

# Mark Scheme (Results)

## Summer 2017

Pearson Edexcel International GCSE In Mathematics A (4MA0) Paper 4HR



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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)
- $\circ$  dep dependent
- indep independent
- $\circ$  eeoo 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.

Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.

If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.

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 in another.

| International GCS                                                                                                                       | SE Maths                                                                                                                                                                                               |        |      |    |                                                                       |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|----|-----------------------------------------------------------------------|--|--|--|
| Apart from questions 9, 14, 17, 21b and 23 (where the mark scheme states otherwise) the correct answer, unless clearly obtained from an |                                                                                                                                                                                                        |        |      |    |                                                                       |  |  |  |
| incorrect method, should be taken to imply a correct method.                                                                            |                                                                                                                                                                                                        |        |      |    |                                                                       |  |  |  |
| Q                                                                                                                                       | Working                                                                                                                                                                                                | Answer | Mark |    | Notes                                                                 |  |  |  |
| <b>1</b> (a)                                                                                                                            | Eg $\frac{30}{12} \times 110$ or $2.5 \times 110$ or $\frac{30}{12}$ or 2.5 or<br>$\frac{110}{12} \times 30$ or $9.16(666) \times 30$ or $\frac{110}{12}$ or $9.16(666)$ oe                            |        | 2    | M1 | Accept 9.16(666) rounded or truncated to at least 3 SF                |  |  |  |
|                                                                                                                                         | 12 12                                                                                                                                                                                                  | 275    |      | A1 |                                                                       |  |  |  |
|                                                                                                                                         | Eg $\frac{375}{100} \times 12 \text{ or } 3.75 \times 12 \text{ or}$<br>$375 \div \frac{100}{12} \text{ or } 375 \div 8.33(333) \text{ or}$<br>$\frac{12}{100} \times 375 \text{ or } 0.12 \times 375$ |        | 2    | M1 | For a complete method<br>Accept 8.33(333) rounded to at<br>least 3 SF |  |  |  |
|                                                                                                                                         | 100                                                                                                                                                                                                    | 45     |      | A1 |                                                                       |  |  |  |
|                                                                                                                                         |                                                                                                                                                                                                        |        |      |    | Total 4 marks                                                         |  |  |  |

| <b>2</b> (a) (i) | 5, 15                   | 1 | B1 |                                 |
|------------------|-------------------------|---|----|---------------------------------|
| (ii)             | 5, 7, 9, 10, 11, 13, 15 | 1 | B1 |                                 |
| (b)              | 4, 6, 8, 10, 12, 14     | 2 | B2 | B2 for all correct and none     |
|                  |                         |   |    | incorrect.                      |
|                  |                         |   |    | If not B2 then B1 for 4 or more |
|                  |                         |   |    | correct and no more than 1      |
|                  |                         |   |    | incorrect.                      |
|                  |                         |   |    | Total 4 marks                   |

| <b>3</b> (a) | 14.37028405 | 2 | M1<br>A1 | 102.66 or 1.843(9) or 7.143(9)<br>Accept 14.37(028) rounded or<br>truncated to at least 4SF |
|--------------|-------------|---|----------|---------------------------------------------------------------------------------------------|
| (b)          | 14.4        | 1 | B1 ft    | As long as from at least 4sf                                                                |
|              |             |   |          | Total 3 marks                                                                               |

| 4 | $10 \times 4.2 \times 7.5 \text{ or } 315 \text{ (cm}^3) \text{ oe}$                                                  |    | 4 | M1         | For volume of cuboid                  |
|---|-----------------------------------------------------------------------------------------------------------------------|----|---|------------|---------------------------------------|
|   | Eg $0.5 \times 7 \times x \times 5$ or $17.5x$ oe                                                                     |    |   | M1         | indep                                 |
|   |                                                                                                                       |    |   |            | For volume of triangular prism        |
|   | $10 \times 4.2 \times 7.5 = 0.5 \times 7 \times x \times 5 \text{ or } 17.5x = 315$                                   |    |   | <b>M</b> 1 | Dep on M2                             |
|   | oe or                                                                                                                 |    |   |            | For a correct equation involving      |
|   | $\frac{10 \times 4.2 \times 7.5}{0.5 \times 7 \times 5} \text{ or } \frac{"315"}{"17.5"} \text{ oe}$                  |    |   |            | volume of cuboid and volume of        |
|   | $\frac{-0.5 \times 7 \times 5}{-0.5 \times 7 \times 5}$ or $\frac{-0.5 \times 7 \times 5}{-0.5 \times 7 \times 5}$ or |    |   |            | prism or                              |
|   |                                                                                                                       |    |   |            | For a correct expression for <i>x</i> |
|   |                                                                                                                       | 18 |   | A1         | 18                                    |
|   |                                                                                                                       |    |   |            | SCB2 for For volume of cuboid =       |
|   |                                                                                                                       |    |   |            | 315 and final answer $= 9$            |
|   |                                                                                                                       |    |   |            | Total 4 marks                         |

