AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

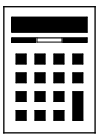
Level 2 Certificate
FURTHER MATHEMATICS

Paper 2 Calculator

Monday 19 June 2017 Morning Time allowed: 2 hours

Materials

For this paper you must have:
- a calculator
- mathematical instruments.



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.
- 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 105.
- You may ask for more answer paper, 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
3	
4 – 5	
6 – 7	
8 – 9	
10 – 11	
12 – 13	
14 – 15	
16 – 17	
18 – 19	
20 – 21	
22 – 23	
24 – 25	
26 – 27	
28 – 29	
30	
TOTAL	

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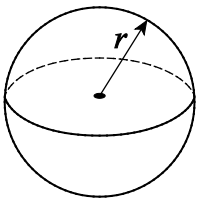
Formulae Sheet

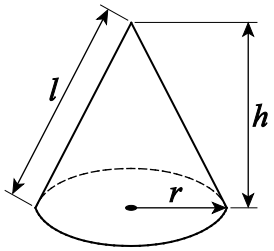
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



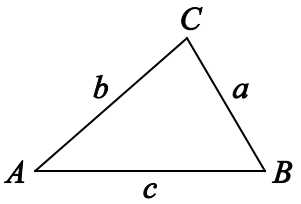
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$



In any triangle ABC

Area of triangle $= \frac{1}{2}ab \sin C$



Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Trigonometric Identities

$\tan \theta \equiv \frac{\sin \theta}{\cos \theta}$ $\sin^2 \theta + \cos^2 \theta \equiv 1$

Do not write outside the box

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

1 (a) The nth term of a sequence is $\dfrac{3-5n}{2}$

Work out the difference between the 20th term and the 8th term.

[2 marks]

Answer _____

1 (b) The nth term of another sequence is $\dfrac{3n}{1-2n}$

Write down the limiting value of the sequence as $n \to \infty$

[1 mark]

Answer _____

Turn over for the next question

3

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2 $\mathbf{A} = \begin{pmatrix} 4 & -1 \\ 3 & -2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$

2 (a) Work out $\mathbf{A}^2$

[2 marks]

Answer _____

2 (b) $k\mathbf{B} = \begin{pmatrix} 11-3k \\ 11-6k \end{pmatrix}$ where k is a constant.

Work out the value of k.

[2 marks]

Answer _____

Do not write outside the box

2 (c) Give a reason why it is **not** possible to work out **BA**

[1 mark]

Turn over for the next question

5

Do not write outside the box

3 (a) p, q and r are all integers greater than 1

$pqr = 1365$

Work out one possible set of values for p, q and r.

[2 marks]

$p =$ _____ $q =$ _____ $r =$ _____

3 (b) a and b are both **square** numbers greater than 1

$ab - 11b$ is also a **square** number.

By factorising $ab - 11b$, work out one possible pair of values for a and b.
You **must** show your working.

[2 marks]

$a =$ _____ $b =$ _____

Do not write outside the box

4 Solve $\dfrac{56}{\sqrt[3]{x}} = 4$

[2 marks]

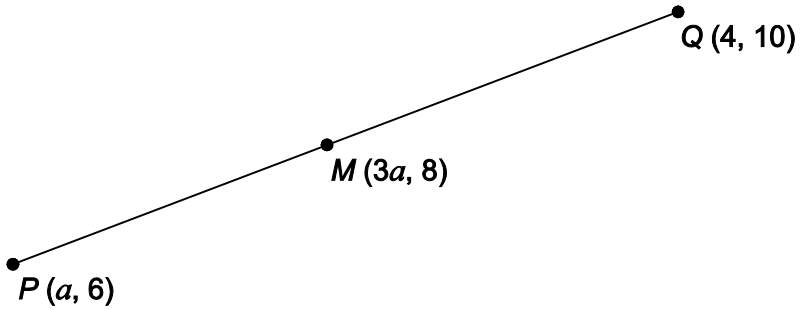
$x =$ _____

Turn over for the next question

6

Do not write outside the box

5 *M* is the midpoint of *PQ*.



