

# Mark Scheme

## AQA Level 2 Further Maths Mock Set D Paper 2

For AQA Level 2 Certificate in Further Mathematics (8365)

Paper 2 (Calculator)

Total 80 marks

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### Key to the marks

|            |                                                                                                             |
|------------|-------------------------------------------------------------------------------------------------------------|
| <b>M</b>   | Method mark: for a correct method that could lead to the correct answer.                                    |
| <b>A</b>   | Accuracy mark: for a correct value or answer that follows from a correct method. The method may be implied. |
| <b>B</b>   | Independent mark: for a correct answer or statement; no method needs to be seen.                            |
| <b>Q</b>   | Quality mark: for a clear, complete and correct explanation or conclusion.                                  |
| <b>ft</b>  | Follow through: credit correct work that uses a wrong value from an earlier step.                           |
| <b>dep</b> | Dependent: can only be given if the mark before it has been given.                                          |
| <b>SC</b>  | Special case: credit for a common misreading that still has some mathematical worth.                        |
| <b>oe</b>  | Or equivalent: accept any equal value or form, e.g. 0.5 for $\frac{1}{2}$ .                                 |
| <b>cao</b> | Correct answer only.                                                                                        |
| $[a, b]$   | Accept any value from $a$ to $b$ inclusive.                                                                 |
| 3.14 ...   | Accept any answer that begins 3.14, e.g. 3.14, 3.142, 3.1416.                                               |
| <b>( )</b> | Working in brackets does not need to be seen.                                                               |

Give credit for any correct method, including ones not listed here. A correct answer with no working scores full marks unless the question asks for working (for example “show that” or “you must show your working”). If a correct answer is followed by further work that does not change it, ignore the further work. Exact answers (fractions, surds, multiples of  $\pi$ ) must be given where the question asks for them.

### Indicative grade boundaries

| Grade                                     | 9   | 8   | 7   | 6  | 5  | 4  |
|-------------------------------------------|-----|-----|-----|----|----|----|
| Whole set: Papers 1 and 2 (out of 160)    | 139 | 121 | 103 | 86 | 69 | 60 |
| This paper alone, rough guide (out of 80) | 70  | 61  | 52  | 43 | 35 | 30 |

Indicative only. Based on the real AQA 8365 boundaries for June 2023 to June 2026 (median), adjusted for how this set compares in difficulty with the real papers. Grades are awarded on the total for both papers; the single-paper guide is about half of the set boundaries.

*These are estimates to help you judge performance on a practice paper; real boundaries change every year.*

