

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

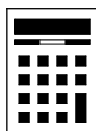
Morning

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.

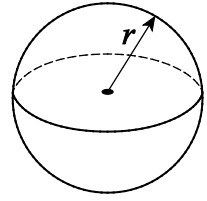
For Examiner's Use	
Pages	Mark
3	
4 – 5	
6 – 7	
8 – 9	
10 – 11	
12 – 13	
14 – 15	
16 – 17	
18 – 19	
20 – 21	
22 – 23	
24 – 25	
26 – 27	
28 – 29	
30	
<b>TOTAL</b>	



### Formulae Sheet

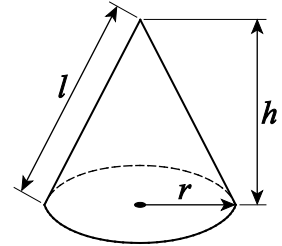
**Volume of sphere**  $= \frac{4}{3} \pi r^3$

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



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

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



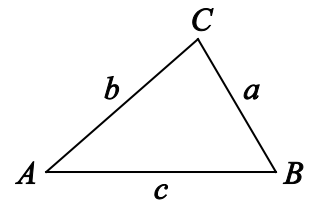
**In any triangle ABC**

**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

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



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

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

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

[2 marks]

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Answer \_\_\_\_\_

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

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

[1 mark]

Answer \_\_\_\_\_

**Turn over for the next question**



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

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 \_\_\_\_\_



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

[1 mark]

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**Turn over for the next question**

5

**Turn over ►**



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]

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$$p = \underline{\hspace{2cm}} \quad q = \underline{\hspace{2cm}} \quad r = \underline{\hspace{2cm}}$$

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]

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$$a = \underline{\hspace{2cm}} \quad b = \underline{\hspace{2cm}}$$



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

[2 marks]

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

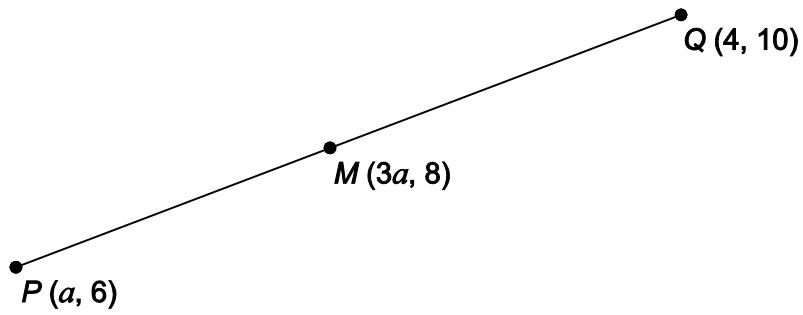
Turn over for the next question

6

Turn over ►



5

 $M$  is the midpoint of  $PQ$ .Not drawn  
accuratelyWork out the value of  $a$ .**[3 marks]**

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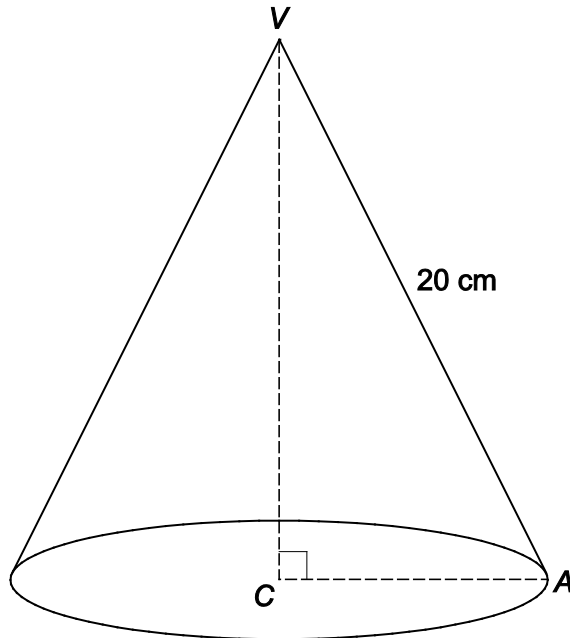
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Answer \_\_\_\_\_



- 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  $38^\circ$



Work out the radius of the base.

