7 (a) Sketch the curve with equation $y = x(x+3)^2$.

[3 marks]

(b) The polynomial $\mathrm{p}(x)$ is given by $\mathrm{p}(x) = x(x+3)^2 + 4$.

(i) Use the Factor Theorem to show that $x+4$ is a factor of $\mathrm{p}(x)$.

[2 marks]

(ii) Use the Remainder Theorem to find the remainder when $\mathrm{p}(x)$ is divided by $x-2$.

[2 marks]

(iii) Express $\mathrm{p}(x)$ in the form $(x-2)(x^2+bx+c)+r$.

[3 marks]

1 (a) The polynomial $\mathrm{f}(x)$ is defined by $\mathrm{f}(x) = 8x^3 - 6x^2 + 9x - 5$.

Find the remainder when $\mathrm{f}(x)$ is divided by $4x-1$.

[2 marks]

(b) The polynomial $\mathrm{g}(x)$ is defined by $\mathrm{g}(x) = 8x^3 - 6x^2 + 9x + d$.

(i) Given that $4x-1$ is a factor of $\mathrm{g}(x)$, find the value of the constant d.

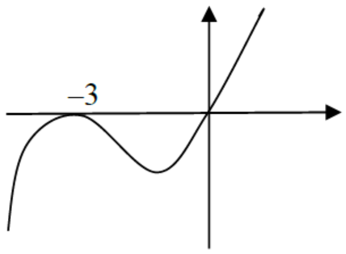
[1 mark]

(ii) Given that $\mathrm{g}(x) = (4x-1)\left(ax^2+bx+c\right)$, find the integers a, b and c.

[2 marks]

(iii) Show that the equation $\mathrm{g}(x) = 0$ has only one real solution and state this solution.

[2 marks]

Q7	Solution	Mark	Total	Comment
(a)		M1		curve through origin with one max and one min and touching negative x-axis
		A1		shape roughly as drawn
		A1	3	–3 marked and correct curvature (must earn previous **A1**)
(b)(i)	$p(-4) = -4(-1)^2 + 4$	M1		clear attempt at p(–4) using given expression or multiplied out
	$= -4 + 4 = 0$ therefore $x+4$ is a factor	A1	2	all working correct plus statement
(ii)	$p(2) = 2(5)^2 + 4$	M1		clear attempt at p(2) using given expression or multiplied out
	(Remainder =) 54	A1	2	
(iii)	Attempt at long division by $(x–2)$	M1		or multiplying out & comparing coefficients
	$x^2 + 8x + \ldots$	A1		
	$(x-2)(x^2+8x+25)+54$	A1	3	
	Total		10	

Q 1	Solution	Mark	Total	Comment
(a)	$f\left(\frac{1}{4}\right) = 8 \times \left(\frac{1}{4}\right)^3 - 6 \times \left(\frac{1}{4}\right)^2 + 9 \times \left(\frac{1}{4}\right) - 5$	M1		Attempt at evaluation of $f\left(\frac{1}{4}\right)$
	$= -3$	A1	2	
	<u>**Alternative**</u> Long division by $(4x-1)$ as far as $2x^2+bx+c$ in quotient **and** a numerical remainder **M1** $R = -3$ **A1**			
(b)(i)	$g\left(\frac{1}{4}\right) = 2 + d = 0 \rightarrow d = -2$	B1	1	NMS: $d = -2$ **B1**
(ii)	$g(x) = (4x-1)(2x^2+bx+2)$	M1		Spotting $a = 2$ and $c = 2$ by factors.
	$b = -1$	A1	2	Correct a, b and c values sufficient
(iii)	Attempt to calculate $b^2 - 4ac$ for **their** quadratic	M1		
	$= 1 - 16$			
	$= -15$			
	Negative (or < 0) so $x = \frac{1}{4}$ is only solution	A1	2	**Must** score 2/2 in part (b)(ii) and correct evaluation of discriminant.

3 The polynomial $p(x)$ is given by $p(x) = x^3 - 7x^2 - 5x + 26$.

(a) (i) Use the Factor Theorem to show that $x + 2$ is a factor of $p(x)$.

[2 marks]

(ii) Express $p(x)$ in the form $(x + 2)(x^2 + bx + c)$, where b and c are integers.

[2 marks]

(b) A curve has equation $y = x^3 - 7x^2 - 5x + 26$.

(i) Use the result from part **(a)(ii)** to determine the number of times the curve crosses the x-axis.

