**Q1.**

| | | | |
|---|---|---|---|
| Circles correct answer | AO1.1b | B1 | 12 |
| **Total** | | **1** | |

**Q2.**

| | | | |
|---|---|---|---|
| Circles correct answer | AO1.1b | B1 | $a^{19}b^4$ |

**Q3.**

| | | | | |
|---|---|---|---|---|
| **(a)** | Forms an appropriate equation to find the position vector of $B$ | AO1.1a | M1 | Let position vector of $B$ be $a\mathbf{i} + b\mathbf{j}$<br>$\frac{a\mathbf{i}+b\mathbf{j}+7\mathbf{i}+9\mathbf{j}}{2} = 3\mathbf{i}+6\mathbf{j}$ |
| | Finds the correct position vector of $B$ | AO1.1b | A1 | $a\mathbf{i}+b\mathbf{j} = -\mathbf{i}+3\mathbf{j}$ |
| | **Total** | | **2** | |
| **(b)** | Finds the components of the vector $\overrightarrow{AB}$ and finds the length using Pythagoras' theorem | AO1.1a | M1 | $\overrightarrow{AB} = -8\mathbf{i}-6\mathbf{j}$<br>$\lvert\overrightarrow{AB}\rvert = \sqrt{8^2+6^2} = 10$ |
| | Obtains correct length of 'their' $AB$ | AO1.1b | A1F | |
| | **Total** | | **2** | |

| Q | Marking Instructions | Marks | Typical Solution |
|---|---|---|---|
| **Q4.** | Attempt to express 8 or 16 as powers of 2.<br>• e.g $8$ seen as $2^3$ **or** $16$ seen as $2^4$.<br>$2^{3a}$ **and** $2^4$ seen.<br>Obtains $a^2 - 3a - 4 = 0$<br>Both correct values for $a$. | **M1**<br>**B1**<br>**A1**<br>**A1**<br>**4 marks** | $2^{a^2} = 8^a \times 16$<br>$2^{a^2} = \left(2^3\right)^a \times 2^4$<br>$2^{a^2} = 2^{3a+4}$<br>$\therefore \quad a^2 = 3a + 4$<br>$0 = a^2 - 3a - 4$<br>$0 = (a-4)(a+1)$<br>$a = 4, \quad a = -1$ |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **5** | Selects an appropriate method by finding the midpoint of *AB* and the gradient of *AB* | AO3.1a | M1 | Mid-point of *AB* = (3, 2)<br>Gradient of *AB* = 2<br>Hence gradient of perpendicular bisector $= -\frac{1}{2}$<br>Equation of perpendicular bisector is<br>$y-2=-\frac{1}{2}(x-3)$<br>$p+6=-\frac{1}{2}(p-3)$<br>$p=-3$ |
| | Finds the correct gradient of the perpendicular bisector of *AB* ft 'their' gradient of *AB* | AO1.1b | A1F | |
| | Forms an appropriate equation and substitutes the given coordinate into 'their' equation to find $p$ | AO1.1a | M1 | |
| | Finds the correct value of $p$ | AO1.1b | A1 | |
| | **Total** | | **4** | |

| | | | | |
|---|---|---|---|---|
| **5 (Alt)** | Selects an appropriate method by using the distance between two points formula to form an expression for the distance between $A$ or $B$ and the point with coordinates $(p, p+8)$ | AO3.1a | M1 | Distances are<br>$\sqrt{(p-1)^2+(p+10)^2}$<br>$\sqrt{(p-5)^2+(p+2)^2}$<br><br>$\sqrt{(p-1)^2+(p+10)^2}=\sqrt{(p-5)^2+(p+2)^2}$<br>$(p-1)^2+(p+10)^2=(p-5)^2+(p+2)^2$<br>$2p^2+18p+101=2p^2-6p+29$<br>$p=-3$ |
| | Forms a correct equation using equal distances between the points $A$ and $B$ and the given point. | AO1.1b | A1 | |
| | Expands brackets correctly to solve the equation | AO1.1a | M1 | |
| | Finds the correct value of $p$ | AO1.1b | A1 | |
| | **Total** | | **4** | |

**Q6.**

| | | |
|---|---|---|
| (a) | Attempts $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$ or similar | M1 |
| | $\overrightarrow{AB} = 5\mathbf{i} + 10\mathbf{j}$ | A1 |
| | | **(2)** |
| (b) | Finds length using 'Pythagoras' $\lvert AB \rvert = \sqrt{(5)^2 + (10)^2}$ | M1 |
| | $\lvert AB \rvert = 5\sqrt{5}$ | A1ft |
| | | **(2)** |

