Questions

Q1.

$$f(x) = 4x^3 - 12x^2 + 2x - 6$$

(a) Use the factor theorem to show that $(x - 3)$ is a factor of $f(x)$.

(2)

(b) Hence show that 3 is the only real root of the equation $f(x) = 0$

(4)

(Total for question = 6 marks)

Q2.

$$g(x) = 4x^3 - 12x^2 - 15x + 50$$

(a) Use the factor theorem to show that $(x + 2)$ is a factor of $g(x)$.

(2)

(b) Hence show that $g(x)$ can be written in the form $g(x) = (x + 2)(ax + b)^2$, where a and b are integers to be found.

(4)

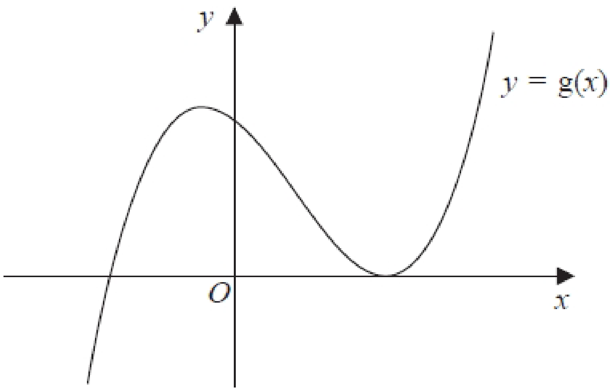

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = g(x)$

(c) Use your answer to part (b), and the sketch, to deduce the values of x for which

(i) $g(x) \leq 0$
(ii) $g(2x) = 0$

(3)

(Total for question = 9 marks)

Q3.

$$f(x) = 2x^3 - 13x^2 + 8x + 48$$

(a) Prove that $(x - 4)$ is a factor of $f(x)$.

(2)

(b) Hence, using algebra, show that the equation $f(x) = 0$ has only two distinct roots.

(4)

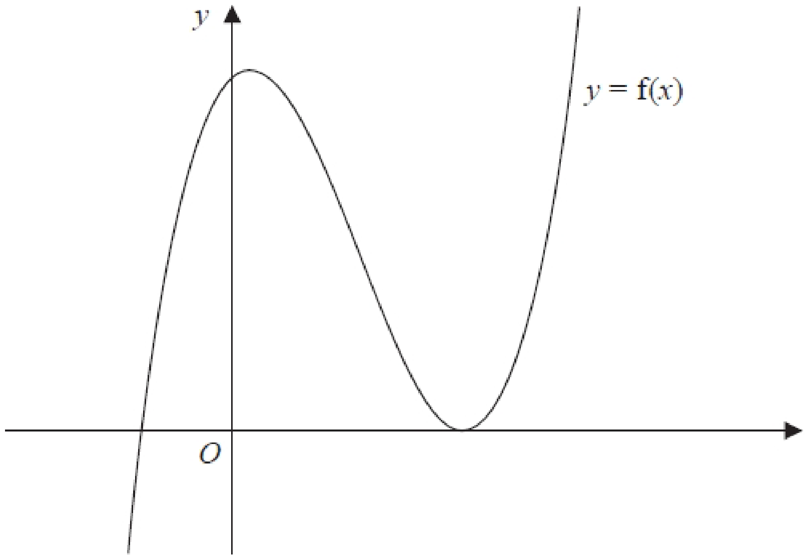

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = f(x)$.

(c) Deduce, giving reasons for your answer, the number of real roots of the equation

$$2x^3 - 13x^2 + 8x + 46 = 0$$

(2)

Given that k is a constant and the curve with equation $y = f(x + k)$ passes through the origin,

(d) find the two possible values of k.

(2)

(Total for question = 10 marks)

Q4.

$$g(x) = 2x^3 + x^2 - 41x - 70$$

(a) Use the factor theorem to show that $g(x)$ is divisible by $(x - 5)$.

(2)

(b) Hence, showing all your working, write $g(x)$ as a product of three linear factors.

(4)

The finite region R is bounded by the curve with equation $y = g(x)$ and the x-axis, and lies below the x-axis.

