Question Number	Scheme	Marks
7	Assume that $\sqrt{7}$ is rational so that $\sqrt{7}=\frac{a}{b} \Rightarrow 7=\frac{a^2}{b^2}$ (where a and b have no factors in common)	M1
	$7=\frac{a^2}{b^2} \Rightarrow 7b^2=a^2$ So a^2 is a multiple of 7 which means a is a multiple of 7	A1
	$a=7k \Rightarrow 7b^2=49k^2 \Rightarrow b^2=7k^2$	M1
	So b^2 is a multiple of 7 which means b is a multiple of 7. As a and b are both multiples of 7, this contradicts the fact that a and b have no factors in common. Hence $\sqrt{7}$ must be irrational.	A1
		(4)
		Total 4

Question Number	Scheme	Marks
7	Assume that $\sqrt{7}$ is rational so that $\sqrt{7}=\frac{a}{b} \Rightarrow 7=\frac{a^2}{b^2}$ (where a and b have no factors in common)	M1
	$7=\frac{a^2}{b^2} \Rightarrow 7b^2=a^2$ So a^2 is a multiple of 7 which means a is a multiple of 7	A1
	$a=7k \Rightarrow 7b^2=49k^2 \Rightarrow b^2=7k^2$	M1
	So b^2 is a multiple of 7 which means b is a multiple of 7. As a and b are both multiples of 7, this contradicts the fact that a and b have no factors in common. Hence $\sqrt{7}$ must be irrational.	A1
		(4)
		Total 4

Question	**Scheme**	**Marks**
8	$y=2x+x^3+\cos x$	
	Assume (there is a stationary point so) $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ for some value of x	**B1**
	So for this x $\frac{\mathrm{d}y}{\mathrm{d}x}=2+3x^2-\sin x$	**M1**
	$\frac{\mathrm{d}y}{\mathrm{d}x}=0 \Rightarrow \sin x=3x^2+2 \ldots 2$	**dM1**
	This is a <u>contradiction</u> as $\lvert\sin x\rvert \leqslant 1$ for all x, hence the assumption is false and so the function has <u>no stationary points</u>.	**A1cso**
		(4)
		(4 marks)

Question Number	Scheme	Marks
4(a)	Assume that there exists a positive number k such that $k+\frac{9}{k}<6$	B1
	$k+\frac{9}{k}<6\Rightarrow k^2+9<6k\Rightarrow k^2-6k+9<0$ **or** $k+\frac{9}{k}<6\Rightarrow k+\frac{9}{k}-6<0\Rightarrow\left(\sqrt{k}...\right)\left(\sqrt{k}...\right)<0$ **or** $k+\frac{9}{k}<6\Rightarrow\left(k+\frac{9}{k}\right)^2<36\Rightarrow k^2+18+\frac{81}{k^2}-36<0$	M1
	$\Rightarrow(k-3)^2<0$ **or** $\Rightarrow\left(\sqrt{k}-\frac{3}{\sqrt{k}}\right)^2<0$ **or** $\Rightarrow\left(k-\frac{9}{k}\right)^2<0$	A1
	But numbers squared are $\geqslant 0$, hence $k+\frac{9}{k}\geqslant 6$	A1*
		(4)
(b)	E.g. When $k=-3$, $-3+\frac{9}{-3}(=-6)$ which is not $\geqslant 6$	B1
		(1)

Question	Scheme	Marks
9	For question 9 many variations on the proof are possible. Below is a general outline with some examples, which cover many cases. If you see an approach you do not know how to score, consult your team leader. **M1:** Will be scored for setting up an algebraic statement in terms of a variable (integer) k or any other variable aside n that engages with divisibility by 4 in some way and can lead to a contradiction and is scored at the point you can see each of these elements. A formal statement of the assumption is not required at this stage. **A1:** Scored for a correct statement from which it is possible to draw a contradiction. **dM1;** For making a complete argument that leads to a (full) contradiction of the initial statement, though may be allowed if there are minor gaps or omissions. **A1:** Correct and complete work with contradiction drawn and conclusion made. There must have been a statement of assumption at the start for which to draw the contradiction, though it may not be technicality a correct assumption as long as a relevant assumption has been made. E.g. Accept "Assume n^2-2 is divisible be 4 for all *n*"	
9	(Assume that there is an n with n^2-2 is divisible by 4 so) $n^2-2=4k$	M1
	then $n^2=4k+2=2(2k+1)$ (so is even)	A1
	Hence n^2 is even so n $(=2m)$ is even hence n^2 is a multiple of 4 As n^2 is a multiple of 4 then $n^2-2=4m^2-2=2(2m^2-1)$ cannot be a multiple of 4 (as $2m-1$ is odd) so there is a contradiction.	dM1
	So the original assumption has been shown false. Hence "n^2-2 is never divisible by 4" is true for all n *	A1*
		(4)
		(4 marks)

