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# INTERNATIONAL GCSE MATHEMATICS EXTENSION 9260/2E

Paper 2E

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Mark scheme

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### Key to mark types and abbreviations

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

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| 1 | 36     | B1   |          |

| Q | Answer    | Mark | Comments |
|---|-----------|------|----------|
| 2 | $17 - 5n$ | B1   |          |

| Q | Answer                   | Mark | Comments |
|---|--------------------------|------|----------|
| 3 | $320 \times \frac{3}{5}$ | B1   |          |

| Q | Answer                 | Mark | Comments |
|---|------------------------|------|----------|
| 4 | $-1$ and $\frac{2}{3}$ | B1   |          |

| Q    | Answer              | Mark | Comments |
|------|---------------------|------|----------|
| 5(a) | 2, 3, 5, 6, 7, 8    | B1   |          |
|      | Additional Guidance |      |          |
|      | {2, 3, 5, 6, 7, 8}  |      | B1       |

| Q    | Answer                | Mark | Comments |
|------|-----------------------|------|----------|
| 5(b) | 1, 2, 3, 4, 5, 7, 9   | B1   |          |
|      | Additional Guidance   |      |          |
|      | {1, 2, 3, 4, 5, 7, 9} |      | B1       |

| Q    | Answer                                                                                  | Mark | Comments                                                  |
|------|-----------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| 6(a) | $5.1 \times 10^6$                                                                       | B2   | B1 incorrect notation<br>eg $51 \times 10^5$ or 5 100 000 |
|      | <b>Additional Guidance</b>                                                              |      |                                                           |
|      | Ignore any truncation after correct answer seen<br>eg $5.1 \times 10^6 = 5 \times 10^6$ |      | B2                                                        |
|      | $5 \times 10^6$ only                                                                    |      | B1                                                        |

| Q    | Answer                     | Mark | Comments                         |
|------|----------------------------|------|----------------------------------|
| 6(b) | $8 \div 125$ or 0.064      | M1   | oe eg $64 \times 10^{-3}$        |
|      | $6.4 \times 10^{-2}$ (: 1) | A1   | SC1 1 : $1.5625 \times 10^{(1)}$ |

| Q | Answer                                                                                                                                                                                      | Mark  | Comments                                                                  |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------|
| 7 | $5x + 40 = 2x + 55$                                                                                                                                                                         | M1    |                                                                           |
|   | $5x - 2x = 55 - 40$<br>or $3x = 15$                                                                                                                                                         | M1dep |                                                                           |
|   | $x = 5$<br>or angle of 65 seen                                                                                                                                                              | A1    | may be on diagram                                                         |
|   | $180 - 2 \times (5 \times \text{their } 5 + 40)$<br>or<br>$180 - 2 \times (2 \times \text{their } 5 + 55)$<br>or<br>$180 - (5 \times \text{their } 5 + 40 + 2 \times \text{their } 5 + 55)$ | M1dep | dep on first M1                                                           |
|   | 50                                                                                                                                                                                          | A1ft  | ft their x provided M1 awarded and<br>$0 < x < 180$<br>SC1 $85 - 7x$ seen |

| Q | Answer                                                                                                             | Mark  | Comments                   |
|---|--------------------------------------------------------------------------------------------------------------------|-------|----------------------------|
| 8 | $\frac{5}{4}$ or 1.25<br>or $\frac{4}{5}$ or 0.8<br>or $\frac{6}{4}$ or 1.5<br>or $\frac{4}{6}$ or 0.66... or 0.67 | M1    | oe                         |
|   | $6 \times \frac{5}{4}$ or 7.5<br>or<br>$5 \times \frac{6}{4}$ or 7.5<br>or<br>$7 \times \frac{4}{5}$ or 5.6        | M1dep | oe eg $6 \div \frac{4}{5}$ |
|   | $w = 7.5$ and $y = 5.6$                                                                                            | A1    | oe                         |
|   | <b>Additional Guidance</b>                                                                                         |       |                            |
|   | Answers may be on diagram but answer line takes precedence                                                         |       |                            |
|   | $6 \times 5 \div 4$ or $7 \times 4 \div 5$                                                                         |       | M1M1                       |
|   | $7.5 : 6$ or $6 : 7.5$ or $5.6 : 7$ or $7 : 5.6$                                                                   |       | M1M1                       |
|   | $w = 5.6$ and $y = 7.5$                                                                                            |       | M1M1A0                     |
|   | $\frac{w}{6} = \frac{5}{4}$ or $4w = 30$                                                                           |       | M1                         |
|   | $\frac{y}{7} = \frac{4}{5}$ or $5y = 28$                                                                           |       | M1                         |
|   | $6 : w = 4 : 5$ or $y : 7 = 4 : 5$ (oe) with no further working                                                    |       | M0                         |

| Q    | Answer                                                                         | Mark | Comments                           |
|------|--------------------------------------------------------------------------------|------|------------------------------------|
| 9(a) | $\frac{1}{6}$                                                                  | B1   | oe fraction, decimal or percentage |
|      | <b>Additional Guidance</b>                                                     |      |                                    |
|      | Ignore attempts to simplify or convert a correct fraction                      |      |                                    |
|      | Ignore probability words                                                       |      |                                    |
|      | Accept 0.16... or 0.17                                                         |      | B1                                 |
|      | 1 out of 6 or 1 in 6 alone on the answer line with a correct answer in working |      | B1                                 |
|      | 1 out of 6 or 1 in 6 together with a correct answer on the answer line         |      | B1                                 |
|      | 1 : 6 together with a correct answer on the answer line                        |      | B0                                 |