(c) Find, using algebraic integration, the exact value of the area of R.

(4)

(Total for question = 10 marks)

Q5.

$$f(x) = 2x^3 - 5x^2 + ax + a$$

Given that $(x + 2)$ is a factor of $f(x)$, find the value of the constant a.

(3)

(Total for question = 3 marks)

Q6.

$f(x) = -3x^3 + 8x^2 - 9x + 10, \quad x \in \mathbb{R}$

(a) (i) Calculate f (2)

(ii) Write f (x) as a product of two algebraic factors.

(3)

Using the answer to (a)(ii),

(b) prove that there are exactly two real solutions to the equation

$$-3y^6 + 8y^4 - 9y^2 + 10 = 0$$

(2)

(c) deduce the number of real solutions, for $7\pi \leq \theta < 10\pi$, to the equation

$$3\tan^3\theta - 8\tan^2\theta + 9\tan\theta - 10 = 0$$

(1)

(Total for question = 6 marks)

Q7.

$$f(x) = 3x^3 + 2ax^2 - 4x + 5a$$

Given that $(x + 3)$ is a factor of $f(x)$, find the value of the constant a.

(Total for question = 3 marks)

Q8.

$$f(x) = ax^3 + 10x^2 - 3ax - 4$$

Given that $(x - 1)$ is a factor of $f(x)$, find the value of the constant a.

You must make your method clear.

(Total for question = 3 marks)

Mark Scheme

Q1.

Question	Scheme	Marks	AOs
(a)	States or uses $f(+3)=0$	M1	1.1b
	$4(3)^3-12(3)^2+2(3)-6=108-108+6-6=0$ and so $(x-3)$ is a factor	A1	1.1b
		(2)	
(b)	Begins division or factorisation so $4x^3-12x^2+2x-6=(x-3)(4x^2+...)$	M1	2.1
	$4x^3-12x^2+2x-6=(x-3)(4x^2+2)$	A1	1.1b
	Considers the roots of their quadratic function using completion of square or discriminant	M1	2.1
	$(4x^2+2)=0$ has no real roots with a reason (e.g. negative number does not have a real square root, or $4x^2+2>0$ for all x) So $x=3$ is the only real root of $f(x)=0$ *	A1*	2.4
		(4)	
			(6 marks)

Notes

(a) M1: States or uses $f(+3)=0$

A1: See correct work evaluating and achieving zero, together with correct conclusion

(b) M1: Needs to have $(x-3)$ and first term of quadratic correct

A1: Must be correct – may further factorise to $2(x-3)(2x^2+1)$

M1: Considers **their** quadratic for no real roots by use of completion of the square or consideration of discriminant then

A1*: a correct explanation.

Q2.

Question	Scheme	Marks	AOs
(a)	$(g(-2))=4\times-8-12\times4-15\times-2+50$	M1	1.1b
	$g(-2)=0\Rightarrow(x+2)$ is a factor	A1	2.4
		(2)	
(b)	$4x^3-12x^2-15x+50=(x+2)(4x^2-20x+25)$	M1 A1	1.1b 1.1b
	$=(x+2)(2x-5)^2$	M1 A1	1.1b 1.1b
		(4)	
(c)	(i) $x\leqslant-2,\ x=2.5$	M1 A1ft	1.1b 1.1b
	(ii) $x=-1,\ x=1.25$	B1ft	2.2a
		(3)	
			(9 marks)

(a)

M1: Attempts $g(-2)$ Some sight of (-2) embedded or calculation is required.

So expect to see $4\times(-2)^3-12\times(-2)^2-15\times(-2)+50$ embedded

Or $-32-48+30+50$ condoning slips for the M1

Any attempt to divide or factorise is M0. (See demand in question)

A1: $g(-2)=0 \Rightarrow (x+2)$ is a factor.

Requires a correct statement and conclusion. Both "$g(-2)=0$" and "$(x+2)$ is a factor" must be seen in the solution. This may be seen in a preamble before finding $g(-2)=0$ but in these cases there must be a minimal statement ie QED, "proved", tick etc.

Also accept, in one coherent line/sentence, explanations such as, 'as g (x) =0 when $x=-2$, $(x+2)$ is a factor.'

