

# Mark Scheme (Results)

January 2016

Pearson Edexcel International GCSE  
Mathematics A (4MA0)  
Paper 3H

Pearson Edexcel Certificate  
Mathematics A (KMA0)  
Paper 3H

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - eoo – each error or omission
  - awrt – answer which rounds to

- **No working**

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

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

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

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

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

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

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

If there is no answer on the answer line then check the working for an obvious answer.
- **Ignoring subsequent work**

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

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

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

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

| International GCSE Maths Jan 2016 – Paper 3H Mark scheme  |                             |        |      |                          |
|---|-----------------------------|--------|------|--------------------------|
| Apart from Questions 8, 15c, 16 and 22 (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method. |                             |        |      |                          |
| Q   | Working                     | Answer | Mark | Notes                    |
| 1 a   | eg. $24 \div 6 \times 800$  |        |      | M1 for a complete method |
|   |                             | 3200   | 2    | A1 accept 3.2 litres     |
| b   | eg. $450 \div 300 \times 6$ |        |      | M1 for a complete method |
|   |                             | 9      | 2    | A1                       |
|   |                             |        |      | <b>Total 4 marks</b>     |

|   |  |    |   |  |
|---|--|----|---|--|
| 2 | 1.75 or $1\frac{3}{4}$ or 105                                |    |   | M1 for correctly converting "1hr 45 mins" into a decimal or fraction or minutes (eg. 1.75h or 105 min) |
|   | $140 \div$ "1.75" or<br>$\frac{140}{\text{"105"}} \times 60$ |    |   | M1 independent but "1.75" or "105" must be correct for their duration<br>accept $140 \div 1.45$        |
|   |  | 80 | 3 | A1   |
|   |  |    |   | <b>Total 3 marks</b>   |

|   |  |                    |   |   |
|---|--|--------------------|---|---|
| 3 | $\frac{3}{8} \times \frac{12}{7}$  |                    |   | M1  |
|   |  | $\frac{36}{56}$ oe | 2 | A1 dep on M1<br>Accept $\frac{9}{14}$ if clear cancelling seen<br>NB: Use of decimals gains M0 A0   |
|   | <b>Alternative :</b><br>$\frac{9n}{24n} \div \frac{14n}{24n}$<br>for any integer $n$ |                    |   | M1 Must see an intention to divide  |
|   |  | $\frac{9}{14}$ oe  | 2 | A1 dep on M1<br>Answer must come directly from their method<br>eg. $\frac{36}{96} \div \frac{56}{96}$ must be followed by $\frac{36}{56}$ |
|   |  |                    |   | <b>Total 2 marks</b>  |

|          |   |                    |                     |   |   |
|----------|---|--------------------|---------------------|---|---|
| <b>4</b> | a |                    | $5(3r + 2)$         | 1 | B1  |
|          | b |                    | $y^9$               | 1 | B1  |
|          | c | $x^2 + 5x - x - 5$ |                     |   | M1 for 3 correct terms out of a maximum of 4 terms<br>or for 4 correct terms ignoring signs<br>or for $x^2 + 4x + k$ for any non-zero value of $k$<br>or for $\dots + 4x - 5$ |
|          |   |                    | $x^2 + 4x - 5$      | 2 | A1  |
|          | d |                    |                     |   | M1 for any one correct application of index laws in a product or quotient<br>eg. $\frac{36m^4}{30k^2m}$ , $\frac{36k^3m^3}{30k^5}$  |
|          |   |                    | $\frac{6m^3}{5k^2}$ | 2 | A1 oe eg. $1.2m^3k^{-2}$  |
|          |   |                    |                     |   | <b>Total 6 marks</b>  |

