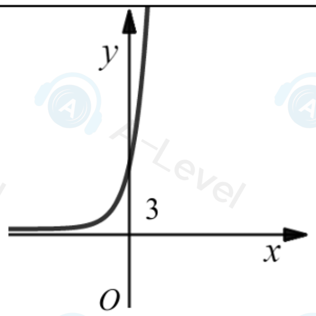
<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>8(i)</td><td>Eg $7^2+11^2=170 \Rightarrow 170$ is a multiple of 10 so the statement is untrue *</td><td>M1A1*</td></tr>
<tr><td></td><td></td><td>(2)</td></tr>
<tr><td>(ii)</td><td>Check first if they have multiplied the inequality e.g. by 4 to give
$4<4x^2-xy<60$
<table>
<tr><th>x</th><th>y</th><th colspan="2">$x^2-\frac{xy}{4}$ or $4x^2-xy$</th></tr>
<tr><td>2</td><td>2</td><td>3</td><td>12</td></tr>
<tr><td>2</td><td>4</td><td>2</td><td>8</td></tr>
<tr><td>4</td><td>2</td><td>14</td><td>56</td></tr>
<tr><td>4</td><td>4</td><td>12</td><td>48</td></tr>
</table>
Concludes that $1<x^2-\frac{xy}{4}<15$ for all x and y that are positive even integers less than 6 *</td><td>M1A1
A1*</td></tr>
<tr><td></td><td></td><td>(3)</td></tr>
<tr><td></td><td></td><td>(5 marks)</td></tr>
</table>

Question Number	Scheme	Marks
	$f(x)=4x^3+ax^2-29x+b$	
4.(a)	Sets $f\left(-\frac{1}{2}\right)=0 \rightarrow 4\times\left(-\frac{1}{2}\right)^3+a\times\left(-\frac{1}{2}\right)^2-29\times\left(-\frac{1}{2}\right)+b=0$	M1
	$\Rightarrow \frac{1}{4}a+b+14=0 \Rightarrow a+4b=-56$ *	A1*
		(2)
(b)	Sets $f(2)=-25 \rightarrow 4\times2^3+a\times2^2-29\times2+b=-25$	M1
	$4a+b=1$	A1
		(2)
(c)	(i) Solves $a+4b=-56$ with their $4a+b=1 \Rightarrow a=\ldots, b=\ldots$	M1
	$a=4,\ b=-15$	A1
	(ii) $4x^3+4x^2-29x-15=(2x+1)(2x^2+x-15)$	M1, A1
	$=(2x+1)(2x-5)(x+3)$ cso	A1
		(5)
		(9 marks)

Question Number	Scheme	Marks
2a	$\left(\mathrm{f}\left(\frac{3}{2}\right)=\right)\ 4\left(\frac{3}{2}\right)^3-8\left(\frac{3}{2}\right)^2+5\left(\frac{3}{2}\right)+a=0\Rightarrow a=...$	M1
	$\Rightarrow\frac{27}{2}-18+\frac{15}{2}+a=0\Rightarrow a=-3\quad *$	A1*
		(2)
b	Example where $2x-3$ is a linear factor: $\begin{array}{r} 2x^2-x+1 \\ 2x-3\overline{)4x^3-8x^2+5x-3} \end{array}$ $4x^3-6x^2$ $-2x^2+5x$ $-2x^2+3x$ $+2x-3$ $+2x-3$ 0	M1A1
	$(-1)^2-4\times2\times1=-7<0\Rightarrow$ no real roots so $x=\frac{3}{2}$ is the only one real root $*$	dM1A1*
		(4)
		(6 marks)

