

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 2 Calculator

Wednesday 21 June 2023

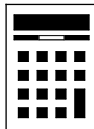
Afternoon

Time allowed: 1 hour 45 minutes

### Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



### 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.
- The use of a calculator is expected but calculators with a facility for symbolic algebra must **not** be used.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22	
<b>TOTAL</b>	



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

1 Solve  $\frac{8d-3}{3d-7} = \frac{5}{2}$

[3 marks]

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$d =$  \_\_\_\_\_

2 (a) The first four terms of a linear sequence are

15            18.5            22            25.5

Work out an expression for the  $n$ th term.

[2 marks]

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Answer \_\_\_\_\_



**2 (b)** A different linear sequence has  $n$ th term  $318 - 9n$

Work out the value of the first **negative** term in the sequence.

**[2 marks]**

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Answer \_\_\_\_\_

**3**

$$\begin{pmatrix} 3 & 5 \\ u & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 4 \end{pmatrix} = \begin{pmatrix} t \\ 6 \end{pmatrix}$$

Work out the values of  $t$  and  $u$ .

**[2 marks]**

$t =$  \_\_\_\_\_       $u =$  \_\_\_\_\_



4 A line passes through  $P(1, k)$  and  $Q(r, 6)$  where  $k$  and  $r$  are constants.

The midpoint of  $PQ$  has  $x$ -coordinate 5

The gradient of the line is 2

Work out the value of  $k$ .

**[4 marks]**

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



5  $y = 0.5x^4$

Work out the value of  $x$  for which the rate of change of  $y$  with respect to  $x$  is 6.75

[3 marks]

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$x =$  \_\_\_\_\_

6 The equation of a circle is  $(x + 7)^2 + (y - 4)^2 = 36$

Complete these statements.

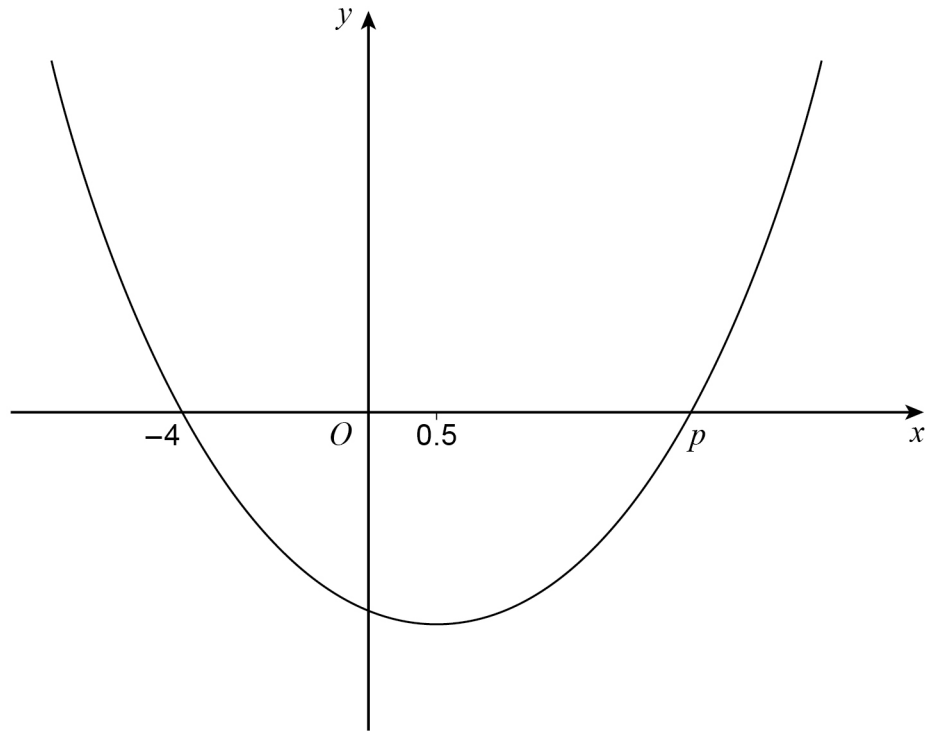
[2 marks]

The coordinates of the centre of the circle are ( \_\_\_\_\_ , \_\_\_\_\_ )

The radius of the circle is \_\_\_\_\_



- 7** Here is a sketch of the curve  $y = ax^2 + bx + c$  where  $a$ ,  $b$  and  $c$  are constants.  
The curve intersects the  $x$ -axis at  $(-4, 0)$  and  $(p, 0)$   
The turning point has  $x$ -coordinate 0.5



- 7 (a)** Work out the value of  $p$ .

