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# Level 2 Certificate

# FURTHER MATHEMATICS

# 8365/1

Paper 1 Non-Calculator

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Mark scheme

June 2026

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Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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# Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

|                |                                                                                                                                        |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>M</b>       | Method marks are awarded for a correct method which could lead to a correct answer.                                                    |
| <b>M dep</b>   | A method mark dependent on a previous method mark being awarded.                                                                       |
| <b>A</b>       | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| <b>B</b>       | Marks awarded independent of method.                                                                                                   |
| <b>B dep</b>   | A mark that can only be awarded if a previous independent mark has been awarded.                                                       |
| <b>ft</b>      | Follow through marks. Marks awarded following a mistake in an earlier step.                                                            |
| <b>SC</b>      | Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.                        |
| <b>oe</b>      | Or equivalent. Accept answers that are equivalent.<br><br>eg accept 0.5 as well as $\frac{1}{2}$                                       |
| <b>[a, b]</b>  | Accept values between $a$ and $b$ inclusive.                                                                                           |
| <b>3.14...</b> | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416                                                                                 |

Examiners should consistently apply the following principles.

### ***Diagrams***

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

### ***Responses which appear to come from incorrect methods***

Whenever there is doubt as to whether a candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

### ***Questions which ask candidates to show working***

Instructions on marking will be given but usually marks are not awarded to candidates who show no working.

### ***Questions which do not ask candidates to show working***

As a general principle, a correct response is awarded full marks.

### ***Misread or miscopy***

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

### ***Further work***

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

### ***Choice***

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

### ***Work not replaced***

Erased or crossed out work that is still legible should be marked.

### ***Work replaced***

Erased or crossed out work that has been replaced is not awarded marks.

### ***Premature approximation***

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

### ***Continental notation***

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the candidate intended it to be a decimal point.

| Q    | Answer              | Mark | Comments |
|------|---------------------|------|----------|
| 1(a) | 7, 20, 21           | B1   |          |
|      | Additional Guidance |      |          |
|      |                     |      |          |

| Q    | Answer                                               | Mark | Comments |
|------|------------------------------------------------------|------|----------|
| 1(b) | $(7 - 1)^2 + (5 - -3)^2$                             | M1   | oe       |
|      | 10                                                   | A1   |          |
|      | Additional Guidance                                  |      |          |
|      | 6 and 8 seen without M1 gained and no correct answer |      | M0A0     |

| Q    | Answer                                                                  | Mark | Comments                                                                                                                                                               |
|------|-------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2(a) | $9 \leq f(x) \leq 19$                                                   | B2   | B1<br>$9 \leq f(x) \leq k$ where $k$ is greater than 9<br>$k \leq f(x) \leq 19$ where $k$ is less than 19<br><br>SC1 $19 \leq f(x) \leq 9$<br>or $-1 \leq f(x) \leq 9$ |
|      | Additional Guidance                                                     |      |                                                                                                                                                                        |
|      | 9 and 19 seen in working but then further incorrect working and not SC1 |      | B0                                                                                                                                                                     |

| Q    | Answer                                                                                                                                                                                                                                               | Mark | Comments |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 2(b) | $x^2 + 5$<br>or<br>$(ax \pm b)^2 + 5$ where $a$ and $b$ are any numbers<br>or<br>$ax^2 + 5$ where $a$ is a positive number and $a \neq 0$<br>or<br>$c(ax \pm b)^2 + 5$ where $a$ and $b$ are any numbers and $c$ is a positive number and $c \neq 0$ | B1   | oe       |
|      | Additional Guidance                                                                                                                                                                                                                                  |      |          |
|      | Do not condone replacements for $x$ (eg. $n$ )                                                                                                                                                                                                       |      |          |
|      | $(ax \pm b)^2 + 5$ could be expanded to get a quadratic expression<br>For the quadratic $dx^2 + ex + f$ the minimum value is $f - \frac{e^2}{4d}$<br>which must equal 5                                                                              |      | B1       |
|      | Incorrect further working eg $(ax \pm b)^2 + 5$ correct but then expanded incorrectly will not score                                                                                                                                                 |      | B0       |

| Q    | Answer                                                                                                                                                                                                                                                                            | Mark | Comments                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------|
| 2(c) | Not defined for $x = 3$<br>or<br>cannot divide by 0 when $x = 3$                                                                                                                                                                                                                  | B1   | must have $x = 3$ or $x \neq 3$ or 3 explicitly substituted for $x$ in the function or in words as part of the reason |
|      | <b>Additional Guidance</b>                                                                                                                                                                                                                                                        |      |                                                                                                                       |
|      | When $x = 3$ the denominator is 0<br>$x = 3$ gives an error<br>$x = 3$ gives $\frac{7}{0}$<br>$x = 3$ gives no solution<br>$x = 3$ is invalid<br>$x = 3$ gives a discontinuity/asymptote (might even draw a sketch)<br>You can't have $x = 3$<br>Domain should include $x \neq 3$ |      | B1                                                                                                                    |
|      | You cannot divide by 0<br>Dividing by 0 gives maths error<br>$x$ can't be 0<br>Denominator can't be 0<br>Domain should be $x > 3$<br>$x = 3$ is infinite<br>$x = 3$ on its own is not sufficient                                                                                  |      | B0                                                                                                                    |
|      | Ignore non-contradictory statements within a B1 response<br>Students may try other values as well as $x = 3$<br>eg You can't have $x = 3$ as it's infinite would be sufficient                                                                                                    |      | B1                                                                                                                    |

