Question number	Scheme	Marks	
3.	(a) Attempt to evaluate f(–4) or f(4)	M1	
1	$f(-4) = 2(-4)^3 + (-4)^2 - 25(-4) + 12 \quad (= 128 + 16 + 100 + 12) \; = 0$, so ….. is a factor.	A1	(2)
	(b) $(x+4)(2x^2 - 7x + 3)$	M1 A1	
	……..$(2x-1)(x-3)$	M1 A1	(4)
			6
	(b) First M requires $(2x^2 + ax + b)$, $a \neq 0, b \neq 0$. Second M for the attempt to factorise the quadratic. Alternative: $(x+4)(2x^2 + ax + b) = 2x^3 + (8+a)x^2 + (4a+b)x + 4b = 0$, then compare coefficients to find values of a and b. [M1] $a = -7, \; b = 3$ [A1] Alternative: Factor theorem: Finding that $f\left(\frac{1}{2}\right) = 0, \therefore (2x-1)$ is a factor [M1, A1] n.b. Finding that $f\left(\frac{1}{2}\right) = 0, \therefore (x - \frac{1}{2})$ is a factor scores M1, A0 ,unless the factor 2 subsequently appears. Finding that $f(3) = 0, \therefore (x-3)$ is a factor [M1, A1]		

Question number	Scheme		Marks	
1.	(a) 2+1-5 + c = 0 or -2 + c = 0		M1	
2	$\underline{c = 2}$		A1	(2)
	(b) $f(x) = (x-1)(2x^2+3x-2)$	$(x-1)$	B1	
		division	M1	
	$= \ldots \underline{(2x-1)(x+2)}$		M1 A1	(4)
	(c) $f\left(\frac{3}{2}\right) = 2\times\frac{27}{8}+\frac{9}{4}-\frac{15}{2}+c$		M1	
	Remainder = c + 1.5 = $\underline{3.5}$	ft their c	A1ft	(2)
			Total 8 marks	

2.	(a) $(1+px)^9 = 1+9px\ ;\ +\binom{9}{2}(px)^2$		B1 B1	(2)
	(b) $9p = 36$, so $\underline{p=4}$		M1 A1	
	$q = \frac{9\times 8}{2}p^2$ or $36p^2$ or $36p$ if that follows from their (a)		M1	
	So $\underline{q = 576}$		A1cao	(4)
			Total 6 marks	
3.	(a) $(AB)^2 = (4-3)^2+(5)^2$ [= 26]		M1	
	$AB = \underline{\sqrt{26}}$		A1	(2)
	(b) $p = \left(\frac{4+3}{2}, \frac{5}{2}\right)$		M1	
	$= \underline{\left(\frac{7}{2}, \frac{5}{2}\right)}$		A1	(2)
	(c) $(x-x_p)^2+(y-y_p)^2 = \left(\frac{AB}{2}\right)^2$	LHS	M1	
		RHS	M1	
	$(x-3.5)^2+(y-2.5)^2 = 6.5$	oe	A1 c.a.o	(3)
			Total 7 marks	

Question Number	Scheme	Marks	
2	(a) Attempting to find $\mathrm{f}(3)$ or $\mathrm{f}(-3)$	M1	
3	$\mathrm{f}(3) = 3(3)^3 - 5(3)^2 - (58 \times 3) + 40 = 81 - 45 - 174 + 40 = -98$	A1	(2)
	(b) $\{3x^3 - 5x^2 - 58x + 40 = (x-5)\}\ (3x^2 + 10x - 8)$	M1 A1	
	Attempt to <u>factorise</u> 3-term quadratic, or to use the quadratic formula (see general principles at beginning of scheme). This mark may be implied by the correct solutions to the quadratic.	M1	
	$(3x-2)(x+4) = 0 \quad x = \ldots.$ <u>or</u> $x = \dfrac{-10 \pm \sqrt{100+96}}{6}$	A1 ft	
	$\dfrac{2}{3}$ (or exact equiv.), -4, 5 (Allow 'implicit' solns, e.g. $\mathrm{f}(5) = 0$, etc.)	A1	(5)
	Completely correct solutions without working: full marks.		7

(a) <u>Alternative (long division):</u>

Divide by $(x-3)$ to get $(3x^2 + ax + b)$, $a \neq 0, b \neq 0$. [M1]

$(3x^2 + 4x - 46)$, and -98 seen. [A1]

(If continues to say 'remainder = 98', isw)

<u>'Grid' method</u>

3	3	−5	−58	40
	0	9	12	−138
	3	4	−46	−98

(b) 1st M requires use of $(x-5)$ to obtain $(3x^2 + ax + b)$, $a \neq 0, b \neq 0$.