Question Number	Scheme	Marks
10	Assume there is an angle x, $90° < x < 180°$, $\left\|\frac{\cos 2x}{\cos x - \sin x}\right\| \ldots 1$ $\frac{\cos 2x}{\cos x - \sin x} \equiv \frac{(\cos x + \sin x)\cancel{(\cos x - \sin x)}}{\cancel{\cos x - \sin x}}$ $\|\cos x + \sin x\| \ldots 1 \Rightarrow (\cos x + \sin x)^2 \ldots 1 \Rightarrow 1 + 2\sin x \cos x \ldots 1 \Rightarrow \sin 2x \ldots 0$ This is a contradiction, as $\sin\alpha$ is negative for all angles $180° < \alpha < 360°$, hence true *	B1 M1 dM1 A1*
		(4 marks)

Question Number	Scheme	Marks
10 **Main**	Assume that $p^2 - 4q + 2 = 0$	B1
	$p^2 = 4q - 2$	M1
	$p^2 = 4q - 2(= 2(2q-1))$ So p^2 is even so p is even oe e.g. so $p = 2k$	A1
	If $p = 2k$ then e.g. $4k^2 = 4q - 2$ or e.g. $4k^2 = 4q - 2 \Rightarrow q = k^2 + \frac{1}{2}$ or e.g. $q = \frac{2k^2+1}{2}$ or e.g. $4k^2 = 4q - 2 \Rightarrow k^2 = q - \frac{1}{2}$ or e.g. $k^2 = \frac{2q-1}{2}$ or e.g. Let $4k^2 = 4q - 2 \Rightarrow 2q - 2k^2 = 1$	**dM1**
	$4k^2$ is a multiple of 4 and $4q-2$ isn't a multiple of 4 or e.g. $q = k^2 + \frac{1}{2}$ which is not an integer or e.g. $k^2 = q - \frac{1}{2}$ which is not an integer or e.g. $2q - 2k^2 = 1$ which is not possible So $p^2 - 4q + 2 \neq 0$	A1
		(5 marks)
Way 1		

Question Number	Scheme	Marks
2	Assume that C_1 and C_2 do intersect so that $x^4+10x^2+8=2x^2-7$ (and has real solutions).	B1
	$x^4+8x^2+15=0 \Rightarrow (x^2+5)(x^2+3)=0 \Rightarrow x^2=...$ or $x^4+8x^2+15=0 \Rightarrow x^2=\dfrac{-8\pm\sqrt{8^2-4\times15}}{2}$ or $x^4+8x^2+15=0 \Rightarrow (x^2+4)^2-1=0 \Rightarrow x^2=...$	M1
	$x^2=-5,-3$	A1
	e.g. The two values of $x^2<0$ (so $x^4+8x^2+15=0$ has no real roots) which is not possible so C_1 and C_2 do not intersect	A1
		(4)
		Total 4

Question Number	Scheme	Marks
8	Solves one of $(3x-y)=25$ and $(x+y)=1$ or $(3x-y)=5$ and $(x+y)=5$	M1
	Correct solution of one. Either $\left.\begin{array}{r}3x-y=25\\ x+y=1\end{array}\right\} \Rightarrow 4x=26 \Rightarrow x=6.5, (y=-5.5)$ Or $\left.\begin{array}{r}3x-y=5\\ x+y=5\end{array}\right\} \Rightarrow 4x=10 \Rightarrow x=2.5, (y=2.5)$	A1
	Solves both equations Both solved correctly with a minimal reason given for the contradiction e.g "not integers" with conclusion "hence there are no integers x and y such that $3x^2+2xy-y^2=25$"	dM1 A1 **(4)**

