Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided – **there may be more space than you need**.
- **Calculators may be used.**
- You must **NOT** write anything on the formulae page. Anything you write on the formulae page will gain NO credit.

Information

- The total mark for this paper is **100**.
- The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
**International GCSE MATHEMATICS**

**FORMULAE SHEET – HIGHER TIER**

- **Pythagoras’ Theorem**
  
  \[ a^2 + b^2 = c^2 \]

- **Volume of cone**
  
  \[ \frac{1}{3} \pi r^2 h \]

- **Curved surface area of cone**
  
  \[ \pi rl \]

- **Volume of sphere**
  
  \[ \frac{4}{3} \pi r^3 \]

- **Surface area of sphere**
  
  \[ 4 \pi r^2 \]

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

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

- **Circumference of circle**
  
  \[ 2\pi r \]

- **Area of circle**
  
  \[ \pi r^2 \]

- **Volume of cylinder**
  
  \[ \pi r^2 h \]

- **Curved surface area of cylinder**
  
  \[ 2\pi rh \]
Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 In January 2007 the population of Canada was 32 million. 
7 million of these Canadian people spoke French as their first language.

(a) Express 7 million as a percentage of 32 million.
    Give your answer correct to 1 decimal place.

                            %

Between January 2007 and January 2009 the population of Canada increased by 4%.

(b) Increase 32 million by 4%.
    Give your answer correct to the nearest million.

                            million

(Total for Question 1 is 5 marks)
2 Here is a fair 5-sided spinner.

![Image of a 5-sided spinner with sides labeled Red, Blue, and Green.]

Hans spins the spinner 30 times.

Work out an estimate for the number of times the spinner lands on Red.

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

(Total for Question 2 is 2 marks)

3 A cylinder has a diameter of 15 cm and a height of 26 cm.

![Diagram of a cylinder with dimensions labeled 15 cm and 26 cm.]

Work out the volume of the cylinder.
Give your answer correct to 3 significant figures.

.............................................................. cm$^3$

(Total for Question 3 is 3 marks)
4 The lengths of the sides of a rhombus are 6 cm.  
The length of the longer diagonal of the rhombus is 10 cm.  
$AB$ is a side of the rhombus.  

**Construct** an accurate, full-size drawing of the rhombus.  
You must show all construction lines.

(Total for Question 4 is 4 marks)
(a) Factorise $5a - 3a^2$

(b) Expand

(i) $2(4 - 3w)$

(ii) $y^2(y + 10)$

(c) $W = \frac{5.6a}{b^2}$

\[ a = 1.28 \quad b = 0.8 \]

Work out the value of $W$. 

\[ W = \]
6  (a) \( \mathcal{E} = \{ \text{Students in Year 12} \} \)
\( G = \{ \text{Students who study German} \} \)
\( F = \{ \text{Students who study French} \} \)
\( M = \{ \text{Students who study Maths} \} \)

(i) \( G \cap M = \emptyset \)

Use this information to write a statement about the students who study German in Year 12

(ii) Preety is a student in Year 12
Preety \( \notin F \).

Use this information to write a statement about Preety.

(b) \( A = \{2, 4, 6, 8, 10\} \)
\( A \cap B = \{2, 4\} \)
\( A \cup B = \{1, 2, 3, 4, 6, 8, 10\} \)

List all the members of set \( B \).

(Total for Question 6 is 4 marks)

Do NOT write in this space.
The table shows information about the numbers of text messages sent by 40 teenagers in one day.

<table>
<thead>
<tr>
<th>Number of text messages</th>
<th>Number of teenagers</th>
<th>Mid-interval value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3 to 5</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>6 to 8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9 to 11</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>12 to 14</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>15 to 17</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

(a) Write down the modal class.

.............................................................. (1)

(b) (i) Work out an estimate for the mean number of texts sent by the 40 teenagers in one day.

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

.............................................................. (5)

(Total for Question 7 is 6 marks)
8 A bag contains 60 beads.
\(x\) of the beads are red and the rest are green.
Altaaf takes at random a bead from the bag.

(a) State, in terms of \(x\), the probability that Altaaf takes a red bead.

\[\text{Probability} = \frac{x}{60}\]

Altaaf puts his bead back in the bag.
Another 20 red beads are added to those in the bag.
The probability that Altaaf takes a red bead is now doubled.

(b) (i) Use this information to write down an equation in \(x\) and show that your equation can be expressed as \(8x = 3(x + 20)\)

(ii) Solve \(8x = 3(x + 20)\)
Show your working clearly.

\[x = \frac{60}{8} = 7.5\]

(Total for Question 8 is 6 marks)
Triangle $PQR$ has a right angle at $Q$.

$PQ = 3.4$ cm and $PR = 5.8$ cm.

