AQA Higher Practice Paper

NOT ORDERED BY DIFFICULTY

240 marks’ worth of questions that **COULD** come up in papers 2 and 3. Do not revise these topics exclusively – this is not a predicted paper.

Materials
- For this paper you must have:
  - A calculator
  - Mathematical instruments

Instructions:
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- 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. Cross through any work you do not want to be marked.

Information:
- The marks for questions are shown in brackets.

Advice:
- In all calculations, show clearly how you work out your answer.
Q1.  \(ABCD\) is a cyclic quadrilateral. Not drawn accurately. Work out \(x\) and \(y\).

\[
\begin{align*}
70^\circ & \quad x + 2y \\
40^\circ & \quad x + y \\
B & \quad x + y
\end{align*}
\]

\[x = \text{___________________________ degrees}
\]

\[y = \text{___________________________ degrees} \quad \text{(Total 4 marks)}
\]

Q2.  \(P\) is the principal amount. \(r\) is the interest rate over a given period. \(n\) is the number of times that the interest is compounded. Circle the expression for the total accrued using compound interest.

\[
\begin{align*}
P\left(1 - \frac{r}{100}\right)^n & \quad P\left(\frac{r}{100}\right)^n \\
P\left(1 - \frac{n}{100}\right)^n & \quad P\left(1 - \frac{r^n}{100}\right)
\end{align*}
\]

(Total 1 mark)
Q3. I increase a number by 24%  
The answer is 6014.  
What number did I start with?
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Answer ___________________________ (Total 3 marks)

Q4. A small toy is made by joining a solid cone and a solid hemisphere together.  
The cone and hemisphere each have radius 6 cm.

(a) Show that the volume of the toy is $312\pi$ cm$^3$.  
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(4)
(b) A larger version of the toy is made that has
- dimensions twice the size of the small toy
- mass 1.5 kilograms.
The toy is made from foam.
Work out the density of the foam.
Give your answer in grams per cubic centimetre.

Answer __________________________ g per cm³
(Total 8 marks)

Q5. An amount of money was invested for 8 years.
It earned compound interest at 2.5% per year.
After 8 years the total value of the investment was £11 696.67
(a) Tom is trying to work out the total interest earned.

Tom

Interest for 8 years = £11696.67 \times 0.025 \times 8

State what is wrong with Tom’s method.

Answer £ __________________________
(Total 4 marks)
Q6. A, B, C and D are points on a circle, centre O. 
AC is a diameter of the circle. 
AT is a tangent to the circle.

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

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\( x = \ldots \) degrees \hspace{2cm} \( y = \ldots \) degrees

(Total 4 marks)
Q7. A, B, C and D are points on a circle. 

Angle $ABC = 92^\circ$
Angle $ACB = 38^\circ$
Angle $ACD = 50^\circ$
Angle $CDE = 32^\circ$

Tick whether each statement is true or false. Give a reason for each answer.

<table>
<thead>
<tr>
<th>Statement</th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$AC$ is a diameter</td>
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<tr>
<td>Reason</td>
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<tr>
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<th>False</th>
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</thead>
<tbody>
<tr>
<td>Angle $ADC = 88^\circ$</td>
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<td></td>
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<tr>
<td>Reason</td>
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<td></td>
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<tr>
<th>Statement</th>
<th>True</th>
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<tbody>
<tr>
<td>$ABCD$ is a trapezium</td>
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<td>Reason</td>
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<thead>
<tr>
<th>Statement</th>
<th>True</th>
<th>False</th>
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</thead>
<tbody>
<tr>
<td>$DE$ is a tangent to circle</td>
<td></td>
<td></td>
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<tr>
<td>Reason</td>
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(Total 4 marks)
Q8.  

**AED** is a straight line.

\[ \overrightarrow{AE} = a + 3b \]

\[ \overrightarrow{EB} = -a + b \]

(a) Work out the vector \( \overrightarrow{AB} \)

_______________________________________________________________________________

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Answer _________________________________________

(1)

(b) Also \( \overrightarrow{ED} = \frac{1}{3} \overrightarrow{AE} \) and \( \overrightarrow{DC} = -\frac{1}{3} a \)

Prove that \( EC \) is parallel to \( AB \).