[2 marks]

(ii) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$.

[3 marks]

(iii) Hence show that the curve has a maximum point when $x = -\frac{1}{3}$.

[3 marks]

3 The polynomial $p(x)$ is given by

$$p(x) = x^3 + bx^2 + cx + 24$$

where b and c are integers.

(a) Given that $x + 2$ is a factor of $p(x)$, show that $2b - c + 8 = 0$.

[2 marks]

(b) The remainder when $p(x)$ is divided by $x - 3$ is -30.

Obtain a further equation in b and c.

[2 marks]

(c) Use the equations from parts **(a)** and **(b)** to find the value of b and the value of c.

[3 marks]

Q3	Solution	Mark	Total	Comment
(a)(i)	$[p(-2)=]\ (-2)^3-7(-2)^2-5(-2)+26$	M1		clear attempt at p(–2) NOT long division
	$=-8-28+10+26$ $=0$ therefore $x+2$ is a factor	A1	2	must see powers of –2 simplified correctly working showing that p(–2)=0 and correct statement
(ii)	$b=-9$ **or** $c=13$	M1		by inspection
	$[p(x)=]\ (x+2)(x^2-9x+13)$	A1	2	correct product with brackets correct
(b)(i)	b^2-4ac for "their" quadratic as far as $\left[(-9)^2-4\times 13=\right]\ 81-52$	M1		condone -9^2 if recovered as 81
	$29>0$ **or** $81-52>0$ **or (*)** (so curve crosses x-axis) 3 times	A1	2	**(*)** stating quadratic has 2 (real) roots correct deduction and quadratic correct
(ii)	$\left[\frac{dy}{dx}=\right]\ 3x^2-14x-5$	M1 A1		2 terms correct all correct
	$\left[\frac{d^2y}{dx^2}=\right]\ 6x-14$	B1	3	
(iii)	$\left[\frac{dy}{dx}=\right]\ 3\left(-\frac{1}{3}\right)^2-14\left(-\frac{1}{3}\right)-5$ **or** $\left[\frac{d^2y}{dx^2}=\right]\ 6\left(-\frac{1}{3}\right)-14$	M1		correct substitution of $x=-\frac{1}{3}$ into "their" $\frac{dy}{dx}$ **or** "their" $\frac{d^2y}{dx^2}$
	$\frac{dy}{dx}=\frac{1}{3}+\frac{14}{3}-5=0$	A1		convincingly showing $\frac{dy}{dx}=0$ **and** $\frac{dy}{dx}=\ldots$ **must** appear on at least one line
	$\frac{d^2y}{dx^2}=-2-14(=-16)<0$ $\Rightarrow$ maximum	A1	3	correct and $\frac{d^2y}{dx^2}$ seen & value shown to be <0 & statement **must** earn **M1 A1** to earn final **A1**

Q3	Solution	Mark	Total	Comment
(a)	$(-2)^3+b(-2)^2+c(-2)+24$	M1		clear attempt at p(–2)
	$-8+4b-2c+24=0$ $2b-c+8=0$	A1	2	**AG** must see powers of –2 simplified correctly and = 0 appearing before last line
(b)	$3^3+3^2b+3c+24=-30$	M1		clear attempt at p(3) **and** $=-30$
	$27+9b+3c+24=-30$ $3b+c+27=0$	A1	2	**ACF** terms need not be collected but powers of 3 must be evaluated **No ISW** - mark their final equation
(c)	Correctly eliminating b or c from $2b-c+8=0$ and an equation from **(b)**	M1		**PI** by one correct answer
	$b=-7$ or $c=-6$	A1		
	$b=-7$ **and** $c=-6$	A1	3	
	Total		7	

4 The polynomial $\mathrm{p}(x)$ is given by $\mathrm{p}(x) = x^3 - 5x^2 - 8x + 48$.

(a) (i) Use the Factor Theorem to show that $x + 3$ is a factor of $\mathrm{p}(x)$.

[2 marks]

(ii) Express $\mathrm{p}(x)$ as a product of three linear factors.

[3 marks]

(b) (i) Use the Remainder Theorem to find the remainder when $\mathrm{p}(x)$ is divided by $x - 2$.

[2 marks]

(ii) Express $\mathrm{p}(x)$ in the form $(x - 2)(x^2 + bx + c) + r$, where b, c and r are integers.

[3 marks]

7 (a) Sketch the curve with equation $y = x^2(x - 3)$.