| Q | Answer                                                                                                                                                                            | Mark  | Comments                                                                                                                |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------|
| 3 | <b>Alternative method 1: solving</b>                                                                                                                                              |       |                                                                                                                         |
|   | $\frac{4-3a}{a+2} = \frac{7}{11}$                                                                                                                                                 | M1    | oe                                                                                                                      |
|   | $4-3a = \frac{7(a+2)}{11}$<br>or $44-33a = 7a+14$<br>or $30 = 40a$                                                                                                                | M1dep | oe with elimination of algebraic denominator                                                                            |
|   | $\frac{3}{4}$                                                                                                                                                                     | A1    | oe eg $\frac{30}{40}$ or 0.75                                                                                           |
|   | <b>Alternative method 2: using simultaneous equations</b>                                                                                                                         |       |                                                                                                                         |
|   | Setting up 2 equations and then making the coefficients of $a$ or $k$ (where $k$ is any letter) the same<br>or setting up 2 equations and then rearranging in order to substitute | M1    | eg $4-3a = 7k$ and $3a+6 = 33k$ (solving by elimination)<br>or<br>$4-3a = 7k$ and $a = 11k-2$ (solving by substitution) |
|   | Finding $a$ or $k$                                                                                                                                                                | M1dep | eg $10 = 40k$ or $k = \frac{1}{4}$                                                                                      |
|   | $\frac{3}{4}$                                                                                                                                                                     | A1    | oe eg $\frac{30}{40}$ or 0.75                                                                                           |
|   | <b>Additional Guidance</b>                                                                                                                                                        |       |                                                                                                                         |
|   | Trying to use the cosine rule to find the opposite side is irrelevant so can be ignored                                                                                           | M0A0  |                                                                                                                         |
|   | $\sin x = \frac{6\sqrt{2}}{11}$ $\tan x = \frac{6\sqrt{2}}{7}$                                                                                                                    | M0A0  |                                                                                                                         |
|   | On Alt 2 $k$ could be any letter                                                                                                                                                  |       |                                                                                                                         |
|   | Incorrect further working will not score A mark                                                                                                                                   |       |                                                                                                                         |
|   | Condone missing brackets if recovered                                                                                                                                             |       |                                                                                                                         |
|   | Condone units stated on answer line                                                                                                                                               |       |                                                                                                                         |
|   | $\frac{4-3a}{a+2} = \frac{7}{11}$ followed by $4-3a = 7$ and/or $a+2 = 11$ is an incorrect attempt at Alt 1                                                                       | M1A0  |                                                                                                                         |

| Q    | Answer                                                                                | Mark | Comments                                                                              |
|------|---------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------|
| 4(a) | <b>Alternative method 1: simultaneous equations</b>                                   |      |                                                                                       |
|      | $0 = -9^2 + 9b + c$ or $c = 81 - 9b$<br>and<br>$0 = -(-3)^2 - 3b + c$ or $c = 9 + 3b$ | M1   | oe eg $81 - 9b = 9 + 3b$                                                              |
|      | $b = 6$                                                                               | A1   |                                                                                       |
|      | $c = 27$                                                                              | A1   | SC1 $b = -6$ and $c = -27$                                                            |
|      | <b>Alternative method 2: using the roots</b>                                          |      |                                                                                       |
|      | $(y = ) -(x + 3)(x - 9) (= 0)$                                                        | M1   | oe                                                                                    |
|      | $b = 6$                                                                               | A1   |                                                                                       |
|      | $c = 27$                                                                              | A1   | SC1 $b = -6$ and $c = -27$                                                            |
|      | <b>Alternative method 3: differentiating to find <math>b</math></b>                   |      |                                                                                       |
|      | $\frac{dy}{dx} = -2x + b$                                                             | M1   |                                                                                       |
|      | $b = 6$                                                                               | A1   |                                                                                       |
|      | $c = 27$                                                                              | A1   | by substituting either root into<br>$y = -x^2 + 6x + c$<br>SC1 $b = -6$ and $c = -27$ |
|      | <b>Additional Guidance</b>                                                            |      |                                                                                       |
|      | Condone missing brackets only if recovered                                            |      |                                                                                       |
|      | 6 or 27 seen without M1 scored                                                        |      | M0A0                                                                                  |

| Q    | Answer                                                    | Mark  | Comments                                                                                        |
|------|-----------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------|
| 4(b) | $x$ value 3                                               | B1    |                                                                                                 |
|      | $y$ value 36                                              | B1 ft | ft substituting their $x$ into<br>$y = -x^2 + (\text{their } b)x + (\text{their } c)$ from 4(a) |
|      | <b>Additional Guidance</b>                                |       |                                                                                                 |
|      | eg for B1ft $y = -x^2 + 5x + 5$ $x = 3$ leads to $y = 11$ |       |                                                                                                 |

| Q    | Answer                                         | Mark | Comments |
|------|------------------------------------------------|------|----------|
| 5(a) | $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ | B1   |          |
|      | <b>Additional Guidance</b>                     |      |          |
|      |                                                |      |          |

| Q    | Answer                                                                                                                                     | Mark  | Comments                                                                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5(b) | <b>Alternative method 1</b>                                                                                                                |       |                                                                                                                                                          |
|      | $\begin{pmatrix} 2 \times 1 + 6 \times -1 & 2 \times 0 + 6 \times 3 \\ 4 \times 1 + -2 \times -1 & 4 \times 0 + -2 \times 3 \end{pmatrix}$ | M1    | allow M1 for any three correct calculations out of the four<br>doesn't need to be seen in a matrix                                                       |
|      | $\begin{pmatrix} -4 & 18 \\ 6 & -6 \end{pmatrix}$                                                                                          | M1dep | any 3 correct values in the correct position would imply M1M0<br>condone no brackets as long as it's in a 2x2 format                                     |
|      | $2 \begin{pmatrix} -2 & 9 \\ 3 & -3 \end{pmatrix}$                                                                                         | A1    | must be in brackets                                                                                                                                      |
|      | <b>Alternative method 2: taking a factor of 2 out first</b>                                                                                |       |                                                                                                                                                          |
|      | $2 \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix}$                                                                                          | M1    | common factor removed from first matrix                                                                                                                  |
|      | $\begin{pmatrix} 1 \times 1 + 3 \times -1 & 1 \times 0 + 3 \times 3 \\ 2 \times 1 + -1 \times -1 & 2 \times 0 + -1 \times 3 \end{pmatrix}$ | M1dep | allow M1dep for any three correct calculations out of the four<br>doesn't need to be seen in a matrix<br>factor of 2 not needed to be seen for this mark |
|      | $2 \begin{pmatrix} -2 & 9 \\ 3 & -3 \end{pmatrix}$                                                                                         | A1    | must be in brackets                                                                                                                                      |
|      | <b>Additional Guidance</b>                                                                                                                 |       |                                                                                                                                                          |
|      | Alt 1 first mark and Alt 2 second mark if more than 4 calculations then do not award mark unless three correct calculations are selected   |       |                                                                                                                                                          |
|      | Commas in matrix will lose the A mark                                                                                                      |       | M2A0                                                                                                                                                     |

