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# GCSE MATHEMATICS 8300/1H

Higher Tier Paper 1 Non-Calculator

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Mark scheme

November 2022

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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.

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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>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.                                                                      |

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

**Questions which ask students to show working**

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

**Questions which do not ask students to show working**

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

**Misread or miscopy**

Students often copy values from a question incorrectly. If the examiner thinks that the student 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 student intended it to be a decimal point.

| Q | Answer         | Mark | Comment |
|---|----------------|------|---------|
| 1 | $\frac{28}{9}$ | B1   |         |

| Q | Answer | Mark | Comment |
|---|--------|------|---------|
| 2 | 36     | B1   |         |

| Q | Answer           | Mark | Comment |
|---|------------------|------|---------|
| 3 | $\frac{3}{1000}$ | B1   |         |

| Q | Answer             | Mark | Comment |
|---|--------------------|------|---------|
| 4 | $3x \equiv x + 2x$ | B1   |         |

| Q | Answer                                                                                         | Mark  | Comments                                                |
|---|------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------|
| 5 | 3 + 7 or 10                                                                                    | M1    | implied by 10 symbols or 6.2                            |
|   | 62 ÷ their 10 × 3<br>or 6.2 × 3 or 18.6<br>or<br>62 ÷ their 10 × 7<br>or 6.2 × 7 or 43.4       | M1dep | oe full method to work out either number                |
|   | 18.6 or $\frac{93}{5}$ or $18\frac{3}{5}$<br>and<br>43.4 or $\frac{217}{5}$ or $43\frac{2}{5}$ | A1    | oe decimals, fractions or mixed numbers<br>either order |
|   | <b>Additional Guidance</b>                                                                     |       |                                                         |
|   | 18.6 and 43.4 in working, but truncated or rounded to 18 or 19 and 43<br>on the answer line    |       | M1M1A1                                                  |
|   | 62 = 10x                                                                                       |       | M1                                                      |
|   | $\frac{x}{62} = \frac{3}{10}$ or $\frac{y}{62} = \frac{7}{10}$                                 |       | M1                                                      |

| Q | Answer                                             | Mark | Comments                            |
|---|----------------------------------------------------|------|-------------------------------------|
| 6 | Definitely true<br>Cannot be true<br>Might be true | B3   | B1 for each<br>any clear indication |
|   | <b>Additional Guidance</b>                         |      |                                     |
|   | Only a cross in a row, mark the cross              |      |                                     |
|   | A tick and cross(es) in a row – mark the tick      |      |                                     |
|   | More than one tick in a row scores B0 for that row |      |                                     |

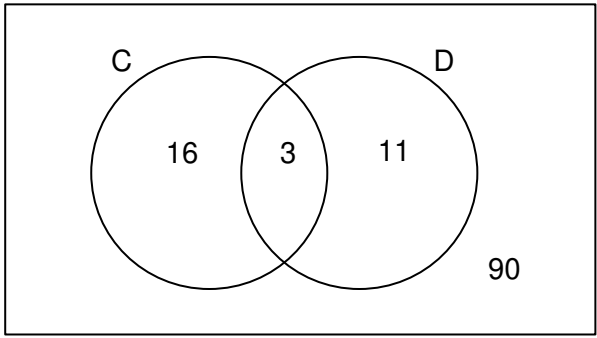
| Q    | Answer                                  | Mark | Comments                                                                                                                                                                                             |
|------|-----------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7(a) | $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$ | B2   | B1 $\begin{pmatrix} 4 \\ \dots \end{pmatrix}$ or $\begin{pmatrix} \dots \\ -1 \end{pmatrix}$<br>or (4, -1)<br>SC1 $\begin{pmatrix} -4 \\ 1 \end{pmatrix}$ or $\begin{pmatrix} -1 \\ 4 \end{pmatrix}$ |
|      | <b>Additional Guidance</b>              |      |                                                                                                                                                                                                      |
|      | Ignore fraction lines                   |      |                                                                                                                                                                                                      |

| Q    | Answer                                                                                                                                           | Mark | Comments |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 7(b) | $\begin{pmatrix} 12 \\ 8 \end{pmatrix}$                                                                                                          | B1   |          |
|      | <b>Additional Guidance</b>                                                                                                                       |      |          |
|      | $4\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ or $\begin{pmatrix} 12 \\ 8 \end{pmatrix}$ in working with answer $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ |      | B0       |
|      | Ignore fraction lines                                                                                                                            |      |          |

| Q    | Answer                                  | Mark | Comments |
|------|-----------------------------------------|------|----------|
| 7(c) | $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$ | B1   |          |

