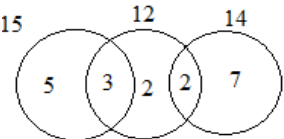

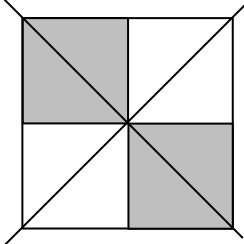


| Question | Working                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Answer | Mark | Notes                                                                                    |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------------------------------------------------------------------------------------------|----|---|---|---|--|---|---|--|--|---|---|--|---|---|--|--|---|---|--|---|--|--|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|----|----|---|---|--|---|---|---|---|--|
| 1        | <p>Two from<br/><math>12 = 2^2 \times 3</math>(or <math>12 = 4 \times 3</math>), <math>14 = 2 \times 7</math> or<br/><math>15 = 3 \times 5</math><br/><b>or</b></p> <table border="1"><tr><td></td><td>12</td><td>14</td><td>15</td></tr><tr><td>2</td><td>6</td><td>7</td><td></td></tr><tr><td>2</td><td>3</td><td></td><td></td></tr><tr><td>3</td><td>1</td><td></td><td>5</td></tr><tr><td>5</td><td></td><td></td><td>1</td></tr><tr><td>7</td><td></td><td>1</td><td></td></tr></table> <p><b>or</b></p>  |        | 12   | 14                                                                                       | 15 | 2 | 6 | 7 |  | 2 | 3 |  |  | 3 | 1 |  | 5 | 5 |  |  | 1 | 7 |  | 1 |  |  | 2 | <p>M1 for correct prime factors for 12 and one of 14 or 15. We are accepting <math>12 = 4 \times 3</math> (may be seen on factor tree)<br/><b>or</b> a list of at least <b>5</b> multiples including 420 for 12 and one of 14 or 15<br/><b>or</b><br/>Use of table method for 12 and one of 14 or 15. Do not need all the rows but the final number in the columns should be prime eg</p> <table border="1"><tr><td></td><td>12</td><td>14</td><td>15</td></tr><tr><td>3</td><td>4</td><td></td><td>5</td></tr><tr><td>2</td><td>2</td><td>7</td><td></td></tr></table> <p><b>or</b> Venn diagram for 12 and one of 14 or 15</p>  |  | 12 | 14 | 15 | 3 | 4 |  | 5 | 2 | 2 | 7 |  |
|          | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 14     | 15   |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 2        | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7      |      |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 2        | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |      |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 3        | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        | 5    |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 5        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        | 1    |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 7        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1      |      |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
|          | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 14     | 15   |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 3        | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        | 5    |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
| 2        | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7      |      |                                                                                          |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
|          | <i>Working required</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 420    |      | A1 oe ISW eg $2^2 \times 3 \times 5 \times 7$ or $2 \times 2 \times 3 \times 5 \times 7$ |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      | <i>Total 2 marks</i>                                                                     |    |   |   |   |  |   |   |  |  |   |   |  |   |   |  |  |   |   |  |   |  |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |    |    |    |   |   |  |   |   |   |   |  |

| Question      | Working                           | Answer                                                                                                                                                            | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2             | $\frac{6}{5} \times \frac{7}{12}$ |                                                                                                                                                                   | 2    | <p>M1 Correct multiplication of an improper fraction.</p> <p><b>ALT</b> <math>[1 \times] \frac{7}{12} + \frac{1}{5} \times \frac{7}{12}</math></p>                                                                                                                                                                                                                                    |
|               | Working required                  | $\frac{\cancel{6}^1}{5} \times \frac{7}{\cancel{12}_2} = \frac{7}{10}$<br>or $\frac{1}{5} \times \frac{7}{2} = \frac{7}{10}$<br>or $\frac{42}{60} = \frac{7}{10}$ |      | <p>A1 cao dep on M1 scored and must see one of cancelling fractions prior to multiplication or a correct uncanceled single fraction eg</p> <p><math>\frac{\cancel{6}}{5} \times \frac{7}{\cancel{12}_2} = \frac{7}{10}</math> or <math>\frac{7}{5 \times 2} = \frac{7}{10}</math> <b>for ALT</b> method allow</p> <p><math>\frac{35}{60} + \frac{7}{60} = \frac{7}{10}</math> ISW</p> |
| Total 2 marks |                                   |                                                                                                                                                                   |      |                                                                                                                                                                                                                                                                                                                                                                                       |

| Question |     | Working | Answer | Mark | Notes                |
|----------|-----|---------|--------|------|----------------------|
| 3        | (a) |         | $8x^2$ | 1    | B1 cao Do not ISW    |
|          | (b) |         | $6y^5$ | 1    | B1 cao Do not ISW    |
|          |     |         |        |      | <i>Total 2 marks</i> |

| Question |     | Working | Answer                                                                             | Mark | Notes                                                                                                                                                 |
|----------|-----|---------|------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4        | (a) |         |  | 1    | B1 cao two lines(allow dashed or dotted) joining opposite corners drawn on diagram. No extra incorrect lines must be drawn unless clearly crossed out |
|          | (b) |         | 3                                                                                  | 1    | B1 cao must be a single number                                                                                                                        |
|          |     |         |                                                                                    |      | <i>Total 2 marks</i>                                                                                                                                  |

| Question |     | Working | Answer | Mark | Notes                                |
|----------|-----|---------|--------|------|--------------------------------------|
| 5        | (a) |         | 38, 45 | 1    | B1 Ignore extra terms. Accept 45, 38 |
|          | (b) |         | 80     | 1    | B1                                   |
|          |     |         |        |      | <i>Total 2 marks</i>                 |