| Q    | Answer                                                                      | Mark | Comments                                                                                                                                                     |
|------|-----------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9(b) | No with correct explanation relating to uncertainty or randomness           | B1   | eg the theoretical probability doesn't tell you what will actually happen<br>eg it might not be exactly half heads and tails<br>eg you can't predict exactly |
|      | <b>Additional Guidance</b>                                                  |      |                                                                                                                                                              |
|      | Accept a correct statement with a non-contradictory or irrelevant statement |      |                                                                                                                                                              |
|      | 25 heads and tails are the theoretical results                              |      | B1                                                                                                                                                           |
|      | She could get 50 heads (and no tails)                                       |      | B1                                                                                                                                                           |
|      | She cannot be sure                                                          |      | B1                                                                                                                                                           |
|      | It will only be around 25 heads                                             |      | B1                                                                                                                                                           |
|      | She could get a lot of heads together then a lot of tails                   |      | B0                                                                                                                                                           |
|      | The probability is only approximately 0.5                                   |      | B0                                                                                                                                                           |
|      | Probabilities are not accurate                                              |      | B0                                                                                                                                                           |
|      | She can't get 25 heads and 25 tails                                         |      | B0                                                                                                                                                           |
|      | The coin has not been tossed enough times                                   |      | B0                                                                                                                                                           |
|      | She tosses the coin differently every time                                  |      | B0                                                                                                                                                           |

| Q  | Answer                                                   | Mark | Comments |
|----|----------------------------------------------------------|------|----------|
| 10 | $168 \div (3 + 5)$<br>or $168 \div 8$<br>or 21<br>or 105 | M1   |          |
|    | 63                                                       | A1   |          |

| Q  | Answer                                                                                                                                                                                                        | Mark  | Comments                                                                                                                                                                                              |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | $\frac{4x}{12}$<br>or<br>$\frac{6x}{12}$<br>or<br>$\frac{2x}{6} + \frac{3x}{6}$ or $\frac{5x}{6}$                                                                                                             | M1    | oe<br>$\frac{4x}{12}$ and $\frac{6x}{12}$ must be using a denominator that is a multiple of 12<br>$\frac{2x}{6} + \frac{3x}{6}$ or $\frac{5x}{6}$ must be using a denominator that is a multiple of 6 |
|    | $\frac{11x}{12} - \left( \frac{4x}{12} + \frac{6x}{12} \right)$<br>or<br>$\frac{11x}{12} - \frac{4x}{12} - \frac{6x}{12}$<br>or<br>$\frac{11x}{12} - \frac{10x}{12}$<br>or<br>$\frac{7x}{12} - \frac{6x}{12}$ | M1dep | must be using a denominator that is a multiple of 12                                                                                                                                                  |
|    | $\frac{x}{12}$ or $\frac{1}{12}x$                                                                                                                                                                             | A1    | SC2 $\frac{13x}{12}$ or $\frac{13}{12}x$                                                                                                                                                              |
|    | <b>Additional Guidance</b>                                                                                                                                                                                    |       |                                                                                                                                                                                                       |
|    | $\frac{6x}{72}$                                                                                                                                                                                               |       | M1M1A0                                                                                                                                                                                                |
|    | Allow multiplication signs in fractions for M marks<br>eg $\frac{4 \times x}{12}$                                                                                                                             |       | M1                                                                                                                                                                                                    |
|    |                                                                                                                                                                                                               |       |                                                                                                                                                                                                       |

| Q  | Answer                                            | Mark  | Comments |
|----|---------------------------------------------------|-------|----------|
| 12 | <b>Alternative method 1</b>                       |       |          |
|    | $10 \times 8 \div 2$ or 40                        | M1    | oe       |
|    | $960 \div$ their 40                               | M1dep | oe       |
|    | 24                                                | A1    |          |
|    | <b>Alternative method 2</b>                       |       |          |
|    | $960 \div 10 \div 8$<br>or $960 \div 80$<br>or 12 | M1    | oe       |
|    | their $12 \times 2$                               | M1dep | oe       |
|    | 24                                                | A1    |          |

| Q     | Answer       | Mark | Comments |
|-------|--------------|------|----------|
| 13(a) | $1260^\circ$ | B1   |          |

| Q            | Answer                                                                                                                         | Mark | Comments                     |
|--------------|--------------------------------------------------------------------------------------------------------------------------------|------|------------------------------|
| <b>13(b)</b> | No and correct reason                                                                                                          | B1   | eg 70 is not a factor of 360 |
|              | <b>Additional Guidance</b>                                                                                                     |      |                              |
|              | If none of the boxes ticked, No may be stated or implied in reason<br>eg It can't be 70 as it does not divide exactly into 360 |      | B1                           |
|              | No, 360 is not a multiple of 70                                                                                                |      | B1                           |
|              | Condone No and 360 does not divide by 70                                                                                       |      | B1                           |
|              | No and $360 \div 70$ is not a whole number                                                                                     |      | B1                           |
|              | No and $360 \div 70 = 5.1\dots$ (which is not an integer)                                                                      |      | B1                           |
|              | No, you can't have 5.1 sides                                                                                                   |      | B1                           |
|              | No and $70 \times 5 = 350$ and $70 \times 6 = 420$                                                                             |      | B1                           |
|              | No, a pentagon is 72 and a hexagon is 60                                                                                       |      | B1                           |
|              | No, (has interior angle) 110 and a pentagon has 108 and a hexagon has 120                                                      |      | B1                           |
|              | No, (has interior angle) 110                                                                                                   |      | B0                           |
|              | No, (interior angle of) a pentagon is 108                                                                                      |      | B0                           |
|              | No, a pentagon is 72                                                                                                           |      | B0                           |
|              | Yes ticked or Cannot tell ticked or more than one box ticked                                                                   |      | B0                           |