| Q | Answer                                                                                                                           | Mark | Comments                                                                                                                                                                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8 | Valid common denominator for subtraction with at least one numerator correct                                                     | M1   | eg $\frac{21}{30} - \frac{8}{30}$ or $\frac{13}{30}$<br>or $\frac{105}{150} - \frac{40}{150}$ or $\frac{65}{150}$<br>condone decimals in numerator(s)                                                                                                                                           |
|   | their $\frac{13}{30} \times \frac{3}{2}$<br>or $\frac{\text{their } 13 \div 2}{\text{their } 30 \div 3}$                         | M1   | oe product<br>their $\frac{13}{30}$ can be any single fraction, mixed number or decimal other than<br>their $\frac{13}{30}$ inverted or $\frac{7}{10}$ or $\frac{4}{15}$<br>condone decimals in numerator(s)<br><br>correct answer not in correct fraction form eg $\frac{6.5}{10}$ scores M1M1 |
|   | $\frac{13}{20}$ or $\frac{39}{60}$                                                                                               | A1   | oe fraction<br>SC2 $\frac{29}{20}$ oe fraction or mixed number                                                                                                                                                                                                                                  |
|   | <b>Additional Guidance</b>                                                                                                       |      |                                                                                                                                                                                                                                                                                                 |
|   | If 10 or 15 is used as the common denominator, both numerators must be correct for the first mark                                |      |                                                                                                                                                                                                                                                                                                 |
|   | Correct fraction in working with incorrectly simplified fraction on answer line                                                  |      | M2A1                                                                                                                                                                                                                                                                                            |
|   | Correct fraction in working with conversion to decimal on answer line                                                            |      | M2A0                                                                                                                                                                                                                                                                                            |
|   | $\frac{65}{150} \div \frac{2}{3} = \frac{32}{50}$<br>$\frac{65}{150} \div \frac{2}{3} = \frac{32.5}{50}$ with no further working |      | M1M0A0<br>M1M1A0                                                                                                                                                                                                                                                                                |

| Q | Answer                                                                                                                                     | Mark | Comments                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------|
| 9 | $\frac{12}{4} \leq x$ or $3 \leq x$<br>or<br>$x < \frac{25}{4}$ or $x < 6.25$ or $x \leq 6$<br>or $x < 7$                                  | M1   | oe<br>fully correct inequality is<br>$\frac{12}{4} \leq x < \frac{25}{4}$<br>or $3 \leq x < 6.25$   |
|   | 3 4 5 6 with no extras                                                                                                                     | A1   | any order<br>SC1 3 4 5 6 with one extra<br>or any three of 3 4 5 6 with no extras<br>or 12 16 20 24 |
|   | <b>Additional Guidance</b>                                                                                                                 |      |                                                                                                     |
|   | Ignore incorrect evaluations of $25 \div 4$ if correct answer is given<br>eg $3 \leq x < 6.5$ and answer 3 4 5 6                           |      | M1A1                                                                                                |
|   | $3 \times 4$ and $4 \times 4$ and $5 \times 4$ and $6 \times 4$ identified as only correct multiplications with no answer given implies M1 |      | M1A0                                                                                                |

| Q  | Answer                                                                                                              | Mark | Comments                                                                         |
|----|---------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------|
| 10 | $120 \div 4 \times 3$ or 90                                                                                         | M1   | oe<br>implied by 90 in the box and outside the circles                           |
|    | 14 + 19 + their 90 – 120<br>or 14 + 19 – 120 ÷ 4 or 3<br>or<br>19 – their 3 in C only<br>and 14 – their 3 in D only | M1   | oe their 90 must be > 87<br><br>$0 < \text{their } 3 < 14$                       |
|    | 16, 3, 11 and 90 in correct positions                                                                               | A1   | SC1 their 4 Venn diagram values total 120, allow a blank intersection to imply 0 |
|    | <b>Additional Guidance</b>                                                                                          |      |                                                                                  |
|    | Allow up to M1M1 for working outside Venn diagram but Venn diagram takes precedence over working                    |      |                                                                                  |
|    | 3 in the intersection with 90 in the box and outside the circles                                                    |      | M1M1                                                                             |
|    | 3 in the intersection with a different number to 90 in the box and outside the circles                              |      | M0M1                                                                             |
|    | $\xi$                           |      | M1M1A1                                                                           |

| Q  | Answer                                                                                                                                                                                                                 | Mark  | Comments                                                                                                                                                                                                   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | $3^{11} (: 3^7)$<br>or<br>$3^6 : 3^2$<br>or<br>$3^5 : 3^{(1)}$<br>or<br>$\frac{a}{3^7}$<br>or<br>$177\,147 : 2187$                                                                                                     | M1    | oe eg $729 : 9$ or $243 : 3$<br>$3^n$ may be implied by a multiplication string of $n$ 3s<br><br>$a$ can be any value other than $3^7$                                                                     |
|    | $\frac{3^{11}}{3^7} (: 1)$<br>or<br>$\frac{3^6}{3^2} (: 1)$ or $3^6 \times 3^{-2} (: 1)$<br>or<br>$\frac{3^5}{3^{(1)}} (: 1)$ or $3^{-1} \times 3^5 (: 1)$<br>or<br>$3^4 (: 1)$<br>or<br>$\frac{177\,147}{2187} (: 1)$ | M1dep | oe left-hand side with one or two components<br>eg $\frac{729}{9} : 1$<br>or<br>$243 \times \frac{1}{3} : 1$<br>allow $(: 1)$ to be $(: 3^0)$<br>$3^n$ may be implied by a multiplication string of $n$ 3s |
|    | 81 : 1                                                                                                                                                                                                                 | A1    |                                                                                                                                                                                                            |
|    | <b>Additional Guidance</b>                                                                                                                                                                                             |       |                                                                                                                                                                                                            |
|    | $\frac{3^6 \times 3^5}{3^7} (: 1)$ with no further work                                                                                                                                                                |       | M1M0A0                                                                                                                                                                                                     |
|    | 81 : 1 or $3^4 (: 1)$ could be seen from incorrect working<br>eg $\frac{9^{11}}{3^7} = 3^4$ Answer 81 : 1                                                                                                              |       | M1M0A0                                                                                                                                                                                                     |

| Q  | Answer  | Mark | Comments |
|----|---------|------|----------|
| 12 | 11 : 10 | B1   |          |

