Question	Answer	Marks	Partial marks
7(a)	Forms a correct equation from which the logarithms can be eliminated : has consistent powers of ln$x$ in all terms $\frac{n}{2}\left(12\ln x+\left(n-1\right)\times 4\ln x\right)*43\times 24\ln x$ oe, soi OR uses log laws to combine terms $\ln\left(x^{6n}\times x^{2n(n-1)}\right)*\ln x^{24\times 43}$ or better	**3**	where * is = or any inequality sign **M2** for $a = 6$ **and** $d = 4$ or $a = 6\ln x$ soi **and** $d = 4\ln x$ soi or $a = \ln x^6$ soi **and** $d = \frac{2}{3}\ln x^6$ soi or $a = \frac{3}{2}\ln x^4$ soi **and** $d = \ln x^4$ soi or for $\ln x^{12\times\frac{n}{2}}+\ln x^{4(n-1)\times\frac{n}{2}}*\ln x^{24\times 43}$ oe or **M1** for any correct expression for d or for a correct expression for the sum to n terms using *their a* and *their d* providing *their d* is not one of the given terms
	$2n^2+4n-1032\left[*0\right]$ oe	**A1**	
	Solves *their* 3-term quadratic in n	**M1**	**dep** on attempt at the sum of an AP
	$n = 22$ cao, nfww	**A1**	**dep** on all previous marks awarded

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Question	Answer	Marks	Partial marks
7(b)	Correct term e.g. $[u_{25} =]$ $6\ln x + 24 \times 4\ln x$ or $\ln x^6 + 24 \times \frac{2}{3}\ln x^6$ or $\frac{3}{2}\ln x^4 + 24\ln x^4$ or $2\ln x^3 + 24 \times \left(2\ln x^7 - 5\ln x^2\right)$ oe or $2\ln x^3 + 24 \times \left(5\ln x^2 - 2\ln x^3\right)$ oe	**B1**	
	Forms and correctly simplifies an equation e.g. $102\ln x = 408$ or $17\ln x^6 = 408$ or $\frac{51}{2}\ln x^4 = 408$ or $\ln \frac{x^6 \times x^{336}}{x^{240}} = 408$ or $\ln \frac{x^6 \times x^{240}}{x^{144}} = 408$	**M1**	**FT** *their* u_{25} providing it is an expression for the term of an AP which requires the simplification/collection of two natural logarithms
	$x = e^4$	**A1**	

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Question	Answer	Marks	Partial marks
8	For A: $x = \frac{1}{3}$	**B1**	
	$\frac{dy}{dx} = -\frac{15}{x^2} + \frac{10}{x^3}$ oe. isw OR $\frac{dy}{dx} = \frac{-15x^2 + 10x}{x^4}$ oe, isw	**B2**	**B1** for each correct term OR for $\frac{dy}{dx} = \frac{-15x^2 + ...}{x^4}$ oe or $\frac{...+10x}{x^4}$
	Solves $their \frac{dy}{dx} = 0$ as far as x = …	**M1**	**FT** *their* $\frac{dy}{dx}$ providing at least one term is correct
	B: $\left(\frac{2}{3}, \frac{45}{4}\right)$ oe, nfww	**A2**	**A1** for each correct coordinate
	Correct plan e.g. $\int_{their\frac{1}{3}}^{their\frac{2}{3}} \left(\frac{15}{x} - \frac{5}{x^2}\right) dx - \frac{1}{2} \times their\frac{45}{4} \times \left(their\frac{2}{3} - their\frac{1}{3}\right)$ or $\int_{their\frac{1}{3}}^{their\frac{2}{3}} \left(\frac{15}{x} - \frac{5}{x^2} - \left(their\frac{135}{4}x - their\frac{45}{4}\right)\right) dx$	**M1**	
	$\int \left(\frac{15}{x} - \frac{5}{x^2}\right) dx = 15\ln x + \frac{5}{x}$ oe	**B2**	**B1** for $15\ln x$ or $k\ln x + \frac{5}{x}$ oe
	$\left(15\ln\frac{2}{3} + \frac{15}{2}\right) - \left(15\ln\frac{1}{3} + 15\right)$ or exact equivalent	**M1**	**FT** *their* $\frac{1}{3}$ and *their* $\frac{2}{3}$ providing at least **B1** awarded for integration
	Area of shaded region: 15ln2 – 9.375 or $15\ln 2 - \frac{75}{8}$ or exact equivalent	**A1**	**dep** on all previous marks awarded
9(a)	$\tan 3x = \frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$ or 0.57735…	**B2**	**B1** for $\frac{3}{\cos 3x} = \frac{\sqrt{3}}{\sin 3x}$ oe
	$3x$ = 30 or 210 or –150 or –330	**M1**	Finds one correct and valid triple angle May be in radians for this mark implied by one correct value of x
	x: 10, 70, –50, –110 and no extras in range	**A2**	**A1** for any two correct angles ignoring extras

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