[3 marks]

(b) The polynomial $\mathrm{p}(x)$ is given by $\mathrm{p}(x) = x^2(x - 3) + 20$.

(i) Find the remainder when $\mathrm{p}(x)$ is divided by $x - 4$.

[2 marks]

(ii) Use the Factor Theorem to show that $x + 2$ is a factor of $\mathrm{p}(x)$.

[2 marks]

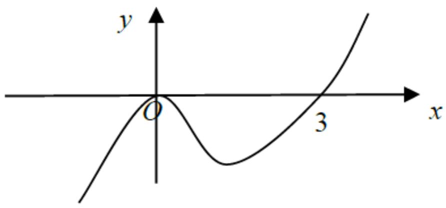
(iii) Express $\mathrm{p}(x)$ in the form $(x + 2)(x^2 + bx + c)$, where b and c are integers.

[2 marks]

(iv) Hence show that the equation $\mathrm{p}(x) = 0$ has exactly one real root and state its value.

[3 marks]

Q4	Solution	Mark	Total	Comment
(a)(i)	$(p(-3)) = (-3)^3 - 5(-3)^2 - 8(-3) + 48$	M1		clear attempt at p(–3) NOT long division
	$= -27 - 45 + 24 + 48$ $= 0$ therefore $x + 3$ is a factor	A1	2	must see powers of –3 simplified correctly working showing that p(–3)=0 and correct statement
(ii)	$x^2 + bx + c$ *with* $b = -8$ **or** $c = 16$	M1		by inspection
	$x^2 - 8x + 16$	A1		may see as quotient in long division
	$(p(x) =)\ (x+3)(x-4)(x-4)$	A1	3	must see product
(b)(i)	$p(2) = 2^3 - 5 \times 2^2 - 8 \times 2 + 48$	M1		clear attempt at p(2) NOT long division
	= 8–20–16+48 (Remainder =) 20	A1	2	
(ii)	Quadratic factor $x^2 + bx + c$			
	$b = -3$ **or** $c = -14$	M1		by inspection
	$x^2 - 3x - 14$	A1		may see as quotient in long division
	$(p(x) =)\ (x-2)(x^2 - 3x - 14) + 20$	A1	3	must see full correct expression
	Total		**10**	

Q7	Solution	Mark	Total	Comment
(a)		M1		cubic curve touching at O – one max, one min (may have minimum at O)
		A1		shape roughly as shown crossing positive x-axis
		A1	3	3 marked and correct curvature for $x < 0$ and $x > 3$
(b)(i)	$p(4) = 4^2(4-3) + 20$	M1		p(4) attempted **or** full long division as far as remainder term
	(Remainder) $= 36$	A1	2	
(ii)	$p(-2) = (-2)^2(-2-3) + 20$	M1		p(–2) attempted NOT long division
	$= 4 \times (-5) + 20 = 0$ *or* $-20 + 20 = 0$ therefore $(x + 2)$ is a factor	A1	2	working showing that p(–2) = 0 and statement
(iii)	$x^2 + bx + c$ *with* $b = -5$ **or** $c = 10$	M1		by inspection
	$(x+2)(x^2 - 5x + 10)$	A1	2	must see product
(iv)	Discriminant of "their" quadratic $= (-5)^2 - 4 \times 10$	M1		be careful that cubic coefficients are not being used
	$-15 < 0$ so quadratic has no real roots	A1cso		
	(only real root is) –2	B1	3	independent of previous marks

3 (a) The polynomial $f(x)$ is defined by $f(x) = 6x^3 - 11x^2 + 2x + 8$.

(i) Use the Factor Theorem to show that $(3x + 2)$ is a factor of $f(x)$.

[2 marks]

(ii) Show that $f(x)$ has no other linear factors.

[4 marks]

(b) The polynomial $g(x)$ is defined by $g(x) = f(x) - (6x^2 - 2x - 4)$.

Given that $(3x + 2)$ is a factor of $g(x)$, express $g(x)$ as a product of three linear factors.

[2 marks]

(c) The function h is defined by $h(x) = \dfrac{g(x)}{6x^3 - 5x^2 - 6x}$.

Show that $h(x)$ can be simplified to the form $p + qx^n$ where p, q and n are integers.