| Q  | Answer         | Mark | Comment |
|----|----------------|------|---------|
| 13 | $0.789\dot{7}$ | B1   |         |

| Q  | Answer                                                | Mark | Comment                                                                                                                               |
|----|-------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------|
| 14 | Explanation that the ratio and graph do not match     | B1   | eg<br>This is the graph of $y = 2x$ , not $y = \frac{1}{2}x$<br>This is the graph of $x : y = 1 : 2$<br>It should go through (3, 1.5) |
|    | Explanation that the domain of the graph is incorrect | B1   | eg<br>The graph goes from $x = 0$ , not $x = -3$                                                                                      |
|    | <b>Additional Guidance</b>                            |      |                                                                                                                                       |
|    | 3 : 6 is 1 : 2                                        |      | B1                                                                                                                                    |
|    | (3, 6) doesn't work                                   |      | B1                                                                                                                                    |
|    | The gradient is 2, not $\frac{1}{2}$                  |      | B1                                                                                                                                    |
|    | He got $x$ and $y$ mixed up                           |      | B1                                                                                                                                    |
|    | His graph is not going up in the ratio 2 : 1          |      | B0                                                                                                                                    |
|    | The gradient is 2                                     |      | B0                                                                                                                                    |
|    | He didn't follow the ratio                            |      | B0                                                                                                                                    |
|    | The graph doesn't have negative numbers               |      | B1                                                                                                                                    |
|    | There are no minuses                                  |      | B1                                                                                                                                    |
|    | It doesn't go from -3 to 3                            |      | B1                                                                                                                                    |
|    | The axes should be the same length                    |      | B0                                                                                                                                    |

| Q  | Answer                                                                                                            | Mark | Comment                                                                             |
|----|-------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------|
| 15 | $6x^2 + 8x - 15x - 20$<br>or $6x^2 - 7x - 20$                                                                     | M1   | allow 4 terms with 3 correct<br>or $6x^2 - 7x + k$ , where $k$ is a non-zero number |
|    | $-11x^2 + 22x$<br>or<br>$5x^2 - 15x - 5$                                                                          | M1   |                                                                                     |
|    | $6x^2 + 8x - 15x - 20$<br>or $6x^2 - 7x - 20$<br>and<br>$-11x^2 + 22x$<br>and<br>$5x^2 - 15x - 5$                 | A1   |                                                                                     |
|    | $6x^2 + 8x - 15x - 20$<br>or $6x^2 - 7x - 20$<br>and<br>$-11x^2 + 22x$<br>and<br>$5x^2 - 15x - 5$<br>and<br>$-25$ | A1   |                                                                                     |
|    | <b>Additional Guidance</b>                                                                                        |      |                                                                                     |
|    | Allow terms seen in a grid                                                                                        |      |                                                                                     |
|    | Sign errors cannot be recovered                                                                                   |      |                                                                                     |
|    | Ignore equating the expression to zero                                                                            |      |                                                                                     |

| Q  | Answer                                                                    | Mark  | Comment                                             |
|----|---------------------------------------------------------------------------|-------|-----------------------------------------------------|
| 16 | $4 = 0^2 + p \times 0 + r$<br>or<br>$r = 4$                               | M1    | oe equation<br>may be implied                       |
|    | $1^2 + p (\times 1) + \text{their } 4 = 3$<br>or $p = -2$                 | M1    | oe equation<br>allow their 4 to be $r$              |
|    | $8^2 + (\text{their } -2) \times 8 + \text{their } 4$<br>or $64 - 16 + 4$ | M1dep | oe<br>dep on M1M1<br>do not allow their 4 to be $r$ |
|    | 52                                                                        | A1    |                                                     |

| Q     | Answer        | Mark | Comment |
|-------|---------------|------|---------|
| 17(a) | 51, 58 and 60 | B1   |         |

| Q     | Answer             | Mark | Comment |
|-------|--------------------|------|---------|
| 17(b) | $160 < h \leq 170$ | B1   |         |

| Q     | Answer                                                                                                                                                                                                                                                                                                  | Mark | Comment                                                                                                                              |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------|
| 17(c) | Points plotted with upper class boundaries and cf values<br>condone (150, 0) omitted or incorrectly plotted for this mark only                                                                                                                                                                          | B1ft | $\pm \frac{1}{2}$ square<br>ft their cumulative frequencies, which must be increasing<br>ignore bars drawn if points clearly plotted |
|       | Smooth curve or polygon                                                                                                                                                                                                                                                                                 | B1ft | ft their 5 or 6 points (point with cf 0 may be omitted)<br>must be increasing and not a single straight line                         |
|       | <b>Additional Guidance</b>                                                                                                                                                                                                                                                                              |      |                                                                                                                                      |
|       | For the second mark,<br>the points must be evenly spaced<br>accept an omission of the point with cf 0, but do not accept an incorrect starting point for the pattern of their points<br>accept a horizontal line drawn from their final point, but do not accept a continuation of the curve or polygon |      |                                                                                                                                      |
|       | Points plotted at lower class boundaries or midpoints, but with correct smooth curve or polygon for their points                                                                                                                                                                                        |      | B0B1                                                                                                                                 |
|       | Bars drawn with correct curve                                                                                                                                                                                                                                                                           |      | B1B1                                                                                                                                 |
|       | Bars drawn without curve but with correct points clearly plotted                                                                                                                                                                                                                                        |      | B1B0                                                                                                                                 |
|       | Bars drawn without correct curve or correct points plotted                                                                                                                                                                                                                                              |      | B0B0                                                                                                                                 |

