AQA

General Certificate of Secondary Education
Higher Tier
November 2012

Mathematics (Linear) 43651H

Paper 1

Thursday 8 November 2012 1.30 pm to 3.00 pm

For this paper you must have:
• mathematical instruments.

You must not use a calculator.

Time allowed
• 1 hour 30 minutes

Instructions
• Use black ink or black ball-point pen. Draw diagrams in pencil.
• Fill in the boxes at the top of this page.
• Answer all questions.
• You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
• Do all rough work in this book.

Information
• The marks for questions are shown in brackets.
• The maximum mark for this paper is 70.
• The quality of your written communication is specifically assessed in Questions 8 and 11. These questions are indicated with an asterisk (*).
• You may ask for more answer paper, tracing paper and graph paper. These must be tagged securely to this answer book.

Advice
• In all calculations, show clearly how you work out your answer.
Formulae Sheet: Higher Tier

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

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

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 = \( \pi rl \)

In any triangle \( ABC \)

Area of triangle = \( \frac{1}{2} ab \sin C \)

Sine rule \( \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \)

Cosine rule \( a^2 = b^2 + c^2 - 2bc \cos A \)

The Quadratic Equation

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

\[ x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a} \]
1 (a) Write down the size of angle $x$. 

Answer ........................................................ degrees  

(1 mark)

1 (b) Work out the size of angle $y$. 

............................................................................................................................................ 

Answer ........................................................ degrees  

(1 mark)

1 (c) Choose the correct word from the list to complete the sentence.

opposite alternate corresponding interior

Angle $x$ and angle $z$ are ......................................................... angles.  

(1 mark)
In a game, players spin two wheels. The wheels are fair.

The numbers are added to get a score. The wheels show a score of \( 4 + 8 = 12 \)

![Diagram of two wheels](image-url)

You may use the grid below to help you answer the questions on the next page.

<table>
<thead>
<tr>
<th>Wheel 1</th>
<th>Wheel 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
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<td>4</td>
<td>4</td>
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<td>5</td>
<td>5</td>
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<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
2 (a) What is the most likely score?

Answer ................................................................. (2 marks)

2 (b) Score
2, 3, 15 or 16
to win a prize

Work out the probability of winning a prize.

Answer ................................................................. (3 marks)

Turn over for the next question
There are 36 men in a running club. The pie chart shows information about their favourite races.
There are 20 women in the running club.

Here is information about their favourite races.

The same proportion of women prefer the half marathon as men.

The same number of women prefer 5 km races as men.

Equal numbers of women prefer 10 km races and the marathon.

Use this information to draw a fully labelled pie chart to show the favourite races of the women.
4 (a)  Describe fully the single transformation that maps shape A to shape B.

............................................................................................................................................
............................................................................................................................................

(2 marks)

4 (b)  Draw the reflection of shape B in the line \( y = -1 \)

(2 marks)
5 Solve \( 9x - 3 = 4x + 17 \)

\[ x = \ldots \]  

(3 marks)

6 (a) Factorise \( 7x - 21 \)

Answer \( \ldots \)  

(1 mark)

6 (b) Multiply out \( 4(y + 9) \)

Answer \( \ldots \)  

(1 mark)

7 Expand and simplify \( 5(x - 3) - 2(x - 1) \)

Answer \( \ldots \)  

(3 marks)
The steepness of a railway track is shown by signs like this.

On the left of the sign the track is level.
On the right of the sign the track rises 1 metre for every 200 metres travelled horizontally.

*8 (a)

Which side of this sign shows the steeper track?
Show clearly how you decide.

You may use a diagram to explain your answer.
8 (b) The steepness can also be measured as a percentage.

For example, \(1\) in \(200\) would be \(\frac{1}{200} \times 100 = 0.5\%\).

The steepest railway line in Britain has a percentage of 2.5%.

Fill in this sign to show a steepness of 2.5%.

\[1 \text{ in .................}\]

(2 marks)
9. The length of this rectangular tile is 6 times the width.

Two tiles are put together to make this shape.

The perimeter of the new shape is 24 cm.

Work out the width of one tile.