[2 marks]

Q3	Solution	Mark	Total	Comment
(a)(i)	$f\left(-\frac{2}{3}\right)=6\left(-\frac{2}{3}\right)^3-11\left(-\frac{2}{3}\right)^2+2\left(-\frac{2}{3}\right)+8$ $=0$ (hence) factor	M1 A1	 2	Attempt at $f\left(-\frac{2}{3}\right)$ **Correct** arithmetic seen **and** conclusion.
	Question says 'Use the factor theorem' so long division scores **0/2**. Candidate could imply conclusion at beginning, e.g. $3x+2$ is a factor if $f\left(-\frac{2}{3}\right)=0$ etc. Just $f\left(-\frac{2}{3}\right)=6\left(-\frac{2}{3}\right)^3-11\left(-\frac{2}{3}\right)^2+2\left(-\frac{2}{3}\right)+8=-8+8=0$ and conclusion is **M1 A0** as no 'arithmetic' but seeing such as $f\left(-\frac{2}{3}\right)=-\frac{48}{27}-\frac{44}{9}-\frac{4}{3}+8$ OE $=0$ and conclusion would score **M1 A1.**			
(a)(ii)	Attempt at quadratic factor $2x^2-5x+4$ $b^2-4ac=25-32$ or -7 <0 OE so no (more) factors / roots / solutions	M1 A1 dM1 A1	 4	e.g. long division or factorising Correct quadratic Correct b^2-4ac for **their** quadratic Valid reason and conclusion needed.
	To earn the **M1** for any approach we must see either $(2x^2-5x+c)$ or $(2x^2+bx+4)$ PI. If $\left(x+\frac{2}{3}\right)$ is used instead of $(3x+2)$ we need $(6x^2-15x+c)$ or $(6x^2+bx+12)$ for **M1** The d**M1** is for a **correct** b^2-4ac for **their** quadratic (can be unsimplified) – e.g. $5^2-4(2)(4)$. If using completing the square we need to see the form $p(x-q)^2=r$ **correct** for their quadratic For final **A1**, candidates must have a **correct** quadratic, **correct** discriminant and **correct** conclusion.			
(b)	$g(x)=(3x+2)(2x^2-5x+4)$ $-(3x+2)(2x-2)$ $=(3x+2)(2x^2-7x+6)$ $=(3x+2)(x-2)(2x-3)$	 M1 A1	 2	or $g(x)=6x^3-17x^2+4x+12$ Attempt at quadratic factor Correct three linear factors
	If using known factor **M1** could be earned for $(3x+2)(2x^2-7x+c)$ or $(3x+2)(2x^2+bx+6)$ If using another factor **M1** could be earned for $(x-2)(6x^2-5x+c)$ or $(x-2)(6x^2+bx-6)$ or $(2x-3)(3x^2-4x+c)$ or $(2x-3)(3x^2+bx-4)$ If a calculator is used to solve the cubic in order to factorise, it scores **0/2** or **2/2** e.g. $\left(x+\frac{2}{3}\right)(x-2)\left(x-\frac{3}{2}\right)$ would score **0/2** but $6\left(x+\frac{2}{3}\right)(x-2)\left(x-\frac{3}{2}\right)$ would score **2/2**.			
(c)	$h(x)=\dfrac{g(x)}{6x^3-5x^2-6x}$ $=\dfrac{(3x+2)(x-2)(2x-3)}{x(3x+2)(2x-3)}$ $\left(=\frac{x-2}{x}\right) \quad = 1-2x^{-1}$	M1 A1	 2	Attempt at full linear factors **and** cancelling at least one common factor. PI by correct answer in any form. Final answer must be seen in this form.
	For **M1** we need to see $\dfrac{\text{their three linear factors from (b)}}{x(3x+2)(rx+s)}$ cancelled down by at least one factor. No need to state $p=1, q=-2$ and $n=-1$; apply **ISW** once correct answer seen.			
	Total		**10**	

9. The curve C has equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}'(x) = (x - 3)(3x + 5)$$

Given that the point P (1, 20) lies on C,

(a) find $\mathrm{f}(x)$, simplifying each term.