(Working need not be seen... this could be done 'by inspection'.)

<u>'Grid' method</u>

3	3	−5	−58	40
	0	15	50	−40
	3	10	−8	0

$(3x^2 + 10x - 8) \longleftarrow$

2nd M for the attempt to <u>factorise</u> their 3-term quadratic, or to solve it using the quadratic formula.

Factorisation: $(3x^2 + ax + b) = (3x + c)(x + d)$, where $|cd| = |b|$.

A1ft: Correct factors for their 3-term quadratic <u>followed by a solution</u> (at least one value, which might be incorrect), <u>or</u> numerically correct expression from the quadratic formula for their 3-term quadratic.

<u>Note</u> therefore that if the quadratic is correctly factorised but no solutions are given, the last 2 marks will be lost.

<u>Alternative (first 2 marks):</u>

$(x-5)(3x^2 + ax + b) = 3x^3 + (a-15)x^2 + (b-5a)x - 5b = 0$,

then compare coefficients to find <u>values</u> of a and b. [M1]

$a = 10,\ b = -8$ [A1]

<u>Alternative 1</u>: (factor theorem)

M1: Finding that $\mathrm{f}(-4) = 0$

A1: Stating that $(x+4)$ is a factor.

M1: Finding third factor $(x-5)(x+4)(3x \pm 2)$.

A1: Fully correct factors (no ft available here) <u>followed by a solution</u>, (which might be incorrect).

A1: All solutions correct.

<u>Alternative 2</u>: (direct factorisation)

M1: Factors $(x-5)(3x+p)(x+q)$ A1: $pq = -8$

M1: $(x-5)(3x \pm 2)(x \pm 4)$

Final A marks as in Alternative 1.

Throughout this scheme, allow $\left(x \pm \dfrac{2}{3}\right)$ as an alternative to $(3x \pm 2)$.

Question Number	Scheme	Marks
1.	$\int\left(2x+3x^{\frac{1}{2}}\right)\,\mathrm{d}x=\frac{2x^2}{2}+\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}$	M1 A1 A1
	$\int_1^4\left(2x+3x^{\frac{1}{2}}\right)\,\mathrm{d}x=\left[x^2+2x^{\frac{3}{2}}\right]_1^4=(16+2\times8)-(1+2)$	M1
	$=29$ (29 + C scores A0)	A1 (5)
		(5 marks)
2. (a)	$(7\times\ldots\times x)$ or $(21\times\ldots\times x^2)$ The 7 or 21 can be in 'unsimplified' form.	M1
	$(2+kx)^7=2^7+2^6\times7\times kx+2^5\times\binom{7}{2}k^2x^2$	
	$=128;\quad +448kx,\quad +672k^2x^2$	B1; A1, A1
	(If $672kx^2$ follows $672(kx)^2$, ignore subsequent working and allow A1)	(4)
(b)	$6\times448k=672k^2$	M1
	$k=4$ (Ignore $k=0$, if seen)	A1 (2)
		(6 marks)
3. (a) 4	$\mathrm{f}(k)=-8$	B1 (1)
(b)	$\mathrm{f}(2)=4\Rightarrow\quad 4=(6-2)(2-k)-8$	M1
	So $k=-1$	A1 (2)
(c)	$\mathrm{f}(x)=3x^2-(2+3k)x+(2k-8)\quad=3x^2+x-10$	M1
	$=(3x-5)(x+2)$	M1 A1 (3)
		(6 marks)
4. (a)	$x=2$ gives 2.236 (allow AWRT) Accept $\sqrt{5}$	B1
	$x=2.5$ gives 2.580 (allow AWRT) Accept 2.58	B1 (2)
(b)	$\left(\frac{1}{2}\times\frac{1}{2}\right)$, $[(1.414+3)+2(1.554+1.732+1.957+2.236+2.580)]$	B1,[M1A1ft]
	$=6.133$ (AWRT 6.13, even following minor slips)	A1 (4)
(c)	Overestimate	B1
	'Since the trapezia lie <u>above the curve</u>', or an equivalent explanation, or sketch of (one or more) trapezia above the curve on a diagram (or on the given diagram, in which case there should be reference to this). (Note that there must be some reference to a trapezium or trapezia in the explanation or diagram).	B1 (2)
		(8 marks)