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(3)

(Total 4 marks)
Q9. \(ABCD\) is a parallelogram.
\(ABE\) is a straight line and \(AB : BE = 3 : 2\)
BC and ED intersect at F.
\(AB = a\) and \(AD = b\)
Not drawn accurately

(a) Work out \(\overrightarrow{ED}\) in terms of a and b.
Give your answer in its simplest form.

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Answer ____________________________________________ (3)

(b) Deduce \(\overrightarrow{EF}\) in terms of a and b.

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Answer ____________________________________________ (2)

(Total 5 marks)
Q10. \(PQRS\) is a parallelogram. 
\(M\) is the midpoint of \(QR\). 
\(QN: NS = 1:2\) 
\[
\overrightarrow{PQ} = a \\
\overrightarrow{PS} = b
\]
(a) Write the vector \(\overrightarrow{PM}\) in terms of \(a\) and \(b\).
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Answer _________________________________________ (1)
_______________________________________________________________________________
(b) Prove that \(PNM\) is a straight line.
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(4) (Total 5 marks)
Q11. A paper filter is in the shape of a hollow cone of diameter 22 cm. The slant height of the cone is 18 cm.

Work out the area of paper used to make the filter. Give your answer to 2 significant figures.

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Answer _______________________________ cm$^2$  
(Total 3 marks)
Q12. Here are two similar solids, $A$ and $B$.

The volume of $B$ is $400 \text{ cm}^3$
Is the volume of $A$ approximately one quarter of the volume of $B$?
You must show your working.

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Answer _________________________________________

(Total 4 marks)
Q13. \(ABCD\) and \(AEFG\) are identical squares.
\(CD = EF = 10\) cm
Angle \(BAG = 45^\circ\)
Not drawn accurately

Prove that triangles \(AGD\) and \(ABE\) are congruent.

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(Total 4 marks)
Q14. The diagram shows two pieces of glass.
Not drawn accurately

The pieces are similar.
The area of the small piece is 6000 cm$^2$
Glass costs £80 per square metre.
Work out the cost of the large piece.

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Answer £ _________________________________
(Total 5 marks)

Q15. The area of shape A is 36 cm$^2$
Shape B is similar to shape A with sides 4 times bigger.
Circle the calculation to work out the area of shape B.

36 + 4   36 ÷ 4   36 × 4   36 × 4$^2$

(Total 1 mark)
Q16. On Friday, Greg takes part in a long jump competition. He has to jump at least 7.5 metres to qualify for the final on Saturday.

- He has up to three jumps to qualify.
- If he jumps at least 7.5 metres he does not jump again on Friday.

Each time Greg jumps, the probability he jumps at least 7.5 metres is 0.8. Assume each jump is independent.

(a) Complete the tree diagram.

(b) Work out the probability that he does not need the third jump to qualify.

Answer ______________________________________ (2)

Q17. A bag contains 12 discs.
7 are red. 3 are blue. 2 are yellow.

Two discs are taken from the bag at random, without replacement.

Work out the probability that the two discs are the same colour.

Answer ______________________________________ (Total 4 marks)
Q18. Two bags, A and B, contain numbered counters. A counter is chosen at random from each bag. Here are the 8 counters in bag A.

1  2  2  3  4  4  4  5

The table gives the probabilities of the numbers on the counters in bag B.

<table>
<thead>
<tr>
<th>Number on counter</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.2</td>
<td>0.1</td>
<td>0.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Which bag has the greater probability of choosing an even number? You must show your working.

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Answer

(Total 2 marks)

Q19. The probability that Gina goes to the gym on Saturday is 0.9
The probability that Dave goes to the gym on Saturday is 0.6
These probabilities are independent.

(a) Calculate the probability that both Gina and Dave go to the gym on Saturday.

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Answer

(1)

(b) If Gina goes to the gym on Saturday the probability that she goes on Sunday is 0.2
If Gina does not go to the gym on Saturday the probability that she goes on Sunday is 0.7
Calculate the probability that Gina goes to the gym on exactly one of the two days.

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Answer

(4)

(Total 5 marks)
Q20. The histogram shows information about the ages of 100 employees.

Work out an estimate of the median age of the employees.

Answer ___________________________________ years

(Total 4 marks)

Q21. (a) Garage A sold 4960 vehicles.
The garage takes a sample of customers, stratified by type of vehicle sold.
Some information about the sample is shown.

