

Please write clearly in block capitals.

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I declare this is my own work.

Level 2 Certificate FURTHER MATHEMATICS

Paper 1 Non-Calculator

Thursday 8 June 2023

Morning

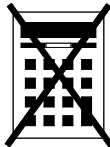
Time allowed: 1 hour 45 minutes

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.

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.

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	



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 _____



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

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

[2 marks]



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



5 X_n and Y_n are the n th terms of two sequences.

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

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

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

[3 marks]

Turn over for the next question



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 _____



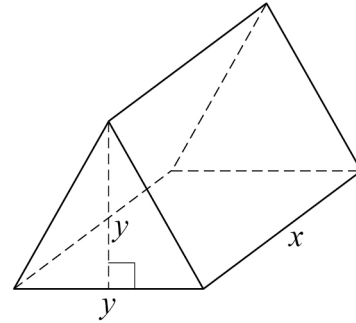
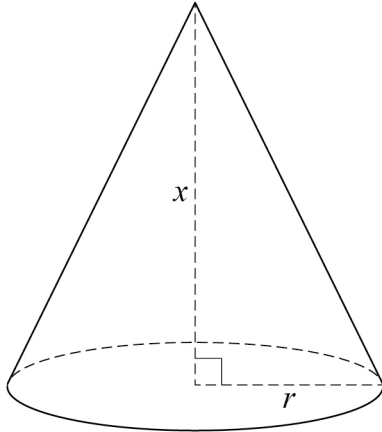
7 The diagram below shows a cone and a prism.

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 .



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

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

Express r in terms of y .

[4 marks]

$$r = \underline{\hspace{10em}}$$



- 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 (_____ , _____)



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

[4 marks]

Answer _____

Turn over for the next question



10 Rationalise the denominator and simplify fully

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

[4 marks]

Answer _____



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

Turn over ►

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

[1 mark]

$x =$ _____

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

[3 marks]

Answer _____



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

Turn over ►



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

[4 marks]

Answer _____



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

Turn over ►



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]

$a =$ _____ $b =$ _____



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]

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



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]

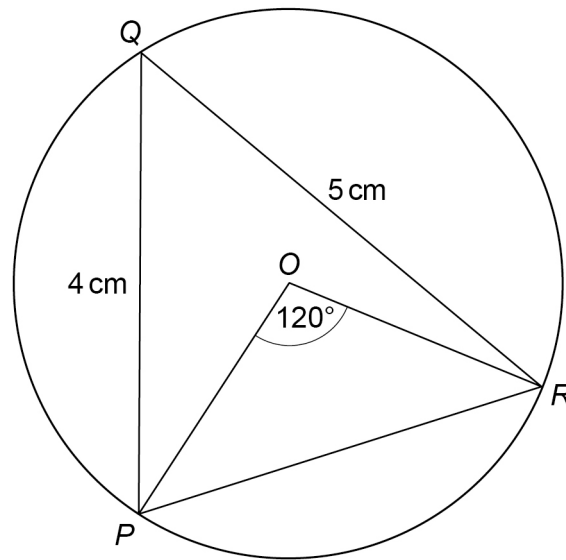
$c =$ _____ $d =$ _____ $n =$ _____



20

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

Angle $POR = 120^\circ$ $PQ = 4$ 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



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2 4



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