OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

# METHODS IN MATHEMATICS

B392/02

Paper 2
(Higher Tier)

Candidates answer on the Question Paper

**OCR Supplied Materials:**
None

**Other Materials Required:**
- Geometrical instruments
- Tracing paper (optional)
- Scientific or graphical calculator

**SPECIMEN**

**Duration:** 2 hours

| Candidate Forename | | Candidate Surname | |
|---|---|---|---|

| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **90**.
- Use the $\pi$ button on your calculator or take $\pi$ to be 3·142 unless the question says otherwise.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- This document consists of **20** pages. Any blank pages are indicated.

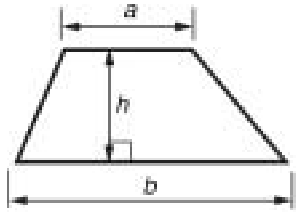
**You are permitted to use a calculator for this paper.**



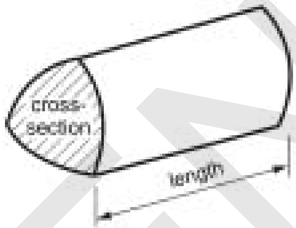
**Turn over**

## Formulae Sheet: Higher Tier

**Area of trapezium** $= \frac{1}{2}(a+b)h$




**Volume of prism** = (area of cross-section)$\times$length

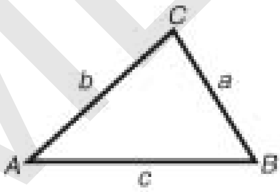



**In any triangle *ABC***

**Sine rule** $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

**Cosine rule** $a^2 = b^2 + c^2 - 2bc\cos A$

**Area of triangle** $= \frac{1}{2}ab\sin C$

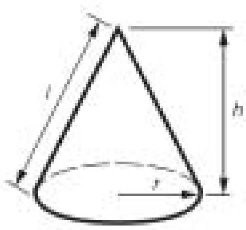



**Volume of sphere** $= \frac{4}{3}\pi r^3$

**Surface area of sphere** $= 4\pi r^2$


**Volume of cone** $= \frac{1}{3}\pi r^2 h$

**Curved surface area of cone** $= \pi rl$




**The Quadratic Equation**

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

**PLEASE DO NOT WRITE ON THIS PAGE**

**1** **(a)** Calculate the size of an interior angle of a regular pentagon.

**(a)** ______________________________ ° **[2]**

**(b)** Regular pentagons do **not** tessellate.

Give an example of another regular polygon that does not tessellate.
Explain how you know that your polygon will not tessellate. **[4]**

**2** **(a)** Make $h$ the subject of this formula.

$$A = 2\pi r(r + h)$$

**(a)** ____________________________ **[2]**

**(b)** Simplify.

$$\frac{9x^2 - 4}{12x + 8}$$

**(b)** ____________________________ **[3]**

**(c)** Solve.

$$3x^2 + 4x - 7 = 0$$

**(b)** $x$ = ________________________ **[3]**

**3** Use your calculator to work out the following.

**(a)** $\dfrac{14 \cdot 9 - 6 \cdot 2}{14 \cdot 9 + 6 \cdot 2}$

Give your answer to 2 decimal places.

**(a)** ______________________________ **[2]**

**(b)** $\sqrt[4]{126}$

Give your answer to 3 significant figures.