|          |          |  |             |   |  |
|----------|----------|--|-------------|---|--|
| <b>5</b> | <b>a</b> |  | 20 to 24 oe | 1 | B1   |
|          | <b>b</b> | $2 \times 6 + 7 \times 3 + 12 \times 5 + 17 \times 12 + 22 \times 14$ <b>or</b><br>$12 + 21 + 60 + 204 + 308$ <b>or</b><br>605 |             |   | M2 freq $\times$ all correct midpoint values stated (or evaluated) with intention to add (condone any two errors in midpoints or frequencies)<br><br>If not M2 then award M1 for all products $t \times f$ (and $t$ is consistently within the interval, including end values) and intention to add (condone any two errors in their midpoints or frequencies) |
|          |          | "605" $\div$ 40 <b>or</b><br>$\frac{2 \times 6 + 7 \times 3 + 12 \times 5 + 17 \times 12 + 22 \times 14}{6 + 3 + 5 + 12 + 14}$ |             |   | M1 dep on at least M1  |
|          |          |  | 15.125      | 4 | A1 accept 15 or 15.1 or 15.13 from correct working with no errors (15 without working gains M0 A0) NB. Accept 15.1625 (using 2.25 as mi-interval in first class)   |
|          | <b>c</b> | $14 \div 40 \times 100$ oe   |             |   | M1 award M1 for $26 \div 40 \times 100$ or 65%   |
|          |          |  | 35          | 2 | A1   |
|          |          |  |             |   | <b>Total 7 marks</b>   |



|          |  |                                 |   |   |
|----------|--|---------------------------------|---|---|
| <b>6</b> |  | bisector with construction arcs | 2 | B2 for bisector within guidelines with two pairs of relevant construction arcs seen<br><br>If not B2 then B1 for a bisector within guidelines with no arcs present <b>or</b> relevant arcs present with no bisector |
|          |  |                                 |   | <b>Total 2 marks</b>  |

|          |   |                 |   |  |
|----------|---|-----------------|---|--|
| <b>7</b> | a | 1,2,3,4,5,6,7,9 | 1 | B1 no repeats  |
|          | b | eg. 4, 5, 7, 8  | 2 | B2 for 4, 5, and any two of 7, 8, 9, 10<br><br>If not B2 then B1 for 4,5 <b>or</b><br>4,5 and any one or two other numbers from the universal set <b>or</b><br>4, 5, 7, 8, 9, 10 <b>or</b><br>7, 8, 9, 10 <b>or</b><br>Venn diagram with 4,5 in intersection and any two correct numbers (eg. 8,10) in C |
|          |   |                 |   | <b>Total 3 marks</b>   |

|          |                   |                    |   |                      |   |
|----------|-------------------|--------------------|---|----------------------|---|
| <b>8</b> | $6x + 15$         |                    |   | M1                   | for correct expansion of bracket <b>OR</b><br>division of all terms in a correct equation by 3  |
|          | $6x + x = 4 - 15$ |                    |   | M1                   | for correct rearrangement within a correct equation with $x$<br>terms on one side and numbers on the other                                      |
|          |                   | $-1\frac{4}{7}$ oe | 3 | A1                   | Award full marks for a correct answer if at least 1 method<br>mark awarded (allow $-\frac{11}{7}$ as final answer)<br>accept $-1.57(1428\dots)$ |
|          |                   |                    |   | <b>Total 3 marks</b> |   |

|          |     |                              |      |   |                      |
|----------|-----|------------------------------|------|---|----------------------|
| <b>9</b> | a   | $\pi \times 5.4^2 \times 16$ |      |   | M1                   |
|          |     |                              | 1466 | 2 | A1                   |
|          | bi  |                              | 5.45 | 1 | B1                   |
|          | bii |                              | 5.35 | 1 | B1                   |
|          |     |                              |      |   | <b>Total 4 marks</b> |

