Question	Answer	Marks	Guidance
4(b)	$\left(-\frac{5}{4}, -\frac{49}{8}\right)$ oe	**2**	**B1** for $-\frac{5}{4}$ as part of a set of coordinates or $x=-\frac{5}{4}$, **FT** on $-$ *their b* **B1** for $-\frac{49}{8}$ as part of a set of coordinates or $y=-\frac{49}{8}$ **FT** on *their c* Need to be using *their* answer to **(a)** and not using differentiation as 'Hence'. **B1** for $-\frac{5}{4}, -\frac{49}{8}$
4(c)		**3**	**B1** for correct shape, with maximum in the second quadrant and cusps on the *x*-axes and reasonable curvature for $x<-3$ and $x>0.5$. **B1** for $(-3,\ 0)$ and $(0.5,\ 0)$ either seen on the graph or stated, must have attempted a correct shape **B1** for $(0,\ 3)$ either seen on the graph or stated, must have attempted a correct shape
4(d)	$\frac{49}{8}$ oe	**B1**	**FT** on *their* $\lvert c\rvert$ from **(a)** Allow $\frac{49}{8}$ from other methods
5(a)	$\begin{pmatrix}-4\\3\end{pmatrix}t$ or $\begin{pmatrix}0\\0\end{pmatrix}+\begin{pmatrix}-4\\3\end{pmatrix}t$ oe	**B1**	
5(b)	$\begin{pmatrix}12\\6\end{pmatrix}+\begin{pmatrix}-5\\8\end{pmatrix}t$ or $\begin{pmatrix}12-5t\\6+8t\end{pmatrix}$	**B1**	

Question	Answer	Marks	Guidance
5(c)	$\overrightarrow{PQ} = \begin{pmatrix} 12 \\ 6 \end{pmatrix} + \begin{pmatrix} -5 \\ 8 \end{pmatrix} t - \begin{pmatrix} -4 \\ 3 \end{pmatrix} t$	**M1**	For $their(b) - their(a)$, or $their(a) - their(b)$ Allow unsimplified. Both vectors must be in terms of t
	$\begin{pmatrix} 12-t \\ 6+5t \end{pmatrix}$ soi	**B1**	
	$\left\lvert \left(\overrightarrow{PQ}\right)^2 \right\rvert = (12-t)^2 + (6+5t)^2$ $\left\lvert \left(\overrightarrow{PQ}\right)^2 \right\rvert = 26t^2 + 36t + 180$	**A1**	Allow **FT** for use of modulus with $\begin{pmatrix} t-12 \\ -6-5t \end{pmatrix}$ and simplification to obtain the given result.
5(d)	Attempt to solve or consider the discriminant of $26t^2 + 36t + 180 = 0$	**M1**	Must be using the equation from part (c) as 'Hence'.
	Conclusion from either $36^2 - 4(26)(180) < 0$ or $t > 0$	**A1**	Must have stated somewhere that $\left\lvert \left(\overrightarrow{PQ}\right)^2 \right\rvert = 0$ oe has been considered not just $\left\lvert \left(\overrightarrow{PQ}\right)^2 \right\rvert$.
6(a)(i)	$a = 10, \ 6 = \frac{a}{1-r}$ $10 = 6 - 6r$	**M1**	For use of first term and sum to infinity to obtain an equation in r only
	$r = -\frac{2}{3}$	**A1**	
6(a)(ii)	$S_7 = 10\frac{\left(1-(their\ r)^7\right)}{1-\ their\ r}$	**M1**	For sum formula with $\lvert their\ r \rvert < 1$.
	$S_7 = 6.35$	**A1**	
6(b)(i)	$\log_x 3$	**B1**	
6(b)(ii)	$S_n = \frac{n}{2}\left(2\log_x 3 + (n-1)\log_x 3\right)$	**M1**	For use of sum formula with *their* (i)
	$\frac{n}{2}(n+1)\log_x 3, \ \frac{n}{2}\log_x 3^{n+1}, \ \frac{n+1}{2}\log_x 3^n$	**A1**	Allow other similar equivalents
6(b)(iii)	$\frac{n}{2}(n+1) = 3081$	**M1**	For a correct attempt to solve *their* (ii) $= 3081\log_x 3$ to obtain an answer for n. Must be a 3 term quadratic in n only.
	$n = 78$	**A1**	