Question Number	Scheme	Marks
9.(a)	 Shape	B1
	$(0,3)$	B1
		(2)
(b)	$6^{1-x}=3\times4^x$ $(1-x)\log6=\log3+x\log4$	M1 dM1 A1
	$x(\log4+\log6)=\log6-\log3$ $\Rightarrow x=\frac{\log\left(\frac{6}{3}\right)}{\log(4\times6)}\Rightarrow x=\frac{\log2}{\log24}$	ddM1 A1*
		(5)
	Alt Method: $6^{1-x}=3\times4^x\Rightarrow\frac{6}{6^x}=3\times4^x$	M1
	$\Rightarrow\frac{6}{3}=6^x4^x\Rightarrow2=24^x$	dM1A1
	$\Rightarrow\log_{10}2=x\log_{10}24\Rightarrow\frac{\log_{10}2}{\log_{10}24}$	ddM1A1*
		(5) **(7 marks)**

Question Number	Please read notes for 8(i) before looking at scheme				Marks
8.(i)	$8^{2x+1}=6\Rightarrow 2x+1=\log_8 6$	M1	$2^{6x+3}=6$		
	$\Rightarrow 2x+1=\frac{\log_2 6}{\log_2 8}$	A1	$\Rightarrow(6x+3)\log_2 2=\log_2 6$	M1 A1	
	$\Rightarrow 2x+1=\frac{\log_2 2+\log_2 3}{3}$	M1	$\Rightarrow(6x+3)=\log_2 2+\log_2 3$	M1	
	$\Rightarrow x=\frac{\log_2 3}{6}-\frac{1}{3}$	A1	$\Rightarrow x=\frac{\log_2 3}{6}-\frac{1}{3}$	A1	
					(4)
(ii)	$\log_5(7-2y)=2\log_5(y+1)-1$		$2\log_5(y+1)-\log_5(7-2y)=1$		
	$\log_5(7-2y)=\log_5(y+1)^2-1$		$\log_5(y+1)^2-\log_5(7-2y)=1$		M1
	$\log_5(7-2y)=\log_5(y+1)^2-\log_5 5$		$\log_5\frac{(y+1)^2}{(7-2y)}=1$		dM1
	$(7-2y)=\frac{(y+1)^2}{5}$		$\frac{(y+1)^2}{(7-2y)}=5$		A1
	$y^2+12y-34=0\Rightarrow y=$		$y^2+12y-34=0\Rightarrow y=$		ddM1
	$y=-6+\sqrt{70}$ oe only				A1
					(5) **(9 marks)**

Question Number	Scheme	Marks
10(i)(a)	$2a$	B1
(b)	$\log_2\left(\frac{\sqrt{3}}{16}\right)=\log_2\sqrt{3}-\log_2 16,=\frac{1}{2}a-4$	M1A1
		(3)

(ii)	Examples: $3^x \times 2^{x+4} = 6 \Rightarrow \log_2 3^x + \log_2 2^{x+4} = \log_2 6$ or $3^x \times 2^{x+4} = 6 \Rightarrow 3^x \times 2^x \times 2^4 = 6 \Rightarrow \log_2 3^x + \log_2 2^x + \log_2 2^4 = \log_2 6$ or $3^x \times 2^{x+4} = 6 \Rightarrow 3^x \times 2^{x+3} = 3 \Rightarrow \log_2 3^x + \log_2 2^{x+3} = \log_2 3$ or $3^x \times 2^{x+4} = 6 \Rightarrow 3^x \times 2^x = \frac{3}{8} \Rightarrow \log_2 3^x + \log_2 2^x = \log_2 \frac{3}{8}$ or $3^x \times 2^{x+4} = 6 \Rightarrow 3^{x-1} \times 2^{x+3} = 1 \Rightarrow \log_2 3^{x-1} + \log_2 2^{x+3} = \log_2 1$	M1
	Examples: $x\log_2 3 + (x+4)\log_2 2 = \log_2 6 \Rightarrow x(\log_2 3 + \log_2 2) = \log_2 6 - 4 \Rightarrow x = ...$ or $x\log_2 3 + x\log_2 2 + 4 = \log_2 6 \Rightarrow x(\log_2 3 + \log_2 2) = \log_2 6 - 4 \Rightarrow x = ...$ or $x\log_2 3 + (x+3)\log_2 2 = \log_2 3 \Rightarrow x(\log_2 3 + \log_2 2) = \log_2 3 - 3\log_2 2 \Rightarrow x = ...$ or $x\log_2 3 + x\log_2 2 = \log_2 \frac{3}{8} \Rightarrow x(\log_2 3 + \log_2 2) = \log_2 \frac{3}{8} \Rightarrow x = ...$ or $(x-1)\log_2 3 + (x+3)\log_2 2 = 0 \Rightarrow ax + x = a - 3 \Rightarrow x = ...$	dM1
	$\log_2 a^b = b\log_2 a$	B1
	$x = \frac{a-3}{a+1}$	A1
		(4)
		(7 marks)