| Question |  | Working      | Answer                          | Mark | Notes                                                                                                                                                                     |
|----------|--|--------------|---------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6        |  | $(x-7)(x+2)$ |                                 | 2    | M1 Factorised form must expand to give 2 terms of the quadratic.<br>eg $(x-2)(x+7)=x^2+5x-14$                                                                             |
|          |  |              | $(x-7)(x+2)$<br>or $(x+2)(x-7)$ |      | A1 Do not ISW This must be the answer on the answer line or if no answer on the answer line their final answer which may be shown for example by circling or underlining. |
|          |  |              |                                 |      | <i>Total 2 marks</i>                                                                                                                                                      |

| Question |     | Working                                                                  | Answer | Mark | Notes                                                                                                                                                         |
|----------|-----|--------------------------------------------------------------------------|--------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7        | (a) |                                                                          | 5      | 1    | B1 cao no other numbers must be given                                                                                                                         |
|          | (b) | 2,3,5,5,5,7,8,9,10,11                                                    |        | 2    | M1 place numbers in order (at least 6 with none missing) or sight of $\frac{5+7}{2}$<br>May be seen in part (a) or in question. Allow with signs eg + between |
|          |     | Correct answer scores full marks (unless from obvious incorrect working) | 6      |      | A1 cao                                                                                                                                                        |
|          |     |                                                                          |        |      |                                                                                                                                                               |

| Question |  | Working                                                                                                                                           | Answer | Mark | Notes                                                                                                                                                                                |
|----------|--|---------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8        |  | $360 \div 24 [= 15]$ oe or<br>$24 \times 180 - 360 [= 3960]$ or<br>$(2 \times 24 - 4) \times 90 [= 3960]$ or<br>$(24 - 2) \times 180 [= 3960]$ oe |        | 3    | M1 for a correct method to find an exterior angle or total of the interior angles. Implied by seeing 15 or 3960 or 165                                                               |
|          |  | $180 - "15"$ or $\frac{3960}{24}$ oe                                                                                                              |        |      | M1 dep on M1 correct method to find one interior angle. This may be implied by seeing 165                                                                                            |
|          |  | <i>Correct answer scores full marks (unless from obvious incorrect working)</i>                                                                   | 165    |      | A1 cao do <b>not</b> ISW This must be the answer on the answer line or if no answer on the answer line their final answer which may be shown for example by circling or underlining. |
|          |  |                                                                                                                                                   |        |      | <i>Total 3 marks</i>                                                                                                                                                                 |

| Question |  | Working                                                                         | Answer               | Mark | Notes                                                                                                                                                     |
|----------|--|---------------------------------------------------------------------------------|----------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9        |  | $T^2 = \frac{2r}{g}$ or $T^2 g = 2r$ or $\sqrt{g} = \frac{\sqrt{2r}}{T}$        |                      | 2    | M1 correctly remove square root sign or make root g the subject.                                                                                          |
|          |  | <i>Correct answer scores full marks (unless from obvious incorrect working)</i> | $g = \frac{2r}{T^2}$ |      | A1 cao Condone missing "g =" on answer line if fully correct expression seen in working. Allow $g = \left(\frac{\sqrt{2r}}{T}\right)^2$ or $g = 2rT^{-2}$ |
|          |  |                                                                                 |                      |      | <i>Total 2 marks</i>                                                                                                                                      |

| Question |  | Working                                                                         | Answer              | Mark | Notes                                                                     |
|----------|--|---------------------------------------------------------------------------------|---------------------|------|---------------------------------------------------------------------------|
| 10       |  | $[x^2(3x+1) = ]3x^3 + x^2$                                                      |                     | 3    | M1 correct expansion of brackets before differentiating. eg $3x^3 + 1x^2$ |
|          |  | $\left[\frac{dy}{dx} = \right]20x^3 + 9x^2 + 2x$                                |                     |      | M1 at least one correct term                                              |
|          |  | <i>Correct answer scores full marks (unless from obvious incorrect working)</i> | $20x^3 + 9x^2 + 2x$ |      | A1 oe eg $20x^3 + 9x^2 + 2x^1$                                            |
|          |  |                                                                                 |                     |      | <b>Total 3 marks</b>                                                      |

| Question |  | Working                                                                         | Answer      | Mark | Notes                                                                                                                                                                                                      |
|----------|--|---------------------------------------------------------------------------------|-------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11       |  | $\frac{120}{360} \pi r^2 = 48\pi [\Rightarrow r = 12]$                          |             | 3    | M1 for forming an equation involving the radius using the given area. eg $\frac{1}{3} \pi r^2 = 48\pi$ or $\frac{1}{3} r^2 = 48$                                                                           |
|          |  | $[\text{Arc length} = ]\frac{120}{360} \times 2\pi \times "12" [= 8\pi]$        |             |      | M1 Find an expression for the arc length $ABC$ , ft their radius. Allow awrt 25.1 May be seen as part of working eg $\frac{1}{3} \times 2 \times \pi \times "12" + 2 \times "12"$ where 12 is their radius |
|          |  | <i>Correct answer scores full marks (unless from obvious incorrect working)</i> | $8\pi + 24$ |      | A1 oe eg $8(3 + \pi)$ <b>allow</b> awrt $15.6\pi$ (need not be simplified) eg $\frac{120}{360} \times 2\pi \times 12 + 12 + 12$ <b>ISW</b>                                                                 |
|          |  |                                                                                 |             |      | <b>Total 3 marks</b>                                                                                                                                                                                       |