Question Number	Scheme	Marks
Q3 (a) 5	$f\left(\frac{1}{2}\right)=2\times\frac{1}{8}+a\times\frac{1}{4}+b\times\frac{1}{2}-6$	M1
	$f\left(\frac{1}{2}\right)=-5 \Rightarrow \frac{1}{4}a+\frac{1}{2}b=\frac{3}{4}$ or $a+2b=3$	A1
	$f(-2)=-16+4a-2b-6$	M1
	$f(-2)=0 \Rightarrow 4a-2b=22$	A1
	Eliminating one variable from 2 linear simultaneous equations in a and b	M1
	$a=5$ and $b=-1$	A1 (6)
(b)	$2x^3+5x^2-x-6=(x+2)(2x^2+x-3)$	M1
	$=(x+2)(2x+3)(x-1)$	M1A1 (3)
	NB $(x+2)(x+\frac{3}{2})(2x-2)$ is A0 But $2(x+2)(x+\frac{3}{2})(x-1)$ is A1	[9]
(a)	1st M1 for attempting $f(\pm\frac{1}{2})$ Treat the omission of the –5 here as a slip and allow the M mark. 1st A1 for first correct equation in a and b simplified to three non zero terms (needs –5 used) s.c. If it is not simplified to three terms but is correct and is then used correctly with second equation to give correct answers- this mark can be awarded later. 2nd M1 for attempting $f(\mp 2)$ 2nd A1 for the second correct equation in a and b. simplified to three terms (needs 0 used) s.c. If it is not simplified to three terms but is correct and is then used correctly with first equation to give correct answers - this mark can be awarded later. 3rd M1 for an attempt to eliminate one variable from 2 linear simultaneous equations in a and b 3rd A1 for both $a = 5$ and $b = -1$ (Correct answers here imply previous two A marks)	
(b)	1st M1 for attempt to divide by (x+2) leading to a 3TQ beginning with correct term usually $2x^2$ 2nd M1 for attempt to factorize their quadratic provided no remainder A1 is cao and needs all three factors Ignore following work (such as a solution to a quadratic equation).	
(a)	Alternative; M1 for dividing by $(2x-1)$, to get $x^2+(\frac{a+1}{2})x+\text{constant}$ **with remainder as a function of a and b**, and A1 as before for equations stated in scheme . M1 for dividing by $(x+2)$, to get $2x^2+(a-4)x...$ (No need to see remainder as it is zero and comparison of coefficients may be used) with A1 as before	
(b)	Alternative; M1 for finding second factor correctly by factor theorem, usually $(x-1)$ M1 for using two known factors to find third factor , usually $(2x\pm 3)$ Then A1 for correct factorisation written as product $(x+2)(2x+3)(x-1)$	

6

Question Number	Scheme	Marks
6 (a)	$f(2) = 16 + 40 + 2a + b$ **or** $f(-1) = 1 - 5 - a + b$	M1 A1
	Finds 2nd remainder and equates to 1st $\Rightarrow$ $16 + 40 + 2a + b = 1 - 5 - a + b$	M1 A1
	$a = -20$	A1cso (5)
(b)	$f(-3) = (-3)^4 + 5(-3)^3 - 3a + b = 0$	M1 A1ft
	$81 - 135 + 60 + b = 0$ gives b = -6	A1 cso (3) [8]
Alternative for (a)	(a) Uses long division, to get remainders as $b + 2a + 56$ or $b - a$ - 4 or correct equivalent	M1 A1
	Uses second long division as far as remainder term, to get $b + 2a + 56 =$ $b - a$ - 4 or correct equivalent	M1 A1
	$a = -20$	A1cso (5)
Alternative for (b)	(b) Uses long division of $x^4 + 5x^3 - 20x + b$ by $(x + 3)$ to obtain $x^3 + 2x^2 - 6x + a + 18$ (with their value for a)	M1 A1ft
	Giving remainder $b + 6 = 0$ and so b = -6	A1 cso (3) [8]
Notes (a)	**M1** : Attempts f(± 2) or f(± 1) **A1** is for the answer shown (or simplified with terms collected) for one remainder **M1**: Attempts other remainder and puts one equal to the other **A1**: for correct equation in a (and b) then **A1 for** $a = -20$ **cso**	
(b)	**M1** : Puts $f(\pm 3) = 0$ **A1** is for f(-3) = 0, (where f is original function), with no sign or substitution errors (follow through on 'a' and could still be in terms of a) **A1**: b = -6 is cso.	
Alternatives	(a) **M1**: Uses long division of $x^4 + 5x^3 + ax + b$ by (x ± 2) **or** by (x ± 1) as far as three term quotient **A1**: Obtains at least one correct remainder **M1**: Obtains second remainder and puts two remainders (no x terms) equal **A1**: correct equation **A1**: correct answer a = -20 following correct work. (b) **M1**: complete long division as far as constant (ignore remainder) **A1ft**: needs correct answer for their a **A1**: correct answer	
Beware: It is possible to get **correct answers with wrong working.** If remainders are equated to 0 in part (a) both correct answers are obtained fortuitously. This could score M1A1M0A0A0M1A1A0		