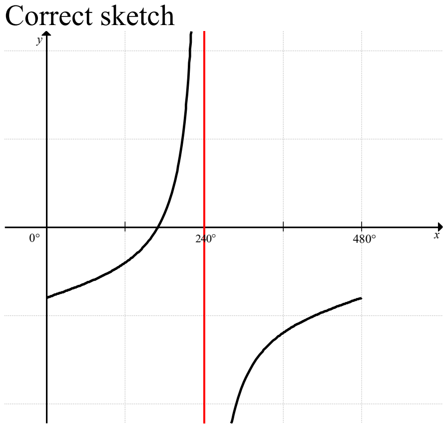
Question	Answer	Marks	Partial Marks
1(a)	$(x-3)^2-8$	**B2**	**B1** for $(x-3)^2+k$ where $k \neq -8$ or $a = -3$ or $(x+m)^2-8$ where $m \neq -3$ or $b = -8$
1(b)	(3, –8)	**B1**	**strict FT** *their* a and b
2	$m = \dfrac{9-5}{8-6}$ oe	**M1**	
	9 = *their* 2(8) + c oe or 5 = *their* 2(6) + c	**M1**	
	$\ln y = 2\ln x - 7$	**A1**	
	Correct completion to answer: $y = e^{\ln x^2 - 7} = e^{-7}x^2$ nfww	**A1**	
	Alternative $\ln y = p + q\ln x$ soi	**(B1)**	
	$m = \dfrac{9-5}{8-6}$ oe	**(M1)**	
	9 = *their* 2(8) + c oe or 5 = *their* 2(6) + c	**(M1)**	
	$y = e^{-7}x^2$	**(A1)**	
3(a)	$4x-1$ *9 oe and $4x-1$*–9 oe OR $16x^2-8x-80$*0 oe soi	**M1**	where * could be = or any inequality sign
	$x > \frac{5}{2}$, $x < -2$ only; **mark final answer**	**A2**	not from wrong working **A1** for CV $\frac{5}{2}$, –2 oe If M0 then **SC1** for any correct inequality with at most one extra inequality

Question	Answer	Marks	Partial Marks
3(b)	$\left(2\sqrt{x}-3\right)\left(\sqrt{x}-4\right)$ or $x = u^2$ and $(2u – 3)(u – 4)$ oe soi	**M1**	
	$\sqrt{x} = \frac{3}{2}$, $\sqrt{x} = 4$ oe	**A1**	
	$x = \frac{9}{4}$, $x = 16$	**B1**	**FT** their $\sqrt{x}$
	Alternative $(2x+12)^2 = \left(11x^{\frac{1}{2}}\right)^2$ simplified to $4x^2 - 73x + 144 = 0$	**(M1)**	
	solves 3 term quadratic in x	**(M1)**	
	$x = \frac{9}{4}$, $x = 16$	**(A1)**	
4(a)	$a = –4$	**B1**	
	$480 = \frac{180}{b}$ oe	**M1**	
	$b = \frac{3}{8}$	**A1**	
4(b)	Correct sketch 	**B2**	correct tan shape, two branches starting and finishing on same negative y value asymptote implied at $x = 240$ root between 120 and 240 **B1** for correct tan shape with exactly two branches plus one other correct property Maximum **B1** if not fully correct

Question	Answer	Marks	Partial Marks
5	$27x = (x^2)^2$ or $y = \left(\frac{y^2}{27}\right)^2$ oe	**M1**	if **M0** then, for first 4 marks, **SC4** if (3, 9) only stated and verified in both equations, ignore (0, 0) or **SC2** for (3, 9) only stated with no working, ignore (0, 0) If first **M1** then (3, 9) with no additional working award **M1SC1**
	$x^4 - 27x = 0$ or $y^4 - 729y = 0$ oe nfww	**A1**	
	$x(x^3 - 27) = 0$ or $y(y^3 - 729) = 0$ oe	**M1**	
	$A(3, 9)$ oe only nfww	**A1**	
	Mid-point = $(1.5, 4.5)$	**B1**	
	$m_{OA} = \frac{9}{3}$ oe	**B1**	
	$m_{\perp} = -\frac{3}{9}$ oe	**M1**	
	$y - 4.5 = -\frac{3}{9}(x - 1.5)$ oe isw	**A1**	**FT** *their* mid-point and *their* $-\frac{1}{\frac{9}{3}}$
6	$\frac{\mathrm{d}(\mathrm{e}^{\frac{x}{2}})}{\mathrm{d}x} = \frac{1}{2}\mathrm{e}^{\frac{x}{2}}$	**B1**	
	$\frac{\mathrm{d}(\cos 2x)}{\mathrm{d}x} = -2\sin 2x$ soi	**B1**	
	$x \times their(-2\sin 2x) + \cos 2x$	**M1**	
	$\left[\frac{\mathrm{d}y}{\mathrm{d}x} =\right] \frac{1}{2}\mathrm{e}^{\frac{x}{2}} - 2x\sin 2x + \cos 2x$	**A1**	**FT** *their* $\frac{\mathrm{d}\left(\mathrm{e}^{\frac{x}{2}}\right)}{\mathrm{d}x} = k\mathrm{e}^{\frac{x}{2}}$
	$\frac{\delta y}{h} = their \left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=1}$	**M1**	
	$-1.41[03...]h$ nfww	**A1**	

