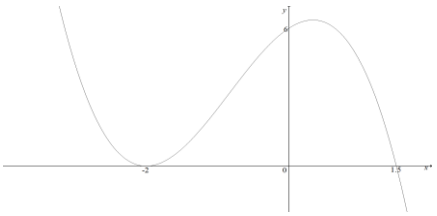
Question	Answer	Marks	Guidance
1(a)	$AOB = \arccos\left(\frac{5}{13}\right)$ oe	**M1**	For a complete method to find *AOB*
	1.18	**A1**	
1(b)	25.9 cm	**3**	**M1** for $AB = 12$ soi **M1** for arc length = $5 \times theirAOB$ in radians
1(c)	Area = 15.3 cm^2	**3**	**M1** for area of triangle = 30 soi **M1** for area of sector = $\frac{1}{2} \times 25 \times theirAOB$ in radians
2(a)	$\frac{dy}{dx} = \frac{1}{2}\left(2(x+2)(3-2x) - 2(x+2)^2\right)$ oe or $\frac{dy}{dx} = \frac{1}{2}\left(-6x^2 - 10x + 4\right)$ oe	**2**	**M1** for attempt to differentiate a product, or expansion and differentiation
	When $\frac{dy}{dx} = 0$, $x = -2$, $x = \frac{1}{3}$ nfww	**2**	**M1** for equating *their* $\frac{dy}{dx}$ to zero and attempt to solve a quadratic equation to obtain 2 *x*-values
2(b)		**3**	**B1** for correct shape with maximum in the first quadrant, continuing into the 4th quadrant. **B1** for correct intercepts -2 and 1.5 on the *x*-axis or stated and no others; must have a cubic graph **B1** for 6 on the *y*-axis or stated; must have a cubic graph
2(c)	$\frac{343}{54}$ or 6.35	**M1**	For finding the *y*-coordinate of the maximum point.
	$0 < k < \frac{343}{54}$ or $0 < k < 6.35$	**A1**	**A0** if additional values are given.

Question	Answer	Marks	Guidance
3	$6x^{\frac{6}{5}} + x^{\frac{3}{5}} - 12 = 0$	**M1**	For attempt to obtain a 3-term quadratic in terms of $x^{\frac{3}{5}}$, allow one sign error. Allow use of substitution
	$x^{\frac{3}{5}} = \frac{4}{3},\ x^{\frac{3}{5}} = -\frac{3}{2}$	**M1**	**Dep** for solution of *their* quadratic equation to obtain 2 solutions in terms of $x^{\frac{3}{5}}$
	1.62, -1.97	**2**	**M1** for correct attempt to solve an equation of the form $x^{\frac{3}{5}} = k$, $k \neq 1$ **A1** for both
4(a)(i)	3003	**B1**	
4(a)(ii)	With the sisters: 792 soi	**B1**	
	Without the sisters: 66 soi	**B1**	
	Total 858	**B1**	
4(b)	68 880	**3**	**B1** Starts with 1, 3, 5, 7, 9: 42 000 soi **B1** Starts with 2, 4, 6 or 8: 26 880 soi
	Alternative		
	68 880	**(3)**	**B1** Ends with 0: 15 120 soi **B1** Ends with 2, 4, 6 or 8: 53 760 soi
5(a)	$e^y = mx^2 + c$ soi	**B1**	
	$m = -3$ used correctly	**B1**	
	$c = 18.75$	**B1**	
	$y = \ln\left(18.75 - 3x^2\right)$ oe	**B1**	Allow 18.8 **B0** for poor use of brackets
5(b)	$their\left(18.75 - 3x^2\right) > 0$	**B1**	May be implied by final answer
	Critical values $\pm$ 2.5 oe seen	**B1**	May be implied by final answer
	$-2.5 < x < 2.5$	**B1**	Mark final answer