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Work out the value of a.

[3 marks]

Answer _____

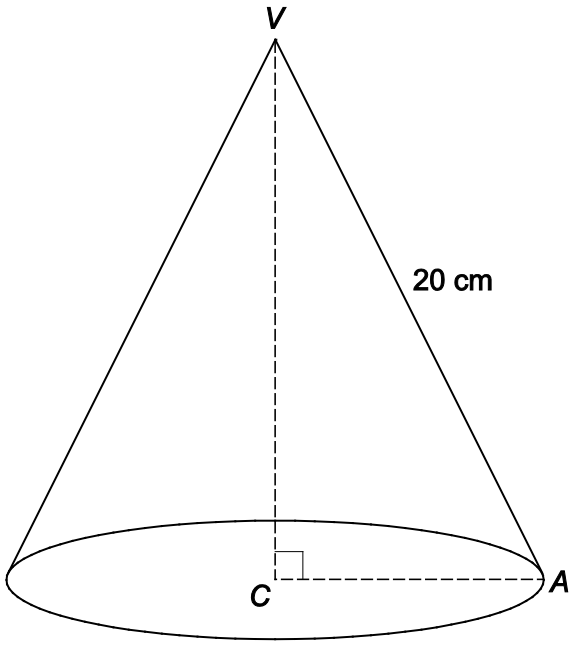
Do not write outside the box

6 A cone has vertex *V*.

C is the centre of the base.

The slant height, *VA*, is 20 cm

The angle between *VA* and *VC* is 38°



Work out the radius of the base.

[3 marks]

Answer _____ cm

6

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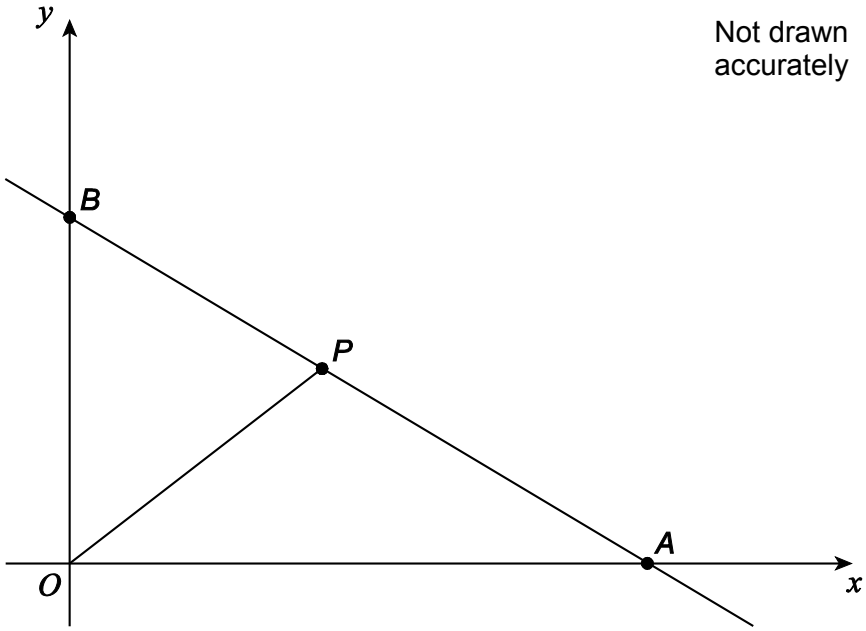
7 The equation of the line through *B*, *P* and *A* is $4x + 5y = 40$

