DIFFERENTIATION – APPLICATIONS TO MECHANICS

1) A particle moves in a straight line such that its displacement, s meters, from a fixed point O, at time t seconds is given by $s = t^2 + 4t + 3$. Find the velocity of the particle when $t = 3$.

2) A particle moves in a straight line such that its displacement, s metres, from a fixed point O, at time t seconds is given by $s = 3t^2 + 2t + 1$. Find the velocity of the particle when $t = 2$.

3) The displacement of a particle is given by $s = t^3 - 6t^2 + 9t$. Work out the acceleration of the particle after 4 seconds.

4) The displacement of a particle is given by $s = 2t^3 - 9t^2 + 12t$. Work out the acceleration of the particle when $t = 1$.

5) A particle's velocity is given by $v = 10t - 2t^2$. Work out the acceleration of the particle when $t = 3$.

6) A car's position is given by the formula $s = 5t^2 - 20t$. At what time is the car instantaneously at rest?

7) A car's displacement is given by $s = 4t^2 - 24t + 5$. At what time is the car instantaneously at rest?

8) A particle's velocity is given by $v = 12t - 3t^2$. Find the acceleration of the particle when $t = 1$.

9) A particle moves in a straight line, such that its displacement, s metres, from a fixed point O, at time t seconds, is given by $s = t^3 - 4t + 5$. Work out the displacement of the particle when the velocity is 8 m/s.

10) A particle moves such that its displacement is given by $s = t^2 - 16t + 2$. Find the time when the velocity of the particle is 6 m/s.

11) The displacement of a particle, at time t seconds is given by the equation $s = 5t^2 - 4t + 7$. Work out the velocity of the particle when $t = 4$.

12) A particle's velocity is given by $v = 6t^2 - 12t$. Work out the time(s) when the particle is at rest.

13) A particle has velocity $v = kt^2 - 4t$. If the acceleration of the particle is $8\ m/s^2$ when $t = 2$, find the value of k.

14) An object has displacement $s = t^3 + at^2 + bt$. Initially, its velocity is $15\ m/s$ and its acceleration is $-10\ m/s^2$. Work out the values of a and b.

Challenge

15) A projectile follows the path $s = 40t - 5t^2$. Find the maximum height reached.

16) A point moves such that $s = t^3 - 9t^2 + 24t$. Find the time interval when the particle is moving in the negative direction.

17) Two particles P and Q have displacements $s_P = t^2 + 2t$ and $s_Q = t^3 - 4t + 10$. At what time do the particles have the same velocity?