(b)

M1: Attempts to divide $g(x)$ by $(x+2)$ May be seen and awarded from part (a)

If inspection is used expect to see $4x^3-12x^2-15x+50=(x+2)(4x^2 \text{..........} \pm 25)$

If algebraic / long division is used expect to see

$$\begin{array}{r} 4x^2 \pm 20x \\ x+2 \overline{) \; 4x^3-12x^2-15x+50} \end{array}$$

A1: Correct quadratic factor is $(4x^2-20x+25)$ may be seen and awarded from part (a)

M1: Attempts to factorise their $(4x^2-20x+25)$ usual rule $(ax+b)(cx+d)$, $ac=\pm4, bd=\pm25$

A1: $(x+2)(2x-5)^2$ oe seen on a single line. $(x+2)(-2x+5)^2$ is also correct.

Allow recovery for all marks for $g(x)=(x+2)(x-2.5)^2=(x+2)(2x-5)^2$

(c)(i)

M1: For identifying that the solution will be where the curve is on or below the axis. Award for either $x \leqslant -2$ or $x=2.5$ Follow through on their $g(x)=(x+2)(ax+b)^2$ only where $ab<0$ (that is a positive root). Condone $x<-2$ See SC below for $g(x)=(x+2)(2x+5)^2$

A1ft: BOTH $x \leqslant -2$, $x = 2.5$ Follow through on their $-\frac{b}{a}$ of their $g(x) = (x+2)(ax+b)^2$

May see $\{x \leqslant -2 \cup x = 2.5\}$ which is fine.

(c) (ii)

B1ft: For deducing that the solutions of $g(2x) = 0$ will be where $x = -1$ and $x = 1.25$

Condone the coordinates appearing $(-1, 0)$ and $(1.25, 0)$

Follow through on their 1.25 of their $g(x) = (x+2)(ax+b)^2$

SC: If a candidate reaches $g(x) = (x+2)(2x+5)^2$, clearly incorrect because of Figure 2, we will award

In (i) M1 A0 for $x \leqslant -2$ or $x < -2$

In (ii) B1 for $x = -1$ and $x = -1.25$

Alt (b)	$4x^3 - 12x^2 - 15x + 50 = (x+2)(ax+b)^2$ $= a^2x^3 + (2ba + 2a^2)x^2 + (b^2 + 4ab)x + 2b^2$		
	Compares terms to get either a or b	M1	1.1b
	Either $a = 2$ or $b = -5$	A1	1.1b
	Multiplies out expression $(x+2)(\pm 2x \pm 5)^2$ and compares to $4x^3 - 12x^2 - 15x + 50$	M1	
	All terms must be compared or else expression must be multiplied out and establishes that $4x^3 - 12x^2 - 15x + 50 = (x+2)(2x-5)^2$	A1	1.1b
		(4)	

Q3.

Question	Scheme	Marks	AOs
(a)	Attempts $\mathrm{f}(4) = 2\times4^3 - 13\times4^2 + 8\times4 + 48$	M1	1.1b
	$\mathrm{f}(4) = 0 \Rightarrow (x-4)$ is a factor	A1	1.1b
		(2)	
(b)	$2x^3 - 13x^2 + 8x + 48 = (x-4)(2x^2 ... x - 12)$	M1	2.1
	$= (x-4)(2x^2 - 5x - 12)$	A1	1.1b
	Attempts to factorise quadratic factor or solve quadratic eqn	dM1	1.1b
	$\mathrm{f}(x) = (x-4)^2(2x+3) \Rightarrow \mathrm{f}(x) = 0$ has only two roots, 4 and -1.5	A1	2.4
		(4)	
(c)	Deduces either three roots or deduces that $\mathrm{f}(x)$ is moved down two units	M1	2.2a
	States three roots, as when $\mathrm{f}(x)$ is moved down two units there will be three points of intersection (with the x - axis)	A1	2.4
		(2)	
(d)	For sight of $k = \pm4, \pm\frac{3}{2}$	M1	1.1b
	$k = 4, -\frac{3}{2}$	A1ft	1.1b
		(2)	
			(10 marks)

