Instructions to Candidates
In the boxes above, write your centre number, candidate number, your surname, initials and signature. Check that you have the correct question paper. Answer ALL the questions. Write your answers in the spaces provided in this question paper. You must NOT write on the formulae page. Anything you write on the formulae page will gain NO credit.
If you need more space to complete your answer to any question, use additional answer sheets.

Information for Candidates
The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 25 questions in this question paper. The total mark for this paper is 100. There are 24 pages in this question paper. Any blank pages are indicated. Calculators may be used.
If your calculator does not have a $\pi$ button, take the value of $\pi$ to be 3.142 unless the question instructs otherwise.

Advice to Candidates
Show all stages in any calculations.
Work steadily through the paper. Do not spend too long on one question.
If you cannot answer a question, leave it and attempt the next one.
Return at the end to those you have left out.
GCSE Mathematics (Linear) 1380

Formulae: Higher Tier

You must not write on this formulae page. Anything you write on this formulae page will gain NO credit.

Volume of a prism = area of cross section × 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

The Quadratic Equation
The solutions of \( ax^2 + bx + c = 0 \)
where \( a \neq 0 \), are given by
\[
x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}
\]

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 = \( \frac{1}{2} ab \sin C \)
Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

1. (a) Use your calculator to work out

\[
\frac{\sqrt{21.5}}{5.8 - 2.36}
\]

Write down all the figures on your calculator display.

\[
1.347909665
\]

(2)

(b) Write down your answer to part (a) correct to 2 decimal places.

\[
1.347909665 \\
= 1.35
\]

(1) Q1

(Total 3 marks)

2. Ishmal invested £3500 for 3 years at 2.5% per annum simple interest.

Work out the total amount of interest Ishmal earned.

\[
2.5\% \times 3500 = £87.50
\]

\[
87.50 \times 3 = £262.50
\]

£262.50 Q2

(Total 3 marks)
3. Gary wants to find out how much time teenagers spend listening to music.

He uses this question on a questionnaire.

How many hours do you spend listening to music?

- 1 to 5
- 5 to 10
- 10 to 20
- over 20

(a) Write down two things wrong with this question.

1. **there is no time-scale**

2. **there is no option for 0**

(there are also overlapping options)  

(b) Design a better question for Gary's questionnaire to find out how much time teenagers spend listening to music.

How many hours do you spend listening to music a week?

- 0
- 1-5 hours
- 6-10 hours
- 11 or more hours

(Total 4 marks)
4. (a) Find the highest common factor (HCF) of 24 and 30

\[
\begin{array}{ccc}
24 & 30 \\
1 \times 24 & 1 \times 30 \\
2 \times 12 & 2 \times 15 \\
3 \times 8 & 3 \times 10 \\
4 \times 6 & 5 \times 6 \\
\end{array}
\]

6

(1)

(b) Find the lowest common multiple (LCM) of 4, 5 and 6

\[
\begin{array}{ccc}
4 & 5 & 6 \\
2 & 5 & 5 \\
4 \times 2 \times 3 \times 5 & 4 \times 3 \times 5 & 2 \times 3 \times 5 \\
12 \times 5 \\
60 & 60 & 60 \\
\end{array}
\]

(2)

(Total 3 marks)

5. Melissa is 13 years old.
Becky is 12 years old.
Daniel is 10 years old.

Melissa, Becky and Daniel share £28 in the ratio of their ages.
Becky gives a third of her share to her mother.

How much should Becky now have?

\[
13 + 12 + 10 = 35 \quad \text{(points)}
\]

\[
\frac{28}{35} = \frac{80}{\text{per point}}
\]

\[
12 \times \frac{80}{\text{per point}} = \£9.60
\]

\[
\frac{9.60}{3} = \£3.20
\]

£6.40

(Total 4 marks)
All angles are measured in degrees.

