Kinematics 2

1) A particle travels in a straight line so that, t s after passing through a fixed point O, its speed, v ms^{-1}, is given by $v = 8\cos\left(\dfrac{t}{2}\right)$.

   (i) Find the acceleration of the particle when $t = 1$. [3]

   The particle first comes to instantaneous rest at the point P.

   (ii) Find the distance OP. [4]

2) A particle starts from rest at a fixed point O and moves in a straight line towards a point A. The velocity, v ms^{-1}, of the particle, t seconds after leaving O, is given by $v = 6 - 6e^{-3t}$. Given that the particle reaches A when $t = \ln 2$, find

   (i) the acceleration of the particle at A, [3]

   (ii) the distance OA. [4]

3) A particle moves in a straight line such that its displacement, s m, from a fixed point O at a time t s, is given by

$$s = \ln(t + 1) \quad \text{for} \quad 0 \leqslant t \leqslant 3,$$

$$s = \tfrac{1}{2}\ln (t - 2) - \ln(t + 1) + \ln 16 \quad \text{for } t > 3.$$

   Find

   (i) the initial velocity of the particle, [2]

   (ii) the velocity of the particle when $t = 4$, [2]

   (iii) the acceleration of the particle when $t = 4$, [2]

   (iv) the value of t when the particle is instantaneously at rest, [2]

   (v) the distance travelled by the particle in the 4th second. [2]

4) A particle, moving in a straight line, passes through a fixed point O with velocity 14 ms^{-1}. The acceleration, a ms^{-2}, of the particle, t seconds after passing through O, is given by $a = 2t - 9$. The particle subsequently comes to instantaneous rest, firstly at A and later at B. Find

   (i) the acceleration of the particle at A and at B, [4]

   (ii) the greatest speed of the particle as it travels from A to B, [2]

   (iii) the distance AB. [4]

5) A particle moves in a straight line, so that, t s after leaving a fixed point O, its velocity, v m s^{-1}, is given by
$$v = pt^2 + qt + 4,$$

   where p and q are constants. When $t = 1$ the acceleration of the particle is 8 m s^{-2}. When $t = 2$ the displacement of the particle from O is 22 m. Find the value of p and of q. [7]