**(b)** ______________________________ **[1]**

**(c)** The reciprocal of 0·008

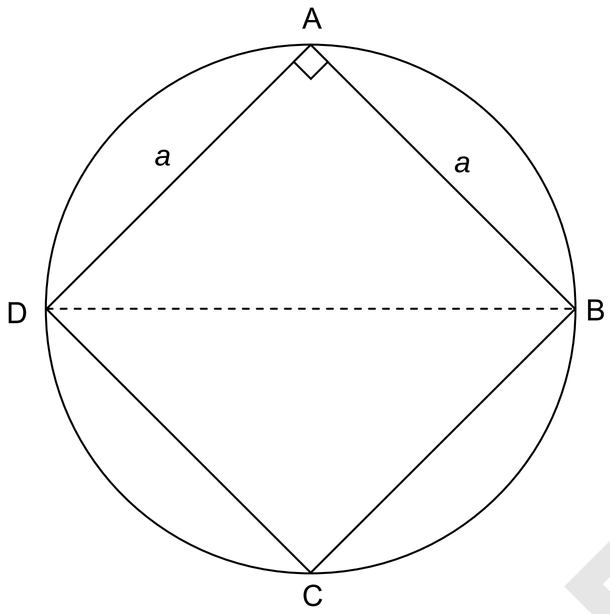
**(c)** ______________________________ **[1]**

**(d)** $4 \cdot 86 \times 10^{12} - 2 \cdot 14 \times 10^{9}$

Give your answer in standard form correct to 3 significant figures.

**(d)** ______________________________ **[2]**

**4**




The four vertices of the square ABCD lie on the circumference of the circle, as shown.
Each side of the square is *a* cm.

Find an expression, in terms of $\pi$ and $a$, for the area of the circle.
Express your answer as simply as possible.

_______________________________ **[5]**

**5** **(a)** The $n$th term of a sequence is $n^2 + n - 1$.

Find the first four terms of the sequence.

**(a)** _______, _______, _______, _______ **[2]**

**(b)** Here are the first four numbers of another sequence.

5 8 11 14

**(i)** Write down the tenth number in the sequence.

**(b)(i)** ___________________________ **[1]**

**(ii)** Write down an expression for the $n$th number in the sequence.

**(ii)** ___________________________ **[2]**

**(c)** The third term in the sequence in part **(b)**, 11, is also in the sequence in part **(a)**.

Show that the sequences do not have any other common $n$th terms. **[4]**

**6** **(a)** Write $0\cdot\dot{1}$ as a fraction.

**(a)** ____________________ **[1]**

**(b)** Write $0\cdot\dot{1}\dot{2}$ as a fraction.
Give your answer in its lowest terms.

**(b)** ____________________ **[3]**

**(c)** Write $0\cdot1\dot{2}\dot{3}$ as a fraction.

**(c)** ____________________ **[3]**

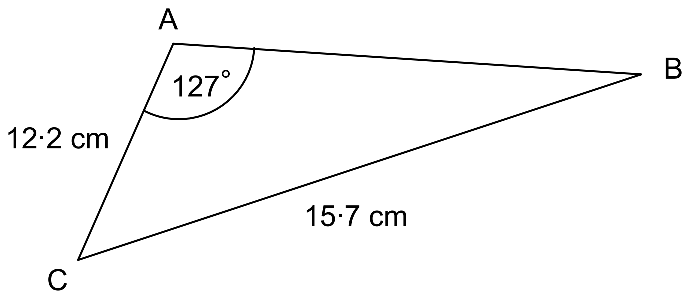
**7*** Harjinder and Ahisha want to tile their kitchen floor.
Harjinder sees blue square tiles of side length 15 cm and white regular octagonal tiles of side length 15 cm.
Harjinder says that these two sorts of tiles can be used together to tile the kitchen floor.
Ahisha says that they will not fit together.

Show which of them is correct.
Use diagrams to help your explanation **[4]**



**8**




**Not to scale**

In the triangle, angle A = 127°, AC = 12·2 cm and BC = 15·7 cm.

Find the length AB.

