Question	Scheme	Marks	AOs
1 (a)	Deduces that the gradient of line l_2 is $-\frac{5}{3}$	B1	1.1b
	Complete attempt to find the equation of line l_2 e.g., $y-0=-\frac{1}{"m_1"}(x-8)$	M1	1.1b
	$5x+3y=40$ *	A1*	2.1
		(3)	
(b)	Deduces $A(-10,0)$	B1	2.2a
	Attempts to solve $y=\frac{3}{5}x+6$ and $5x+3y=40$ simultaneously to find the y coordinate of their point of intersection	M1	1.1b
	y coordinate of C is $\frac{135}{17}$ o.e.	A1	1.1b
	Complete attempt at area $ABC = \frac{1}{2}\times(8+"10")\times"\frac{135}{17}"$	dM1	2.1
	$=\frac{1215}{17}$	A1	1.1b
		(5)	
			(8 marks)

Notes:

(a)

B1: Deduces that the gradient of line l_2 is $-\frac{5}{3}$ (accept $-\frac{5}{3}x$)

M1: Complete attempt to find the equation of line l_2 using $B(8,0)$ and a changed gradient.
If using $y = mx + c$ they must be using a changed gradient and proceed as far as $c = \ldots$

A1*: Clear work leading to the given answer of $5x+3y=40$ with no errors seen.
There is a requirement to "show that" so the must be at least one intermediate line between $y-0=-\frac{5}{3}(x-8)$ or finding c (e.g., $y=-\frac{5}{3}x+\frac{40}{3}$) and the answer.
Condone $3y+5x=40$

(a) Alternative

B1: Rearranges $5x+3y=40$ to $y=-\frac{5}{3}x+\ldots$

M1: Complete attempt to show that the equation of line l_2 is perpendicular to l_1 and that it passes through $B(8,0)$. Requires:

- **either** $-\frac{5}{3}$ is the negative reciprocal of $\frac{3}{5}$ **or** shows $-\frac{5}{3}\times\frac{3}{5}=-1$
- evidence that l_2 passes through $(8,0)$, e.g., $5(8)+3(0)=40$ **or** $y=-\frac{5}{3}(8)+\frac{40}{3}=0$

A1*: Clear work showing all elements of $5x+3y=40$ being perpendicular to l_1 and that $(8,0)$ lies on $5x+3y=40$, as above, with no errors seen and a minimal conclusion.

(b)

B1: Deduces $A(-10,0)$ May be awarded on the diagram as -10 or within a calculation.

M1: For the attempt to solve $y=\frac{3}{5}x+6$ (or e.g., $5y-3x=30$) and $5x+3y=40$ simultaneously to find the ***y* coordinate** of their point of intersection.
May be implied, i.e., from a calculator solution which must be correct to 1d.p.
They should be using the given equations but allow slips in rearranging.

A1: *y* coordinate of *C* is $\frac{135}{17}$ (Accept awrt 7.9 for this mark)

dM1: Scored for a complete and correct attempt to find the **exact** area of triangle *ABC*.
There may be numerical slips, e.g., in finding the *x* coordinates of *A*, but, e.g., the *x* and *y* coordinates should not be used the wrong way round.
Do not allow the use of decimals in place of exact values as they cannot meet the demand of the question.
See scheme using just the *y* coordinate of *C*.
Another option is to use Pythagoras' theorem to find *AC* and *BC* lengths using $A(-10,0)$, $B(8,0)$ and their $C\left(\frac{55}{17},\frac{135}{17}\right)$ Note: $AC=\frac{45\sqrt{34}}{17}$ and $BC=\frac{27\sqrt{34}}{17}$

A1: Proceeds correctly to area $ABC=\frac{1215}{17}$

(b) Alternative – you might see the following from Further Maths candidates:
B1M1A1 as above.

dM1: $$\frac{1}{2}\begin{vmatrix} 8 & "\frac{55}{17}" & "-10" & 8 \\ 0 & "\frac{135}{17}" & 0 & 0 \end{vmatrix}=\frac{1}{2}\left(8\times"\frac{135}{17}"-"-10"\times"\frac{135}{17}"\right)$$

or $$\frac{1}{2}\begin{vmatrix} 8 & 0 & 1 \\ "\frac{55}{17}" & "\frac{135}{17}" & 1 \\ "-10" & 0 & 1 \end{vmatrix}=\frac{1}{2}\left(8\times"\frac{135}{17}"-"-10"\times"\frac{135}{17}"\right)$$

A1: Proceeds correctly to area $ABC=\frac{1215}{17}$

Question	Scheme	Marks	AOs
2 (a)	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = (-8\mathbf{i}+9\mathbf{j}) - (10\mathbf{i}-3\mathbf{j})$	M1	1.1b
	$= -18\mathbf{i}+12\mathbf{j}$	A1	1.1b
		(2)	
(b)	$\lvert\overrightarrow{AB}\rvert = \sqrt{"18"^2 + "12"^2}\ \{= \sqrt{468}\}$	M1	1.1b
	$= 6\sqrt{13}$	A1	1.1b
		(2)	
(c)	For the key step in using the fact that *BCA* forms a straight line in an attempt to find "*p*" $\overrightarrow{AB} = \lambda\overrightarrow{BC} \Rightarrow -18\mathbf{i}+12\mathbf{j} = 6\lambda\mathbf{i} + \lambda(p-9)\mathbf{j}$ with components equated leading to a value for λ and to $p = \ldots$	M1	2.1
	(i) $p = 5$	A1	1.1b
	(ii) ratio = 2: 3	B1 (A1 on EPEN)	2.2a
		(3)	
			(7 marks)

Notes:

(a) **Must be seen in (a)**

M1: Attempts subtraction either way round. This cannot be awarded for adding the two vectors. If no method shown it may be implied by one correct component. Allow as coordinates for this mark. Condone missing brackets, e.g., $-8\mathbf{i}+9\mathbf{j}-10\mathbf{i}-3\mathbf{j}$

A1: cao $-18\mathbf{i}+12\mathbf{j}$ o.e. $\begin{pmatrix}-18\\12\end{pmatrix}$ Condone $\begin{matrix}-18\\12\end{matrix}$

Do not allow $\begin{pmatrix}-18\mathbf{i}\\12\mathbf{j}\end{pmatrix}$ or $(-18,\ 12)$ or $\left(\dfrac{-18}{12}\right)$ for the A1.