| <b>5</b> (a) |                                                         | 12 - 28c        | 1 | B1 |                                                                                                                                                |
|--------------|---------------------------------------------------------|-----------------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------|
| (b)          |                                                         | y(y + 8)        | 1 | B1 |                                                                                                                                                |
| (c)          | $x^2 - 3x + 7x - 21$                                    |                 | 2 | M1 | For 3 correct terms<br>or for 4 correct terms ignoring signs<br>or for $x^2 + 4x + c$ for any non-zero<br>value of <i>c</i> or for + $4x - 21$ |
|              |                                                         | $x^2 + 4x - 21$ |   | A1 | cao                                                                                                                                            |
| (d)          | 5p - 3p = 9 or $2p = 9$ or $-9 = 3p - 5p$ or $-9 = -2p$ |                 | 2 | M1 |                                                                                                                                                |
|              |                                                         | 4.5             |   | A1 | oe                                                                                                                                             |
|              |                                                         |                 |   |    | eg $\frac{9}{2}$ or $4\frac{1}{2}$                                                                                                             |
| (e)          |                                                         | y <sup>11</sup> | 1 | B1 |                                                                                                                                                |
| (f)          |                                                         | $h^8$           | 1 | B1 |                                                                                                                                                |
| (g)          |                                                         | $e^{15}$        | 1 | B1 |                                                                                                                                                |
|              |                                                         |                 |   |    | Total 9 marks                                                                                                                                  |

| 6 | (a) |                                                                                     | $30 < d \le 40$ | 1 | B1         | Accept 30–40                                  |
|---|-----|-------------------------------------------------------------------------------------|-----------------|---|------------|-----------------------------------------------|
| - |     | $5\sqrt{5} + 15\sqrt{10} + 25\sqrt{17} + 25\sqrt{20} + 45\sqrt{6}$ or               | 50 < u <u></u>  | 1 |            | 1                                             |
|   | (b) | $5 \times 5 + 15 \times 12 + 25 \times 17 + 35 \times 20 + 45 \times 6$ or          |                 | 4 | M2         | $f \times d$ for at least 4 products with     |
|   |     | 25 + 180 + 425 + 700 + 270 <b>or</b>                                                |                 |   |            | correct mid- interval values and              |
|   |     | 1600                                                                                |                 |   |            | intention to add.                             |
|   |     |                                                                                     |                 |   |            |                                               |
|   |     |                                                                                     |                 |   |            | If not M2 then award M1 for                   |
|   |     |                                                                                     |                 |   |            | d used consistently for at least 4            |
|   |     |                                                                                     |                 |   |            | products within interval (including           |
|   |     |                                                                                     |                 |   |            | end points) and intention to add              |
|   |     |                                                                                     |                 |   |            | or                                            |
|   |     |                                                                                     |                 |   |            | for at least 4 correct products with          |
|   |     |                                                                                     |                 |   |            | correct mid-interval values with no           |
|   |     |                                                                                     |                 |   |            | intention to add                              |
|   |     | $\frac{25+180+425+700+270}{25+180+425+700+270}$ or $\left(=\frac{1600}{100}\right)$ |                 |   | <b>M</b> 1 | dep on M1 (ft their products)                 |
|   |     | $\frac{25+180+425+700+270}{5+12+17+20+6} \text{ or } \left(=\frac{1600}{60}\right)$ |                 |   |            | NB: accept their 60 if addition of            |
|   |     | 3+12+17+20+0 ( 00 )                                                                 |                 |   |            | frequencies is shown                          |
|   |     |                                                                                     | 26.7            |   | A1         | Accept 26.6 – 26.7 inclusive                  |
|   |     |                                                                                     |                 |   |            | Accept 27 if M3 awarded                       |
|   |     |                                                                                     |                 |   |            | Do not accept fractions or mixed              |
|   |     |                                                                                     |                 |   |            | -                                             |
|   |     |                                                                                     |                 |   |            | numbers, eg $\frac{80}{3}$ or $26\frac{2}{3}$ |
|   |     |                                                                                     |                 |   |            | 3 3                                           |
|   |     |                                                                                     |                 |   |            | Total 5 marks                                 |