[3 marks]

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Answer \_\_\_\_\_ cm

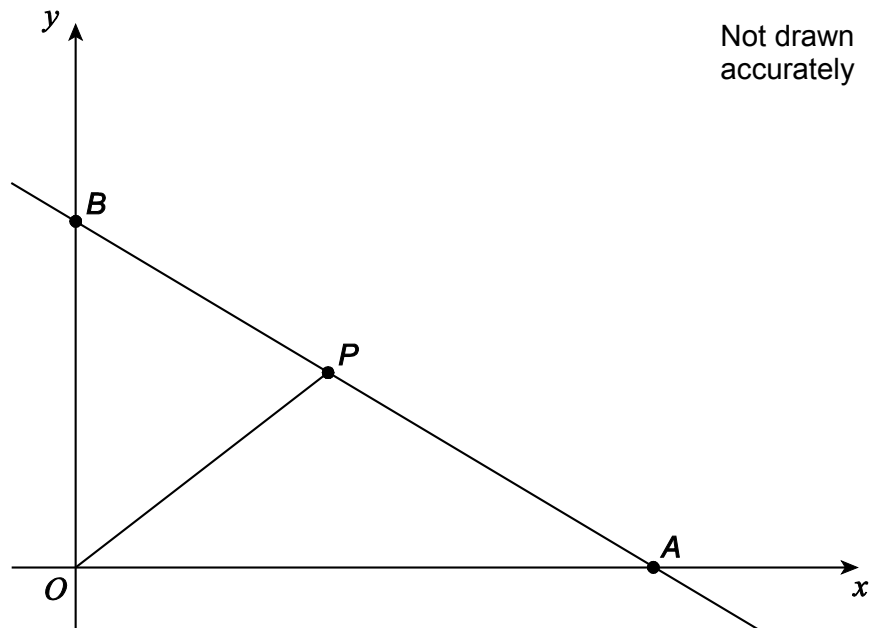
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Turn over ►



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

$$BP : PA = 2 : 3$$



Work out the area of triangle  $OBP$ .

[4 marks]

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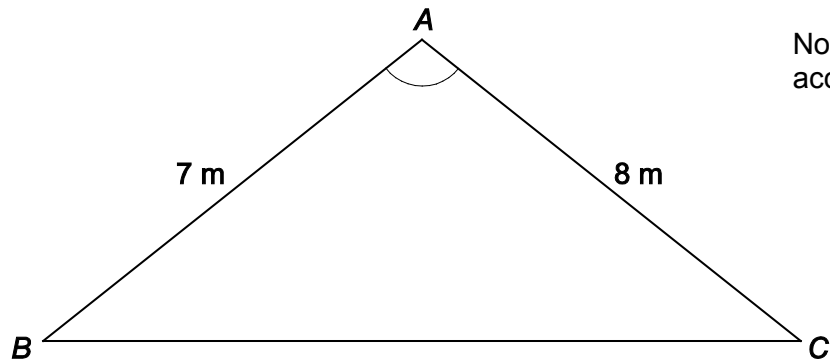


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Answer \_\_\_\_\_ square units



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



Work out the size of angle  $BAC$ .

[4 marks]

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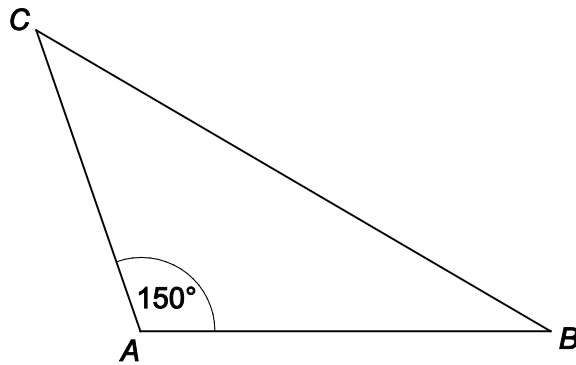
Answer \_\_\_\_\_ degrees

Turn over for the next question





- 10  $ABC$  is an isosceles triangle with  $AB = AC$   
The area of  $ABC$  is  $57.76 \text{ cm}^2$



Not drawn  
accurately

Work out the length of  $AB$ .