Question	Answer	Marks	Partial Marks
7	$4x^2 + kx + k - 2 = 2x + 1$	M1	
	$4x^2 + (k-2)x + k - 3$ [*0] soi	A1	* can be <, >, =, ≤, ≥
	$(k-2)^2 - 4(4)(k-3)$	M1	
	$k^2 - 20k + 52 * 0$	A1	
	$k = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(1)(52)}}{2}$	M1	
	$k = 10 \pm \sqrt{48}$ oe isw	A1	
	Alternative (using calculus) $2 = 8x + k$ oe	(M1)	
	$y = 4x^2 + (2-8x)x + 2 - 8x - 2$ or $y = -4x^2 - 6x$	(M1)	
	$0 = 4x^2 + 8x + 1$	(A1)	
	$x = \frac{-8 \pm \sqrt{8^2 - 4(4)(1)}}{8}$	(M1)	
	$x = -1 \pm \frac{\sqrt{48}}{8}$ oe	(A1)	
	for $k = 10 \pm \sqrt{48}$ oe	(A1)	
8(a)(i)	Valid explanation e.g. This ensures the argument of both logarithms is greater than 0	B1	
8(a)(ii)	$\log_a 6 = \log_a (y+3)^2$ oe	B1	
	$(y+3)^2 = 6$	M1	
	$y = -3 + \sqrt{6}$ oe only final answer	A1	

Question	Answer	Marks	Partial Marks
8(b)	Within a complete expression: Correct change of base to *a*: $\log_{\sqrt{b}} 9a = \frac{\log_a 9a}{\log_a \sqrt{b}}$ Correct use of power law: $\log_a \sqrt{b} = \frac{1}{2}\log_a b$ Correct use of addition/multiplication law: $\log_a 9a = \log_a 9 + \log_a a$ Correct use of $\log_a a = 1$	**M3**	**M2** for 2 or 3 correct steps within complete expression or **M1** for 1 correct step within complete expression
	leading to $2 + 3\log_a 9$. nfww	**A1**	
9	$\int \sin\left(6x - \frac{\pi}{2}\right)dx = -\frac{\cos\left(6x - \frac{\pi}{2}\right)}{6} + c$	**B2**	**B1** for $\int \sin\left(6x - \frac{\pi}{2}\right)dx = k\cos\left(6x - \frac{\pi}{2}\right) + c$ where $k < 0$ or $k = \frac{1}{6}$ or $-\frac{1}{6}\cos\left(6x - \frac{\pi}{2}\right)$
	$\frac{1}{2} = -\frac{1}{6}\cos\left(\frac{6\pi}{4} - \frac{\pi}{2}\right) + c$	**M1**	**FT** *their k* provided **B1** awarded
	$\int \left(-\frac{\cos\left(6x - \frac{\pi}{2}\right)}{6} + \frac{1}{3}\right)dx$ $= -\frac{\sin\left(6x - \frac{\pi}{2}\right)}{36} + \frac{1}{3}x + A$	**M2**	**FT** *their* $k\cos\left(6x - \frac{\pi}{2}\right) +$ *their* c provided at least **B1** awarded **M1** for $m\sin\left(6x - \frac{\pi}{2}\right) + \left(\textit{their}\ \frac{1}{3}\right)x + A$ where $m < 0$ or $m = \frac{1}{36}$
	$\frac{13\pi}{12} = -\frac{1}{36}\sin\left(\frac{6\pi}{4} - \frac{\pi}{2}\right) + \frac{1}{3}\left(\frac{\pi}{4}\right) + A$	**M1**	**FT** *their m* and *their c* provided at least **M1** awarded
	$y = -\frac{\sin\left(6x - \frac{\pi}{2}\right)}{36} + \frac{1}{3}x + \pi$ oe cao	**A1**	