| <b>7</b> (a) | $4x \ge 27 - 13 \text{ or } 4x \ge 14$<br>or $-4x \le 13 - 27 \text{ or } -4x \le -14$ |                    | 2 | M1 | Accept an equation in place of an<br>inequality or<br>accept wrong inequality sign or<br>accept 3.5 oe given as answer                                         |
|--------------|----------------------------------------------------------------------------------------|--------------------|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |                                                                                        | $x \ge 3.5$        |   | A1 | oe<br>Must be the final answer                                                                                                                                 |
| (b)          |                                                                                        | Correct line drawn | 1 | B1 | For a closed circle at -1 with line<br>that goes at least as far as 3 or<br>for a closed circle at -1 with an<br>arrow on a line pointing to the<br>right      |
| (c)          |                                                                                        | -2, -1, 0, 1, 2    | 2 | B2 | B1 for list with one error or<br>omission:<br>e.g.<br>-2, -1, 0, 1, 2, 3;<br>-1, 0, 1, 2;<br>-2, -1, 1, 2;<br>-3, -2, -1, 0, 1, 2<br>SCB1 for -3, -2, -1, 0, 1 |
|              |                                                                                        |                    |   |    | Total 5 marks                                                                                                                                                  |

| 8 | $(x^2 =) 18^2 - 13^2$ or $324 - 169$ or $155$                       |      | 3 | M1    | Squaring and subtracting      |
|---|---------------------------------------------------------------------|------|---|-------|-------------------------------|
|   | $(x =) \sqrt{18^2 - 13^2}$ or $\sqrt{"155"}$                        |      |   | M1dep | for square rooting            |
|   |                                                                     | 12.4 |   | A1    | Accept 12.4 – 12.46 inclusive |
|   | Alternative Methods - Using Trigonometry                            |      |   |       |                               |
|   | Eg sin <sup>-1</sup> ( $\frac{13}{18}$ ) and 18cos"46.2(382)" oe or |      |   | M2    | For a complete method         |
|   | $\cos^{-1}(\frac{13}{18})$ and $18\sin''43.7(617)$ " oe             |      |   |       |                               |
|   |                                                                     |      |   | A1    | Accept 12.4 – 12.46 inclusive |
|   |                                                                     |      |   |       | Total 3 marks                 |

| 9 | Eg 9x = 22.5 or 18y = 27 or $-18y = -27$ or<br>5x - (13 - 4x) = 9.5 or $4x + 5x - 9.5 = 13$ or<br>$5\left(\frac{13 - 2y}{4}\right) - 2y = 9.5$ or<br>$4\left(\frac{9.5 + 2y}{5}\right) + 2y = 13$ |                                | 3 | M1       | For a complete method to<br>eliminate one variable (condone<br>one arithmetic error)                                                                                                 |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | Eg 5 × "2.5" – 2y = 9.5 or 5x – 2 × "1.5" = 9.5                                                                                                                                                   | <i>x</i> = 2.5, <i>y</i> = 1.5 |   | M1<br>A1 | Dep on M1<br>For substituting the other variable<br>or starting again to eliminate the<br>other variable<br>dep on M1<br>NB: candidates showing no correct<br>working score 0 marks. |
|   |                                                                                                                                                                                                   |                                |   |          | Total 3 marks                                                                                                                                                                        |

| <b>10</b> (a) | 22 000 000          | 1 | B1            |
|---------------|---------------------|---|---------------|
| (b)           | $9.5 \times 10^{5}$ | 1 | B1            |
|               |                     |   | Total 2 marks |

| 11 | $7500 \times 0.04$ or $300$ or $7500 \times 1.04$ or $7800$<br>or $7500 \times 1.04^n$ ( $n > 1$ )                                                         |         | 3 | M1 | For interest for first year or<br>for $7500 \times 0.04 \times 3$ oe or $900$<br>or<br>for $7500 + 7500 \times 0.04 \times 3$ oe<br>or an answer of $8400$ | M2 for $7500 \times 1.04^3$ oe |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|    | Eg 7500 + $\frac{4}{100}$ × 7500 + $\frac{4}{100}$ × (7500 +<br>"300")<br>+ $\frac{4}{100}$ × (7500 + "300" + "312") or<br>7500 + "300" + "312" + "324.48" | 8436.48 |   | M1 | For a complete method                                                                                                                                      |                                |
|    |                                                                                                                                                            |         |   | A1 | Accept answers in the range 843<br>NB: Answer in the range 936 -9                                                                                          |                                |
|    |                                                                                                                                                            |         |   |    |                                                                                                                                                            | Total 3 marks                  |