$ABC$ is a straight line.
Angle $APB = x + 50$
Angle $PAB = 2x - 10$
Angle $PBC = y$

(a) Show that $y = 3x + 40$
Give reasons for each stage of your working.

\[
\begin{align*}
\angle APB &= 180 - (2x - 10) - (x + 50) \\
&= 180 - 2x + 10 - x - 50 \\
\angle PBC &= 180 - \angle APB \\
&= 180 - (180 - 3x - 40) \\
&= 180 - 180 + 3x + 40 \\
&= 3x + 40
\end{align*}
\]

(b) Given that $y = 145,$

(i) work out the value of $x,$

\[
3x + 40 = 145 \\
3x = 105 \\
x = 35
\]

(ii) work out the size of the largest angle in triangle $ABP.$

\[
\begin{align*}
\frac{35}{x + 50} &= 8.5 \\
2(35) - 10 &= 60
\end{align*}
\]

(Total 7 marks)
7. The diagrams show a right-angled triangle and a rectangle.

The area of the right-angled triangle is equal to the area of the rectangle.

Find the value of $x$.

\[
\frac{1}{2} \times 8 \times 15 = 12x,
\]

\[4 \times 15 = 12x\]

\[60 = 12x\]

\[
\frac{60}{12} = \frac{12x}{12}
\]

\[x = 5\]

$x = 5$

(Total 4 marks)
8. The diagram shows a CD.
The CD is a circle of radius 6 cm.

Diagram NOT accurately drawn

(a) Work out the circumference of the CD.

\[
\text{Circumference} = 2\pi r \\
= 2\pi \times 6 \\
= 12\pi \\
\approx 37.7 \text{ cm}
\]

(b) Work out the greatest number of CDs that can be cut from one rectangular sheet.

32

(Total 4 marks)
9. The exchange rate in London is \( £1 = €1.14 \)
The exchange rate in Paris is \( £1 = €0.86 \)

Elaine wants to change some pounds into euros.

In which of these cities would Elaine get the most euros?
You must show all of your working.

\[
\begin{align*}
\text{London} & \quad £1 = €1.14 \\
\text{Paris} & \quad \frac{£0.86}{0.86} = \frac{€1}{0.86} \\
& \quad £1 = €1.16 \quad [2 \text{dp}]
\end{align*}
\]

Elaine gets more euros in Paris.
10. The temperature ($T^\circ C$) at noon at a seaside resort was recorded for a period of 60 days. The table shows some of this information.

<table>
<thead>
<tr>
<th>Temperature ($T^\circ C$)</th>
<th>Number of days</th>
<th>mid point</th>
<th>mid point x f</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 &lt; T \leq 14$</td>
<td>2</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>$14 &lt; T \leq 18$</td>
<td>8</td>
<td>16</td>
<td>128</td>
</tr>
<tr>
<td>$18 &lt; T \leq 22$</td>
<td>14</td>
<td>20</td>
<td>280</td>
</tr>
<tr>
<td>$22 &lt; T \leq 26$</td>
<td>23</td>
<td>24</td>
<td>552</td>
</tr>
<tr>
<td>$26 &lt; T \leq 30$</td>
<td>9</td>
<td>28</td>
<td>252</td>
</tr>
<tr>
<td>$30 &lt; T \leq 34$</td>
<td>4</td>
<td>32</td>
<td>128</td>
</tr>
</tbody>
</table>

Calculate an estimate for the mean temperature at noon during these 60 days. Give your answer correct to 3 significant figures.

\[
\frac{1364}{60} = 22.73^\circ C
\]

\[
= 22.7^\circ C \quad (3 \text{ sig. figs})
\]

\[
22.7^\circ C
\]
11. (a) Simplify \( m^3 \times m^6 \)

\[ \frac{m^7}{m} \]

(b) Simplify \( \frac{p^8}{p^2} \)

\[ p^6 \]

(c) Simplify \( (2n^3)^4 \)

\[ 2n^{12} \]

\[ \frac{16n^{12}}{n} \]

(Total 4 marks)

12. \(-2 \leq n < 5\)
   \(n\) is an integer.

