Question 1: Jan 05 Q4

(a)	$\ddot{\mathbf{r}} = 6\mathbf{i} + (2t+3)\mathbf{j}$	B1
	$\mathbf{F} = 0.4(6\mathbf{i} + 11\mathbf{j})$ — 0.4×something obtained by differentiation, with $t = 4$	M1
	$\lvert\mathbf{F}\rvert = \sqrt{(2.4^2 + 4.4^2)}$ — modulus of a vector	M1
	≈ 5.0 — accept more accurate answers	A1 4
(b)	$\mathbf{r} = (3t^2 + 4t)\mathbf{i} + (\frac{1}{3}t^3 + \frac{3}{2}t^2)\mathbf{j} (+\mathbf{C})$	M1
Using boundary values,	$\mathbf{r} = (3t^2 + 4t - 3)\mathbf{i} + (\frac{1}{3}t^3 + \frac{3}{2}t^2 + 4)\mathbf{j}$	A1
$t = 4$,	$\mathbf{r} = 61\mathbf{i} + 49\frac{1}{3}\mathbf{j}$	A1
$OS = \sqrt{(61^2 + 49\frac{1}{3}^2)} \approx 78$ (m)	accept more accurate answers	M1 A1 5 9

Question 2: June 05 Q3

3 (a)	$\mathbf{v} = (18 - 12t^2)\mathbf{i} + 2c\mathbf{j}$	M1 A1 A1	
	$t = \frac{3}{2}$: $\mathbf{v} = -9\mathbf{i} + 3c\mathbf{j}$	M1	
	$\lvert\mathbf{v}\rvert = 15 \Rightarrow 9^2 + (3c)^2 = 15^2$	M1	
	$\Rightarrow (3c)^2 = 144 \Rightarrow c = 4$	A1	(6)
(b)	$\mathbf{a} = -24\mathbf{i} + 8\mathbf{j}$	M1	
	$t = \frac{3}{2}$: $\mathbf{a} = -36\mathbf{i} + 8\mathbf{j}$	M1	
		A1 √	(3)

Question 3: Jan 06 Q2

	(a)	$\dot{\mathbf{r}} = (2t+4)\mathbf{i} + (3-3t^2)\mathbf{j}$	M1 A1
		$\dot{\mathbf{r}}_3 = 10\mathbf{i} - 24\mathbf{j}$ substituting $t=3$	M1
		$\lvert\dot{\mathbf{r}}_3\rvert = \sqrt{(10^2+24^2)} = 26 \ (\mathrm{m\,s^{-1}})$	M1 A1
			(5)

Question 4: June 06 Q1

$a = 5-2t \Rightarrow v = 5t-t^2, +6$		M1 A1, A1
$v=0 \Rightarrow t^2 - 5t - 6 = 0$	indep	M1
$(t-6)(t+1) = 0$	dep	M1
$t = \underline{6\text{ s}}$		A1
		(6)

Question 5: Jan 07 Q6

	(a)	N2L $(1.5t^2-3)\mathbf{i} + 2t\mathbf{j} = 0.5\mathbf{a}$		M1
		$\mathbf{a} = (3t^2-6)\mathbf{i} + 4t\mathbf{j}$		A1 2
	(b)	$\mathbf{v} = (t^3-6t)\mathbf{i} + 2t^2\mathbf{j} \quad (+\mathbf{c})$		M1 A1
	$t=2$	$-4\mathbf{i}+5\mathbf{j} = -4\mathbf{i}+8\mathbf{j}+\mathbf{c} \quad (\mathbf{c}=-3\mathbf{j})$		M1
		$\mathbf{v} = (t^3-6t)\mathbf{i} + (2t^2-3)\mathbf{j} \quad (\mathrm{m\,s^{-1}})$		A1
	$t=3$	$\mathbf{v} = 9\mathbf{i}+15\mathbf{j} \ (\mathrm{m\,s^{-1}})$ *	cso	A1 5

Question 6: June 07 Q8

Question Number	Scheme	Marks
(a)	$\mathbf{a} = dv/dt = 6\mathbf{i} - 4\mathbf{j}$	M1 A1
(b)	Using $\mathbf{F} = ½\mathbf{a}$, sub $t = 2$, finding modulus e.g. at $t = 2$, $\mathbf{a} = 12\mathbf{i} - 4\mathbf{j}$ $\mathbf{F} = 6\mathbf{i} - 2\mathbf{j}$ $\lvert\mathbf{F}\rvert = \sqrt{(6^2 + 2^2)} \approx \underline{6.32\text{ N}}$	M1, M1, M1 A1(CSO)
	M1 Clear attempt to differentiate. Condone **i** or **j** missing. A1 both terms correct (column vectors are OK) The 3 method marks can be tackled in any order, but for consistency on epen grid please enter as: M1 **F**=m**a** (their **a**, (correct **a** or following from (a)), not **v**. $\mathbf{F}=\frac{1}{2}\mathbf{a}$). Condone **a** not a vector for this mark. M1 subst t = 2 into candidate's vector **F** or **a** (**a** correct or following from (a), not **v**) M1 Modulus of candidate's **F** or **a** (not **v**) A1 CSO All correct (beware fortuitous answers e.g. from 6**t**i+4**j**)) Accept 6.3, awrt 6.32, any exact equivalent e.g. $2\sqrt{10}$, $\sqrt{40}$, $\frac{\sqrt{160}}{2}$	

Question 7: Jan 08 Q2

Question Number	Scheme	Marks
	(a) $\dot{\mathbf{p}} = (6t-6)\mathbf{i} + (9t^2-4)\mathbf{j} \quad (\text{ms}^{-1})$	M1 A1 **(2)**
	(b) $9t^2 - 4 = 0$ $t = \frac{2}{3}$	M1 DM1 A1 **(3)**