| <b>12</b> (a) |                                                                           | $y = \frac{1}{2}x - 1$ oe         | 2 | M1<br>A1   | For $(y=) \frac{3}{6}x + c$ (c may be any<br>number or letter) or<br>For $(y=)mx-1$ where <i>m</i> is non-<br>zero or for<br>Gradient = $\frac{3}{6}$ oe or $m = \frac{3}{6}$ oe<br>clearly stated<br>For a fully a correct equation for <b>L</b><br>Eg<br>$y = \frac{3}{6}x-1$ or $2y = x-2$ or |
|---------------|---------------------------------------------------------------------------|-----------------------------------|---|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                                                           |                                   |   |            | 6<br>$y - 1 = \frac{1}{2}(x - 4)$ or<br>$y - 2 = \frac{1}{2}(x - 2)$<br>M1A0 for $L = \frac{1}{2}x - 1$ or $\frac{1}{2}x - 1$                                                                                                                                                                    |
| (b)           | $4 = "\frac{1}{2}" \times 5 + c \text{ or } y - 4 = "\frac{1}{2}"(x - 5)$ | $y = \frac{1}{2}x + 1\frac{1}{2}$ | 2 | M1ft<br>A1 | For correct substitution of given<br>coordinate into their equation<br>Follow through their gradient in (a)<br>oe<br>Eg $y = \frac{1}{2}(x+3)$<br>SCB1 for $(l =)\frac{1}{2}x + 1\frac{1}{2}$                                                                                                    |
|               |                                                                           |                                   |   |            | Total 4 marks                                                                                                                                                                                                                                                                                    |

| 13 | (Angle $ABD =$ ) $\tan^{-1}(\frac{5}{9})$ or (Angle $ADB =$ ) $\tan^{-1}(\frac{9}{5})$ or<br>(Angle $ABC =$ ) $\cos^{-1}(\frac{9}{15})$ or (Angle $ACB =$ ) $\sin^{-1}(\frac{9}{15})$<br>( $BD =$ ) $\sqrt{9^2 + 5^2}$ or ( $AC =$ ) $\sqrt{15^2 - 9^2}$ ( $DC =$ ) $\sqrt{15^2 - 9^2} - 5$                                                           |    | 4 | M1 | For correct method to find angle <i>ABD</i> or <i>ADB</i> or <i>ABC</i> or <i>ACB</i> or for correct method to find side <i>BD</i> , <i>AC</i> or <i>DC</i> .                                                                                                         |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                       |    |   | A1 | For angle $ABD = 29.(0546)$ or<br>for angle $ADB = 60.(9453)$ or<br>for angle $ABC = 53.(1301)$ or<br>for angle $ACB = 36.(8698)$ or<br>For $BD = \sqrt{106}$ or $10.(2956)$ or<br>for $AC = 12$ or<br>for $DC = 7$<br>Accept rounded or truncated to at<br>least 2SF |
|    | Eg (x =) $\cos^{-1}(\frac{9}{15}) - \tan^{-1}(\frac{5}{9})$ or<br>(x =) $180 - 90 - "29.(0546)" - "36.(8698)"$ or<br>$\cos x = \frac{15^2 + "10.(2956)"^2 - 7^2}{2 \times 15 \times "10.(2956)"}$ or $\cos x = 0.913(009)$ or<br>$\sin x = \frac{7\sin"36.(8698)"}{\sqrt{106}}$ or $\sin x = \frac{7\sin"119.(054)"}{15}$ or<br>$\sin x = 0.407(940)$ |    |   | M1 | For a complete method to find x or<br>$\sin x$ or $\cos x$<br>Accept $0.912 \le \cos x \le 0.9152$<br>Accept $0.407 \le \sin x \le 0.413$                                                                                                                             |
|    |                                                                                                                                                                                                                                                                                                                                                       | 24 |   | A1 | Awrt 24                                                                                                                                                                                                                                                               |
|    |                                                                                                                                                                                                                                                                                                                                                       |    |   |    | Total 4 marks                                                                                                                                                                                                                                                         |

| 14 | 6(5-x) - 6(x-1)                                       |     | 4 | M1         | For a clear intention to multiply   |
|----|-------------------------------------------------------|-----|---|------------|-------------------------------------|
|    | $\frac{6(5-x)}{2} - \frac{6(x-1)}{3} = 6 \times 1$ or |     |   |            | both sides by 6 or a multiple of 6  |
|    | $2^{2} - 3^{3}$<br>3(5-x) - 2(x - 1) = 6 or           |     |   |            | or to express LHS as a single       |
|    |                                                       |     |   |            | fraction with denominator of 6 or a |
|    | $\frac{3(5-x)-2(x-1)}{6}$ (=1) or                     |     |   |            | multiple of 6 or to express LHS as  |
|    |                                                       |     |   |            | the sum of 2 fractions with         |
|    | $\frac{3(5-x)}{6} - \frac{2(x-1)}{6}(=1)$             |     |   |            | denominator of 6 or a multiple of 6 |
|    | 6 6                                                   |     |   |            | denominator of 0 of a manuple of 0  |
|    | 15 - 3x - 2x + 2 = 6 or                               | -   |   | M1         | Expanding brackets in a correct     |
|    | $\frac{15 - 3x - 2x + 2}{1} = 1$                      |     |   |            | equation.                           |
|    | <u> </u>                                              |     |   |            | -                                   |
|    | $\frac{15-3x}{2x-2} = 1$                              |     |   |            |                                     |
|    |                                                       |     |   |            |                                     |
|    | $\begin{array}{cccccccccccccccccccccccccccccccccccc$  |     |   | 1          |                                     |
|    | Eg - 3x - 2x = 6 - 2 - 15 or $-5x = -11$ or           |     |   | <b>M</b> 1 | dep on both preceding marks for a   |
|    | 3x + 2x = 15 + 2 - 6 or $5x = 11$                     |     |   |            | correct rearrangement of a correct  |
|    |                                                       |     |   |            | equation with terms in x on one     |
|    |                                                       |     |   |            | side and numbers on the other.      |
|    |                                                       | 2.2 |   | A1         | oe                                  |
|    |                                                       |     |   |            | Dependent on M2                     |
|    |                                                       |     |   |            | Total 4 marks                       |