[1 mark]

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$p =$  \_\_\_\_\_

- 7 (b)** Solve  $ax^2 + bx + c > 0$

[2 marks]

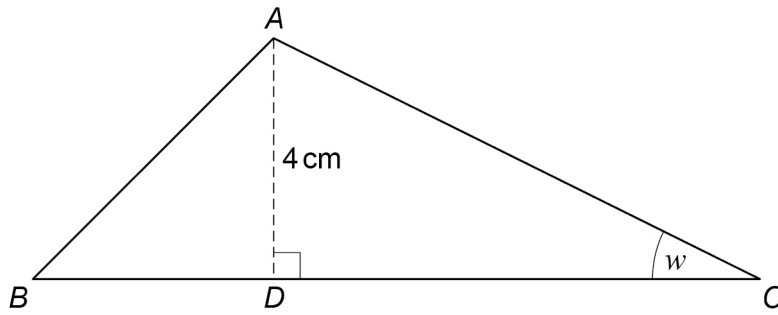
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Answer \_\_\_\_\_



- 8  $ABC$  is a triangle with perpendicular height  $AD$ .



Not drawn  
accurately

$$\text{Area of } ABC = 25 \text{ cm}^2$$

$$BD : DC = 2 : 3$$

Work out the size of angle  $w$ .

**[4 marks]**

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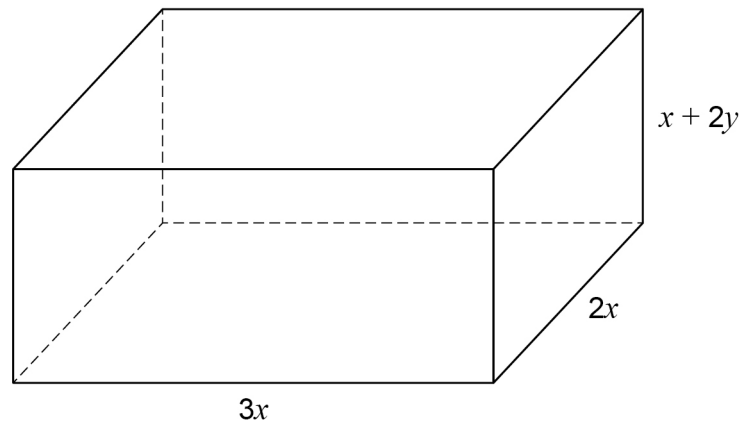


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$$w = \underline{\hspace{10em}}^\circ$$



- 9 The dimensions of the cuboid are given in centimetres.



The total length of all 12 edges is 300 cm

- 9 (a) Show that  $y = \frac{75 - 6x}{2}$

[2 marks]

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9 (b) The volume of the cuboid is  $V \text{ cm}^3$

Show that  $V = 450x^2 - 30x^3$

[2 marks]

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9 (c) Use calculus to work out the maximum value of  $V$  as  $x$  varies.

[3 marks]

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Answer \_\_\_\_\_

7
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Turn over ►



10

Line K has equation  $4x - 5y = 17$ 

Line L passes through the points (3, 6) and (-5, 16)

Tick (✓) the correct statement about lines K and L.

The lines are parallel.

The lines are perpendicular.

The lines are neither parallel nor perpendicular.

Show working to support your answer.

**[3 marks]**

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11 Expand and simplify fully  $(2x^3 - 9)(3x^2 + 4) + x(x - 4)^2$  [4 marks]