Question Number	Scheme	Marks
10 (a)	Writes $2\left(4p^3+6p^2+3p\right)+1$ which is odd	B1
		(1)
(b)	Assumption:	
	E.g. States that there exists integers p and q such that $\sqrt[3]{2}=\frac{p}{q}$ (where $\frac{p}{q}$ is in its simplest form) and then cubes to get $2=\frac{p^3}{q^3}$	M1
	$2=\frac{p^3}{q^3}\Rightarrow p^3=2q^3$ and concludes that p^3 is even so therefore p is even	A1
	If p is even then it can be written $p=2m$ so $(2m)^3=2q^3$	M1
	States that $q^3=4m^3$ and concludes that q^3 is even so therefore q is even	A1
	This contradicts our initial statement, as if they both have a factor of 2 it means that $\frac{p}{q}$ is not in its simplest form, so $\sqrt[3]{2}$ is irrational *	A1*
		(5)
		(6 marks)

Question Number	Scheme	Marks
6	Assumption: e.g. (Assume) "n^2-4n+5 is even and n is even"	B1
	Sets e.g. $n=2k$ and attempts $(2k)^2-4(2k)+5$	M1
	$4k^2-8k+5$ (oe for their n)	A1
	Completes proof with: (i) Statement "which is odd" (ii) Reason odd E.g. $4\left(k^2-2k\right)+5$ or e.g. $4\left(k^2-2k+1\right)+1$ or e.g. $2\left(2k^2-4k+2\right)+1$ or e.g. $(2k-2)^2+1$ Condone $4k^2-8k+5=even-even+odd=odd$ (iii) A (minimal) conclusion e.g. "Hence contradiction", "so proven", "the statement is true" etc.	A1*
		(4 marks)

Question Number	Scheme	Marks
2	Assume that C_1 and C_2 do intersect so that $x^4+10x^2+8=2x^2-7$ (and has real solutions).	B1
	$x^4+8x^2+15=0 \Rightarrow (x^2+5)(x^2+3)=0 \Rightarrow x^2=...$ or $x^4+8x^2+15=0 \Rightarrow x^2=\dfrac{-8\pm\sqrt{8^2-4\times15}}{2}$ or $x^4+8x^2+15=0 \Rightarrow (x^2+4)^2-1=0 \Rightarrow x^2=...$	M1
	$x^2=-5,\,-3$	A1
	e.g. The two values of $x^2<0$ (so $x^4+8x^2+15=0$ has no real roots) which is not possible so C_1 and C_2 do not intersect	A1
		(4)
		Total 4

Question Number	Scheme	Marks
6	Assumption: e.g. (Assume) "n^2-4n+5 is even and n is even"	B1
	Sets e.g. $n=2k$ and attempts $(2k)^2-4(2k)+5$	M1
	$4k^2-8k+5$ (oe for their n)	A1
	Completes proof with: (i) Statement "which is odd" (ii) Reason odd E.g. $4(k^2-2k)+5$ or e.g. $4(k^2-2k+1)+1$ or e.g. $2(2k^2-4k+2)+1$ or e.g. $(2k-2)^2+1$ Condone $4k^2-8k+5=even-even+odd=odd$ (iii) A (minimal) conclusion e.g. "Hence contradiction", "so proven", "the statement is true" etc.	A1*
		(4 marks)

Question	**Scheme**	**Marks**
8(a)	$(8-3x)^{\frac{4}{3}}=16\left(1-\frac{3}{8}x\right)^{\frac{4}{3}}$ but condone $16(1-kx)^{\frac{4}{3}}, k\neq3$	**M1**
	"Correct" term 3 or term 4 in $(1-kx)^{\frac{4}{3}}=1\pm\frac{4}{3}kx+\dfrac{\frac{4}{3}\times\frac{1}{3}}{2}(\pm kx)^2+\dfrac{\frac{4}{3}\times\frac{1}{3}\times\left(-\frac{2}{3}\right)}{6}(\pm kx)^3+...$	**M1**
	Two terms correct of $16-8x+\dfrac{x^2}{2}+\dfrac{x^3}{24}+...$ following M1, M1 and $k=\pm\dfrac{3}{8}$	**A1**
	$=16-8x+\dfrac{x^2}{2}+\dfrac{x^3}{24}+...$	**A1**
		(4)