| Question | Working                                                                                                                                                                                                                | Answer | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12       | eg $2(x+2)+3(x-3)=60$ or<br>$4(x+2)+6(x-3)=120$ or<br><br>$\frac{2(x+2)}{12}+\frac{3(x-3)}{12}[=5]$ or<br>$\frac{4(x+2)}{24}+\frac{6(x-3)}{24}[=5]$ or<br><br>$\frac{x}{6}+\frac{1}{3}+\frac{x}{4}-\frac{3}{4}[=5]$ oe |        | 3    | M1 Clear intention to multiply all terms by a multiple of 12<br>If correct expression with brackets in is not seen allow a maximum of one incorrect term if the brackets are expanded <b>or</b><br><br>express the LHS as two fractions over a multiple of 12 or as a single fraction with a denominator which is a multiple of 12 eg $\frac{2(x+2)+3(x-3)}{12}=5$ If correct expression with brackets in is not seen allow a maximum of one incorrect term if the brackets are expanded No need for = 5 <b>or</b><br><br>expressing the LHS as 4 fractions. No need for = 5 |
|          | $5x=60-4+9$ or $10x=120-8+18$<br>$\frac{5x}{12}=5-\frac{1}{3}+\frac{3}{4}$ oe                                                                                                                                          |        |      | M1 indep for a correct equation with the terms in x combined<br>eg $\frac{5x-5}{12}=5$ or $5x=65$ or $\frac{5}{12}x=\frac{65}{12}$                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|          | <i>Working required</i>                                                                                                                                                                                                | $x=13$ |      | A1 dependent on at least one M mark being awarded                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|          |                                                                                                                                                                                                                        |        |      | <b>Total 3 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Question | Working                                                                         | Answer    | Mark | Notes                                                                                                                                                                                                                                                                     |
|----------|---------------------------------------------------------------------------------|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13       |                                                                                 | $p = 15$  | 3    | B1 cao                                                                                                                                                                                                                                                                    |
|          | $-5 - 2p$ or $-5 - 2 \times "15"$<br>or $-5b - 2pb = qb$<br>or $2p + q = -5$ oe |           |      | M1 compare coefficients of <b>b</b> Allow one sign error in $-5 - 2p$ eg $-5 + 2p$ or allow ft of their $p$ value and one sign error ie $5 - 2 \times "15"$ or $-5 + 2 \times "15"$ or $-5b + 2pb = qb$ or $5b - 2pb = qb$ or $-5b - 2pb = -qb$ oe Allow $p = "15"$ subst |
|          | Correct answer scores full marks (unless from obvious incorrect working)        | $q = -35$ |      | A1                                                                                                                                                                                                                                                                        |
|          |                                                                                 |           |      | SC if $p$ and $q$ are correct but not written on the answer line, at least one must be labelled in their working to award full marks. If both values are correct but neither labelled or they are on the wrong answer lines they get 2/3 marks                            |
|          |                                                                                 |           |      | Total 3 marks                                                                                                                                                                                                                                                             |

| Question | Working | Answer                                                                                                                                                | Mark | Notes                                                                                                           |
|----------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------|
| 14       | (a)     | $0.07y$                                                                                                                                               | 1    | B1 cao oe $\left(\frac{7}{100}y\right)$                                                                         |
|          | (b)     | number bottle $B = 0.12y$<br>increase = $0.05y$ or 5%                                                                                                 | 1    | M1 for sight of $0.12y$ or $\frac{12}{100}y$ or $0.05y$ or $\frac{5}{100}y$ or 5% 12% – 7%<br>or $12\%y - 7\%y$ |
|          |         | $0.12y - "0.07y" = 60$ or<br>$0.05y = 60$ or<br>$60 \div 5 \times 100$ or<br>$5\% = 60$ or $5\%y = 60$ or<br>$12\% - 7\% = 60$ or $12\%y - 7\%y = 60$ | 1    | M1 oe follow through their result from part (a)                                                                 |
|          |         | 1200                                                                                                                                                  | 1    | A1 cao Must come from a correct equation<br>Correct answer with no working gains full marks                     |
|          |         |                                                                                                                                                       |      | Total 4 marks                                                                                                   |

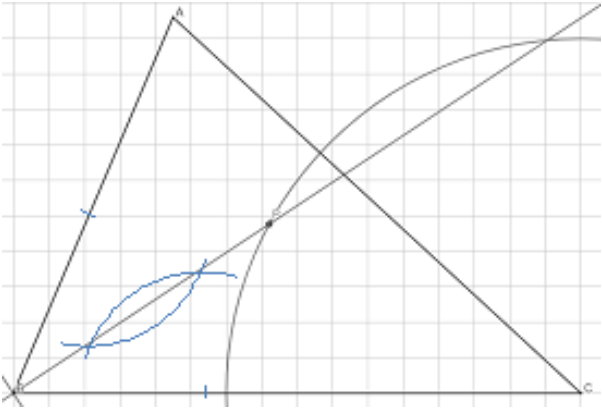
| Question | Working                                                                                                                                                                                                                                                                                                                                                                        | Answer                                 | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15       | $\begin{array}{rcl} 20x + 7y = 4 & 40x + 14y = 8 \\ \underline{20x - 20y = -50} & \underline{14x - 14y = -35} \\ 27y = 54 & 54x = -27 \end{array}$ <p>or</p> $20\left(\frac{2y-5}{2}\right) + 7y = 4 \text{ or}$ $20x + 7\left(\frac{2x+5}{2}\right) = 4 \text{ or}$ $2\left(\frac{4-7y}{20}\right) - 2y = -5 \text{ or}$ $2x - 2\left(\frac{4-20x}{7}\right) = -5 \text{ oe}$ |                                        | 4    | <p>M1 eliminating either <math>x</math> or <math>y</math> (equate coefficient and use correct operation) Allow 1 error either one incorrect term in equating the coefficients eg <math>-4</math> instead of <math>8</math> <b>or</b> one error when eliminating either <math>x</math> or <math>y</math></p> <p><b>or</b></p> <p>substitute for <math>x</math> or <math>y</math> to form an equation in only one variable. Allow 1 sign slip only</p> |
|          |                                                                                                                                                                                                                                                                                                                                                                                | $x = -\frac{1}{2} \text{ or}$ $y = 2$  |      | A1 dep on M1                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|          | $20 \times "-\frac{1}{2}" + 7y = 4 \text{ or}$ $20x + 7 \times "2" = 4 \text{ or}$ $2 \times "-\frac{1}{2}" - 2y = -5 \text{ or}$ $2x - 2 \times "2" = -5 \text{ oe}$                                                                                                                                                                                                          |                                        |      | <p>M1dep on previous method mark</p> <p>For repeating first method (allow one sign error) or substitute their <math>x</math> or <math>y</math> into a correct equation</p>                                                                                                                                                                                                                                                                           |
|          | <i>Working required</i>                                                                                                                                                                                                                                                                                                                                                        | $x = -\frac{1}{2}$ $\text{and } y = 2$ |      | A1 dep on M1 M1                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          |                                                                                                                                                                                                                                                                                                                                                                                |                                        |      | <b>Total 4 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |

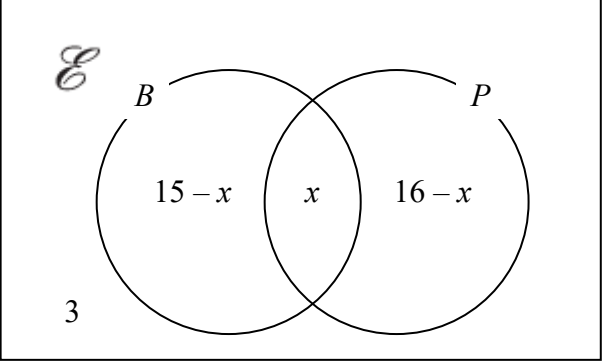
| Question | Working                                                                                                                                                                                                                                                                                                                                                              | Answer | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16       | Let $t$ = total number of students and $c$ = number of students who travel by car Allow any letters for $t$ and $c$                                                                                                                                                                                                                                                  |        |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|          | $[t =] \frac{208}{0.104}$ <b>or</b><br>$[t =] 718 + 0.896t - 510$ <b>or</b><br>$\frac{208}{208 + 510 + c} = 0.104$ <b>or</b><br>$[c =] \frac{208}{0.104} - 208 - 510$ <b>or</b><br>$[c =] 0.896 \times \frac{208}{0.104} - 510$ <b>or</b> $[c =] \frac{208}{0.104} - 718$<br><b>or</b> $0.896 \times (718 + c) = 510 + c$ <b>or</b><br>$\frac{510}{208} \times 10.4$ |        | 4    | M1 correct method to find $t$ or $c$ <b>or</b> correct equation (any form) in terms of $t$ or $c$ <b>or</b> correct method to find the % that represents 510 students<br>May be implied by seeing 25.5 or 1282 or 2000                                                                                                                                                                                                                            |
|          | $[t =] 2000$ or $[c =] 1282$ or 25.5                                                                                                                                                                                                                                                                                                                                 |        |      | A1 correct value for $t$ <b>or</b> $c$ <b>or</b> percentage                                                                                                                                                                                                                                                                                                                                                                                       |
|          | $\frac{"1282"}{2000} \times 100$ or $\frac{"1282"}{"1282" + 208 + 510} \times 100$ or<br>$\frac{1282}{"2000"} \times 100$ or $100 - 10.4 - "25.5"$ or<br>$100 - 10.4 - \frac{510}{"2000"} \times 100$                                                                                                                                                                |        |      | M1 For an attempt at a correct method to find the percentage.<br>Allow $\frac{n}{2000} \times 100$ <b>or</b> $\frac{n}{n + 718} \times 100$ where $n < 2000$ <b>or</b><br>$\frac{1282}{m} \times 100$ where $m > 1282$ <b>or</b> $\frac{r - 718}{r} \times 100$ where $r > 718$ <b>or</b><br>$100 - 10.4 - \frac{510}{"p"} \times 100$ where $p > 510$ or $100 - 10.4 - q$<br>where $20 < q < 30$ may be implied by 64.1 Condone rounded figures. |
|          | Correct answer scores full marks (unless from obvious incorrect working)                                                                                                                                                                                                                                                                                             | 64.1   |      | A1 cao Allow 64 Do <b>not</b> ISW This must be the answer on the answer line or if no answer on the answer line their final answer which may be shown for example by circling or underlining.                                                                                                                                                                                                                                                     |
|          |                                                                                                                                                                                                                                                                                                                                                                      |        |      | Total 4 marks                                                                                                                                                                                                                                                                                                                                                                                                                                     |