| Q | Answer                                                                             | Mark | Comments                         |
|---|------------------------------------------------------------------------------------|------|----------------------------------|
| 6 | $36x^5 - 60x^3$                                                                    | B2   | oe<br>B1 for either term correct |
|   | <b>Additional Guidance</b>                                                         |      |                                  |
|   | oe could be $12x^3(3x^2 - 5)$ or any correct factorisation                         |      | B2                               |
|   | Either or both terms correct but then incorrect further working                    |      | B1                               |
|   | Use of product rule to get $\left(\frac{dy}{dx} =\right) 12x^3 (2x^2 - 5) + 12x^5$ |      | B2                               |

| Q | Answer                                                                                                                                                                                | Mark  | Comments                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------|
| 7 | $y - 8 = \frac{3}{rw}$ or $yw = 8w + \frac{3}{r}$<br>or $yr = 8r + \frac{3}{w}$ or $yr - 8r = \frac{3}{w}$<br>or $ryw = 8rw + 3$                                                      | M1    |                              |
|   | $rw(y - 8) = 3$ or $w(y - 8) = \frac{3}{r}$<br>or $rw = \frac{3}{(y - 8)}$ or $w(ry - 8r) = 3$<br>or $\frac{1}{ry - 8r} = \frac{w}{3}$ or $\frac{3}{ry - 8r}$ or $\frac{3}{r(y - 8)}$ | M1dep | oe one step away from answer |
|   | $w = \frac{3}{r(y - 8)}$ or $w = \frac{3}{ry - 8r}$                                                                                                                                   | A1    |                              |
|   | <b>Additional Guidance</b>                                                                                                                                                            |       |                              |
|   | Do not allow $\times$ or $\div$ written in final answer                                                                                                                               |       | M2A0                         |
|   | Unsimplified final answers will not score the A mark<br>eg $w = \frac{1}{r\left(\frac{y - 8}{3}\right)}$                                                                              |       | M2A0                         |
|   | For methods that manipulate so that terms become negative follow same MS equivalent.<br>Answers would be or $w = \frac{-3}{r(8 - y)}$ or $w = \frac{-3}{8r - ry}$                     |       | M2A1                         |
|   | $w = \frac{3}{r(y - 8)}$ or $w = \frac{3}{ry - 8r}$ seen in working then further incorrect working                                                                                    |       | M2A0                         |
|   | $w = \frac{3}{r(y - 8)}$ or $w = \frac{3}{ry - 8r}$ not seen in working then without $w =$ on answer line                                                                             |       | M2A0                         |
|   | $w = \frac{3}{r(y - 8)}$ or $w = \frac{3}{ry - 8r}$ seen in working then without $w =$ on answer line                                                                                 |       | M2A1                         |

| Q | Answer                                                                                                                   | Mark  | Comments                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------|
| 8 | <b>Alternative method 1: nth term first</b>                                                                              |       |                                                                                 |
|   | $(nth \text{ term} = ) \frac{6}{\sqrt{3}}n + \frac{3}{\sqrt{3}}$                                                         | M1    | oe eg $\frac{6n+3}{\sqrt{3}}$                                                   |
|   | $\frac{6\sqrt{3}n}{3} + \frac{3\sqrt{3}}{3}$                                                                             | M1dep | for rationalising (no surds in denominator)<br>oe eg $\frac{\sqrt{3}}{3}(6n+3)$ |
|   | $\sqrt{3}(2n+1)$ with M2 awarded                                                                                         | A1    |                                                                                 |
|   | <b>Alternative method 2: rationalising first</b>                                                                         |       |                                                                                 |
|   | Terms are $\frac{9\sqrt{3}}{3} \quad \frac{15\sqrt{3}}{3} \quad \frac{21\sqrt{3}}{3}$                                    | M1    | oe any two correct adjacent terms will gain M1 (must be rationalised)           |
|   | $nth \text{ term } 2\sqrt{3}n + \sqrt{3}$                                                                                | M1dep | oe eg $\frac{6\sqrt{3}n}{3} + \frac{3\sqrt{3}}{3}$                              |
|   | $\sqrt{3}(2n+1)$ with M2 awarded                                                                                         | A1    |                                                                                 |
|   | <b>Alternative method 3: using simultaneous equations</b>                                                                |       |                                                                                 |
|   | $\frac{9}{\sqrt{3}} = \sqrt{3}(a+b)$<br>$\frac{15}{\sqrt{3}} = \sqrt{3}(2a+b)$<br>$\frac{21}{\sqrt{3}} = \sqrt{3}(3a+b)$ | M1    | oe for any two when substituting for $n = 1, n = 2$ and $n = 3$                 |
|   | $9 = 3(a+b)$<br>$15 = 3(2a+b)$<br>$21 = 3(3a+b)$                                                                         | M1dep | oe for any two                                                                  |
|   | $\sqrt{3}(2n+1)$ with M2 awarded                                                                                         | A1    |                                                                                 |