Notes
(a) **M1:** Attempts to calculate $\mathrm{f}(4)$. Do not accept $\mathrm{f}(4)=0$ without sight of embedded values or calculations. If values are not embedded look for two correct terms from $\mathrm{f}(4)=128-208+32+48$ Alternatively attempts to divide by $(x-4)$. Accept via long division or inspection. See below for awarding these marks. **A1:** Correct reason with conclusion. Accept $\mathrm{f}(4)=0$, hence factor as long as M1 has been scored. This should really be stated on one line after having performed a correct calculation. It could appear as a preamble if the candidate states "If $\mathrm{f}(4)=0$, then $(x-4)$ is a factor before doing the calculation and then writing hence proven or ✓ oe. If division/inspection is attempted it must be correct and there must be some attempt to explain why they have shown that $(x-4)$ is a factor. Eg Via division they must state that there is no remainder, hence factor **(b)** **M1:** Attempts to find the quadratic factor by inspection (correct first and last terms) or by division (correct first two terms)

So for inspection award for $2x^3-13x^2+8x+48=(x-4)(2x^2 ... x \pm 12)$ For division look for $$\begin{array}{r} 2x^2-5x \\ x-4\overline{)2x^3-13x^2+8x+48} \\ \underline{2x^3-8x^2} \\ -5x^2 \end{array}$$ **A1:** Correct quadratic factor $(2x^2-5x-12)$ For division award for sight of this "in the correct place" You don't have to see it paired with the $(x-4)$ for this mark. **If a student has used division in part (a) they can score the M1 A1 in (b) as soon as they start attempting to factorise their $(2x^2-5x-12)$.** **dM1:** Correct attempt to solve or factorise their $(2x^2-5x-12)$ including use of formula Apply the usual rules $(2x^2-5x-12)=(ax+b)(cx+d)$ where $ac=\pm 2$ and $bd=\pm 12$ Allow the candidate to move from $(x-4)(2x^2-5x-12)$ to $(x-4)^2(2x+3)$ for this mark.

dM1: Correct attempt to solve or factorise their $(2x^2-5x-12)$ including use of formula

Apply the usual rules $(2x^2-5x-12)=(ax+b)(cx+d)$ where $ac=\pm2$ and $bd=\pm12$

Allow the candidate to move from $(x-4)(2x^2-5x-12)$ to $(x-4)^2(2x+3)$ for this mark.

A1: Via factorisation

Factorises twice to $f(x)=(x-4)(2x+3)(x-4)$ or $f(x)=(x-4)^2(2x+3)$ or

$f(x)=2(x-4)^2\left(x+\frac{3}{2}\right)$ followed by a valid explanation why there are only two roots.

The explanation can be as simple as

- hence $x=4$ and $-\frac{3}{2}$ (only). The roots must be correct
- only two distinct roots as 4 is a repeated root

There must be some understanding between roots and factors.

E.g. $f(x)=(x-4)^2(2x+3)$

only two distinct roots is insufficient.

This would require two distinct factors, so there are two distinct roots.

Via solving.

Factorsises to $(x-4)(2x^2-5x-12)$ and solves $2x^2-5x-12=0 \Rightarrow x=4,-\frac{3}{2}$ followed by an explanation that the roots are $4,4,-\frac{3}{2}$ so only two distinct roots.

Note that this question asks the candidate to use algebra so you cannot accept any attempt to use their calculators to produce the answers.

(c)

M1: For a valid **deduction.**

Accept **either** there are 3 roots **or** state that it is a solution of $f(x)=2$ or $f(x)-2=0$

A1: Fully explains:

Eg. States three roots, as $f(x)$ is moved down by **two** units (giving three points of intersection with the x - axis)

Eg. States three roots, as it is where $f(x)=2$ (You may see $y=2$ drawn on the diagram)

(d)

M1: For sight of ±4 **and** $\pm\frac{3}{2}$ Follow through on $\pm$ their roots.

A1ft: $k=4,-\frac{3}{2}$ Follow through on their roots. Accept $4,-\frac{3}{2}$ but not $x=4,-\frac{3}{2}$

Q4.