______________________________ cm **[7]**

**9** Solve.

$(x + 3)^2 < x^2 + 2x + 7$

______________________________ **[3]**

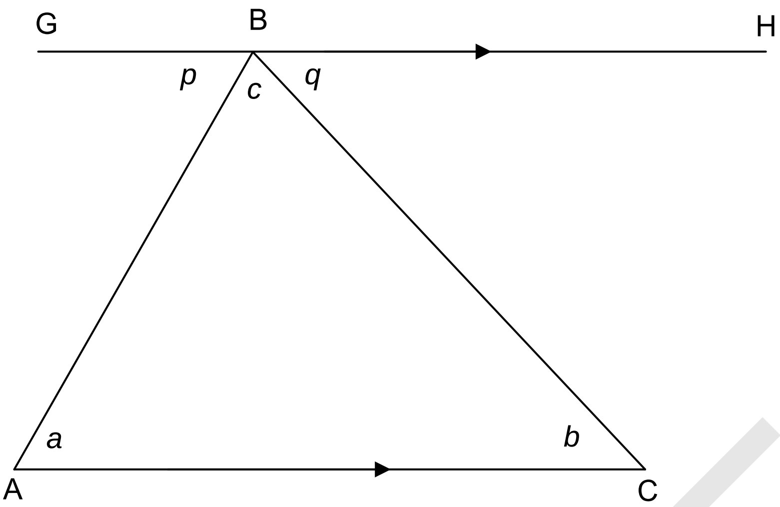
**10** Alexis buys 7 packets of pastilles and 9 packets of chocolate buttons for £6·24.
Karel buys 4 packets of pastilles and 7 packets of chocolate buttons for £4·16.

By forming and solving two simultaneous equations, calculate the cost of a packet of pastilles and a packet of chocolate buttons.

Pastilles £______________________

Chocolate Buttons £______________________ **[5]**

**11** **(a)** Complete this geometric proof that the sum of the angles in a triangle is 180°.
Use this diagram to help.




Not to scale

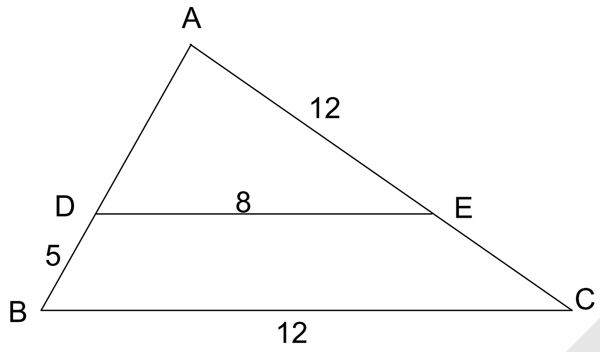
Angle $a$ = angle $p$ because ______________________________

Angle $b$ = __________________________________________

_________________________________________________

And so the sum of the angles of any triangle is 180°. **[3]**

**(b)** In triangle ABC the line DE is drawn parallel to BC, with D on side AB and E on side AC.
BD = 5cm, BC = 12 cm, DE = 8 cm, AE = 12 cm.




Calculate the length of

**(i)** AD,

**(i)** ________________________ cm **[3]**

**(ii)** AC.

**(ii)** ________________________ cm **[2]**

**12** To travel a journey at 'scout's pace' Robert runs for 100 m and then walks for 100 m. He then runs for another 100 m, walks for another 100 m and so on.

Robert runs 2 $ms^{-1}$ faster than he walks.
He takes 33 mins 20 secs to travel a total distance of 4200 m.

Let Robert's walking speed be $x\,ms^{-1}$.

**(a)** Write down an equation in $x$ and show that it simplifies to

$$\frac{21}{x} + \frac{21}{x+2} = 20\,.$$

______________________________________________________________________

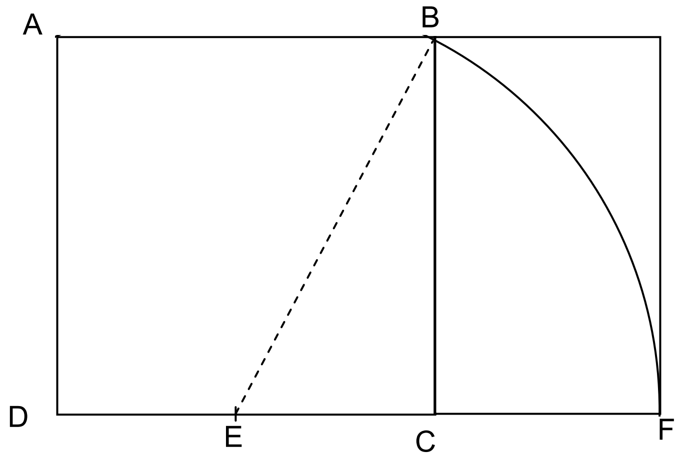
______________________________________________________________________

