| Question | Scheme | Marks |
|---|---|---|
| 7(a) | (3,6) | B1 |
| | | (1) |
| (b) | Gradient $= \frac{6-0}{3-0} (=2)$ | M1 |
| | Hence equation of $l$ is $y = 2x$ | A1 |
| | | (2) |
| (c) | Distance from $O$ to centre is $\sqrt{3^2+6^2} = ... \left(= 3\sqrt{5}\right)$ | M1 |
| | $\Rightarrow r = 3\sqrt{5} \pm \sqrt{5}$ | M1 |
| | For radius either $2\sqrt{5}$ or $4\sqrt{5}$ or one correct value for $k$ | A1 |
| | For both 20 and 80 | A1 |
| | | (4) |
| | | **(7 marks)** |

**Notes:**

**(a)**

**B1:** Correct centre. Allow $x = 3$, $y = 6$

**(b)**

**M1:** Attempts the gradient from $O$ to the centre. May be implied by $\pm\frac{6}{3}$ ft their centre.

OR from the equation $y = 2x$ seen.

**A1:** Correct equation from correct centre.

**(c)**

**M1:** Attempts the distance from the origin to the centre of the circle.

**M1:** Finds the radius as the sum or difference of their distance and $\sqrt{5}$

**A1:** For one of the two possible radii correct or one of the two possible values for $k$ correct.

**A1:** Both values correct.

| Alt 1(c) | | |
|---|---|---|
| | $A$ lies on the line $y = 2x \Rightarrow x^2 + (2x)^2 = \left(\sqrt{5}\right)^2 \Rightarrow x = ...$ | M1 |
| | $\Rightarrow k = \left("\pm 1" - 3\right)^2 + \left("\pm 2" - 6\right)^2 = ...$ | M1 |
| | One of 20 or 80 ; both 20 and 80 | A1;A1 |
| | | (4) |

**M1:** Uses the equation to obtain a general point on the line and applies distance $OA = \sqrt{5}$ to find at least one $x$ coordinate.

**M1:** Uses their coordinates of $A$ to find at least one value for $k$ using the circle equation.

**A1:** One of the two possible values for $k$ correct.

**A1:** Both values correct.

| | | |
|---|---|---|
| **Alt 2 (c)** | Deduces that as $A$ lies on $y=2x$ then<br>**EITHER** $\sqrt{5}=\sqrt{1^2+2^2}$ **OR** $\sqrt{5}=\sqrt{(-1)^2+(-2)^2}$ | **M1** |
| | $\Rightarrow k=("\pm 1"-3)^2+("\pm 2"-6)^2=...$ | **M1** |
| | One of 20 or 80 ; both 20 and 80 | **A1;A1** |
| | | **(4)** |

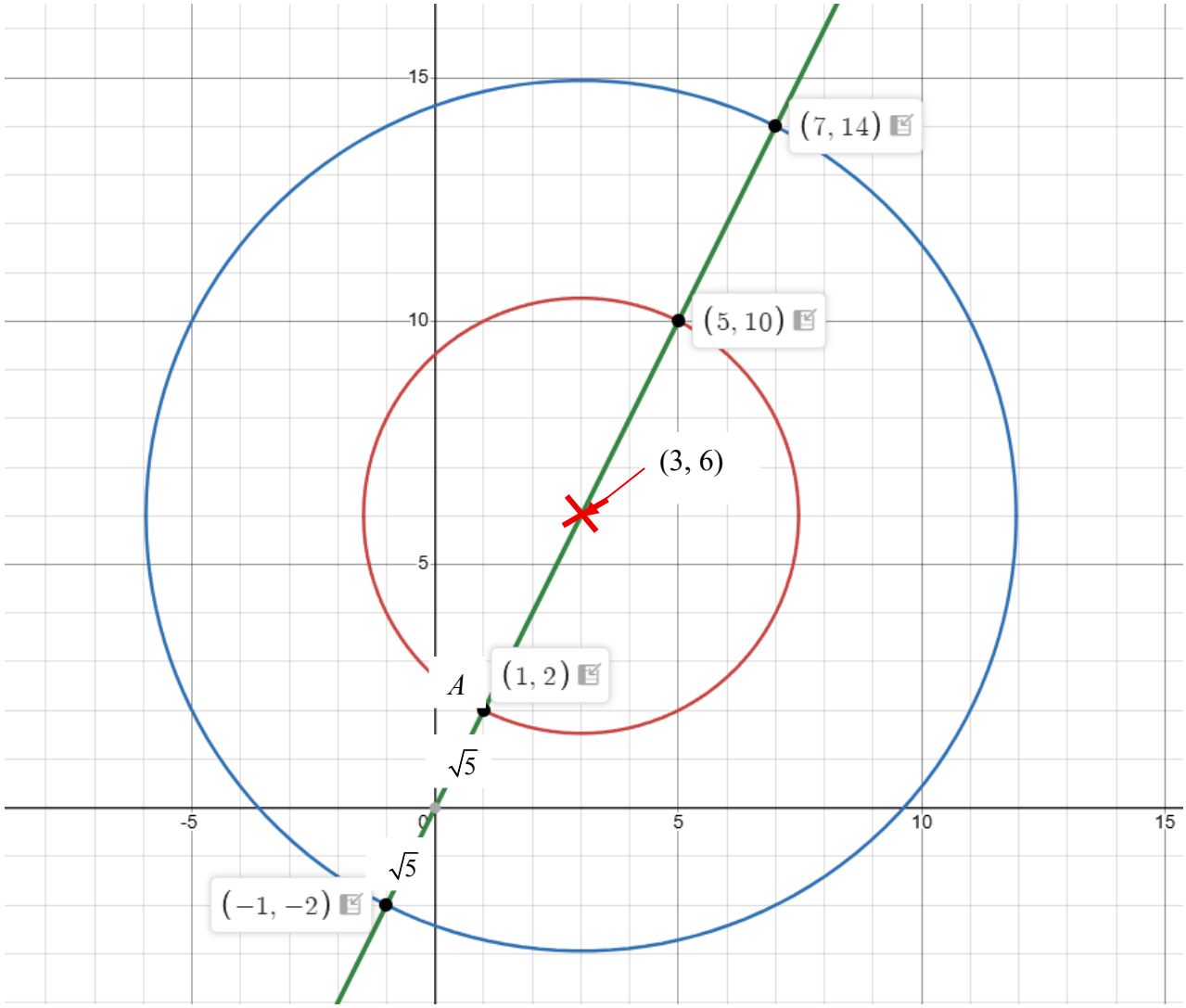
**M1:** Deduces that the coordinates of $A$ must be either (1, 2) or $(-1,-2)$