[3 marks]

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Answer \_\_\_\_\_ cm

Turn over for the next question

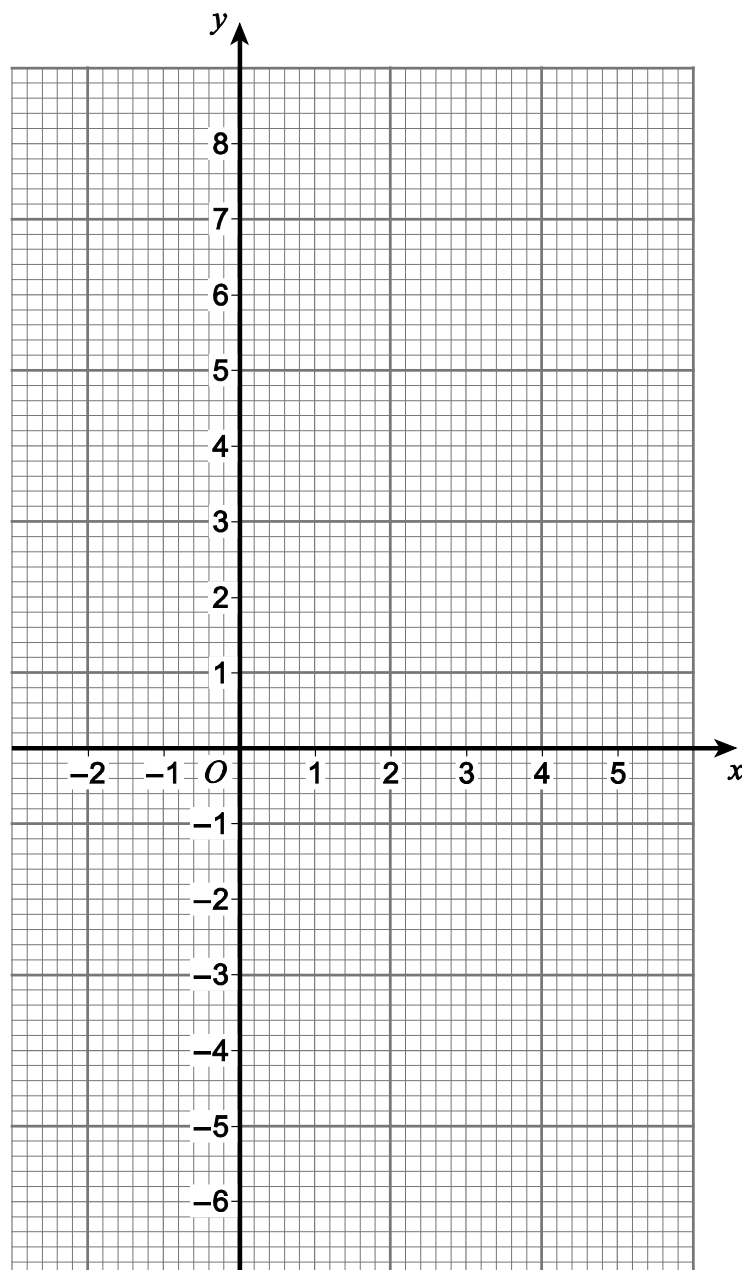


11 A function  $f(x)$  is defined as

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

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

[4 marks]



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

[2 marks]

Answer \_\_\_\_\_

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

[2 marks]

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Answer \_\_\_\_\_

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

[2 marks]

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Answer \_\_\_\_\_



13

Simplify fully

$$\frac{8a}{3a+6} \times \frac{5a+10}{3a^2} \div \frac{4}{15a^3}$$

[3 marks]

Answer \_\_\_\_\_





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

[3 marks]

