Question	Answer	Marks	Partial marks
10(a)	Maximum point at (2, 1) oe, nfww and $h = 5$ nfww	**B4**	**B3** for maximum point at (2, 1) oe or **B2** for maximum point when $x = 2$ or **B1** for a correct method which could be used to find the maximum point $\left[x\left(1-\frac{x}{4}\right)=0 \text{ when } x=0 \text{ and}\right] x = 4$ or [differentiating and equating to 0:] $1-\frac{2x}{4}=0$ or [completing the square to find:] $1-\frac{1}{4}(x-2)^2$ If 0 scored, **SC1** for $h = 5$ with incorrect or no method shown
10(b)	$x^2 - 4x - 16$ [= 0] oe or $-\frac{1}{4}(x-2)^2 = -4-1$ oe	**B1**	**FT** *their* attempt to complete the square, if already seen and of the form $a+b(x+c)^2$ where *a*, *b* and *c* are constants and *b* is negative
	Solves *their* 3-term quadratic using the formula or completing the square	**M1**	**FT** *their* rearrangement of $-4 = x - \frac{x^2}{4}$ oe
	$x = 2+2\sqrt{5}$ oe	**A1**	
10(c)	First derivative $1 - \frac{x}{2}$ and substitution of *their* $2+2\sqrt{5}$ or 6.47	**M1**	**FT** *their* attempt to differentiate $x-\frac{x^2}{4}$, if already seen, and *their* $2+2\sqrt{5}$
	$1 - 2\times\frac{2+2\sqrt{5}}{4}$ or $-\sqrt{5}$ or awrt –2.24 soi	**A1**	**dep** on correct derivative and correct *x*-coordinate of *A*
	Correct method to find the angle e.g. $-\tan^{-1}\left(1 - 2\times\frac{2+2\sqrt{5}}{4}\right)$ soi or $\tan^{-1}\sqrt{5}$ or $-\tan^{-1}(-\sqrt{5})$ soi	**M1**	**dep** on previous **M1 A1**
	Degrees: awrt 65.9 or Radians: awrt 1.15	**A1**	
11(a)	$x = 5$ $y = 5\sqrt{3}$	**B2**	**B1** for either component correct

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Question	Answer	Marks	Partial marks
11(b)	$\left[\begin{pmatrix}0\\0\end{pmatrix}+\right]\quad t\begin{pmatrix}5\\5\sqrt{3}\end{pmatrix}$ oe, isw	**B1**	**FT** *their* $\begin{pmatrix}5\\5\sqrt{3}\end{pmatrix}$, which must be a vector with at least one non-zero component
11(c)	$\begin{pmatrix}2\sqrt{3}\\9\end{pmatrix}+t\begin{pmatrix}\frac{5}{3}\\0\end{pmatrix}$ oe, isw	**B2**	**B1** for x component $2\sqrt{3}+\frac{5}{3}t$ seen or y component 9 seen or $\begin{pmatrix}2\sqrt{3}\\9\end{pmatrix}+t\begin{pmatrix}\frac{5}{3}\\0\end{pmatrix}$ with at most one error but must include t
11(d)	$5t\sqrt{3}=9$ or $5t=2\sqrt{3}+\frac{5}{3}t$	**M1**	**FT** *their* position vector of A and *their* position vector of B providing • both are in terms of t and • at least one is of form $\begin{pmatrix}a\\b\end{pmatrix}+t\begin{pmatrix}c\\d\end{pmatrix}$ where a, b, c and d are constants
	$\left(5\sqrt{3}\right)t=9$ and $5t=2\sqrt{3}+\frac{5}{3}t$ oe	**A1**	
	Shows the exact times to be the same e.g. $t=\frac{9}{5\sqrt{3}}=\frac{3\sqrt{3}}{5}$ oe **and** $\frac{10}{3}t=2\sqrt{3}\rightarrow t=\frac{3\sqrt{3}}{5}$ or $t=\frac{6\sqrt{3}}{10}\rightarrow t=\frac{3\sqrt{3}}{5}$ or $\frac{5}{3}t=\sqrt{3}\rightarrow t=\frac{3\sqrt{3}}{5}$ oe OR Finds a correct value for t, as above, and shows this satisfies the other equation OR Finds a correct value for t, as above, and shows both particles are at $\begin{pmatrix}\frac{9}{\sqrt{3}}\\9\end{pmatrix}$ oe at this time	**A2**	**A1** for $t=\frac{9}{5\sqrt{3}}$ **and** $t=\frac{2\sqrt{3}}{\frac{10}{3}}$ oe

Question	Answer	Marks	Partial marks
12	Correct use of $x^2h = 5$ to find an expression that can be used to eliminate h	**M2**	**M1** for $x^2h = 5$ soi
	Surface area: $x^2 + 4x\left(\frac{5}{x^2}\right)$ oe	**B1**	
	Derivative of the surface area: $2x - 20x^{-2}$ oe	**B1**	**FT** *their* surface area of form $ax^2 + \frac{b}{x}$
	Equates *their* $2x - 20x^{-2}$ to 0 and solves to find a value of x	**M1**	**FT** *their* derivative of form $ax + \frac{b}{x^2}$ oe
	$x = 2.15$ or 2.154[…] $h = 1.08$ or 1.077[…] nfww	**A1**	**dep** on all previous marks awarded
	Alternative		
	Correct use of $x^2h = 5$ to find an expression that can be used to eliminate x	**(M2)**	**M1** for $x^2h = 5$ soi
	Surface area: $\left(\sqrt{\frac{5}{h}}\right)^2 + 4h \times \sqrt{\frac{5}{h}}$ oe	**(B1)**	
	Derivative of the surface area: $4\sqrt{5} \times \frac{1}{2}h^{-\frac{1}{2}} - \frac{5}{h^2}$ oe	**(B1)**	**FT** *their* surface area of form $\frac{a}{h} + b\sqrt{h}$
	Equates *their* $4\sqrt{5} \times \frac{1}{2}h^{-\frac{1}{2}} - \frac{5}{h^2}$ to 0 and solves to find a value of h	**(M1)**	**FT** *their* derivative of form $\frac{a}{\sqrt{h}} + \frac{b}{h^2}$ oe
	$h = 1.08$ or 1.077[…] $x = 2.15$ or 2.154[…] nfww	**(A1)**	**dep** on all previous marks awarded

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