| Q            | Answer                                                                                                                                                                                                                                | Mark | Comments                                                             |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------|
| <b>14(a)</b> | $30 \div 0.15 = 200$<br>or<br>$0.15 \times 200 = 30$<br>or<br>$15(\%) \times 20 \div 3 = 100(\%)$ and<br>$30 \times 20 \div 3 = 200$<br>or<br>$(200 - 30) \div (1 - 0.15) = 200$<br>or<br>$30 + 30 \div 0.15 \times (1 - 0.15) = 200$ | B1   | oe<br>eg $30 \div 15 \times 100 = 200$<br>eg $\frac{30}{200} = 0.15$ |

| Q     | Answer                                                                                                                  | Mark  | Comments                                                                    |
|-------|-------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------|
| 14(b) | <b>Alternative method 1</b>                                                                                             |       |                                                                             |
|       | $30 + n + 50 + 3n + 2n = 200$<br>or $n + 50 + 3n + 2n = 170$<br>or $6n = 200 - 30 - 50$<br>or $6n = 170 - 50$           | M1    | oe                                                                          |
|       | $6n = 120$ or $n = 20$                                                                                                  | M1dep |                                                                             |
|       | their $20 \times 2$ or 40                                                                                               | M1dep |                                                                             |
|       | $\frac{40}{200}$                                                                                                        | A1    | oe fraction, decimal or percentage                                          |
|       | <b>Alternative method 2</b>                                                                                             |       |                                                                             |
|       | $200 - 30 - 50$ or 120                                                                                                  | M1    |                                                                             |
|       | their $120 \div 6$ or 20                                                                                                | M1dep |                                                                             |
|       | their $20 \times 2$ or 40                                                                                               | M1dep |                                                                             |
|       | $\frac{40}{200}$                                                                                                        | A1    | oe fraction, decimal or percentage                                          |
|       | <b>Alternative method 3</b>                                                                                             |       |                                                                             |
|       | $0.15 + r + 0.25 + 3r + 2r = 1$<br>or $r + 0.25 + 3r + 2r = 0.85$<br>or $6r = 1 - 0.15 - 0.25$<br>or $6r = 0.85 - 0.25$ | M1    | oe<br>$r$ stands for relative frequency – accept any letter and condone $n$ |
|       | $6r = 0.6$ or $r = 0.1$                                                                                                 | M1dep | oe                                                                          |
|       | their $0.1 \times 2$                                                                                                    | M1dep |                                                                             |
|       | 0.2                                                                                                                     | A1    | oe fraction, decimal or percentage                                          |
|       | <b>Additional Guidance</b>                                                                                              |       |                                                                             |
|       | Ignore an incorrect simplification or conversion following a correct answer seen                                        |       |                                                                             |

| Q  | Answer                                                                                                                                            | Mark  | Comments                                                                                                 |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------|
| 15 | $3x - cx = 5 - a$<br>or<br>$a - 5 = cx - 3x$                                                                                                      | M1    |                                                                                                          |
|    | $x(3 - c) = 5 - a$<br>or<br>$a - 5 = x(c - 3)$<br>or<br>$\frac{5 - a}{3 - c}$<br>or<br>$\frac{a - 5}{c - 3}$                                      | M1dep | oe single fraction                                                                                       |
|    | $x = \frac{5 - a}{3 - c}$<br>or<br>$x = \frac{a - 5}{c - 3}$                                                                                      | A1    | oe single fraction with $x =$ or $= x$<br><br>SC1 $x = \frac{5 + a}{3 - c}$ or $x = \frac{5 - a}{3 + c}$ |
|    | <b>Additional Guidance</b>                                                                                                                        |       |                                                                                                          |
|    | Must have $x =$ or $= x$ but allow this to be in the working<br>eg $\frac{5 - a}{3 - c}$ on answer line, but $x = \frac{5 - a}{3 - c}$ in working |       | M1M1A1                                                                                                   |

| Q  | Answer                                                       | Mark  | Comments |
|----|--------------------------------------------------------------|-------|----------|
| 16 | $100(\%) - 55(\%)$ or $45(\%)$<br>or<br>$1 - 0.55$ or $0.45$ | M1    |          |
|    | $\frac{1170}{0.45}$                                          | M1dep | oe       |
|    | 2600                                                         | A1    |          |

| Q  | Answer                          | Mark | Comments |
|----|---------------------------------|------|----------|
| 17 | $x \geq 1, x + y < 5, y \geq 2$ | B1   |          |