(a) Write down all the possible values of \(n\).

\[ -2, -1, 0, 1, 2, 3, 4 \]

(b) Solve the inequality \( 4x + 1 > 11 \)

\[ \begin{align*}
4x &> 10 \\
x &> \frac{10}{4} \\
x &> \frac{5}{2}
\end{align*} \]

\[ x > 2.5 \]

(Total 4 marks)
13. (a) Complete the table of values for \(3x + 2y = 6\)

<table>
<thead>
<tr>
<th>(x)</th>
<th>(-2)</th>
<th>(-1)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>6</td>
<td>4.5</td>
<td>3</td>
<td>1.5</td>
<td>0</td>
<td>-1.5</td>
</tr>
</tbody>
</table>

\[
3(-2) + 2y = 6 \\
-6 + 2y = 6 \\
2y = 6 \\
y = 3
\]

\[
3(1) + 2y = 6 \\
3 + 2y = 6 \\
2y = 3 \\
y = 1.5
\]

\[
3(2) + 2y = 6 \\
6 + 2y = 6 \\
2y = 0
\]

(b) On the grid, draw the graph of \(3x + 2y = 6\)

(c) Find the gradient of the graph of \(3x + 2y = 6\)

(going down in 1.5 s)

\[
-1.5
\]

(Total 6 marks)
14. (a) Factorise  $6x + 4$

$$2(3x + 2)$$

(b) Factorise fully  $9x^2y - 15xy$

$$3xy(3x - 5)$$

(Total 3 marks)

15. A garage sells used cars. The table shows the number of used cars it sold from July to December.

<table>
<thead>
<tr>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>25</td>
<td>34</td>
<td>46</td>
<td>28</td>
<td>40</td>
</tr>
</tbody>
</table>

(a) Work out the 3-point moving averages for the information in the table. The first two have been worked out for you.

$$\frac{34 + 46 + 28}{3} = \frac{462}{3} = 154$$

$$\frac{46 + 28 + 40}{3} = \frac{114}{3} = 38$$

| 29   | 35     | 36       | 38       |

(b) Comment on the trend shown by the 3-point moving averages.

It is increasing.

(Total 3 marks)
16. Barry drew an angle of $60^\circ$.
He asked some children to estimate the size of the angle he had drawn.
He recorded their estimates.
The box plot gives some information about these estimates.

Children’s estimates

![Box plot for children’s estimates]

Size of estimate

0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100°

Adults’ estimates

![Box plot for adults’ estimates]

Size of estimate

0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100°

(a) Write down the median of the children’s estimates.

$55^\circ$

(1)

(b) Find the interquartile range of the children’s estimates.

\[IQR = 70\]
\[LC = 47\]

\[70 - 47\]

$23^\circ$

(2)
Barry then asked some adults to estimate the size of the angle he had drawn. The table gives some information about the adults’ estimates.

<table>
<thead>
<tr>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest estimate</td>
</tr>
<tr>
<td>Lower quartile</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Upper quartile</td>
</tr>
<tr>
<td>Highest estimate</td>
</tr>
</tbody>
</table>

(c) On the grid opposite, draw a box plot to show this information. 

(d) Use the two box plots, to compare the distribution of the children’s estimates with the distribution of the adults’ estimates.

- The median for the adults (62°) was closer to 60° than the children (55°).

- The adults’ scores were more spread out than the children’s.

1.0R (30°) compared to 23° for children. 

(Total 7 marks)
Triangle $ABC$ is similar to triangle $ADE$.

$AC = 15\text{ cm}$.

$CE = 6\text{ cm}$.

$BC = 12.5\text{ cm}$.

Work out the length of $DE$.

$$12.5 \times \frac{21}{15} = 17.5$$

$17.5\text{ cm}$

(Total 3 marks)

18. Change $9\text{ cm}^2$ to $\text{mm}^2$.

$1\text{ cm}^2 = 100\text{ mm}^2$

$900\text{ mm}^2$

(Total 2 marks)
19. Find the exact solutions of \( x + \frac{3}{x} = 7 \) \( \times \) everything by \( x \)

\[
x^2 + 3 = 7x
\]

\[
x^2 - 7x + 3 = 0
\]

\( a = 1 \) \( b = -7 \) \( c = 3 \)

\[
x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(1)(3)}}{2(1)}
\]

\[
= \frac{7 + \sqrt{37}}{2} \quad \text{or} \quad \frac{7 - \sqrt{37}}{2}
\]

(Total 3 marks)
PQRS is a trapezium.
PQ is parallel to SR.
Angle PSR = 90°.
Angle PRS = 62°.
PQ = 14 cm.
PS = 8 cm.