______________________________________________________________________ **[3]**

**(b)** Solve the equation and hence find Robert's walking speed.

**(b)** ____________________________ $ms^{-1}$ **[6]**

**13** This diagram shows a square ABCD of side 10 cm with a rectangle joined to it.
E is the mid-point of one side of the square and is the centre of a circle with radius EB.




**(a)** Calculate the length EB.

**(a)** ______________________ cm **[2]**

**(b)** Calculate the ratio AD : DF in the form 1 : *n*.
This is called the Golden Ratio.

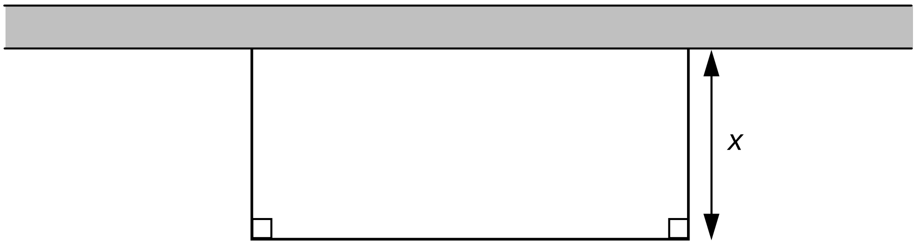
**(b)** __________________________ **[2]**

**(c)** A different rectangle is to be drawn with the ratio of its sides being the Golden Ratio.
The longest side will be 48 cm.

Calculate the length of the shortest side, expressing the answer to an appropriate accuracy.

**(c)** _______________________ cm **[2]**

**14*** Farmer Barber has 20 metres of fence.
She wishes to use it to make a rectangular hen run next to her garden wall.
Each hen must have at least 3 $m^2$ of space to meet farming guidelines.

