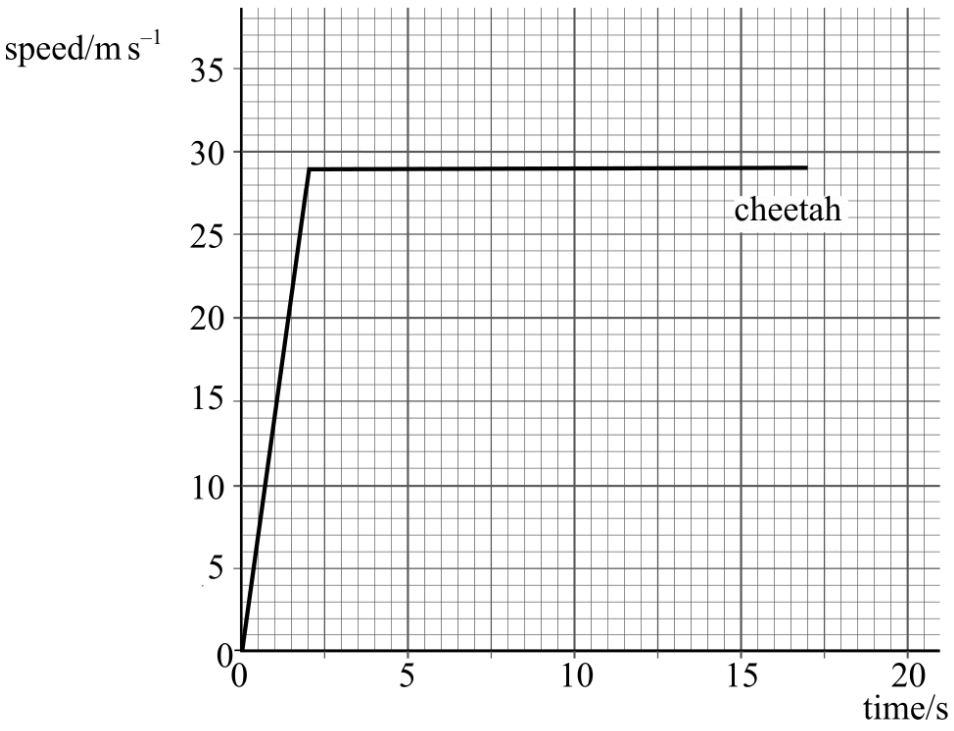
(4 marks)

(b) The cheetah and an antelope are both at rest and 100 m apart. The cheetah starts to chase the antelope. The antelope takes 0.50 s to react. It then accelerates uniformly for 2.0 s to a speed of 25 m s^{-1} and then maintains this speed. The graph shows the speed-time graph for the cheetah.



(i) Using the same axes plot the speed-time graph for the antelope during the chase.

(ii) Calculate the distance covered by the antelope in the 17 s after the cheetah started to run.

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(iii) How far apart are the cheetah and the antelope after 17 s?

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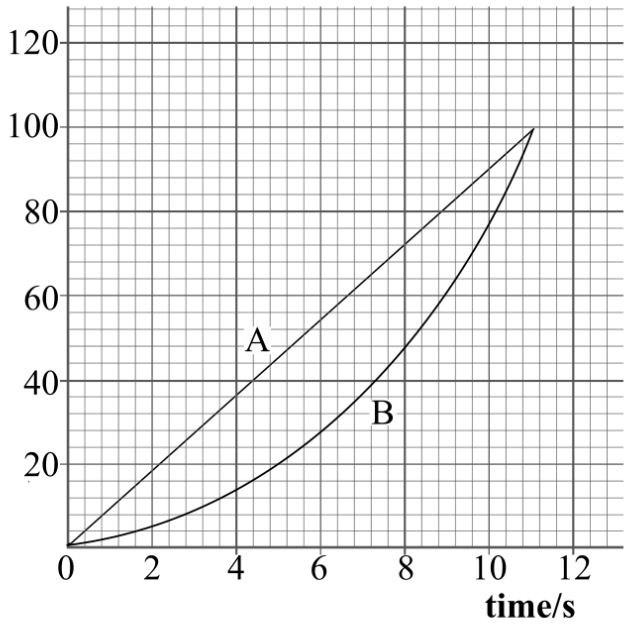
(6 marks)

1 The distance-time graphs for two runners, A and B, in a 100 m race are shown.



Q1 Jun 2007

(a) Explain how the graph shows that athlete B accelerates throughout the race.

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(1 mark)

(b) Estimate the maximum distance between the athletes.

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(1 mark)

(c) Calculate the speed of athlete A during the race.

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(1 mark)

(d) The acceleration of athlete B is uniform for the duration of the race.

(i) State what is meant by uniform acceleration.

.....

(ii) Calculate the acceleration of athlete B.