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Answer \_\_\_\_\_

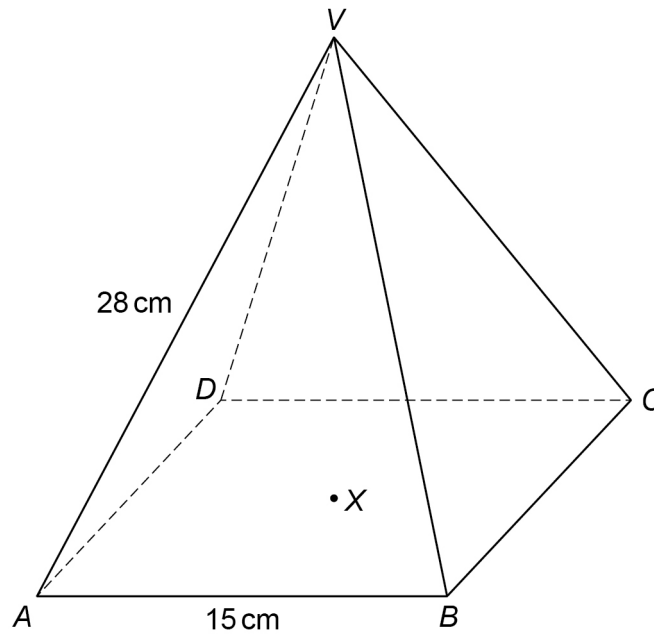
**Turn over for the next question**

7
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**Turn over ►**



12

 $VABCD$  is a pyramid.The square horizontal base,  $ABCD$ , has side length 15 cm $V$  is directly above the centre,  $X$ , of the base. $VA = 28$  cmWork out the size of the angle that  $VA$  makes with  $ABCD$ .**[3 marks]**


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Answer \_\_\_\_\_ °



13 (a) Circle the expression equivalent to  $3x^{-7}$

[1 mark]

$$-\frac{3}{x^7}$$

$$-\frac{1}{3x^7}$$

$$\frac{1}{3x^7}$$

$$\frac{3}{x^7}$$

13 (b) Simplify fully  $\frac{12w^8}{(4w^3)^2}$

[2 marks]

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Answer \_\_\_\_\_

13 (c)  $\sqrt{y} \times \sqrt[3]{y} = \sqrt[c]{y^d}$  where  $c$  and  $d$  are positive integers.

Work out the **least** possible values of  $c$  and  $d$ .

[3 marks]

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$c =$  \_\_\_\_\_  $d =$  \_\_\_\_\_



14

Simplify fully

$$\frac{15a^2}{a^2 + 6a - 16} \times \frac{8 - 4a}{3a}$$

**[4 marks]**

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Answer \_\_\_\_\_

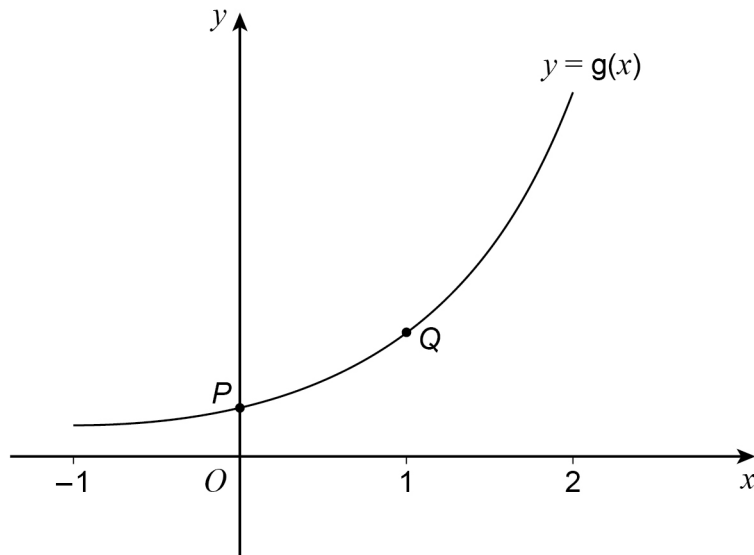


15

The function  $g$  is given by  $g(x) = a \times b^x$  where  $a$  and  $b$  are constants.

The domain of the function is  $-1 \leq x \leq 2$

$P\left(0, \frac{1}{2}\right)$  and  $Q\left(1, \frac{3}{2}\right)$  are points on the graph  $y = g(x)$



Not drawn  
accurately

Work out the range of the function.

[4 marks]

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Answer \_\_\_\_\_



16  $(2x - 3)$  is a factor of  $6x^3 - 25x^2 + 28x - 6$

Solve  $6x^3 - 25x^2 + 28x - 6 = 0$

Give all solutions as **exact** values.

[4 marks]

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Answer \_\_\_\_\_





- 17** The function  $h$  is given by  $h(x) = ax(3x^2 - 2) + 5x$  where  $a$  is a **positive** constant.  
 $h$  is an **increasing** function for all values of  $x$ .

Work out the possible values of  $a$ .

Give your answer as an inequality.