Question 8: June 08 Q4

Question Number	Scheme	Marks
(a)	N2L $(6t-5)\mathbf{i} + (t^2-2t)\mathbf{j} = 0.5\mathbf{a}$	M1
	$\mathbf{a} = (12t-10)\mathbf{i} + (2t^2-4t)\mathbf{j}$	A1
	$\mathbf{v} = (6t^2-10t)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2\right)\mathbf{j} \quad (+\mathbf{C})$ ft their a	M1 A1ft+A1ft
	$\mathbf{v} = (6t^2-10t+1)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2 - 4\right)\mathbf{j}$	A1 (6)

Question 9: Jan 09 Q4

(a)	$v = 10t - 2t^2$, $s = \int v\,dt$	M1
	$= 5t^2 - \frac{2t^3}{3} (+C)$	A1
	$t = 6 \Rightarrow s = 180 - 144 = \underline{36}$ (m)	A1 (3)
(b)	$\underline{s} = \int v\,dt = \frac{-432t^{-1}}{-1}(+K) = \underline{\frac{432}{t}(+K)}$	B1
	t = 6, s = "36" $\Rightarrow 36 = \frac{432}{6} + K$	M1*
	$\Rightarrow K = -36$	A1
	At $t = 10$, $s = \frac{432}{10} - 36 = \underline{7.2}$ (m)	d*M1 A1 (5) **[8]**

Question 10: June 09 Q4

Question Number	Scheme	Marks
(a)	$\frac{dv}{dt} = 8 - 2t$	M1
	$8 - 2t = 0$	M1
	Max $v = 8 \times 4 - 4^2 = 16\,(\text{ms}^{-1})$	M1A1 (4)
(b)	$\int 8t - t^2 dt = 4t^2 - \frac{1}{3}t^3 (+c)$	M1A1
	(t=0, displacement = 0 $\Rightarrow$ c=0)	
	$4T^2 - \frac{1}{3}T^3 = 0$	DM1
	$T^2(4 - \frac{T}{3}) = 0 \Rightarrow T = 0, 12$	DM1
	$T = 12$ (seconds)	A1 (5) [9]

Question 11: Jan 10 Q1

Question Number	Scheme	Marks
	$\frac{\mathrm{d}v}{\mathrm{d}t} = 6t - 4$	M1 A1
	$6t - 4 = 0 \Rightarrow t = \frac{2}{3}$	M1 A1
	$s = \int 3t^2 - 4t + 3 \,\mathrm{d}t = t^3 - 2t^2 + 3t\ (+c)$	M1 A1
	$t = \frac{2}{3} \Rightarrow s = -\frac{16}{27} + 2$ so distance is $\frac{38}{27}$ m	M1 A1 [8]

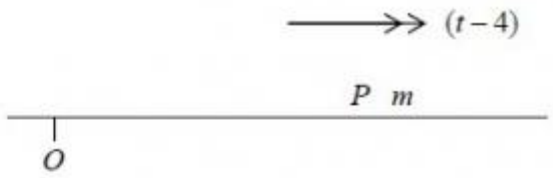
Question 12: June 10 Q1

Question Number	Scheme	Marks
		
	$\frac{dv}{dt} = 3t + 5$	
	$v = \int (3t+5)\,dt$	M1*
	$v = \frac{3}{2}t^2 + 5t \ (+c)$	A1
	$t = 0 \ \ v = 2 \ \Rightarrow \ c = 2$	B1
	$v = \frac{3}{2}t^2 + 5t + 2$	
	$t = T \quad 6 = \frac{3}{2}T^2 + 5T + 2$	DM1*
	$12 = 3T^2 + 10T + 4$	
	$3T^2 + 10T - 8 = 0$	
	$(3T-2)(T+4) = 0$	M1
	$T = \frac{2}{3} \quad (T = -4)$	
	$\therefore T = \frac{2}{3}$ (or 0.67)	A1
		[6]

Question 13: Jan 11 Q3

(a)	$a = 4t^3 - 12t$ Convincing attempt to integrate $v = t^4 - 6t^2 \ (+c)$ Use initial condition to get $v = t^4 - 6t^2 + 8 \left(\text{ms}^{-1}\right)$.	M1 A1 A1 (3)
(b)	Convincing attempt to integrate $s = \frac{t^5}{5} - 2t^3 + 8t \ (+0)$ Integral of their v	M1 A1ft (2)
(c)	Set their $v = 0$ Solve a quadratic in t^2 $(t^2-2)(t^2-4) = 0 \Rightarrow$ at rest when $t = \sqrt{2}, \ t = 2$	M1 DM1 A1 (3) **[8]**

Question 14: June 11 Q6

Question Number	Scheme	Marks
(a)		
	$\frac{dv}{dt} = t - 4$	
	$v = \frac{1}{2}t^2 - 4t(+c)$	M1 A1
	$t = 0 \quad v = 6 \quad \Rightarrow c = 6$	M1
	$\therefore v = \frac{1}{2}t^2 - 4t + 6$	A1
		(4)
(b)	$v = 0 \quad 0 = t^2 - 8t + 12$	M1
	$(t-6)(t-2) = 0$	DM1
	$t = 6 \quad t = 2$	A1
		(3)
(c)	$x = \frac{t^3}{6} - 2t^2 + 6t + k$	M1 A1 ft
	$x_6 - x_2 = \frac{6^3}{6} - 2\times 6^2 + 6^2 + k$	DM1
	$-\left(\frac{2^3}{6} - 2\times 2^2 + 6\times 2 + k\right)$	
	$= -5\frac{1}{3}$	
	$\therefore$ Distance is $5\frac{1}{3}$ m	A1
		(4)
		11