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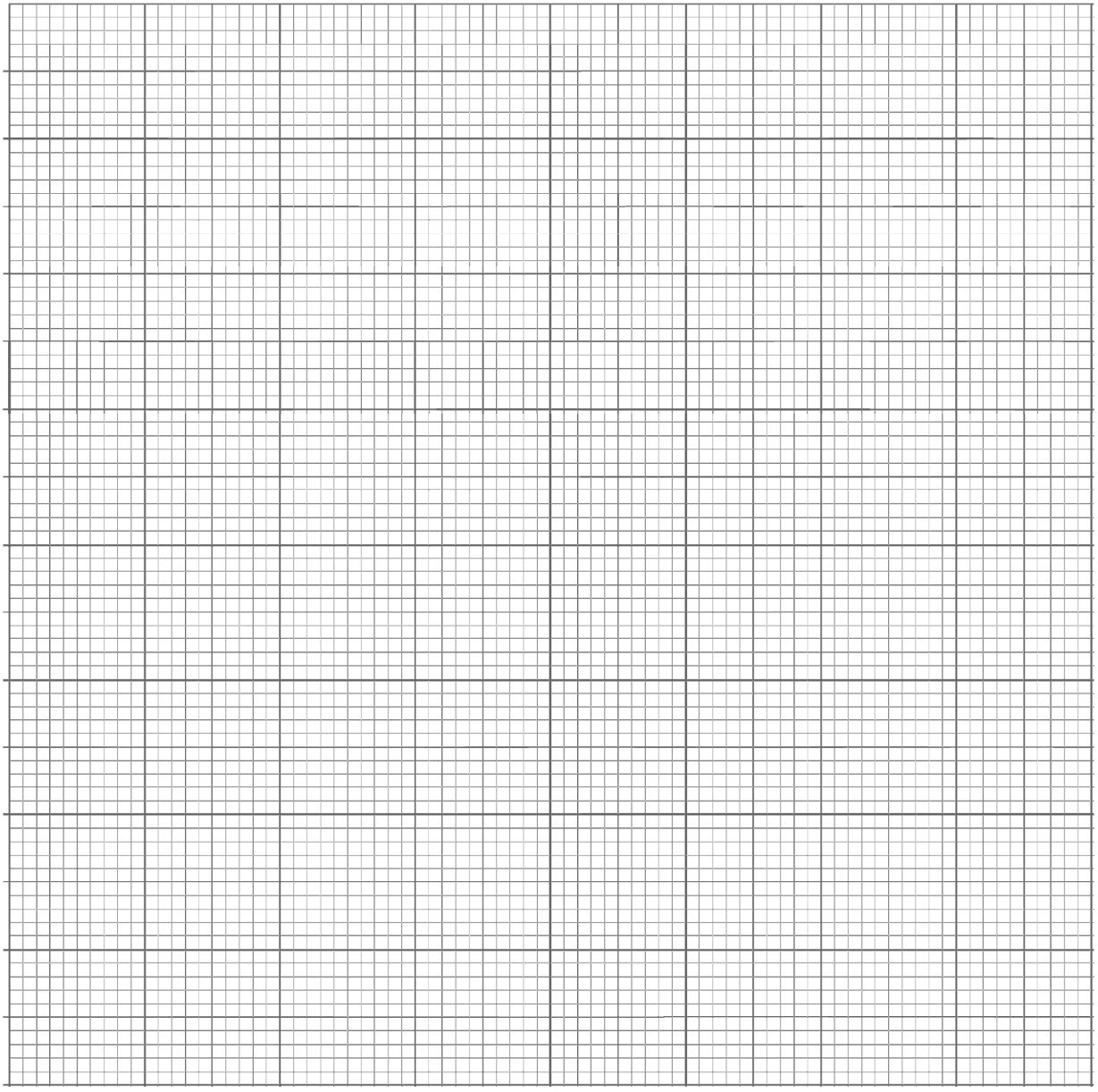
(3 marks)

Q1 Jan 2009

1 A car is travelling on a level road at a speed of $15.0\,m\,s^{-1}$ towards a set of traffic lights when the lights turn red. The driver applies the brakes 0.5 s after seeing the lights turn red and stops the car at the traffic lights. The table below shows how the speed of the car changes from when the traffic lights turn red.

time/s	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
speed/$m\,s^{-1}$	15.0	15.0	12.5	10.0	7.5	5.0	2.5	0.0

1 (a) Draw a graph of speed on the y-axis against time on the x-axis on the grid provided.



(5 marks)

1 (b) (i) State and explain what feature of the graph shows that the car's deceleration was uniform.

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(2 marks)

1 (b) (ii) Use your graph to calculate the distance the car travelled after the lights turned red to when it stopped.

Answer ..... m

(4 marks)