| Question | Scheme | Marks |
|---|---|---|
| 8(a) | $\left(\text{Grad}_{AB}\right) = \dfrac{2-8}{12-(-6)}$  oe <br><br> $y - 2 = "\left(-\dfrac{1}{3}\right)"(x-12)$  oe <br><br> $\Rightarrow x + 3y - 18 = 0$  or  $-x - 3y + 18 = 0$  oe | M1 <br> dM1 <br> (A1 on ePen) <br> A1 <br> [3] |
| (b) | Length $= \sqrt{(12--6)^2 + (2-8)^2} = 6\sqrt{10}$  eg $\sqrt{360}$  oe | M1A1 <br> [2] |
| (c) | $\left(\left(\dfrac{2\times-6+1\times12}{1+2}, \dfrac{2\times8+1\times2}{1+2}\right)\right)$ <br><br> $(0,6)$ or $m = 0, n = 6$ | B1 B1 <br> (M1A1 on ePen) <br> [2] |
| (d) <br> **Mark parts (i) and (ii) together** | Gradient of $CA = \dfrac{q-8}{p+6}$ **or** gradient of $CB = \dfrac{q-2}{p-12}$  oe <br><br> $\dfrac{q-8}{p+6} = -\dfrac{1}{\dfrac{q-2}{p-12}} = -\left(\dfrac{p-12}{q-2}\right) \Rightarrow q^2 - 10q + 16 = -p^2 + 6p + 72$ <br><br> Gradient of $XC = -\dfrac{1}{"-\dfrac{1}{3}"} \Rightarrow -\dfrac{1}{"-\dfrac{1}{3}"} = \dfrac{q-6}{p-0}(\Rightarrow q = 3p+6)$ <br><br> $('3p+6')^2 - 10('3p+6') + 16 = -p^2 + 6p + 72 \Rightarrow 10p^2 - 80 = 0$ <br><br> $10p^2 - 80 = 0 \Rightarrow p = \sqrt{8}$  oe   $q = 3\times\sqrt{8} + 6 = 6 + 6\sqrt{2}$  oe | M1 <br><br> M1 <br><br> B1ft <br><br> ddM1A1 <br><br> M1A1 <br> [7] |
| **ALT1** <br> **Mark parts (i) and (ii) together** | $(\text{midpoint of } AB =)\left(\dfrac{-6+12}{2}, \dfrac{8+2}{2}\right)$  $\left(=(3,5)\right)$ <br><br> $(\text{radius of } C) = \dfrac{"6\sqrt{10}"}{2}$  oe <br> or $\sqrt{(-6-3)^2 + (8-5)^2}$  oe <br><br> $y = \dfrac{-1}{"-\dfrac{1}{3}"}x + 6$  $(y = 3x+6)$  oe <br><br> $(x-"3")^2 + (y-"5")^2 = \left(\dfrac{"6\sqrt{10}"}{2}\right)^2 \Rightarrow (x-"3")^2 + ("3x+6"-"5")^2 = \left(\dfrac{"6\sqrt{10}"}{2}\right)^2$ <br><br> $10x^2 = 80$  oe <br> $x = \sqrt{8}$  oe <br> $p = \sqrt{8}, q = 6 + 3\sqrt{8}$  oe | M1 <br><br> M1 <br><br> B1ft <br><br> ddM1 <br><br> A1 <br> M1 <br> A1 <br> [7] |

| | | |
|---|---|---|
| **ALT2 Mark parts (i) and (ii) together** | $\left((AC)^2 =\right)(p--6)^2+(q-8)^2$ or $(AC=)\sqrt{(p--6)^2+(q-8)^2}$ oe | M1 |
| | $\left((BC)^2 =\right)(p-12)^2+(q-2)^2$ or $(AC=)\sqrt{(p-12)^2+(q-2)^2}$ oe | M1 |
| | $q=3p+6$ | B1ft |
| | $\left((AB)^2=(AC)^2+(BC)^2\right)$ $\left("6\sqrt{10}"\right)^2=(p--6)^2+("3p+6"-8)^2+(p-12)^2+("3p+6"-2)^2$ | ddM1A1 |
| | $10p^2=80$ oe | M1 |
| | $p=\sqrt{8}$ oe | A1 |
| | $p=\sqrt{8}, q=6+3\sqrt{8}$ oe | [7] |
| **(e)** | Length $CX=\sqrt{\left("\sqrt{8}"-"0"\right)^2+\left("6+6\sqrt{2}"-"6"\right)^2}\left(=4\sqrt{5}\right)$ | M1 |
| | Area of triangle $ABC=\frac{1}{2}\times"4\sqrt{5}"\times"6\sqrt{10}"=60\sqrt{2}$ oe | dM1 A1 [3] |
| **ALT** | $\frac{1}{2}\begin{vmatrix} -6 & 12 & "\sqrt{8}" & -6 \\ 8 & 2 & "6+3\sqrt{8}" & 8 \end{vmatrix}$ oe | M1 |
| | $\frac{1}{2}\left[\left(-6\times2+12\times"(6+3\sqrt{8})"+"\sqrt{8}"\times8\right)-\left(-6\times"(6+3\sqrt{8})"+"\sqrt{8}"\times2+12\times8\right)\right]$ oe | dM1 |
| | $60\sqrt{2}$ oe | A1 [3] |
| | | **Total 17 marks** |