BP : *PA* = 2 : 3



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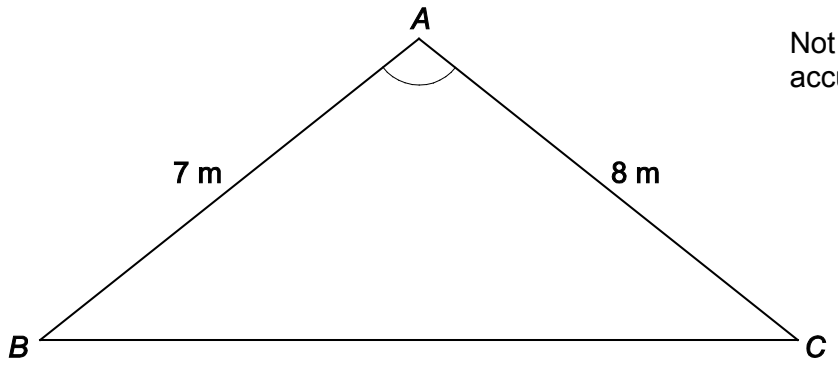
Work out the area of triangle OBP.

[4 marks]

Answer _____ square units

Do not write outside the box

8 The perimeter of a triangular flower bed, *ABC*, is marked out using 27 metres of rope.



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Work out the size of angle *BAC*.

[4 marks]

Answer _____ degrees

Turn over for the next question

8

Do not write outside the box

9 $-11 < 5x \leqslant 5$ and $6x + 7 \leqslant 4x + 4$

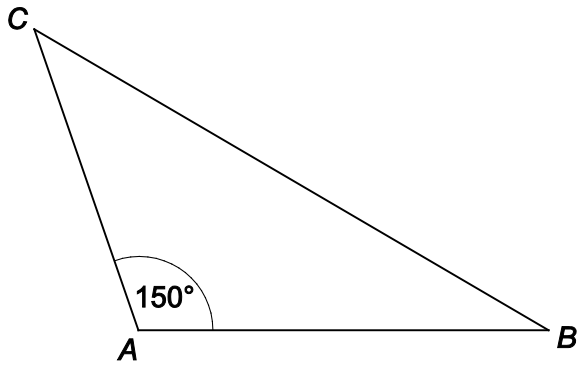
Show that there is **exactly** one integer that x can be.

[5 marks]

Do not write outside the box

10 ABC is an isosceles triangle with $AB = AC$

The area of ABC is 57.76 cm^2



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Work out the length of AB.

[3 marks]