|           |   |  |                |   |  |
|-----------|---|--|----------------|---|--|
| <b>10</b> | a | (-2, -1)<br>(-1, 1)<br>(0, 3)<br>(1, 5)<br>(2, 7)<br>(3, 9)<br>(4, 11) | correct line   | 3 | B3 for $y = 2x + 3$ drawn from $x = -2$ to 4<br><br>if not B3 then B2 for a correct straight line segment through at least 3 of (-2, -1) (-1, 1) (0, 3) (1, 5) (2, 7) (3, 9) (4, 11) <b>OR</b><br><br>for all of (-2, -1) (-1, 1) (0, 3) (1, 5) (2, 7) (3, 9) (4, 11) plotted but not joined<br><br>if not B2 then B1 for any 2 correct points stated (could be in a table) or plotted <b>OR</b><br>a line with a positive gradient through (0, 3) <b>OR</b><br>a line with gradient 2 |
|           | b |  |                |   | M1 for $x = 3$ <b>and</b> $y = 2$ drawn  |
|           |   |  | correct region | 2 | A1 for correct region identified ( <b>R</b> need not be labelled)<br>Accept shaded or unshaded   |
|           |   |  |                |   | <b>Total 5 marks</b>   |

|           |  |  |      |   |   |
|-----------|--|--|------|---|---|
| <b>11</b> | $\tan ACB = \frac{4.5}{9.6}$               |  |      |   | M1 for correct trig statement<br>eg. $\sin ACB = \frac{4.5}{\sqrt{112.41}}$ <b>or</b><br>$\cos ACB = \frac{9.6}{\sqrt{112.41}}$ |
|           | $\tan^{-1} \left( \frac{4.5}{9.6} \right)$ |  |      |   | M1 dep  |
|           |  |  | 25.1 | 3 | A1 awrt 25.1  |
|           |  |  |      |   | <b>Total 3 marks</b>  |

|           |                    |                        |   |   |
|-----------|--------------------|------------------------|---|---|
| <b>12</b> | $5t - 5g = 2t + 7$ |                        |   | M1 for expanding bracket within the equation <b>or</b> division of all terms by 5 |
|           | $5t - 2t = 7 + 5g$ |                        |   | M1 (ft a 4 term equation) to isolate terms in $t$                                 |
|           |                    | $t = \frac{5g + 7}{3}$ | 3 | A1 oe   |
|           |                    |                        |   | <b>Total 3 marks</b>  |

|                      |   |  |   |   |  |
|----------------------|---|--|---|---|--|
| <b>13</b>            | a | 11 12 <u>13</u> 13 16 17 17 18 <u>19</u> 19 20                           |   |   | M1 13 or 12.75 (LQ)<br>19 or 18.25 (UQ) identified from ordered list<br><b>OR</b> attempt to find IQR eg.<br>3(rd) and 9(th) seen or<br>2.75(th) and 8.25(th) seen |
|                      |   | 11 12 <u>13</u> 13 16 <u>17</u> 17 18 <u>19</u> 19 20 <b>or</b><br>19-13 |   |   | M1 Identify<br>13 or 12.75 (LQ),<br><b>AND</b><br>19 or 18.25 (UQ)   |
|                      |   |  | 6                                       | 3 | A1 accept 5.5  |
|                      | b |  | James <b>and</b><br>reason using<br>IQR | 1 | B1 ft from (a) James - he has a lower IQR oe<br>(IQR must be part of the statement)  |
|                      | c |  | no change with<br>reason                | 1 | B1 no change box ticked with reason eg. 2 new<br>scores above median and 2 new scores<br>below median <b>or</b> median of 4 numbers is 17                          |
| <b>Total 5 marks</b> |   |  |   |   |  |