| 15 ( | a)(i) |                         | 61°               | 1 | B1 |                                    |
|------|-------|-------------------------|-------------------|---|----|------------------------------------|
|      | (ii)  |                         | Alternate segment | 1 | B1 | Dep on B1 for (a)(i)               |
|      |       |                         | theorem           |   |    | Accept alternate segment(s)        |
|      |       |                         |                   |   |    | Accept angles in alternate         |
|      |       |                         |                   |   |    | segments are equal or              |
|      |       |                         |                   |   |    | Accept Angle between a chord and   |
|      |       |                         |                   |   |    | a tangent is equal to the angle on |
|      |       |                         |                   |   |    | the circumference subtended/made   |
|      |       |                         |                   |   |    | by the same chord                  |
| (    | b)    | 180 - (180 - (61 + 53)) |                   | 2 | M1 | For 61 + 53 or 180 - 66            |
|      |       |                         | 114°              |   | A1 | cao                                |
|      |       |                         |                   |   |    | Total 4 marks                      |

| <b>16</b> (a) | $\frac{2}{6} \times \frac{1}{5}$ oe                                                                                                                                                                                                                                                                                                                     |                | 2 | M1 | For a complete method                                                                                |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---|----|------------------------------------------------------------------------------------------------------|
|               |                                                                                                                                                                                                                                                                                                                                                         | $\frac{1}{15}$ |   | A1 | oe<br>Eg $\frac{2}{30}$<br>Accept 0.066(666) rounded or<br>truncated to at least 3 decimal<br>places |
| (b)           | $\frac{4}{6} \times \frac{3}{5} \text{ or } 0.4 \text{ or } \frac{2}{6} \times \frac{1}{5} \text{ or } 0.066(666) \text{ or}$ $\frac{1}{6} \times \frac{3}{5} \text{ or } \frac{3}{6} \times \frac{1}{5} \text{ or } 0.1 \text{ or } \frac{3}{6} \times \frac{2}{5} \text{ or } 0.2 \text{ or } \frac{2}{6} \times \frac{1}{5} \text{ or}$ $0.066(666)$ |                | 3 | M1 | One correct product that gives an even number                                                        |
|               | $\frac{\frac{4}{6} \times \frac{3}{5} + \frac{2}{6} \times \frac{1}{5} \text{ or}}{\frac{1}{6} \times \frac{3}{5} + \frac{3}{6} \times \frac{1}{5} + \frac{3}{6} \times \frac{2}{5} + \frac{2}{6} \times \frac{1}{5}}$                                                                                                                                  |                |   | M1 | Sum of correct products                                                                              |
|               |                                                                                                                                                                                                                                                                                                                                                         | $\frac{7}{15}$ |   | A1 | oe<br>Accept 0.466(666) rounded or<br>truncated to at least 3 decimal<br>places                      |

| With Replacement $\frac{4}{6} \times \frac{4}{6}$ or 0.444(444) or $\frac{2}{6} \times \frac{2}{6}$ or 0.111(111) or $\frac{1}{6} \times \frac{3}{6}$ or $\frac{3}{6} \times \frac{1}{6}$ or 0.083(333) or $\frac{2}{6} \times \frac{2}{6}$ or 0.111(111) or $\frac{3}{6} \times \frac{3}{6}$ or 0.25 or $\frac{1}{6} \times \frac{1}{6}$ or 0.027(777) $\frac{4}{6} \times \frac{4}{6} + \frac{2}{6} \times \frac{2}{6}$ oe or $\frac{1}{6} \times \frac{3}{6} + \frac{3}{6} \times \frac{1}{6} + \frac{2}{6} \times \frac{2}{6} + \frac{3}{6} \times \frac{3}{6} + \frac{1}{6} \times \frac{1}{6}$ oe or         or $\frac{5}{9}$ or 0.555(555) |                |   | M1<br>M1                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---|------------------------------------------------------------------------------------------|
| Alternative method<br>$1 - \left(\frac{2}{6} \times \frac{4}{5} + \frac{4}{6} \times \frac{2}{5}\right) \text{ oe}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $\frac{7}{15}$ | 3 | M2<br>A1 oe<br>Accept 0.466(666) rounded or<br>truncated to at least 3 decimal<br>places |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |   | Total 5 marks                                                                            |