## Marking guidance

| Q                                    | Answer                                                                                            | Marks | Guidance                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------|---------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                    | Ruled straight line from $(-3, 5)$ to $(5, -1)$                                                   | B3    | ruled line from $(-3, 5)$ to $(5, -1)$                                                                                                                                                                                                                                                                                              |
|                                      |                                                                                                   | (B2)  | at least two correct points plotted or correct ruled line through at least two of $(-3, 5)$ , $(1, 2)$ , $(5, -1)$ not covering the full range                                                                                                                                                                                      |
|                                      |                                                                                                   | (B1)  | one correct point plotted or calculated or $y = \frac{11-3x}{4}$ oe or a line with gradient $-\frac{3}{4}$<br><i>Additional guidance:</i> Mark intention. Ignore any line drawn for $x < -3$ or $x > 5$ . Points may be in a table. A line with gradient $+\frac{3}{4}$ or $-\frac{4}{3}$ scores B0 unless a correct point is seen. |
| 2(a)                                 | $12t^2 - 2t + 5 = 11$ , so<br>$12t^2 - 2t - 6 = 0$ , so<br>$6t^2 - t - 3 = 0$                     | M1    | $12t^2 - 2t + 5$ oe                                                                                                                                                                                                                                                                                                                 |
|                                      |                                                                                                   | A1    | $12t^2 - 2t + 5 = 11$ and $6t^2 - t - 3 = 0$ with no errors seen<br><i>Additional guidance:</i> This is a show that question: $6t^2 - t - 3 = 0$ must follow from a correct equation, eg $12t^2 - 2t - 6 = 0$ .<br>$4t^3 - t^2 + 5t + 7 = 11$ scores MOA0. Condone $\frac{dV}{dt}$ not written as long as $12t^2 - 2t + 5$ is seen. |
| 2(b)                                 | 0.795 minutes                                                                                     | M1    | $\frac{1 \pm \sqrt{(-1)^2 - 4 \times 6 \times (-3)}}{2 \times 6}$ oe or $\frac{1 \pm \sqrt{73}}{12}$ or<br>[0.795, 0.7954] seen                                                                                                                                                                                                     |
|                                      |                                                                                                   | A1    | [0.795, 0.7954] only<br><i>Additional guidance:</i> Condone + for $\pm$ for M1. 0.795 and $-0.629$ both given as the answer scores M1A0. SC1 0.80 or 0.8 with the negative value rejected. Completing the square is a valid method.                                                                                                 |
| <b>Total for Question 2: 4 marks</b> |                                                                                                   |       |                                                                                                                                                                                                                                                                                                                                     |
| 3(a)                                 | $50.9 - 2.3n$                                                                                     | B2    | $50.9 - 2.3n$ oe                                                                                                                                                                                                                                                                                                                    |
|                                      |                                                                                                   | (B1)  | $-2.3n + k$ ( $k \neq 50.9$ ) or $50.9 + kn$ ( $k \neq 0$ )<br><i>Additional guidance:</i> Accept eg $-2.3n + 50.9$ or $48.6 - 2.3(n - 1)$ . $n = 50.9 - 2.3n$ scores B1. $2.3n + 50.9$ scores B1. $50.9 - 2.3$ scores B0.                                                                                                          |
| 3(b)                                 | $50.9 - 2.3n = -20$ gives $n = 30.8 \dots$ , which is not a whole number, so $-20$ is not a term. | M1    | $50.9 - 2.3n = -20$ oe or $70.9 \div 2.3$ or $-18.1$ and $-20.4$ seen as consecutive terms (ft their $n$ th term from (a))                                                                                                                                                                                                          |

(continued)

| Q                                    | Answer                                                             | Marks          | Guidance                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------|--------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      |                                                                    | A1             | $n = [30.8, 30.83]$ and a statement that $n$ is not an integer, so $-20$ is not a term or $-18.1$ and $-20.4$ as the 30th and 31st terms with a statement<br><i>Additional guidance:</i> Counting down from $41.7$ in steps of $2.3$ to $-18.1$ and $-20.4$ with a statement is a valid method. $n = 30.8$ with no statement scores M1A0.               |
| <b>Total for Question 3: 4 marks</b> |                                                                    |                |                                                                                                                                                                                                                                                                                                                                                         |
| 4(a)                                 | $0 \leq n^2 < 36$                                                  | B2<br>(B1)     | $0 \leq n^2 < 36$ oe<br>$n^2 < 36$ or $n^2 \geq 0$ or $0 \leq n^2 \leq 36$ or $0 < n^2 < 36$<br><i>Additional guidance:</i> Accept eg $36 > n^2 \geq 0$ or interval notation $[0, 36)$ . $9 < n^2 < 36$ or $9 \leq n^2 < 36$ scores B0. $-36 < n^2 < 9$ scores B0.                                                                                      |
| 4(b)                                 | $-16 < 20 - n^2 \leq 20$                                           | B1ft           | $-16 < 20 - n^2 \leq 20$ oe ft their (a) in the form $p \leq n^2 < q$<br><i>Additional guidance:</i> Accept eg $20 \geq 20 - n^2 > -16$ . $-16 \leq 20 - n^2 \leq 20$ scores B0 unless ft from $0 \leq n^2 \leq 36$ in (a).                                                                                                                             |
| <b>Total for Question 4: 3 marks</b> |                                                                    |                |                                                                                                                                                                                                                                                                                                                                                         |
| 5(a)                                 | $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$ | B1             | $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$                                                                                                                                                                                                                                                                                      |
| 5(b)                                 | $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$                     | B1<br>M1<br>A1 | $\mathbf{S} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ or $\mathbf{T} = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$<br>$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ with their matrices, with at least two entries of their product correct<br>$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ |

(continued)

| Q | Answer                                                    | Marks                     | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---|-----------------------------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                           |                           | <p>Additional guidance: <math>\mathbf{ST} = \begin{pmatrix} 0 &amp; -1 \\ -1 &amp; 0 \end{pmatrix}</math> scores</p> <p>B1M0A0. <math>\mathbf{S} = \begin{pmatrix} 0 &amp; -1 \\ 1 &amp; 0 \end{pmatrix}</math> (rotation <math>90^\circ</math> anticlockwise) used scores B1 for <math>\mathbf{T}</math> only and M1 if the order is correct. Alternative: tracking the images of (1, 0) and (0, 1) through both transformations: (1, 0) <math>\rightarrow</math> (0, -1) <math>\rightarrow</math> (0, 1) and (0, 1) <math>\rightarrow</math> (1, 0) <math>\rightarrow</math> (1, 0) scores M1 for one correct final image and A1 for the correct matrix (B1 for a correct matrix for <math>\mathbf{S}</math> or <math>\mathbf{T}</math> if seen, otherwise implied by the correct answer). Correct answer with no working scores 3 marks.</p> <p style="text-align: right;"><b>Total for Question 5: 4 marks</b></p> |
| 6 | 227 700                                                   | B3<br>(B2)<br>(B1)        | <p>227 700</p> <p><math>23 \times 22 \times 9 \times 10 \times 5</math> with at least four of the five numbers correct (product of exactly five numbers)</p> <p><math>23 \times 22 \times 9 \times 10 \times 5</math> with at least three of the five numbers correct (product of exactly five numbers) or 506 or 450 seen</p> <p>Additional guidance: Products may be in any order.<br/><math>23 \times 23 \times 9 \times 10 \times 5 = 238\,050</math> scores B2.<br/><math>26 \times 25 \times 9 \times 10 \times 5 = 292\,500</math> (I, O and Q not removed) scores B1.<br/><math>23 \times 22 \times 10 \times 10 \times 5 = 253\,000</math> scores B2.<br/><math>23 + 22 + 9 + 10 + 5</math> scores B0.</p>                                                                                                                                                                                                    |
| 7 | $a = 2.4, b = 6$                                          | M1<br>M1dep<br>A1<br>A1ft | <p><math>86.4 = ab^2</math> or <math>0.4 = ab^{-1}</math> oe</p> <p>correct elimination of <math>a</math> or <math>b</math>, eg <math>b^3 = 86.4 \div 0.4</math> or <math>b^3 = 216</math> or <math>86.4 = 0.4b \times b^2</math></p> <p><math>b = 6</math></p> <p><math>a = 2.4</math> oe ft <math>0.4 \times</math> their <math>b</math></p> <p>Additional guidance: <math>86.4 = ab^{-2}</math> (sign error with the power) scores M0 for that equation. Working with <math>y = a \times b^x</math> instead (<math>86.4 = ab^{-2}</math> and <math>0.4 = ab</math>) leads to <math>b = \frac{1}{6}</math> and <math>a = 2.4</math> and scores MOM0A0A0. Correct values with no working score 4 marks.</p>                                                                                                                                                                                                           |
| 8 | $18k^2 + 54 = 18(k^2 + 3)$ ,<br>which is a multiple of 18 | M1<br>M1dep               | <p><math>k^3 + 9k^2 + 27k + 27</math> or <math>k^3 - 9k^2 + 27k - 27</math> (one cube expanded correctly)</p> <p><math>k^3 + 9k^2 + 27k + 27 - (k^3 - 9k^2 + 27k - 27)</math> or <math>k^3 + 9k^2 + 27k + 27 - k^3 + 9k^2 - 27k + 27</math> or <math>18k^2 + 54</math> (correct and no errors)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

(continued)