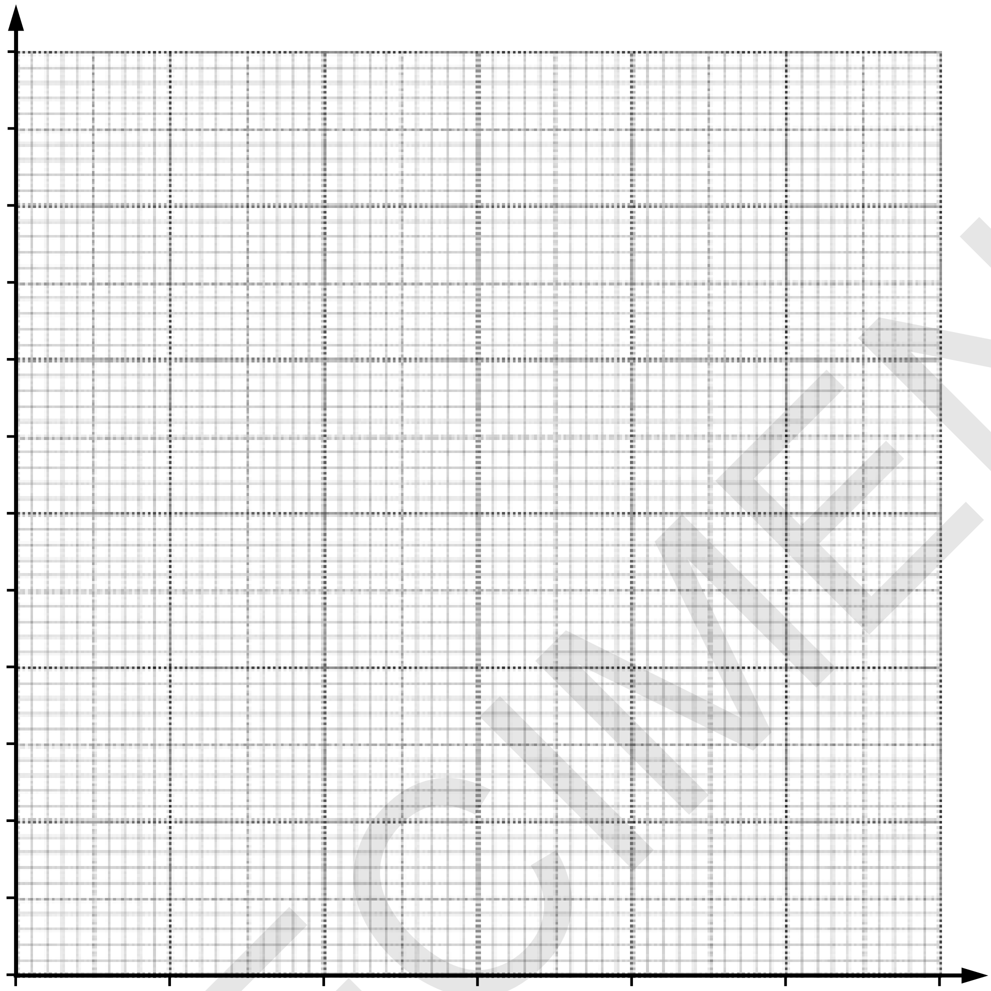



The width of the hen run is *x* metres as shown on the diagram.

Use the information to decide how many hens Farmer Barber can keep in her hen run.

You must support your answer with evidence.
You may use this table and the grid on the following page to help work out your answer.

| *x* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 – 2x | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |





______________________________ [7]

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OXFORD CAMBRIDGE AND RSA EXAMINATIONS

General Certificate of Secondary Education

# METHODS IN MATHEMATICS B392/02

Paper 2 (Higher)

**Specimen Mark Scheme**

The maximum mark for this paper is **90**.



This document consists of **5** printed pages and **1** blank page.