| Q     | Answer                                                                                                                         | Mark | Comments                                                                                 |
|-------|--------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------|
| 18(a) | Points plotted at upper class boundaries                                                                                       | B1   | must be increasing<br>$\pm \frac{1}{2}$ square                                           |
|       | Points at correct cf values and smooth curve or polygon                                                                        | B1ft | ft from consistently plotted points<br>must be increasing and not a single straight line |
|       | <b>Additional Guidance</b>                                                                                                     |      |                                                                                          |
|       | A fully correct graph should start at (40, 0) or (50, 8) and end at $m = 80$ unless continued by a horizontal line             |      |                                                                                          |
|       | Points plotted at lower class boundaries or midpoints, but with correct cf values and smooth curve or polygon for their points |      | B0B1ft                                                                                   |
|       | Bars drawn without correct curve                                                                                               |      | B0B0                                                                                     |
|       | Bars drawn with cumulative frequency diagram                                                                                   |      | Mark diagram                                                                             |

| Q     | Answer                                                                                                         | Mark | Comments                                                                                                                                                                                              |
|-------|----------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18(b) | <b>Alternative method 1</b>                                                                                    |      |                                                                                                                                                                                                       |
|       | Vertical line drawn from 56 to curve or polygon                                                                | M1   | their curve or polygon must be increasing up to 60<br>implied by correct reading for their curve or polygon or mark at correct place on curve or polygon or vertical axis<br>$\pm \frac{1}{2}$ square |
|       | Correct value for 70 – their reading                                                                           | A1ft | ft their curve or polygon which must be increasing up to 60<br>answer must be an integer                                                                                                              |
|       | <b>Alternative method 2</b>                                                                                    |      |                                                                                                                                                                                                       |
|       | $8 + \frac{6}{10} \times (43 - 8)$ or $8 + 21$<br>or $43 - \frac{4}{10} \times (43 - 8)$ or $43 - 14$<br>or 29 | M1   | oe method leading to 29 or 41<br>eg $4 + 23 + \frac{4}{10} \times 35$                                                                                                                                 |
|       | 41                                                                                                             | A1   |                                                                                                                                                                                                       |

| Q  | Answer                      | Mark  | Comments |
|----|-----------------------------|-------|----------|
| 19 | <b>Alternative method 1</b> |       |          |
|    | $3 = k \div 2$ or $(k =) 6$ | M1    |          |
|    | their $6 \div 0.2$          | M1dep |          |
|    | 30                          | A1    |          |
|    | <b>Alternative method 2</b> |       |          |
|    | $2 \div 0.2$ or 10          | M1    |          |
|    | $3 \times$ their 10         | M1dep |          |
|    | 30                          | A1    |          |

| Q  | Answer                                          | Mark | Comments |
|----|-------------------------------------------------|------|----------|
| 20 | $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ | B1   |          |

| Q  | Answer                                         | Mark | Comments                                |
|----|------------------------------------------------|------|-----------------------------------------|
| 21 | $7x^2 - 3x^5$                                  | M1   |                                         |
|    | $14x$ or $-15x^4$                              | M1   | oe eg $2 \times 7x$ or $5 \times -3x^4$ |
|    | $14x - 15x^4$ or $x(14 - 15x^3)$               | A1   |                                         |
|    | <b>Additional Guidance</b>                     |      |                                         |
|    | Accept correct use of quotient or product rule |      |                                         |

| Q  | Answer                                                                        | Mark | Comments            |  |
|----|-------------------------------------------------------------------------------|------|---------------------|--|
| 22 | False<br>Cannot tell<br>True<br>Cannot tell                                   | B4   | B1 each correct row |  |
|    | Additional Guidance                                                           |      |                     |  |
|    | Allow a cross if it is the only answer in that row                            |      |                     |  |
|    | If a combination of ticks and crosses are used in a row then mark the tick(s) |      |                     |  |

| Q  | Answer                                                   | Mark | Comments                     |
|----|----------------------------------------------------------|------|------------------------------|
| 23 | $2 \times \pi \times 3.6 \times \frac{20}{360}$          | M1   | oe                           |
|    | [1.25, 1.26] or 1.3 or $0.4\pi$                          | A1   | oe implied by correct answer |
|    | [8.45, 8.46] or 8.5                                      | A1   |                              |
|    | <b>Additional Guidance</b>                               |      |                              |
|    | $\frac{2}{5}\pi + \frac{36}{5}$ or $\frac{2\pi + 36}{5}$ |      | M1A1A0                       |

| Q  | Answer                                                                                                       | Mark  | Comments                                   |
|----|--------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------|
| 24 | <b>Alternative method 1</b>                                                                                  |       |                                            |
|    | (Gradient $TW =$ ) $\frac{5-3}{6}$ or $\frac{1}{3}$                                                          | M1    | oe                                         |
|    | (Gradient $UW =$ ) $\frac{-1}{\text{their } \frac{1}{3}}$ or $-3$                                            | M1    | oe                                         |
|    | $y - 5 = \text{their} - 3(x - 6)$<br>or $y = \text{their} - 3x + 23$<br>or $y - 5 = \text{their} - 3(0 - 6)$ | M1dep | oe<br>dep on using perpendicular gradients |
|    | 23                                                                                                           | A1    |                                            |
|    | <b>Alternative method 2</b>                                                                                  |       |                                            |
|    | $(UTW =) \tan^{-1}\left(\frac{6}{5-3}\right)$<br>or [71.5, 71.6]                                             | M1    |                                            |
|    | $(TW =) \sqrt{6^2 + (5-3)^2}$ or $\sqrt{40}$                                                                 | M1    |                                            |
|    | $\cos(\text{their } 71.56) = \frac{\text{their } \sqrt{40}}{TU}$<br>or $(TU =) 20$                           | M1dep | dep on M2                                  |
|    | 23                                                                                                           | A1    |                                            |
|    | <b>Additional Guidance</b>                                                                                   |       |                                            |
|    | (0, 23)                                                                                                      |       | M1M1M1A1                                   |