| Q  | Answer              | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----|---------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                     | A1    | $18k^2 + 54$ and valid explanation involving 18 and $(k^2 + 3)$ , eg $18k^2 + 54 = 18(k^2 + 3)$ , which is a multiple of 18<br><br><i>Additional guidance:</i> Expansions may come from multiplying out brackets, eg $(k + 3)(k^2 + 6k + 9)$ . Missing brackets must be recovered.<br>$k^3 + 9k^2 + 27k + 27 - k^3 - 9k^2 + 27k - 27 = 54k$ scores M1M0AO. Incomplete explanations include “ $18k^2 + 54$ , which is divisible by 18” and “both terms are multiples of 18”. Substituting values of $k$ is not a proof and scores M0AO. |
| 9  | $\frac{4}{3x-2}$    | M1    | $(x + 6)(3x - 2)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|    |                     | M1dep | $\frac{5(3x - 2) + 34 - 11x}{(x + 6)(3x - 2)}$ oe or $\frac{4x + 24}{(x + 6)(3x - 2)}$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    |                     | A1    | $\frac{4}{3x-2}$<br><br><i>Additional guidance:</i> Using the denominator $(x + 6)(3x^2 + 16x - 12)$ : $\frac{5(3x^2+16x-12)+(34-11x)(x+6)}{(x+6)(3x^2+16x-12)}$ scores M1M0 unless it is simplified to $\frac{4}{3x-2}$ (full marks). $\frac{4x+24}{3x^2+16x-12}$ as the final answer scores M1M1A0. $\frac{4}{3x-2}$ followed by further incorrect work scores M1M1A0.                                                                                                                                                               |
| 10 | $y = -\frac{5}{9}x$ | M1    | correct method for one coordinate of $C$ , eg $3.6 + \frac{3}{5} \times 6$ or $0.8 - \frac{3}{5} \times 8$ or $-2.4 + \frac{8}{5} \times 6$ or $8.8 - \frac{8}{5} \times 8$                                                                                                                                                                                                                                                                                                                                                            |
|    |                     | A1    | $C(7.2, -4)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|    |                     | B1ft  | $y = -\frac{5}{9}x$ oe exact equation ft $y = \frac{\text{their } y_C}{\text{their } x_C}x$ for non-zero coordinates of $C$<br><br><i>Additional guidance:</i> Accept eg $y = -\frac{4}{7.2}x$ or $9y = -5x$ or $5x + 9y = 0$ or $y = -0.5\dot{x}$ .<br>$y = -0.56x$ (not exact) with $\frac{5}{9}$ not seen scores M1A1B0. $C$ taken between $A$ and $B$ with $AC:CB = 5:3$ gives $(1.35, 3.8)$ and $y = \frac{76}{27}x$ :<br>M0A0B1ft. $y = -\frac{9}{5}x$ scores M1A1B0.                                                            |
| 11 | $x = 1.35$          | M1    | $\frac{1}{3}x^3$ or $-\frac{3}{2}x^{-2}$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|    |                     | M1dep | $x^2 + 3x^{-3}$ oe ft their two-term expression, with at least one term correct                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|    |                     | M1dep | $2x - 9x^{-4} = 0$ oe ft their $\frac{dy}{dx}$ with at least one term correct, eg $2x^5 = 9$ or $x^5 = 4.5$                                                                                                                                                                                                                                                                                                                                                                                                                            |

(continued)