(5)

(b) Show that

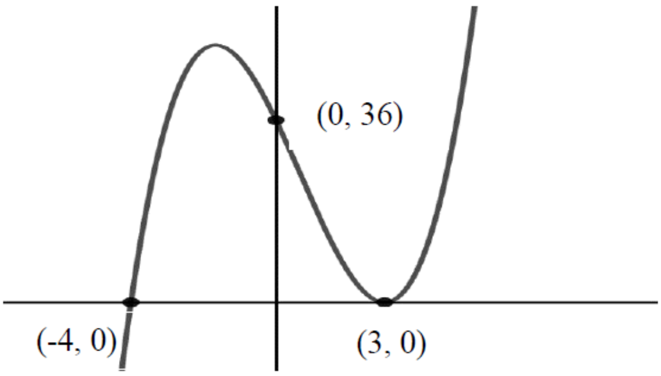
$$\mathrm{f}(x) = (x - 3)^2(x + A)$$

where A is a constant to be found.

(3)

(c) Sketch the graph of C. Show clearly the coordinates of the points where C cuts or meets the x-axis and where C cuts the y-axis.

(4)

Question Number	Scheme		Marks
9.(a)	$(x-3)(3x+5)=3x^2-4x-15$ Allow $3x^2+5x-9x-15$	Correct expansion simplified or un-simplified.	B1
	$f(x)=x^3-2x^2-15x+c$	M1: $x^n \to x^{n+1}$ for any term. Follow through on incorrect indices but not for "+ c" A1: All terms correct. Need not be simplified. No need for + c here.	M1A1
	$x=1, y=20 \Rightarrow 20=1-2-15+c$ $\Rightarrow c=36$	Substitutes x = 1 and y = 20 into their f(x) to find c. Must have + c at this stage. **Dependent on the first method mark.**	**d**M1
	$(f(x)=)x^3-2x^2-15x+36$	Cao $(f(x)=)x^3-2x^2-15x+36$ (All together and on one line)	A1
			(5)
(b) Way 1	$A=4$	Correct value (may be implied)	B1
	$f(x)=(x-3)^2(x+A)=(x^2-6x+9)(x+A)$ $f(x)=x^3+(A-6)x^2+(9-6A)x+9A$ $A-6=-2 \Rightarrow A=4 \quad 9-6A=-15 \Rightarrow A=4 \quad 9A=36 \Rightarrow A=4$ M1: Expands $(x-3)^2(x+A)$ and compares coefficients with their f(x) from part (a) to **form 3 equations** and attempts to solve **at least two of them** in an attempt to show that A is the same in each case or substitutes their A to show that the coefficients are the same. A1: Fully correct proof – must use all 3 coefficients		M1A1
			(3)
9(c)			

8. (a) Factorise completely $9x - 4x^3$

(3)

(b) Sketch the curve C with equation

$$y = 9x - 4x^3$$

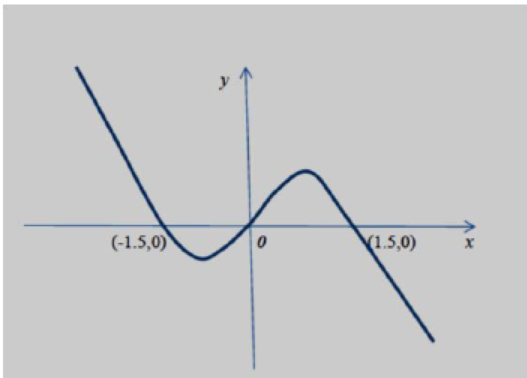
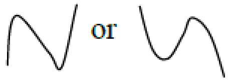
Show on your sketch the coordinates at which the curve meets the x-axis.

(3)

The points A and B lie on C and have x coordinates of -2 and 1 respectively.

(c) Show that the length of AB is $k\sqrt{10}$ where k is a constant to be found.

(4)