**M1:** Uses their coordinates of $A$ to find at least one value for $k$ using the circle equation.

**A1:** One of the two possible values for $k$ correct.

**A1:** Both values correct.

**USEFUL SKETCH**



| Question | Scheme | Marks |
|---|---|---|
| **8(a)** | $(k+4x)^{12} = k^{12} + \ldots$ | **B1** |
| | $+\underline{\binom{12}{1}}k^{11}(4x)^1 + \underline{\binom{12}{2}}k^{10}(4x)^2 + \underline{\binom{12}{3}}k^9(4x)^3 + \ldots$ | **M1** |
| | $(k+4x)^{12} = k^{12} + 48k^{11}x + 1056k^{10}x^2 + 14080k^9x^3 + \ldots$ | **A1A1** |
| | | **(4)** |
| **(b)** | $14080k^9 = \frac{55}{2} \Rightarrow k^9 = \frac{1}{512} \Rightarrow k = \ldots$ | **M1** |
| | $k = \frac{1}{2}$ | **A1** |
| | | **(2)** |
| **(c)** | "$48\left(\frac{1}{2}\right)^{11}$" or "$1056\left(\frac{1}{2}\right)^{10} \times 2$" | **M1** |
| | $48\left(\frac{1}{2}\right)^{11} + 1056\left(\frac{1}{2}\right)^{10} \times 2 = \ldots = \frac{267}{128}$ | **dM1A1** |
| | | **(3)** |
| | | **(9 marks)** |

**Notes:**

**(a)**

**B1:** For the correct constant term of $k^{12}$ in their expression. They may have initially factored out the $k$, but must achieve the correct constant in the final expression for this mark.

**M1: Correct** binomial coefficients linked with **correct** powers of $x$ in their expansion. Accept alternative notation, such as ${}^{12}C_1$ or just 12, 66, 220, for the coefficients. (The power 1 need not be seen.) The powers of 4 and $k$ may be missing or incorrect.

**ALT for the M mark**

$$k^{12}\left(1+\frac{4x}{k}\right)^{12} = \left[k^{12}\right]\left(1+\underline{12}\times\left(\frac{4\underline{x}}{k}\right)+\left[\frac{12\times11}{2!}\right]\times\left(\frac{4\underline{x}}{k}\right)^2+\left[\frac{12\times11\times10}{3!}\right]\times\left(\frac{4\underline{x}}{k}\right)^3+\right)$$

With **correct** coefficients (with the correct denominators [2 and 6 oe]) and with the **correct** power of $x$

**A1:** Any two of the final three terms correct and simplified

**A1:** All three of the final terms correct and simplified.

Note: Students may attempt to take out a common factor of $k^{12}$ first. In such cases the **B** mark is for correct constant term in their final expansion, **M** follows as above, correct coefficients linked to correct powers of $x$. The first **A** can be awarded as above or SC $k^{12}\left(1+\frac{48}{k}x+\frac{1056}{k^2}x^2+\frac{14080}{k^3}x^3\right)$ (oe), final **A** as scheme