



Mark Scheme (Results)

Summer 2024

Pearson Edexcel International GCSE  
In Mathematics A (4MA1) Paper 2HR

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Summer 2024

Question Paper Log Number P73470A

Publications Code 4MA1\_2HR\_2406\_MS

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

- **Types of mark**

- M marks: method marks
- A marks: accuracy marks
- B marks: unconditional accuracy marks (independent of M marks)

- **Abbreviations**

- cao – correct answer only
- ft – follow through
- isw – ignore subsequent working
- SC - special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- awrt – answer which rounds to
- eeo – each error or omission

- **No working**

If no working is shown then correct answers normally score full marks

If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks.

If a candidate misreads a number from the question. Eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review. If there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

If there is no answer on the answer line then check the working for an obvious answer.

- **Ignoring subsequent work**

It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**

Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

| International GCSE Maths                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Apart from Questions 1, 6a, 10, 18, 20, 22 and 25 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| Q                                                                                                                                                               | Working                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | Answer                    | Mark | Notes                                                                                                                                                                          |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 1                                                                                                                                                               | <div>eg<br/><math>2 \times 2 \times 350</math><br/><b>or</b> <math>2 \times 7 \times 100</math><br/><b>or</b> <math>2 \times 5 \times 140</math><br/><b>or</b> <math>5 \times 7 \times 40</math><br/><b>or</b> <math>5 \times 5 \times 56</math><br/><b>or</b> <math>(14 \times 100 =) 2 \times 7 \times 100</math><br/><b>or</b> <math>(28 \times 50 = 4 \times 7 \times 50 =) 2 \times 2 \times 7 \times 50 =</math><br/><b>or</b><table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td></td><td>350</td></tr></table></div> |   | 2                         | 1400 | 2                                                                                                                                                                              | 700 |     | 350 |    | 3 | <div>M1 for 2 correct stages in prime factorisation with 0 incorrect stages<br/>or<br/>at least 3 stages in prime factorisation with no more than 1 incorrect stage.</div> <div>Each stage gives 2 factors – may be in a factor tree or a table or listed eg 2, 2, 350 (see LHS for examples of the amount of work needed for the award of this mark).</div> <div>Example of 3 stages with 1 incorrect stage:<br/><math>1400 = 10 \times 14 = 2 \times 5 \times 2 \times 7</math></div> |  |   |  |  |                                                                                                                                                                                                                                             |
| 2                                                                                                                                                               | 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 2                                                                                                                                                               | 700                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|                                                                                                                                                                 | 350                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|                                                                                                                                                                 | <div>eg<br/>2, 2, 2, 5, 5, 7</div> <div>eg<table><tr><td>2</td><td>1400</td></tr><tr><td>2</td><td>700</td></tr><tr><td>5</td><td>350</td></tr><tr><td>2</td><td>70</td></tr><tr><td>5</td><td>35</td></tr><tr><td></td><td>7</td></tr></table></div> <div>eg<div><div>1400</div><div><div>140</div><div>10</div></div><div><div><div>14</div><div>10</div><div>2</div></div><div>5</div></div><div><div><div>2</div><div>7</div></div><div>2</div><div>5</div></div></div></div>                                                                      | 2 | 1400                      | 2    | 700                                                                                                                                                                            | 5   | 350 | 2   | 70 | 5 | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | 7 |  |  | <div>M1 dep on M1 for <math>2 \times 2 \times 2 \times 5 \times 5 \times 7</math> or <math>2^3, 5^2, 7</math> or <math>2^3 + 5^2 + 7</math></div> <div>(Ignore 1's)</div> <div>(may be seen in a fully correct factor tree or ladder)</div> |
| 2                                                                                                                                                               | 1400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 2                                                                                                                                                               | 700                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 5                                                                                                                                                               | 350                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 2                                                                                                                                                               | 70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
| 5                                                                                                                                                               | 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|                                                                                                                                                                 | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                           |      |                                                                                                                                                                                |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | $2^3 \times 5^2 \times 7$ |      | <div>A1 dep on M2 (do not allow 1 in the final answer)</div> <div>Can be in any order (allow <math>2^3 \cdot 5^2 \cdot 7</math>) but must be in index form as asked for.</div> |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |
|                                                                                                                                                                 | Working required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                           |      | Total 3 marks                                                                                                                                                                  |     |     |     |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |   |  |  |                                                                                                                                                                                                                                             |

|   |     |                                                                                                                |                                                                               |   |                                                                                                                                                                                |
|---|-----|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | (a) | <p>Allow translated<br/>translating<br/>translate</p> <p>Allow misspelling of the word<br/>eg<br/>translat</p> | Translation                                                                   | 2 | B1 for translation<br>(with none of reflection, rotation, enlargement, mirrored, turned, move or flipped stated)<br>NB Move with translation is acceptable                     |
|   |     |                                                                                                                | $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$                                       |   | B1 for (vector =) $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$                                                                                                                      |
|   | (b) |                                                                                                                | <p>Shape drawn at</p> <p><math>(-6, -1) (-4, -1) (-4, -2) (-5, -2)</math></p> | 2 | <p>B2 condone missing label</p> <p>If not B2 then</p> <p>B1 for a correct trapezium drawn with correct orientation in wrong position <b>or</b> 3 points plotted correctly)</p> |
|   |     |                                                                                                                |                                                                               |   | <b>Total 4 marks</b>                                                                                                                                                           |

|   |  |  |                             |   |                                                                                                                                                                                   |
|---|--|--|-----------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 |  |  | $(x =) 11$ (and) $(y =) 14$ | 2 | <p>B2 for <math>x = 11</math> and <math>y = 14</math></p> <p>(B1 for <math>x = 11</math> or <math>y = 14</math>)</p> <p>SC B1 for <math>x = 14</math> and <math>y = 11</math></p> |
|   |  |  |                             |   | <b>Total 2 marks</b>                                                                                                                                                              |