| | | | | |
|---|---|---|---|---|
| **1** | **(a)** | 108° | **2** | **M1** for (5 – 3) × 180 or 360/5 |
| | **(b)** | Any regular polygon except equilateral triangle, square and hexagon.<br>Find interior angle of their regular polygon<br>Attempt to divide 360 by interior angle<br>Show there is remainder | **1**<br><br>**1**<br>**1**<br>**1** | |
| | | | | |
| **2** | **(a)** | $h = \frac{A}{(2\pi r)} - r$ or $h = \frac{A - 2\pi r^2}{2\pi}$ | **2** | 1 for getting either $r + h =$...<br>or $2\pi rh =$ ... |
| | **(b)** | $(3x + 2)(3x - 2)$<br>$4(3x + 2)$<br>$\frac{3x - 2}{4}$ | **1**<br>**1**<br>**1** | Top line factorised<br>bottom line fully factorised<br>cao oe |
| | **(c)** | $(3x + 7)(x - 1)$<br><br>$x = \frac{-7}{3}$, $x = 1$ | **2**<br><br>**1** | Allow **B1** if factorised correctly but with wrong signs.<br>Allow ft from two bracket factorisation.<br>Allow use of formula. |
| | | | | |
| **3** | **(a)** | 0·412 (…) www<br>0·41 | **1**<br>**1ft** | From their longer answer, correctly rounded to 2dp<br>**SC1** for 14·68 as final answer |
| | **(b)** | 3·35 (0368959) | **1** | Do not penalise longer (correct) answer |
| | **(c)** | 125 | **1** | |
| | **(d)** | (figs) 486 or better (4·85786)<br>$4{\cdot}86 \times 10^{12}$ | **1**<br>**1** | <br>cao |
| | | | | |
| **4** | | $d^2 = a^2 + a^2$ or $r^2 + r^2 = a^2$<br>$r = \frac{a\sqrt{2}}{2}$<br>$A = \pi \times (\textit{their } r)^2$<br><br>$\frac{\pi a^2}{2}$ | **1**<br>**2**<br>**1**<br><br>**1** | <br>**A1** for $d = a\sqrt{2}$<br>their $r$ must involve $\sqrt{2}$<br><br>Allow alternative methods. |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **5** | **(a)** | 1, 5, 11, 19 | **2** | Allow 1 for any consistent error (like starting with 5 or ⁻1) |
| | **(b) (i)** | 32 | **1** | |
| | **(ii)** | $3n$<br>+2 | **1**<br>**1** | |
| | **(c)** | Formulates equation $n^2 + n - 1 = 3n + 2$<br>Simplifies to $n^2 - 2n - 3 = 0$<br>Solves to get $n = 3$, $n = {}^-1$<br>States only positive solution is a valid term | **1**<br>**1**<br>**1**<br>**1** | Allow alternative, correct, argument. |
| | | | | |
| **6** | **(a)** | $\frac{1}{9}$ | **1** | |
| | **(b)** | $x = 0{\cdot}121212121212$<br>$100x = 12{\cdot}1212121212$<br>$99x = 12$<br>$x = \frac{12}{99} = \frac{4}{33}$ | <br>**1**<br>**1**<br>**1** | |
| | **(c)** | $x = 0{\cdot}123232323232$<br>$100x = 12{\cdot}3232323232$<br>$99x = 12{\cdot}2$<br>$x = \frac{122}{990}$ or $\frac{61}{495}$ | <br>**1**<br>**1**<br>**1** | |
| | | | | |
| **7*** | | A full, clearly expressed, and complete explanation indicating that Harjinder is correct showing how a square and two octagons can fit together. This will include the fact that the corners of a square are 90° and of an octagon 135°. The explanation can be in words with or without a diagram.<br><br>Clear calculation of the internal angles of a square and/or octagon, and knowledge of tessellations provided eg calculation of the internal angle of a regular octagon and attempt to fit these together.<br><br>No relevant comment or calculation. | **3-4**<br><br><br><br>**1-2**<br><br><br>**0** | For lower mark – diagram showing angles of 135°, 135° and 90° meeting at a point with poorly expressed, explanation.<br><br>For lower mark – diagram showing angles of 135°, 135° and 90° meeting at a point with no supporting evidence. |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **8** | | Attempt to find B using sine rule<br>$\sin B = \frac{12{\cdot}2 \times \sin 127^\circ}{15{\cdot}7}$<br>B = 38·(…)° WWW<br>Recognition that angle C is needed, but initially only angle B can be found<br>C = 14·(…)°<br>Use of sine rule or cosine rule to find AB<br>4·97 www | 1<br>1<br>1<br>1<br>1ft<br>1<br>1 | for substitution<br>This could be earned at almost any point, possibly by implication<br>Depends on only third **M1**<br>Accept more accurate answer provided consistent with 4·96870835 |
| | | | | |
| **9** | | correct expansion<br>correct collection of terms<br>$x < {}^{-}0{\cdot}5$ oe | 1<br>1<br>1 | eg $x^2 + 6x + 9 < x^2 + 2x + 7$<br>eg $4x < {}^{-}2$<br>cao |
| | | | | |
| **10** | | Attempt at two equations<br>7*p* + 9*b* = 624<br>4*p* + 7*b* = 416<br>Attempt to equate coeffs of *p* or *b*<br>Subtraction attempted<br>48 packets of pastilles<br>32 packets of buttons | 1<br>1<br>1<br>1<br>1 | Allow one coeff wrong and one sign wrong in each equation; they may not use *p* and *b*<br>Accept omitting multiplying one term<br>Accept one error or omission<br>for 32 and 48 not clearly and correctly Labelled as pastilles/buttons, award **SC B1**, not **A1A1** |
| | | | | |
| **11** | **(a)** | alternate angles, or Z angles<br>(angle *b*) = angle *q* because they are alternate angles<br>*p* + *c* + *q* = 180 because they are angles at a point on a straight line<br>*a* + *b* + *c* = 180 | 1<br>1<br>1 | |
| | **(b)** | (i) Showing correct ratio in either part of the question<br>sight of 2/3 or 2:1<br>AD = 10(cm) | **B1**<br>**M1**<br>**A1** | For example AD/AB = 8/12 |
| | | (ii) Use of 3/2 or 3:2<br>AC = 18(cm) | **M1**<br>**A1** | |
| | | | | |
| **12** | **(a)** | $\frac{2100}{x} + \frac{2100}{x+2} = 2000$<br>÷ 100 | 2<br>1 | **B1** for LHS or $\frac{4200}{x} + \frac{4200}{x+2} = 2000$ soi<br>by intermediate stage |

