1 Kinematics

1. It takes 12 minutes to fill an oil tank. The volume of oil V litres, after time t minutes, is given by
$$V = 24t - t^2, \qquad 0 \leq t \leq 12.$$

   (i) Find the instantaneous rate of change of volume when $t = 10$.

   (ii) Find the volume of oil in the tank when the instantaneous rate of change of volume is 23 litres/minute.

   (iii) Find the instantaneous rate of change of volume when the volume of oil in the tank is 44 litres.

2. The displacement s (metres) of an object at time t (seconds) is given by $s = -t^3 + 3t^2 + 6t$, for $t \geq 0$. Find

   (i) the velocity and acceleration

   (ii) the velocity after 2 seconds

   (iii) the acceleration after 7 seconds

   (iv) the velocity when the acceleration is 0

   (v) the acceleration when the velocity is -3 (metres/second).

3. It takes 10 minutes to fill a water tank. The volume of water V litres, after time t minutes, is given by
$$V = 20t - t^2, \qquad 0 \leq t \leq 10.$$

   (i) Find the instantaneous rate of change of volume when $t = 9$.

   (ii) Find the volume of water in the tank when the instantaneous rate of change of volume is 14 litres/minute.

   (iii) Find the instantaneous rate of change of volume when the volume of water in the tank is 84 litres.

4. The displacement s (metres) of an object at time t (seconds) is given by $s = -2t^3 + 6t^2 + 18t$, for $t \geq 0$. Find

   (i) the velocity and acceleration

   (ii) the velocity after 2 seconds

(iii) the acceleration after 3 seconds

(iv) the velocity when the acceleration is 0

(v) the acceleration when the velocity is -30 (metres/second).