AS/A Level Mathematics

Variable Acceleration

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
- Answer the questions in the spaces provided
  – there may be more space than you need.
- You should show sufficient working to make your methods clear.
  Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

1 The acceleration of a particle after t seconds is given by $(4t - 8)$ ms^{-2}.
Given the velocity (v) of the particle is 6 ms^{-1} when $t = 0$.

(a) Find v in terms of t. **(3)**

(b) Find the distance between the two points the particle is instantaneously at rest. **(7)**

(Total for question 1 is 10 marks)

2 The velocity of a particle after t seconds is given by $v = (6t - 2)$ m s^{-1}.
After 5 seconds the displacement is 75m from O.

(a) Find an expression for the displacement. **(3)**

(b) Find the displacement after 10 seconds. **(2)**

(Total for question 2 is 5 marks)

3 A particle P moves in a straight line so that, at time t seconds, its acceleration a m s^{-2} is given by

$$a = \begin{cases} 4t - t^2 & 0 \leqslant t \leqslant 3 \\ \dfrac{27}{t^2} & t > 3 \end{cases}$$

At $t = 0$, P is at rest. Find the speed of P when

(a) $t = 3$ **(3)**

(b) $t = 6$ **(5)**

(Total for question 3 is 8 marks)

4 A particle P moves in a straight line so that, at time t seconds, its velocity v m s^{-1} is given by

$$v = \begin{cases} 7t - t^2 & 0 \leqslant t \leqslant 5 \\ 10 - 2t & t > 5 \end{cases}$$

(a) Find the acceleration of P when t = 4 **(3)**

(b) Find the total distance traveled by P in the first 10 seconds. **(7)**

(Total for question 4 is 10 marks)

5 The velocity of a particle after t seconds is given by $v = (6t - 2t^2)$ m s^{-1}.

Find the time at which the acceleration of the particle is zero.

(Total for question 5 is 3 marks)

6 A particle P moves on the x axis. The acceleration of P at time t seconds is $(6t - 24)$ m s^{-2} measured in the positive x direction. Initially the particle is at O with a velocity of 60 m s^{-1}.

(a) Show that the particle will never travel in the negative x direction. **(3)**

(b) Find the distance travelled by the particle in the first 10 seconds. **(3)**

(Total for question 6 is 6 marks)

7 A particle P moves in a straight line such that at t seconds, $t \geq 0$, its velocity, v ms^{-1} is given by:

$$v = 12 - 2t^2$$

Find:

(a) the distance travelled by P in the first second, **(3)**

(b) the value of t when P changes direction of motion, **(2)**

(c) the value of t at the instant P returns to its starting point. **(3)**

(Total for question 7 is 8 marks)

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8 A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = t^3 - 15t^2 + 62t$

Find

(a) the initial velocity of P, **(3)**

(b) the value of t for which P has zero acceleration. **(2)**

(Total for question 8 is 5 marks)

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9 A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = 2t^3 - 18t^2 + 48t$

Find

(a) the times when P is instantaneously at rest, **(3)**

(b) the total distance travelled in the first 5 seconds. **(5)**

(Total for question 9 is 8 marks)

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10 A particle P moves on the x axis.
The acceleration of P at time t seconds, $t \geq 0$, is $(3t + 5)$ m s^{-2} in the positive x direction.
When $t = 0$, the velocity of P is 2 m s^{-1} in the positive x direction.
When $t = T$, the velocity of P is 6 m s^{-1} in the positive x direction.
Find the value of T.

(Total for question 10 is 6 marks)

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11 The displacement of a particle P from the origin after t seconds is given by s = $t^2(t + k)$ m
Given P is at instantaneous rest when $t = 4$.

Find the acceleration of P when $t = 10$.

(Total for question 11 is 8 marks)

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12 The velocity of a particle after t seconds is given by $v = (6t - 2t^2)$ m s^{-1}.
When $t = 0$ the particle is at the origin O.

Find an the distance of the particle from O when the particle comes to instantaneous rest.

(Total for question 12 is 5 marks)