|           |   |                                |         |   |  |   |
|-----------|---|--------------------------------|---------|---|--|---|
| <b>14</b> | a | $8000 \times 1.045$ oe (=8360) |         |   | M1 or $8000 \times 1.0275^3$<br>(=8678.316375)   | M2 for<br>$8000 \times 1.045 \times 1.0275^3$ |
|           |   | "8360" $\times 1.0275^3$ oe    |         |   | M1 "8678.316375" $\times 1.045$  |   |
|           |   |                                | 9068.84 | 3 | A1 accept 9069 and<br>answers in the range 9068.8(0) - 9068.9(0)<br><br>SC: B1 for an answer of 9020 ( $8000 + 360 + 3 \times 220$ ) |   |
|           | b | $1 + 0.02$ (=1.02)             |         |   | M1   | M1 for $100(\%) + 2(\%)$ (= 102(%))           |
|           |   | $5763 \div "1.02"$ oe          |         |   | M1 dep   | M1 (dep) for $5763 \div "102" \times 100$ oe  |
|           |   |                                | 5650    | 3 | A1   |   |
|           |   |                                |         |   |  | <b>Total 6 marks</b>                          |

|           |   |  |  |   |   |                      |
|-----------|---|--|--|---|---|----------------------|
| <b>15</b> | a |  | 5  | 1 | B1  |                      |
|           | b |  | $(-7 \leq) k < 5,$<br>$13 < k (\leq 25)$ | 2 | B2 accept $k \leq 5, k \geq 13$<br>If not B2 then B1 for 5 and 13<br><b>or</b> $k < 5$ <b>or</b> $k > 13$ |                      |
|           | c | tangent drawn at $x = -2.5$                    |  |   | M1  |                      |
|           |   |  | 7.5                                      | 3 | M1 complete method to find gradient<br>A1 accept answers in range 7 - 8 with<br>working seen              |                      |
|           | d |  | -2                                       | 1 | B1  |                      |
|           | e | $\frac{1}{2+3}$ <b>or</b> -1 <b>or</b> $f(-1)$ |  |   | M1  |                      |
|           |   |  | 9  | 2 | A1  |                      |
|           |   |  |  |   |   | <b>Total 9 marks</b> |

|           |  |              |   |                                     |
|-----------|--|--------------|---|-------------------------------------|
| <b>16</b> | $x^2 < 9$ or $x^2 - 9 < 0$ or<br>$\frac{\pm\sqrt{-4 \times 5 \times -45}}{2 \times 5}$ |              |   | M1 Allow $x^2 = 9$ or $x^2 - 9 = 0$ |
|           | $\pm\sqrt{"9"}$ or $\pm 3$ or $(x + 3)(x - 3)$ or<br>$x < 3$ or $x > -3$               |              |   | M1                                  |
|           |  | $-3 < x < 3$ | 3 | A1                                  |
|           |  |              |   | <b>Total 3 marks</b>                |

|           |                           |   |  |   |   |
|-----------|---------------------------|---|--|---|---|
| <b>17</b> | ai                        |   | 96   | 1 | B1  |
|           | aii                       |   | <u>Angle at the centre is twice angle at the circumference</u> | 1 | B1 (indep)                                      |
| b         |                           | $73 - 26$   |  |   | M1 for a complete method                        |
|           |                           |   | 47   |   | A1  |
|           |                           |   |  | 3 | B1 (dep on M1) <u>Alternate segment theorem</u> |
| b         | <b>Alternative Scheme</b> |   |  |   |   |
|           |                           | Angle $RST = 180 - 73 (=107)$ and<br>Angle $SRT = 180 - 26 - "107"$ |  |   | M1  |
|           |                           |   | 47   |   | A1  |
|           |                           |   |  |   | B1 (dep on M1) <u>Alternate segment theorem</u> |
|           |                           |   |  |   | <b>Total 5 marks</b>                            |