Answer \_\_\_\_\_



**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]**

$8^{3m}$

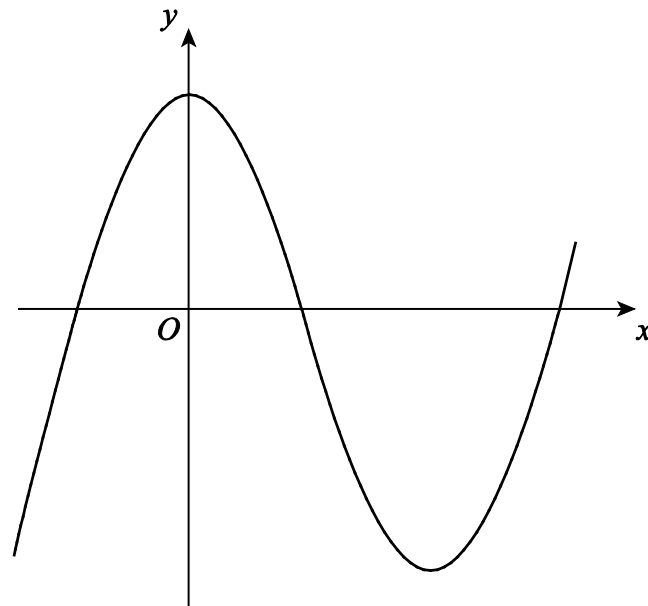
$6^m$

$2^{m+3}$

$2^{3m}$

**Turn over for the next question****Turn over ►**

17

Here is a sketch of  $y = x^3 - 6x^2 + 7$ Not drawn  
accurately

17 (a)

Use differentiation to work out the coordinates of the stationary point that is a minimum. You **must** show your working.**[4 marks]**

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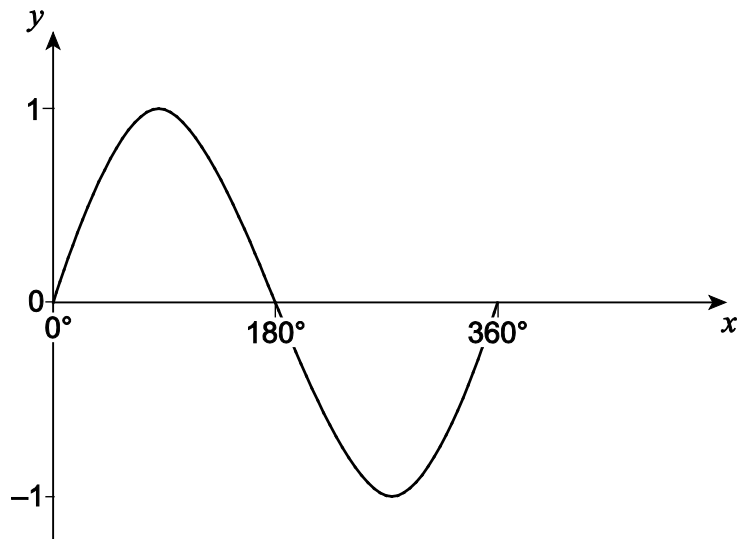
Answer ( \_\_\_\_\_ , \_\_\_\_\_ )







- 19 Here is a sketch of  $y = \sin x$  for  $0^\circ \leq x \leq 360^\circ$



Not drawn accurately

$\alpha$  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)  $\sin(180^\circ - \alpha)$

[1 mark]

Answer \_\_\_\_\_

19 (b)  $\sin(360^\circ - \alpha)$

[1 mark]

Answer \_\_\_\_\_

19 (c)  $\cos \alpha$

[2 marks]