| Q     | Answer                                                                                                                                                                                                                                                        | Mark  | Comments                                                                                                                                      |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 25(a) | $\frac{x(x-16) + (x+1)(2x+5)}{x(x+1)}$                                                                                                                                                                                                                        | M1    | allow numerator only<br>accept $x^2 + x$ for denominator<br>accept two separate terms                                                         |
|       | $x^2 - 16x$<br>or $2x^2 + 2x + 5x + 5$ or $2x^2 + 7x + 5$                                                                                                                                                                                                     | M1dep |                                                                                                                                               |
|       | $\frac{x^2 - 16x + 2x^2 + 2x + 5x + 5}{x(x+1)}$<br>$= \frac{3x^2 - 9x + 5}{x(x+1)}$                                                                                                                                                                           | A1    | accept left hand side as separate terms<br>accept $x^2 + x$ for $x(x+1)$ on left hand side<br>accept $2x^2 + 7x + 5$ for $2x^2 + 2x + 5x + 5$ |
|       | <b>Additional Guidance</b>                                                                                                                                                                                                                                    |       |                                                                                                                                               |
|       | Allow the numerator to be fully simplified separately as $3x^2 - 9x + 5$ for up to 3 marks, eg<br>$\frac{x(x-16) + (x+1)(2x+5)}{x(x+1)}$<br>(numerator $\Rightarrow$ ) $x^2 - 16x + 2x^2 + 2x + 5x + 5 = 3x^2 - 9x + 5$<br>$P = \frac{3x^2 - 9x + 5}{x(x+1)}$ |       | M1M1A1                                                                                                                                        |
|       | $\frac{x(x-16) + (x+1)(2x+5)}{x(x+1)}$<br>$= x^2 - 16x + 2x^2 + 2x + 5x + 5$<br>$= \frac{3x^2 - 9x + 5}{x(x+1)}$ (no denominator on previous line and numerator not fully simplified)                                                                         |       | M1M1A0                                                                                                                                        |
|       | $x(x-16) + (x+1)(2x+5)$<br>$x^2 - 16x + 2x^2 + 2x + 5x + 5 = 3x^2 - 9x + 5$<br>$P = \frac{3x^2 - 9x + 5}{x(x+1)}$ (no denominator seen in working)                                                                                                            |       | M1M1A0                                                                                                                                        |

| Q     | Answer                                                                                                                                                                                    | Mark  | Comments |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 25(b) | $3x^2 - 9x + 5 = 0$                                                                                                                                                                       | M1    |          |
|       | $\frac{- -9 \pm \sqrt{(-9)^2 - 4 \times 3 \times 5}}{2 \times 3}$ or $\frac{3}{2} \pm \sqrt{\left(\frac{3}{2}\right)^2 - \frac{5}{3}}$<br>or 2.26... or 2.3<br>or 0.736... or 0.74 or 0.7 | M1dep | oe       |
|       | $\frac{9 \pm \sqrt{21}}{6}$ or<br>2.26... or 2.3<br>and<br>0.736... or 0.74 or 0.7                                                                                                        | A1    | oe       |
|       | <b>Additional Guidance</b>                                                                                                                                                                |       |          |
|       | 2.3 and/or 0.7 and 0 and/or -1                                                                                                                                                            |       | M1M1A0   |
|       | $3x^2 - 9x + 5 = 0$ and $x(x + 1) = 0$                                                                                                                                                    |       | M1       |
|       | $\frac{3x^2 - 9x + 5}{x(x + 1)} = 0$ or $x(x + 1) = 0$ with no other valid work                                                                                                           |       | M0M0A0   |

| Q  | Answer                     | Mark  | Comments                    |
|----|----------------------------|-------|-----------------------------|
| 26 | $CAD = w$ or $ACD = 33$    | M1    | may be indicated on diagram |
|    | $33 + w + 2w = 180$        | M1dep | oe                          |
|    | 49                         | A1    |                             |
|    | <b>Additional Guidance</b> |       |                             |
|    | Ignore reasons throughout  |       |                             |