| Part | Mark | Notes |
|---|---|---|
| **(a)** | **M1** | For correctly finding the gradient of *AB* in unsimplified form. |
| | **dM1** **(A1 on ePen)** | For a full and correct attempt to find the equation of the line using their gradient. No simplification is required. If using $y = mx + c$, a value for *c* must be found. |
| | **A1** | For a correct equation in the required form. |
| **(b)** | **M1** | For using a correct method to find the length of line segment *AB*, in unsimplified form. |
| | **A1** | For the correct exact length. |
| **(c)** | **B1 (M1 on ePen)** | For either coordinate correct. |
| | **B1 (A1 on ePen)** | For both correct coordinates (0, 6) For part c the values of *m* and *n* can be explicitly identified or written in a coordinate. |
| **In part (d) allow *p* to be interchangeable with *x*, *q* to be interchangeable with *y* throughout** | |
| **(d)** | **M1** | For a correct statement of the gradient for either *CA* or *CB* |
| | **M1** | For using the negative perpendicular of either gradient and equating the gradients to form an equation in terms of *p* and *q* only. |
| | **B1ft** | For finding the negative reciprocal of their gradient of *XC* and placing this equal to a correct expression in *p* and *q* as shown. |
| | **ddM1** | For correctly substituting their **linear** expression for *p* or *q* into a **quadratic** equation in *q* or *p* to obtain an equation in one variable. Must use their $q = 3p + 6$ and is dependent on both previous method marks. |
| | **A1** | For the correct two term quadratic.. |
| | **M1** | For **correctly solving their** quadratic to find a value for either *p* or *q* |
| | **A1** | For **both** *p* and *q* correct. |
| **ALT1** **(d)** | **M1** | For the correct method to find the midpoint of *AB* |
| | **M1** | For the correct method to find the radius of *C*, ft their answer from part b if used. |
| | **B1ft** | For the equation of the line, unsimplified, ft their gradient of *AB* |
| | **ddM1** | For correctly substituting their $y = 3x + 6$ into the equation of a circle, using their midpoint of *AB* and their radius of *C* Must use their $y = 3x + 6$ and is dependent on both previous method marks. |
| | **A1** | Correct equation |
| | **M1** | For **correctly solving their** quadratic to find a value for either *x* or *y* |
| | **A1** | For **both** *p* and *q* correct. |
| **ALT2** **(d)** | **M1** | For the correct method to find the length of *AC* or $(AC)^2$ |
| | **M1** | For the correct method to find the length of *BC* or $(BC)^2$ |
| | **B1ft** | For the equation of the line, unsimplified, ft their gradient of *AB* |
| | **ddM1** | For correctly substituting their lengths and their $q = 3p + 6$ into a correct Pythagorean equation, dependent on both previous method marks. |
| | **A1** | Correct equation |
| | **M1** | For **correctly solving their** quadratic to find a value for either *p* or *q* |
| | **A1** | For **both** *p* and *q* correct. |

| (e) | M1 | For using a correct method to find the length of the perpendicular from *AB* to *C* |
|---|---|---|
| | dM1 | For using their results from part (b) and their length of perpendicular from *AB* to *C* with the correct formula for the area of a triangle. Dependent on previous method mark. |
| | A1 | For the correct area of $60\sqrt{2}$ or $30\sqrt{8}$ (units²) |
| ALT | M1 | For a correct statement for the area such as the one shown, using their values of *p* and *q* |
| | dM1 | For the correct evaluation of their determinant Dependent on previous method mark. |
| | A1 | For the correct area of $60\sqrt{2}$ or $30\sqrt{8}$ (units²) |

Useful Sketch for Parts c/d – look for any working on or near a sketch.