| Question number | Scheme | Marks |
|---|---|---|
| 3 a | $\left\vert\overrightarrow{OA}\right\vert = \sqrt{p^2+16}$ and $\left\vert\overrightarrow{OB}\right\vert = \sqrt{4p^2+4p+2}$ | |
| | $\sqrt{2}\left\vert\overrightarrow{OA}\right\vert = \left\vert\overrightarrow{OB}\right\vert \Rightarrow 2p^2+32 = 4p^2+4p+2$ | M1 |
| | $2p^2+4p-30=0 \Rightarrow p^2+2p-15=0$ | M1 |
| | $(p+5)(p-3)=0$ | M1 |
| | $p=3$ | A1<br>(4) |
| b | $\overrightarrow{AB} = -'3'\mathbf{i}+4\mathbf{j}+\mathbf{i}+(2\times'3'+1)\mathbf{j} = -2\mathbf{i}+11\mathbf{j}$ | M1 A1 |
| | $\left\vert\overrightarrow{AB}\right\vert = \sqrt{'4'+'121'}\ \left[=5\sqrt{5}\right]$ | M1 |
| | $'\left[\dfrac{1}{5\sqrt{5}}\right]"(-2\mathbf{i}+11\mathbf{j})'$ | dM1 |
| | $(\pm)\ \dfrac{1}{5\sqrt{5}}(-2\mathbf{i}+11\mathbf{j})$ | A1<br>(5) |
| | | **Total 9 marks** |

| Part | Mark | Notes |
|---|---|---|
| (a) | M1 | For use of $\sqrt{2}\left\|\overrightarrow{OA}\right\| = \left\|\overrightarrow{OB}\right\|$<br>i.e., $\sqrt{2}\times\sqrt{p^2+(-4)^2}=\sqrt{1+(2p+1)^2} \Rightarrow \left(\sqrt{2}\times\sqrt{p^2+16}=\sqrt{4p^2+4p+2}\right)$<br>They may find $\left\|\overrightarrow{OA}\right\|$ and $\left\|\overrightarrow{OB}\right\|$ separately. Award when combined with $\sqrt{2}$ and condone arithmetical slips. |
| | M1 | For forming a 3TQ in any order.<br>[The correct 3TQ is $2p^2+4p-30=0$ or $p^2+2p-15=0$] |
| | M1 | For a correct attempt to solve **their** 3TQ by any valid method.<br>They must reach a value of $p$ for this mark. |
| | A1 | For $p=3$<br>If they also give $p = -5$ without evidence of rejecting this solution, withhold the A mark |
| (b) | M1 | For the vector statement $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ o.e.<br>This can be implied by sight of $\overrightarrow{AB} = '-2'\mathbf{i} + '11'\mathbf{j}$ or $\overrightarrow{AB} = \begin{pmatrix}'-2'\\'11'\end{pmatrix}$<br>If there is no vector statement you must check their vector for substitution of their $p$. |
| | A1 | For the correct $\overrightarrow{AB}$ (allow unsimplified) $\left(\overrightarrow{AB} = -2\mathbf{i}+11\mathbf{j}\right)$<br>and also allow $\overrightarrow{AB} = \begin{pmatrix}-2\\11\end{pmatrix}$ Award for sight of $-2\mathbf{i}+11\mathbf{j}$ only. |
| | M1 | For using Pythagoras theorem on their $\overrightarrow{AB}$<br>i.e., $\sqrt{('-2')^2+'11'^2}$ |
| | dM1 | For correct method to find a unit vector using their values and their $\overrightarrow{AB}$<br>NB: this mark is dependent on the previous M mark |
| | A1 | For $\frac{1}{5\sqrt{5}}(-2\mathbf{i}+11\mathbf{j})$ oe $\left[\text{Allow } -\frac{1}{5\sqrt{5}}(-2\mathbf{i}+11\mathbf{j})\right]$<br>**OR**<br>$\overrightarrow{AB} = \pm\frac{1}{5\sqrt{5}}\begin{pmatrix}-2\\11\end{pmatrix}$ |