| Question |     | Working                                                                                                                                                                                                              | Answer | Mark | Notes                                                                                                                                                                 |                                        |
|----------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 17       | (a) | eg $\frac{16.1}{48}$ [= 0.335] or $\frac{1610}{48}$ or<br>$\frac{16.1}{12\cancel{25}} \text{ or } \frac{x}{16.1} = \frac{1}{48} \text{ or } \frac{x}{1610} = \frac{1}{48}$<br>or $\frac{x}{16.1} = \frac{25}{12}$ oe |        | 2    | M1 correct method or equation to find length in m or cm. Implied by 0.335                                                                                             |                                        |
|          |     | <i>Correct answer scores full marks (unless from obvious incorrect working)</i>                                                                                                                                      | 33.5   |      | A1 awrt 33.5                                                                                                                                                          |                                        |
|          | (b) | $48^3$ [= 110 592] or<br>$0.48^3$ [= 0.110 592]                                                                                                                                                                      |        | 3    | M1 Consideration of cube of scale factor seen. eg $\left(\frac{16.1}{(a)}\right)^3$ or<br>$\left(\frac{1610}{(a)}\right)^3$ or $\frac{995}{V} = \frac{(a)^3}{1610^3}$ | M2 for $\frac{995}{100^3} \times 48^3$ |
|          |     | $\frac{995}{100^3}$ [= 0.000995] or<br>[995×"110 592"]÷100 <sup>3</sup><br>$0.48^3$ [= 0.110 592]                                                                                                                    |        |      | M1 for unit conversion by dividing by 100 <sup>3</sup>                                                                                                                |                                        |
|          |     | <i>Correct answer scores full marks (unless from obvious incorrect working)</i>                                                                                                                                      | 110    |      | A1 awrt 110                                                                                                                                                           |                                        |
|          |     |                                                                                                                                                                                                                      |        |      | <i>Total 5 marks</i>                                                                                                                                                  |                                        |

| Question |  | Working | Answer                                | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|--|---------|---------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18       |  |         | angle bisector constructed accurately | 4    | B2 for a line within the limits and a pair of suitable arcs. One arc centred on a point $D$ on $BC$ and one centred on the point $E$ on $AB$ such that $BE = BD$ <b>or</b> 2 arcs centred at $B$ with the cross to find the middle.<br>(B1 for a line within the limits (Can be any length - does not need to cross $AC$ but should remain within the guidelines if it were to be extended) <b>or</b> a pair of suitable arcs |
|          |  |         | Accurate arc drawn from $C$           |      | B1 for an arc within the limits indicated. It does not need to cross $AC$ or $BC$                                                                                                                                                                                                                                                                                                                                             |
|          |  |         | $P$ correctly labelled                |      | B1ft dependent on at least B1 for the angle bisector and B1 for the arc. Must clearly identify it is the point.                                                                                                                                                                                                                                                                                                               |
|          |  |         |                                       |      | <b>Total 4 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                          |



| Question |     | Working                                                                           | Answer          | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|-----|-----------------------------------------------------------------------------------|-----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19       | (a) |  |                 | 2    | <p>B2 <math>15 - x</math>, <math>16 - x</math> and 3 in correct regions on Venn diagram</p> <p>B1 2 of <math>15 - x</math>, <math>16 - x</math> and 3 in correct regions or all 3 values correct, one in correct region.</p> <p>Allow 11 for <math>15 - x</math> and 12 for <math>16 - x</math></p> <p><b>SC</b> B1 <math>x</math> is replaced with a number <math>x \neq 4</math> and they use this incorrect value, to find <math>15 - x</math> and <math>16 - x</math></p> |
|          | (b) | $3 + "15 - x" + x + "16 - x" = 30$ oe                                             |                 | 2    | <p>M1 Correct equation formed, in <math>x</math>, ft their values for <math>B' \cap P</math> and <math>B \cap P'</math> May see only one of these values used eg <math>3 + 15 + "16 - x" = 30</math></p>                                                                                                                                                                                                                                                                      |
|          |     | Correct answer scores full marks (unless from obvious incorrect working)          | 4               |      | A1 cao                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          | (c) |                                                                                   | $\frac{11}{30}$ | 1    | <p>B1 ft follow through their answer to part (b), if <math>0 &lt; \text{part(b)} &lt; 15</math> only ie <math>\frac{15 - "their(b)"}{30}</math> with numerator a single number. Allow awrt 0.367</p>                                                                                                                                                                                                                                                                          |
|          |     |                                                                                   |                 |      | Total 5 marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Question | Working                                                                                                                                                                                                                                                                                                                            | Answer | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20       | Throughout this question condone mis-labelling. eg if they label the volume of the cone as being the hemisphere                                                                                                                                                                                                                    |        |      |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                              |
|          | $\frac{2}{3}\pi \times 10^3 \left[ = \frac{2000\pi}{3} = 2094.395... \right]$                                                                                                                                                                                                                                                      |        | 5    | M1 Allow for $\frac{4}{3}\pi \times 10^3 \left[ = \frac{4000\pi}{3} = 4188.790... \right]$<br>Allow sight of 4189, awrt 4190 or awrt 2090 or exact fraction<br>May be embedded within other working. Ignore labelling                                                                                                                                                   |                                                                                                                                                                              |
|          | $\frac{1}{3}\pi \times 10^2 x \left[ = \frac{100\pi}{3} x = 104.719...x \right]$                                                                                                                                                                                                                                                   |        |      | M1 or $\frac{1}{3}\pi 10^2 (h-10)$ Allow sight of 104, awrt 105 or exact fraction.<br>Allow any letter for x. (Condone h for x) Ignore labelling                                                                                                                                                                                                                        |                                                                                                                                                                              |
|          | $\frac{1}{3}\pi \times 10^2 x = \frac{3}{4} \times \left( \frac{2}{3}\pi \times 10^3 \right)$ or<br>" $\frac{100\pi}{3}$ " x = $\frac{3}{4} \times \left( " \frac{2000\pi}{3} " \right)$ or<br>$\frac{\frac{1}{3}\pi \times 10^2 x}{\frac{2}{3}\pi \times 10^3} = \frac{3}{4}$ oe                                                  |        |      | M1 using $V_{\text{cone}} = \frac{3}{4} \times V_{\text{hemisphere}}$ oe<br>with at least one of the volumes correct<br>Allow h – 10 or any letter for x (condone h)<br>You may ft their values eg<br>"2094" x = $\frac{3}{4} \times$ "105" <b>NB</b> x = 15<br><b>NB useful number</b><br>$\frac{3}{4} \times \left( \frac{2}{3}\pi \times 10^3 \right) = 1570.795...$ | $M2 \text{ for } \frac{\frac{1}{3}\pi 10^2 (h-10)}{\frac{2}{3}\pi \times 10^3} = \frac{3}{4}$<br><br>or $\frac{\frac{100\pi}{3} (h-10)}{\frac{2000\pi}{3}} = \frac{3}{4}$ oe |
|          | "15"+10                                                                                                                                                                                                                                                                                                                            |        |      | M1 For using h – 10 anywhere<br><b>OR</b> if all 3 previous method marks awarded allow for "their x" + 10                                                                                                                                                                                                                                                               |                                                                                                                                                                              |
|          | Correct answer scores full marks<br>(unless from obvious incorrect working)                                                                                                                                                                                                                                                        | 25     |      | A1 awrt 25                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                              |
|          | <b>SC</b> r = 10 not substituted could get <b>M1 M1 M0 M1 A0</b><br>1 <sup>st</sup> M1 for $\frac{\frac{1}{3}\pi r^2 x}{\frac{2}{3}\pi r^3 x} = \frac{3}{4}$ (allow sphere)    2 <sup>nd</sup> M1 $\frac{x}{2 \times r} = \frac{3}{4}$ or $\frac{x}{4 \times r} = \frac{3}{4}$ 4 <sup>th</sup> M1 for using h – 10 or adding 10 A0 |        |      |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                              |
|          |                                                                                                                                                                                                                                                                                                                                    |        |      | <b>Total 5 marks</b>                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                              |