Answer _____ cm

Turn over for the next question

8

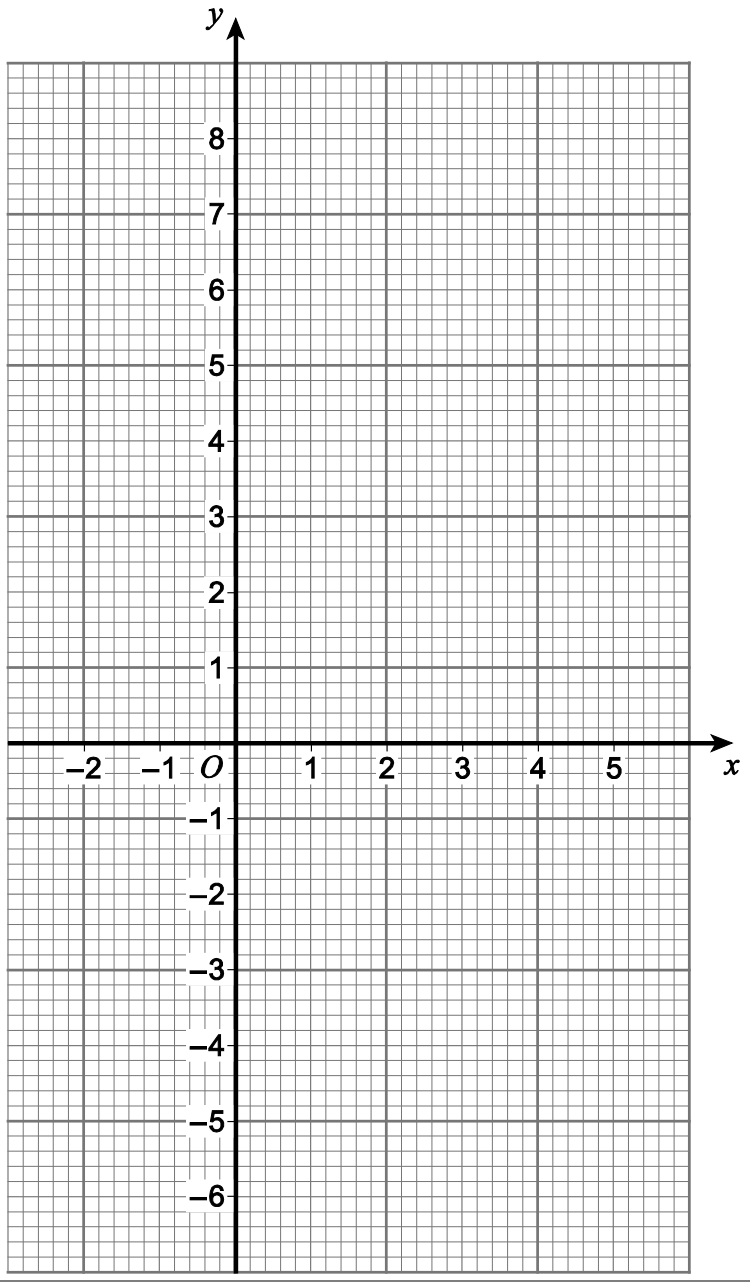
Do not write outside the box

11 A function f(x) is defined as

$$\begin{aligned} f(x) &= 3 - 2x && -2 \leqslant x < 0 \\ &= (1 + x)(3 - x) && 0 \leqslant x < 4 \\ &= 5x - 25 && 4 \leqslant x \leqslant 5 \end{aligned}$$

11 (a) Draw the graph of $y = f(x)$ on the axes below.

[4 marks]



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11 (b) State the range of f(x)

[2 marks]

Answer _____

12 (a) Factorise fully $75 - 3x^2$

[2 marks]

_____

_____

_____

Answer _____

12 (b) Simplify fully $(3n + 1)^2 - (3n - 1)^2$

[2 marks]

_____

_____

_____

_____

Answer _____

10

Do not write outside the box

13 Simplify fully $\dfrac{8a}{3a+6} \times \dfrac{5a+10}{3a^2} \div \dfrac{4}{15a^3}$

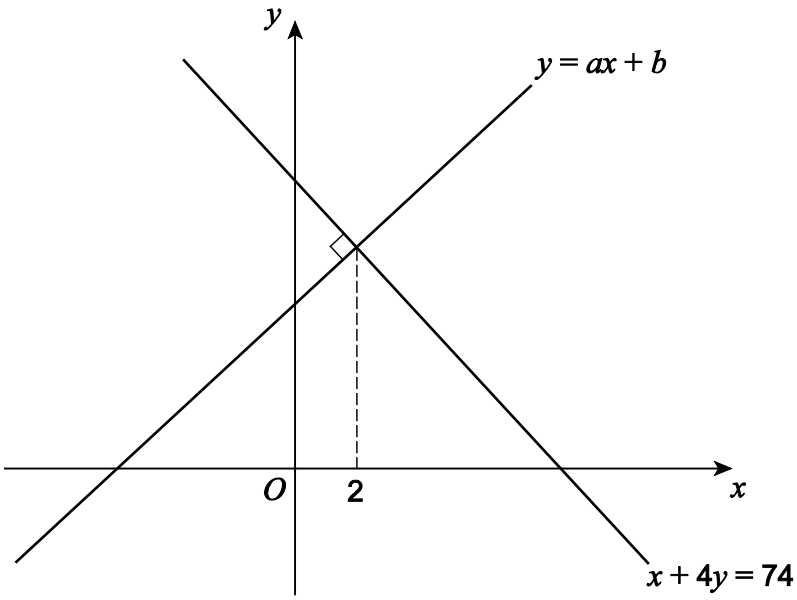
[3 marks]

Answer _____

Do not write outside the box

14 The line $y = ax + b$ is perpendicular to the line $x + 4y = 74$

The lines intersect at the point where $x = 2$



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Work out the values of a and b.