(b)

M1: Attempts to use Pythagoras' theorem on their vector from part (a). Allow restarts.

$\lvert\overrightarrow{AB}\rvert = \sqrt{"18"^2 + "12"^2}\ \{= \sqrt{468}\}$ Note that -18 will commonly be squared as 18

May be implied by awrt 21.6 This will need checking if (a) is incorrect.

A1: cao $6\sqrt{13}$ May come from $\begin{pmatrix}\pm18\\\pm12\end{pmatrix}$

(c)

M1: For the key step in using the fact that *BCA* forms a straight line in an attempt to find "*p*"

Condone sign slips. Award, for example, for $\pm\dfrac{p-9}{6} = \pm\dfrac{2}{3}$ leading to $p = \ldots$

It is implied by $p = 5$ unless it comes directly from work that is clearly incorrect.

e.g., award for an attempt to use

- $\overrightarrow{AB} = \alpha\overrightarrow{AC} \Rightarrow -18\mathbf{i} + 12\mathbf{j} = -12\alpha\mathbf{i} + \alpha(p+3)\mathbf{j}$ with components equated leading to a value for α and to $p = \ldots$
- gradient BC = gradient $BA = -\frac{2}{3}$ e.g., $\frac{p-9}{6} = \frac{9--3}{-8-10}$ leading to $p = \ldots$
- triangles BCM and BAN are similar with lengths in a ratio 1:3. e.g., $p = 9 - \frac{1}{3}\times 12$ **or** $p = -3 + \frac{2}{3}\times 12$
- attempt to find the equation of line AB using both points (FYI line AB has equation $y = -\frac{2}{3}x + \frac{11}{3}$) and then sub in $x = -2$ leading to $p = \ldots$
- $\frac{p+3}{12} = \frac{2}{3}$ **or** $\frac{p+3}{2} = 9 - p$ leading to $p = \ldots$

A1: $p = 5$ Correct answer implies both marks, unless it comes directly from work that is clearly incorrect.

B1: States ratio = 2: 3 or equivalent such as 1: 1.5 or 22:33
Note that 3:2 is incorrect but condone {Area}AOB : {Area}AOC = 3: 2
This might follow incorrect work or even incorrect p
For reference, area AOC = 22, area AOB = 33 and area BOC = 11

Question	Scheme	Marks	AOs
3 (a)	(i) $x^2+y^2-10x+16y=80 \Rightarrow (x-5)^2+(y+8)^2=...$	M1	1.1b
	Centre $(5,-8)$	A1	1.1b
	(ii) Radius 13	A1	1.1b
		(3)	
(b)	Attempts $\sqrt{"5"^2+"8"^2}+"13"$	M1	3.1a
	$13+\sqrt{89}$ but ft on their centre and radius	A1ft	1.1b
		(2)	
			(5 marks)
Notes:			

(a)(i)

M1: Attempts to complete the square on **both** *x* and *y* terms.

Accept $(x\pm5)^2+(y\pm8)^2=...$ or imply this mark for a centre of $(\pm5,\pm8)$

Condone $(x\pm5)^2....(y\pm8)^2=...$ where the first ... could be , or even –

A1: Correct centre $(5,-8)$.

Accept without brackets. May be written $x=5, y=-8$

(a)(ii)

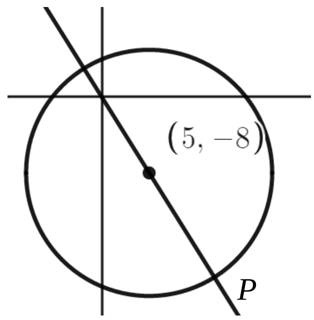
A1: 13. The M mark must have been awarded, so it can be scored following a centre of $(\pm5,\pm8)$.

Do not allow for $\sqrt{169}$ or ±13

(b)

M1: Attempts $\sqrt{"5"^2+"8"^2}+"13"$ for their centre $(5,-8)$ and their radius 13.

Award when this is given as a decimal, e.g. 22.4 for correct centre and radius. Look for $\sqrt{a^2+b^2}+r$ where centre is $(\pm a,\pm b)$ and radius is r



A1ft: $13+\sqrt{89}$ Follow through on their $(5,-8)$ and their 13 leading to an exact answer. ISW for example if they write $13+\sqrt{89}=22.4$

....

There are more complicated attempts which could involve finding *P* by solving $y="-\frac{8}{5}x"$ and $x^2+y^2-10x+16y=80$ simultaneously and choosing the coordinate with the greatest modulus. The method is only scored when the distance of the largest coordinate from *O* is attempted. Such methods are unlikely to result in an exact value but can score 1 mark for the method. Condone slips

FYI. Solving $y=-\frac{8}{5}x$ and $x^2+y^2-10x+16y=80 \Rightarrow 89x^2-890x-2000=0 \Rightarrow P=(11.89,-19.02)$

Hence *OP* = $\sqrt{"11.89"^2+"19.02"^2}\ (=22.43)$ scores M1 A0 but *OP* = $\sqrt{258+26\sqrt{89}}$ is M1 A1