(a) Work out the length of PR.
   Give your answer correct to 3 significant figures.

\[
\sin \chi = \frac{O}{H}
\]

\[
\sin(62^\circ) = \frac{8}{x}
\]

\[
\chi = \frac{8}{\sin(62^\circ)} = 9.06 \hspace{1cm} (3)
\]

(b) Work out the length of QR.
   Give your answer correct to 3 significant figures.

\[
\alpha^2 = b^2 + c^2 - 2bc \cos A
\]

\[
\alpha^2 = 14^2 + 9.06^2 - 2(14)(9.06) \cos(62^\circ)
\]

\[
= 158.97
\]

\[
\alpha = \sqrt{158.97}
\]

\[
= 12.6 \hspace{1cm} (3.5)
\]
21. The table and histogram give some information about the weights of parcels received at a post office during one day.

(a) Use the histogram to complete the frequency table.

<table>
<thead>
<tr>
<th>Weight (w) kg</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; w ≤ 2</td>
<td>40</td>
</tr>
<tr>
<td>2 &lt; w ≤ 3</td>
<td>34</td>
</tr>
<tr>
<td>3 &lt; w ≤ 4</td>
<td>24</td>
</tr>
<tr>
<td>4 &lt; w ≤ 5</td>
<td>18</td>
</tr>
<tr>
<td>5 &lt; w ≤ 8</td>
<td>12</td>
</tr>
</tbody>
</table>

(b) Use the table to complete the histogram.

(Total 4 marks)
The diagram shows a triangle $ABC$.

$LMNB$ is a parallelogram where
- $L$ is the midpoint of $AB$,
- $M$ is the midpoint of $AC$,
and $N$ is the midpoint of $BC$.

Prove that triangle $ALM$ and triangle $MNC$ are congruent.
You must give reasons for each stage of your proof.

- $AM = MC$ \(\text{ (as } M \text{ is midpoint of } AC)\)
- $NM = LB$ \(\text{ (opposite sides in a parallelogram)}\)
- $BL = LA$ \(\text{ (as } L \text{ is midpoint of } AB)\)
- $LM = BN$ \(\text{ (opposite sides in a parallelogram)}\)
- $BN = NC$ \(\text{ (as } N \text{ is the midpoint of } BC)\)

$ALM$ is congruent to $MNC$ \(\text{(SSS)}\)
23. (a) Factorise \( x^2 + px + qx + pq \)

\[
(x + p)(x + q)
\]

(b) Factorise \( m^2 - 4 \)

\[
(m + 2)(m - 2)
\]

(c) Write as a single fraction in its simplest form

\[
\frac{(x+3)x}{x+4} - \frac{1}{x+3} \frac{x}{x-4}
\]

\[
= \frac{2(x+3)}{(x+3)(x-4)} - \frac{1(x-4)}{(x+3)(x-4)}
\]

\[
= \frac{2(x+3) - 1(x-4)}{(x+3)(x-4)}
\]

\[
= \frac{2x + 6 - x + 4}{(x+3)(2x-4)}
\]

\[
= \frac{x + 10}{(x+3)(x-4)}
\]

(Total 6 marks)
24. The diagram shows a solid hemisphere of radius 8 cm.

Work out the total surface area of the hemisphere.
Give your answer correct to 3 significant figures.

\[
\text{surface area of sphere} = 4\pi r^2 \\
\text{surface area of curved section} = 2\pi r^2 \\
\text{area of top} = \pi r^2 \\
\text{total s.a} = 3\pi r^2 \\
= 3 \times \pi \times 8^2 \\
= 603 \text{ cm}^2 \ (3s) \\
\]

\underline{603 \text{ cm}^2} 

(Total 3 marks)
25. Steve measured the length and the width of a rectangle. He measured the length to be 645 mm correct to the nearest 5 mm. He measured the width to be 400 mm correct to the nearest 5 mm.

Calculate the lower bound for the area of this rectangle. Give your answer correct to 3 significant figures.

\[
\text{Lower area} = \text{Lower length} \times \text{Lower width}
\]

\[
= 642.5 \times 397.5
\]

\[
= 255000 \text{ mm}^2 (3 \text{ sf})
\]