[5 marks]

$a =$ _____ $b =$ _____

8

Turn over ►

Do not write outside the box

15 Rearrange $w = \dfrac{8x - y}{y}$ to make y the subject.

[3 marks]

Answer _____

Do not write outside the box

16 (a) $a = 3^{2b}$

Circle the correct expression for $\frac{1}{a}$

[1 mark]

3^{2b-1} 3^{-2b} -3^{2b} $\left(\frac{1}{3}\right)^{-2b}$

16 (b) $y = 5^{x}$

Circle the correct expression for $25y$

[1 mark]

5^{x+2} 25^{x} 5^{2x} 125^{x}

16 (c) $w = 2^{m}$

Circle the correct expression for w^3

[1 mark]

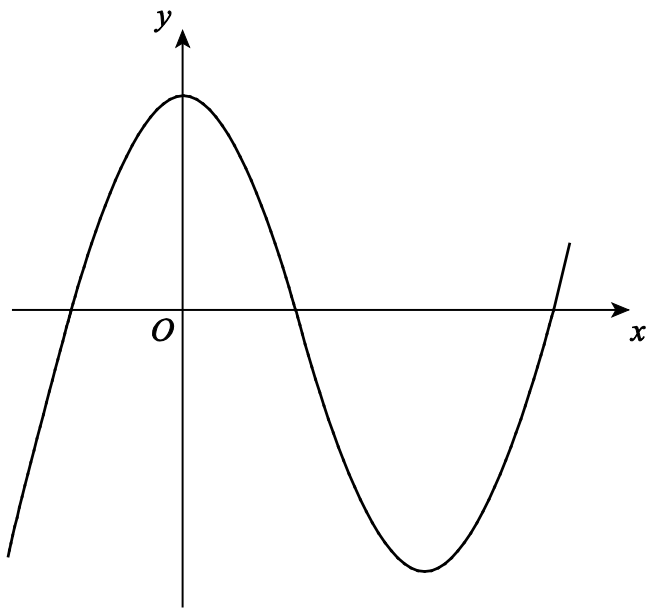
8^{3m} 6^{m} 2^{m+3} 2^{3m}

Turn over for the next question

6

Do not write outside the box

17 Here is a sketch of $y = x^3 - 6x^2 + 7$



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17 (a) Use differentiation to work out the coordinates of the stationary point that is a minimum. You **must** show your working.

[4 marks]

Answer (_____ , _____)

Do not write outside the box

17 (b) The three roots of $x^3 - 6x^2 + 7 = 0$ are the x-coordinates of the points where the graph intersects the x-axis.

Show that $x = -1$ is one root of $x^3 - 6x^2 + 7 = 0$

[1 mark]

17 (c) Hence, work out the other two roots of $x^3 - 6x^2 + 7 = 0$

Give your answers to 2 decimal places.
You **must** show your working.

[5 marks]

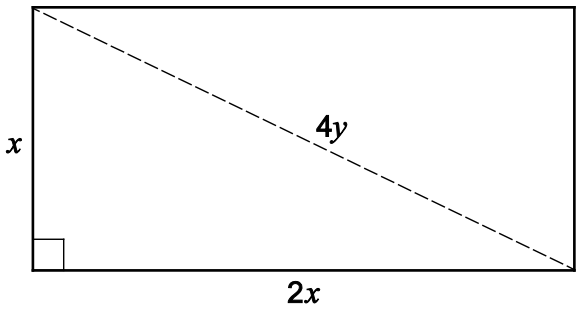
Answer _____

10

Do not write outside the box

18 The diagram shows a rectangle with a diagonal drawn.

The given expressions for the measurements are in centimetres.