| Q     | Answer                                                                                                                                                               | Mark | Comment                                                                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17(d) | <b>Alternative method 1</b>                                                                                                                                          |      |                                                                                                                                                                                    |
|       | Vertical line drawn from 176 to curve or polygon                                                                                                                     | M1   | implied by correct reading for their increasing curve or polygon or mark at correct place on their increasing curve or polygon or on the vertical axis<br>$\pm \frac{1}{2}$ square |
|       | Correct value for 60 – their reading<br>or<br>correct value for their 60 – their reading                                                                             | A1ft | ft their increasing curve or polygon<br>answer must be an integer<br>their 60 must be from an increasing curve or polygon                                                          |
|       | <b>Alternative method 2</b>                                                                                                                                          |      |                                                                                                                                                                                    |
|       | $2 + 7 + \frac{4}{10} \times 35$ or $2 + 7 + 14$<br>or<br>$4 + 12 + \frac{6}{10} \times 35$<br>or $4 + 12 + 21$<br>or 37                                             | M1   |                                                                                                                                                                                    |
|       | 23                                                                                                                                                                   | A1   |                                                                                                                                                                                    |
|       | <b>Additional Guidance</b>                                                                                                                                           |      |                                                                                                                                                                                    |
|       | In alternative method 1 condone the curve or polygon drawn only for the required section (170 – 180) as long as the cumulative frequencies are increasing throughout |      |                                                                                                                                                                                    |
|       | Answer 23 not from alternative method 2 must match their graph                                                                                                       |      |                                                                                                                                                                                    |

| Q  | Answer                                                                                                                 | Mark  | Comment                                                                                                                                          |
|----|------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 18 | <b>Alternative method 1 – combining the ratios</b>                                                                     |       |                                                                                                                                                  |
|    | $21 : 35$ and $35 : 20$<br>or $(3 : 5 \text{ and } ) 5 : \frac{20}{7}$<br>or $\frac{21}{5} : 7$ (and $7 : 4$ )         | M1    | oe making the E term common<br>allow as fractions with a common denominator eg $\frac{21}{35}$ and $\frac{20}{35}$                               |
|    | $21 : 35 : 20$<br>or $3 : 5 : \frac{20}{7}$<br>or $\frac{21}{5} : 7 : 4$<br>or $\frac{21/5}{76/5}$ or $\frac{3}{76/7}$ | M1dep | oe<br>allow as integers 21 and 35 and 20 or as fractions with a common denominator<br>eg $\frac{21}{35}$ and $\frac{35}{35}$ and $\frac{20}{35}$ |
|    | $\frac{21}{76}$                                                                                                        | A1    |                                                                                                                                                  |
|    | <b>Alternative method 2 – based on D</b>                                                                               |       |                                                                                                                                                  |
|    | $\frac{5(D)}{3}$ and $\frac{20(D)}{21}$                                                                                | M1    | oe                                                                                                                                               |
|    | $\frac{21(D)}{21} + \frac{35(D)}{21} + \frac{20(D)}{21}$<br>or $\frac{76(D)}{21}$                                      | M1dep | oe with common denominator                                                                                                                       |
|    | $\frac{21}{76}$                                                                                                        | A1    |                                                                                                                                                  |

The mark scheme for Question 18 continues on the next page

|              |                                                                                   |       |                            |
|--------------|-----------------------------------------------------------------------------------|-------|----------------------------|
| 18<br>(cont) | <b>Alternative method 3 – based on E</b>                                          |       |                            |
|              | $\frac{3(E)}{5}$ and $\frac{4(E)}{7}$                                             | M1    | oe                         |
|              | $\frac{21(E)}{35} + \frac{35(E)}{35} + \frac{20(E)}{35}$<br>or $\frac{76(E)}{35}$ | M1dep | oe with common denominator |
|              | $\frac{21}{76}$                                                                   | A1    |                            |
|              | <b>Alternative method 4 – based on F</b>                                          |       |                            |
|              | $\frac{21(F)}{20}$ and $\frac{7(F)}{4}$                                           | M1    | oe                         |
|              | $\frac{21(F)}{20} + \frac{35(F)}{20} + \frac{20(F)}{20}$<br>or $\frac{76(F)}{20}$ | M1dep | oe with common denominator |
|              | $\frac{21}{76}$                                                                   | A1    |                            |
|              | <b>Additional Guidance</b>                                                        |       |                            |
|              | Allow unrounded decimal values throughout                                         |       |                            |

| Q     | Answer                                                                                                                                                                                                                                                              | Mark | Comment                                                                                                                  |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------|
| 19(a) | $\left(\frac{4}{5}\right)^2$ or $\frac{4^2}{5^2}$ or $\left(\frac{25}{16}\right)^{-1}$<br>or $\frac{1}{\left(\frac{5}{4}\right)^2}$ or $\frac{1}{\frac{5^2}{4^2}}$ or $\left(\frac{1}{\frac{5}{4}}\right)^2$<br>or $\frac{1}{\frac{25}{16}}$ or $\frac{1/25}{1/16}$ | M1   | missing brackets must be recovered<br>accept a correct decimal or mixed number for any fraction<br>eg $\frac{1}{1.25^2}$ |
|       | $\frac{16}{25}$                                                                                                                                                                                                                                                     | A1   | oe fraction or decimal                                                                                                   |
|       | <b>Additional Guidance</b>                                                                                                                                                                                                                                          |      |                                                                                                                          |
|       | Ignore any attempt to convert a correct fraction into a decimal                                                                                                                                                                                                     |      | M1A1                                                                                                                     |

