GCSE MATHEMATICS
Higher Tier  Paper 3  Calculator

Exam Date  Morning  Time allowed: 1 hour 30 minutes

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.
• The maximum mark for this paper is 80.
• You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice
• In all calculations, show clearly how you work out your answer.
Answer all questions in the spaces provided.

1. Circle the multiplier that reduces a quantity by 12.5% [1 mark]
   - 0.125
   - 0.875
   - 12.5
   - 87.5

2. Simplify \((x^6)^3\) [1 mark]
   - \(x^2\)
   - \(x^9\)
   - \(x^{18}\)
   - \(x^{216}\)

3. Circle the quadratic sequence. [1 mark]
   - 2  8  14  22
   - 1  8  27  64
   - 2  4  8  16
   - 1  4  9  16
4. The bearing of $A$ from $B$ is $235^\circ$.

Circle the bearing of $B$ from $A$.  

[1 mark]

055°  125°  145°  325°
The direct route between two airports A and B is 450 km

An aircraft leaves A at 09.15
It arrives at B at 10.55

5 (a) Work out the average speed of the aircraft.
Assume the aircraft travelled the direct route.

Answer \( \text{km/h} \)

5 (b) In fact the aircraft did not travel the direct route.

How does this affect the average speed?

Tick a box

- Faster
- Slower
- The same

Give a reason for your answer.
The diagram shows the results, to the nearest percentage, of a survey of 1000 motorists.

**Driverless cars**

- **Good idea**: 20%
- **Bad idea**: 34%
- **Not sure**: 45%

Source: IAM Roadsmart survey April 2016

Work out the **largest** possible number of motorists who thought driverless cars were a good idea.

[2 marks]

Answer ____________________________

Turn over for the next question
7 (a) Write these numbers in ascending order.

9812  \(9.82 \times 10^2\)  \(9.81 \times 10^3\)

[1 mark]

Answer

7 (b) Jon is multiplying two numbers given in standard form.

\[2 \times 10^6 \times 3 \times 10^7 = (2 \times 3) \times 10^{(6 + 7)}\]

\[= 6 \times 10^{13}\]

He says,

“So, for any numbers
\[a \times 10^b \times c \times 10^d = (a \times c) \times 10^{(b + d)}\]

which will always be in standard form.”

Is he correct that \((a \times c) \times 10^{(b + d)}\) will always be in standard form?

Tick a box.

\[\square \quad \text{Correct} \quad \square \quad \text{Not correct}\]

Show working to support your answer.

[2 marks]
After landing, an aircraft is delayed in reaching its parking stand.

The aircraft uses 11.4 kg of fuel for each minute of delay.

1 litre of fuel is 0.82 kg

Fuel costs 65p per litre.

Work out the cost of a delay of 8 minutes.

[4 marks]

Answer £ ___________________________
9 The diagram shows a cuboid and its diagonal.

The formula to work out the length of the diagonal in centimetres is

\[ \text{Length of diagonal} = \sqrt{a^2 + b^2 + c^2} \]

9 (a) Work out the length of the diagonal when \( a = 8 \), \( b = 3 \) and \( c = 2 \)

Give your answer to 2 significant figures.

[3 marks]

Answer \[ \text{cm} \]
9 (b) Work out the length of the diagonal in terms of $a$
when $b = 2a$ and $c = 2a$  

[3 marks]

Answer ____________________________ cm

10 Eva writes $4^2 \times 4^2 \times 4^2 = 4^2 \times 2 \times 2$

$= 4^8$

What is wrong with her method?
Give the correct answer.  

[2 marks]

Answer ____________________________

turn over for the next question
The diagram shows two circular arcs with centre $O$.

How much longer is the big arc than the small arc?

Give your answer to 1 decimal place.

[4 marks]

Answer ___________________________ cm
12 Solve the simultaneous equations

\[ 3x + 2y = 10 \]
\[ 3x - y = 13 \]

[3 marks]

Answer \( x = \) \( y = \)

Turn over for the next question
13  

$P$ 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.  