Question Number	Scheme	Marks
4(a)	$(2+px)^6=(2^6+)\ 6\times2^5(px)+\frac{6\times5}{2}\times2^4(px)^2+\dots$ or $\left(1+\frac{"p"}{2}x\right)^6=1+6\times\left(\frac{"p"}{2}x\right)+\frac{6\times5}{2}\times\left(\frac{"p"}{2}x\right)^2+\dots$	M1
	2^6 or 64	B1
	$+192px$ or $+240p^2x^2$	A1
	$(64+)192px+240p^2x^2$	A1
		(4)
(b)	$\left(3-\frac{1}{2}x\right)(2+px)^6\Rightarrow\left(3-\frac{1}{2}x\right)\left(64+192px+240p^2x^2\right)$	
	Attempts $3\times"240p^2"$ and $\left(-\frac{1}{2}\right)\times"192p"$	M1
	$3\times"240p^2"+\left(-\frac{1}{2}\right)\times"192p"=-\frac{3}{4}$	dM1
	$2880p^2-384p+3=0\Rightarrow p=\dots$	ddM1
	$(p=)\ \frac{1}{8},\frac{1}{120}$	A1
		(4)
		(8 marks)

Question	Answer	Marks	Guidance
7(a)	Equate y to 3 and confirm $p=\frac{1}{2\sin 2p}$	**B1**	AG
		1	
7(b)	Consider sign of $p-\frac{1}{2\sin 2p}$ or equivalent for 0.5 and 0.6	**M1**	
	Obtain $-0.09\dots$ and $0.06\dots$ or equivalents and justify conclusion	**A1**	AG
		2	
7(c)	Use iteration process correctly at least once	**M1**	Need to see 0.55494…
	Obtain final answer 0.557 only	**A1**	Allow recovery. Allow if iterations are to 4sf Allow if insufficient iterations seen.
	Show sufficient iterations to 5 s.f. to justify answer or show sign change in interval [0.5565, 0.5575]	**A1**	If not starting at 0.55 then max marks M1A1A0
		3	

Question Number	Scheme	Marks
	$f(x)=ax^3+bx^2+5x-3$	
4(a)	Sets $f(-3)=0 \rightarrow a\times(-3)^3+b\times(-3)^2+5\times(-3)-3=0$	M1
	$\Rightarrow -27a+9b=18 \Rightarrow b=3a+2$ *	A1*
		(2)
(b)	Sets $f\left(\frac{1}{2}\right)=\frac{7}{4} \rightarrow a\times\left(\frac{1}{2}\right)^3+b\times\left(\frac{1}{2}\right)^2+5\times\left(\frac{1}{2}\right)-3=\frac{7}{4}$	M1
	$a+2b=18$	A1
	Solves $b=3a+2$ with their $a+2b=18 \Rightarrow a=\ldots, b=\ldots$	M1
	$a=2, b=8$	A1
		(4)
(c)	e.g. $\frac{2x^3+8x^2+5x-3}{x-2}=\left(\ldots x^2+\ldots x+\ldots\right)+\text{Remainder}$	M1
	(Quotient =) $2x^2+12x+29$	A1
	Remainder = 55	B1
		(3)
		(9 marks)