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>People carrier</th>
<th>Van</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number sold</td>
<td>2520</td>
<td></td>
<td></td>
<td>4960</td>
</tr>
<tr>
<td>Number in sample</td>
<td>126</td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Complete the table.

(b) Garage B sold 3790 vehicles, to 3 significant figures.
Write down the minimum and maximum possible number sold by Garage B.

Minimum ________________________________

Maximum ________________________________

(Total 5 marks)
Q22. The pie chart shows the proportion of male and female teachers in 15,074 schools.

Primary school teachers

The mean number of teachers per school is 13.7
Work out the total number of female teachers in these schools.
Give your answer to 2 significant figures.

_______________________________________________________________________________

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Answer _________________________________________ (Total 5 marks)

Q23. Circle the quadratic sequence.

2 8 14 22

1 8 27 64

2 4 8 16

1 4 9 16

(Total 1 mark)
Joe asked 230 students how long it took them to travel to school. The results are shown in the table.

<table>
<thead>
<tr>
<th>Travelling time, $t$ (minutes)</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; t \leq 5$</td>
<td>44</td>
</tr>
<tr>
<td>$5 &lt; t \leq 10$</td>
<td>50</td>
</tr>
<tr>
<td>$10 &lt; t \leq 20$</td>
<td>54</td>
</tr>
<tr>
<td>$20 &lt; t \leq 30$</td>
<td>37</td>
</tr>
<tr>
<td>$30 &lt; t \leq 60$</td>
<td>45</td>
</tr>
</tbody>
</table>

This is Joe’s attempt to draw a histogram to show the data.

Make two criticisms of his histogram.

Criticism 1 ______________________________________________________________
_______________________________________________________________________________
Criticism 2 ______________________________________________________________
_______________________________________________________________________________

(Total 2 marks)
Q25. Here is some information about the number of books read by a group of people in 2014.
One of the frequencies is missing.

<table>
<thead>
<tr>
<th>Number of books</th>
<th>Frequency</th>
<th>Midpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 4</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>5 – 9</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>10 – 14</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>15 – 19</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

Midpoints are used to work out an estimate for the mean number of books read.
The answer is 8.5
Work out the missing frequency.

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Answer _________________________________________ (Total 5 marks)

Q26. The histogram shows the ages, in years, of members of a chess club.

There are 22 members with ages in the range 40 ≤ age < 65
Work out the number of members with ages in the range 25 ≤ age < 40

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Answer _________________________________________ (Total 4 marks)
Q27. The histogram shows information about the times some students revised for a test. The first bar represents students who revised for less than 10 minutes.

Estimate the number of students who revised for less than 45 minutes.

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Answer _________________________________________  (Total 3 marks)

Q28. (a) The \( n \)th term of a sequence is \( n^2 + 12n + 27 \)
By factorising, or otherwise, show that the 20th term can be written as the product of two prime numbers.

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Answer _________________________________________  (Total 3 marks)

(b) The \( n \)th term of a different sequence is \( n^2 - 6n + 14 \)
By completing the square, or otherwise, show that every term is positive.

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(2) 

(3)  (Total 5 marks)
Q29. Points in the shaded region satisfy three inequalities.

Use inequalities to describe the shaded region.

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(Total 3 marks)

Q30. (a) Write \( x^2 + 6x + 10 \) in the form \((x + a)^2 + b\)

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Answer _________________________________________ (2)

(b) Hence, write down the coordinates of the turning point of the curve \( y = x^2 + 6x + 10 \)

Answer (........................... , ...........................) (1)

(Total 3 marks)
Q31. (a) Write \( x^2 - 10x + 29 \) in the form \( (x - a)^2 + b \)

Answer: 

(b) A sketch of \( y = x^2 + cx + d \) is shown. The turning point is (3, 5)

Work out the values of \( c \) and \( d \).

\[ c = \ldots \]
\[ d = \ldots \]

(Total 5 marks)
Q32. Work out an expression for the $n$th term of the quadratic sequence

| 11 | 15 | 21 | 29 | 39 | __ |

---

$r$th term = __________________________ (Total 4 marks)

Q33. (a) Line $M$ has the equation $3x + 2y = 7$
Circle the gradient of line $M$.

\[-3 \quad -\frac{3}{2} \quad 3 \quad \frac{3}{2}\]

(1)

(b) Line $N$ has the equation $y = 5 - \frac{3}{4}x$
Circle the gradient of a line that is perpendicular to line $N$.

\[-\frac{4}{3} \quad \frac{3}{4} \quad \frac{4}{3} \quad 3\]

(1)

(Total 2 marks)
Q34. The gradient of line OR is $\frac{7}{4}$.
PQ is perpendicular to OR.
P is the point (14, 0).
Not drawn accurately

Work out the equation of line PQ.
Give your answer in the form $ax + by = c$, where $a$, $b$ and $c$ are integers.