8(a)	$9x-4x^3=x(9-4x^2)$ or $-x(4x^2-9)$	Takes out a common factor of x or $-x$ **correctly.**	B1
	$9-4x^2=(3+2x)(3-2x)$ or $4x^2-9=(2x-3)(2x+3)$	$9-4x^2=(\pm3\pm2x)(\pm3\pm2x)$ or $4x^2-9=(\pm2x\pm3)(\pm2x\pm3)$	M1
	$9x-4x^3=x(3+2x)(3-2x)$	Cao but allow equivalents e.g. $x(-3-2x)(-3+2x)$ or $-x(2x+3)(2x-3)$	A1
Note: $4x^3-9x=x(4x^2-9)=x(2x-3)(2x+3)$ so $9x-4x^3=x(3-2x)(2x+3)$ **would score full marks**			
	Note: Correct work leading to $9x\left(1-\frac{2}{3}x\right)\left(1+\frac{2}{3}x\right)$ **would score full marks**		
	Allow ($x\pm0$) or ($-x\pm0$) instead of x and $-x$		
			(3)
(b)		 or A cubic shape with one maximum and one minimum	M1
		Any line or curve drawn passing through (not touching) the origin	B1
		Must be the correct shape and in all four quadrants and pass through (-1.5, 0) and (1.5, 0) (Allow (0, -1.5) and (0, 1.5) or just -1.5 and 1.5 provided they are positioned correctly). **Must be on the diagram** (Allow $\sqrt{\frac{9}{4}}$ for 1.5)	A1
			(3)
(c)	$A=(-2,\ 14),\quad B=(1,\ 5)$	B1: $y=14$ **or** $y=5$ B1: $y=14$ **and** $y=5$	B1 B1
	These must be seen or used in (c)		
	$(AB=)\sqrt{(-2-1)^2+(14-5)^2}\left(=\sqrt{90}\right)$	**Correct** use of Pythagoras <u>including the square root.</u> Must be a correct expression for their A and B if a correct formula is not quoted	M1
	E.g. $AB=\sqrt{(-2+1)^2+(14-5)^2}$ **scores M0.** **However** $AB=\sqrt{(y_2-y_1)^2+(x_2-x_1)^2}=\sqrt{(-2+1)^2+(14-5)^2}$ **scores M1**		
	$(AB=)3\sqrt{10}$	cao	A1
			(4)
			(10 marks)

2.

$$f(x) = 3x^3 - 25x^2 + ax - 15, \text{ where } a \text{ is a constant}$$

Given that $(x - 3)$ is a factor of $f(x)$,

(a) find the value of a,

(2)

(b) factorise $f(x)$ completely, using algebra.

(4)

3. $$f(x) = 24x^3 + Ax^2 - 3x + B$$

where A and B are constants.

When $f(x)$ is divided by $(2x - 1)$ the remainder is 30

(a) Show that $A + 4B = 114$

(2)

Given also that $(x + 1)$ is a factor of $f(x)$,

(b) find another equation in A and B.

(2)

(c) Find the value of A and the value of B.

(2)

(d) Hence find a quadratic factor of $f(x)$.

(2)

2. (a)	Way 1: Attempt $f(3)$ or $f(-3)$ and put equal to 0 (So $81-225+3a-15=0$ and) obtains $a = 53$	M1 A1 **(2)**
	Way 2: Divides by $(x-3)$ to obtain quadratic and puts their remainder " $a-48-5$" = 0 obtains $a = 53$	M1 A1 **(2)**
(b)	$(f(x)=)\quad (x-3)(3x^2 \ldots\ldots\ldots\ldots)$	M1
	$\ldots\ldots\ldots\ldots(3x^2-16x+5)$	A1
	$(f(x)=)\quad (x-3)(3x-1)(x-5)$	dM1A1 cso
		(4) **(6 marks)**

3. (a)	Way 1 Use $f(1/2)$ or $f(-1/2)$ and put equal to 30	Way 2 Long division of f(x) by ($2x$ -1) as far as remainder put = 30	M1
	Stated $\frac{24}{8}+\frac{1}{4}A-\frac{3}{2}+B=30$ and $A + 4B = 114$ *	Obtains $B+\frac{1}{4}A+\frac{3}{2}=30$ (o.e) and $A + 4B = 114$ *	A1* **(2)**
(b)	Way 1 Used f(-1) or f(1) = 0	Way 2 Long division of f(x) by (x +1) as far as remainder put = 0	M1
	Stated -24+A+3+B = 0 so $A + B = 21$	Obtains $B - 21 + A = 0$	A1 **(2)**
(c)	Solves to obtain one of A or B		M1
	Obtains both A = -10 and B = 31		A1 **(2)**
(d)	$f(x)=(x+1)(24x^2-34x+31)$ or factor is $(24x^2-34x+31)$		M1A1 **(2)**
			(8 marks)

6. $$f(x) = -6x^3 - 7x^2 + 40x + 21$$

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

(2)

(b) Factorise $f(x)$ completely.

(4)

(c) Hence solve the equation

$$6(2^{3y}) + 7(2^{2y}) = 40(2^y) + 21$$

giving your answer to 2 decimal places.

(3)

4. $$f(x) = 6x^3 + 13x^2 - 4$$

(a) Use the remainder theorem to find the remainder when $f(x)$ is divided by $(2x + 3)$.