| | | | | |
|---|---|---|---|---|
| | **(b)** | $x = 1{\cdot}5$ and $^{-}1{\cdot}4$<br><br><br><br><br>Final answer 1·5 ($ms^{-1}$) | **5**<br><br><br><br><br>**1** | **M2** for $21(x + 2) + 21x = 20x(x + 20)$ soi or<br>**M1** for common denominator $x(x + 2)$ or attempt to multiply both sides by $x(x + 2)$<br>+ **A1** for $20x^2 - 2x - 42 = 0$<br>+ **A1** for $(2x - 3)(5x + 7)$ oe or subst in formula<br>(indep) Answer without working gets final mark only. |
| | | | | |
| **13** | **(a)** | Use of Pythagoras with sides 10 and 5<br>√125 or 11·18(...) | **1**<br>**1** | |
| | **(b)** | 10 : √125 + 5 or 16·18(...)<br>1 : 1·68(...) | **1**<br>**1** | ft their answer if gained using Pythagoras |
| | **(c)** | 48 / *their* **(b)**<br>29·6 or 29·7 | **1**<br>**1** | ft<br>cao |
| | | | | |
| **14*** | | Sight of $20 - 2x$ | **1** | |
| | | A full solution and clear explanation of the problem, ending up with the conclusion that 16 hens can be kept. This may be done by completing the table, using the grid to draw a graph, or equivalent valid method.<br><br>A substantial but incomplete solution e.g. first line of table completed correctly, calculation of areas completed and an attempt to calculate the number of hens **or** some calculation errors in a complete solution. An explanation of the calculations required will be provided<br><br>First line of table completed correctly and a little further progress towards a solution. Some attempt at providing an explanation which may be poorly expressed.<br><br>No relevant comment or calculation. | **5-6**<br><br><br><br>**3-4**<br><br><br><br>**1-2**<br><br><br>**0** | For lower mark – a full solution but the number of hens has been rounded up to 17, this may be done by completing the table, using the grid to draw a graph, or equivalent valid method **or** the explanation is not clear, or contains a minor error in the calculation.<br><br>For lower mark – An answer of 16 or 17 will have been produced, possibly justified by working on the table or grid, but with no explanation provided.<br><br>For lower mark – first line of table completed with errors and/or omissions, little by way of a commentary. |
| | | | | |

**Assessment Objectives**

**GCSE Method in Mathematics**

**B392/02 (Higher)**

| Qn | AO1 | AO2 | AO3 |
|---|---|---|---|
| 1 | 2 | 4 | |
| 2 | 8 | | |
| 3 | 6 | | |
| 4 | | | 5 |
| 5 | 5 | 4 | |
| 6 | 7 | | |
| 7 | | | 4 |
| 8 | | | 7 |
| 9 | | 3 | |
| 10 | | 5 | |
| 11 | 5 | 3 | |
| 12 | 9 | | |
| 13 | 6 | | |
| 14* | | | 7 |
| | | | |
| | 48 | 19 | 23 |