See over for Alt 4 & Additional Guidance

|             |                                                                                             |       |                               |
|-------------|---------------------------------------------------------------------------------------------|-------|-------------------------------|
| 8<br>cont'd | <b>Alternative method 4: nth term then manipulating using <math>\sqrt{3}(an + b)</math></b> |       |                               |
|             | (nth term =) $\frac{6}{\sqrt{3}}n + \frac{3}{\sqrt{3}}$                                     | M1    | oe eg $\frac{6n+3}{\sqrt{3}}$ |
|             | $6n + 3 = 3(an + b)$<br>or<br>$3a = 6$ and $3b = 3$                                         | M1dep |                               |
|             | $\sqrt{3}(2n+1)$ with M2 awarded                                                            | A1    |                               |
|             | <b>Additional Guidance</b>                                                                  |       |                               |
|             | For Alt 1 $\frac{9}{\sqrt{3}} + (n-1)\frac{6}{\sqrt{3}}$ is oe for the first M mark         |       |                               |
|             | For Alt 2 $\frac{9\sqrt{3}}{3} + (n-1)\frac{6\sqrt{3}}{3}$ is oe for the second M mark      |       |                               |
|             | Condone missing + in working as long as it's replaced later                                 |       |                               |

| Q | Answer                                                                                | Mark  | Comments                                                                                                                                        |
|---|---------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 9 | $x^2 + 1 + 1 + x^{-2}$<br>or $x^2 + x^0 + x^0 + x^{-2}$                               | M1    | four terms with three correct<br>if three terms M1 can be implied by<br>$x^2 + 2 + \dots$<br>or $\dots + 2 + x^{-2}$<br>could be seen in a grid |
|   | $x^2 + 2 + x^{-2}$<br>or $x^2 + 2 + \frac{1}{x^2}$<br>or $x^2 = 16$ or $x^2 - 16 = 0$ | M1dep | all three terms correct<br><br>if simplified                                                                                                    |
|   | 4 and -4<br>or $\pm 4$                                                                | A1    | needs both solutions with no additional answers                                                                                                 |
|   | <b>Additional Guidance</b>                                                            |       |                                                                                                                                                 |
|   | $x^4 + 2x^2 + 1$ (multiplying LHS by $x^2$ )                                          |       | M2                                                                                                                                              |
|   | Accept $\frac{1}{x^2}$ as interchangeable with $x^{-2}$                               |       |                                                                                                                                                 |

| Q  | Answer                                                                                                                    | Mark  | Comments                                                                                                                                        |
|----|---------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | $3ax^2 + 2bx$                                                                                                             | M1    | either term correct                                                                                                                             |
|    | $6ax + 2b$                                                                                                                | M1dep | both terms must be correct                                                                                                                      |
|    | $3a + 2b = 2$<br>$6a + 2b = 8$                                                                                            | M1dep | $3a + 2b = 2$ with no incorrect working<br>implies the first M mark<br>$6a + 2b = 8$ with no incorrect working<br>implies the first two M marks |
|    | $a = 2$ $b = -2$                                                                                                          | A1    |                                                                                                                                                 |
|    | <b>Additional Guidance</b>                                                                                                |       |                                                                                                                                                 |
|    | Up to M2 can be awarded for correct work if no answer or incorrect answer, even if this is seen amongst multiple attempts |       |                                                                                                                                                 |

| Q  | Answer                                                                                                                | Mark  | Comments                                                                                                                                                                                                                                                     |
|----|-----------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | (Gradient of L =) $\frac{2}{3}$ or $\frac{7-3}{18-12}$                                                                | M1    | oe could be embedded in the equation of the line L                                                                                                                                                                                                           |
|    | Gradient of perpendicular = $\frac{-1}{\left(\text{their } \frac{2}{3}\right)}$<br>or $= \frac{-3}{2}$                | M1    | oe could be embedded in the equation of their perpendicular                                                                                                                                                                                                  |
|    | $y - 3 = \left(\text{their } \frac{-3}{2}\right)(x - 12)$<br>or $3 = \left(\text{their } \frac{-3}{2}\right)(12) + c$ | M1dep | oe where $\left(\text{their } \frac{-3}{2}\right)$ is the negative reciprocal of their gradient of L<br>dependent on second M only<br>gradient must not be written as a fraction within a fraction<br>eg $= \frac{-3}{2}$ and not $= \frac{-1}{\frac{2}{3}}$ |
|    | $y = \frac{-3}{2}x + 21$                                                                                              | A1    | oe for $\frac{-3}{2}$ eg -1.5 or $-1\frac{1}{2}$ or $\frac{-6}{4}$<br>but not $\frac{-1}{0.67}$                                                                                                                                                              |
|    | <b>Additional Guidance</b>                                                                                            |       |                                                                                                                                                                                                                                                              |
|    | Condone $y = 21 - \frac{3}{2}x$                                                                                       | M3A1  |                                                                                                                                                                                                                                                              |