| Q  | Answer                                                                                | Mark   | Comments                                                                            |
|----|---------------------------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------|
| 27 | <b>Alternative method 1</b>                                                           |        |                                                                                     |
|    | $x + y = 1$                                                                           | M1     | may be implied                                                                      |
|    | $3x = -1$ or $x = -\frac{1}{3}$<br>or<br>$3y = 4$ or $y = \frac{4}{3}$                | M1     | oe<br>a correct equation in one variable from their linear equations                |
|    | $x = -\frac{1}{3}$ and $y = \frac{4}{3}$                                              | A1     | oe                                                                                  |
|    | <b>Alternative method 2</b>                                                           |        |                                                                                     |
|    | $3^{x+2x+2} = 3$ or $3^{\frac{y}{2}-1+y} = 3$                                         | M1     | oe<br>a correct substitution from the linear equation into the exponential equation |
|    | $x + 2x + 2 = 1$<br>or $\frac{y}{2} - 1 + y = 1$                                      | M1     | oe<br>a correct linear equation in x or y by equating their power to 1              |
|    | $x = -\frac{1}{3}$ and $y = \frac{4}{3}$                                              | A1     | oe                                                                                  |
|    | <b>Additional Guidance</b>                                                            |        |                                                                                     |
|    | $x + 2x + 2 = 1$                                                                      | M1M1   |                                                                                     |
|    | $x + y = 0$ and then $3x = -2$ or $x = -\frac{2}{3}$ or $3y = 2$ or $y = \frac{2}{3}$ | M0M1A0 |                                                                                     |
|    | $x + y = 3$ and then $3x = 1$ or $x = \frac{1}{3}$ or $3y = 8$ or $y = \frac{8}{3}$   | M0M1A0 |                                                                                     |

| Q  | Answer                                                     | Mark | Comments                                                                                                                                                                                                           |
|----|------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28 | $\sin FAC = \frac{15}{27}$<br>or $\sin^{-1} \frac{15}{27}$ | M1   | allow any letter<br>oe eg $\tan FAC = \frac{15}{\sqrt{27^2 - 15^2}}$<br>or $\cos FAC = \frac{\sqrt{27^2 - 15^2}}{27}$<br>or $\cos FAC = \frac{27^2 + (27^2 - 15^2) - 15^2}{2 \times 27 \times \sqrt{27^2 - 15^2}}$ |
|    | [33.7, 33.75] or 34                                        | A1   |                                                                                                                                                                                                                    |
|    | <b>Additional Guidance</b>                                 |      |                                                                                                                                                                                                                    |
|    | Accept $\sin FAC = \frac{15 \sin 90}{27}$ for M mark       |      | M1                                                                                                                                                                                                                 |
|    | Answer in range seen followed by 33                        |      | M1A1                                                                                                                                                                                                               |
|    | 33 with no correct working                                 |      | M0A0                                                                                                                                                                                                               |

| Q  | Answer                                                                                                                       | Mark  | Comments                                                                                                              |
|----|------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------|
| 29 | <b>Alternative method 1</b>                                                                                                  |       |                                                                                                                       |
|    | $n^2$ and $(n + 1)^2$                                                                                                        | M1    | accept any letter                                                                                                     |
|    | $n^2 + n^2 + n + n + 1$<br>or $n^2 + n^2 + 2n + 1$<br>or $2n^2 + 2n + 1$<br>or $2n(n + 1) + 1$<br>or $2(n^2 + n) + 1$        | A1    |                                                                                                                       |
|    | Full explanation that the correct expression is always odd<br>eg $2n(n + 1)$ is always even so $2n(n + 1) + 1$ is always odd | A1    | for $n^2 + n^2 + n + n + 1$ or $n^2 + n^2 + 2n + 1$ a full explanation must consider $n$ being even and $n$ being odd |
|    | <b>Alternative method 2</b>                                                                                                  |       |                                                                                                                       |
|    | If $n$ is odd then $n + 1$ is even<br>and<br>if $n$ is even then $n + 1$ is odd                                              | M1    |                                                                                                                       |
|    | odd squared is odd<br>and<br>even squared is even                                                                            | M1dep |                                                                                                                       |
|    | odd + even = odd                                                                                                             | A1    |                                                                                                                       |
|    | <b>Additional Guidance</b>                                                                                                   |       |                                                                                                                       |
|    | Accept the use of other expressions for consecutive numbers<br>eg $(n + 1)^2$ and $(n + 2)^2$                                |       |                                                                                                                       |
|    | Evaluating sum of squares of consecutive numbers with no other relevant working                                              |       | M0                                                                                                                    |

| Q  | Answer            | Mark | Comments |
|----|-------------------|------|----------|
| 30 | $a^{\frac{3}{2}}$ | B1   |          |

| Q  | Answer                                                                                                                                                                                                                                                                                                                                                                                          | Mark  | Comments                                         |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------|
| 31 | <b>Alternative method 1 Working with 0.84...</b>                                                                                                                                                                                                                                                                                                                                                |       |                                                  |
|    | $10x = 8.44(4\dots)$<br>or $100x = 84.44(4\dots)$                                                                                                                                                                                                                                                                                                                                               | M1    | oe multiplication by a power of 10<br>any letter |
|    | $10x - x = 8.44(4\dots) - 0.84(4\dots)$<br>or $9x = 7.6$<br>with $x = 0.84(4\dots)$<br>and $10x = 8.44(4\dots)$ seen<br>or<br>$100x - 10x = 84.44(4\dots) - 8.44(4\dots)$<br>or $90x = 76$<br>with $10x = 8.44(4\dots)$<br>and $100x = 84.44(4\dots)$ seen<br>or<br>$100x - x = 84.44(4\dots) - 0.844(4\dots)$<br>or $99x = 83.6$<br>with $x = 0.84(4\dots)$<br>and $100x = 84.44(4\dots)$ seen | M1dep | oe subtraction to eliminate recurring digits     |
|    | $\frac{38}{45}$ with M2 seen                                                                                                                                                                                                                                                                                                                                                                    | A1    |                                                  |