|           |  |                |   |  |   |   |
|-----------|--|----------------|---|--|---|---|
| <b>18</b> | eg. $\frac{3-1}{1-2} \left( = \frac{4}{3} \right)$   |                |   | M1 for gradient of line <i>AB</i>  | M1 for $y = \frac{4}{3}x + \frac{5}{3}$                             | M2 for sketch of <b>L</b> with $(0, \frac{4}{3})$ and               |
|           | $y = \frac{4}{3} - \frac{2}{3}x$ <b>or</b> $y = \frac{4-2x}{3}$<br><b>or</b><br>$(m =) -\frac{2}{3}$ |                |   | M1   | M1 for $\frac{4}{3}x + \frac{5}{3} = \frac{4}{3} - \frac{2}{3}x$ oe | $(2, 0)$ marked on axes <b>AND</b><br>$(1,3)$ and $(-2, -1)$ joined |
|           |  | No with reason | 3 | A1<br>accept no with $-\frac{2}{3}$ (or $-0.666\dots$ ) <b>and</b> $\frac{4}{3}$ (or $1.333\dots$ )<br>$-\frac{2}{3}$ and $\frac{4}{3}$ may be seen as coefficients of $x$ in $y = mx + c$ <b>OR</b><br><br>shows that $3y = 4 - 2x$ and line through <i>AB</i><br>$(y = \frac{4}{3}x + \frac{5}{3})$ intersect at $x = -\frac{1}{6}$ <b>or</b> $y = \frac{13}{9}$ <b>OR</b><br><br><b>L</b> has a negative gradient (with evidence), line <i>AB</i> has a positive gradient (with evidence)<br><br>NB: Any value given for a gradient must be correct |   |   |
|           |  |                |   |  |   | <b>Total 3 marks</b>  |

|    |  |                   |   |  |
|----|--|-------------------|---|--|
| 19 | $\frac{1}{3}\pi(3r)^2h$                      |                   |   | M1<br>or $\frac{4}{3}\pi\left(\frac{y}{3}\right)^3$<br><br>Condone missing brackets around $3r$ or $\frac{y}{3}$ for this mark only<br>Allow use of 3.14 consistently (or other correct value) |
|    | $\frac{4}{3}\pi r^3 = \frac{1}{3}\pi(3r)^2h$ |                   |   | M1<br>or $\frac{4}{3}\pi\left(\frac{y}{3}\right)^3 = \frac{1}{3}\pi y^2h$  |
|    |  | $\frac{9h}{4}$ oe | 3 | A1<br>for $\frac{9h}{4}$ oe or $r = \frac{9h}{4}$<br><br>NB : $h = \frac{4r}{9}$ scores M2 A0  |
|    |  |                   |   | <b>Total 3 marks</b>   |



|    |   |     |   |   |
|----|---|-----|---|---|
| 20 | $\frac{\sin A}{36} = \frac{\sin 48}{57}$  |     |   | M1 or $\frac{36}{\sin A} = \frac{57}{\sin 48}$  |
|    | $A = \sin^{-1}\left(\frac{\sin 48}{57} \times 36\right)$ <b>or</b><br>$A$ in range 27.9 – 28  |     |   | M1 dep  |
|    | $\frac{1}{2} \times 57 \times 36 \times \sin(180 - 48 - "28")$ (=995.49...)   |     |   | M1 dep on the first M1<br><b>or</b> $\frac{1}{2} \times AC \times 36 \times \sin(48)$ with<br>$AC$ in range 74 – 74.5 or $AC$ from a correct method |
|    |   | 995 | 4 | A1 for answer in the range 995 - 996  |
|    |   |     |   |   |
|    | <b>Alternative</b>  |     |   |   |
|    | Let $BD$ be altitude of triangle<br>$BD = 36 \times \sin 48^\circ$ (= 26.7..) <b>AND</b><br>$DC = 36 \times \cos 48^\circ$ (= 24.0..) |     |   | M1 correct method to find $BD$ <b>and</b> $DC$  |
|    | $AD = \sqrt{57^2 - "26.7.."^2} = 50.331$  |     |   | M1 dep  |
|    | $\frac{1}{2} \times "26.7.." \times ("24.0.." + "50.331")$  |     |   | M1 dep on the first M1  |
|    |   | 995 | 4 | A1 for answer in the range 995 - 996  |
|    |   |     |   | <b>Total 4 marks</b>  |