(b)	Assume the curves meet so $8x-\frac{15x^2}{2}+8="16-8x+\frac{x^2}{2}+\frac{x^3}{24}"$ (for some x)	**M1**
	$\Rightarrow 0=8-16x+8x^2+\frac{x^3}{24}+\ldots \Rightarrow 0=8\left(x^2-2x\right)+8+\frac{x^3}{24}+\ldots \Rightarrow 8\left(x-1\right)^2 \pm..+..$	**M1**
	$\Rightarrow 0=8\left(x-1\right)^2+\frac{x^3}{24}$	**A1**
	Requires • Argument that $8\left(x-1\right)^2+\frac{x^3}{24}>0$. E.g. $8\left(x-1\right)^2 \geqslant 0$ and $\frac{x^3}{24}>0$ (for $0<x<\frac{8}{3}$) so $8\left(x-1\right)^2+\frac{x^3}{24}>0$ • Minimal statement (contradiction) and conclusion	**A1**
		(4)
		(8 marks)

Question Number	Scheme	Marks
1	Assume that there exists a number m such that when m^3 is even, m is odd	B1
	If m is odd then $m=2p+1$ (where p is an integer) and $m^3=\left(2p+1\right)^3=\ldots$	M1
	$=8p^3+12p^2+6p+1$	A1
	$2\times\left(4p^3+6p^2+3p\right)+1$ is odd and hence we have a contradiction so if n^3 is even, then n is even.	A1
		(4) **(4 marks)**

Question Number	Scheme	Marks
10 Main	Assume that $p^2-4q+2=0$	B1
	$p^2=4q-2$	M1
	$p^2=4q-2(=2(2q-1))$ So p^2 is even so p is even oe e.g. so $p=2k$	A1
	If $p=2k$ then e.g. $4k^2=4q-2$ or e.g. $4k^2=4q-2\Rightarrow q=k^2+\frac{1}{2}$ or e.g. $q=\frac{2k^2+1}{2}$ or e.g. $4k^2=4q-2\Rightarrow k^2=q-\frac{1}{2}$ or e.g. $k^2=\frac{2q-1}{2}$ or e.g. Let $4k^2=4q-2\Rightarrow 2q-2k^2=1$	dM1
	$4k^2$ is a multiple of 4 and $4q-2$ isn't a multiple of 4 or e.g. $q=k^2+\frac{1}{2}$ which is not an integer or e.g. $k^2=q-\frac{1}{2}$ which is not an integer or e.g. $2q-2k^2=1$ which is not possible So $p^2-4q+2\neq 0$	A1
		(5 marks)

Question Number	Scheme	Marks
9 (a)	Let $p=3k+2$ then $\left(3k+2\right)^3=27k^3+54k^2+36k+8$	**M1**
	$=3\times\left(9k^3+18k^2+12k+3\right)-1$ not a multiple of 3	**A1**
	So p cannot be of form $3k+1$ or $3k+2$, since p^3 is a multiple of 3. Hence p must be a multiple of 3, a contradiction of our assumption, hence for all integers p, when p^3 is a multiple of 3, then p is a multiple of 3	**A1**
		(3)
(b)	Assumption: there exist (integers) p and q such that $\sqrt[3]{3}=\frac{p}{q}$ (where p and q have no (non-trivial) common factors.)	**B1**
	Then $\sqrt[3]{3}=\frac{p}{q}\Rightarrow p^3=3q^3$	**M1**
	So p^3 is a multiple of 3 and (so) p is a multiple of 3	**A1**
	But $p=3k\Rightarrow 27k^3=3q^3\Rightarrow q^3=9k^3$	**dM1**
	Hence q^3 is a multiple of 3 so q is a multiple of 3, but as p and q have no (non-trivial) common factors, this is a contradiction. Hence $\sqrt[3]{3}$ is an irrational number.*	**A1***
		(5)
		(8 marks)

Question	Scheme	Marks
6	Assume the sequence is geometric	**B1**
	So $(r=)\dfrac{1+2k}{k}=\dfrac{3+3k}{1+2k}$	**M1**
	$\Rightarrow (1+2k)^2=k(3+3k)\Rightarrow k^2+k+1=0$	**A1**
	But $k^2+k+1=\left(k+\frac{1}{2}\right)^2-\frac{1}{4}+1\geqslant\frac{3}{4}>0$ (since $\left(k+\frac{1}{2}\right)^2\geqslant 0$ for all (real) k)	**dM1**
	This is a contradiction and hence the original assumption is not true. The sequence is not geometric.	**A1**
		(5)
		(5 marks)

