Constant Acceleration - Questions

June 2017 Mathematics Advanced Paper 1: Mechanics 1

1.

6. A cyclist is moving along a straight horizontal road and passes a point A. Five seconds later, at the instant when she is moving with speed 10 m s^{-1}, she passes the point B. She moves with constant acceleration from A to B.

Given that $AB = 40$ m, find

(a) the acceleration of the cyclist as she moves from A to B,

(4)

(b) the time it takes her to travel from A to the midpoint of AB.

(5)

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2.

7. A train travels along a straight horizontal track between two stations, A and B. The train starts from rest at A and moves with constant acceleration 0.5 m s^{-2} until it reaches a speed of V m s^{-1}, ($V < 50$). The train then travels at this constant speed before it moves with constant deceleration 0.25 m s^{-2} until it comes to rest at B.

(a) Sketch a speed-time graph for the motion of the train between the two stations A and B.

(2)

The total time for the journey from A to B is 5 minutes.

(b) Find, in terms of V, the length of time, in seconds, for which the train is

    (i)   accelerating,

    (ii)   decelerating,

    (iii) moving with constant speed.

(5)

Given that the distance between the two stations A and B is 6.3 km,

(c) find the value of V.

(6)

3.

4. A lorry is moving along a straight horizontal road with constant acceleration. The lorry passes a point A with speed u m s^{-1}, $(u < 34)$, and 10 seconds later passes a point B with speed 34 m s^{-1}. Given that $AB = 240$ m, find

(a) the value of u,

(3)

(b) the time taken for the lorry to move from A to the mid-point of AB.

(6)

4.

5. A car is travelling along a straight horizontal road. The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is 22 m s^{-1}. The car maintains this speed for T seconds. The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch a speed-time graph for the motion of the car between the two sets of traffic lights.

(2)

(b) Find the value of T.

(3)

A motorcycle leaves the first set of traffic lights 10 s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration, a m s^{-2}, and passes the car at the point A which is 990 m from the first set of traffic lights. When the motorcycle passes the car, the car is moving with speed 22 m s^{-1}.

(c) Find the time it takes for the motorcycle to move from the first set of traffic lights to the point A.

(4)

(d) Find the value of a.

(2)

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5.

4.   A car is moving on a straight horizontal road. At time $t = 0$, the car is moving with speed
20 m s^{-1} and is at the point A. The car maintains the speed of 20 m s^{-1} for 25 s. The car then
moves with constant deceleration 0.4 m s^{-2}, reducing its speed from 20 m s^{-1} to 8 m s^{-1}. The
car then moves with constant speed 8 m s^{-1} for 60 s. The car then moves with constant
acceleration until it is moving with speed 20 m s^{-1} at the point B.

(*a*) Sketch a speed-time graph to represent the motion of the car from A to B.

(3)

(*b*) Find the time for which the car is decelerating.

(2)

Given that the distance from A to B is 1960 m,

(*c*) find the time taken for the car to move from A to B.

(8)

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6.

2.   An athlete runs along a straight road. She starts from rest and moves with constant
acceleration for 5 seconds, reaching a speed of 8 m s^{-1}. This speed is then maintained for
T seconds. She then decelerates at a constant rate until she stops. She has run a total of 500 m
in 75 s.

(*a*) Sketch a speed-time graph to illustrate the motion of the athlete.

(3)

(*b*) Calculate the value of T.

(5)