|                      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                           |   |     |                                                                                                                                                                                                                           |
|----------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                    | (a)(i)  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1, 2, 3, 5, 6, 7                                          | 1 | B1  | in any order with no repeats                                                                                                                                                                                              |
|                      | (a)(ii) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4, 5, 7, 8, 9, 10                                         | 1 | B1  | in any order with no repeats                                                                                                                                                                                              |
|                      | (b)     | eg<br>1. 2 ( <b>or</b> 3 <b>or</b> 2 and 3) is in both sets oe<br>2. A and B have 2 ( <b>or</b> 3 <b>or</b> 2 and 3) oe<br>3. 2 ( <b>or</b> 3 <b>or</b> 2 and 3) is common oe<br>4. 2 ( <b>or</b> 3 <b>or</b> 2 and 3) is in the intersection oe<br>5. $A \cap B = \{2, 3\}$ oe or $A \cap B = \{2\}$ oe or $A \cap B = \{3\}$ oe<br>6. They share 2 ( <b>or</b> 3 <b>or</b> 2 and 3)oe<br>7. As 2 and/or 3 are factors of 6 and also prime numbers oe<br><br>Allow sector for set<br>This is not an exhaustive list | 2 ( <b>or</b> 3 <b>or</b> 2 and 3) is a member of A and B | 1 | B1  | for identifying the element 2 <b>or</b> 3 <b>or</b> 2 and 3 with a correct explanation to show they know the meaning of intersection and empty set<br><br>If students mention a number that is common, it must be correct |
|                      | (c)     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1, 5, 6, 7                                                | 2 | B2  | for 1, 5, 6, 7                                                                                                                                                                                                            |
|                      |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                           |   | (B1 | for three correct values with no more than one incorrect or for four correct values with no more than one incorrect)                                                                                                      |
| <b>Total 5 marks</b> |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                           |   |     |                                                                                                                                                                                                                           |

|   |                                                                                                          |      |   |                      |                                                                                                                                                                             |
|---|----------------------------------------------------------------------------------------------------------|------|---|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | $\sqrt{81} (= 9)$ <b>or</b> 9 <b>or</b> $9 \times 9 (= 81)$                                              |      | 4 | M1                   | for method to find the length of the side of the square (may be seen on the diagram)                                                                                        |
|   | $4 \times "9" (= 36)$ oe                                                                                 |      |   | M1                   | for the perimeter of the square (the first M mark can be implied by 36)                                                                                                     |
|   | eg<br>$\pi \times "9" (= 28.2(743\dots))$ or $9\pi$                                                      |      |   | M1                   | for a correct expression for the circumference for using $2\pi r$ or $\pi D$ (the first M mark can be implied by 28.2(743\dots) rounded or truncated to 1 dp or by $9\pi$ ) |
|   | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i> | 64.3 |   | A1                   | accept 64.26 – 64.3                                                                                                                                                         |
|   |                                                                                                          |      |   | <b>Total 4 marks</b> |                                                                                                                                                                             |

|       |                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |   |                                                                                                                                                                                                                                                       |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6 (a) | eg<br>$2f = 12f - 51$ <b>or</b><br>$\frac{f}{3} = \frac{4}{2}f - \frac{17}{2}$ <b>or</b> $\frac{f}{3} = 2f - \frac{17}{2}$ <b>or</b> $0.3f = 2f - 8.5$ <b>or</b><br>$f = 6f - \frac{51}{2}$ <b>or</b> $f = 6f - 25.5$ <b>or</b><br>$17 = 4f - \frac{2}{3}f$ <b>or</b> $17 = 4f - 0.6f$ <b>or</b> $17 = 4f - 0.7f$ <b>or</b><br>$\frac{2}{3}f - 4f = -17$ <b>or</b> $0.6f - 4f = -17$ <b>or</b> $0.7f - 4f = -17$ |                 | 3 | M1 for a correct first step – multiplying both sides by 3 correctly and expanding to find $2f = 12f - 51$ or $2f = -51 + 12f$<br><br>or<br><br>writing the RHS as 2 terms each over 2<br><br>(Allow decimals to 1dp or better – rounded or truncated) |
|       | eg<br>$-10f = -51$ <b>or</b><br>$10f = 51$ <b>or</b><br>$\frac{5f}{3} = \frac{17}{2}$ <b>or</b><br>$5f = \frac{51}{2}$ <b>or</b><br>$17 = \frac{10f}{3}$ <b>or</b><br>$3.3f = 17$ <b>or</b><br>$-\frac{10f}{3} = -17$ <b>or</b><br>$-3.3f = -17$                                                                                                                                                                 |                 |   | M1 for a correct 2 term equation in the form $af = b$<br><br>ft the following equations only<br>$2f = 12f - 17$ oe<br>$2f = 4f - 51$ oe<br>$6f = 12f - 51$ oe<br><br>(Allow decimals to 1dp or better – rounded or truncated)                         |
|       | Working required                                                                                                                                                                                                                                                                                                                                                                                                 | $\frac{51}{10}$ |   | A1 (dep on at least M1) oe                                                                                                                                                                                                                            |