Question	Scheme	Marks	AOs
(a)	$g(5)=2\times5^3+5^2-41\times5-70=...$	M1	1.1a
	$g(5)=0\Rightarrow(x-5)$ is a factor, hence $g(x)$ is divisible by $(x-5)$.	A1	2.4
		(2)	
(b)	$2x^3+x^2-41x-70=(x-5)(2x^2...x\pm14)$	M1	1.1b
	$=(x-5)(2x^2+11x+14)$	A1	1.1b
	Attempts to factorise quadratic factor	dM1	1.1b
	$(g(x))=(x-5)(2x+7)(x+2)$	A1	1.1b
		(4)	
(c)	$\int 2x^3+x^2-41x-70\,dx=\frac{1}{2}x^4+\frac{1}{3}x^3-\frac{41}{2}x^2-70x$	M1 A1	1.1b 1.1b
	Deduces the need to use $\int_{-2}^{5}g(x)dx$ $-\frac{1525}{3}-\frac{190}{3}$	M1	2.2a
	Area $=571\frac{2}{3}$	A1	2.1
		(4)	
			(10 marks)

Notes

(a)

M1: Attempts to calculate $g(5)$ Attempted division by $(x-5)$ is M0

Look for evidence of embedded values or two correct terms of $g(5)=250+25-205-70=...$

A1: Correct calculation, reason and conclusion. It must follow M1. Accept, for example,

$g(5)=0\Rightarrow(x-5)$ is a factor, hence divisible by $(x-5)$

$g(5)=0\Rightarrow(x-5)$ is a factor ✓

Do not allow if candidate states

$f(5)=0\Rightarrow(x-5)$ is a factor, hence divisible by $(x-5)$ **(It is not f)**

$g(x)=0\Rightarrow(x-5)$ is a factor **(It is not g(x) and there is no conclusion)**

This may be seen in a preamble before finding $g(5)=0$ but in these cases there must be a minimal statement ie QED, "proved", tick etc.

(b)

M1: Attempts to find the quadratic factor by inspection (correct coefficients of first term and ± last term) or by division (correct coefficients of first term and ± second term). Allow this to be scored from division in part (a)

A1: $(2x^2+11x+14)$ You may not see the $(x-5)$ which can be condoned

dM1: Correct attempt to factorise their $(2x^2+11x+14)$

A1: $(g(x)=)\ (x-5)(2x+7)(x+2)$ or $(g(x)=)\ (x-5)(x+3.5)(2x+4)$
It is for the product of factors and not just a statement of the three factors
Attempts with calculators via the three roots are likely to score 0 marks. The question was "Hence" so the two M's must be awarded.

(c)

M1: For $x^n \to x^{n+1}$ for any of the terms in x for $g(x)$ so
$2x^3 \to ...x^4,\ x^2 \to ...x^3,\ -41x \to ...x^2,\ -70 \to ...x$

A1: $\int 2x^3 + x^2 - 41x - 70 \,dx = \frac{1}{2}x^4 + \frac{1}{3}x^3 - \frac{41}{2}x^2 - 70x$ which may be left unsimplified (ignore any reference to $+C$)

M1: Deduces the need to use $\int_{-2}^{5} g(x)dx$.

This may be awarded from the limits on their integral (either way round) or from embedded values which can be subtracted either way round.

A1: For clear work showing all algebraic steps leading to area $= 571\frac{2}{3}$ oe

So allow $\int_{-2}^{5} 2x^3 + x^2 - 41x - 70 \,dx = \left[\frac{1}{2}x^4 + \frac{1}{3}x^3 - \frac{41}{2}x^2 - 70x\right]_{-2}^{5} = -\frac{1715}{3} \Rightarrow$ area $= \frac{1715}{3}$ for 4 marks

Condone spurious notation, as long as the algebraic steps are correct. If they find $\int_{-2}^{5} g(x)dx$ then withhold the final mark if they just write a positive value to this integral since $\int_{-2}^{5} g(x)dx = -\frac{1715}{3}$

Note $\int_{-2}^{5} 2x^3 + x^2 - 41x - 70 \,dx \Rightarrow \frac{1715}{3}$ with no algebraic integration seen scores M0A0M1A0

Q5.

