$\frac{d}{dt}$ (Displacement
↓ Velocity) $\int dt$
$\frac{d}{dt}$ (↓ Acceleration) $\int dt$

Ex 11A

1. $s = 9t - t^3$

a) when $t = 1$, $s = 9 - 1 = 8$ metres

b) when $s = 0$, $t^3 - 9t = 0$
$$t(t^2 - 9) = 0$$
$$t = 0, \pm 3$$

2. $s = 5t^2 - t^3$

a) Δs from $t = 2$ to $t = 4$ $t = 2 : s = 20 - 8 = 12$ $t = 4 : 80 - 64 = 16$

∴ $\Delta s = 16 - 12 = 4$ m

b) Δs in the 3rd second $= \Delta s$ from $t = 2$ to $t = 3$

$t = 2 : s = 12$ $t = 3 : s = 45 - 27 = 18$ ∴ $\Delta s = 18 - 12 = 6$ m

3. $v = 3 + 5t - t^2$, $t \geq 0$

a) when $t = 1$, $v = 3 + 5 - 1 = 7$ ms^{-1}

b) $\frac{dv}{dt} = 5 - 2t = 0$
$$t = \frac{5}{2} \text{ secs}$$
when $t = \frac{5}{2}$, $v = 3 + \frac{25}{2} - \frac{25}{4} = \frac{37}{4} = 9.25$ ms^{-1}

c) when $t = 7$, $v = 3 + 35 - 49 = -11$ ms^{-1}

Particle is travelling in reverse (back towards origin)

4. $s = \frac{1}{5}(4t-t^2)$ metres away from point P (when $t=0$, $s=0$)

a) $\frac{ds}{dt} = \frac{d}{dt}\left(\frac{4}{5}t - \frac{1}{5}t^2\right) = \frac{4}{5} - \frac{2}{5}t = 0$ when $t=2$, $s = \frac{1}{5}(8-4) = \frac{4}{5}$ metres
$$t=2$$

b) $s=0$, $\frac{4}{5}t - \frac{1}{5}t^2 = 0$
$$\frac{1}{5}t(4-t) = 0$$
$$t = 0, 4 \quad \therefore \quad 4 \text{ seconds}$$

c) total distance $= \frac{4}{5} \times 2 = \frac{8}{5}$ metres.

d) $0 \le t \le 4$

5. $v = 3t^2 - 10t + 8$, $t \ge 0$

a) initial velocity is when $t=0$: $v = 0-0+8 = 8 \text{ ms}^{-1}$

b) $v=0$, $3t^2 - 10t + 8 = 0$ $\begin{pmatrix} 3t - 4 \\ t - 2 \end{pmatrix}$
$$(3t-4)(t-2) = 0$$
$$t = \frac{4}{3} \text{ or } 2 \text{ seconds}$$

c)