|   |     |  |                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---|-----|--|----------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6 | (b) |  | 1                    | 1 | B1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|   | (c) |  | $3a^3h^4$            | 2 | <p>B2 for <math>3a^3h^4</math> oe</p> <p>B1 for a product in the form <math>ka^ph^q</math> where 2 from <math>k</math>, <math>p</math> or <math>q</math> are correct (allow multiplication signs)</p> <p>eg <math>5a^3h^4</math> or <math>\frac{12a^3h^4}{4}</math></p> <p>(Allow <math>3a^3</math> or <math>a^3h^4</math> or <math>3h^4</math> as long as not added to any other term)</p>                                                                                                                                                                        |
|   | (d) |  | $4x^3y(5x^2 + 3y^3)$ | 2 | <p>B2 for <math>4x^3y(5x^2 + 3y^3)</math></p> <p>B1 for any correct factorisation with at least a 2 term factor outside the bracket</p> <p>eg <math>2x^3y(10x^2 + 6y^3)</math> <b>or</b> <math>x^3y(20x^2 + 12y^3)</math> <b>or</b> <math>2x(10x^4y + 6x^2y^4)</math> <b>or</b> <math>4y(5x^5 + 3x^3y^3)</math> <b>or</b> <math>4x^3(5x^2y + 3y^4)</math> etc</p> <p><b>or</b> the correct highest common factor <b>and</b> a 2 term expression with at most one incorrect term</p> <p>eg <math>4x^3y(5x^2 + \dots)</math> or <math>4x^3y(\dots + 3y^3)</math></p> |
|   |     |  |                      |   | <b>Total 8 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|   |                                                                                                                                                                                                                                                                                                                                                |  |    |                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|--------------------------------------------------------------------------------------------------------------------------------|
| 7 | <p>eg</p> <p><math>3^3</math> or <math>(3^{-2}) \times 3^{-5}</math> or <math>\frac{3^3}{(3^{10})}</math> or <math>\frac{(3^5)}{3^{12}}</math> or <math>\frac{(3^{-2})}{3^5}</math> or <math>3^{-12}(\times 3^5)</math> oe</p> <p>or</p> <p><math>-2 + 5 - 10</math> oe or</p> <p><math>-12 + 5</math> oe or</p> <p><math>3 - 10</math> oe</p> |  | 2  | <p>M1 for a correct application of an index rule as a first step</p> <p>or</p> <p>a correct calculation for <math>n</math></p> |
|   | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                                                                                                                                                                                                       |  | -7 | A1 Allow $3^{-7}$                                                                                                              |
|   |                                                                                                                                                                                                                                                                                                                                                |  |    | <b>Total 2 marks</b>                                                                                                           |

|          |                                                                                                                                      |      |   |                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|------|---|----------------------|
| <b>8</b> | $1 - 0.17$ or $0.83$ or $\frac{83}{100}$ <b>or</b><br>$100(\%) - 17(\%)$ or $83(\%)$ <b>or</b><br>$\frac{6225}{83}$ (= 75) oe        |      | 3 | M1                   |
|          | $6225 \div "0.83"$ <b>or</b><br>$6225 \div "83" \times 100$ <b>or</b><br>$6225 \times 100 \div "83"$ oe <b>or</b><br>$75 \times 100$ |      |   | M1                   |
|          | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                             | 7500 |   | A1                   |
|          |                                                                                                                                      |      |   | <b>Total 3 marks</b> |

|          |     |                                                                                                          |                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------|-----|----------------------------------------------------------------------------------------------------------|--------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>9</b> | (a) |                                                                                                          | 604 000            | 1 | B1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | (b) |                                                                                                          | $7 \times 10^{-5}$ | 1 | B1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | (c) | 380 000 or<br>$3.8 \times 10^5$ or<br>$38 \times 10^4$ oe                                                |                    | 2 | M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          |     | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i> | $2 \times 10^5$    |   | <p>A1 Accept <math>2.0 \times 10^5</math> or <math>2.00 \times 10^5</math> etc</p> <p>Accept a dot or a comma for a multiplication sign</p> <p>eg<br/> <math>2, 10^5</math><br/> <math>2. 10^5</math></p> <p>SC B1 for</p> <p>200 000 or <math>20 \times 10^4</math> or <math>0.2 \times 10^6</math> oe<br/> or<br/> <math>2 \times 10^n</math> where <math>n \neq 5</math></p> <p>when given as a final answer (not for incorrect simplification of the denominator)</p> |
|          |     |                                                                                                          |                    |   | <b>Total 4 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                     |       |   |                                                                              |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------|---|------------------------------------------------------------------------------|
| 10 | $23 \times 4.7 (= 108.1)$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |       | 5 | B1 (indep)<br>May be embedded in<br>$23 \times (4.7 + 2.5)$<br>(= 165.6)     |
|    | $\sin 30 = \frac{(x)}{5}$<br>or<br>$\frac{(x)}{\sin 30} = \frac{5}{\sin 90}$ oe<br>where $x$ = height of trapezium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $5 \cos 30 \left( = \frac{5\sqrt{3}}{2} = 4.33... \right)$<br><b>and</b><br>$(x^2 =) 5^2 - "5 \cos 30"'^2 (= 6.25)$ |       |   | M1                                                                           |
|    | $(x =) 5 \sin 30 (= 2.5)$ oe<br>or<br>$(x =) \frac{5}{\sin 90} \times \sin 30 (= 2.5)$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | $(x =) \sqrt{5^2 - "5 \cos 30"'^2} (= 2.5)$                                                                         |       |   | M1                                                                           |
|    | $\frac{1}{2} \times (11 + 23) \times "2.5" (= 42.5)$ oe or $\left( \frac{1}{2} \times "2.5" \times (23 - 11) \right) + (11 \times "2.5") (= 42.5)$ oe or<br>$\left( \frac{1}{2} \times "2.5" \times (23 - 11 - "4.3") \right) + (11 \times "2.5") + \left( \frac{1}{2} \times "2.5" \times "4.3" \right) (= 42.5)$ oe or<br>$(11 \times "2.5") + \left( \frac{1}{2} \times 5 \times (23 - 11) \times \sin 30 \right) (= 42.5)$ oe or<br>$(23 \times "2.5") - \left( \frac{1}{2} \times "2.5" \times (23 - 11 - "4.3") \right) - \left( \frac{1}{2} \times "2.5" \times "4.3" \right) (= 42.5)$ oe or<br>$(23 \times ("2.5" + 4.7)) - \left( \frac{1}{2} \times "2.5" \times (23 - 11 - "4.3") \right) - \left( \frac{1}{2} \times "2.5" \times "4.3" \right)$ oe |                                                                                                                     |       |   | M1 for a correct method to find the area of the trapezium or the whole shape |
|    | <i>Working required</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     | 150.6 |   | A1 dep on M1 awrt 150.6<br>Allow 151<br>Accept $\frac{753}{5}$               |
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                     |       |   | <b>Total 5 marks</b>                                                         |