| Question             |                                                                                 | Working                                                                                                                                                 | Answer                                                                                                                                                                                                                                                       | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                       |
|----------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 21                   | (a)                                                                             | $[AG^2 = ]12^2 + 4^2 (=160)$ or<br>$[AC^2 = ]12^2 + 3^2 (=153)$ or<br>$[AE^2 = ]4^2 + 3^2 (=25)$                                                        |                                                                                                                                                                                                                                                              | 3    | M1 A correct method to find $AG^2, AC^2, AE^2, AG, AC$ or $AE$ . Allow use of trig but must be fully correct method eg<br>$[\angle GAB = ]\tan^{-1}\left(\frac{4}{12}\right)[=18.434....]$ <b>and</b><br>$[AG = ]\frac{12}{\cos"18.434..."}$ Ignore incorrect labels labels                                                                                                                                                                                                             | M2 for<br>$[AF^2 = ]3^2 + 12^2 + 4^2$ |
|                      |                                                                                 | $[AF^2 = ]3^2 + "160"$ or $3^2 + ("4\sqrt{10}")^2$<br>$[AF^2 = ]4^2 + "153"$ or $4^2 + ("3\sqrt{17}")^2$<br>$[AF^2 = ]12^2 + "25"$ or<br>$[AF^2 = ]169$ | M1 full method to find $AF^2$<br>For this mark allow values correct to 3sf. but condone truncation eg $4^2 + (\text{awrt } 12.3)^2$ or $3^2 + (\text{awrt } 12.64)^2$ Ignore incorrect labels<br><b>NB</b> $\sqrt{160} = 12.649...$ $\sqrt{153} = 12.369...$ |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |
|                      |                                                                                 | <i>Working required</i>                                                                                                                                 | 13                                                                                                                                                                                                                                                           |      | A1 dependent on both method marks awarded. For a full method to find $AF$ with no incorrect working seen and 13 stated<br>Must see 169 or a correct expression for $AF^2$ with exact values used.                                                                                                                                                                                                                                                                                       |                                       |
|                      | (b)                                                                             | $\sin GAF = \frac{3}{"13"}$ or $\tan GAF = \frac{3}{"\sqrt{160}"}$<br><br>or $\cos GAF = \frac{"\sqrt{160}"}{"13"}$ oe                                  |                                                                                                                                                                                                                                                              | 2    | M1 A correct method to find $\angle GAF$ or trig ratio of $\angle GAF$<br>May ft values from part (a) including their $AF$ if it is not 13 if it is clearly labelled or comes from a correct calculation<br><br>Allow ( $\tan AFG = \frac{\sqrt{160}}{3}$ <b>or</b> $\sin AFG = \frac{\sqrt{160}}{13}$ <b>or</b> $\cos AFG = \frac{3}{13}$ ) <b>and</b><br><br>$90 - \angle AFG$<br><br>Allow use of cosine or sine rule eg $3^2 = 160 + 13^2 - 2 \times \sqrt{160} \times 13 \cos GAF$ |                                       |
|                      | <i>Correct answer scores full marks (unless from obvious incorrect working)</i> |                                                                                                                                                         | 13.3                                                                                                                                                                                                                                                         |      | A1 awrt 13.3 Allow awrt 13.4                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                       |
|                      |                                                                                 |                                                                                                                                                         |                                                                                                                                                                                                                                                              |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |
| <i>Total 5 marks</i> |                                                                                 |                                                                                                                                                         |                                                                                                                                                                                                                                                              |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |

