Mathematics (Linear)  

Paper 1

Wednesday 5 November 2014    9.00 am to 10.30 am

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 3, 9, 12 and 14. 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.
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

\[ x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a} \]
Answer all questions in the spaces provided.

1

Anna wants to know the colours of cars in the school car park.
Brian wants to find out what students think about school dinners.
Carl wants to test people’s reaction time.

Here are four data collection methods.

1 Questionnaire
2 Controlled experiment
3 Observation
4 Data logging

Choose the method each person should use.

[2 marks]

Anna .................................................................

Brian .................................................................

Carl .................................................................

Turn over for the next question
Here are six quadrilaterals.

2 (a) Write down the names of the three quadrilaterals that have diagonals crossing at right-angles.

[2 marks]

Answer ......................................................................

and ............................................................................

and ............................................................................

and ............................................................................
2 (b) Three quadrilaterals are

Square  Rectangle  Parallelogram

The parallelogram could be the odd one out. Give a reason why.

[1 mark]

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2 (c) Three quadrilaterals are

Rectangle  Parallelogram  Rhombus

Tick the one property that these three quadrilaterals have in common.

[1 mark]

All four sides the same length

All four angles equal

Diagonals bisect each other

Two lines of symmetry
Here is the net of a cuboid. The net shows the area of each face.

Work out the **volume** of the cuboid. [4 marks]

Answer ............................................................... cm³
4 (a) The manager of a leisure centre uses this question in a survey.

How much time do you spend taking exercise?

- Never
- 0 – 1 hours
- 1 – 2 hours
- 3 – 4 hours

Write down two things that are wrong with this question.

[2 marks]

1

2

4 (b) Complete the response section for this question.

[1 mark]

How many days in a week would you use the leisure centre?
5 You will need a ruler and compasses to answer this question.
Construct the angle bisector of angle $A$.

6 Expand and simplify $3(x + 2) + 2(x - 1)$

Answer: $\ldots$
7 (a) Three electric cars are tested by driving them around a track until the battery runs out. The table shows some information about their performance.

<table>
<thead>
<tr>
<th>Car</th>
<th>Total time travelled (hours)</th>
<th>Average speed (km/h)</th>
<th>Total distance travelled (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>40</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

Complete the table. [3 marks]

7 (b) Two cars are driven around a 10 kilometre track. Both cars leave from the start line at the same time.

Car X travels at exactly 40 km/h
Car Y travels at exactly 30 km/h

How many minutes will it be before they pass the start line together again? [2 marks]

Answer ........................................ minutes
The table shows the length of the forearm, \( f \), measured in cm, and the height, \( h \), measured in cm, for 10 people.

<table>
<thead>
<tr>
<th>Person</th>
<th>Length of forearm, ( f ) (cm)</th>
<th>Height, ( h ) (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>108</td>
</tr>
<tr>
<td>B</td>
<td>25</td>
<td>160</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>140</td>
</tr>
<tr>
<td>D</td>
<td>28</td>
<td>180</td>
</tr>
<tr>
<td>E</td>
<td>15</td>
<td>120</td>
</tr>
<tr>
<td>F</td>
<td>21</td>
<td>140</td>
</tr>
<tr>
<td>G</td>
<td>17</td>
<td>118</td>
</tr>
<tr>
<td>H</td>
<td>26</td>
<td>164</td>
</tr>
<tr>
<td>I</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>J</td>
<td>24</td>
<td>150</td>
</tr>
</tbody>
</table>

A scatter diagram of the data is shown opposite.

8 (a) Another person has a height of 145 cm

Use the scatter diagram to estimate the length of their forearm. Show clearly how you found your estimate.

Answer: ................................................. cm
8 (b) An approximate formula connecting \( h \) and \( f \) is \( h = 4 \times f + 60 \)

Choose a person from the table and test the formula.

Person chosen ........

Does the formula work **exactly**?
Tick a box.

[ ] Yes  [ ] No

Show how you worked out your answer.

........................................................................................................................................
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........................................................................................................................................
A small building company has 10 employees. The table shows their monthly salaries.

<table>
<thead>
<tr>
<th>Job</th>
<th>Number of employees</th>
<th>Monthly salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labourer</td>
<td>5</td>
<td>£1200</td>
</tr>
<tr>
<td>Driver</td>
<td>3</td>
<td>£1400</td>
</tr>
<tr>
<td>Supervisor</td>
<td>1</td>
<td>£2500</td>
</tr>
<tr>
<td>Manager</td>
<td>1</td>
<td>£13,500</td>
</tr>
</tbody>
</table>

9 (a) What is the modal monthly salary? [1 mark]

Answer £ .................................................................