|    |     |                                                                                                                                                                                                                                                                                                  |                 |   |                                                                                                                                                                                                                                                                                                                                                                                                       |
|----|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | (a) | <b>USE OVERLAY</b><br><br>(NB: a 'bar chart' type graph scores zero marks)<br><br>(ignore any part of the graph before (5, 6))                                                                                                                                                                   |                 | 2 | B2 for a fully correct cf graph – points at ends of intervals and joined with curve or line segments.<br><br>(B1 for 5 correct points plotted and joined<br>or<br>B1 for 6 correct points plotted but not joined<br>or<br>B1 for 5 or 6 points plotted consistently within each interval (not at upper end) at their correct heights <b>and</b> joined eg plotted at 2.5, 7.5, 12.5, 17.5, 22.5, 27.5 |
|    | (b) | Readings are [8 – 9.5] and [21 – 23] (but for this M1 these do not have to be correct if correct working is shown – eg lines or marks indicating a <b>correct use</b> of CF 15 and CF 45 with an indication on the time axis at the correct points (or they can just show the correct readings)) |                 | 2 | M1ft for a correct method to <b>allow</b> readings to be taken on the time axis from cf 45 (or 45.75) and from cf 15 (or 15.25) oe<br><br>ft from their cf graph                                                                                                                                                                                                                                      |
|    |     | <i>If a graph is drawn, answer is in the given range then award the marks</i>                                                                                                                                                                                                                    | 11.5 – 13.5     |   | A1ft Accept a single value in the range <b>or</b> ft from their cf graph                                                                                                                                                                                                                                                                                                                              |
|    | (c) | 35 or lines or marks indicating use of CF 35 or an indication on the time axis at the correct point (or they can just show the correct reading)                                                                                                                                                  |                 | 2 | M1ft for using or stating 35<br><br>(ft from incorrect graph if method shown)                                                                                                                                                                                                                                                                                                                         |
|    |     | <i>If a graph is drawn, answer is in the given range then award the marks</i>                                                                                                                                                                                                                    | 16.5 – 18.5     |   | A1ft ft from their cf graph                                                                                                                                                                                                                                                                                                                                                                           |
|    | (d) |                                                                                                                                                                                                                                                                                                  | $\frac{11}{60}$ | 1 | B1 Accept 0.18(333....) or 18.(333...)%                                                                                                                                                                                                                                                                                                                                                               |
|    |     |                                                                                                                                                                                                                                                                                                  |                 |   | <b>Total 7 marks</b>                                                                                                                                                                                                                                                                                                                                                                                  |

|    |     |                                                                                                                                                         |      |   |                                           |
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| 12 | (a) | $(AD=)10 \times 1.5 (= 15)$ oe                                                                                                                          |      | 2 | M1                                        |
|    |     | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                | 5    |   | A1                                        |
|    | (b) | $(2x+5) + (3x-5) = 1.5 \times (2x+5)$ oe<br>or<br>$5x = 1.5 \times (2x+5)$ oe<br>or<br>$5x = 3x + 7.5$ oe<br>or<br>$\frac{3x-5}{2x+5} = \frac{1}{2}$ oe |      | 2 | M1 for a correct equation for x           |
|    |     | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                | 3.75 |   | A1 oe eg $\frac{15}{4}$ or $3\frac{3}{4}$ |
|    |     |                                                                                                                                                         |      |   | <b>Total 4 marks</b>                      |

|           |                                                                                                                            |                                            |   |                                                                                                                                                                                                  |
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| <b>13</b> | $\frac{60}{360} \times 2 \times \pi \times r$ oe or<br>$\frac{1}{6} \times 2 \times \pi \times r$ oe                       |                                            | 3 | M1 for finding the length of the arc                                                                                                                                                             |
|           | " $\frac{60}{360} \times 2 \times \pi \times r$ " + $2r$ oe or<br>" $\frac{1}{6} \times 2 \times \pi \times r$ " + $2r$ oe |                                            |   | M1 dep on M1 for a complete expression from correct working for a method for the perimeter                                                                                                       |
|           | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                   | $P = r \left( \frac{1}{3} \pi + 2 \right)$ |   | A1 oe<br>eg $P = r (0.33... \pi + 2)$ or<br>$P = \left( \frac{1}{3} \pi + 2 \right) r$ or<br>$P = \left( 2 + \frac{120}{360} \pi \right) r$ or<br>$P = \left( \frac{120}{360} \pi + 2 \right) r$ |
|           |                                                                                                                            |                                            |   | <b>Total 3 marks</b>                                                                                                                                                                             |

|           |                                                                                                                                                 |      |   |                                                  |
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| <b>14</b> | $0.24 \div 0.8 (= 0.3)$ oe                                                                                                                      |      | 3 | M1                                               |
|           | "0.3" $\times (1 - 0.8)$ oe or<br>"0.3" $\times 0.2$ oe or<br>$1 - ("0.3" \times 0.8 + 0.7 \times 0.8 + 0.7 \times 0.2)$ oe or<br>$1 - 0.94$ oe |      |   | M1 for a complete method                         |
|           | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                        | 0.06 |   | A1 oe eg $\frac{3}{50}$ or $\frac{6}{100}$ or 6% |
|           |                                                                                                                                                 |      |   | <b>Total 3 marks</b>                             |