| Question | Working                                                                                           | Answer | Mark | Notes                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|---------------------------------------------------------------------------------------------------|--------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22       | $(-k)^3 + 4(-k)^2 - 20(-k) - (-k) [= 0]_{\text{or}}$<br>$-k^3 + 4k^2 + 20k + k [= 0]_{\text{oe}}$ |        | 5    | M1 substitutes $x = -k$ Allow 1 sign error if brackets removed or<br>long division to obtain 2 correct terms $x^2 + (4 - k)x + (-20 - 4k + k^2)$<br>or two of 1 <b>or</b> $4 - k$ <b>or</b> $-20k - 4k + k^2$<br>attempt to expand $(x + k)(x^2 + gx + 1)$ with at least 4 out of 6 terms<br>correct cubic is $x^3 + kx^2 + gx^2 + gkx + x + k$ oe                                                           |
|          | $-k^3 + 4k^2 + 21k = 0$ or<br>$-20 - 4k + k^2 = 1$ or<br>$k + g = 4$ and $1 + kg = -20$ oe        |        |      | A1 correct simplified 3 term cubic equation or a correct quadratic equation or both correct equations from comparing $x^2$ and $x$ coefficients.                                                                                                                                                                                                                                                             |
|          | $(k)(-k^2 + 4k + 21) = 0$ or<br>$k^2 - 4k - 21 = 0$ oe                                            |        |      | M1 dep on first M mark. Divide by or take $k$ out as a common factor from a cubic in $k$ to form a 3-term quadratic equation. An answer of 7 or $-3$ can imply this mark                                                                                                                                                                                                                                     |
|          | $(k)(-k + 7)(k + 3) = 0$ or<br>$(k - 7)(k + 3) = 0$                                               |        |      | M1 dep on second M mark. Correct method for solving their 3-term quadratic – either by formula, completing the square or factorising.<br>By factorising: brackets must expand to give 2 out of 3 correct terms<br>By formula: correct substitution into fully correct formula (allow 1 sign error)<br>By completing the square: must see $(k - 2)^2 \pm \dots$<br>An answer of 7 or $-3$ can imply this mark |
|          | <i>Correct answer scores full marks<br/>(unless from obvious incorrect working)</i>               | 7, -3  |      | A1 cao (both) condone 0, 7, $-3$ but do not allow any other incorrect extras                                                                                                                                                                                                                                                                                                                                 |
|          |                                                                                                   |        |      | <b>Total 5 marks</b>                                                                                                                                                                                                                                                                                                                                                                                         |

| Question | Working                                                                                                                                                                         | Answer                       | Mark | Notes                                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23       | (a) $[ON^2 =] 19.5^2 - 18^2$ or $19.5^2 = ON^2 + 18^2$<br>or $39^2 - 36^2$ or $[ON =] 19.5 \cos(67.3801\dots)$<br>or $[ON =] 19.5 \sin(22.6198\dots)$ oe                        |                              | 2    | M1 use of Pythagoras <b>or</b> trig seen – allow angles given to at least 3sf<br>Allow $XD = \sqrt{39^2 - 36^2}$ where $BX$ is the diameter                                                                                                                                   |
|          | Working required                                                                                                                                                                | $\sqrt{19.5^2 - 18^2} = 7.5$ |      | A1 allow $\sqrt{56.25} = 7.5$ or $19.5 \cos(67.3801\dots) = 7.5$ or $\frac{\sqrt{39^2 - 36^2}}{2}$ oe or $19.5 \sin(22.6198\dots) = 7.5$ or $ON^2 = 56.25 \Rightarrow ON = 7.5$ Allow angles given to 3sf                                                                     |
|          |                                                                                                                                                                                 |                              |      | <b>NB</b> verification using 7.5 is M0 A0                                                                                                                                                                                                                                     |
|          | (b) $EN = 36 - 18 - 8 [= 10]$ <b>or</b> $EN = \frac{36}{2} - 8$<br>$AE \times EC = 8 \times 28$ <b>or</b> $AE \times EC = 224$<br>$\frac{AC}{2} + 7.5$ and $\frac{AC}{2} - 7.5$ |                              | 4    | M1 Find $EN$ either labelled or comes from correct working may be seen on diagram <b>or</b> $AE \times EC = 224$ or $AC/2 + 7.5$ and $AC/2 - 7.5$ identified as $AB$ and $BC$ or used in a formula.<br>Allow $x + 7.5$ and $x - 7.5$ may be implied by the 2 <sup>nd</sup> M1 |
|          | $[AM^2 =] 19.5^2 - 10^2 [= 280.25]$ or<br>$\left(\frac{AC}{2} + 7.5\right)\left(\frac{AC}{2} - 7.5\right) = 8 \times 28$                                                        |                              |      | M1 correct use of Pythagoras involving $AM$ where $M$ is the mid-point of $AC$ NB $AM = \sqrt{280.25} [= 16.7406\dots]$<br>ft their 10 if clearly labelled or comes from $36 - 18 - 8$<br>Correct use of intersecting chord theorem Allow $(x + 7.5)(x - 7.5) = 8 \times 28$  |
|          | $[AC] = 2 \times \sqrt{19.5^2 - 10^2}$ or<br>$[AC =] \frac{8 \times 28}{(16.7406\dots + 7.5)} + (16.7406\dots + 7.5)$<br>$\left(\frac{AC}{2}\right)^2 = 224 + 7.5^2$ or         |                              |      | M1 dep on previous method marks awarded. For using $AC = 2 \times$ "their $AM$ " ft their 10 if clearly labelled or comes from $36 - 18 - 8$ or their awrt 16.7 if clearly labelled or comes from $\sqrt{19.5^2 - 10^2}$<br>find value for $\left(\frac{AC}{2}\right)^2$      |
|          | Correct answer scores full marks (unless from obvious incorrect working)                                                                                                        | 33.5                         |      | A1 awrt 33.5                                                                                                                                                                                                                                                                  |
|          |                                                                                                                                                                                 |                              |      | <b>Total 6 marks</b>                                                                                                                                                                                                                                                          |

