

$$1a) \quad a = 4t - 8$$

$$v = \frac{4t^2}{2} - 8t + C$$

$$v = 2t^2 - 8t + C$$

$$v = 6 \text{ when } t = 0$$

$$6 = C$$

$$\therefore v = \underline{\underline{2t^2 - 8t + 6}}$$

b) Instantaneously at rest when $v = 0$

$$0 = 2t^2 - 8t + 6$$

$$0 = t^2 - 4t + 3$$

$$0 = (t - 3)(t - 1)$$

$$t = 3 \quad t = 1$$

$$s = \frac{2t^3}{3} - \frac{8t^2}{2} + 6t + C$$

$$= \frac{2}{3}t^3 - 4t^2 + 6t + C$$

$$\text{when } t = 1 \quad s = \frac{2}{3}(1)^3 - 4(1)^2 + 6(1) + C$$

$$s = \frac{8}{3} + C$$

$$\text{when } t = 3 \quad s = 0 + C$$

$$\text{distance between points} = \left(\frac{8}{3} + C\right) - (0 + C)$$

$$= \underline{\underline{\frac{8}{3} \text{ m}}}$$

2a)

$$v = 6t - 2$$

$$s = \frac{6t^2}{2} - 2t + C$$

$$s = 3t^2 - 2t + C \quad \text{when } t=5 \quad s=75$$

$$75 = 3(5)^2 - 2(5) + C$$

$$C = 10$$

$$\underline{\underline{s = 3t^2 - 2t + 10}}$$

b/

$$s = 3(10)^2 - 2(10) + 10$$

$$= \underline{\underline{290 \text{ m}}}$$

3a)

$$a = 4t - t^2$$

$$v = \frac{4t^2}{2} - \frac{t^3}{3} + C$$

$$v = 2t^2 - \frac{1}{3}t^3 + C \quad \text{when } t=0 \quad v=0$$

$$C = 0$$

$$v = 2t^2 - \frac{1}{3}t^3$$

when $t=3$

$$v = 2(3)^2 - \frac{1}{3}(3)^3$$

$$= \underline{\underline{9 \text{ ms}^{-1}}}$$

b/

$$a = 27t^{-2}$$

$$v = \frac{27t^{-1}}{-1} + C$$

$$v = -27t^{-1} + C \quad \text{when } t=3 \quad v=9$$

$$9 = -27(3)^{-1} + C$$

$$9 = -9 + C$$

$$C = 18$$

$$v = -27t^{-1} + 18$$

$$v = -27(6)^{-1} + 18$$

$$= \underline{\underline{13.5 \text{ ms}^{-1}}}$$

4a

$$v = 7t - t^2$$

$$a = 7 - 2t$$

when $t = 4$

$$\begin{aligned} a &= 7 - 2(4) \\ &= \underline{\underline{-1 \text{ ms}^{-2}}} \end{aligned}$$

b/

$$v = 7t - t^2$$

$$s = \frac{7t^2}{2} - \frac{t^3}{3} + c$$

when $t = 0$ $s = 0$

$$s = \frac{7}{2}t^2 - \frac{t^3}{3}$$

when $t = 5$

$$s = \frac{7}{2}(5)^2 - \frac{(5)^3}{3}$$

$$= \frac{275}{6} \text{ m} \quad (\text{In the first 5 seconds})$$

$$v = 10 - 2t$$

$$s = 10t - t^2 + c$$

when $t = 5$ $s = 0$

$$0 = 10(5) - (5)^2 + c$$

$$0 = 25 + c$$

$$c = -25$$

$$s = 10t - t^2 - 25$$

$$s = 10(10) - (10)^2 - 25$$

$$= -25$$

25 m travelled between 5 and 10 seconds

$$\text{Total distance} = \frac{275}{6} + 25$$

$$= \underline{\underline{\frac{425}{6} \text{ m}}}$$

5

$$v = 6t - 2t^2$$

$$a = 6 - 4t$$

$$0 = 6 - 4t$$

$$4t = 6$$

$$\underline{\underline{t = 1.5 \text{ s}}}$$

6a)

$$a = 6t - 24$$

$$v = \frac{6t^2}{2} - 24t + c$$

$$v = 3t^2 - 24t + c \quad t=0 \quad v=60$$

$$60 = 3(0)^2 - 24(0) + c$$

$$c = 60$$

$$v = 3t^2 - 24t + 60$$

$$v = 3(t^2 - 8t + 20)$$

$$= 3((t-4)^2 - 16 + 20)$$

$$= 3((t-4)^2 + 4)$$

$$= 3(t-4)^2 + 12$$

min $v = 12 \text{ ms}^{-1}$ when $t=4$.

