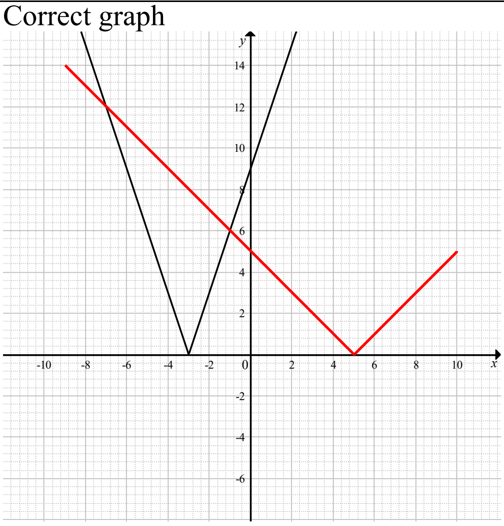
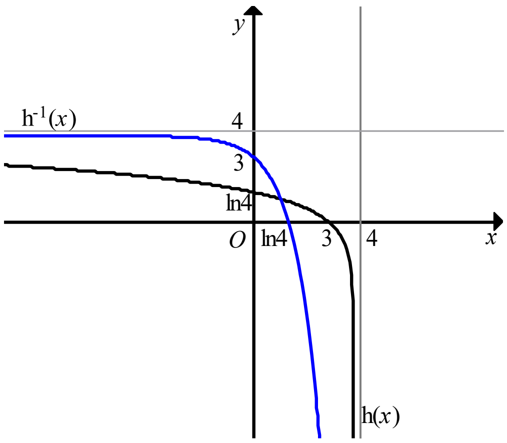
Question	Answer	Marks	Partial Marks
1(a)	$4x-5=7$ and $4x-5=-7$ oe, soi	M1	
	$x=3,\ x=-\frac{1}{2}$	A1	
1(b)	Correct graph  AND $-7\leqslant x\leqslant -1$	3	**B1** for correct graph and **B2 dep** for $-7\leqslant x\leqslant -1$; dependent on a correct graph for $-7\leqslant x\leqslant -1$ or **B1 STRICT FT** for *their* critical values from the two intersections of *their* straight-line section of graph providing it has negative gradient
2	$\frac{7\sqrt{2}x^6\left(3-\sqrt{2}\right)}{\left(3+\sqrt{2}\right)\left(3-\sqrt{2}\right)}$	M2	**M1** for $7\sqrt{2}x^6$ or $\frac{\sqrt{98x^{12}}\left(3-\sqrt{2}\right)}{\left(3+\sqrt{2}\right)\left(3-\sqrt{2}\right)}$ or $\frac{\sqrt{98}x^6\left(3-\sqrt{2}\right)}{\left(3+\sqrt{2}\right)\left(3-\sqrt{2}\right)}$ or $\frac{\textit{their}\,7\sqrt{2}x^6\left(3-\sqrt{2}\right)}{\left(3+\sqrt{2}\right)\left(3-\sqrt{2}\right)}$
	$\frac{21\sqrt{2}x^6-14x^6}{9-2}$ or $\frac{7x^6(3\sqrt{2}-2)}{9-2}$ oe	A1	
	$(3\sqrt{2}-2)x^6$	A1	
	Alternative method		
	$\frac{\sqrt{98x^{12}}}{3+\sqrt{2}}\times\frac{3-\sqrt{2}}{3-\sqrt{2}}$ or $\frac{\sqrt{98}x^6}{3+\sqrt{2}}\times\frac{3-\sqrt{2}}{3-\sqrt{2}}$	(M1)	
	$\frac{3\sqrt{98x^{12}}-\sqrt{196x^{12}}}{9-2}$ or $\frac{3\sqrt{98}x^6-\sqrt{196}x^6}{9-2}$	(M1)	
	$\frac{3\sqrt{98x^{12}}-\sqrt{196x^{12}}}{\sqrt{49}}$ or $\frac{3\times 7\sqrt{2}x^6-14x^6}{7}$ oe	(A1)	
	$(3\sqrt{2}-2)x^6$	(A1)	