Question	Answer	Marks	Partial Marks
9	Alternative $\int -\cos 6x \, dx = -\frac{\sin 6x}{6} + c$	**B2**	**B1** for $\int -\cos 6x \, dx = k \sin 6x + c$ where $k < 0$ or $k = \frac{1}{6}$ or $-\frac{\sin 6x}{6}$
	$\frac{1}{2} = -\frac{1}{6}\sin\frac{3\pi}{2} + c$ oe	**M1**	**FT** *their k* provided **B1** awarded
	$\int\left(-\frac{\sin 6x}{6} + \frac{1}{3}\right)dx =$ $\frac{\cos 6x}{36} + \frac{1}{3}x + A$	**M2**	**FT** $\textit{their}\, k \sin 6x + \textit{their}\, c$ provided at least **B1** awarded **M1** for $m\cos 6x + \left(\textit{their}\,\frac{1}{3}\right)x + A$ where $m > 0$ or $m = -\frac{1}{36}$
	$\frac{13\pi}{12} = \frac{\cos\frac{3\pi}{2}}{36} + \frac{1}{3}\left(\frac{\pi}{4}\right) + A$	**M1**	**FT** *their m* and *their c*
	$y = \frac{\cos 6x}{36} + \frac{1}{3}x + \pi$ oe cao	**A1**	
10(a)	$\overline{AB} = \begin{pmatrix} 4 \\ 8 \end{pmatrix}$	**B1**	
	$\sqrt{4^2 + 8^2}$	**M1**	**FT** *their* $\begin{pmatrix} 4 \\ 8 \end{pmatrix}$
	$\frac{1}{\sqrt{80}}\begin{pmatrix} 4 \\ 8 \end{pmatrix}$ oe isw	**A1**	**FT** provided working shown
10(b)	$\begin{pmatrix} 6 \\ -5 \end{pmatrix} = \frac{1}{2}\begin{pmatrix} 10 + x \\ 3 + y \end{pmatrix}$ oe	**M1**	
	$x = 2,\ y = -13$	**A1**	

Question	Answer	Marks	Partial Marks
10(c)	$\overrightarrow{OE} = \frac{1}{1+\lambda}\begin{pmatrix}12\\7\end{pmatrix}$ oe seen	**B1**	
	Solves *their* $\frac{7}{1+\lambda} = 3$	**M1**	
	$\lambda = \frac{4}{3}$ oe	**A1**	
	Alternative $\overrightarrow{OE} = \begin{pmatrix}x\\3\end{pmatrix}$ $\frac{12}{7} = \frac{x}{3}$ $x = \frac{36}{7}$	**(B1)**	
	$\frac{1+\lambda}{1} = \frac{12}{36/7}$	**(M1)**	**FT** *their x*
	$\lambda = \frac{4}{3}$	**(A1)**	
11(a)(i)	$1 + d$, $1 + 7d$, $1 + 43d$ soi	**B1**	
	$[r =]$ *their* $\frac{1+7d}{1+d} =$ *their* $\frac{1+43d}{1+7d}$	**M2**	**FT** *their* ratios of terms provided in terms of *a* and *d* **M1 FT** for either $[r =]\frac{1+7d}{1+d}$ or $[r] = \frac{1+43d}{1+7d}$
	Simplifies to $6d^2 - 30d = 0$ oe nfww	**A1**	
	Verifies that $d = 5$ by substitution or factorises and solves to obtain $d = 5$ only	**A1**	

Question	Answer	Marks	Partial Marks
11(a)(i)	Alternative 1 + *d*, 1 + 7*d*, 1 + 43*d* soi	**B1**	
	$\left(\frac{7a-6}{a}\right)^2 = \frac{43a-42}{a}$ oe	**M2**	**M1** for $\frac{7a-6}{a}$ or for $\frac{43a-42}{a}$ oe
	$6a^2 - 42a + 36 = 0$ oe	**A1**	
	Finds *a* = 6 and uses it to show that *d* = 5 only	**A1**	
11(a)(ii)	$S_{20} = \frac{20}{2}\{2[1]+(20-1)(5)\}$	**M1**	
	970	**A1**	
11(b)(i)	7776 nfww	**B2**	**B1** for $6 \times 6^{5-1}$
11(b)(ii)	Valid explanation e.g. The sum to infinity does not exist for this GP as the common ratio is greater than 1.	**B1**	
12	*x*-coordinate of *A* = 6 soi	**B1**	
	x-coordinate of *B* = 9 soi	**B1**	
	k – 3 = (9 – *k*)(*k* – 3)	**M1**	
	k = 8 [therefore *C*(8, 5)]	**A1**	
	$(8-6)\times 5$ or 10 oe soi	**B1**	
	$\int_{their 8}^{their 9} (12x - 27 - x^2)\,dx$ $= \frac{12}{2}x^2 - 27x - \frac{x^3}{3}$	**M2**	**M1** for 2 correct terms
	*their*10 + F(*their* 9) – F(*their* 8)	**M1**	DEP on at least M1 for integration
	$\frac{38}{3}$ or $12\frac{2}{3}$ or 12.7 or 12.66[66...] rot to 4 or more figs nfww	**A1**	