Question Number	Scheme	Marks
8.(a)	Substitutes $x=4$ in $f'(4)=4\times2-2-\dfrac{8}{3\times4^{2}}=\left(\dfrac{35}{6}\right)$	M1
	Attempts to find the gradient of the perpendicular = $-\dfrac{6}{35}$	dM1
	Attempts the normal $y-1=-\dfrac{6}{35}\times(x-4)\Rightarrow 6x+35y-59=0$	M1A1
		(4)
(b)	$f'(x)=4x^{\frac{1}{2}}-2-\dfrac{8}{3x^{2}}\Rightarrow f(x)=\dfrac{8}{3}x^{\frac{3}{2}}-2x+\dfrac{8}{3x}(+c)$	M1 A1 A1
	$x=4, f(x)=1\Rightarrow\ 1=\dfrac{8}{3}\times8-8+\dfrac{2}{3}+c\Rightarrow c=...(-13)$	dM1
	$f(x)=\dfrac{8}{3}x^{\frac{3}{2}}-2x+\dfrac{8}{3x}-13$	A1
		(5) **(9 marks)**

Notes

Points for marking:

- If all a candidate does is integrate, then mark as though they are attempting (b) even though their solution may have part (a) marked in the margin
- If a candidate differentiates $f'(x)$ in (a) and integrates $f''(x)$ in (b) getting back to the same or similar expression it is 0 marks in (b)
- See Practice items. Read annotations carefully to understand how to apply these principles.
- If in any doubt ask your TL for advice

(a)

M1 Attempts $f'(4)=4\times2-2-\dfrac{8}{3\times4^{2}}$.

If you do not see embedded values

1) award if the candidate has two of the three terms correct. Eg two of $8-2-"0.166"$

2) award for sight of $\dfrac{35}{6}$ or awrt 5.83 if the candidate just offers a value

dM1 Attempts perpendicular gradient using the correct rule. The M1 must have been awarded

M1 Attempts to find the equation of the normal using $(4,1)$ and a **changed** gradient.

If the candidate differentiates $f'(x)$ they can be awarded this mark

Condone one sign slip when using the $(4,1)$

A1 $6x+35y-59=0$

Accept any $\pm k(6x+35y-59)=0$ where $k\in\mathbb{N}$

(b)

M1 Raises any correct index by one $x^{\frac{1}{2}} \to x^{\frac{3}{2}}, 2 \to 2x, \frac{1}{x^2} \to \frac{1}{x}$ The indices must be processed

A1 Any two terms correct (may be un-simplified) with or without $+c$

Do not allow the indices or the coefficients to be left un processed Eg $4x^{\frac{1}{2}} \to \frac{4}{1+\frac{1}{2}} x^{\frac{1}{2}+1}$

A1 All three terms correct and simplified with or without $+c$. Condone spurious notation.

Look for $\frac{8}{3}x^{\frac{3}{2}} - 2x + \frac{8}{3x}$ or exact simplified equivalent such as $\frac{8x^{\frac{3}{2}}}{3} - 2x + \frac{8}{3}x^{-1}$

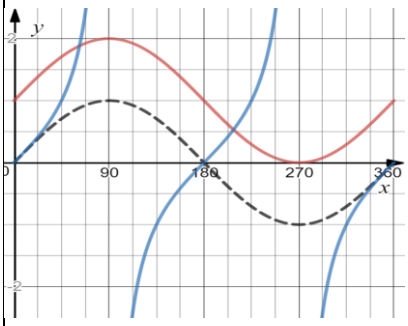
This may be implied by a final line where c has been found.

dM1 Substitute $x = 4, y = 1$ into their $\mathrm{f}(x)$ containing $+c$ to obtain c

A1 $\mathrm{f}(x) = \frac{8}{3}x^{\frac{3}{2}} - 2x + \frac{8}{3x} - 13$ or exact simplified equivalent such as $\mathrm{f}(x) = \frac{8}{3}x\sqrt{x} - 2x + \frac{8}{3}x^{-1} - 13$

Condone $\mathrm{f}(x) = y$ or allow if there is no left- hand side at all.

Isw after a correct answer.

Question Number	Scheme	Marks
9. (a)	$(270°, -4)$	B1 B1 **(2)**
(b)	 For $y = 1 + \sin\theta$	B1
	$y = \tan\theta$	B1 **(2)**
(c)	(i) $6 \times 2 = 12$ (ii) 11	M1 A1 B1 ft **(3)** **(7 marks)**

(a)

B1 Either coordinate correct. Look for either $270^{(°)}$ or -4 in the correct position within (,) .

Alternatively look for either $x = 270$ or $y = -4$ Condone $\frac{3\pi}{2} = 270°$

Do not accept multiple answers unless one point is chosen or it is clearly part of their thought process.

There is no need for the degrees symbol. Condone swapped coordinates, ie $(-4, 270)$ for this mark

B1 For correct coordinates.

$(270°, -4)$ with or without degrees symbol. Condone $x = 270(°), y = -4$

(b) These may appear on Figure 3 rather than Diagram 1

B1 For $y = 1 + \sin\theta$ Score for a curve passing through $(0,1), (90°, 2), (180°, 1), (270°, 0), (360°, 1)$ with acceptable curvature. Do not accept straight lines

B1 For $y = \tan\theta$ with acceptable curvature. Must go beyond $y = 1$ and -1

Score for the general shape of the curve rather than specific coordinates. See practice and qualification items for clarification.

First quadrant from $(0,0) \rightarrow (90°, \infty)$

Second and third quadrants from $(90°, -\infty) \rightarrow (270°, \infty)$ passing through $(180°, 0)$

Fourth quadrant from $(270°, -\infty) \rightarrow (0,0)$

(c)(i) The question states hence so it is expected the results come from graphs.

If neither or only one graph is drawn then score for 12 in (i) for M1 A1 and 11 in (ii) B1

M1 For the calculation $\frac{2160}{360} = 6$ or $\frac{2160}{180} = 12$ or multiplying the number of intersections in their (b) by 6

Sight of 6 or 12 will imply this mark.

A1 12. 12 will score both marks.

(c) (ii)

B1 ft For either 11 (correct answer)

or follow through on n less than their answer to (c) (i) where n is their number of solutions in the range $180° < \theta \leqslant 360°$