

**Dr Oliver Mathematics**  
**AQA Further Maths Level 2**  
**June 2017 Paper 2**  
**2 hours**

The total number of marks available is 105.

You must write down all the stages in your working.

You are permitted to use a scientific or graphical calculator in this paper.

1. The  $n$ th term of a sequence is

$$\frac{3 - 5n}{2}.$$

- (a) Work out the difference between the 20th term and the 8th term. (2)

The  $n$ th term of another sequence is

$$\frac{3n}{1 - 2n}.$$

- (b) Write down the limiting value of the sequence as  $n \rightarrow \infty$ . (1)

- 2.

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

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

$$k\mathbf{B} = \begin{pmatrix} 11 - 3k \\ 11 - 6k \end{pmatrix},$$

where  $k$  is a constant.

- (b) Work out the value of  $k$ . (2)

- (c) Give a reason why it is not possible to work out  $\mathbf{BA}$ . (1)

3.  $p$ ,  $q$ , and  $r$  are all integers greater than 1.

$$pqr = 1365.$$

- (a) Work out one possible set of values for  $p$ ,  $q$ , and  $r$ . (2)

$a$  and  $b$  are both square numbers greater than 1.

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

- (b) By factorising  $ab - 11b$ , work out one possible pair of values for  $a$  and  $b$ . (2)  
You **must** show your working.

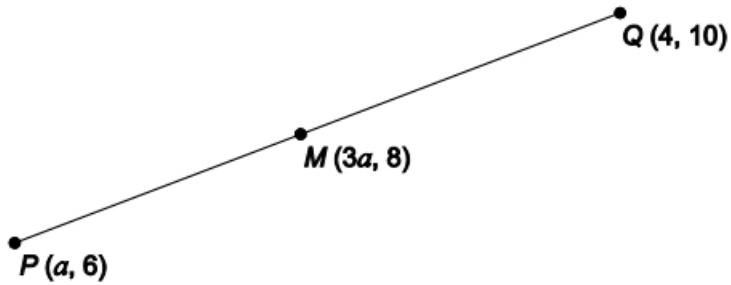
4. Solve

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

(2)

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

(3)



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Work out the value of  $a$ .

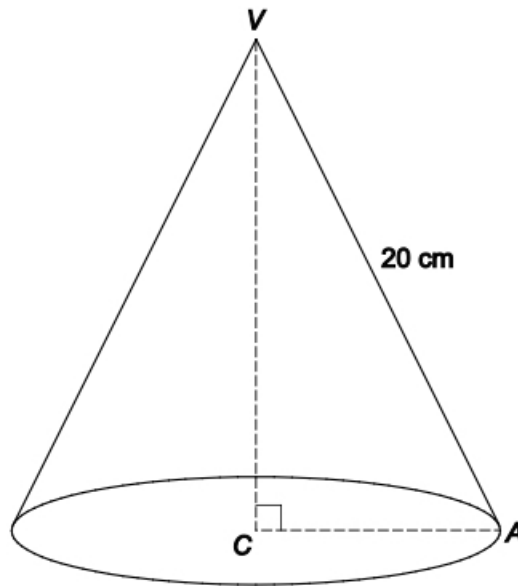
6. A cone has vertex  $V$ .

$C$  is the centre of the base.

The slant height,  $VA$ , is 20 cm.

The angle between  $VA$  and  $VC$  is  $38^\circ$ .

(3)

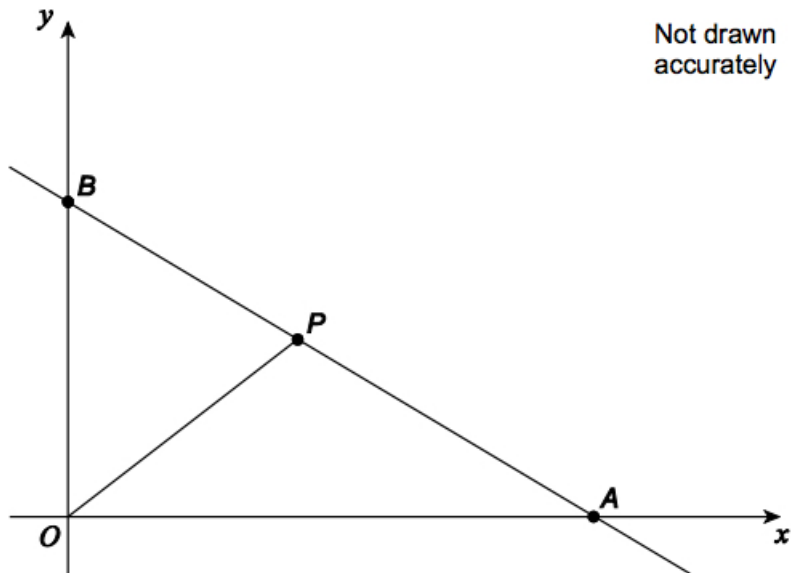


Work out the radius of the base.

