DYNAMICS WITH CALCULUS : 2

1. A vehicle, moving along a straight horizontal road, has velocity v ms^{-1} at time t seconds modelled by

$$v = \frac{1}{60}t(60-t), \qquad\qquad 0 \leqslant t \leqslant 60.$$

    (a)   Write down the times at which the vehicle is stationary.   [1]

    (b)   Calculate the distance travelled by the vehicle between $t = 0$ and $t = 60$.   [5]

    (c)   (i)   Find, in terms of t, an expression for the acceleration of the vehicle at time t seconds.

          (ii)   Find the greatest speed of the vehicle.   [4]

2. A vehicle travels in a straight line so that its velocity v ms^{-1} at time t s is given by

$$v = \frac{1}{20}\left(3t^2 + 4t + 5\right), \qquad 0 \leqslant t \leqslant 20.$$

    (a)   Find the time when the acceleration of the vehicle is 5 ms^{-2}.   [4]

    (b)   Determine the distance travelled by the vehicle from $t = 0$ to $t = 20$.   [4]

3. A particle moves along a horizontal straight line. At time t s, the velocity of the particle is v ms^{-1}, where

$$v = \frac{t^2 - 4}{3t}, \qquad\qquad t > 0.$$

    (a)   Find the value of t when the particle is at rest.   [2]

    (b)   Calculate the distance travelled by the particle between $t = 2$ and $t = 5$. Give your answer correct to three significant figures.   [7]

4. A particle of mass 4 kg moves along the x-axis, starting, when $t = 0$, from the point where $x = 3$. At time t s, its velocity v ms^{-1} is given by

$$v = 12t^2 - 7kt + 1,$$

where k is constant.
When $t = 2$, the displacement of the particle from the origin is 16 m.

    (a)   Determine the value of k.   [5]

    (b)   Calculate the magnitude of the force acting on the particle when $t = 5$.   [4]