**9 (b) The median monthly salary is £1300**

Explain why. [1 mark]

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

9 (c) The mean monthly salary is £2620

Give a reason why the mean is not the best average to use for the 10 employees. [1 mark]

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............................................................................................................................................
............................................................................................................................................
A cuboid is drawn on a 3D coordinate grid, as shown.

\( OC = 3 \) units, \( OA = 5 \) units, \( OD = 4 \) units

\( M \) is the centre of the face \( DEFG \).

10 (a) Which point has coordinates (3, 5, 0)?
Circle the correct letter.

[1 mark]

\( \text{ABCDEFG} \)

10 (b) The numbers 3, 4 and 5 form a Pythagorean triple because \( 3^2 + 4^2 = 5^2 \)

Which other point, apart from \( A \), is 5 units from \( O \)?
Circle the correct letter.

[1 mark]

\( \text{BCDEFG} \)

10 (c) Work out the coordinates of the centre, \( M \), of the face \( DEFG \).

[2 marks]

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

Answer ( ............. , ............. , ............. )
11 Loren puts £600 in a bank account. The account pays 3% compound interest each year. After one year she withdraws £200. How much will she have in the account after two years? [3 marks]

Answer £ ..................................................................................
Here are six rods. The two longest rods are the same length.

\[2(2x + 1) \text{ cm} \]
\[(2x + 7) \text{ cm} \]
\[(2x + 3) \text{ cm} \]
\[(x + 4) \text{ cm} \]
\[(3x - 2) \text{ cm} \]
\[(2x - 1) \text{ cm} \]

The six rods can be fitted together to make a quadrilateral with equal sides.

Use algebra to show clearly how this can be done.

[5 marks]
13 (a) Write the number 0.000 000 7 in standard form. [1 mark]

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

Answer ............................................................

13 (b) Write $3 \times 10^5$ as an ordinary number. [1 mark]

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

Answer ............................................................

13 (c) Work out $4 \times 10^3 \times 8 \times 10^5$
Give your answer in standard form. [2 marks]

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

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

Answer ............................................................
6 cups of tea and 4 cakes cost £13.20
5 cups of tea and 4 cakes cost £12.00

Is £10 enough to buy 3 cups of tea and 4 cakes?

[4 marks]
Rearrange the formula \( y = \frac{3x - 2}{x + 1} \) to make \( x \) the subject.

[4 marks]

Answer ..............................................................................................................
The table and histogram show some information about the cholesterol level in the blood of 100 hospital patients.

<table>
<thead>
<tr>
<th>Cholesterol level, c</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; c ≤ 2</td>
<td>8</td>
</tr>
<tr>
<td>2 &lt; c ≤ 3</td>
<td>13</td>
</tr>
<tr>
<td>3 &lt; c ≤ 4</td>
<td></td>
</tr>
<tr>
<td>4 &lt; c ≤ 5</td>
<td>19</td>
</tr>
<tr>
<td>5 &lt; c ≤ 7</td>
<td></td>
</tr>
<tr>
<td>7 &lt; c ≤ 10</td>
<td>15</td>
</tr>
</tbody>
</table>

16 (a) Use the table to complete the histogram. [2 marks]

16 (b) Use the histogram to complete the table. [2 marks]
17 $OAB$ is a sector of a circle of radius 12 cm
Angle $AOB = 60^\circ$

Work out the length of the arc $AB$.
Give your answer in terms of $\pi$.

[2 marks]

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............................................................................................................................................
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Answer ................................................................. cm
18 Solve \( x^2 + 6x + 2 = 0 \)
Give your answer in the form \( a \pm \sqrt{b} \) where \( a \) and \( b \) are integers. [4 marks]

Answer

Turn over for the next question
19. $B, X, Y$ and $Z$ are points on the circumference of a circle.
$ABC$ is a tangent to the circle.
$BX$ is parallel to $ZY$.

Work out the size of angle $ZXY$.

You **must** show your working, which may be on the diagram.

[3 marks]

Answer ........................................................ degrees
20 (a) Circle the value that is equivalent to $\sqrt{50} + \sqrt{32}$

[1 mark]

- $9\sqrt{2}$
- 41
- $\sqrt{82}$
- $2\sqrt{41}$

20 (b) Circle the value that is equivalent to $4\sqrt{75} + 2\sqrt{3}$

[1 mark]

- $2\sqrt{72}$
- 10
- $2\sqrt{15}$
- 20

21 Given that $3^x = 9^{x+1}$ work out the value of $x$.

[2 marks]

$\frac{3^x}{3^{x+1}} = \frac{1}{3}$

$\frac{1}{3} = \frac{1}{3}$

$x = \frac{1}{3}$

END OF QUESTIONS
There are no questions printed on this page