Kinematics 1

1) A particle travels in a straight line so that, t s after passing through a fixed point O, its displacement s m from O is given by $s = \ln(t^2 + 1)$.

(i) Find the value of t when $s = 5$. [2]

(ii) Find the distance travelled by the particle during the third second. [2]

(iii) Show that, when $t = 2$, the velocity of the particle is $0.8\,\text{ms}^{-1}$. [2]

(iv) Find the acceleration of the particle when $t = 2$. [3]

2) A particle moves in a straight line so that, at time t s after passing a fixed point O, its velocity is $v\,\text{ms}^{-1}$, where

$$v = 6t + 4\cos 2t.$$

Find

(i) the velocity of the particle at the instant it passes O, [1]

(ii) the acceleration of the particle when $t = 5$, [4]

(iii) the greatest value of the acceleration, [1]

(iv) the distance travelled in the fifth second. [4]

3) A particle moves in a straight line so that, t seconds after passing through a fixed point O, its velocity, $v\,\text{ms}^{-1}$, is given by $v = \dfrac{20}{(2t + 4)^2}$. Find

(i) the velocity of the particle at O, [1]

(ii) the acceleration of the particle when $t = 3$, [3]

(iii) the distance travelled by the particle in the first 8 seconds. [4]

4) A particle moves in a straight line such that its displacement, x m, from a fixed point O on the line at time t seconds is given by $x = 12\{\ln(2t + 3)\}$. Find

(i) the value of t when the displacement of the particle from O is 48 m, [3]

(ii) the velocity of the particle when $t = 1$, [3]

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

5) A particle moves in a straight line such that t s after passing through a fixed point O, its velocity, v m s^{-1}, is given by $v = k \cos 4t$, where k is a positive constant. Find

(i) the value of t when the particle is first instantaneously at rest, [1]

(ii) an expression for the acceleration of the particle t s after passing through O. [2]

Given that the acceleration of the particle is 12 m s^{-2} when $t = \frac{3\pi}{8}$,

(iii) find the value of k. [2]

Using your value for k,

(iv) sketch the velocity-time curve for the particle for $0 \leqslant t \leqslant \pi$, [2]

(v) find the displacement of the particle from O when $t = \frac{\pi}{24}$. [4]

6) A particle moves in a straight line so that t seconds after passing a fixed point O its acceleration, a ms^{-2}, is given by $a = 4t - 12$. Given that its speed at O is 16 ms^{-1}, find

(i) the values of t at which the particle is stationary, [5]

(ii) the distance the particle travels in the fifth second. [5]