(2)

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

(2)

(c) Factorise $f(x)$ completely.

(4)

3. $f(x) = 6x^3 + 3x^2 + Ax + B$, where A and B are constants.

Given that when $f(x)$ is divided by $(x + 1)$ the remainder is 45,

(a) show that $B - A = 48$

(2)

Given also that $(2x + 1)$ is a factor of $f(x)$,

(b) find the value of A and the value of B.

(4)

(c) Factorise $f(x)$ fully.

(3)

6. (a)	Attempt $f(3)$ or $f(-3)$ Use of long division is M0A0 as factor theorem was required.	M1
	$f(-3) = 162 - 63 - 120 + 21 = 0$ so $(x + 3)$ is a factor	A1
		(2)
(b)	Either (Way 1): $f(x) = (x + 3)(-6x^2 + 11x + 7)$	M1A1
	$= (x + 3)(-3x + 7)(2x + 1)$ or $-(x + 3)(3x - 7)(2x + 1)$	M1A1
		(4)
	Or (Way 2) Uses trial or factor theorem to obtain $x = -1/2$ **or** $x = 7/3$	M1
	Uses trial or factor theorem to obtain both $x = -1/2$ **and** $x = 7/3$	A1
	Puts three factors together (see notes below)	M1
	Correct factorisation : $(x + 3)(7 - 3x)(2x + 1)$ or $-(x + 3)(3x - 7)(2x + 1)$ oe	A1
		(4)
	Or (Way 3) No working three factors $(x + 3)(-3x + 7)(2x + 1)$ otherwise need working	M1A1M1A1
		(4)
(c)	$2^y = \frac{7}{3}, \rightarrow \log(2^y) = \log\left(\frac{7}{3}\right)$ or $y = \log_2\left(\frac{7}{3}\right)$ or $\frac{\log(7/3)}{\log 2}$	B1, M1
	$\{y = 1.222392421...\} \Rightarrow y =$ awrt 1.22	A1
		(3)
		[9]

4.	$f(x) = 6x^3 + 13x^2 - 4$		
(a)	$f\left(-\frac{3}{2}\right) = 6\left(-\frac{3}{2}\right)^3 + 13\left(-\frac{3}{2}\right)^2 - 4 = 5$	Attempting $f\left(-\frac{3}{2}\right)$ or $f\left(\frac{3}{2}\right)$	M1
		5	A1 cao
			[2]
(b)	$f(-2) = 6(-2)^3 + 13(-2)^2 - 4$	Attempts $f(-2)$.	M1
	$= 0$, **and** so $(x + 2)$ is a factor.	$f(-2) = 0$ with no sign or substitution errors **and for conclusion.**	A1
			[2]
(c)	$f(x) = \{(x + 2)\}(6x^2 + x - 2)$		M1 A1
	$= (x + 2)(2x - 1)(3x + 2)$		M1 A1
			[4]
			8

3.	$f(x) = 6x^3 + 3x^2 + Ax + B$	
Way 1 (a)	Attempting $f(1) = 45$ or $f(-1) = 45$	M1
	$f(-1) = -6 + 3 - A + B = 45$ or $-3 - A + B = 45 \Rightarrow B - A = 48$ * (allow $48 = B - A$)	A1 * **cso**
		(2)
Way 1 (b)	Attempting $f(-\frac{1}{2}) = 0$	M1
	$6(-\frac{1}{2})^3 + 3(-\frac{1}{2})^2 + A(-\frac{1}{2}) + B = 0$ or $-\frac{1}{2}A + B = 0$ or $A = 2B$	A1 o.e.
	Solve to obtain $B = -48$ and $A = -96$	M1 A1
		(4)
(c)	Obtain $(3x^2 - 48), (x^2 - 16), (6x^2 - 96), \left(3x^2 + \frac{A}{2}\right), (3x^2 + B), \left(x^2 + \frac{A}{6}\right)$ or $\left(x^2 + \frac{B}{3}\right)$ as factor or as quotient after division by $(2x + 1)$. Division by $(x+4)$ or $(x-4)$ see below	B1ft
	Factorises $(3x^2 - 48), (x^2 - 16), (48 - 3x^2), (16 - x^2)$ or $(6x^2 - 96)$	M1
	$= 3(2x + 1)(x + 4)(x - 4)$ (if this answer follows from a wrong A or B then award A0)	A1cso
	isw if they go on to solve to give $x = 4$, -4 and -1/2	**(3) [9]**