|                                                                                                                                                                                                                                                                                                                                                   |                   | - |    |                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17<br>$\frac{3\pm\sqrt{9+220}}{22} \text{ or } \frac{3\pm\sqrt{9+220}}{2\times11} \text{ or } \frac{3\pm\sqrt{(-3)^2220}}{2\times11} \text{ or } \frac{3\pm\sqrt{(-3)^2220}}{22}$ NB: denominator must be 2×11 or 22 and there must be evidence for correct order of operations in the numerator Do not accept sign error or omission of brackets |                   | 3 | M2 | Or for<br>$\frac{3\pm\sqrt{(-3)^2-4\times11\times-5}}{2\times11}$ (allow<br>partial correct evaluation)<br>and $\frac{3\pm\sqrt{229}}{22}$<br>If not M2 then<br>M1 for<br>$\frac{3\pm\sqrt{(-3)^2-4(11)(-5)}}{2\times11}$ Condone one sign error in<br>substitution;<br>Condone omission of brackets<br>Allow partial correct evaluation |
|                                                                                                                                                                                                                                                                                                                                                   | 0.82 and<br>-0.55 |   | A1 | for awrt 0.82 <b>and</b> awrt -0.55<br>Award M2 A1 for awrt 0.82, -0.55<br>with sufficient correct working that<br>would gain at least M1                                                                                                                                                                                                |
| Alternative scheme                                                                                                                                                                                                                                                                                                                                |                   |   |    |                                                                                                                                                                                                                                                                                                                                          |
| $11[(x-\frac{3}{22})^2 - \frac{229}{484}]$ oe                                                                                                                                                                                                                                                                                                     |                   |   | M1 |                                                                                                                                                                                                                                                                                                                                          |
| $11[(x-\frac{1}{22})^2 - \frac{1}{484}]$ oe                                                                                                                                                                                                                                                                                                       |                   |   |    |                                                                                                                                                                                                                                                                                                                                          |

| $\frac{3}{22} \pm \sqrt{\frac{229}{484}}$ oe |                   | M1                                                                                                                                           |
|----------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|                                              | 0.82 and<br>-0.55 | A1 for awrt 0.82 <b>and</b> awrt -0.55<br>Award M2 A1 for awrt 0.82, -0.55<br>with sufficient correct working that<br>would gain at least M1 |
|                                              |                   | Total 3 marks                                                                                                                                |

| 18 | $480 = k \times 5^2$ or $480 \propto k \times 5^2$ oe or |      | 3 | M1                      |
|----|----------------------------------------------------------|------|---|-------------------------|
|    | or $(k =) \frac{480}{5^2}$ or $(k =)$ 19.2 oe            |      |   |                         |
|    | $k \propto \frac{480}{5^2}$ or $k \propto 19.2$ oe       |      |   |                         |
|    | "19.2" × 1.5 <sup>2</sup>                                |      |   | M1 Dep on M1            |
|    |                                                          |      |   | or for $A = 19.2x^2$ oe |
|    |                                                          | 43.2 |   | A1 oe                   |
|    |                                                          |      |   | Total 3 marks           |

| 19 | (a) | Frequency densities: 1.2, 2.8, 1.6, 0.4, 0.2                                                                                             |           | 3 | M1 | For 3 or more correctly calculated<br>freq densities or<br>For a correct scale indicated or<br>1 small square = 1 (person)<br>1 big square = 25 (people) |
|----|-----|------------------------------------------------------------------------------------------------------------------------------------------|-----------|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |     |                                                                                                                                          |           |   | M1 | For at least 2 additional correct<br>bars (with or without scale)<br>Implies first M1                                                                    |
|    |     |                                                                                                                                          | A fully   |   | A1 | All 4 additional bars correct                                                                                                                            |
|    |     |                                                                                                                                          | correct   |   |    |                                                                                                                                                          |
|    |     |                                                                                                                                          | histogram |   |    |                                                                                                                                                          |
|    | (b) | $\begin{vmatrix} \frac{100}{150} \times 240 + 100 \text{ or } 1.6 \times 100 + 100 \text{ or } ``160'' + 100 \\ \text{oe} \end{vmatrix}$ |           | 2 | M1 | A fully complete method to find<br>the number of people who took<br>from 200 to 300 minutes + 100                                                        |
|    |     | or $600 - (120 + 140 + \frac{1}{3} \times 240)$ or                                                                                       |           |   |    |                                                                                                                                                          |
|    |     | $600 - (120 + 140 + 50 \times 1.6))$ or $600 - 340$ oe                                                                                   |           |   |    |                                                                                                                                                          |
|    |     |                                                                                                                                          | 260       |   | A1 |                                                                                                                                                          |
|    |     |                                                                                                                                          |           |   |    | Total 5 marks                                                                                                                                            |