|           |   |   |    |  |
|-----------|---|---|----|--|
| <b>21</b> | <b>Scheme 1</b> $P(L,L) + P(L, NL) + P(NL, L)$  |   |    | Bus L = 0.07 ; BusNL = 0.63<br>BikeL = 0.015; BikeNL = 0.285<br>correct products may be seen instead of these values   |
|           | $1 - 0.1 (=0.9)$ <b>or</b> $1 - 0.05 (=0.95)$ <b>or</b> $1 - 0.7 (=0.3)$  |   |    | M1   |
|           | P(not late for work)<br>$= 0.7 \times 0.9 + 0.3 \times 0.95 (= 0.915 \text{ or } \frac{183}{200})$                                |   |    | M1 or at least 4 correct products from<br>(addition not needed)<br>$0.07^2 + 2 \times 0.07 \times 0.63 + 2 \times 0.07 \times 0.015 + 2 \times 0.07 \times 0.285 + 2 \times 0.63 \times 0.015 + 0.015^2 + 2 \times 0.015 \times 0.285$ |
|           | P(late for work)<br>$= 0.7 \times 0.1 + 0.3 \times 0.05 (= 0.085 \text{ or } \frac{17}{200})$ <b>OR</b><br>$1 - "0.915" (=0.085)$ |   |    | M1 or at least 8 correct products from<br>(addition not needed)<br>$0.07^2 + 2 \times 0.07 \times 0.63 + 2 \times 0.07 \times 0.015 + 2 \times 0.07 \times 0.285 + 2 \times 0.63 \times 0.015 + 0.015^2 + 2 \times 0.015 \times 0.285$ |
|           | P(late on at least one day)<br>$= 2 \times "0.085" \times "0.915" + "0.085" \times "0.085"$                                       |   |    | M1 or all 12 correct products with addition :<br>dep<br>$0.07^2 + 2 \times 0.07 \times 0.63 + 2 \times 0.07 \times 0.015 + 2 \times 0.07 \times 0.285 + 2 \times 0.63 \times 0.015 + 0.015^2 + 2 \times 0.015 \times 0.285$            |
|           | $0.162775$<br>or $\frac{6511}{40000}$<br>oe   | 5 | A1 |  |
|           |   |   |    | <b>Total 5 marks</b>   |

|           |  |   |    |  |
|-----------|--|---|----|--|
| <b>21</b> | <b>Scheme 2</b> 1 – P(NL,NL)   |   |    | BusNL = 0.63<br>BikeNL = 0.285<br>correct products may be seen instead of these values   |
|           | 1 – 0.1 (=0.9) <b>or</b> 1 – 0.05 (=0.95) <b>or</b> 1 – 0.7 (=0.3)           |   |    | M1   |
|           | P(not late for work)<br>= 0.7×0.9 + 0.3×0.95 (= 0.915 or $\frac{183}{200}$ ) |   |    | M1 or any two correct products from (addition not needed)<br><br>$0.63^2 + 0.285^2 + 2 \times 0.63 \times 0.285$   |
|           | P(not late both days)<br>= "0.915" × "0.915" (= 0.837225)                    |   |    | M1 or all correct products<br>dep (addition not needed)<br>$0.63^2 + 0.285^2 + 2 \times 0.63 \times 0.285$<br>(= 0.3969 + 0.081225 + 2×0.17955 = 0.837225) |
|           | P(late on at least one day)<br>= 1 – "0.837225"= 0.162775                    |   |    | M1<br>dep  |
|           | 0.162775<br>or<br>$\frac{6511}{40000}$<br>oe                                 | 5 | A1 |  |
|           |  |   |    | Total 5 marks  |