(a) Work out the size of angle $QRP$.
   Give your answer correct to 1 decimal place.

\[
\begin{align*}
\text{\,} &\quad \text{°} \\
\text{(3)} &
\end{align*}
\]

The length 5.8 cm, of $PR$, is correct to 2 significant figures.

(b) (i) Write down the upper bound of the length of $PR$.

\[
\begin{align*}
\text{\,} &\quad \text{cm} \\
\text{(2)} &
\end{align*}
\]

(ii) Write down the lower bound of the length of $PR$.

\[
\begin{align*}
\text{\,} &\quad \text{cm} \\
\text{(2)} &
\end{align*}
\]

(Total for Question 9 is 5 marks)
10 A bank pays compound interest of 6% per annum on its savings accounts. Julia invests $7500 for 3 years. Calculate the total interest gained after 3 years.

\[ \text{Total for Question 10 is 3 marks} \]

11 Make \( y \) the subject of  \[ 3(y + 2x - 1) = x + 5y \]

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

\( y = \text{..............................................................} \)

\( \text{(Total for Question 11 is 3 marks)} \)
12  \(ABCD\) and \(APQR\) are two similar quadrilaterals.

\[\begin{align*}
PQ &= 9 \text{ cm.} \\
BC &= 6 \text{ cm.} \\
AD &= 5 \text{ cm.} \\
QR &= 12 \text{ cm.}
\end{align*}\]

(a) Find the length of \(DC\).

\[
.............................................................. \text{ cm} \\
(2)
\]

(b) Find the length of \(AR\).

\[
.............................................................. \text{ cm} \\
(2)
\]

The area of the quadrilateral \(ABCD\) is 32 cm\(^2\).

(c) Calculate the area of the shaded region.

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

(Total for Question 12 is 7 marks)
P, Q, R and S are points on the circumference of a circle. PR and QS intersect at T. Angle QPR = 34° and angle PRS = 41°

(a) (i) Find the size of angle PQS.

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

(ii) Give a reason for your answer.

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

(b) (i) Find the size of angle PTS.

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

(ii) Explain why T cannot be the centre of the circle.

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

(Total for Question 13 is 4 marks)
The diagram shows a rectangular photo frame of area $A$ cm$^2$.
The width of the photo frame is $x$ cm.
The height of the photo frame is $y$ cm.
The perimeter of the photo frame is 72 cm.

(a) Show that $A = 36x - x^2$

(b) Find $\frac{dA}{dx}$

(c) Find the maximum value of $A$.

$A =$
15 Two small magnets attract each other with a force, $F$ newtons.
$F$ is inversely proportional to the square of the distance, $d$ cm, between them.

When $d = 2$, $F = 12$

(a) Express $F$ in terms of $d$.

(b) Calculate the value of $F$ when $d = 5$

(c) Calculate the value of $d$ when $F = 3$

(Total for Question 15 is 6 marks)
The incomplete table shows information about the times, in minutes, that runners took to complete a race.

<table>
<thead>
<tr>
<th>Time ((t) minutes)</th>
<th>(30 \leq t &lt; 35)</th>
<th>(35 \leq t &lt; 40)</th>
<th>(40 \leq t &lt; 50)</th>
<th>(50 \leq t &lt; 60)</th>
<th>(60 \leq t &lt; 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of runners</td>
<td>12</td>
<td>20</td>
<td>12</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

(a) Use the histogram to calculate the number of runners who took between 40 and 50 minutes to complete the race.

(b) Complete the histogram for the remaining results.
Runners who achieved a time between 37 and 48 minutes to complete the race were each awarded a silver medal.

(c) Calculate an estimate of the number of runners awarded silver medals.

17 Show that the recurring decimal $0.1\overline{7} = \frac{8}{45}$

(Total for Question 16 is 6 marks)

(Total for Question 17 is 2 marks)
Diagram NOT accurately drawn

\[ AOD \text{ is a diameter of a circle, with centre } O \text{ and radius 9 cm.} \]
\[ ABC \text{ is an arc of the circle.} \]
\[ AC \text{ is a chord.} \]
\[ \text{Angle } ADC = 35° \]

Calculate the area of the shaded segment.
Give your answer correct to 3 significant figures.

\[ \text{.................. cm}^2 \]

(Total for Question 18 is 6 marks)
19 Show that \( \frac{\sqrt{3} + \sqrt{27}}{\sqrt{2}} \) can be expressed in the form \( \sqrt{k} \) where \( k \) is an integer.

State the value of \( k \).

\[
k = \ldots }
The diagram shows a trapezium $ABCD$ with $AD$ parallel to $BC$. $AB = x \text{ cm}$, $BC = (x + 5) \text{ cm}$ and $AD = (x + 8) \text{ cm}$. The area of the trapezium is $42 \text{ cm}^2$.

(a) Show that $2x^2 + 13x - 84 = 0$

(b) Calculate the perimeter of the trapezium.

(Total for Question 21 is 7 marks)