[1 mark]

$P \left( 1 + \frac{r}{100} \right)^n$

$P + \left( \frac{r}{100} \right)^n$

$P \left( 1 + \frac{n}{100} \right)^r$

$P \left( 1 + \frac{rn}{100} \right)$

14  

Rearrange the formula $v^2 = u^2 + 2as$ to make $s$ the subject.  

[2 marks]

Answer

______________________________
Work out an approximate solution to \( x^3 + 3x - 1 = 0 \)

Use the iteration \( x_{n+1} = \frac{1}{x_n^2 + 3} \)

Start with \( x_1 = 1 \)

Give your answer to 2 decimal places. [3 marks]

Answer ________________________________

Turn over for the next question
16 (a) Here is a circle, centre $O$.

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

[1 mark]

26°  72°  84°  90°  104°
16 (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. 

[3 marks]
17 The density of steel is between 7750 kg/m$^3$ and 8050 kg/m$^3$

$1000 \text{ kg/m}^3 = 1 \text{ g/cm}^3$

A solid metal object has a volume of 1430 cm$^3$
The mass of the object is 9.6 kg

Is it possible that it is made of steel?

Tick a box.

- [ ] Definitely steel
- [ ] Might be steel
- [ ] Definitely not steel

You must show your working.

[3 marks]
The following data is about the same types of plants.

Some of the plants are treated with plant food.

<table>
<thead>
<tr>
<th>Mean height (cm)</th>
<th>Interquartile range (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>30.2</td>
</tr>
<tr>
<td>Treated</td>
<td>35.1</td>
</tr>
</tbody>
</table>

Compare the untreated plants and treated plants. [2 marks]

Comparison 1  

Comparison 2  

Turn over for the next question
19 Here is a box plot.

Test scores

19 (a) Circle the value of the range. [1 mark]

33 36 50 80

19 (b) Circle the value of the median. [1 mark]

38 55 62 64

19 (c) Circle the value of the interquartile range. [1 mark]

34 36 38 50 62
A knife is twice the cost of a spoon.
8 spoons and 12 knives cost £46.08

Work out the cost of 1 knife.

[5 marks]

Answer £ ________________________

Turn over for the next question
The diagram shows an empty container of height 21 cm. The container consists of a cylinder on a frustum of a cone.

Water is added to the container at a constant rate for 11 seconds. The sketch graph shows the depth of the water as the container fills. The graph is a curve for the first 6 seconds and a straight line for the next 5 seconds.
21 (a) Circle the height of the cylinder. [1 mark]

8 cm 10.5 cm 13 cm 21 cm

21 (b) Work out the rate of increase of the depth of the water between 6 seconds and 11 seconds. State the units of your answer. [3 marks]

Answer ________________________

Turn over for the next question
22 (a) Amy drew this histogram to show the times taken to complete a task.

Give one reason why it is misleading.

[1 mark]
22 (b) Here is another histogram showing the times taken to complete another task.

![Histogram showing times taken to complete a task]

Estimate the percentage of people who took less than 30 seconds. [5 marks]

Answer ______________________________ %
The diagram shows a rectangle split into three triangles.

The total shaded area is 7.5 cm\(^2\)

Work out the value of \(x\).

Give your answer to 1 decimal place.

[5 marks]

Answer _____________________________
This 3D diagram represents a paperweight. The horizontal base $ABC$ is a right-angled triangle. $CT$ is vertical.

Angle $ACB = 36^\circ$, $BC = 13.3 \text{ cm}$ and $CT = 9.6 \text{ cm}$.

Work out the size of the angle between $AT$ and the horizontal base.

[4 marks]

Answer ______________ degrees
The number of bacteria, \( N \), after \( t \) hours, of an experiment is given by

\[ N = A \times 2^{\frac{t}{4}} \]

where \( A \) is constant.

25 (a) At the start of the experiment there are 250 bacteria.

Show that \( A = 250 \) \( [1 \text{ marks}] \)

Answer

25 (b) How long is it before the number of bacteria doubles? \( [2 \text{ marks}] \)

Answer \( \) hours

25 (c) Megan works out that there will be more than 1 million bacteria after 2 days.

Is she correct?

You must show your working. \( [2 \text{ marks}] \)

Answer

END OF QUESTIONS