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Answer _______________________________________ (Total 4 marks)

Q35. (a) Solve $\frac{2w-3}{6} = 4$

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$w =$ _____________________________________________________________ (3)
(b) Solve \(4x^2 - 25 < 0\)

Answer _________________________________________

(3)

(c) Solve \(\frac{1}{y-6} = 5\)

\[ y = \] ____________________________________________

(3)

(Total 9 marks)

Q36. A circle has equation \(x^2 + y^2 = \frac{1}{4}\)
Circle the length of its radius.

\[
\begin{array}{cccc}
\frac{1}{16} & \frac{1}{8} & \frac{1}{4} & \frac{1}{2} \\
\end{array}
\]

(Total 1 mark)
Q37. Points in the shaded region satisfy three inequalities. One of the inequalities is \( y \leq 2x + 5 \)

(a) Circle the inequality with boundary line A.
\[
\begin{align*}
  x + y &\geq 7 \\
  x + y &< 7 \\
  x + y &\leq 7 \\
  x + y &> 7
\end{align*}
\]  

(b) Circle the inequality with boundary line B.
\[
\begin{align*}
  2y &\geq x + 4 \\
  2y &\leq x + 4 \\
  y &\geq x + 2 \\
  y &\leq x + 2
\end{align*}
\]  

Q38. Solve \( 5x - y = 5 \) and \( 2y - x^2 = 11 \). You must show your working. Do not use trial and improvement.

\[
\begin{align*}
  5x - y &= 5 \\
  2y - x^2 &= 11
\end{align*}
\]  

Answer ____________________________________________

(Total 6 marks)
Q39. The Venn diagram shows information about a coin collection.
\[\xi = 120\] coins in the collection
\[T = \text{coins from the 20th century}\]
\[B = \text{British coins}\]

A coin is chosen at random.
It is British.
Work out the probability that it is from the 20th century.

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Answer _________________________________________

(Total 5 marks)
Q40. For all values of \( x \), \( f(x) = x^2 + 1 \) \( g(x) = x - 5 \)
(a) Show that \( fg(x) = x^2 - 10x + 26 \)

(b) Solve \( fg(x) = gf(x) \)

\[ x = \boxed{ } \]

(Total 6 marks)

Q41. A circle has equation \( x^2 + y^2 = 4 \)
Circle the length of its radius.

\[ \boxed{2} \quad 4 \quad 8 \quad 16 \]

(Total 1 mark)
Q42. The speed-time graph for a car’s journey is shown.

(a) Estimate the acceleration at 6 seconds.
You must show your working.

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Answer ____________________________ m/s²

(b) Estimate the average speed of the car for the journey.
You must show your working.

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Answer ____________________________ m/s

(c) Evaluate your answer to part (b). Tick a box.

[ ] underestimate  [ ] exact  [ ] overestimate

Comment __________________________________________________________

_______________________________________________________________________________

(Total 8 marks)
Q43. (a) Here is a circle, centre $O$.

\[
\begin{array}{c}
\text{52°} \\
\text{20°} \\
\text{32°} \\
\end{array}
\]

Work out the size of angle $x$.
Circle your answer.

\[
\begin{array}{cccccc}
26° & 72° & 84° & 90° & 104° \\
\end{array}
\]

(1)

(b) $M$, $N$ and $S$ are points on circle $C_1$

$RST$ is a tangent to $C_1$

Circle $C_2$ passes through the centre $O$, $S$ and $M$ of circle $C_1$

Prove that $SM$ is not a diameter of circle $C_2$
Give reasons for your answer.

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(3) (Total 4 marks)
Q44. Expand and simplify \((2x + 5)(2x - 5)(3x + 7)\)

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Answer

(Total 3 marks)

Q45. Prove that \(5n - (2n + 3)(n + 1)\) is always negative.