**Q7.**

| | | | | | | |
|---|---|---|---|---|---|---|
| (i) | | **DR**<br>$(\sqrt{3})^7$ or $\sqrt{3^7}$ or $3^3 \times \sqrt{3}$ or $3\sqrt{243}$<br>$27\sqrt{3}$ | **M1**<br>**A1**<br>**[2]** | **1.1a**<br>**1.1** | **or any correct intermediate step using √** or $3^3 \times 3^{\frac{1}{2}}$<br>or $a = 27, b = 3$ | **If this step is not seen, M0A0** |
| (ii) | | **DR**<br>$\frac{\sqrt{2}}{1-\sqrt{2}} \times \frac{1+\sqrt{2}}{1+\sqrt{2}}$<br>$= \frac{\sqrt{2}+2}{1-2}$ or $\frac{\sqrt{2}+2}{-1}$ or $\frac{\sqrt{2}+2}{1+\sqrt{2}-\sqrt{2}-2}$<br>$= -2 - \sqrt{2}$ ISW | **M1**<br>**A1**<br>**A1**<br>**[3]** | **1.1a**<br>**1.1**<br>**1.1** | **A1 for correct num OR denom**<br>or $-2 + (-1\sqrt{2})$ or $c = -2$, $d = -1$ and $e = 2$ | **If this step is not seen, M0A0**<br>Allow $-(2 + \sqrt{2})$ |

**Q8.**

| | | | | | | |
|---|---|---|---|---|---|---|
| (i) | (a) | $c - a$ oe | B1 [1] | 1.2 | | |
| (i) | (b) | $a + \frac{1}{2}(c - a)$ or $c + \frac{1}{2}(a - c)$<br>$= \frac{1}{2}(a + c)$ or $\frac{1}{2}a + \frac{1}{2}c$ | M1<br>A1 [2] | 3.1a<br>1.1b | $a + \frac{1}{2}$ their (a) or $c - \frac{1}{2}$ their (a)<br>Correct ans without wking: M1A1 | |
| (ii) | | $\overrightarrow{OB} = (a + c)$<br>$\Rightarrow \overrightarrow{OP} = \frac{1}{2}\overrightarrow{OB}$ Must see previous line<br>$\Rightarrow P$ is midpt of $OB$<br>or $OPB$ is a straight line and $OP = PB$<br>Hence diagonals of //m bisect one another | M1<br>A1*<br>dep* A1<br>E1 [4] | 3.1a<br>1.1<br>2.1<br>2.2a | $\overrightarrow{PB} = a + \frac{1}{2}(c - a)$ or $a + \frac{1}{2}$ their (i)(a) or $c + \frac{1}{2}(a - c)$<br>$(= \frac{1}{2}(a+c)$ oe), ft their (i)(a)<br>NB $\overrightarrow{PB} = \frac{1}{2}(a + c)$ without justification: M0A0A0E0<br>$\Rightarrow \overrightarrow{PB} = \overrightarrow{OP}$<br>dep M1A1A1 | or $\overrightarrow{PB} = c - \frac{1}{2}$ their (i)(a)<br>or similar with $\overrightarrow{BP}$ or $\overrightarrow{BO}$ |

**Q9.**

| | | | | | |
|---|---|---|---|---|---|
| **(i)** | | $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$<br>$\begin{pmatrix} 4 \\ -2 \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} - \begin{pmatrix} -2 \\ 1 \end{pmatrix} = \mathbf{d} - \mathbf{a} = \overrightarrow{AD}$<br>$\overrightarrow{OD} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ | **B1**<br>**M1**<br>**A1**<br>**[3]** | **1.1**<br>**3.1a**<br>**1.1** | soi |
| **(ii)** | | $\overrightarrow{OM} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$<br>$\overrightarrow{AM} = \overrightarrow{OM} - \overrightarrow{OA} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$<br>$\left\lvert \overrightarrow{AM} \right\rvert = \sqrt{6^2 + 3^2} = 3\sqrt{5}$ | **B1**<br>**M1**<br>**A1**<br>**[3]** | **1.1**<br>**1.1**<br>**2.2a** | soi<br>Accept 6.71 |