7. The equation of the line through  $B$ ,  $P$ , and  $A$  is (4)

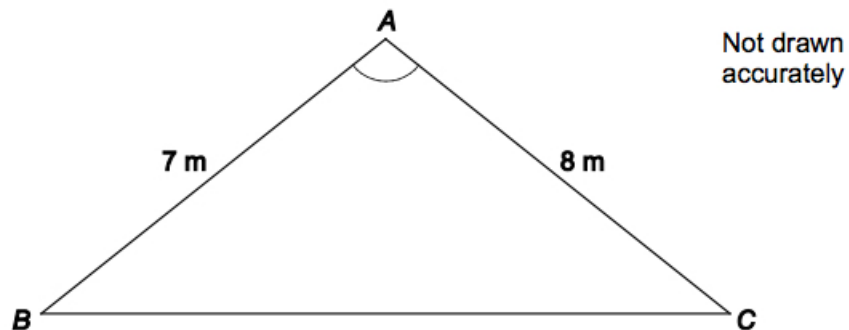
$$4x + 5y = 40.$$

$$BP : PA = 2 : 3.$$



Work out the area of triangle  $OBP$ .

8. The perimeter of a triangular flower bed,  $ABC$ , is marked out using 27 metres of rope. (4)



Work out the size of angle  $BAC$ .

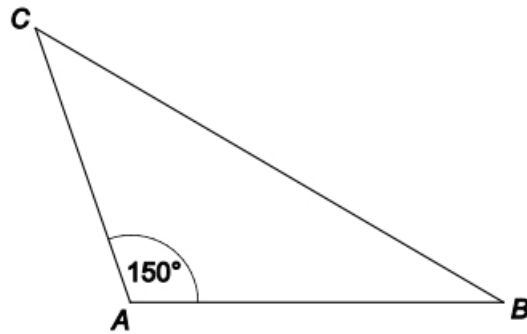
9. (5)

$$-11 < 5x \leq 5 \text{ and } 6x + 7 \leq 4x + 4.$$

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

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

(3)



Not drawn  
accurately

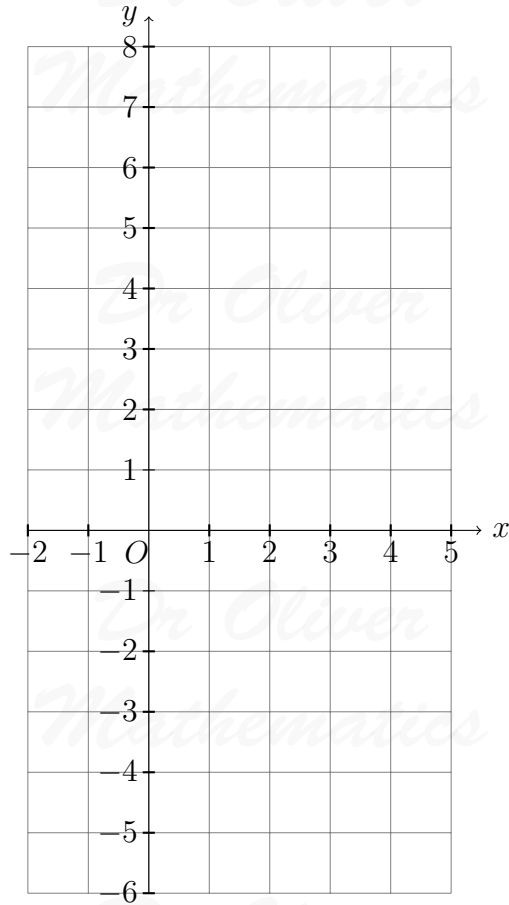
Work out the length of  $AB$ .

