1)

$t(s)$	$x(m)$	$v\ (ms^{-1})$	a (constant) (ms^{-2})
0	0	3	1.9
14	x_2	v_2	1.9
t_3	159	v_3	1.9

$$x_2 = ut + \frac{1}{2}at^2$$

$$= 3(14) + \frac{1}{2}(1.9)(14)^2$$

$$= 228.2\ m$$

$$v_2 = u + at$$

$$= 3 + 1.9(14)$$

$$= 29.6\ ms^{-1}$$

$$159 = ut + \frac{1}{2}at_3^2$$

$$159 = 3t_3 + \frac{1}{2}(1.9)t_3^2$$

$$0.95t_3^2 + 3t_3 - 159 = 0$$

$$t_3 = 11.454144975$$

$$v_3 = u + at$$

$$= 3 + 1.9(11.45414497)$$

$$= 24.762875544\ ms^{-1}$$

2) $a = A\cos(\omega t)$

$$v = \int a\,dt = \int A\cos(\omega t) = \frac{A\sin(\omega t)}{\omega} + c \quad , c = -36$$

A (constant)	w (constant)	t (s)	v (ms^{-1})	a (ms^{-2})
1	28	0	-36	1
1	28	13	v_2	a_2

$$v_2 = \frac{A\sin(\omega t)}{\omega} - 36$$

$$= \frac{\sin(28 \times 13)}{28} - 36$$

$$= -36.014717754\ ms^{-1}$$

$$a_2 = A\cos(\omega t)$$

$$= 0.911142684545\ ms^{-2}$$

3) $a = A + Bx$

$$a = v\frac{dv}{dx}$$

$$\int a\,dx = \int v\,dv$$

$$Ax + \frac{Bx^2}{2} = \frac{v^2}{2}$$

$$v = \sqrt{2Ax + Bx^2 + C}, \quad c = -22$$

A (constant)	B (constant)	x (m)	v (ms^{-1})	a (ms^{-2})
8	3	0	-22	8
8	3	7	v_2	a_2

$$v_2 = \sqrt{2Ax + Bx^2 - 22}$$

$$= \sqrt{2(8)(7) + 3(7)^2 - 22}$$

$$= -5.906523061\,ms^{-1}$$

$$a_2 = A + Bx$$

$$= 8 + 3(7)$$

$$= 29\,ms^{-2}$$

4) $x = At^2$, $y = Bt^3$

A	B	t(s)	x(m)	y(m)	$\dot{x}(ms^{-1})$	$\dot{y}(ms^{-1})$	$\ddot{x}(ms^{-2})$	$\ddot{y}(ms^{-2})$
1.2	0.03	0	x_1	y_1	$\dot{x}_1$	$\dot{y}_1$	$\ddot{x}_1$	$\ddot{y}_1$
1.2	0.03	22	x_2	y_2	$\dot{x}_1$	$\dot{y}_1$	$\ddot{x}_2$	$\ddot{y}_2$

$v(ms^{-1})$	$a(ms^{-2})$
v_1	a_1
v_2	a_2

$x = At^2$ $\quad y = Bt^3$

$\dot{x} = 2At$ $\quad \dot{y} = 3Bt^2$

$\ddot{x} = 2A$ $\quad \ddot{y} = 6Bt$

when $t = 0$,

$x = A(0)^2$, $\quad y = B(0)^3$, $\quad \dot{x}_1 = 2A(0)$, $\quad \dot{y} = 3B(0)^2$

$= 0$ $\quad = 0$ $\quad = 0$ $\quad = 0$

$\ddot{x} = 2A$, $\quad \ddot{y} = 6B(0)$, $\quad v_1 = \sqrt{\dot{x}_1^2 + \dot{y}_1^2}$,