Answer .......................................................... cm  (3 marks)
On the grid draw lines to show the region satisfied by the three inequalities.

\[ x \leq 4 \]
\[ y \leq x \]
\[ x + y \geq 4 \]

Label the region clearly with the letter R.

(3 marks)
11 (a) \(ABC\) is a right-angled triangle.

Work out the size of angle \(y\).

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Answer ........................................................ degrees \( (3\) marks)
A circle is drawn around $ABC$.

Give a reason why $BC$ is a diameter of the circle.

............................................................................................................................................
............................................................................................................................................

(1 mark)
12 \( PQR \) is an enlargement of \( ABC \).

\[ \begin{align*}
\text{Not drawn accurately}
\end{align*} \]

12 (a) Work out the scale factor of the enlargement.

............................................................................................................................................

Answer ...................................................................... \((1 \text{ mark})\)

12 (b) Write down the size of angle \( P \).

Answer ........................................................ degrees \((1 \text{ mark})\)

12 (c) Work out the length \( AB \).

............................................................................................................................................

............................................................................................................................................

Answer ................................................................ cm \((2 \text{ marks})\)
13 Cucumbers are grown in a greenhouse or in a garden. The box plots show data about their lengths, in centimetres.

13 (a) Write down the median length of the cucumbers grown in the garden.

Answer ................................................................. cm  (1 mark)

13 (b) Give two comparisons between the lengths of cucumbers grown in the greenhouse and cucumbers grown in the garden.

Comparison 1 ........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

Comparison 2 ........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

(3 marks)
14 (a) Factorise \( x^2 - 9 \)

Answer ............................................................ (1 mark)

14 (b) Hence, simplify fully \( \frac{x^2 - 9}{2x^2 - 5x - 3} \)

Answer ............................................................ (3 marks)
15 The area of a trapezium is given by the formula

\[ \text{Area of trapezium} = \frac{1}{2}(a+b)h \]

15 (a) For a trapezium, \( a = 5 \text{ cm} \), \( b = 8 \text{ cm} \) and \( h = 6 \text{ cm} \)

All measurements are given to the nearest centimetre.

Work out the minimum possible area.

\[ \text{Answer} \quad \text{...... cm}^2 \quad (3 \text{ marks}) \]

15 (b) Rearrange \( A = \frac{1}{2}(a + b)h \) to make \( h \) the subject.

\[ \text{Answer} \quad \text{......} \quad (2 \text{ marks}) \]
The manager of a company wants to survey his employees. He decides to sample 20% of them, stratified by the type of job they do. This table shows the number of employees.

<table>
<thead>
<tr>
<th></th>
<th>Office staff</th>
<th>Drivers</th>
<th>Mechanics</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office staff</td>
<td>12</td>
<td>24</td>
<td>4</td>
<td>40</td>
</tr>
</tbody>
</table>

Fill in the table below to show how many of each group he should survey.

<table>
<thead>
<tr>
<th></th>
<th>Office staff</th>
<th>Drivers</th>
<th>Mechanics</th>
</tr>
</thead>
</table>

(3 marks)
17 Write \( \sqrt{12} + \sqrt{75} \) in the form \( a\sqrt{3} \) where \( a \) is an integer.

Answer ................................................................. (2 marks)

18 Write these numbers in order of size starting with the smallest.
You must show your working.

\[
\frac{2}{3}, \frac{1}{3}, \frac{3}{2}
\]

Answer ................., ............... , ............... (3 marks)
19. \(ABCD\) is a triangular based pyramid.  
The base \(BCD\) is a right-angled triangle.  

\(A\) is directly above \(B\).  
\(BC = BD\)  
\(AB = 2 \times BC\)  
The volume of the pyramid is 72 cm\(^3\).  

The formula for the volume of a pyramid is \(\frac{1}{3} \times \text{base area} \times \text{height}\).  

Calculate the length of \(BC\), labelled \(x\) in the diagram.  

Answer .............................................. cm \(\text{(3 marks)}\)
20 The diagram shows a sketch of the graph of \[ y = x^2 + ax + b \]
The graph crosses the \( x \)-axis at (2, 0) and (4, 0).

Work out the value of \( b \).
You must show your working.

\[ b = \text{...} \]  

(4 marks)

END OF QUESTIONS