Question	Scheme	Marks	AOs
	Sets $f(-2)=0 \Rightarrow 2\times(-2)^3 - 5\times(-2)^2 + a\times -2 + a = 0$	M1	3.1a
	Solves linear equation $2a - a = -36 \Rightarrow a =$	dM1	1.1b
	$\Rightarrow a = -36$	A1	1.1b
			(3 marks)

Notes:

M1: Selects a suitable method given that $(x + 2)$ is a factor of $f(x)$
Accept either setting $f(-2) = 0$ or attempted division of $f(x)$ by $(x + 2)$

dM1: Solves linear equation in a. Minimum requirement is that there are two terms in 'a' which must be collected to get $..a = .. \Rightarrow a =$

A1: $a = -36$

Q6.

Question	Scheme	Marks	AOs
	(a) $f(x) = -3x^3 + 8x^2 - 9x + 10, \quad x \in \mathbb{R}$		
(a)	(i) $\{f(2) = -24 + 32 - 18 + 10 \Rightarrow\}\ f(2) = 0$	B1	1.1b
	(ii) $\{f(x) =\}\ (x-2)(-3x^2 + 2x - 5)$ or $(2-x)(3x^2 - 2x + 5)$	M1	2.2a
		A1	1.1b
		(3)	
(b)	$-3y^6 + 8y^4 - 9y^2 + 10 = 0 \Rightarrow (y^2 - 2)(-3y^4 + 2y^2 - 5) = 0$		
	Gives a partial explanation by • explaining that $-3y^4 + 2y^2 - 5 = 0$ has no {real} solutions with a reason, e.g. $b^2 - 4ac = (2)^2 - 4(-3)(-5) = -56 < 0$ • or stating that $y^2 = 2$ has 2 {real} solutions or $y = \pm\sqrt{2}$ {only}	M1	2.4
	Complete proof that the given equation has exactly two {real} solutions	A1	2.1
		(2)	
(c)	$3\tan^3\theta - 8\tan^2\theta + 9\tan\theta - 10 = 0;\ 7\pi \le \theta < 10\pi$		
	{Deduces that} there are 3 solutions	B1	2.2a
		(1)	
			(6 marks)

Notes for Question	
(a)(i)	
B1:	$f(2)=0$ or 0 stated by itself in part (a)(i)
(a)(ii)	
M1:	Deduces that $(x-2)$ or $(2-x)$ is a factor and attempts to find the other quadratic factor by • using long division to obtain either $\pm 3x^2 \pm kx + ...$, $k=$ value $\neq 0$ or $\pm 3x^2 \pm \alpha x + \beta$, $\beta =$ value $\neq 0$, α can be 0 • factorising to obtain their quadratic factor in the form $(\pm 3x^2 \pm kx \pm c)$, $k=$ value $\neq 0$, c can be 0, or in the form $(\pm 3x^2 \pm \alpha x \pm \beta)$, $\beta =$ value $\neq 0$, α can be 0
A1:	$(x-2)(-3x^2+2x-5)$, $(2-x)(3x^2-2x+5)$ or $-(x-2)(3x^2-2x+5)$ stated together as a product
(b)	
M1:	See scheme
A1:	See scheme. Proof must be correct *with no errors*, e.g. giving an incorrect discriminant value
Note:	Correct calculation e.g. $(2)^2-4(-3)(-5)$, $4-60$ or -56 must be given for the first explanation
Note:	Note that M1 can be allowed for • a correct follow through calculation for the discriminant of their "$-3y^4+2y^2-5$" which would lead to a value <0 together with an explanation that $-3y^4+2y^2-5=0$ has no {real} solutions • or for the omission of <0
Note:	<0 must also been stated in a discriminant method for A1
Note:	Do not allow A1 for incorrect working, e.g. $(2)^2-4(-3)(-5)=-54<0$
Note:	$y^2=2 \Rightarrow y=\pm 2$, so 2 solutions is not allowed for A1, but can be condoned for M1
Note:	Using the formula on $-3y^4+2y^2-5=0$ or $-3x^2+2x-5=0$ gives y^2 or $x=\frac{-2\pm\sqrt{-56}}{-6}$ or $\frac{-1\pm\sqrt{-14}}{-3}$
Note:	Completing the square on $-3x^2+2x-5=0$ gives $x^2-\frac{2}{3}x+\frac{5}{3}=0 \Rightarrow \left(x-\frac{1}{3}\right)^2-\frac{1}{9}+\frac{5}{3}=0 \Rightarrow x=\frac{1}{3}\pm\sqrt{\frac{-14}{9}}$
Note:	Do not recover work for part (b) in part (c)
(c)	
B1:	See scheme
Note:	Give B0 for stating $\theta =$ awrt 23.1, awrt 26.2, awrt 29.4 **without** reference to 3 solutions