| Q     | Answer                                                                                                                                                                                                                                                                                              | Mark | Comment                                                                                                                              |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------|
| 19(b) | $\left(\sqrt{\frac{9}{100}}\right)^3$ or $\frac{3^3}{10^3}$ or $\left(\frac{3}{10}\right)^3$<br>or $\sqrt{\frac{9^3}{100^3}}$ or $\sqrt{\left(\frac{9}{100}\right)^3}$<br>or $\frac{(\sqrt{9})^3}{(\sqrt{100})^3}$ or<br>or $\sqrt{\frac{729}{1000\ 000}}$ or $\frac{\sqrt{729}}{\sqrt{1000\ 000}}$ | M1   | oe with 0.09 for $\frac{9}{100}$ or 0.3 for $\frac{3}{10}$<br>or $3^2$ for 9 or $10^2$ for 100<br>missing brackets must be recovered |
|       | $\frac{27}{1000}$ or 0.027                                                                                                                                                                                                                                                                          | A1   |                                                                                                                                      |
|       | <b>Additional Guidance</b>                                                                                                                                                                                                                                                                          |      |                                                                                                                                      |
|       | Ignore any attempt to convert a correct fraction into a decimal                                                                                                                                                                                                                                     |      | M1A1                                                                                                                                 |
|       | For M1 do not allow power $\frac{1}{2}$ with no square root                                                                                                                                                                                                                                         |      |                                                                                                                                      |

| Q  | Answer                                                                                                                       | Mark  | Comment                                                                             |
|----|------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|
| 20 | <b>Alternative method 1</b>                                                                                                  |       |                                                                                     |
|    | $(x + 15)^2$                                                                                                                 | M1    |                                                                                     |
|    | $x^2 + 15x + 15x + 225$<br>or $x^2 + 30x + 225$<br>or $b = 30$<br>or $c = 225$                                               | M1dep |                                                                                     |
|    | $b = 30$ and $c = 225$                                                                                                       | A1    |                                                                                     |
|    | <b>Alternative method 2: simultaneous equations using <math>x = -15</math> and <math>b^2 - 4ac = 0</math></b>                |       |                                                                                     |
|    | $(-15)^2 - 15b + c = 0$<br>or<br>$b^2 - 4(\times 1) \times c = 0$                                                            | M1    | oe<br>do not allow missing brackets unless recovered                                |
|    | $b^2 - 4(\times 1) \times (15b - 225) = 0$<br>or $b^2 - 60b + 900 = 0$<br>or $(b - 30)^2 = 0$<br>or $b = 30$<br>or $c = 225$ | M1dep | oe method to eliminate one unknown<br>eg $\left(\frac{225+c}{15}\right)^2 - 4c = 0$ |
|    | $b = 30$ and $c = 225$                                                                                                       | A1    |                                                                                     |
|    | <b>Alternative method 3: using <math>b^2 - 4ac = 0</math> in the quadratic formula</b>                                       |       |                                                                                     |
|    | $-15 = \frac{-b}{2(\times 1)}$                                                                                               | M1    | oe                                                                                  |
|    | $b = 30$                                                                                                                     | M1dep |                                                                                     |
|    | $b = 30$ and $c = 225$                                                                                                       | A1    |                                                                                     |
|    | <b>Additional Guidance</b>                                                                                                   |       |                                                                                     |
|    | 30 and 225 may come from incorrect working<br>eg do not allow $c = 225$ from $(x - 15)^2$                                    |       |                                                                                     |