Question Number	Scheme	Marks
10(a)	$\dfrac{\mathrm{d}x}{\mathrm{d}t}=6t$ o.e.	B1
	$\text{Area}=\left(\int \sin t\sin 2t\times 6t\,\mathrm{d}t=\right)\int \sin t\times 2\sin t\cos t\times 6t\,\mathrm{d}t$	M1
	$=12\int_0^{\frac{\pi}{2}} t\sin^2 t\cos t\,\mathrm{d}t$	A1
		(3)
(b)	$=(12)\left[\frac{t}{3}\sin^3 t\right]_0^{\frac{\pi}{2}}-(12)\int_0^{\frac{\pi}{2}}\frac{1}{3}\sin^3 t\,\mathrm{d}t$	M1
	$=(12)\left[\frac{t}{3}\sin^3 t\right]_0^{\frac{\pi}{2}}-\left(\frac{12}{3}\right)\int_0^{\frac{\pi}{2}}\sin t\left(1-\cos^2 t\right)\mathrm{d}t$	M1
	$=\left[4t\sin^3 t+4\cos t-\frac{4}{3}\cos^3 t\right]_0^{\frac{\pi}{2}}$	A1
	$=2\pi-\left(4-\frac{4}{3}\right)$	M1
	$=2\pi-\frac{8}{3}$	A1
		(5)
		Total 8

(a) On EPEN this is M1M1A1 but we are marking this as B1M1A1

Question Number	Scheme	Marks
2	Assume that C_1 and C_2 do intersect so that $x^4+10x^2+8=2x^2-7$ (and has real solutions).	B1
	$x^4+8x^2+15=0 \Rightarrow (x^2+5)(x^2+3)=0 \Rightarrow x^2=...$ or $x^4+8x^2+15=0 \Rightarrow x^2=\dfrac{-8\pm\sqrt{8^2-4\times15}}{2}$ or $x^4+8x^2+15=0 \Rightarrow (x^2+4)^2-1=0 \Rightarrow x^2=...$	M1
	$x^2=-5,-3$	A1
	e.g. The two values of $x^2<0$ (so $x^4+8x^2+15=0$ has no real roots) which is not possible so C_1 and C_2 do not intersect	A1
		(4)
		Total 4

Question Number	Scheme	Marks
3	States the largest odd number and an odd number that is greater E.g. odd number n and $n+2$	M1
	Fully correct proof including • the assumption: there exists a greatest odd number "n" • a correct statement that their second odd number is greater than their assumed greatest odd number • a minimal conclusion " this is a contradiction, hence proven" You can ignore any spurious information e.g. $n>0$, $n+2>0$ etc.	A1*
		(2)
		(2 marks)

Question Number	Scheme	Marks
1	Assume there are positive numbers *a* and *b* such that $\dfrac{9a}{b}+\dfrac{4b}{a}<12$	B1
	Multiplies by $ab \Rightarrow 9a^2+4b^2<12ab$	M1
	$\Rightarrow 9a^2-12ab+4b^2<0 \Rightarrow (3a-2b)^2<0$	A1
	Square numbers cannot be negative, so we have a contradiction and hence, if *a* and *b* are positive real numbers, then $\dfrac{9a}{b}+\dfrac{4b}{a}\geq 12$	A1*
		(4 marks)

Question Number	Scheme	Marks
1	Assume there are positive numbers *a* and *b* such that $\frac{9a}{b}+\frac{4b}{a}<12$	B1
	Multiplies by $ab \Rightarrow 9a^2+4b^2<12ab$	M1
	$\Rightarrow 9a^2-12ab+4b^2<0 \Rightarrow (3a-2b)^2<0$	A1
	Square numbers cannot be negative, so we have a contradiction and hence, if *a* and *b* are positive real numbers, then $\frac{9a}{b}+\frac{4b}{a}\geq 12$	A1*
		(4 marks)