|    |                                                                                                                                                                                           |      |   |                                                                                                                                                                                                                                                                                                                |
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| 15 | $360 \div 5 (= 72)$ oe or<br>$(5 - 2) \times 180 \div 5 (= 108)$ oe or<br>$540 \div 5 (= 108)$ oe                                                                                         |      | 3 | M1 for a method to find an exterior or interior angle for a regular pentagon<br><br>Do not award this mark if 108 is assigned as an exterior angle or 72 is assigned as an interior angle<br><br>Ignore angles on the diagram other than exterior/interior angles of the pentagon even if incorrectly labelled |
|    | $\frac{1}{2} \times 6.5 \times 3 \times \sin[\text{angle } DCE]$ oe<br>or<br>$(h =) 6.5 \times \sin[\text{angle } DCE] (= 6.18\dots)$ and<br>$\frac{1}{2} \times 3 \times "6.18\dots"$ oe |      |   | M1 ft their angle <i>DCE</i> when substituting in<br>$\frac{1}{2} \times 6.5 \times 3 \times \sin[\text{angle } DCE]$<br>[ <i>angle DCE</i> ] means their angle <i>DCE</i> provided it is less than $90^\circ$                                                                                                 |
|    | Working not required, so correct answer scores full marks (unless from obvious incorrect working)                                                                                         | 9.27 |   | A1 accept 9.26 – 9.28<br>SC B2 for<br>$\frac{1}{2} \times 6.5 \times 3 \times \sin "108" = 9.27\dots$                                                                                                                                                                                                          |
|    |                                                                                                                                                                                           |      |   | <b>Total 3 marks</b>                                                                                                                                                                                                                                                                                           |

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| 16 | (i)  |  | E | 1 | B1                   |
|    | (ii) |  | A | 1 | B1                   |
|    |      |  |   |   | <b>Total 2 marks</b> |

|    |                                                                                                                                                                                                         |               |   |                                                                                                                      |
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| 17 | $(fg(k) =) \frac{3k+1}{2(3k+1)-4}$ oe or $\frac{3k+1}{2(3k+1)-4} = 2$ oe or<br>$(fg(k) =) \frac{3k+1}{6k-2}$ oe or $\frac{3k+1}{6k-2} = 2$ oe or<br>$x = 2(2x-4)$ or $x = 4x-8$ or $x = \frac{8}{3}$ oe |               | 3 | M1 for a correct expression for $fg(k)$ or $fg(x)$ or for $f(x) = 2$<br><br>Allow $x$ instead of $k$ for all marks   |
|    | $3k+1 = 2(6k-2)$ oe or<br>$3k+1 = 2(2(3k+1)-4)$ oe or<br>$3k+1 = 12k-4$ oe or<br>$3k+1 = \frac{8}{3}$ oe                                                                                                |               |   | M1 dep on M1 for <b>correctly</b> removing the denominator to form a correct equation or<br>for $g(k) = \frac{8}{3}$ |
|    | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                                                                | $\frac{5}{9}$ |   | A1 oe eg 0.55(555...) rounded or truncated or<br>0.5 (must show recurring)                                           |
|    |                                                                                                                                                                                                         |               |   | <b>Total 3 marks</b>                                                                                                 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                           |       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| 18 | eg<br>$\begin{array}{r} 1000x = 306.306..._ \\ \underline{x = \quad 0.306...} \end{array}$<br><br>OR<br>eg<br>$\begin{array}{r} 1000\ 000x = 306\ 306.(...)_ \\ \underline{1000x = \quad 306.306...} \end{array}$                                                                                                                                                                                         |       | 2 | M1 M1 for two correct <b>algebraic equations</b> involving recurring decimals that when subtracted give a whole number or terminating decimal (306 or 306 000 etc) with intention to subtract.<br><br>eg<br>$1000x = 306.306...$ and $x = 0.306...$<br><b>or</b><br>$1000\ 000x = 306306.(...)$ and $1000x = 306.306$<br><br>(if recurring dots not shown in both numbers then showing at least <b>one</b> of the numbers to at least 6sf) |
|    | eg<br>$1000x - x = 306.306.... - 0.306306.... = 306$ <b>and</b><br>$\frac{306}{999} = \frac{34}{111}$<br>or<br>$999x = 306$ <b>and</b> $\frac{306}{999} = \frac{34}{111}$ OR<br><br>eg<br>$1000\ 000x - 1000x = 306306.(...) - 306.306 = 306\ 000$<br><b>and</b> $\frac{306\ 000}{999\ 000} = \frac{34}{111}$<br><br>or<br>$999\ 000x = 306\ 000$ <b>and</b> $\frac{306\ 000}{999\ 000} = \frac{34}{111}$ | shown |   | A1 for completion to $\frac{34}{111}$ dep on M1                                                                                                                                                                                                                                                                                                                                                                                            |
|    | Working required                                                                                                                                                                                                                                                                                                                                                                                          |       |   | <b>Total 2 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |

|    |                                                                                                          |      |   |                                                                                          |
|----|----------------------------------------------------------------------------------------------------------|------|---|------------------------------------------------------------------------------------------|
| 19 | 18.5 or 19.5 or 1.45 or 1.55                                                                             |      | 3 | B1 for one correct bound<br>Allow $19.\dot{4}9$ for 19.5<br>Allow $1.54\dot{9}$ for 1.55 |
|    | (distance =) $19.5 \times 1.55$                                                                          |      |   | M1 for $UB_s \times UB_t$<br>where<br><br>$19 < UB_s, 19.5$ and $1.5 < UB_t, 1.55$       |
|    | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i> | 30.2 |   | A1 accept 30.225 or 30.23<br>answer must come from correct figures (19.5, 1.55)          |
|    |                                                                                                          |      |   | <b>Total 3 marks</b>                                                                     |