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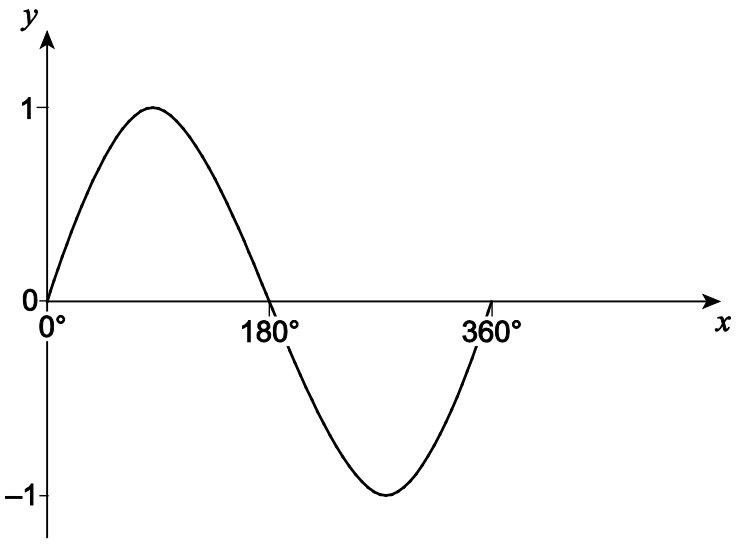
Work out an expression for the area of the rectangle, in cm^2
Give your answer in its simplest form, in terms of y.

[4 marks]

Answer _____ cm^2

Do not write outside the box

19 Here is a sketch of $y = \sin x$ for $0° \leqslant x \leqslant 360°$



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α is an acute angle measured in degrees.

$\sin \alpha = k$ where k is a constant.

Write the answers to each of the following in terms of k, without involving trigonometric functions.

19 (a) $\sin(180° - \alpha)$

[1 mark]

Answer _____

19 (b) $\sin(360° - \alpha)$

[1 mark]

Answer _____

19 (c) $\cos \alpha$

[2 marks]

Answer _____

8

Do not write outside the box

20 Two circles overlap.

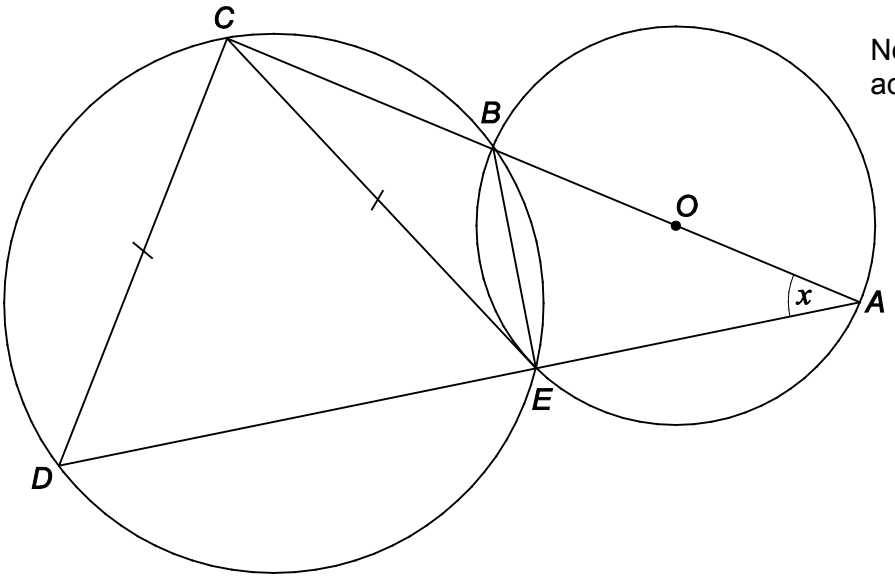
A, *B* and *E* lie on the circle, centre *O*.