| <b>20</b> (a) |                                                                                                                                                                                             | -5              | 1 | B1                                            |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---|-----------------------------------------------|
| (b)           |                                                                                                                                                                                             | 23              | 1 | B1                                            |
| (c)           | $(f(-7)) = \frac{1}{-7+5}$ or $(f(-7)) = -\frac{1}{2}$ or                                                                                                                                   |                 | 2 | M1                                            |
|               | $2\left(\frac{1}{-7+5}\right)+3 \text{ or } 2 \times -\frac{1}{2}+3$                                                                                                                        |                 |   |                                               |
|               |                                                                                                                                                                                             | 2               |   | A1                                            |
| (d)           | $x-3=2y \text{ or } \frac{x}{2}=y+\frac{3}{2} \text{ or}$                                                                                                                                   |                 | 2 | M1                                            |
|               | $y-3 = 2x \text{ or } \frac{y}{2} = x + \frac{3}{2} \text{ or}$                                                                                                                             |                 |   |                                               |
|               | $x-3 = 2y \text{ or } \frac{x}{2} = y + \frac{3}{2} \text{ or}$<br>$y-3 = 2x \text{ or } \frac{y}{2} = x + \frac{3}{2} \text{ or}$<br>$\frac{y-3}{2} \text{ or } \frac{y}{2} - \frac{3}{2}$ |                 |   |                                               |
|               |                                                                                                                                                                                             |                 |   | A 1                                           |
|               |                                                                                                                                                                                             | $\frac{x-3}{2}$ |   | A1 oe                                         |
|               |                                                                                                                                                                                             | 2               |   | $\operatorname{Eg} \frac{x}{2} - \frac{3}{2}$ |
|               |                                                                                                                                                                                             |                 |   | Total 6 marks                                 |

|                   |                                                                                                             | 21 (                        | 1 | D 1  | 0                                                                                                         |
|-------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|---|------|-----------------------------------------------------------------------------------------------------------|
| <b>21</b> (a) (i) |                                                                                                             | 3 <b>b</b> – 6 <b>a</b>     | I | B1   | Oe                                                                                                        |
|                   |                                                                                                             |                             |   |      | Need not be simplified                                                                                    |
|                   |                                                                                                             |                             |   |      | Mark the final answer                                                                                     |
| (ii)              |                                                                                                             | $2\mathbf{b} - 4\mathbf{a}$ | 1 | B1ft | $oe eg \frac{2}{3}('3b - 6a')$                                                                            |
|                   |                                                                                                             |                             |   |      | Need not be simplified                                                                                    |
|                   |                                                                                                             |                             |   |      | Mark the final answer                                                                                     |
| (iii)             |                                                                                                             | 6 <b>b</b> – 3 <b>a</b>     | 1 | B1   | oe                                                                                                        |
|                   |                                                                                                             |                             |   |      | Need not be simplified                                                                                    |
|                   |                                                                                                             |                             |   |      | Mark the final answer                                                                                     |
| (b)               | Eg $\overrightarrow{XY} = 2\mathbf{b} - \mathbf{a}$ oe or $\overrightarrow{YB} = 4\mathbf{b} - 2\mathbf{a}$ |                             | 2 | M1   | Work out $\overrightarrow{XY}$ or $\overrightarrow{YX}$ or $\overrightarrow{YB}$ or $\overrightarrow{BY}$ |
|                   |                                                                                                             | shown                       |   | A1   | Dep on M1                                                                                                 |
|                   |                                                                                                             |                             |   |      | Correct conclusion from correct                                                                           |
|                   |                                                                                                             |                             |   |      | simplified vectors                                                                                        |
|                   |                                                                                                             |                             |   |      | Eg $\overrightarrow{XB} = 3\overrightarrow{XY}$ or $\overrightarrow{YB} = 2\overrightarrow{XY}$ or        |
|                   |                                                                                                             |                             |   |      | $\overrightarrow{XB} = 1.5\overrightarrow{YB}$                                                            |
|                   |                                                                                                             |                             |   |      | or <i>XB</i> and <i>XY</i> are parallel                                                                   |
|                   |                                                                                                             |                             |   |      | or YB and XY are parallel                                                                                 |
|                   |                                                                                                             |                             |   |      | or XB and YB are parallel                                                                                 |
|                   |                                                                                                             |                             |   |      | Total 5 marks                                                                                             |