Question	Answer	Marks	Partial Marks
3(a)	$\frac{3(x+2)}{x(x+3)}$ or $\frac{3x+6}{x^2+3x}$ or simplified equivalent;	2	mark final answer **B1** for $\frac{3x^2+6x}{x^3+3x^2}$ oe
3(b)	$\frac{1}{3}\ln(x^3+3x^2)\ +c$	2	**B1** for $\frac{1}{3}\ln(x^3+3x^2)$
4(a)	$2(-4)^3+11(-4)^2+22(-4)+40=0$ oe	1	
4(b)	$(x+4)(2x^2+3x+10)$	B2	**B1** for $2x^2+3x+10$ with two terms out of three correct
	Correct use of b^2-4ac for *their* 3-term quadratic factor	M1	
	$3^2-4(2)(10)<0$ isw or $3^2-4(2)(10)=-71$ oe, cao	A1	
5(a)(i)	35700	2	**M1** for ${}^{20}C_6-{}^{18}C_4$ or ${}^{18}C_6+{}^{18}C_5\times{}^{2}C_1$ oe
5(a)(ii)	32400	2	**M1** for ${}^{6}P_4\times{}^{10}P_2$ or (6 × 5 × 4 × 3) × (10 × 9) oe
5(b)(i)	Correct algebraic method to show $(n-3)\,{}^{n}C_3$ is the same as $4\times{}^{n}C_4$ oe	2	**B1** for ${}^{n}C_3=\frac{n!}{3!(n-3)!}$ or ${}^{n}C_4=\frac{n!}{4!(n-4)!}$
5(b)(ii)	$\frac{n(n-1)(n-2)}{6}=5n$ or $n(n-1)(n-2)=30n$ and completion to given answer: $n^2-3n-28=0$	B2	**B1** for $\left[{}^{n}C_3=\right]\frac{n(n-1)(n-2)}{6}$ or $n(n-1)(n-2)=30n$ seen
	$(n-7)(n+4)=0$ oe	M1	
	$n=7$	A1	

Question	Answer	Marks	Partial Marks
6	$\frac{dy}{dx} = 10e^{2x}$	**B1**	
	[At A, m =] 10	**B1**	
	[At A, y =] 2	**B1**	
	[Equation tangent is] $y = 10x + 2$ oe	**B1**	
	$AB^2 = \left(\frac{-their\,2}{their\,10}\right)^2 + (their\,2)^2$ oe	**M1**	providing *their* 10 is derived using differentiation
	[AB =] 2.01 or 2.009[9…] nfww, isw	**A1**	
7	$\frac{d(4x^3 + 2\sin 8x)}{dx} = 12x^2 + 16\cos 8x$ soi	**B2**	**B1** for $12x^2 + k\cos 8x$, where $k > 0$
	Correct quotient rule: $\frac{(1-x)\left(their\left(12x^2 + 16\cos 8x\right)\right) - (4x^3 + 2\sin 8x)(-1)}{(1-x)^2}$	**M1**	or applies correct product rule to $(4x^3 + 2\sin 8x)(1-x)^{-1}$: $(4x^3 + 2\sin 8x)\left(-(1-x)^{-2} \times -1\right) + \left(their(12x^2 + 16\cos 8x)\right)(1-x)^{-1}$
	Fully correct derivative; isw	**A1**	**FT** *their* $12x^2 + 16\cos 8x$
	$\frac{\delta y}{h} = their\left(\left.\frac{dy}{dx}\right\|_{x=0.1}\right)$	**M1**	
	$14.3h$ or $14.29[54...]h$ with coefficient rot to 4 or more figs isw	**A1**	
8(a)(i)	$f \leqslant -1$	**1**	

Question	Answer	Marks	Partial Marks
8(a)(ii)	$x = -2$ nfww	3	**M1** for $\left[x = \mathrm{f}\left(\frac{2\pi}{3}\right) = \right]\sec\left(\frac{2\pi}{3}\right)$ or $\sec^{-1} x = \frac{2\pi}{3}$ **A1** for $\frac{1}{\cos\left(\frac{2\pi}{3}\right)}$ OR **M1** for a complete attempt to find $\mathrm{f}^{-1}(x)$; includes swapping the variables **A1** for $\mathrm{f}^{-1}(x) = \cos^{-1}\left(\frac{1}{x}\right)$
8(a)(iii)	$\frac{\pi}{2} < x < \frac{3\pi}{2}$	1	
8(a)(iv)	$\mathrm{gf}(x) = 3(\sec^2 x - 1)$	B1	
	$3\tan^2 x = 1$ or $\frac{1}{\cos^2 x} = \frac{4}{3}$ oe	M1	
	$\tan x = [\pm]\sqrt{\frac{1}{3}}$ oe or $\cos x = [\pm]\sqrt{\frac{3}{4}}$ oe and solves for x, soi	M1	
	$x = \frac{5\pi}{6}, \frac{7\pi}{6}$ and no other solutions	A2	**A1** for one correct solution, condoning extras
8(b)	Correct diagram with intercepts indicated and asymptotes shown. 	4	**B1** for correct shape for h; may not be over correct domain but must have positive y-intercept and x-intercept and appear to tend to an asymptote in the 4th quadrant **B1** for 3 and ln4 correctly marked; must have attempted correct shape **B1** for the position of the vertical asymptote indicated; must have attempted correct shape **B1** for h^{-1} the reflection of *their* h in the line $y = x$ **Maximum of 3 marks if not fully correct**