|    |  |            |   |  |
|----|--|------------|---|--|
| 22 | (length =) $\frac{28-2x}{2}$ <b>or</b> $14-x$ <b>or</b><br>$\sqrt{12^2-x^2}$     |            |   | M1 correct expression for length of rectangle <b>OR</b><br>a pair of correct simultaneous equations<br>eg. $x^2 + y^2 = 12^2$ and $2x + 2y = 28$ |
|    | $12^2 = x^2 + (14-x)^2$ <b>oe</b>  |            |   | M1 for correct equation in one variable<br>accept other forms eg. $2\sqrt{12^2-x^2} + 2x = 28$   |
|    | $144 = x^2 + 196 - 28x + x^2$ <b>or</b><br>$144 = x^2 + \frac{784-112x+4x^2}{4}$ |            |   | M1 (indep) for expansion of brackets<br>$196 - 28x + x^2$ <b>or</b><br>$\frac{784-112x+4x^2}{4}$   |
|    | $2x^2 - 28x + 52 = 0$ <b>or</b> $x^2 - 14x + 26 = 0$                             |            |   | A1 for a correct simplified quadratic equation   |
|    | eg. $x = \frac{- -14 \pm \sqrt{(-14)^2 - 4 \times 1 \times 26}}{2 \times 1}$     |            |   | M1 ft for correct substitution into quadratic formula<br>for their quadratic (condone one sign error;<br>condone missing brackets and $14^2$ )   |
|    | eg. $\frac{14 \pm \sqrt{92}}{2}$ <b>or</b> $7 \pm \sqrt{23}$                     |            |   | M1 (indep) correct simplification of discriminant<br>for correct quadratic equation  |
|    |  | 11.8, 2.20 | 7 | A1 answers in the ranges<br>11.7 - 11.8 and 2.2 - 2.21<br>dep on a correct quadratic equation and at least<br>M4                                 |
|    |  |            |   | <b>Total 7 marks</b>   |

|    |   |      |   |  |
|----|---|------|---|--|
| 23 | $\overrightarrow{OP} = 4\mathbf{a}$ or $\overrightarrow{PO} = 4\mathbf{a}$ or<br>$\overrightarrow{PA} = 2\mathbf{a}$ or $\overrightarrow{AP} = -2\mathbf{a}$  |      |   | M1 for correct use of ratio to find a relevant vector<br>NB: may be seen on diagram  |
|    | $\overrightarrow{AB} = 4\mathbf{b} - 6\mathbf{a}$ oe or<br>$\overrightarrow{AM} = 2\mathbf{b} - 3\mathbf{a}$ oe or<br>$\overrightarrow{MB} = 2\mathbf{b} - 3\mathbf{a}$ oe  |      |   | M1   |
|    | $\overrightarrow{PM} = 2\mathbf{b} - \mathbf{a}$ oe or<br>$\overrightarrow{MC} = 6\mathbf{b} - 3\mathbf{a}$ oe or<br>$\overrightarrow{PC} = 8\mathbf{b} - 4\mathbf{a}$ oe   |      |   | M1 indep<br>correct vector equation for<br>$\overrightarrow{PM}$ or $\overrightarrow{MC}$ or $\overrightarrow{PC}$ in terms of $\mathbf{a}$<br>and/or $\mathbf{b}$ |
|    | $\overrightarrow{PM} = 2\mathbf{b} - \mathbf{a}$ oe AND $\overrightarrow{MC} = 6\mathbf{b} - 3\mathbf{a}$ oe or<br>$\overrightarrow{PM} = 2\mathbf{b} - \mathbf{a}$ oe AND $\overrightarrow{PC} = 8\mathbf{b} - 4\mathbf{a}$ oe or<br>$\overrightarrow{PC} = 8\mathbf{b} - 4\mathbf{a}$ oe AND $\overrightarrow{MC} = 6\mathbf{b} - 3\mathbf{a}$ oe |      |   | A1   |
|    |   | Show | 5 | A1 Completion with final reasons given using simplified vectors  |
|    |   |      |   | <b>Total 5 marks</b>   |