Question	Answer	Marks	Guidance
6(a)	$\dfrac{\left(\dfrac{4x}{2x^2+1}\times(x+2)\right)-\ln(2x^2+1)}{(x+2)^2}$ oe, isw	**3**	**B1** for $\dfrac{4x}{2x^2+1}$ **M1** for attempt at differentiation of a quotient or correct product **A1** for all terms apart from $\dfrac{4x}{2x^2+1}$ correct
6(b)	When $x=2$, $\dfrac{dy}{dx}=0.0849$ and attempt at correct use of small changes	**M1**	Substitution of $x=2$ needs to be seen if simplification of **(a)** is incorrect.
	Change = $0.0849h$	**A1**	Must have full marks in part **(a)**
6(c)	$\dfrac{dy}{dt}=-0.4$ soi	**B1**	
	$\dfrac{dx}{dt}=-\dfrac{0.4}{their\ \dfrac{dy}{dx}_{x=2}}$	**M1**	
	awrt -4.71	**A1**	
7(a)	Least value of a when $2+a=1$ so $a=-1$.	**2**	**B1** for range of f: $2+a$, may be implied by $a+1$ or $\sqrt{a+1}$
7(b)	$\sqrt{(2e^x+5)-1}$ $[=3]$	**M1**	For correct order
	$x=0.916$	**2**	**M1** for correct attempt to solve to obtain $x=\ldots$
8(a)	Numerator: $\dfrac{\sin\theta\times\sin^2\theta}{\cos^2\theta}$ or Denominator: $\dfrac{1}{\cos^2\theta}$ soi	**B1**	Allow for a correct step and equivalent methods
	$\dfrac{\dfrac{\sin\theta\times\sin^2\theta}{\cos^2\theta}}{\dfrac{1}{\cos^2\theta}}=\sin^3\theta$	**B1**	Must have sufficient detail

Question	Answer	Marks	Guidance
8(b)	$\sin 3x = \frac{1}{2}$	**B1**	
	$3x = 30^o ...$	**M1**	Any correct triple angle
	$x = -110^o,\ -70^o,\ 10^o,\ 50^o,\ 130^o,\ 170^o$	**3**	**M1** for one correct solution **A1** for three further correct solutions **A1** for a further two correct solutions and no extra solutions in the range
9(a)	$v = \frac{10}{2t+1} - 5$	**2**	**M1** for $v = \frac{A}{2t+1} - 5$
	When $v = 0,\ t = \frac{1}{2}$	**2**	**Dep M1** for attempt to solve *their* $v = 0$
9(b)	When $t = \frac{1}{2}$, $s = 0.9657$ or $5\ln 2 - 2.5$ **and** when $t = 2$ $s = -1.9528$ or $5\ln 5 - 10$	**2**	**FT** on *their t* from part **(a)** **B1FT** for when $t = \frac{1}{2}$, $s = 0.9657$ or $5\ln 2 - 2.5$
	3.88	**2**	**M1** for distance = $2(their 0.9657) + 1.9528$
9(c)	$-\frac{20}{(2t+1)^2}$ oe	**2**	**M1** for $\frac{B}{(2t+1)^2}$, where B is an integer
9(d)	–0.2	**B1**	Mark final answer, do not isw.
10	$a^4x^4 - 8a^3x^3 + 24a^2x^2 ...$ soi	**3**	**B1** for each term
	$1 + \frac{3b}{x} + \frac{3b^2}{x^2} ...$ soi	**2**	**B1** for two correct terms
	$a = 3$	**B1**	
	$b = 5$	**2**	**B1** for $-8a^3 + 3a^4b = 999$ oe or $243b - 216 = 999$ oe
	$c = 3051$	**2**	**B1** for $3a^4b^2 - 24a^3b + 24a^2 = c$ oe or $6075 - 3240 + 216 = c$ oe

Question	Answer	Marks	Guidance
11	$\tan(y+1.5)=\frac{1}{3}$	**B1**	
	Allow 1.96 or 1.9625 to 1.964 Allow 5.10 to 5.11	**3**	**M1** for a correct order of operations, may be implied by $y=-1.178$ oe **A1** for one correct solution **A1** for a second correct solution and no extras