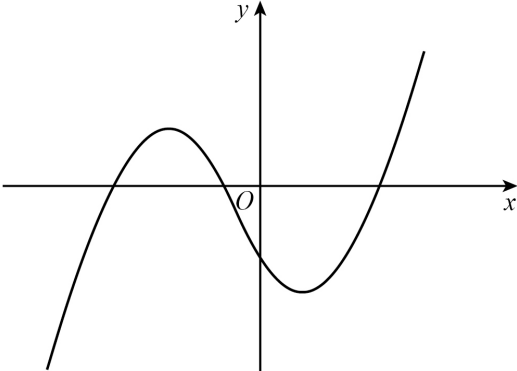
| Q  | Answer                                                                                                                                   | Mark  | Comments                                                                                                                                                 |
|----|------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | <b>Alternative method 1: Factorising and cancelling</b>                                                                                  |       |                                                                                                                                                          |
|    | $(x+2)(x-3)$                                                                                                                             | M1    | oe                                                                                                                                                       |
|    | $5(x+2)$ or $3(x-3)$                                                                                                                     | M1    |                                                                                                                                                          |
|    | $\frac{(x+2)(x-3)}{5(x+2)} \times \frac{25}{3(x-3)}$                                                                                     | M1dep | oe changing the division to a multiplication and factorised into something that can be fully cancelled (would imply previous M marks)<br>dependent on M2 |
|    | $\frac{5}{3}$                                                                                                                            | A1    | oe accept $1\frac{2}{3}$ but not $\frac{25}{15}$                                                                                                         |
|    | <b>Alternative method 2: Cancelling a common factor of <math>x^2 - x - 6</math></b>                                                      |       |                                                                                                                                                          |
|    | $\frac{25(x^2 - x - 6)}{(5x+10)(3x-9)}$                                                                                                  | M1    | changing the division to a multiplication and writing as a single fraction                                                                               |
|    | $\frac{25(x^2 - x - 6)}{15x^2 - 15x - 90}$ or $\frac{25x^2 - 25x - 150}{15x^2 - 15x - 90}$<br>or $\frac{5x^2 - 5x - 30}{3x^2 - 3x - 18}$ | M1dep |                                                                                                                                                          |
|    | $\frac{25(x^2 - x - 6)}{15(x^2 - x - 6)}$ or $\frac{5(x^2 - x - 6)}{3(x^2 - x - 6)}$                                                     | M1dep | factorised into something that can be fully cancelled (would imply previous M marks)<br>dependent on M2                                                  |
|    | $\frac{5}{3}$                                                                                                                            | A1    | oe accept $1\frac{2}{3}$ but not $\frac{25}{15}$                                                                                                         |
|    | <b>Additional Guidance</b>                                                                                                               |       |                                                                                                                                                          |
|    | Students may factorise, cancel or change divide to multiply at various stages. Follow whichever Alt method gives the best mark           |       |                                                                                                                                                          |
|    | Incorrect further work will lose the A mark                                                                                              |       | M3A0                                                                                                                                                     |
|    | $\frac{5}{3}$ followed by 1.67 (or other correct rounded decimal equivalent)                                                             |       | M3A1                                                                                                                                                     |
|    | Terminating decimal answers without seeing $\frac{5}{3}$ or $1\frac{2}{3}$ first                                                         |       | M3A0                                                                                                                                                     |

| Q  | Answer                                                                                                                | Mark | Comments                                                                                                                                                                                            |
|----|-----------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13 | Correctly eliminating one variable                                                                                    | M1   | eg $4d + f = 15$<br>or $4e + 3f = 9$<br>or $2e + 5f = 1$<br>or $-2e + 9f = -15$<br>or $5d + 3e = 29$<br>or $d + (3d - 9) + f = 6$<br>or $3(6 - e - f) - e = 9$<br>or $2(6 - e - f) - 3f = 11$<br>oe |
|    | $d = 4$ and $e = 3$ and $f = -1$ with M1 awarded                                                                      | A3   | A2 two correct with valid working seen<br>or<br>A1 one correct with valid working seen                                                                                                              |
|    | <b>Additional Guidance</b>                                                                                            |      |                                                                                                                                                                                                     |
|    | M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts |      |                                                                                                                                                                                                     |
|    | Correct values embedded in equations                                                                                  |      | M1A2                                                                                                                                                                                                |
|    | Two correct values embedded in equations                                                                              |      | M1A1                                                                                                                                                                                                |
|    | Stop marking as soon as T&I/inspection methods begin (but check for restarts)                                         |      |                                                                                                                                                                                                     |

| Q     | Answer                                                                                | Mark | Comments |
|-------|---------------------------------------------------------------------------------------|------|----------|
| 14(a) | 215                                                                                   | B1   |          |
|       | Additional Guidance                                                                   |      |          |
|       | Condone $\sin 215$ or $\sin 215 = k$                                                  |      | B1       |
|       | May use grid lines but do not allow approximations from graph (unless they state 215) |      | B0       |

| Q     | Answer                                                                                                 | Mark | Comments                           |
|-------|--------------------------------------------------------------------------------------------------------|------|------------------------------------|
| 14(b) | $(\sin a =) \frac{2}{5}$ or 0.4                                                                        | M1   | may be seen as a line on the graph |
|       | $[20^\circ, 27^\circ]$                                                                                 | A1   | $23.6^\circ$                       |
|       | Additional Guidance                                                                                    |      |                                    |
|       | $\tan a = \frac{2}{5}$ as an approximation is incorrect and can't be used as we don't have a tan graph |      | M0A0                               |
|       | Additional correct or incorrect answers outside the range                                              |      | M1A0                               |

| Q  | Answer                                                                                                                                                                                                                                | Mark  | Comments                                                                                                                                                                                                     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 | 10 as part of coefficient of $x^3$ in first expansion<br>or<br>15 as part of coefficient of $x^4$ in second expansion<br>or $\binom{5}{3}$ or ${}^5C_3$ or $\binom{6}{4}$ or ${}^6C_4$<br>seen and used in correct place in expansion | M1    | just stating Pascal's triangle isn't sufficient to get this mark<br>do not award if + seen as part of coefficient rather than $\times$ (could be recovered only if recovered to $40(px)^3$ and $240(px)^4$ ) |
|    | $10 \times 2^2 \times p^3$ or $40p^3$                                                                                                                                                                                                 | M1dep | oe<br>could be within an expansion                                                                                                                                                                           |
|    | $15 \times 1^2 \times 16p^4$ or $240p^4$                                                                                                                                                                                              | M1dep | oe eg $16 = 2^4$<br>could be within an expansion<br>dependent on first M mark only                                                                                                                           |
|    | $\frac{1}{6}$                                                                                                                                                                                                                         | A1    | oe eg $\frac{40}{240}$                                                                                                                                                                                       |
|    | <b>Additional Guidance</b>                                                                                                                                                                                                            |       |                                                                                                                                                                                                              |
|    | Further incorrect simplification of their oe for answer will not gain A mark<br>eg $\frac{40}{240} = \frac{1}{8}$                                                                                                                     |       | M3A0                                                                                                                                                                                                         |
|    | Condone $x^3$ and $x^4$ seen with coefficients for M marks (must be recovered to gain the A mark)                                                                                                                                     |       |                                                                                                                                                                                                              |
|    | $10 \times 2^2 \times (px)^3$ without correct expansion will not score first Mdep mark<br>$15 \times 1^2 \times (2px)^4$ without correct expansion will not score second Mdep mark                                                    |       |                                                                                                                                                                                                              |
|    | Either Mdep mark implies the M mark                                                                                                                                                                                                   |       |                                                                                                                                                                                                              |
|    | Candidates attempting to expand the brackets will need to get either Mdep mark to get the first M mark. They could have made errors in their expansions as long as they get $40p^3$ or $240p^4$                                       |       |                                                                                                                                                                                                              |