| Q     | Answer                                                   | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|----------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |                                                          | A1    | [1.35, 1.351]<br><i>Additional guidance:</i> Accept $\frac{x^3}{3} - \frac{3}{2x^2}$ for the first M1. $\frac{2x^7-9x^2}{6x^4}$ differentiated as a quotient of derivatives, eg $\frac{14x^6-18x}{24x^3}$ , scores M0. Solving $\frac{dy}{dx} = 0$ instead ( $x^5 = -3$ , $x = -1.25$ ) scores M1M1M0A0. Answer $\sqrt[5]{4.5}$ unprocessed scores M3A0.                                     |
| 12    | 35.3 units <sup>2</sup>                                  | M1    | $x = 7$ or $x = -7$ or $AB = 14$ or half-chord 7 (may be on the diagram)                                                                                                                                                                                                                                                                                                                     |
|       |                                                          | M1    | angle $AOB = [108.9, 108.93]$ or $[54.4, 54.47]$ seen as half of it or $2 \tan^{-1} \frac{7}{5}$ or $\cos AOB = \frac{74+74-196}{2 \times 74}$ oe                                                                                                                                                                                                                                            |
|       |                                                          | M1dep | $\frac{\text{their } 108.9}{360} \times \pi \times 74 - \frac{1}{2} \times 14 \times 5$ oe or their $[70.3, 70.35] - 35$ or their sector $-\frac{1}{2} \times 74 \times \sin 108.9$                                                                                                                                                                                                          |
|       |                                                          | A1    | [35.3, 35.35]<br><i>Additional guidance:</i> Accept [3.14, 3.142] for $\pi$ . SC2 [197.1, 197.2] (area of the major segment). Using 74 as the radius in the sector area gives [5170, 5171] and scores M1M1M0A0.                                                                                                                                                                              |
| 13    | 4.89 cm                                                  | M1    | correct cosine rule for any angle, eg $\cos Q = \frac{8.4^2+11.7^2-6.9^2}{2 \times 8.4 \times 11.7}$ or $11.7^2 = 8.4^2 + 6.9^2 - 2 \times 8.4 \times 6.9 \cos P$ oe                                                                                                                                                                                                                         |
|       |                                                          | A1    | $Q = [35.5, 35.6]$ or $P = [99.2, 99.3]$ or $R = [45.1, 45.2]$                                                                                                                                                                                                                                                                                                                               |
|       |                                                          | M1dep | complete method for $PN$ , eg $8.4 \sin Q$ or $6.9 \sin R$ or $\frac{2 \times \frac{1}{2} \times 8.4 \times 6.9 \sin P}{11.7}$                                                                                                                                                                                                                                                               |
|       |                                                          | A1    | [4.88, 4.89]<br><i>Additional guidance:</i> Up to M1A1 may be awarded for correct work with no answer or an incorrect answer. A complete correct method using Heron's formula and area $= \frac{1}{2} \times 11.7 \times PN$ scores full marks. Assuming $N$ is the midpoint of $QR$ scores M0 for the third mark. Premature rounding of the angle to the nearest degree loses the final A1. |
| 14(a) | $(x-3)^2 + (8-2x)^2 = 18$<br>gives $5x^2 - 38x + 55 = 0$ | M1    | $y = 7 - 2x$ substituted and $x^2 - 6x + 9$ or $64 - 32x + 4x^2$ or $49 - 28x + 4x^2 + 2(7 - 2x) + 1$ oe expansion (may be embedded in an equation)                                                                                                                                                                                                                                          |
|       |                                                          | M1dep | $x^2 - 6x + 9 + 64 - 32x + 4x^2 = 18$ oe equation in $x$ with all relevant expansions seen                                                                                                                                                                                                                                                                                                   |

(continued)

| Q                                     | Answer                   | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------|--------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       |                          | A1    | $5x^2 - 38x + 55 = 0$ with no rearrangement errors seen<br><br><i>Additional guidance:</i> After the first M1 an expression may be simplified when forming the equation, eg $5x^2 - 38x + 73 = 18$ . The M1dep equation cannot be $5x^2 - 38x + 55 = 0$ itself. $(8 - 2x)^2 = 64 + 4x^2$ scores M0 for that expansion. $y = 7 + 2x$ (rearrangement error) scores M0.                                                                      |
| 14(b)                                 | 8.29 units               | M1    | $\frac{38 \pm \sqrt{(-38)^2 - 4 \times 5 \times 55}}{2 \times 5}$ oe or [5.65, 5.655] and [1.945, 1.95]                                                                                                                                                                                                                                                                                                                                   |
|                                       |                          | M1dep | their $y$ -coordinates from $7 - 2 \times$ their $x$ and $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ with their values, eg $\sqrt{3.71^2 + 7.42^2}$                                                                                                                                                                                                                                                                                            |
|                                       |                          | A1    | [8.29, 8.3]<br><br><i>Additional guidance:</i> Marks may be awarded from working in (a). Using $-38^2$ in the discriminant is M0 unless recovered. Substituting into the equation of the circle for $y$ is a valid method for the second M1. Coordinates rounded to 2 decimal places, (5.65, -4.31) and (1.95, 3.11), give 8.29 and score full marks. Exact $\sqrt{68.8}$ or $\frac{4\sqrt{430}}{10}$ seen with no decimal scores M1M1A0. |
| <b>Total for Question 14: 6 marks</b> |                          |       |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 15                                    | $a = 2.5$                | M1    | $15 \times a^4 \times 3^2$ or $135a^4$ oe (may include $x^2$ )                                                                                                                                                                                                                                                                                                                                                                            |
|                                       |                          | M1    | $20 \times a^3 \times 3^3$ or $540a^3$ oe (may include $x^3$ )                                                                                                                                                                                                                                                                                                                                                                            |
|                                       |                          | M1dep | $8 \times$ their $135a^4 = 5 \times$ their $540a^3$ or $\frac{135a^4}{540a^3} = \frac{5}{8}$ or $1080a^4 = 2700a^3$ oe dep on M2                                                                                                                                                                                                                                                                                                          |
|                                       |                          | A1    | 2.5 oe with no other values<br><br><i>Additional guidance:</i> Ignore other terms in the expansions. After M1M1 an equation still containing $x$ cannot score M1dep unless the $x$ terms are cancelled. $a = 2.5$ and $a = 0$ scores M3A0. Ratio used the wrong way round ( $5 \times 135a^4 = 8 \times 540a^3$ , giving $a = 6.4$ ) scores M1M1M0A0. $(3x)^2$ taken as $3x^2$ gives $45a^4$ : M0 for that coefficient.                   |
| 16(a)                                 | $f^{-1}(x) = \sqrt{x+4}$ | M1    | $x^2 = y + 4$ or $y^2 = x + 4$ or $x = \sqrt{y+4}$ oe                                                                                                                                                                                                                                                                                                                                                                                     |
|                                       |                          | A1    | $\sqrt{x+4}$ oe                                                                                                                                                                                                                                                                                                                                                                                                                           |