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(Total 3 marks)

Q46. Prove that \(3(x + 1)(x + 7) - (2x + 5)^2\) is never positive.

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(Total 5 marks)
Q47.  
\( w, x \) and \( y \) are three integers.
\( w \) is 2 less than \( x \)
\( y \) is 2 more than \( x \)
Prove that \( wy + 4 = x^2 \)

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(Total 3 marks)

Q48.  
Show that \( \frac{2w+4}{w^2-25} \times \frac{w+5}{w^2+3w+2} \times (3w^2 - 16 + 5) \) simplifies to \( \frac{aw + b}{cw + d} \) where \( a, b, c \) and \( d \) are integers.

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(Total 5 marks)
Q49. An empty container has a capacity of 80 000 litres to 1 significant figure. Mel pours in 7400 litres of water to 2 significant figures. She says, “I have filled more than 10% of the container.” Is she correct? You must show your working.

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Answer _________________________________________
(Total 4 marks)

Q50. (a) Show clearly that \((2x - 3y)(2x + 3y) \equiv 4x^2 - 9y^2\)

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Answer _________________________________________
(Total 5 marks)
Q51. \(AB, CD\) and \(YZ\) are straight lines.
All angles are in degrees.
Not drawn accurately

Show that \(AB\) is parallel to \(CD\).
Q52. In this question use
1 pound = 0.4536 kilograms
1 inch = 2.54 centimetres.
The pressure of a basketball is 7.5 pounds per square inch.
Work out this pressure in grams per square centimetre.

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________________________________________________________

Answer ____________________________________ g/cm² (Total 4 marks)

Q53. Circle the expression that is equivalent to \( \frac{2x^2+1}{x} \) where \( x \) is not equal to 0

\[
\begin{align*}
2x + 1 & \quad 2x^2 + \frac{1}{2} \\
\quad & \quad 2x + \frac{1}{2} \\
\quad & \quad 4x + \frac{1}{2}
\end{align*}
\]

(Total 1 mark)

Q54. A calculator gives a value of \( \pi \) as 3.14159
An approximation for \( \pi \) is \( \sqrt{\frac{40}{3}} - \sqrt{12} \)
Show that the value of the approximation is within 0.01% of the calculator value.

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(Total 4 marks)
Q55. Here is a sketch of a speed-time graph for part of a journey.

The average speed from 0 to $t$ seconds was 7.2 m/s. Work out the value of $t$.

Answer ________________________ seconds
(Total 5 marks)
Q56. Two triangular lawns are shown. Wire fencing is needed for all five sides.

Wire fencing is sold in 50-metre rolls. Work out the number of rolls needed.

Answer _________________________________________

(Total 6 marks)
Q57. A formula connecting speed \((s)\), distance \((d)\) and time \((t)\) is
\[
s = \frac{d}{t}
\]
\(d = 160\) to 2 significant figures
\(t = 7.2\) to 2 significant figures
Work out the upper and lower bounds for \(s\).
Give your answers to 3 significant figures.

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Upper bound

Lower bound

(Total 4 marks)

Q58. The area of a right-angled, isosceles triangle is 4 cm\(^2\).

Work out the perimeter of the triangle in centimetres.
Give your answer in the form \(a + b\sqrt{c}\), where \(a\), \(b\) and \(c\) are integers.

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Answer __________________________ cm

(Total 4 marks)
Q59. A menu has a choice of 3 starters, 5 main courses and 4 desserts. 
How many different choices of a 3-course meal are possible? 
Circle your answer. 

<table>
<thead>
<tr>
<th>12</th>
<th>23</th>
<th>60</th>
<th>972</th>
</tr>
</thead>
</table>

(Total 1 mark)

Q60. Work out \( \sqrt[3]{8} \times 5^{-2} \)
Give your answer as a decimal. 

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Answer ____________________________
(Total 3 mark)

Q61. A sequence of numbers is formed by the iterative process \( a_{n+1} = (a_n)^2 - a_n \)
(a) Describe the sequence of numbers when \( a_1 = 1 \)
Show working to justify your answer. 

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(1)

(b) Describe the sequence of numbers when \( a_1 = -1 \)
Show working to justify your answer. 

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(2)

(c) Work out the value of \( a_2 \) when \( a_1 = 1 - \sqrt{2} \)

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Answer _________________________________________
(Total 5 marks)