| Q     | Answer                                                                                                                                 | Mark | Comments                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16(a) | Continuous positive cubic curve crossing $y$ -axis at a negative value<br>Correct quadrant for maximum<br>Correct quadrant for minimum | B3   | B2<br>continuous positive cubic curve crossing $y$ -axis at a negative value<br><b>and</b> either stationary point in the correct quadrant<br><b>or</b><br>both stationary points in the correct quadrants and a continuous positive cubic curve crossing $y$ -axis at a positive value or at 0<br>B1<br>any continuous cubic curve with two distinct stationary points |
|       | <b>Additional Guidance</b>                                                                                                             |      |                                                                                                                                                                                                                                                                                                                                                                         |
|       | Continuous positive cubic curve crossing $y$ -axis at a negative value should be clear (not touching the origin)                       |      |                                                                                                                                                                                                                                                                                                                                                                         |
|       | Drawing part, or all of the curve using a ruler will gain a maximum of B2                                                              |      |                                                                                                                                                                                                                                                                                                                                                                         |
|       | Ignore any labels on points                                                                                                            |      |                                                                                                                                                                                                                                                                                                                                                                         |
|       | Condone slight feathering and slight incorrect curvature                                                                               |      |                                                                                                                                                                                                                                                                                                                                                                         |
|       |                                                     |      |                                                                                                                                                                                                                                                                                                                                                                         |

| Q     | Answer                                          | Mark | Comments |
|-------|-------------------------------------------------|------|----------|
| 16(b) | $a < x < c$<br>or $0 < x < c$<br>or $a < x < 0$ | B1   |          |
|       | <b>Additional Guidance</b>                      |      |          |
|       |                                                 |      |          |

| Q  | Answer                                                                                          | Mark  | Comments                                                                                                                                                     |
|----|-------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17 | <b>Alternative method 1: Using sine rule</b>                                                    |       |                                                                                                                                                              |
|    | $(\sin 60 =) \frac{\sqrt{3}}{2}$<br>or $(\sin 45 =) \frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$ | M1    | identified or used in the correct place in the working<br>do not accept a list of values which includes irrelevant values unless correct value(s) identified |
|    | $\frac{x}{\sin 60} = \frac{\sqrt{48}}{\sin 45}$                                                 | M1    | oe                                                                                                                                                           |
|    | $\frac{x}{\frac{\sqrt{3}}{2}} = \frac{\sqrt{48}}{\frac{\sqrt{2}}{2}}$                           | M1dep | oe<br>dependent on M2 and sin 60 and sin 45 substituted in correctly<br>eg $x = 4\sqrt{3} \times \frac{\sqrt{3}}{2} \times \sqrt{2}$                         |
|    | $(x =) 6\sqrt{2}$ with correct manipulation of fractions and surds seen                         | A1    |                                                                                                                                                              |
|    | <b>Alternative method 2: Dropping a vertical (<math>h</math>)</b>                               |       |                                                                                                                                                              |
|    | $(\sin 60 =) \frac{\sqrt{3}}{2}$<br>or $(\sin 45 =) \frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$ | M1    | identified or used in the correct place in the working<br>do not accept a list of values which includes irrelevant values unless correct value(s) identified |
|    | $(h =) \sqrt{48} \sin 60$                                                                       | M1    |                                                                                                                                                              |
|    | $\frac{1}{\sqrt{2}} = \frac{6}{x}$                                                              | M1dep | oe values substituted into $\sin 45 = \frac{h}{x}$<br>dependent on M2                                                                                        |
|    | $(x =) 6\sqrt{2}$                                                                               | A1    |                                                                                                                                                              |
|    | <b>Additional Guidance</b>                                                                      |       |                                                                                                                                                              |
|    | Condone use of other letters used instead of $x$                                                |       |                                                                                                                                                              |
|    | $(x =) 6\sqrt{2}$ with no working                                                               |       | MOA0                                                                                                                                                         |

| Q  | Answer                                                                                    | Mark  | Comments                                   |
|----|-------------------------------------------------------------------------------------------|-------|--------------------------------------------|
| 18 | <b>Alternative method 1: equating coefficients</b>                                        |       |                                            |
|    | $ax^2 + 2abx + ab^2 (+c)$                                                                 | M1    | using identities                           |
|    | $(a =) 4$ and $2ab = 24$<br>and $ab^2 + c = 15$                                           | M1dep | oe                                         |
|    | $4(x + 3)^2 - 21$                                                                         | A1    |                                            |
|    | <b>Alternative method 2: common factor first</b>                                          |       |                                            |
|    | $4(x^2 + 6x \dots\dots$<br>or $4(x + 3)^2 \dots\dots\dots$                                | M1    | oe<br>eg $4[(x^2 + 6x) \dots\dots]$        |
|    | $4[(x + 3)^2 - 3^2] + 15$                                                                 | M1dep | oe<br>eg $4[(x + 3)^2 - 9 + \frac{15}{4}]$ |
|    | $4(x + 3)^2 - 21$                                                                         | A1    |                                            |
|    | <b>Alternative method 3: common factor last</b>                                           |       |                                            |
|    | $(2x + 6)^2 \dots\dots$                                                                   | M1    | oe                                         |
|    | $(2x + 6)^2 - 36 + 15$                                                                    | M1dep | oe                                         |
|    | $4(x + 3)^2 - 21$                                                                         | A1    |                                            |
|    | <b>Additional Guidance</b>                                                                |       |                                            |
|    | M1 can be awarded from multiple methods                                                   |       |                                            |
|    | Candidates may use a combination of these methods and any correct working to reach A mark |       | M2A1                                       |

