Question Number	Scheme	Marks
3(a)	Attempts $\left(8-3\right)^2+\left(5--7\right)^2=...$	M1
	Writes $\left(x-3\right)^2+\left(y-5\right)^2=k$	M1
	$\left(x-3\right)^2+\left(y-5\right)^2=169$	A1
		(3)
(b)	Attempts $d^2+\left(2\sqrt{22}\right)^2=169\Rightarrow d=...$	M1
	States or uses $\left(y=\right)\ 5+d$	dM1
	$y=14$	A1
		(3)
		(6 marks)

(a)

M1: Attempts to find the radius or radius ^{2}. Must proceed to find a value. Condone a sign slip if attempting $5--7$ if this is seen as $5-7$ o.e. May be implied by 13 or 169. Do not be concerned with the labelling of the expression or value as r or r^2

M1: Writes the equation of the circle in the form $\left(x-3\right)^2+\left(y-5\right)^2=k$, where $k>0$, o.e.

e.g. $x^2+y^2-6x-10y+c=0$ where $c<0$

Invisible brackets may be implied by further work. Condone $\left(x-3\right)^2+\left(y-5\right)^2=r^2$ where no attempt has been made to find the radius or radius^2

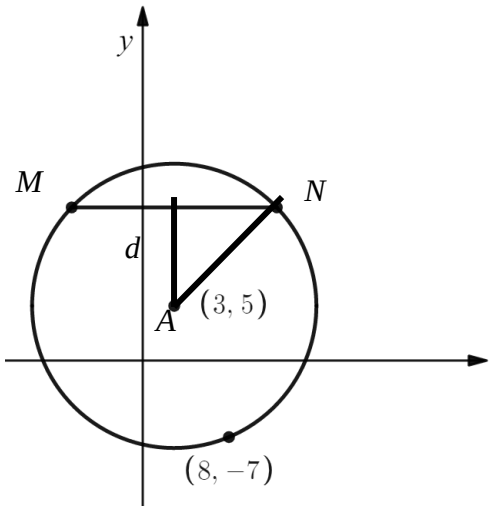
A1: $\left(x-3\right)^2+\left(y-5\right)^2=169$ o.e. e.g. $x^2+y^2-6x-10y-135=0$ isw once a correct unsimplified equation for C is found. Condone $\left(x-3\right)^2+\left(y-5\right)^2=13^2$. A correct equation scores M1M1A1 but it must be seen in (a).

(b) **Note that** $(3+2\sqrt{22},\ 14)$ **as the final answer is A0**

M1: Attempts Pythagoras' theorem with "13" (as the hypotenuse) and $2\sqrt{22}$ to find d. Not just d^2 (See diagram)

dM1: States or uses the equation for MN, $\left(y=\right)\ 5+d$ but also condone stating/using $\left(y=\right)\ 5-d$ (may be implied by their value for y)

A1: $y=14$ only (Must be exactly 14 e.g. $13.99...=14$ is A0). **Further work leading to a different equation of a line is A0.**



Alternative using their centre and the *x* coordinates of *M* and *N* are equidistant from the centre

M1: Attempts to find the *x* coordinates of *M* or *N* e.g. $3\pm2\sqrt{22}$, uses their equation of the circle with one of $x=3\pm2\sqrt{22}$ and forms a three term quadratic in *y* (e.g. $y^2-10y-56=0$)

dM1: Attempts to solve their quadratic proceeding to a value for *y*. Usual rules for solving a quadratic. Accept via a calculator. It is dependent on the previous method mark.

A1: $y=14$ only (Must be exactly 14 e.g. $13.99...=14$ is A0) **Further work leading to a different equation of a line is A0.**

Alternative finding an angle in the triangle *MNA*, then using the angle to find *d*