$= 2.4 ms^{-2}$ $\quad = 0$ $\quad = \sqrt{0 + 0}$

$= 0$

$a_1 = \sqrt{\ddot{x}_1^2 + \ddot{y}_1^2}$

$= \sqrt{2.4^2 + 0^2}$

$= 2.4 ms^{-2}$

4) when $t = 22$,

$x_2 = At^2$, $y_2 = Bt^3$

$= 1.2(22)^2$ $= 0.03(22)^3$

$= 580.8m$ $= 319.44m$

$\dot{x}_2 = 2At$, $\dot{y}_2 = 3Bt^2$

$= 2(1.2)(22)$ $= 3(0.03)(22)^2$

$= 52.8ms^{-1}$ $= 43.56ms^{-1}$

$\ddot{x}_2 = 2A$, $\ddot{y}_2 = 6Bt$

$= 2(1.2)$ $= 6(0.03)(22)$

$= 2.4ms^{-2}$ $= 3.96ms^{-2}$

$V_2 = \sqrt{\dot{x}_1^2 + \dot{y}_1^2}$

$= \sqrt{52.8^2 + 43.56^2}$

$= 68.44935062ms^{-1}$

$a_2 = \sqrt{\ddot{x}_2^2 + \ddot{y}_2^2}$

$= \sqrt{2.4^2 + 3.96^2}$

$= 4.630507532ms^{-2}$

5)

ρ	$t(s)$	$v(ms^{-1})$	$a_t(ms^{-2})$	$a_n(ms^{-2})$	a	ω	α
236	0	22	-1.41	a_{n_1}	a_1	ω_1	α_1
236	3	v_2	-1.41	a_{n_2}	a_2	ω_2	α_2

when $t = 0$,

$$\omega_1 = \frac{v}{\rho}$$

$$= \frac{22}{236}$$

$$= 0.093220338898 \text{ rads}^{-1}$$

$$a_{n_1} = -\omega_1^2 r$$

$$= -2.050847458 \text{ ms}^{-2}$$

$$\alpha_1 = \frac{a_t}{r}$$

$$= \frac{-1.41}{236}$$

$$= -0.0597457627 \text{ rads}^{-2}$$

$$a_1 = a_{n_1} + a_t.$$

$$= -2.050847458 + -1.41|$$

$$= -3.460847458 \text{ ms}^{-2}$$

5) when $t = 3$,

$v_2 = u + at$

$= 22 - 1.41(3)$

$= 17.77 ms^{-1}$

$\omega_2 = \frac{v}{r}$

$= \frac{17.77}{236}$

$= 0.075296610 17 rads^{-1}$

$\alpha_2 = \alpha_1 = -0.059745762 7 rads^{-2}$

$a_{n_2} = -\omega^2 r$

$= (-0.075296610(7)^2 (236)$

$= -1.338020763 rads^{-2}$

$a_2 = a_{t_2} + a_{n_2}$

$= -1.41 - 1.338020763$

$= -2.748020763 ms^{-2}$

6) $\theta = At^2$ $\quad r = Bt^2 - Ct^3$

$\dot{\theta} = 2At$ $\quad \dot{r} = 2Bt - 3Ct^2$

$\ddot{\theta} = 2A$ $\quad \ddot{r} = 2B - 6Ct$

$v_\theta = r\dot{\theta}$ $\quad v_r = \dot{r}$

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$ $\quad a_r = \ddot{r} - r\dot{\theta}^2$

When $t = 0$,

$r = B(0)^2 - C(0)^3$, $\quad \theta = A(0)^2$, $\quad \dot{r} = 2B(0) - 3C(0)^2$, $\quad \dot{\theta} = 2A(0)$

$= 0$ $\quad = 0$ $\quad = 0$ $\quad = 0$

$\ddot{\theta} = 2(s)$, $\quad \ddot{r} = 2(0.07) - 6C(0)$, $\quad v_r = \dot{r}$, $\quad v_\theta = r\dot{\theta}$

$= 10\ rads^{-2}$ $\quad = 0.14\ ms^{-2}$ $\quad = 0$ $\quad = 0$

$a_r = \ddot{r} - r\dot{\theta}^2$ $\quad a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$