| Q  | Answer                                                                                                                                             | Mark  | Comments                                                                                                                                                                                                |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19 | $4 \times a \times b$<br>where $a$ and $b$ are integers less than or equal to 6                                                                    | M1    | 4 can be in any place of the three terms<br>could be embedded in<br>$3 \times (4 \times a \times b) + 8$<br>or $\frac{2}{3} \times (4 \times a \times b)$ or $\frac{1}{3} \times (4 \times a \times b)$ |
|    | $4 \times 5 \times 4$<br>or $3 \times 24 + 8$<br>or $\frac{2}{3} \times 6 \times 5 \times 4$<br>or $(6 \times 5 \times 4) - (2 \times 5 \times 4)$ | M1dep | oe for fully correct calculation                                                                                                                                                                        |
|    | 80                                                                                                                                                 | A1    | SC1 for $\frac{80}{120}$ on answer line                                                                                                                                                                 |
|    | <b>Additional Guidance</b>                                                                                                                         |       |                                                                                                                                                                                                         |
|    | M1 can be awarded from multiple methods                                                                                                            |       |                                                                                                                                                                                                         |
|    | Correct answer done by observation<br>(not coming from incorrect working)                                                                          |       | M2A1                                                                                                                                                                                                    |
|    | Incorrect answer done by observation                                                                                                               |       | M0A0                                                                                                                                                                                                    |

| Q  | Answer                                                                                                                                                                                                     | Mark                                                                                                       | Comments                                                                                                                                                                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20 | All steps shown<br>and all reasons<br>and concluding statement<br>(Must say alternate and parallel)                                                                                                        | B4                                                                                                         | B3 all steps shown but either reason(s)<br>or concluding statement missing or<br>insufficient<br>B2 angle $EDC = x$<br>and alternate segment theorem<br>B1 angle $EDC = x$ |
|    | <b>Additional Guidance</b>                                                                                                                                                                                 |                                                                                                            |                                                                                                                                                                            |
|    | angle $EDC = x$<br>angle $CDA = 180 - x$<br>angle $CBA = x$<br>Alternate angles so $EF$ is parallel to $AB$                                                                                                | Alternate segment theorem<br>Adjacent angles on a straight line<br>Opposite angles of cyclic quadrilateral | B4                                                                                                                                                                         |
|    | angle $EDC = x$<br>angle $CBA = x$<br>Alternate angles so $EF$ is parallel to $AB$                                                                                                                         | Alternate segment theorem<br>Exterior angle of a cyclic quadrilateral<br>equals interior opposite angle    | B4                                                                                                                                                                         |
|    | angle $EDC = x$<br>angle $CDA = 180 - x$<br>angle $CBA = x$<br>with no concluding statement                                                                                                                | Alternate segment theorem<br>Adjacent angles on a straight line<br>Opposite angles of cyclic quadrilateral | B3                                                                                                                                                                         |
|    | angle $EDC = x$<br>angle $CBA = x$<br>with no concluding statement                                                                                                                                         | Alternate segment theorem<br>Exterior angle of a cyclic quadrilateral<br>equals interior opposite angle    | B3                                                                                                                                                                         |
|    | angle $EDC = x$<br>angle $CDA = 180 - x$<br>angle $CBA = x$<br>Alternate angles so $EF$ is parallel to $AB$<br>with no or insufficient reasons                                                             |                                                                                                            | B3                                                                                                                                                                         |
|    | angle $CBA = x$ without angle $CDA = 180 - x$ either in working or on<br>diagram must have exterior angle of a cyclic quadrilateral equals interior<br>opposite angle stated to be used as part of a proof |                                                                                                            |                                                                                                                                                                            |
|    | Marks can be awarded from the diagram                                                                                                                                                                      |                                                                                                            |                                                                                                                                                                            |
|    | B1 can be awarded if seen in working or on the diagram with no reason<br>or an incorrect reason or possible incorrect working                                                                              |                                                                                                            |                                                                                                                                                                            |

|  |                                                                                                                                       |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Up to B3 can be awarded for multiple attempts or with additional incorrect statements in working or on diagram                        |  |
|  | Condone poorly explained reasons as long as meaning is clear<br>eg angles on a line, alt seg, alternating angles                      |  |
|  | Condone using $B$ for $CBA$ where there is no doubt about which angle they are referring to but do not condone $D$ for $EDC$ or $CDA$ |  |
|  | Condone $CBA$ for angle $CBA$                                                                                                         |  |
|  | Condone alternative ways of stating angles such as $EBA (=CBA)$                                                                       |  |
|  | Students adding additional angles ( $y$ ) and manipulating those will need to follow an equivalent method to this MS to gain marks    |  |