M1: e.g. attempts the cosine rule to find the angle *MNA*, and then trigonometry to find *d*

$$\cos(\angle MNA)=\frac{13^2+\left(4\sqrt{22}\right)^2-13^2}{2\times13\times4\sqrt{22}}\Rightarrow\angle MNA=43.8...^\circ$$

$$d=\sin43.8...\times13=...$$

dM1: Same as main scheme

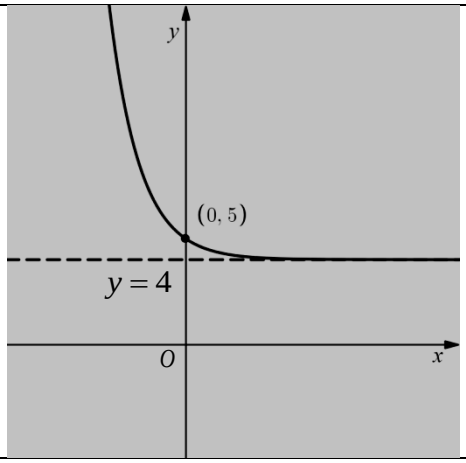
A1: $y=14$ only (Must be exactly 14 e.g. $13.99...=14$ is A0) **Further work leading to a different equation of a line is A0.**

Note: There may be other more complex attempts (including use of area) Send to review if unsure.

e.g. Attempting to find the line which passes through *AN* $\left(y=\frac{9}{2\sqrt{22}}x+\frac{220-27\sqrt{22}}{44}\right)$ and solving simultaneously with the equation of the circle $\Rightarrow y=14$

This typically will score M1 for attempting Pythagoras' theorem, but can score for attempting the gradient of the line *AN*.

The dM1 mark would be for the full attempt to find where the line through *AN* intersects the equation of the circle.

Question Number	Scheme	Marks
4(a)	 Correct shape Correct intercept Correct equation for asymptote	B1 B1 B1
		(3)
(b)	Strip width = 2.5	B1
	$\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}+4\right)\mathrm{d}x \approx \frac{5}{4}\left\{13+4.009+2\times(6.280+4.577+4.146+4.037)\right\}$ $=68.86125\left(=\text{awrt } 69\right)$	M1 A1
		(3)
(c)	(i) $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}\right)\mathrm{d}x = 69-4\times\left(8.5--4\right)=\text{awrt } 19$	M1, A1ft
	(ii) $\int_{-4}^{8.5}\left(3^{-\frac{1}{2}x}+4\right)\mathrm{d}x + \int_{-8.5}^{4}\left(3^{\frac{1}{2}x}+4\right)\mathrm{d}x = \text{awrt } 138$	B1ft
		(3)
		(9 marks)

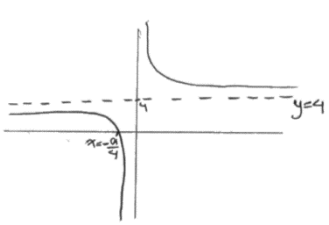
(a) **If there are multiple attempts then mark the most complete attempt. If coordinates/the equation of the asymptote are stated by the question and on their diagram, then the sketch takes precedence.**

B1: Correct shape in quadrants 1 and 2 and does not appear in quadrants 3 or 4 or touch the *x*-axis. Do not be concerned about the y intercept or asymptote. Mark the intention to draw an exponentially decreasing graph – do not penalise parts of the curve which may appear linear.

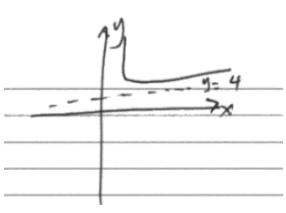
B1: Intercept at (0, 5). Condone invisible brackets, or may just have 5 marked on the *y*-axis, or $x=0,\ y=5$. If the point is labelled as $(5,\ 0)$ then condone provided it is a *y* intercept which is above the *x*-axis.

B1: Graph with asymptote at $y=4$ (asymptote does not need to be drawn) Must be an equation. There must be a graph with the intention of a horizontal asymptote above the *x*-axis to score the mark. If more than one horizontal asymptote is given, then B0. Where the asymptote is not drawn (e.g. with dashed lines) it must be clear that $y=4$ refers to the asymptote of the graph and not the *y*-intercept.

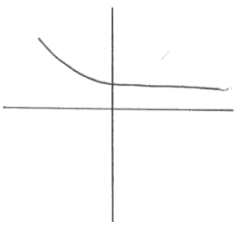
Examples:



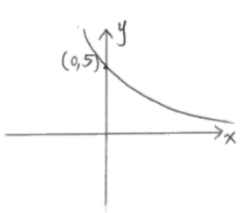
B0B0B1



B0B0B1



B1B0B0



B1B1B0