| 22 |                                                                                                                                                                                                                                                       |      | 4 | B1 | Identifying correct triangle                                                               |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|----|--------------------------------------------------------------------------------------------|
|    | $\sqrt{8^2 + 15^2}$ or $\sqrt{289}$ or 17                                                                                                                                                                                                             |      |   | M1 | Complete method to find <i>MG</i>                                                          |
|    | Eg tan24 = $\frac{BG}{\sqrt{8^2 + 15^2}}$ or tan24 = $\frac{BG}{17}$<br>or $\frac{BG}{\sin 24} = \frac{\sqrt{8^2 + 15^2}}{\sin(90 - 24)}$ or $\frac{BG}{\sin 24} = \frac{17}{\sin 66}$<br>(BG =) 17tan24 or (BG=) $\frac{17}{\sin 66} \times \sin 24$ |      |   | M1 | Dep<br>For a correct equation involving<br>BG or a correct expression for BG<br>Implies B1 |
|    |                                                                                                                                                                                                                                                       | 7.57 |   | A1 | Accept 7.56 – 7.57                                                                         |
|    |                                                                                                                                                                                                                                                       |      |   |    | Total 4 marks                                                                              |

| 23 | 27.25 or 27.35 or 17.5 or 18.5 or 9.805 or<br>9.815 |       | 3 | B1 | Accept 27.349 or 27.3499 or<br>18.49 or 18.499 or 9.8149 or<br>9.81499                                                           |
|----|-----------------------------------------------------|-------|---|----|----------------------------------------------------------------------------------------------------------------------------------|
|    | $(t=)\frac{27.25-18.5}{9.815}$                      |       |   | M1 | For $\frac{LB - UB_1}{UB_2}$ oe where                                                                                            |
|    |                                                     |       |   |    | $\begin{array}{l} 27.25 \leq LB < 27.3 \\ \text{and} \ 18 < UB_1 \leq 18.5 \\ \text{and} \ 9.81 < UB_2 \leq \ 9.815 \end{array}$ |
|    |                                                     | 0.891 |   | A1 | dep on seeing $\frac{27.25-18.5}{9.815}$<br>Correct working must be seen<br>Accept 0.891 - 0.8915                                |
|    |                                                     |       |   |    | Total 3 marks                                                                                                                    |

| 24 | Eg $12.6^2 = 10.4^2 + 18^2 - 2 \times 10.4 \times 18 \times \cos L$ or<br>$158.76 = 108.16 + 324 - 374.4 \cos L$                                |      | 5 | M1 | Correct substitution into cosine rule to find <i>L</i> or                                                                                                                                                                                                                             |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------|------|---|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Note: $\cos K = \frac{-57.08}{262.08} (= -0.217(796))$ and $K = 102.(579)$<br>$\cos M = \frac{374.6}{453.6} (= 0.825(837))$ and $M = 34.3(264)$ |      |   |    | For $\cos K = \frac{10.4^2 + 12.6^2 - 18^2}{2 \times 10.4 \times 12.6}$ oe<br><b>AND</b><br>$\sin L = \frac{12.6 \sin "102.(579)"}{18}$ or<br>For $\cos M = \frac{18^2 + 12.6^2 - 10.4^2}{2 \times 18 \times 12.6}$ oe<br><b>AND</b><br>$\sin L = \frac{12.6 \sin "34.3(264)"}{10.4}$ |
|    | Eg cosL = $\frac{10.4^2 + 18^2 - 12.6^2}{2 \times 10.4 \times 18}$ or cosL = $\frac{273.4}{374.4}$ or cosL = 0.73(0235) oe or L = 43.0(938)     |      |   | A1 | Rearranging cosine rule correctly.<br>Accept $L = 43^{\circ}$<br>Accept 43.0(938) rounded or<br>truncated to at least 3 SF                                                                                                                                                            |
|    | (Area of sector =) $\frac{"43.0(938)"}{360} \times \pi \times 10.4^2$ or 40.6(752)                                                              |      |   | M1 | Dep on at least M1<br>Accept 40.5 – 40.7                                                                                                                                                                                                                                              |
|    |                                                                                                                                                 |      |   | B1 | For (area of triangle=) 63.9(471)<br>Accept 63.8 - 64.0                                                                                                                                                                                                                               |
|    |                                                                                                                                                 | 23.3 |   | A1 | Accept 23.2 – 23.3                                                                                                                                                                                                                                                                    |
|    |                                                                                                                                                 |      |   |    | Total 5 marks                                                                                                                                                                                                                                                                         |

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