| Q  | Answer                                                                                                                                                                                                   | Mark  | Comments                                                                        |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------|
| 21 | $\frac{1}{2} \times 5x \times (2x - 2)$ and $\frac{1}{2} \times 4x \times 3x$<br>or<br>$5x(x - 1) + 6x^2$                                                                                                | M1    | oe using three separate triangular areas                                        |
|    | $11x^2 - 5x - 16$<br>or $11x^2 - 5x < 16$ (but only if they are completing the square)                                                                                                                   | M1dep | condone $11x^2 - 5x = 16$ if completing the square                              |
|    | $(11x - 16)(x + 1)$<br>or $11 \left[ \left( x - \frac{5}{22} \right)^2 - \frac{729}{484} \right]$<br>or $11 \left( x - \frac{5}{22} \right)^2 - \frac{729}{44}$<br>or $\frac{5 \pm \sqrt{25 + 704}}{22}$ | M1dep | $(11x - 16)(11x + 11)$ would be an acceptable method to factorise for this mark |
|    | so $x < 1\frac{5}{11}$<br><b>and</b> since $2x - 2 > 0$ then $x > 1$                                                                                                                                     | A1    | oe must see M marks<br><br>must refer to $2x - 2$                               |
|    | <b>Additional Guidance</b>                                                                                                                                                                               |       |                                                                                 |
|    | $\frac{1}{2} \sin 90 \times 4x \times 3x$ is oe to $\frac{1}{2} \times 4x \times 3x$                                                                                                                     | M1    |                                                                                 |
|    | Condone $x < 1\frac{5}{11}$ and $x > 1$ instead of $1 < x < 1\frac{5}{11}$                                                                                                                               | M3A1  |                                                                                 |
|    | Condone $\frac{16}{11}$ for $1\frac{5}{11}$                                                                                                                                                              |       |                                                                                 |
|    | Equivalents for the last statement could include:<br>When $x = 1$ , $2x - 2 = 0$ so $x > 1$<br>$x > 1$ to make $2x - 2$ positive                                                                         |       |                                                                                 |

| Q  | Answer                                                                                                 | Mark  | Comments                                                                                    |
|----|--------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------|
| 22 | <b>Alternative method 1</b>                                                                            |       |                                                                                             |
|    | $y = \frac{28-3x}{4}$ or $y = 7 - \frac{3x}{4}$                                                        | M1    | oe rearranging the linear equation for $y$                                                  |
|    | $(x-1)^2 + \left(\frac{28-3x}{4}\right)^2 = 25$<br>or $(x-1)^2 + \left(7 - \frac{3x}{4}\right)^2 = 25$ | M1dep | oe correctly substituting                                                                   |
|    | $25x^2 - 200x + 400 (= 0)$<br>or $x^2 - 8x + 16 (= 0)$                                                 | M1dep | oe quadratic expression with three terms (= 0)                                              |
|    | $(x-4)^2 (= 0)$<br>or $8^2 - 4 \times 1 \times 16 = 0$                                                 | M1dep | oe a perfect square (= 0)<br>eg $(5x - 20)^2 (= 0)$<br>oe for discriminant                  |
|    | $x = 4$ or discriminant = 0<br><b>and</b><br>valid conclusion                                          | A1    | oe value for 4<br>statement making it clear that there is exactly one point of intersection |
|    | <b>Alternative method 2</b>                                                                            |       |                                                                                             |
|    | $x = \frac{28-4y}{3}$                                                                                  | M1    | oe rearranging the linear equation for $x$                                                  |
|    | $\left(\frac{28-4y}{3} - 1\right)^2 + y^2 = 25$                                                        | M1dep | oe correctly substituting                                                                   |
|    | $25y^2 - 200y + 400 (= 0)$<br>or $y^2 - 8y + 16 (= 0)$                                                 | M1dep | oe quadratic expression with three terms (= 0)                                              |
|    | $(y-4)^2 (= 0)$<br>or $8^2 - 4 \times 1 \times 16 = 0$                                                 | M1dep | oe a perfect square (= 0)<br>eg $(5y - 20)^2 (= 0)$<br>oe for discriminant                  |
|    | $y = 4$ or discriminant = 0<br><b>and</b><br>valid conclusion                                          | A1    | oe value for 4<br>statement making it clear that there is exactly one point of intersection |

See over for Alt 3 & Additional Guidance

| Q  | Answer                                                                                                                                                                                                                                                                                                 | Mark  | Comments                                                                                               |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------|
| 22 | <b>Alternative method 3: showing that the line is a tangent to the circle</b>                                                                                                                                                                                                                          |       |                                                                                                        |
|    | (Gradient of straight line =) $\frac{-3}{4}$                                                                                                                                                                                                                                                           | M1    |                                                                                                        |
|    | (Equation of perpendicular =)<br>$y - 0 = \frac{4}{3}(x - 1)$<br>or $y = \frac{4}{3}x - \frac{4}{3}$                                                                                                                                                                                                   | M1dep | oe<br>equation of perpendicular passing through centre of circle<br>would imply first M mark           |
|    | (Point of intersection of straight line and perpendicular =) (4, 4)<br>with correct working                                                                                                                                                                                                            | M1dep | eg $7 - \frac{3x}{4} = \frac{4}{3}x - \frac{4}{3}$ and (4, 4)<br>would imply the first and second mark |
|    | Showing (4, 4) lies on the circle<br>or<br>Showing the distance between (1, 0) and (4, 4) is equal to the radius of the circle                                                                                                                                                                         | M1dep | minimum working would be $3^2 + 4^2 = 25$<br>would not imply previous marks                            |
|    | Statement clarifying that (4, 4) lies on the circle and because the straight line must be a tangent to the circle they intersect at one point                                                                                                                                                          | A1    |                                                                                                        |
|    | <b>Additional Guidance</b>                                                                                                                                                                                                                                                                             |       |                                                                                                        |
|    | M1 can be scored from multiple attempts                                                                                                                                                                                                                                                                |       |                                                                                                        |
|    | Trial and Improvement                                                                                                                                                                                                                                                                                  |       | M0A0                                                                                                   |
|    | Attempt to draw an accurate graph alone                                                                                                                                                                                                                                                                |       | M0A0                                                                                                   |
|    | In Alt 1 and Alt 2 for the A mark accept conclusions such as:<br>Only one point of intersection<br>It is a repeated root<br>Exactly one point of intersection<br>The point of intersection is (4, 4)<br>The straight line is a tangent to the circle so one point<br>Only one $x$ (or $y$ ) coordinate |       |                                                                                                        |
|    | No need to find second coordinate in either Alt 1 or Alt 2 and if they do (correctly or incorrectly) it can be ignored                                                                                                                                                                                 |       |                                                                                                        |