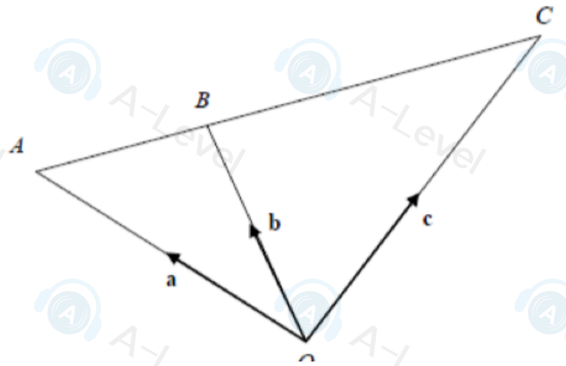
Question Number	Scheme	Notes	Marks
8	Assume that there exist positive real numbers x and y such $\frac{9x}{y}+\frac{y}{x}<6$	Starts the proof by contradicting the given statement	B1
	$\frac{9x}{y}+\frac{y}{x}<6 \Rightarrow 9x^2+y^2<6xy$ as x and y are both positive	Multiplies through by xy	M1
	$\Rightarrow 9x^2+y^2-6xy<0$ $\Rightarrow (3x-y)^2<0$	Reaches a correct contradictory statement	A1
	As x and y are positive real numbers, this is a contradiction and so $\frac{9x}{y}+\frac{y}{x}<6$ must be incorrect and so $\frac{9x}{y}+\frac{y}{x}\ldots 6$*	Makes a suitable conclusion	A1*
			(4)
			Total 4

Question Number	Scheme	Marks
4(a)	Assume that there exists a positive number k such that $k+\frac{9}{k}<6$	B1
	$k+\frac{9}{k}<6 \Rightarrow k^2+9<6k \Rightarrow k^2-6k+9<0$ **or** $k+\frac{9}{k}<6 \Rightarrow k+\frac{9}{k}-6<0 \Rightarrow \left(\sqrt{k}...\right)\left(\sqrt{k}...\right)<0$ **or** $k+\frac{9}{k}<6 \Rightarrow \left(k+\frac{9}{k}\right)^2<36 \Rightarrow k^2+18+\frac{81}{k^2}-36<0$	M1
	$\Rightarrow (k-3)^2<0$ **or** $\Rightarrow \left(\sqrt{k}-\frac{3}{\sqrt{k}}\right)^2<0$ **or** $\Rightarrow \left(k-\frac{9}{k}\right)^2<0$	A1
	But numbers squared are $\geqslant 0$, hence $k+\frac{9}{k}\geqslant 6$	A1*
		(4)
(b)	E.g. When $k=-3$, $-3+\frac{9}{-3}\left(=-6\right)$ which is not $\geqslant 6$	B1
		(1)

Question Number	Scheme	Marks
9 (a)	Let $p=3k+2$ then $\left(3k+2\right)^3=27k^3+54k^2+36k+8$	**M1**
	$=3\times\left(9k^3+18k^2+12k+3\right)-1$ not a multiple of 3	**A1**
	So p cannot be of form $3k+1$ or $3k+2$, since p^3 is a multiple of 3. Hence p must be a multiple of 3, a contradiction of our assumption, hence for all integers p, when p^3 is a multiple of 3, then p is a multiple of 3	**A1**
		(3)
(b)	Assumption: there exist (integers) p and q such that $\sqrt[3]{3}=\frac{p}{q}$ (where p and q have no (non-trivial) common factors.)	**B1**
	Then $\sqrt[3]{3}=\frac{p}{q} \Rightarrow p^3=3q^3$	**M1**
	So p^3 is a multiple of 3 and (so) p is a multiple of 3	**A1**
	But $p=3k \Rightarrow 27k^3=3q^3 \Rightarrow q^3=9k^3$	**dM1**
	Hence q^3 is a multiple of 3 so q is a multiple of 3, but as p and q have no (non-trivial) common factors, this is a contradiction. Hence $\sqrt[3]{3}$ is an irrational number.*	**A1***
		(5)
		(8 marks)