**[4 marks]**

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Answer \_\_\_\_\_

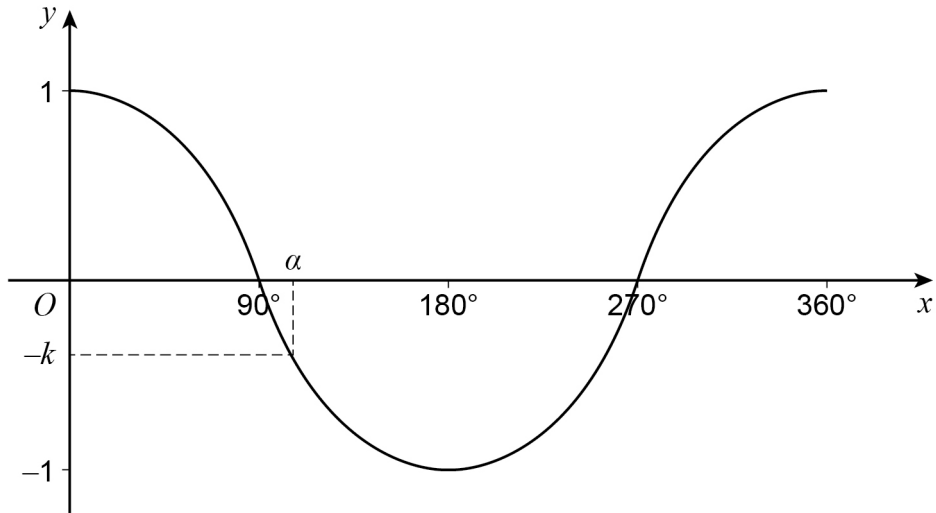
**Turn over for the next question**



18 Here is a sketch of  $y = \cos x$  for values of  $x$  from  $0^\circ$  to  $360^\circ$

$\alpha$  is an obtuse angle measured in degrees.

$\cos \alpha = -k$  where  $k$  is a positive constant.



18 (a) Tick ( $\checkmark$ ) **two** boxes that show expressions for  $x$  where  $\cos x = -k$

[2 marks]

$180^\circ - \alpha$

$180^\circ + \alpha$

$270^\circ - \alpha$

$270^\circ + \alpha$

$360^\circ - \alpha$

$360^\circ + \alpha$

18 (b) Circle the expression for  $x$  where  $\sin x = -k$

[1 mark]

$\alpha$

$90^\circ + \alpha$

$180^\circ - \alpha$

$180^\circ + \alpha$



**19** In these simultaneous equations,  $k$  is a positive constant.

$$3x + 4y = k$$

$$y = 2kx$$

Solve the simultaneous equations.

Give the answers in their simplest form in terms of  $k$ .

**[3 marks]**

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$x = \underline{\hspace{2cm}}$

$y = \underline{\hspace{2cm}}$



**20**

Show that

$2 \sin^3 x + 2 \sin x \cos^2 x + 5 \tan x \cos x$  simplifies to  $p \sin x$  where  $p$  is a constant.

**[3 marks]**

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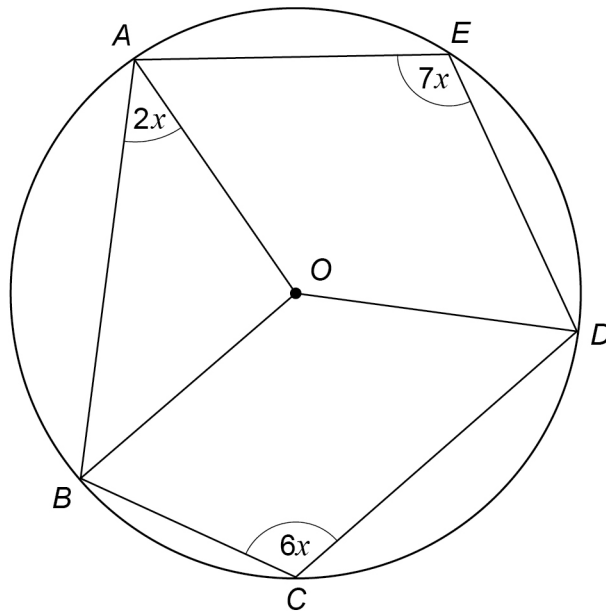
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21

$A, B, C, D$  and  $E$  are points on a circle, centre  $O$ .



Not drawn  
accurately

Work out the value of  $x$ .

[4 marks]

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$$x = \underline{\hspace{4cm}}$$

Turn over ►



**22** Five-digit integers are made using

1                  2                  7                  8                  9

For each integer, all the digits are used exactly once.

The integers are

greater than 40 000 **and** odd.

How many different integers can be made?

You **must** show your working.

**[3 marks]**

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Answer \_\_\_\_\_

**END OF QUESTIONS**

3



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2 8



6 G 2 3 8 3 6 5 / 2

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