Q7.

Part	Working or answer an examiner might expect to see	Mark	Notes
	$f(-3) = 3 \times (-3)^2 + 2a \times (-3)^2 - 4 \times -3 + 5a = 0$	M1	This mark is given for a method to set $f(-3) = 0$
	$f(-3) = 23a - 69 = 0$ $23a = 69$	M1	This mark is given for finding an equation to solve for a
	$a = 3$	A1	This mark is given for finding the correct value of a

Q8.

Question	Scheme	Marks	AOs
	$f(1)=a(1)^3+10(1)^2-3a(1)-4=0$	M1	3.1a
	$6-2a=0 \Rightarrow a=...$	M1	1.1b
	$a=3$	A1	1.1b
		(3)	
		(3 marks)	
Notes			

Main method seen:

M1: Attempts f (1) = 0 to set up an equation in a It is implied by $a+10-3a-4=0$

Condone a slip but attempting f $(-1)=0$ is M0

M1: Solves a linear equation in a .

Using the main method it is dependent upon having set f $(\pm1)=0$

It is implied by a solution of $\pm a\pm10\pm3a\pm4=0$.

Don't be concerned about the mechanics of the solution.

A1: $a=3$ (following correct work)

Answers without working scores 0 marks. The method must be made clear. Candidates cannot guess. However if a candidate states for example, when $a=3$, $f(x)=3x^3+10x^2-9x-4$ and shows that $(x-1)$ is a factor of this $f(x)$ by an allowable method, they should be awarded M1 M1 A1

E.g. 1: $3x^3+10x^2-9x-4=(x-1)(3x^2+13x+4)$ Hence $a=3$

E.g. 2: $f(x)=3x^3+10x^2-9x-4$, $f(1)=3+10-9-4=0$ Hence $a=3$

The solutions via this method must end with the value for a to score the A1

Other methods are available. They are more difficult to determine what the candidate is doing.
Please send to review if you are uncertain
It is important that a correct method is attempted so look at how the two M's are scored

Amongst others are:
Alt (1) by inspection which may be seen in a table

	ax^2	$(10+a)x$	4
x	ax^3	$(10+a)x^2$	$4x$
-1	$-ax^2$	$-(10+a)x$	-4

$ax^3+10x^2-3ax-4=(x-1)\left(ax^2+(10+a)x+4\right)$ and sets terms in x equal

$-3a=-(10+a)+4 \Rightarrow 2a=6 \Rightarrow a=3$

M1: This method is implied by a **correct** equation, usually $-3a=-(10+a)+4$

M1: Attempts to find the quadratic factor which must be of the form $ax^2+\mathrm{g}(a)x\pm4$ and then forms and solves a linear equation formed by linking the coefficients or terms in x

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Alt (2) By division:

$$\begin{array}{r|l} & ax^2+(\pm10\pm a)x+(10-2a) \\ x-1 & ax^3 \; +10x^2 \quad -3ax-4 \\ & \underline{ax^3-ax^2} \\ & \quad (10+a)x^2-3ax \\ & \quad \underline{(10+a)x^2-(10+a)x} \\ & \qquad\qquad (-2a+10)x \end{array}$$

M1: This method is implied by a **correct** equation, usually $-10+2a=-4$

M1: Attempts to divide with quotient of $ax^2+(\pm10\pm a)x+\mathrm{h}(a)$ and then forms and solves a linear equation in a formed by setting the remainder $=0$.