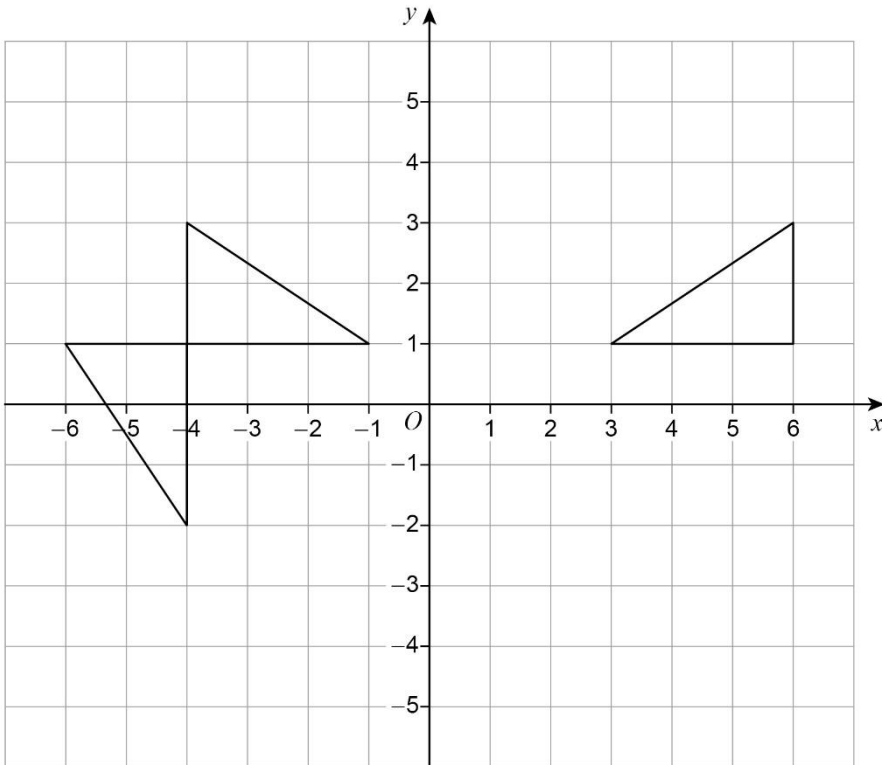
| Q  | Answer                                                                                                                              | Mark   | Comment                                                                                                                                                                                                                                       |
|----|-------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21 | <b>Alternative method 1</b>                                                                                                         |        |                                                                                                                                                                                                                                               |
|    | $10x = 6.11\dots$ and $x = 0.61\dots$<br>or<br>$100x = 61.11\dots$ and $10x = 6.11\dots$                                            | M1     | oe two powers of 10                                                                                                                                                                                                                           |
|    | $10x - x = 6.11\dots - 0.61\dots$<br>or $9x = 5.5$                                                                                  | M1dep  | oe subtraction of powers of 10<br>eg $100x - 10x = 61.1\dots - 6.1\dots$                                                                                                                                                                      |
|    | $\frac{11}{18}$ or $\frac{55}{90}$ or $\frac{605}{990}$                                                                             | A1     | oe fraction                                                                                                                                                                                                                                   |
|    | <b>Alternative method 2</b>                                                                                                         |        |                                                                                                                                                                                                                                               |
|    | $(0.6\dot{1} =) 0.6 + 0.0\dot{1}$<br>and<br>$10x = 0.11\dots$ and $x = 0.01\dots$<br>or<br>$100x = 1.11\dots$ and $10x = 0.11\dots$ | M1     | oe two powers of 10                                                                                                                                                                                                                           |
|    | $10x - x = 0.11\dots - 0.01\dots$<br>or $9x = 0.1$<br>and<br>$\frac{6}{10} + \text{their } \frac{1}{90}$                            | M1dep  | oe subtraction of powers of 10, with $x$<br>evaluated as a fraction and added to $\frac{6}{10}$<br>eg $1000x - 10x = 11.11\dots - 0.11\dots$<br>or $990x = 11$<br>and $\frac{3}{5} + \frac{11}{990}$<br>sum of correct fractions implies M1M1 |
|    | $\frac{11}{18}$ or $\frac{55}{90}$ or $\frac{605}{990}$                                                                             | A1     | oe fraction                                                                                                                                                                                                                                   |
|    | <b>Additional Guidance</b>                                                                                                          |        |                                                                                                                                                                                                                                               |
|    | Ignore incorrect simplification of a correct fraction eg $\frac{605}{990}$ and $\frac{121}{190}$                                    | M1M1A1 |                                                                                                                                                                                                                                               |
|    | Otherwise correct fraction with fraction(s) or decimal(s) as the numerator and/or denominator, eg $\frac{5.5}{9}$                   | M1M1A0 |                                                                                                                                                                                                                                               |

| Q  | Answer                                                                     | Mark  | Comment                                                                                                    |
|----|----------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------|
| 22 | <b>Alternative method 1</b>                                                |       |                                                                                                            |
|    | $\frac{8-0}{4-0}$ or 2                                                     | M1    | oe gradient from origin to point                                                                           |
|    | $-\frac{1}{2}$ or $y = -\frac{1}{2}x \dots$                                | M1    | oe gradient of tangent<br>negative inverse of their gradient                                               |
|    | 8 = their $-\frac{1}{2} \times 4 + c$<br>or<br>$c = 10$                    | M1dep | oe equation in $c$ (any letter)<br>dep on previous mark                                                    |
|    | 0 = their $-\frac{1}{2}x + \text{their } 10$                               | M1    | oe equation in $x$<br>ft their equation of the form $y = mx + c$<br>where $m$ and $c$ are numbers $\neq 0$ |
|    | 20                                                                         | A1    | condone (20, 0)                                                                                            |
|    | <b>Alternative method 2</b>                                                |       |                                                                                                            |
|    | $\frac{8-0}{4-0}$ or 2                                                     | M1    | oe gradient from origin to point                                                                           |
|    | $-\frac{1}{2}$ or $y = -\frac{1}{2}x \dots$                                | M1    | oe gradient of tangent<br>negative inverse of their gradient                                               |
|    | $\frac{8-0}{4-x} = \text{their } -\frac{1}{2}$                             | M1dep | oe equation in $x$<br>dep on previous mark                                                                 |
|    | their $2 \times (8-0) = \text{their } -1 \times (4-x)$<br>or $16 = -4 + x$ | M1dep | oe linear equation in $x$                                                                                  |
|    | 20                                                                         | A1    | condone (20, 0)                                                                                            |

The mark scheme for Question 22 continues on the next page

|              |                                                     |       |                                                                    |
|--------------|-----------------------------------------------------|-------|--------------------------------------------------------------------|
| 22<br>(cont) | <b>Alternative method 3</b>                         |       |                                                                    |
|              | $\frac{8-0}{4-0}$ or 2                              | M1    | oe gradient from origin to point                                   |
|              | $-\frac{1}{2}$ or $y = -\frac{1}{2}x \dots$         | M1    | oe gradient of tangent<br>negative inverse of their gradient       |
|              | $y - 8 = \text{their } -\frac{1}{2} \times (x - 4)$ | M1dep | oe equation eg $x + 2y = 20$<br>dep on previous mark               |
|              | $0 - 8 = \text{their } -\frac{1}{2} \times (x - 4)$ | M1    | oe linear equation in $x$<br>ft their equation in $y$ and $x$      |
|              | 20                                                  | A1    | condone (20, 0)                                                    |
|              | <b>Alternative method 4</b>                         |       |                                                                    |
|              | $4^2 + 8^2$ and $(x - 4)^2 + 8^2$                   | M1    |                                                                    |
|              | $x^2 = 4^2 + 8^2 + (x - 4)^2 + 8^2$                 | M1dep | oe equation in $x$                                                 |
|              | $x^2 = 16 + 64 + x^2 - 8x + 16 + 64$                | M1dep | oe equation in $x$ with brackets expanded<br>and squares evaluated |
|              | $8x = 16 + 64 + 16 + 64$<br>or $8x = 160$           | M1dep | oe linear equation in $x$                                          |
|              | 20                                                  | A1    | condone (20, 0)                                                    |