$= 0.14 - 0$ $\quad = 0 + 2(0)$

$= 0.14\ ms^{-2}$ $\quad = 0$

6) $\theta = At^2$ $\quad r = Bt^2 - Ct^3$

$\dot{\theta} = 2At$ $\quad \dot{r} = 2Bt - 3Ct^2$

$\ddot{\theta} = 2A$ $\quad \ddot{r} = 2B - 6Ct$

$v_\theta = r\dot{\theta}$ $\quad v_r = \dot{r}$

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$ $\quad a_r = \ddot{r} - r\dot{\theta}^2$

When $t = 3$,

$r = 0.07(3)^2 - 0.04(3)^3$, $\quad \theta = 5(3)^2$, $\quad \dot{r} = 2(0.07)(3) - 3(0.04)(3)^2$,

$= -0.45\,m$ $\quad = 45\,rad$ $\quad = -0.66\,ms^{-1}$

$\dot{\theta} = 2(5)(3)$, $\quad \ddot{\theta} = 2(5)$, $\quad \ddot{r} = 2(0.07) - 6(0.04)(3)$,

$= 30\,rads^{-1}$ $\quad = 10\,rads^{-2}$ $\quad = -0.58\,ms^{-2}$

$v_r = \dot{r}$

$= -0.66\,ms^{-1}$

$v_\theta = r\dot{\theta}$

$= -0.45(30)$

$= -13.5$

$a_r = \ddot{r} - r\dot{\theta}^2$

$= -0.58 - (-0.45)(30)^2$

$= 404.42\,ms^{-2}$

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$

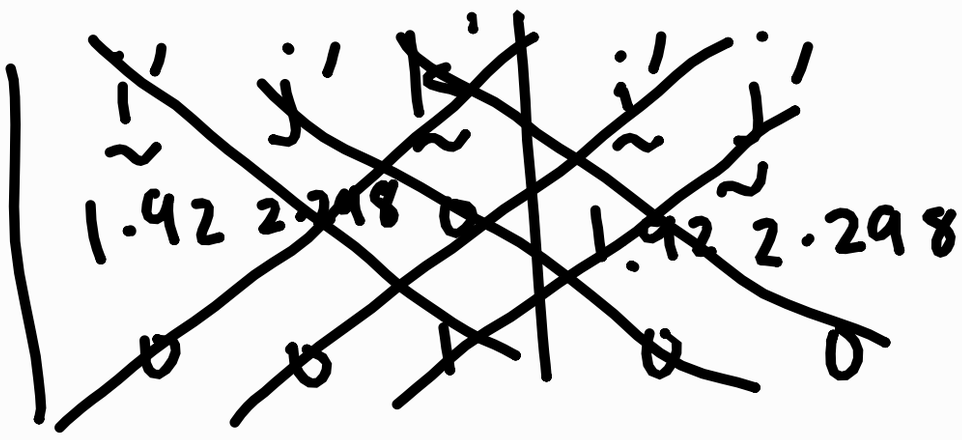
$= -0.45(-0.58) + 2(-0.45)(30)$

$= -26.739\,ms^{-2}$

7) $\vec{r} = 3\cos 50^\circ \underset{\sim}{i}' + 3\sin 50^\circ \underset{\sim}{j}'$

$= 1.928362829 \underset{\sim}{i}' + 2.298133329 \underset{\sim}{j}'$

$\vec{v} = \vec{\omega} \times \vec{r}$

$=$ 

$= 1.92 \underset{\sim}{j}' - 2.298 \underset{\sim}{i}'$

$= -2.298133329 \underset{\sim}{i}' + 1.928362829 \underset{\sim}{j}'$

$\underset{\sim}{j}' = \cos 29^\circ \underset{\sim}{j} + \sin 29^\circ \underset{\sim}{k}$

$= 0.874619707 \underset{\sim}{j} + 0.484809620 \underset{\sim}{k}$

$\vec{v} = -2.298133329 \underset{\sim}{i} + 1.928362829(0.874619707 \underset{\sim}{j} + 0.484809620 \underset{\sim}{k})$

$= -2.298133329 \underset{\sim}{i} + 1.686584133 \underset{\sim}{j} + 1.114157147 \underset{\sim}{k}$