AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

Level 2 Certificate
FURTHER MATHEMATICS

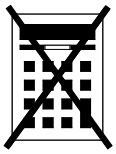
Paper 1 Non-Calculator

Thursday 8 June 2023 Morning Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- mathematical instruments
- the Formulae Sheet (enclosed).

You must **not** use a calculator.



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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more graph paper and tracing paper. These must be tagged securely to this answer book.

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Answer **all** questions in the spaces provided.

1 The function f is given by $f(x) = 2x + 1$

1 (a) Work out x when $f(x) = -5$

[2 marks]

$x =$ _____

1 (b) The function g is given by $g(x) = x^2$

Work out $fg(3)$

[2 marks]

Answer _____

Do not write outside the box

2 Factorise fully $6x^2y + 21xy$

[2 marks]

Answer _____

3 (a) Circle the transformation matrix that represents a reflection in the line $y = -x$

[1 mark]

$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

3 (b) Show that

$$\begin{pmatrix} 2 & 4 \\ -1 & -3 \end{pmatrix}\begin{pmatrix} -3 & -4 \\ 1 & 2 \end{pmatrix} = k\,\mathbf{I}$$ where k is an integer.

[2 marks]

9

Do not write outside the box

4 S (7, 2) and T (5, –4) are points on a straight line.

4 (a) Work out the gradient of the line.

[2 marks]

Answer _____

4 (b) Work out the distance between S and T.

Give your answer in the form $a\sqrt{b}$ where a and b are both integers greater than 1

[3 marks]

Answer _____ units

Do not write outside the box

5 X_n and Y_n are the nth terms of two sequences.

$$X_n = (n - 1)(n + 1)$$

$$Y_n = (n + 1)(n + 2)$$

Prove that every term of the sequence with nth term $Y_n - X_n$ is a multiple of 3

[3 marks]

Turn over for the next question

8

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6 The equation of a curve is $y = x^6 + 4x^2 - 7$

Work out the equation of the tangent to the curve at the point (1, –2)

Give your answer in the form $y = mx + c$

[4 marks]

Answer _____

Do not write outside the box

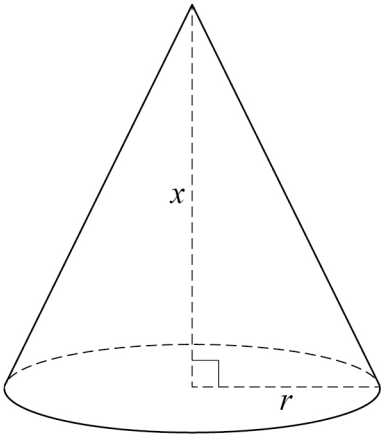
7 The diagram below shows a cone and a prism.

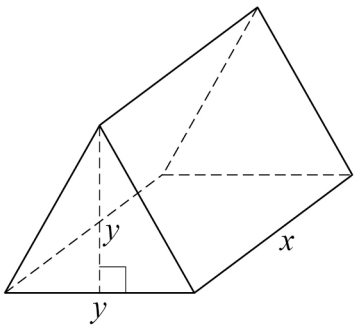
All measurements are in cm

The cone has base radius r and perpendicular height x.

The prism has a triangular cross section with base y and perpendicular height y.

The length of the prism is x.





Volume of a cone $= \frac{1}{3} \times$ area of base $\times$ perpendicular height

The volume of the cone is **four** times the volume of the prism.

Express r in terms of y.

[4 marks]

$r =$ _____

8

Turn over ►

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8 A circle has centre (0, 0) and radius 5

A straight line has equation $2y = x + 5$

Work out the coordinates of the **two** points where the circle and straight line intersect.

Do **not** use trial and improvement.

You **must** show your working.

[6 marks]

Answer (_____ , _____) and (_____ , _____)

Do not write outside the box

9 Rearrange $w = \dfrac{y^2 + 5}{y^2 - 2}$ to make y the subject.

[4 marks]

Answer _____

Turn over for the next question

10

Do not write outside the box

10 Rationalise the denominator and simplify fully

$$\frac{1+\sqrt{5}}{3-\sqrt{5}}$$

[4 marks]

Answer _____

Do not write outside the box

11 $y = \frac{1}{12}x^4 + 3x^2 + 4$

Work out the **positive** value of x for which $\frac{d^2y}{dx^2} = 55$

[3 marks]

$x =$ _____

Turn over for the next question

7

Do not write outside the box

12 (a) Write down the value of x for $0° \leqslant x \leqslant 360°$ when $\sin x = -1$

[1 mark]

$x =$ _____

12 (b) Work out the values of y for $0° \leqslant y \leqslant 360°$ when $\sqrt{3} \tan y = 1$

[3 marks]

Answer _____

Do not write outside the box

13 Write $\frac{2x-3}{x} - \frac{1}{3x} + 1$ as a single fraction.

Give your answer in its simplest form.

[3 marks]

Answer _____

Turn over for the next question

7

Do not write outside the box

14 Solve $\frac{8}{x} + 3x \leqslant 10$ where x is positive.

[4 marks]

Answer _____

Do not write outside the box

15 Solve $\left(x^{\frac{1}{2}} - x^{\frac{3}{2}}\right)^2 = x^2 + x$

[4 marks]

Answer _____

16 The expansions of $(1 + 12x)^4$ and $(a + 4x)^3$ have the same coefficient of x^2

Work out the value of a.

[4 marks]

$a =$ _____

12

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17 The curve $y = ax^3 + bx^2 + 7$ has a stationary point at (–2, 11)

Work out the values of a and b.

[5 marks]

$a =$ _____ $b =$ _____

Do not write outside the box

18 Solve the simultaneous equations

$$2x + y = 13$$
$$x + 3z = 2$$
$$z - 2y = -7$$

Do **not** use trial and improvement.

You **must** show your working.

[5 marks]

$x =$_____ $y =$_____ $z =$_____

10

Do not write outside the box

19 $8x^2 + 20x + n \equiv c(x + d)^2 + 3$ where c, d and n are constants.

Work out the values of c, d and n.

[3 marks]

$c =$ _____ $d =$ _____ $n =$ _____

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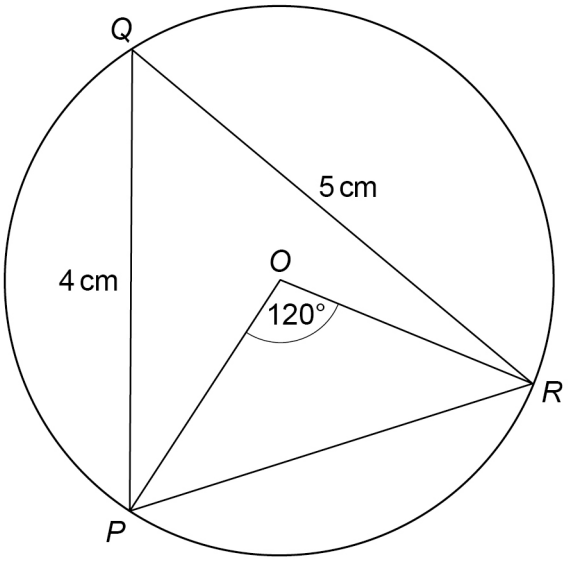
20 P, Q and R are points on a circle, centre O.

Angle $POR = 120°$ $PQ = 4$ cm $QR = 5$ cm



Not drawn accurately

Work out the radius of the circle.

Give your answer in the form $\sqrt{k}$ where k is an integer.

[6 marks]

Answer _____ cm

END OF QUESTIONS

9

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