Topic assessment

1. A particle moves on the x-axis. Its displacement, x m, from the origin O is given by

$$x = 3t^2 - 3t + 2$$, where t is the time in seconds.

How far is the particle from O when it is instantaneously at rest? [5]

2. A racing car starts off down a straight section of track towards the first corner. Its speed, v ms^{-1}, is modelled for the first four seconds of its motion by

$$v = t^3 - 9t^2 + 24t, \qquad 0 \le t \le 4.$$

(i) Find an expression for the distance travelled by the car in the first t seconds.

Calculate the distance travelled from $t = 2$ to $t = 4$. [5]

(ii) Show that the acceleration, a ms^{-2}, of the car at time t is given by $a = k(t-2)(t-4)$, where k is a constant to be determined. [2]

3. The velocity, v, of a particle is given as

$$v = 2t^2 - 3t - \tfrac{1}{3}t^3.$$

(i) Show that the acceleration of the particle is zero when $t = 1$ and when $t = 3$. [3]

(ii) Calculate the displacement of the particle from its position when $t = 1$ to its position when $t = 2$. [4]

4. A car starts from rest and travels along a straight road. Its speed, v ms^{-1}, at time t seconds is modelled by

$$v = 4t - 0.2t^2, \qquad 0 \le t \le 10,$$
$$v = \text{constant}, \qquad 10 \le t \le 15,$$
$$v = 8 + 0.8t, \qquad t \ge 15.$$

(i) Calculate the speed of the car at $t = 0$, $t = 10$, $t = 15$ and $t = 20$. [3]

(ii) Find the values of the acceleration at
(A) $t = 7$,
(B) $t = 12$,
(C) $t = 16$. [4]

(iii) Calculate the distance the car travels in the interval $10 \le t \le 20$. [5]

(iv) Calculate the distance the car travels in the interval $0 \le t \le 10$. [4]

Edexcel AS Maths Variable acceleration Assessment

5. An insect moves in a straight line. The time, t, is in seconds and distance travelled is in metres.

   The velocity, v ms^{-1}, of the insect is given by

$$\begin{aligned} v &= t^2 - 4t, & 0 \le t \le 6, \\ v &= c, & 6 \le t \le 10, \\ v &= at + b, & 10 \le t \le 15. \end{aligned}$$

   You are also given that $v = 4$ when $t = 12$.

   (i) Show that $c = 12$. [2]

   (ii) Calculate the values of a and b and briefly describe the motion of the insect in the interval $10 \le t \le 15$. [4]

   (iii) Calculate the values of v for $t = 0$, $t = 2$ and $t = 4$. Sketch the v-t curve for the motion of the insect in the interval $0 \le t \le 6$. [3]

   (iv) Calculate the **distance** travelled by the insect in the interval $0 \le t \le 6$. [6]

Total 50 marks