|               |                                                                                                                                                                                                                         |                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20            | eg<br>$(3x+4)(2x-5)$<br><b>or</b><br>$(x=)\frac{- -7 \pm \sqrt{(-7)^2 - 4 \times 6 \times (-20)}}{2 \times 6}$ oe<br><b>or</b><br>$6\left[\left(x - \frac{7}{12}\right)^2 - \left(\frac{7}{12}\right)^2\right] - 20$ oe |                                         | 4 | M1 first step to finding the critical values - if factorising (in the form $(ax + b)$ where $a$ and $b$ are integers), allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\frac{7 \pm \sqrt{49 + 480}}{12}$ oe <b>or</b><br>$6\left(x - \frac{7}{12}\right)^2 - \frac{529}{24}$ oe or $\left(x - \frac{7}{12}\right)^2 - \frac{529}{144}$ oe |
|               | $(x=) -\frac{4}{3}$ and $\frac{5}{2}$ oe                                                                                                                                                                                |                                         |   | A1 dep on M1 for two <b>correct</b> critical values<br>Accept $-1.3\dots\dots$<br>May use $<, \leq, >$ or $\geq$ instead of $=$                                                                                                                                                                                                                                                                                                                                  |
|               |                                                                                                                                                                                                                         |                                         |   | M1ft (dep on M1 and two critical values found)<br><br>for $x < a$ and $x > b$ where $a$ is their lower critical value and $b$ is their upper critical value<br><b>or</b> $x > \frac{5}{2}$ oe<br><b>or</b> $x < -\frac{4}{3}$ oe<br><b>or</b> $-\frac{4}{3} > x > \frac{5}{2}$ oe                                                                                                                                                                                |
|               | Working required                                                                                                                                                                                                        | $x < -\frac{4}{3}$<br>$x > \frac{5}{2}$ |   | A1 oe dep on previous M1<br>Accept $-1.3\dots\dots$ or<br>$\left(-\infty, -\frac{4}{3}\right), \left(\frac{5}{2}, (+)\infty\right)$ or $\left(-\infty, -\frac{4}{3}\right) \cup \left(\frac{5}{2}, (+)\infty\right)$<br>Do not ISW                                                                                                                                                                                                                               |
| Total 4 marks |                                                                                                                                                                                                                         |                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|               |                                                                                                                                                                                                                                              |                    |   |                                                                                                                                                                                                                                                                                                                                  |
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| 21            | eg $\frac{5-2}{3-(-5)} \left( = \frac{3}{8} = 0.375 \right)$ oe or<br>$(2 = -5m + c \text{ and } 5 = 3m + c \text{ leading to})$<br>$(m =) \frac{3}{8} (= 0.375)$ or<br>$(C =) (6, -3) \text{ or } (0, 13)$                                  |                    | 4 | M1<br>for a method to find the gradient of AB<br>or for finding the possible coordinates of C                                                                                                                                                                                                                                    |
|               | eg $\left[ \frac{3}{8} \right] \times m = -1$ oe<br>or $(m =) "-\frac{8}{3}"$ oe<br>or $\frac{5-(-3)}{3-6} \left( = -\frac{8}{3} = -2.6(666...) \right)$<br>or $\frac{5-13}{3-0} \left( = -\frac{8}{3} = -2.6(666...) \right)$               |                    |   | M1ft (indep) for finding the gradient of BC<br><br>Allow perpendicular gradient to be truncated or rounded to 1 dp<br><br>$\left[ \frac{3}{8} \right]$ means their gradient of AB                                                                                                                                                |
|               | eg $5 = "-\frac{8}{3}" \times 3 + c$ or $c = 13$ or $y = "-\frac{8}{3}"x + 13$<br>or $y - 5 = "-\frac{8}{3}"(x - 3)$ oe<br>or $y - -3 = "-\frac{8}{3}"(x - 6)$ oe<br>or $y - 13 = "-\frac{8}{3}"(x - 0)$ oe or $y - 13 = "-\frac{8}{3}"x$ oe |                    |   | M1ft (ft dep on previous M1 for their perpendicular gradient)<br>for substitution to find 'c'<br>or<br>to find an equation for BC<br><br>If students find the coordinates of D $[(-2, -6) \text{ or } (-8, 10)]$ then allow for this mark<br><br>$y - -6 = "-\frac{8}{3}"(x - -2)$ oe or<br>$y - 10 = "-\frac{8}{3}"(x - -8)$ oe |
|               | Working not required, so correct answer scores full marks (unless from obvious incorrect working)                                                                                                                                            | $8x + 3y - 39 = 0$ |   | A1<br>oe $a, b$ and $c$ must be integers<br>eg. $16x + 6y = 78$ or $-8x - 3y + 39 = 0$<br>or $3y = -8x + 39$                                                                                                                                                                                                                     |
| Total 4 marks |                                                                                                                                                                                                                                              |                    |   |                                                                                                                                                                                                                                                                                                                                  |