| Q  | Answer                                                                                                                          | Mark  | Comment                                                                                                        |
|----|---------------------------------------------------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------|
| 23 | <b>Alternative method 1</b>                                                                                                     |       |                                                                                                                |
|    | $(\sin 30 =) \frac{1}{2}$<br>or $(\tan 30 =) \frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$<br>or $(\cos 30 =) \frac{\sqrt{3}}{2}$ | M1    | oe may be implied by $(4 \times \sin 30 =) 2$<br>may be implied by correct position in a multiplication string |
|    | $4 \times \frac{1}{2} \times \frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{2}$                                                      | M1dep | oe with all trig values correct<br>condone any order unless error seen                                         |
|    | 1 with all three values seen                                                                                                    | A1    | implied by 90 with all three values seen                                                                       |
|    | 90 with M1M1A1 scored                                                                                                           | A1    | accept any angle of the form $90 + 360n$ , where $n$ is an integer                                             |
|    | <b>Alternative method 2</b>                                                                                                     |       |                                                                                                                |
|    | $4 \times \sin 30^\circ \times \frac{\sin 30^\circ}{\cos 30^\circ} \times \cos 30^\circ$                                        | M1    |                                                                                                                |
|    | $4 \times \frac{1}{2} \times \frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}} \times \frac{\sqrt{3}}{2}$                                  | M1dep | oe eg $4 \times \left(\frac{1}{2}\right)^2$                                                                    |
|    | 1 with $\frac{\sin 30^\circ}{\cos 30^\circ}$ and $\frac{1}{2}$ and $\frac{\sqrt{3}}{2}$ seen                                    | A1    | if $\cos 30^\circ$ is cancelled out only $\frac{1}{2}$ need be seen                                            |
|    | 90 with M1M1A1 scored                                                                                                           | A1    | accept any angle of the form $90 + 360n$ , where $n$ is an integer                                             |
|    | <b>Additional Guidance</b>                                                                                                      |       |                                                                                                                |
|    | Condone a square root sign on 1 up to M1M1                                                                                      |       |                                                                                                                |

| Q  | Answer                                                                                                           | Mark  | Comment                                           |
|----|------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------|
| 24 | Line $x = 1$ drawn                                                                                               | M1    | any indication<br>implied by a correct reflection |
|    | Correct shape drawn, with vertices at (3, 1), (6, 1) and (6, 3)                                                  | M1dep |                                                   |
|    | Correct shape drawn, with vertices at (–6, 1), (–4, 1) and (–4, –2),                                             | M1    | ft their $A'B'C'$                                 |
|    | $B$ or (–4, 1)<br>and<br>both correct shapes drawn                                                               | A1    | accept $B$ circled with both correct shapes drawn |
|    | <b>Additional Guidance</b>                                                                                       |       |                                                   |
|    | Ignore incorrect labelling                                                                                       |       |                                                   |
|    | Accept lines not ruled                                                                                           |       |                                                   |
|    | Ignore extra lines drawn, but do not accept extra triangles unless the correct triangle(s) are clearly indicated |       |                                                   |
|    |                              |       |                                                   |

| Q     | Answer                                                                                                                                                     | Mark | Comment                                                              |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------|
| 25(a) | $(x + 1)(x - 6)$<br>or<br>$\frac{5 \pm \sqrt{(-5)^2 - 4(\times 1) \times (-6)}}{2(\times 1)}$<br>or<br>$2.5 \pm \sqrt{12.25}$<br>or<br>-1 and 6 identified | M1   | oe<br><br>do not accept missing bracket on $(-5)^2$ unless recovered |
|       | $-1 < x < 6$                                                                                                                                               | A1   | condone $-1 < x$ and $x < 6$                                         |

| Q     | Answer                                  | Mark | Comment                                                                                                                                                                                                                                                         |
|-------|-----------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25(b) | Open circles at -1 and 6 joined by line | B1ft | ft their double-sided inequality in (a) if the bounds are within the number line<br><br>condone ft an inequality given in two parts if the bounds are within the number line<br><br>condone ft a single-sided inequality if the bound is within the number line |