(continued)

| Q                              | Answer       | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|--------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                |              |       | <i>Additional guidance:</i> Ignore any domain given. Correct expression in terms of $y$ , eg $\sqrt{y+4}$ , scores M1A0. $\pm\sqrt{x+4}$ scores M1A0. $\sqrt{x}+4$ or $\sqrt{x}+2$ scores M0A0.                                                                                                                                                                                 |
| 16(b)                          | $x = 3.39$   | M1    | $\sqrt{2(x^2 - 4) + 10} = 5$ or $2(x^2 - 4) + 10 = 25$ or $2x^2 + 2 = 25$ or $x^2 = 11.5$ oe                                                                                                                                                                                                                                                                                    |
|                                |              | A1    | [3.39, 3.391] only<br><i>Additional guidance:</i> $\pm 3.39$ or 3.39 and $-3.39$ given as the answer scores M1A0. fg used instead ( $2x + 6 = 5$ , $x = -0.5$ ) scores M0A0. $\sqrt{2x^2 - 8 + 10} = 5$ is M1.                                                                                                                                                                  |
| Total for Question 16: 4 marks |              |       |                                                                                                                                                                                                                                                                                                                                                                                 |
| 17                             | $x = 6.02$   | M1    | $4u^2 - 9u - 2 = 0$ oe where $u = x^{\frac{1}{2}}$ or $4(x^{\frac{1}{2}})^2 - 9x^{\frac{1}{2}} - 2 = 0$ or $16x^2 - 97x + 4 = 0$ (from squaring $4x - 2 = 9x^{\frac{1}{2}}$ )                                                                                                                                                                                                   |
|                                |              | M1dep | $\frac{9 \pm \sqrt{(-9)^2 - 4 \times 4 \times (-2)}}{2 \times 4}$ oe or $\frac{9 \pm \sqrt{113}}{8}$ (or correct formula for $16x^2 - 97x + 4 = 0$ )                                                                                                                                                                                                                            |
|                                |              | A1    | $x^{\frac{1}{2}} = [2.453, 2.454]$ (negative value rejected or not used) or $x = [6.02, 6.021]$ and $[0.041, 0.042]$ from the squaring route                                                                                                                                                                                                                                    |
|                                |              | A1    | [6.02, 6.021] only<br><i>Additional guidance:</i> Answers with no working score 0 (the question says do not use trial and improvement). 2.45 given as the value of $x$ scores M1M1A1A0. Squaring route: 6.02 and 0.0415 both given (the second does not satisfy the equation) scores M1M1A1A0. $u^2 = -0.2037 \dots$ used to give $x = 0.0415$ as well scores at most M1M1A1A0. |
| 18                             | $55^\circ$   | M1    | angle $ACB = 90$ or angle $ABC = 3x - 5$ (may be on the diagram)                                                                                                                                                                                                                                                                                                                |
|                                |              | M1dep | $x + 15 + 90 + 3x - 5 = 180$ oe or $x + 15 + 3x - 5 = 90$ oe                                                                                                                                                                                                                                                                                                                    |
|                                |              | A1    | 55<br><i>Additional guidance:</i> Reasons are not required. $x = 20$ given as the answer scores M1M1A0. $x + 15 = 3x - 5$ (equating the two given angles) scores M0. $x + 15 + 3x - 5 = 180$ (no right angle, $x = 42.5$ , answer 122.5) scores M0A0.                                                                                                                           |
| 19                             | $52.9^\circ$ | M1    | $8^2 + 11^2$ or 185 or $AC = [13.6, 13.602]$ or $N$ identified as the midpoint of $AC$ or $4^2 + 5.5^2$                                                                                                                                                                                                                                                                         |