|    |                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                              |                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| 22 | eg $x^2 + (3x-1)^2 = 3x-1+11$                                                                                                                                                                                                                                             | eg $\left(\frac{y+1}{3}\right)^2 + y^2 = y+11$                                                                                                                                                                                                                                               |                                                    | 5 | M1 for substitution of $y = 3x-1$ (or $x = \frac{\pm y \pm 1}{3}$ ) into $x^2 + y^2 = y+11$ to obtain an equation in $x$ only (or $y$ only)                                                                                                                                                                                                                                                                                                                                      |
|    | $10x^2 - 9x - 9 (=0)$ oe <b>or</b><br>$10x^2 - 9x = 9$ oe <b>or</b><br>$10x^2 = 9 + 9x$ oe                                                                                                                                                                                | $10y^2 - 7y - 98 (=0)$ oe <b>or</b><br>$10y^2 - 7y = 98$ oe <b>or</b><br>$10y^2 = 98 + 7y$ oe                                                                                                                                                                                                |                                                    |   | M1ft dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2 + bx + c (=0)$ where at least 2 coefficients ( $a$ or $b$ or $c$ ) are correct                                                                                                                                                                                                                                                                             |
|    | $(5x+3)(2x-3)(=0)$<br><b>or</b><br>$(x=)\frac{9 \pm \sqrt{(-9)^2 - 4 \times 10 \times (-9)}}{2 \times 10}$<br><b>or</b><br>$10\left[\left(x - \frac{9}{20}\right)^2 - \left(\frac{9}{20}\right)^2\right] - 9 (=0)$<br><b>or</b><br>$x = -0.6$ and $x = 1.5 = \frac{3}{2}$ | $(5y+14)(2y-7)(=0)$<br><b>or</b><br>$(y=)\frac{7 \pm \sqrt{(-7)^2 - 4 \times 10 \times (-98)}}{2 \times 10}$<br><b>or</b><br>$10\left[\left(y - \frac{7}{20}\right)^2 - \left(\frac{7}{20}\right)^2\right] - 98 (=0)$<br><b>or</b><br>$y = -2.8 = -\frac{14}{5}$ and $y = 3.5 = \frac{7}{2}$ |                                                    |   | M1ft dep on first M1 method to solve <b>their</b> 3 term quadratic using any correct method (allow one sign error and some simplification<br>– allow as far as eg $\frac{9 \pm \sqrt{81+360}}{20}$ <b>or</b><br>$\frac{7 \pm \sqrt{49+3920}}{20}$<br><b>or</b> if factorising allow brackets which expanded give 2 out of 3 terms correct)<br><b>or</b> correct values for $x$<br><b>or</b> correct values for $y$<br>(Allow incorrect labels for $x$ or $y$ for this mark only) |
|    | $(y=) 3 \times "-0.6" - 1 (= -2.8)$<br><b>and</b><br>$(y=) 3 \times "1.5" - 1 (=3.5)$                                                                                                                                                                                     | $(x=) \frac{"-2.8"+1}{3} (= -0.6)$<br><b>and</b> $(x=) \frac{"3.5"+1}{3} (=1.5)$                                                                                                                                                                                                             |                                                    |   | M1ft dep on previous M1 for substituting <b>their</b> 2 found values of $x$ or $y$ into one of the two given equations<br><b>or</b> fully correct values for the other variable                                                                                                                                                                                                                                                                                                  |
|    | <i>Working required</i>                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                              | $x = -0.6$<br>$y = -2.8$<br>$x = 1.5$<br>$y = 3.5$ |   | A1 oe dep on M2 for 4 correct values correctly labelled or correctly shown as coordinates                                                                                                                                                                                                                                                                                                                                                                                        |
|    | <b>Total 5 marks</b>                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                              |                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| 23 | (i)  |  | (6, 7)  | 1 | B1                   |
|    | (ii) |  | (2, -3) | 1 | B1                   |
|    |      |  |         |   | <b>Total 2 marks</b> |