Question	Answer	Marks	Partial Marks
9(a)	$\frac{x+4}{\sqrt[3]{x}} = x^{\frac{2}{3}} + 4x^{-\frac{1}{3}}$	**B1**	
	$\left[\frac{3}{5}x^{\frac{5}{3}} + 6x^{\frac{2}{3}}\right]_1^8$	**M1**	**FT** providing one term is correct in $x^{\frac{2}{3}} + 4x^{-\frac{1}{3}}$
	$\frac{3}{5}(8)^{\frac{5}{3}} + 6(8)^{\frac{2}{3}} - \left(\frac{3}{5}(1)^{\frac{5}{3}} + 6(1)^{\frac{2}{3}}\right) = 36.6$	**A1**	

Question	Answer	Marks	Partial Marks
9(b)	$10(0.1) = 7 - 3x$ and $0.1 = \frac{1}{3x+4}$ and evaluates both expressions as $x = 2$ oe	**M2**	**M1** for $10(0.1) = 7 - 3x$ and $0.1 = \frac{1}{3x+4}$ oe
	[Area trapezium =] $\frac{1}{2}(0.1+0.7)\times \textit{their}\,2$ oe or $\frac{7(\textit{their}\,2)}{10} - \frac{3(\textit{their}\,2)^2}{20} - [0]$ oe or 0.8	**B1**	
	$\left[\int \frac{1}{3x+4}\,dx = \right] \frac{1}{3}\ln(3x+4)\quad [+c]$	**B2**	**B1** for $k\ln(3x+4)$ $k \neq \frac{1}{3}$ or for $\frac{1}{3}\ln 3x+4$
	$\frac{1}{3}\ln(3(2)+4) - \frac{1}{3}\ln(3(0)+4)$	**M1**	**dep** on at least previous **B1**
	their 0.8 – 0.3054…oe	**M1**	**dep** previous **M1**; **FT** *their* 0.8 providing the difference results in a positive value
	0.495 or 0.4945[69…] rot to 4 or more sf	**A1**	
10(a)(i)	$a + d$, $a + 13d$, $a + 16d$ soi	**B1**	
	$\frac{a+13d}{a+d} = \frac{a+16d}{a+13d}$ oe	**M2**	**FT** *their* 3 distinct terms providing of the form $a + kd$ where $k \neq 0$ and at least one is correct **M1** for either $[r =]\frac{a+13d}{a+d}$ or $[r =]\frac{a+16d}{a+13d}$ or $[r =]\sqrt{\frac{a+16d}{a+d}}$
	Clears fractions and expands oe: $a^2 + 26ad + 169d^2 = a^2 + 17ad + 16d^2$	**A1**	
	$9ad + 153d^2 = 0$ or $9ad = -153d^2$	**A1**	
	Convincingly derives $a = -17d$ e.g. $9d(a + 17d) = 0$ [therefore] $a = -17d$ oe	**A1**	

Question	Answer	Marks	Partial Marks
10(a)(ii)	$r = 0.25$ oe	**2**	**M1** $\frac{-17d+13d}{-17d+d}$ or $\frac{-17d+16d}{-17d+13d}$ or $-16d$, $-4d$, $-d$
10(b)	$\frac{q}{1-0.25} = \frac{256}{3}$ oe	**M1**	**FT** *their* 0.25 providing it is between –1 and 1
	$q = 64$	**A1**	
	[$a + d =$ *their* 64] $-17d + d =$ *their* 64 or $a - \frac{a}{17} =$ *their* 64	**DM1**	**dep** on previous **M1**
	$d = -4$ and $a = 68$ oe OR $d = -4$ and $S_{20} = -150d$ oe	**A2**	**A1** for either correct
	$S_{20} = \frac{20}{2}\{2(\textit{their}68) + 19(\textit{their}(-4))\}$ or $S_{20} = -150(\textit{their } d)$	**M1**	**FT** *their a* and *d*
	600	**A1**	