(continued)

| Q  | Answer                                 | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                            |
|----|----------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                        | M1dep | $BN = \frac{1}{2} \times \text{their } AC$ or $\sqrt{4^2 + 5.5^2}$ or [6.8, 6.801] or $BN^2 = 46.25$                                                                                                                                                                                                                                                                                                |
|    |                                        | M1    | right-angled triangle $MNB$ with $MN = 9$ used, eg $\tan B = \frac{9}{\text{their } BN}$ or $MB = \sqrt{\text{their } 6.8^2 + 9^2}$ (= [11.28, 11.281])                                                                                                                                                                                                                                             |
|    |                                        | M1dep | $\tan^{-1} \frac{9}{\text{their } 6.8}$ or $\sin^{-1} \frac{9}{\text{their } 11.28}$ or $\cos^{-1} \frac{\text{their } 6.8}{\text{their } 11.28}$ oe                                                                                                                                                                                                                                                |
|    |                                        | A1    | [52.9, 53]<br><i>Additional guidance:</i> Up to M3 may be awarded for correct work with no answer or an incorrect answer. Accept any clear indication of the angle. Using $BN = \text{half of } AB$ or half of $BC$ scores MOMO but the third and fourth marks may be awarded. [37, 37.1] (the angle at $M$ ) scores M1M1M1MOA0.                                                                    |
| 20 | $x - 6y = -50$                         | M1    | $8 = k \times (-2)^3 + 3 \times (-2)^2$ oe or $k = \frac{1}{2}$                                                                                                                                                                                                                                                                                                                                     |
|    |                                        | M1    | $3kx^2 + 6x$ oe (may use their value of $k$ )                                                                                                                                                                                                                                                                                                                                                       |
|    |                                        | M1dep | gradient of normal = $-\frac{1}{\text{their } (12k - 12)}$ and $y - 8 = \text{their } m(x + 2)$ oe dep on the second M1                                                                                                                                                                                                                                                                             |
|    |                                        | A1    | $x - 6y = -50$ oe with integers, eg $6y - x = 50$ or $2x - 12y = -100$<br><i>Additional guidance:</i> Tangent gradient used instead: $y - 8 = -6(x + 2)$ , $6x + y = -4$ scores M1M1MOA0. Correct equation not in the required form, eg $y = \frac{1}{6}x + \frac{25}{3}$ , scores M1M1M1A0. $k = -\frac{1}{2}$ (sign error) leads to $\frac{dy}{dx} = -18$ at $P$ and $x - 18y = -146$ : MOM1M1A0. |
| 21 | $x = 187.1^\circ$ or $x = 352.9^\circ$ | M1    | $7(1 - \sin^2 x) - 9 \sin x = 8$ oe                                                                                                                                                                                                                                                                                                                                                                 |
|    |                                        | M1dep | $7 \sin^2 x + 9 \sin x + 1 = 0$ oe solved, eg $\frac{-9 \pm \sqrt{9^2 - 4 \times 7 \times 1}}{2 \times 7}$ or [-0.123, -0.1228] or [-1.17, -1.16]                                                                                                                                                                                                                                                   |
|    |                                        | A1    | [187.05, 187.1] or [352.9, 352.95]                                                                                                                                                                                                                                                                                                                                                                  |
|    |                                        | A1    | [187.05, 187.1] and [352.9, 352.95] with no other values in the range 0 to 360<br><i>Additional guidance:</i> Ignore any values outside 0 to 360. -7.1 alone scores M1M1A0A0. Using $\cos^2 x = 1 - \sin x$ scores M0. Answers with no working score 0. Both correct angles with one extra value in the range 0 to 360 (eg 7.1 or 172.9 from a sign error) scores M1M1A1A0.                         |