Question	Scheme	Marks	AOs
13 (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)	$\left\|\overrightarrow{AB}\right\| = \sqrt{"18"^2 + "12"^2}$ $\{= \sqrt{468}\}$	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 $\begin{pmatrix} -18 \\ 12 \end{pmatrix}$ for the A1.

(b)

M1: Attempts to use Pythagoras' theorem on their vector from part (a). Allow restarts.
$\left\|\overrightarrow{AB}\right\| = \sqrt{"18"^2 + "12"^2}$ $\{= \sqrt{468}\}$ 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 $\begin{pmatrix} \pm 18 \\ \pm 12 \end{pmatrix}$

(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 $\pm\frac{p-9}{6} = \pm\frac{2}{3}$ 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