| Q  | Answer                                                                                                    | Mark  | Comment                                                                                                                             |
|----|-----------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------|
| 26 | <b>Alternative method 1</b>                                                                               |       |                                                                                                                                     |
|    | $RPQ = y$                                                                                                 | M1    | may be seen on diagram                                                                                                              |
|    | $RPQ = y$<br>and<br>$RQP = 180 - 2y$                                                                      | M1dep | may be seen on diagram                                                                                                              |
|    | $RQP = 2x$<br>and<br>$2x = 180 - 2y$<br>and correct rearrangement to<br>$y = 90 - x$<br>with M1M1 awarded | A1    | $RQP = 2x$ may be implied by 'alternate segment theorem'                                                                            |
|    | Correct reasons given with M1M1 scored and a correct initial equation for the A mark                      | B1    | (base angles of an) isosceles triangle (are equal)<br>sum of the angles in a triangle is $180^\circ$<br>alternate segment (theorem) |
|    | <b>Alternative method 2</b>                                                                               |       |                                                                                                                                     |
|    | $RPQ = y$                                                                                                 | M1    | may be seen on diagram                                                                                                              |
|    | $RQP = 2x$                                                                                                | M1    | may be seen on diagram                                                                                                              |
|    | $2x + 2y = 180$<br>and correct rearrangement to<br>$y = 90 - x$<br>with M1M1 awarded                      | A1    |                                                                                                                                     |
|    | Correct reasons given with M1M1 scored and a correct initial equation for the A mark                      | B1    | (base angles of an) isosceles triangle (are equal)<br>alternate segment (theorem)<br>sum of the angles in a triangle is $180^\circ$ |

The mark scheme for Question 26 continues on the next page

|                                                                                              |                                                                                         |       |                                                                                                                                   |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------|
| 26<br>(cont)                                                                                 | <b>Alternative method 3</b>                                                             |       |                                                                                                                                   |
|                                                                                              | $RQP = 2x$                                                                              | M1    | may be seen on diagram                                                                                                            |
|                                                                                              | $RQP = 2x$<br>and<br>$RPQ = 180 - 2x - y$                                               | M1dep | may be seen on diagram                                                                                                            |
|                                                                                              | $y = 180 - 2x - y$<br>and correct rearrangement to<br>$y = 90 - x$<br>with M1M1 awarded | A1    |                                                                                                                                   |
|                                                                                              | Correct reasons given with M1M1 scored and a correct initial equation for the A mark    | B1    | alternate segment theorem<br>sum of the angles in a triangle is $180^\circ$<br>(base angles of an) isosceles triangle (are equal) |
|                                                                                              | <b>Alternative method 4</b>                                                             |       |                                                                                                                                   |
|                                                                                              | $RPQ = y$                                                                               | M1    | may be seen on diagram                                                                                                            |
|                                                                                              | $SP$ extended to $T$<br>and<br>$QPT = y$                                                | M1    | may be seen on diagram<br>any or no letter for $T$                                                                                |
|                                                                                              | $2x + 2y = 180$<br>and correct rearrangement to<br>$y = 90 - x$<br>with M1M1 awarded    | A1    |                                                                                                                                   |
|                                                                                              | Correct reasons given with M1M1 scored and a correct initial equation for the A mark    | B1    | (base angles of an) isosceles triangle (are equal)<br>alternate segment theorem<br>angles on a straight line sum to $180^\circ$   |
| <b>Additional Guidance</b>                                                                   |                                                                                         |       |                                                                                                                                   |
| Method marks can be scored using angle notation<br>eg $RPQ = QRP$ is equivalent to $RPQ = y$ |                                                                                         |       |                                                                                                                                   |

| Q  | Answer                                                                                                                                                                      | Mark  | Comment                                                                                                                                    |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 27 | <b>Alternative method 1</b>                                                                                                                                                 |       |                                                                                                                                            |
|    | $\left(\sqrt{2\frac{13}{16}} = \right) \sqrt{\frac{45}{16}}$ or $\frac{\sqrt{45}}{4}$ or $\frac{3\sqrt{5}}{4}$                                                              | M1    | oe conversion from a mixed number                                                                                                          |
|    | $\frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ or $\frac{2\sqrt{5}}{5}$                                                                                              | M1    | oe rationalisation                                                                                                                         |
|    | $\frac{15\sqrt{5}}{20} - \frac{8\sqrt{5}}{20}$<br>or<br>$(0.75\sqrt{5} - 0.4\sqrt{5} =) 0.35\sqrt{5}$                                                                       | M1dep | oe with common surd in numerator and common non-surd denominator<br>do not allow fraction(s) in numerator(s) or denominator<br>dep on M1M1 |
|    | $\frac{7\sqrt{5}}{20}$                                                                                                                                                      | A1    | oe in the form $\frac{a\sqrt{5}}{b}$<br>eg $\frac{28\sqrt{5}}{80}$                                                                         |
|    | <b>Alternative method 2</b>                                                                                                                                                 |       |                                                                                                                                            |
|    | $\left(\sqrt{2\frac{13}{16}} = \right) \sqrt{\frac{45}{16}}$ or $\frac{\sqrt{45}}{4}$ or $\frac{3\sqrt{5}}{4}$                                                              | M1    | oe conversion from a mixed number                                                                                                          |
|    | $\frac{\sqrt{45}\sqrt{5}}{4\sqrt{5}} - \frac{8}{4\sqrt{5}}$ or $\frac{15}{4\sqrt{5}} - \frac{8}{4\sqrt{5}}$<br>or $\frac{7}{4\sqrt{5}}$                                     | M1dep | oe with common denominator<br>do not allow fraction(s) in numerator(s) or denominator                                                      |
|    | $\frac{15}{4\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} - \frac{8}{4\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$<br>or $\frac{7}{4\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ | M1dep | oe with all denominators rationalised                                                                                                      |
|    | $\frac{7\sqrt{5}}{20}$                                                                                                                                                      | A1    | oe in the form $\frac{a\sqrt{5}}{b}$ eg $\frac{28\sqrt{5}}{80}$                                                                            |