1a) $v = (9t^2 - 1)i + (4t + 2)j \quad ms^{-1}$

b) $a = (18t)i + 4j \quad ms^{-2}$

2a) $r = ((2)^2 + 5(2) - 2)i + ((2)^3 + 2(2)^2)j \quad m$

$= 12i + 16j \quad m$

b) $v = (2t + 5)i + (3t^2 + 4t)j \quad ms^{-1}$

when $t = 3$

$v = (2(3) + 5)i + (3(3)^2 + 4(3))j \quad ms^{-1}$

$= 11i + 39j \quad ms^{-1}$

3a) $v = 6t\,i + (4t + 12)j$

Bearing of $045°$ is in the direction $(i + j)$

$6t\,i + (4t + 12)j = k(i + j)$

i// $6t = k$ j// $4t + 12 = k$

$6t = 4t + 12$

$2t = 12$

$t = 6$

b) $a = 6i + 4j$

$= \sqrt{6^2 + 4^2}$

$= 2\sqrt{13} \quad ms^{-2}$

4a

$$a = (3t^2 - 4)i + (2t^2 + 4t)j$$

$$v = \left(\frac{3t^3}{3} - 4t + c\right)i + \left(\frac{2}{3}t^3 + \frac{4t^2}{2} + D\right)j$$

$$= \left(t^3 - 4t + c\right)i + \left(\frac{2}{3}t^3 + 2t^2 + D\right)j$$

when $t = 3$, $v = 10i + 20j$

$$\cancel{t} \quad (3)^3 - 4(3) + c = 10$$

$$15 + c = 10$$

$$c = -5$$

$$\frac{2}{3}(3)^3 + 2(3)^2 + D = 20$$

$$36 + D = 20$$

$$D = -16$$

$$\underline{v = \left(t^3 - 4t - 5\right)i + \left(\frac{2}{3}t^3 + 2t^2 - 16\right)j} \quad ms^{-1}$$

b/

$$r = \left(\frac{t^4}{4} - \frac{4t^2}{2} - 5t + c\right)i + \left(\frac{2}{12}t^4 + \frac{2t^3}{3} - 16t + D\right)j \quad m$$

$$= \left(\frac{t^4}{4} - 2t^2 - 5t + c\right)i + \left(\frac{1}{6}t^4 + \frac{2}{3}t^3 - 16t + D\right)j$$

when $t = 0$, $r = 2i - 5j$

$$c = 2 \qquad\qquad D = -5$$

$$r = \left(\frac{t^4}{4} - 2t^2 - 5t + 2\right)i + \left(\frac{1}{6}t^4 + \frac{2}{3}t^3 - 16t - 5\right)j \quad m$$

5a)
$$a = (3t - 3)i + (2t - 4)j \quad ms^{-2}$$

$$v = \left(\frac{3}{2}t^2 - 3t + c\right)i + (t^2 - 4t + D)j \quad ms^{-1}$$

when $t = 0$, $v = -4i + 4j$ $\quad \therefore c = -4 \quad D = 4$

$$v = \left(\frac{3}{2}t^2 - 3t - 4\right)i + (t^2 - 4t + 4)j \quad ms^{-1}$$

b) $\left(\frac{3}{2}t^2 - 3t - 4\right)i + (t^2 - 4t + 4)j = k(2i + j)$

i) $\frac{3}{2}t^2 - 3t - 4 = 2k$ $\qquad$ j) $t^2 - 4t + 4 = k$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad 2t^2 - 8t + 8 = 2k$

$$\frac{3}{2}t^2 - 3t - 4 = 2t^2 - 8t + 8$$

$$0 = \frac{1}{2}t^2 - 5t + 12$$

$$0 = t^2 - 10t + 24$$

$$0 = (t - 4)(t - 6)$$

$$t = 4 \qquad t = 6$$

when $t = 4$, $v = \left(\frac{3}{2}(4)^2 - 3(4) - 4\right)i + ((4)^2 - 4(4) + 4)j$

$$= \underline{8i + 4j} \quad ms^{-1}$$

when $t = 6$, $v = \left(\frac{3}{2}(6)^2 - 3(6) - 4\right) + ((6)^2 - 4(6) + 4)j$

$$= \underline{32i + 16j} \quad ms^{-1}$$