|    |     |                                                                                                                                                                                                                                                                                                                                                                                                                  |     |   |                                                                                                                                                                                                   |
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| 24 | (a) | eg<br>$\frac{1}{3} \times \pi \times x^2 \times 3x (= \pi x^3)$ oe or $\frac{1}{2} \times \frac{4}{3} \times \pi \times x^3 (= \frac{4}{6} \pi x^3 = \frac{2}{3} \pi x^3)$ oe or<br>$\frac{4}{3} \times \pi \times (kx)^3$ oe                                                                                                                                                                                    |     | 4 | M1<br>for an expression for the volume of the cone <b>or</b> the hemisphere <b>or</b> the sphere<br><br>NB Ignore missing brackets around $kx$ for this mark<br>Allow $r$ for $x$ for all M marks |
|    |     | eg<br>$\frac{4}{3} \times \pi \times (kx)^3 = 12.5 \times \left( \frac{1}{2} \times \frac{4}{3} \pi x^3 + \frac{1}{3} \pi x^2 (3x) \right)$ oe or<br>$\frac{4}{3} \times \pi \times (kx)^3 = 12.5 \left( \frac{2}{3} \pi x^3 + \pi x^3 \right)$ oe or $\frac{4}{3} \times \pi \times (kx)^3 = 12.5 \times \frac{5}{3} \pi x^3$ oe<br><b>or</b> $\frac{4}{3} \times \pi \times (kx)^3 = \frac{125}{6} \pi x^3$ oe |     |   | M1<br>for a <b>correct</b> equation for the volumes<br><br>NB If $(kx)^3$ not expanded at this stage then must see brackets                                                                       |
|    |     | eg $(k^3 =) \frac{\frac{125}{6} \pi}{\frac{4}{3} \pi}$ oe or $(k^3 =) \frac{125}{8}$ oe or $(k =) \sqrt[3]{\frac{125}{8}}$ oe<br>$k^3 x^3 = \frac{12.5 \times \frac{5}{3} \pi x^3}{\frac{4}{3} \pi}$ oe or $kx = \frac{\sqrt[3]{12.5 \times \frac{5}{3} \pi x^3}}{\sqrt[3]{\frac{4}{3} \pi}}$ <b>or</b> $kx = \sqrt[3]{\frac{125x^3}{8}}$ oe                                                                     |     |   | M1<br>for a <b>correct</b> calculation for $k$ or $k^3$ or<br>for a <b>correct</b> equation for $kx$ or $k^3 x^3$                                                                                 |
|    |     | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                                                                                                                                                                                                                                                                         | 2.5 |   | A1 oe                                                                                                                                                                                             |
|    | (b) |                                                                                                                                                                                                                                                                                                                                                                                                                  | 64  | 1 | B1                                                                                                                                                                                                |
|    |     |                                                                                                                                                                                                                                                                                                                                                                                                                  |     |   | <b>Total 5 marks</b>                                                                                                                                                                              |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |   |                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25<br>(a)<br>(i) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $\frac{8}{5}\mathbf{a} + 3\mathbf{b}$ | 1 | B1oe must be in simplest form<br>eg $1.6\mathbf{a} + 3\mathbf{b}$ or $\frac{8\mathbf{a} + 15\mathbf{b}}{5}$                                                                                                                                                                                                                                                                      |
| (ii)             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $\frac{9}{4}\mathbf{b} - 2\mathbf{a}$ | 1 | B1oe must be in simplest form<br>eg $2.25\mathbf{b} - 2\mathbf{a}$ or $\frac{9\mathbf{b} - 8\mathbf{a}}{4}$                                                                                                                                                                                                                                                                      |
| (b)              | eg $(\overrightarrow{OM} =) 2\mathbf{a} + \frac{3}{4}\mathbf{b}$ oe or $(\overrightarrow{OY} =) k\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right)$ oe or $(\overrightarrow{YN} =)(1-k)\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right)$<br>oe or $(\overrightarrow{OY} =) 2\mathbf{a} + \frac{3}{4}\mathbf{b} + \lambda\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ oe or<br>$(\overrightarrow{OY} =) 3\mathbf{b} - \mu\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                       | 4 | M1ft ft their answers in (a)<br>for a correct expression for a<br>vector eg $\overrightarrow{OM}$ or $\overrightarrow{OY}$ or $\overrightarrow{YN}$<br>Students may use other<br>variations eg $\overrightarrow{MO}$ or $\overrightarrow{YO}$ or $\overrightarrow{NY}$<br>For all M marks<br>Allow any letter for $k$ eg $n, \lambda$<br>Allow any letter for $\lambda$ eg $\mu$ |
|                  | eg $(\overrightarrow{OY} =) k\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right)$ oe and $2\mathbf{a} + \frac{3}{4}\mathbf{b} + \lambda\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ oe or<br>$(\overrightarrow{OY} =) k\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right)$ oe and $3\mathbf{b} - \mu\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ oe or<br>$(\overrightarrow{OM} =) 2\mathbf{a} + \frac{3}{4}\mathbf{b}$ oe and $k\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right) - \lambda\left(-2\mathbf{a} + \frac{9}{4}\mathbf{b}\right)$ oe or<br>$(\overrightarrow{YN} =)(1-k)\left(\frac{8}{5}\mathbf{a} + 3\mathbf{b}\right)$ oe and $-\lambda\left(-2\mathbf{a} + \frac{9}{4}\mathbf{b}\right) + \frac{3}{4}(3\mathbf{b}) - \frac{1}{5}(2\mathbf{a})$ oe or<br>$(\overrightarrow{OY} =) 2\mathbf{a} + \frac{3}{4}\mathbf{b} + \lambda\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ and $3\mathbf{b} - \mu\left(\frac{9}{4}\mathbf{b} - 2\mathbf{a}\right)$ |                                       |   | M1ft for 2 independent expressions<br>for the same vector (may be<br>embedded in a correct equation)                                                                                                                                                                                                                                                                             |
|                  | eg $3k = \frac{3}{4} + \frac{9}{4}\left(1 - \frac{4}{5}k\right)$ oe or $3k = 3 - \frac{9}{4}\left(\frac{4}{5}k\right)$ oe or<br>$4k = 3\left(\frac{5-4k}{5}\right) + 1$ oe or $\lambda = 0.5$ oe or $\mu = 0.5$ oe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                       |   | M1 a <b>correct</b> equation for $k$ or the<br>correct value of $\lambda$ or $\mu$ (cannot<br>assume that Y is the midpoint of<br>$MR$ )                                                                                                                                                                                                                                         |
|                  | Question requires a complete <b>vector method</b> to be awarded marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | $\frac{5}{8}$                         |   | A1oe dep on M2                                                                                                                                                                                                                                                                                                                                                                   |
|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |   | <b>Total 6 marks</b>                                                                                                                                                                                                                                                                                                                                                             |

|    |                                                                                                                                                              |                                                                                      |                 |   |                                                                                                                                                                       |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 26 | $(3x-5)(x+2)$                                                                                                                                                | $\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{3x^2+x-10}$ oe<br>or<br>$\frac{27x-45}{3x^2+x-10}$ |                 | 4 | M1 for correctly factorising $3x^2+x-10$ to give $(3x-5)(x+2)$ (may be seen later on in working)<br><b>OR</b><br>combining 2 fractions into a correct single fraction |
|    | $\frac{4x-1}{x+2}$<br>implies first M1                                                                                                                       | $\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{(3x-5)(x+2)}$<br>or $\frac{27x-45}{(3x-5)(x+2)}$   |                 |   | M1 for inverting and cancelling giving a correct fraction<br><b>OR</b><br>for a correct single fraction where the denominator is factorised                           |
|    | $\frac{4(x+2)-(4x-1)}{x+2}$<br>or<br>$\frac{4x+8-4x+1}{x+2}$<br>or<br>$\frac{4(x+2)}{x+2} - \frac{4x-1}{x+2}$<br>or<br>$\frac{4x+8}{x+2} - \frac{4x-1}{x+2}$ | $\frac{9(3x-5)}{(3x-5)(x+2)}$                                                        |                 |   | M1 for a correct single fraction or two correct fractions with a common denominator<br><br><b>OR</b><br><br>for a correct fully factorised single fraction            |
|    | <i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>                                                     |                                                                                      | $\frac{9}{x+2}$ |   | A1                                                                                                                                                                    |
|    |                                                                                                                                                              |                                                                                      |                 |   | <b>Total 4 marks</b>                                                                                                                                                  |