Question	Scheme	Marks
8(a)	$(8-3x)^{\frac{4}{3}}=16\left(1-\frac{3}{8}x\right)^{\frac{4}{3}}$ but condone $16(1-kx)^{\frac{4}{3}}, k\neq 3$	M1
	"Correct" term 3 or term 4 in $(1-kx)^{\frac{4}{3}}=1\pm\frac{4}{3}kx+\frac{\frac{4}{3}\times\frac{1}{3}}{2}(\pm kx)^2+\frac{\frac{4}{3}\times\frac{1}{3}\times\left(-\frac{2}{3}\right)}{6}(\pm kx)^3+...$	M1
	Two terms correct of $16-8x+\frac{x^2}{2}+\frac{x^3}{24}+...$ following M1, M1 and $k=\pm\frac{3}{8}$	A1
	$=16-8x+\frac{x^2}{2}+\frac{x^3}{24}+...$	A1
		(4)
(b)	Assume the curves meet so $8x-\frac{15x^2}{2}+8=\text{"}16-8x+\frac{x^2}{2}+\frac{x^3}{24}\text{"}$ (for some x)	M1
	$\Rightarrow 0=8-16x+8x^2+\frac{x^3}{24}+...\Rightarrow 0=8\left(x^2-2x\right)+8+\frac{x^3}{24}+...\Rightarrow 8\left(x-1\right)^2\pm..+..$	M1
	$\Rightarrow 0=8\left(x-1\right)^2+\frac{x^3}{24}$	A1
	Requires • Argument that $8\left(x-1\right)^2+\frac{x^3}{24}>0$. E.g. $8\left(x-1\right)^2\geqslant 0$ and $\frac{x^3}{24}>0$ (for $0<x<\frac{8}{3}$) so $8\left(x-1\right)^2+\frac{x^3}{24}>0$ • Minimal statement (contradiction) and conclusion	A1
		(4)
		(8 marks)

Question Number	Scheme	Marks
9 (i)	Attempts two of $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$, $\overrightarrow{AC} = \mathbf{c} - \mathbf{a}$ and $\overrightarrow{BC} = \mathbf{c} - \mathbf{b}$ either way around	M1
	Attempts $\mathbf{c} - \mathbf{b} = 2 \times (\mathbf{b} - \mathbf{a})$ oe such as $\mathbf{c} - \mathbf{a} = 3 \times (\mathbf{b} - \mathbf{a})$	dM1
	$\Rightarrow \mathbf{c} = 3\mathbf{b} - 2\mathbf{a}$ *	A1 *
		(3)
(ii)	Assume that there exists a number n that isn't a multiple of 3 yet n^2 is a multiple of 3	B1
	If n is not a multiple of 3 then $m = 3p+1$ or $m = 3p+2$ $(p \in \mathbb{N})$ giving	
	$m^2 = (3p+1)^2 = 9p^2 + 6p + 1$	M1
	Or $m^2 = (3p+2)^2 = 9p^2 + 12p + 4 = 3(3p^2 + 4p + 1) + 1$	M1 A1
	$(3p+1)^2 = 9p^2 + 6p + 1 (= 3(3p^2 + 2p) + 1)$ is one more than a multiple of 3	
	$(3p+2)^2 = 9p^2 + 12p + 4$ is not a multiple of 3 as 3 does not divide into 4 (exactly)	
	Hence if n is a multiple of 3 then n^2 is a multiple of 3	A1
		(5)
		(8 marks)



Question	Scheme	Marks
8	$y = 2x + x^3 + \cos x$	
	Assume (there is a stationary point so) $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ for some value of x	**B1**
	So for this x $\frac{\mathrm{d}y}{\mathrm{d}x} = 2 + 3x^2 - \sin x$	**M1**
	$\frac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow \sin x = 3x^2 + 2 \ldots 2$	**dM1**
	This is a <u>contradiction</u> as $\lvert \sin x \rvert \leqslant 1$ for all x, hence the assumption is false and so the function has <u>no stationary points</u>.	**A1cso**
		(4)
		(4 marks)

Question Number	Scheme	Marks
10	Assume there is an angle x, $90° < x < 180°$, $\left\lvert \dfrac{\cos 2x}{\cos x - \sin x} \right\rvert \ldots 1$ $\dfrac{\cos 2x}{\cos x - \sin x} \equiv \dfrac{(\cos x + \sin x)\,\cancel{(\cos x - \sin x)}}{\cancel{\cos x - \sin x}}$ $\lvert \cos x + \sin x \rvert \ldots 1 \Rightarrow (\cos x + \sin x)^2 \ldots 1 \Rightarrow 1 + 2\sin x \cos x \ldots 1 \Rightarrow \sin 2x \ldots 0$ This is a contradiction, as $\sin \alpha$ is negative for all angles $180° < \alpha < 360°$, hence true *	B1 M1 dM1 A1*
		(4 marks)