B, *C*, *D* and *E* lie on the other circle.

AOBC and *AED* are straight lines.

$CD = CE$

angle $BAE = x$



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20 (a) Give a reason why angle $BEA = 90°$

[1 mark]

Do not write outside the box

20 (b) Prove that angle $DCE = 2x$

[4 marks]

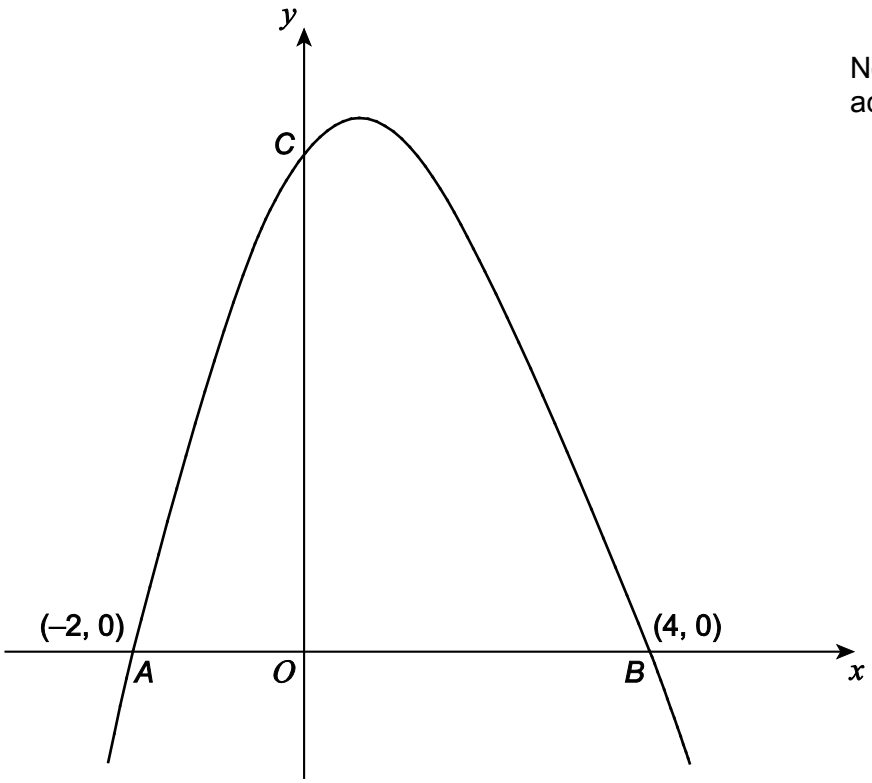
Turn over for the next question

5

Do not write outside the box

21 Here is a sketch of $y = (x + 2)(4 - x)$

The graph intersects the axes at A (–2, 0), B (4, 0) and C.



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21 (a) Work out the coordinates of C.

[1 mark]

Answer (_____ , _____)

Do not write outside the box

21 (b) Work out the gradient function of the curve.

[3 marks]

Answer _____

21 (c) The normal to the curve at C intersects the x-axis at D.

Show that length $BD = 2 \times$ length AB

[5 marks]

9

Turn over ►

Do not write outside the box

22 The equation of a circle is $(x - 2)^2 + (y - 1)^2 = 16$

The equation of a line is $y = 2x + 1$

The circle and the line intersect at two points.

Work out the coordinates of the two points.
You **must** show your working.
Do **not** use trial and improvement.

[5 marks]

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

Do not write outside the box

23 In this question, $\tan x \neq 0$ and $\sin x \neq 0$

Show that $\dfrac{1}{\tan^2 x} - \dfrac{1}{\sin^2 x}$ is a constant.

[3 marks]

Turn over for the next question

8

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24 Write $12x^2 - 60x + 5$ in the form $a(bx + c)^2 + d$ where a, b, c and d are integers.

[5 marks]

Answer _____

END OF QUESTIONS

5

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