| Question | Working                                                                                                                                                                                      | Answer               | Mark | Notes                                                                                                                                                                                                                                                                                                                    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24       | 1.95 or 2.05 seen                                                                                                                                                                            |                      | 6    | B1                                                                                                                                                                                                                                                                                                                       |
|          | $215[\times 1] + 362 \times 2 + 181 \times 3 + 94 \times 4 + 15 \times 5 [= 1933]$                                                                                                           |                      |      | M1 Find total number of children, at least 4 correct products seen added (215 + 724 + 543 + 376 + 75) or 1933 seen                                                                                                                                                                                                       |
|          | $\frac{"1933"}{867 + k} = 1.95$ <b>or</b> $\frac{"1933"}{1.95} - 867$ <b>or</b><br>$\frac{"1933"}{867 + k} = 2.05$ <b>or</b> $\frac{"1933"}{2.05} - 867$ <b>oe</b>                           |                      |      | M1 for $\frac{"1933"}{867 + k} = b$ where $1.5 \leq b \leq 2.5$ <b>or</b><br>$\frac{"1933"}{b} - 867$ <b>oe</b> Allow < or > or $\leq$ or $\geq$ for =<br>Allow equivalent<br><b>NB</b> $k + 215 + 362 + 181 + 94 + 15 \equiv k + 867$                                                                                   |
|          | $\frac{"1933"}{867 + k_{\min}} = 1.95$ or $\frac{"1933"}{1.95} - 867$ <b>oe and</b><br>$\frac{"1933"}{867 + k_{\max}} = 2.05$ or $\frac{"1933"}{2.05} - 867$ <b>oe</b>                       |                      |      | M1 Form two equations/expression for their mean.<br>$\frac{"1933"}{867 + k} = b$ <b>or</b> $\frac{"1933"}{b} - 867$ where $1.95 \leq b < 2$ for one<br><b>and</b> $\frac{"1933"}{867 + k} = b$ <b>or</b> $\frac{"1933"}{b} - 867$ where $2 < b \leq 2.05$ for the other equation. Allow < or > or $\leq$ or $\geq$ for = |
|          | $[k =] \frac{1933}{1.95} - 867 \left[ = \frac{4847}{39} \text{ or } 124.282... \right]$ <b>and</b><br>$[k =] \frac{1933}{2.05} - 867 \left[ = \frac{3113}{41} \text{ or } 75.926... \right]$ |                      |      | A1 both equations fully correct followed by awrt 124 and awrt 75.9 <b>or</b> for a fully correct expression for <b>both</b> values of $k$ seen<br>allow 2.0499 for 2.05                                                                                                                                                  |
|          |                                                                                                                                                                                              | $76 \leq k \leq 124$ |      | A1 The 3 <sup>rd</sup> M1 must be awarded. Allow [76, 124]                                                                                                                                                                                                                                                               |
|          |                                                                                                                                                                                              |                      |      | <b>Total 6 marks</b>                                                                                                                                                                                                                                                                                                     |



| Question |            | Working                                                                                                                                                                                                                                                                                            | Answer                                                                                                                                                                                                                                                                                                                                                                                                   | Mark | Notes                                                                                                                                                                                                                 |
|----------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25       | (a)        | $[AC = ] \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix} \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix}$ or<br>$[CA = ] \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix}$ or<br>$3 \times 2 - 1 \times 5$ or<br>$3 \times 2 - (-1) \times (-5)$ or $6 - 5$ |                                                                                                                                                                                                                                                                                                                                                                                                          | 2    | M1 for writing down either of the multiplications or the correct method shown to find the determinant of <b>A</b> or <b>C</b> .                                                                                       |
|          |            | working must be shown                                                                                                                                                                                                                                                                              | $\begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix}$ or $\begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix}$ or<br>$\begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix} \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ or<br>$\begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ |      | A1 for writing down an inverse or matrices multiplied = identity matrix                                                                                                                                               |
|          | (b)<br>(i) |                                                                                                                                                                                                                                                                                                    | $\begin{pmatrix} 20 & 7 \\ 35 & 13 \end{pmatrix}$                                                                                                                                                                                                                                                                                                                                                        | 2    | B2 fully correct<br>(B1 2 numbers correct)<br>ignore order of matrices                                                                                                                                                |
|          | (ii)       |                                                                                                                                                                                                                                                                                                    | $\begin{pmatrix} 5 & 1 \\ 5 & 4 \end{pmatrix} \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix}$                                                                                                                                                                                                                                                                                                              | 1    | B1 for seeing the matrices given in the correct order                                                                                                                                                                 |
|          | (c)        | <b>AB = BA</b> or <b>C<sup>-1</sup>B = BC<sup>-1</sup></b>                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                          | 2    | M1 for either expression implied by a fully correct expression required for the A1 (no need to see <b>BC = CB</b> )                                                                                                   |
|          |            |                                                                                                                                                                                                                                                                                                    | <b>A<sup>-1</sup>ABA<sup>-1</sup> = A<sup>-1</sup>BAA<sup>-1</sup></b> or <b>CABC = CBAC</b><br>or <b>CC<sup>-1</sup>BC = CBC<sup>-1</sup>C</b> or <b>AC<sup>-1</sup>BA = ABC<sup>-1</sup>A</b><br>oe<br><b>followed by BC = CB</b>                                                                                                                                                                      |      | A1 multiplies equation by <b>C</b> or <b>A<sup>-1</sup></b> both before and after (allow mixture)<br><b>AC = CA = I</b> and/or <b>C = A<sup>-1</sup></b> and/or <b>C<sup>-1</sup> = A</b> leading to correct equation |
|          |            |                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |      | <i>Total 7 marks</i>                                                                                                                                                                                                  |