**Alternative method and Additional Guidance on the next page**

|            |                                                                                                                                                                                                                                                                                                                                                                                          |          |                                                  |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------|
| 31<br>cont | <b>Alternative method 2 Working with 0.04...</b>                                                                                                                                                                                                                                                                                                                                         |          |                                                  |
|            | $10x = 0.44(4\dots)$<br>or $100x = 4.44(4\dots)$                                                                                                                                                                                                                                                                                                                                         | M1       | oe multiplication by a power of 10<br>any letter |
|            | $10x - x = 0.44(4\dots) - 0.04(4\dots)$<br>or $9x = 0.4$<br>with $x = 0.04(4\dots)$<br>and $10x = 0.44(4\dots)$ seen<br>or<br>$100x - 10x = 4.44(4\dots) - 0.44(4\dots)$<br>or $90x = 4$<br>with $10x = 0.44(4\dots)$<br>and $100x = 4.44(4\dots)$ seen<br>or<br>$100x - x = 4.44(4\dots) - 0.04(4\dots)$<br>or $99x = 4.4$<br>with $x = 0.04(4\dots)$<br>and $100x = 4.44(4\dots)$ seen | M1dep    | oe subtraction to eliminate recurring digits     |
|            | $\frac{0.4}{9} + \frac{8}{10} = \frac{38}{45}$<br>or<br>$\frac{4}{90} + \frac{8}{10} = \frac{38}{45}$<br>or<br>$\frac{4.4}{99} + \frac{8}{10} = \frac{38}{45}$                                                                                                                                                                                                                           | A1       | working for M2 must be shown                     |
|            | <b>Additional Guidance</b>                                                                                                                                                                                                                                                                                                                                                               |          |                                                  |
|            | Use of $x$ may be implied<br>eg $10 \times 0.844(4\dots) = 10.84(4\dots)$<br>$9 \times 0.844(4\dots) = 7.6$                                                                                                                                                                                                                                                                              | M1<br>M1 |                                                  |
|            | In alt 2 when awarding the A mark accept equivalent fractions for $\frac{0.4}{9}$ or $\frac{4}{90}$ or $\frac{4.4}{99}$                                                                                                                                                                                                                                                                  |          |                                                  |

| Q     | Answer                                                                                                                                 | Mark  | Comments                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------|
| 32(a) | Alternative method 1                                                                                                                   |       |                                                     |
|       | $M = \frac{416}{d^2}$                                                                                                                  | M1    | oe equation<br>implied by $6.5 = \frac{k}{d^2}$ oe  |
|       | $(k =) 6.5 \times 8^2$ or $(k =) 416$                                                                                                  | M1dep | oe                                                  |
|       | $M = \frac{416}{d^2}$                                                                                                                  | A1    | oe equation                                         |
|       | Alternative method 2                                                                                                                   |       |                                                     |
|       | $cM = \frac{1}{d^2}$                                                                                                                   | M1    | oe equation<br>implied by $6.5c = \frac{1}{d^2}$ oe |
|       | $(c =) \frac{1}{8^2} \div 6.5$ or $(c =) \frac{1}{416}$                                                                                | M1dep | oe                                                  |
|       | $\frac{1}{416}M = \frac{1}{d^2}$                                                                                                       | A1    | oe equation                                         |
|       | Additional Guidance                                                                                                                    |       |                                                     |
|       | $\frac{416}{d^2}$ on answer line with $M =$ seen in working                                                                            |       | M1M1A1                                              |
|       | Alt 1 $(k =) 416$ or $(k \propto) 416$ with no incorrect working                                                                       |       | M1M1                                                |
|       | Condone use of $\propto$ for up to M1M1A0<br>eg (Alt 1)<br>$M \propto \frac{k}{d^2}$<br>$k \propto 416$<br>$M \propto \frac{416}{d^2}$ |       | M1<br><br>M1dep<br><br>A0                           |

| Q     | Answer                                                                    | Mark | Comments                                                                                                      |
|-------|---------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------|
| 32(b) | <b>Alternative method 1</b>                                               |      |                                                                                                               |
|       | $4.8 = \frac{416}{d^2}$ or $4.8 = \frac{\text{their } k}{d^2}$            | M1   | oe<br>ft their $k$ if equation in (a) of the form<br>$M = \frac{k}{d^2}$                                      |
|       | [9.3, 9.31] or $\frac{2\sqrt{195}}{3}$                                    | A1ft | oe<br>ft $\sqrt{\frac{\text{their } k}{4.8}}$ if equation in (a) of the form<br>$M = \frac{k}{d^2}$           |
|       | <b>Alternative method 2</b>                                               |      |                                                                                                               |
|       | $\frac{4.8}{416} = \frac{1}{d^2}$ or their $c \times 4.8 = \frac{1}{d^2}$ | M1   | oe<br>ft their $c$ if equation in (a) of the form<br>$cM = \frac{1}{d^2}$                                     |
|       | [9.3, 9.31] or $\frac{2\sqrt{195}}{3}$                                    | A1ft | oe<br>ft $\sqrt{\frac{1}{\text{their } c \times 4.8}}$ if equation in (a) of the<br>form $cM = \frac{1}{d^2}$ |
|       | <b>Additional Guidance</b>                                                |      |                                                                                                               |
|       | Accept answers with $\pm$<br>eg $\pm 9.3$                                 | M1A1 |                                                                                                               |
|       | $d \propto 9.3$                                                           | M1A0 |                                                                                                               |