Question Number	Scheme	Marks
4.(a)	$\left(2-\frac{1}{4}x\right)^6=2^6,+{}^6C_1 2^5\left(-\frac{1}{4}x\right)^1+{}^6C_2 2^4\left(-\frac{1}{4}x\right)^2+{}^6C_3 2^3\left(-\frac{1}{4}x\right)^3+\ldots$	B1, M1
	$=64-48x+15x^2-2.5x^3$	A1 A1
		(4)
(b)	$\left(2-\frac{1}{4}x\right)^6+\left(2+\frac{1}{4}x\right)^6=\left(64-48x+15x^2-2.5x^3\right)+\left(64+48x+15x^2+2.5x^3\right)$	M1
	$\approx 128+30x^2$	B1ft A1
		(3)
		(7 marks)

Question Number	Scheme	Marks
5 (a)	$f(x)=3x^3+ax^2-10x+b$	
	$f\left(\frac{4}{3}\right)=0 \Rightarrow 3\times\left(\frac{4}{3}\right)^3+a\left(\frac{4}{3}\right)^2-10\left(\frac{4}{3}\right)+b=0$	M1
	$\frac{64}{9}+\frac{16}{9}a-\frac{40}{3}+b=0 \Rightarrow 64+16a-120+9b=0 \quad \Rightarrow 16a+9b=56$ *	A1*
		(2)
(b)	$f(2)=b \Rightarrow 3\times(2)^3+a(2)^2-10(2)+b=b$ leading to an equation in just a	M1
	$4a=-4 \Rightarrow a=-1$	A1
	Substitutes $a=$ '-1' in $-16+9b=56 \Rightarrow b=\ldots$	M1
	$\Rightarrow b=8$	A1
		(4)
(c)	$f(x)=3x^3-x^2-10x+8=(3x-4)\left(x^2+x-2\right)$	M1, A1
	$=(3x-4)(x+2)(x-1)$	A1
		(3)
		(9 marks)

Question Number	Scheme	Marks
3. (a)	Attempts $f\left(-\frac{3}{2}\right)=6\left(-\frac{3}{2}\right)^3+17\left(-\frac{3}{2}\right)^2+4\left(-\frac{3}{2}\right)-12$ $=0\Rightarrow(2x+3)$ is a factor *	M1 A1* **(2)**
(b)	$6x^3+17x^2+4x-12=(2x+3)(3x^2+4x-4)$ $=(2x+3)(3x-2)(x+2)$	M1 A1 dM1 A1 **(4)**
(c)	Solves $\tan\theta=-\frac{3}{2}$ or “ -2” or “ $\frac{2}{3}$ “ $\theta=$ awrt 2.03, 2.16	M1 A1 **(2)** **(8 marks)**

Question Number	Scheme	Marks
3. (a)	$\left(1+\frac{x}{4}\right)^{12}=1+12\left(\frac{x}{4}\right)^1+\frac{12\times11}{2}\left(\frac{x}{4}\right)^2+\frac{12\times11\times10}{3!}\left(\frac{x}{4}\right)^3+\ldots$ $=1+3x,+\frac{33}{8}x^2+\frac{55}{16}x^3$	M1 B1, A1 **(3)**
(b)	$\left(\frac{x^2+8}{x^5}\right)\left(1+\frac{x}{4}\right)^{12}=$ Sight of a term independent of x $=$ "$\frac{55}{16}$" or $8\times{}^{12}C_5\left(\frac{1}{4}\right)^5$ $(=\frac{99}{16})$ "$\frac{55}{16}$" $+8\times{}^{12}C_5\left(\frac{1}{4}\right)^5=\frac{55}{16}+\frac{99}{16}=\frac{77}{8}$	B1ft, M1 A1 **(3)** **(6 marks)**