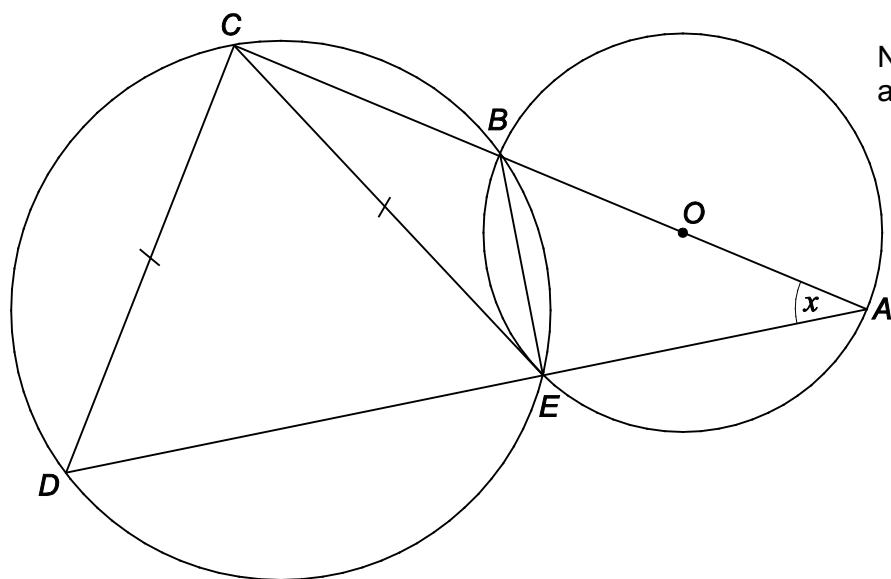
Answer \_\_\_\_\_

Turn over ►



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  $BAE = x$ 20 (a) Give a reason why angle  $BEA = 90^\circ$ 

[1 mark]

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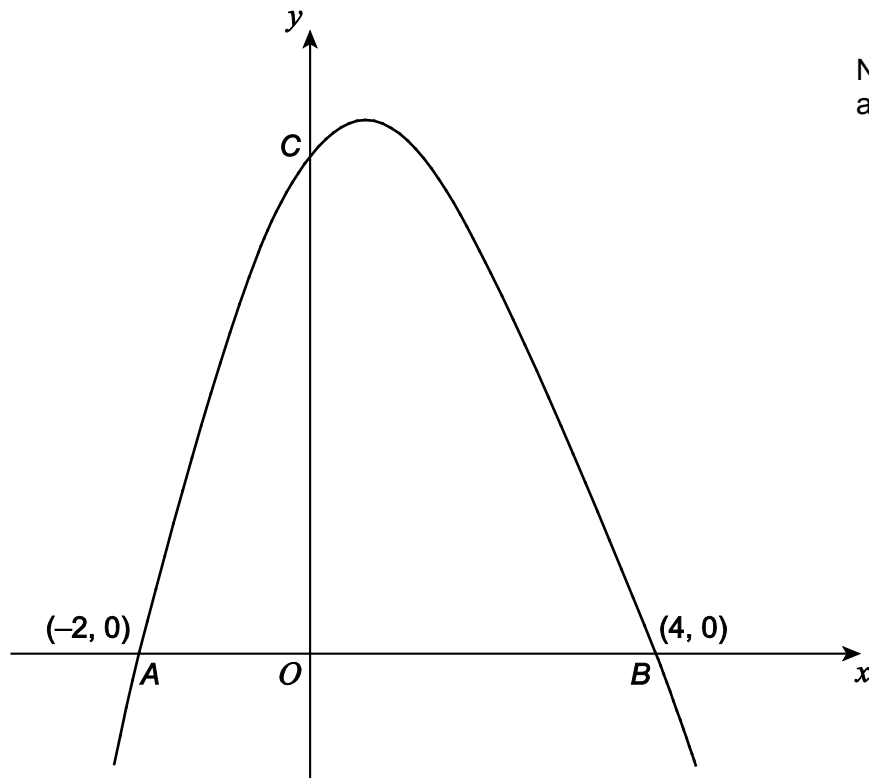
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21 Here is a sketch of  $y = (x + 2)(4 - x)$

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



21 (a) Work out the coordinates of  $C$ .

[1 mark]

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Answer ( \_\_\_\_\_ , \_\_\_\_\_ )







23

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

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

**[3 marks]**

Turn over for the next question

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8

**Turn over ►**



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