| Q  | Answer                                                                                                                                                   | Mark  | Comments                      |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------|
| 33 | <b>Alternative method 1</b>                                                                                                                              |       |                               |
|    | $\frac{30}{60} \times 25$ or 12.5<br>and<br>$\frac{30}{60} \times 18$ or 9                                                                               | M1    | oe                            |
|    | (their 12.5) <sup>2</sup> + (their 9) <sup>2</sup> –<br>2 × their 12.5 × their 9 × cos 45<br>or<br>[78, 78.2]                                            | M1dep | oe                            |
|    | $\sqrt{\text{their [78, 78.2]}}$                                                                                                                         | M1dep |                               |
|    | [8.8, 8.9]                                                                                                                                               | A1    | accept 9 from correct working |
|    | <b>Alternative method 2</b>                                                                                                                              |       |                               |
|    | $25^2 + 18^2 - 2 \times 25 \times 18 \times \cos 45$<br>or<br>[312.6, 313]                                                                               | M1    | oe                            |
|    | $\sqrt{\text{their [312.6, 313]}}$<br>or<br>[17.6, 17.7]                                                                                                 | M1dep |                               |
|    | their [17.6, 17.7] × $\frac{30}{60}$                                                                                                                     | M1dep | oe                            |
|    | [8.8, 8.9]                                                                                                                                               | A1    | accept 9 from correct working |
|    | <b>Additional Guidance</b>                                                                                                                               |       |                               |
|    | Other methods to work out [78, 78.2] in alt 1 or [312.6, 313] in alt 2, eg using two right angled triangles, are acceptable but must be complete methods |       |                               |
|    | 9 with no working                                                                                                                                        |       | M0                            |

| Q  | Answer                                                                                                                                                                                                              | Mark  | Comments                                                                |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------|
| 34 | $\frac{21+\sqrt{7}}{3-\sqrt{7}} \times \frac{3+\sqrt{7}}{3-\sqrt{7}}$                                                                                                                                               | M1    | may be implied by the second mark                                       |
|    | $63 + 21\sqrt{7} + 3\sqrt{7} + 7$<br>or $63 + 24\sqrt{7} + 7$<br>or $70 + 21\sqrt{7} + 3\sqrt{7}$<br>and<br>$9(+3\sqrt{7} - 3\sqrt{7}) - 7$                                                                         | M1dep | accept $3^2$ for 9                                                      |
|    | $\frac{63 + 21\sqrt{7} + 3\sqrt{7} + 7}{9 - 7}$ and $35 + 12\sqrt{7}$<br>or<br>$\frac{63 + 24\sqrt{7} + 7}{9 - 7}$ and $35 + 12\sqrt{7}$<br>or<br>$\frac{70 + 21\sqrt{7} + 3\sqrt{7}}{9 - 7}$ and $35 + 12\sqrt{7}$ | A1    | allow $a = 35$ and $b = 12$ for $35 + 12\sqrt{7}$<br>accept $3^2$ for 9 |
|    | <b>Additional Guidance</b>                                                                                                                                                                                          |       |                                                                         |
|    | Further working eg $35 + 12\sqrt{7} = 47\sqrt{7}$                                                                                                                                                                   |       | M1M1A0                                                                  |
|    | Multiplying across to reach $35 + 12\sqrt{7}$ or $a = 35$ and $b = 12$                                                                                                                                              |       | M0M0A0                                                                  |

| Q  | Answer                                                                                      | Mark | Comments                                           |
|----|---------------------------------------------------------------------------------------------|------|----------------------------------------------------|
| 35 | <b>Alternative method 1</b>                                                                 |      |                                                    |
|    | $(\vec{RQ} =) -2\mathbf{b} + 2\mathbf{a}$                                                   | M1   | oe                                                 |
|    | $(\vec{RX} =) -2\mathbf{b} + (5\mathbf{a} - 3\mathbf{b})$<br>or $5\mathbf{a} - 5\mathbf{b}$ | M1   | oe                                                 |
|    | $\frac{5}{2}$                                                                               | A1   | oe                                                 |
|    | <b>Alternative method 2</b>                                                                 |      |                                                    |
|    | $(\vec{RQ} =) -2\mathbf{b} + 2\mathbf{a}$                                                   | M1   | oe                                                 |
|    | $(\vec{QX} =) -2\mathbf{a} + 5\mathbf{a} - 3\mathbf{b}$<br>or $3\mathbf{a} - 3\mathbf{b}$   | M1   | oe                                                 |
|    | $\frac{5}{2}$                                                                               | A1   | oe                                                 |
|    | <b>Alternative method 3</b>                                                                 |      |                                                    |
|    | $(\vec{PX} =) 2\mathbf{b} + k(2\mathbf{a} - 2\mathbf{b})$                                   | M1   | oe                                                 |
|    | $5 = 2k$<br>or<br>$2 - 2k = -3$                                                             | M1   | oe<br>equates coefficients of <b>a</b> or <b>b</b> |
|    | $\frac{5}{2}$                                                                               | A1   | oe                                                 |
|    | <b>Additional Guidance</b>                                                                  |      |                                                    |
|    | Accept consistent use of $\vec{QR}$ and $\vec{XR}$ for the first two marks                  |      |                                                    |