as min = 12 v cannot be negative.

b/

$$s = \frac{3t^3}{3} - \frac{24t^2}{2} + 60t + c$$

$$s = t^3 - 12t^2 + 60t + c$$

$$s=0 \quad t=0$$

$$s = t^3 - 12t^2 + 60t$$

$$s = (10)^3 - 12(10)^2 + 60(10)$$

$$= \underline{\underline{400 \text{ m}}}$$

7a

$$v = 12 - 2t^2$$

$$s = 12t - \frac{2t^3}{3} + c$$

$$s=0 \quad t=0$$

$$s = 12t - \frac{2}{3}t^3$$

$$s = 12(1) - \frac{2}{3}(1)^3$$

$$= \underline{\underline{\frac{34}{3} \text{ m}}}$$

b/ changes motion when $v=0$

$$0 = 12 - 2t^2$$

$$2t^2 = 12$$

$$t^2 = 6$$

$$t = \underline{\underline{\sqrt{6} \text{ s}}}$$

c/ returns to starting point when $s=0$

$$0 = 12t - \frac{2}{3}t^3$$

$$0 = t\left(12 - \frac{2}{3}t^2\right)$$

$$t=0 \quad \text{or} \quad 12 - \frac{2}{3}t^2 = 0$$

$$12 = \frac{2}{3}t^2$$

$$18 = t^2$$

$$t = \sqrt{18}$$

$$= \underline{\underline{3\sqrt{2} \text{ s}}}$$

8

$$x = t^3 - 15t^2 + 62t$$

$$v = 3t^2 - 30t + 62$$

$$\begin{aligned} \text{initial } v &= 3(0)^2 - 3(0) + 62 \\ &= \underline{\underline{62 \text{ ms}^{-1}}} \end{aligned}$$

b/

$$a = 6t - 30$$

$$0 = 6t - 30$$

$$30 = 6t$$

$$\underline{\underline{t = 5 \text{ s}}}$$

9a/

$$x = 2t^3 - 18t^2 + 48t$$

$$v = 6t^2 - 36t + 48$$

$$6t^2 - 36t + 48 = 0$$

$$t^2 - 6t + 8 = 0$$

$$(t - 2)(t - 4) = 0$$

$$\underline{\underline{t = 2}} \quad \underline{\underline{t = 4}}$$

$$t = 0 \quad s = 0$$

$$\begin{aligned} t = 2 \quad s &= 2(2)^3 - 18(2)^2 + 48(2) \\ &= 40 \end{aligned}$$

$$\begin{aligned} t = 4 \quad s &= 2(4)^3 - 18(4)^2 + 48(4) \\ &= 32 \end{aligned}$$

$$\begin{aligned} t = 5 \quad s &= 2(5)^3 - 18(5)^2 + 48(5) \\ &= 40 \end{aligned}$$

$$\begin{aligned} \text{Total Distance} &= 40 + 8 + 8 \\ &= \underline{\underline{56 \text{ m}}} \end{aligned}$$

10

$$a = 3t + 5$$

$$v = \frac{3t^2}{2} + 5t + c$$

$$t=0 \quad v=2$$

$$2 = c$$

$$v = \frac{3}{2}t^2 + 5t + 2$$

$$t=T \quad v=6$$

$$6 = \frac{3}{2}T^2 + 5T + 2$$

$$0 = \frac{3}{2}T^2 + 5T - 4$$

$$0 = 3T^2 + 10T - 8$$

$$0 = (3T - 2)(T + 4)$$

$$\underline{\underline{T = \frac{2}{3}}} \quad T = -4$$

$$t \geq 0 \quad \therefore \underline{\underline{T = \frac{2}{3}}}$$

11

$$s = t^2(t + k)$$

$$s = t^3 + kt^2$$

$$v = 3t^2 + 2kt$$

$$v = 0 \quad t = 4$$

$$0 = 3(4)^2 + 2(4)k$$

$$0 = 48 + 8k$$

$$k = -6$$

~~$$a = 6t$$~~

$$v = 3t^2 - 12t$$

$$a = 6t - 12$$

$$a = 6(10) - 12$$

$$= \underline{\underline{48 \text{ ms}^{-2}}}$$

12

$$v = 6t - 2t^2$$

$$0 = 6t - 2t^2$$

$$0 = 2t(3 - t)$$

$$t = 0 \quad \underline{\underline{t = 3}}$$

$$s = \frac{6t^2}{2} - \frac{2t^3}{3} + c$$

$$s = 0 \quad t = 0$$

$$s = 3t^2 - \frac{2}{3}t^3$$

$$s = 3(3)^2 - \frac{2}{3}(3)^3$$

$$= \underline{\underline{9 \text{ m}}}$$