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

$$f(x) = \begin{cases} 3 - 2x & \text{for } -2 \leq x < 0, \\ (1 + x)(3 - x) & \text{for } 0 \leq x < 4, \\ 5x - 25 & \text{for } 4 \leq x \leq 5. \end{cases}$$

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

(4)



(b) State the range of  $f(x)$ . (2)

12. (a) Factorise fully (2)

$$75 - 3x^2.$$

(b) Simplify fully (2)

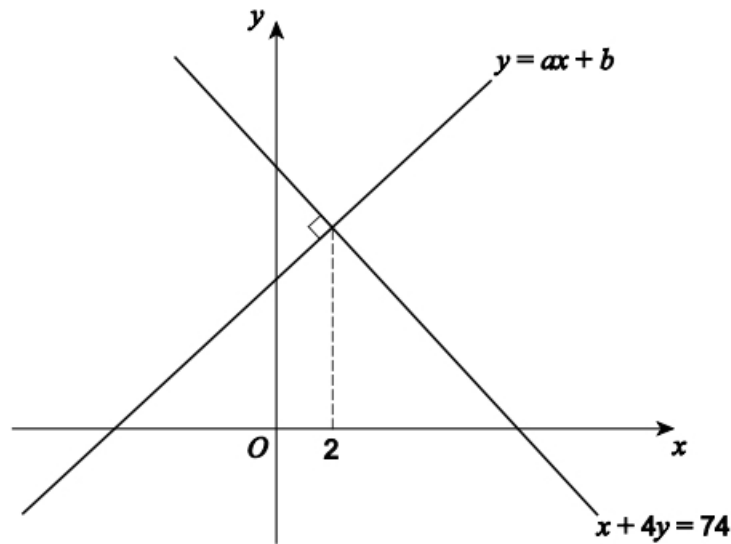
$$(3n + 1)^2 - (3n - 1)^2.$$

13. Simplify fully (3)

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

14. The line  $y = ax + b$  is perpendicular to the line  $x + 4y = 74$ . (5)

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



Not drawn accurately

Work out the values of  $a$  and  $b$ .

15. Rearrange

$$w = \frac{8x - y}{y}$$

to make  $y$  the subject.

16. (a)

$$a = 3^{2b}$$

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

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

(b)

$$y = 5^x$$

Circle the correct expression for  $25y$ .

$$5^{x+2} \quad 25^x \quad 5^{2x} \quad 125^x$$

(c)

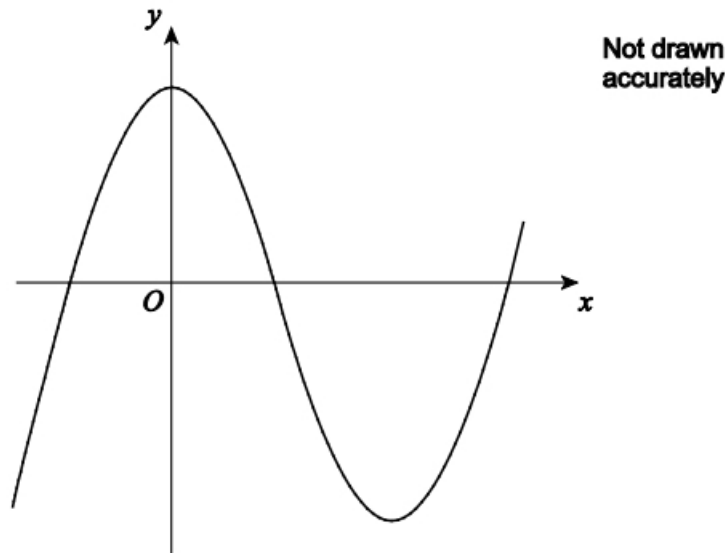
$$w = 2^m$$

Circle the correct expression for  $w^3$ .

$$8^{3m} \quad 6^m \quad 2^{m+3} \quad 2^{3m}$$

17. Here is a sketch of

$$y = x^3 - 6x^2 + 7.$$



- (a) Use differentiation to work out the coordinates of the stationary point that is a minimum. (4)

You **must** show your working.

The three roots of

$$x^3 - 6x^2 + 7 = 0$$

are the  $x$ -coordinates of the points where the graph intersects the  $x$ -axis.

- (b) Show that  $x = -1$  is one root of (1)

$$x^3 - 6x^2 + 7 = 0.$$

- (c) Hence, work out the other two roots of (5)

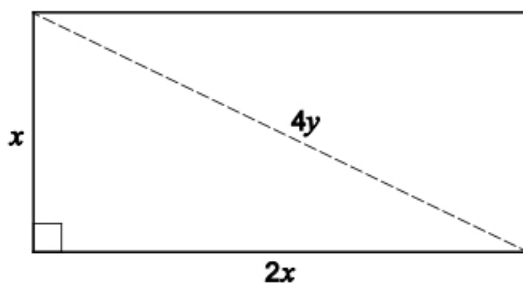
$$x^3 - 6x^2 + 7 = 0.$$

Give your answers to 2 decimal places.

You **must** show your working.

18. The diagram shows a rectangle with a diagonal drawn. (4)

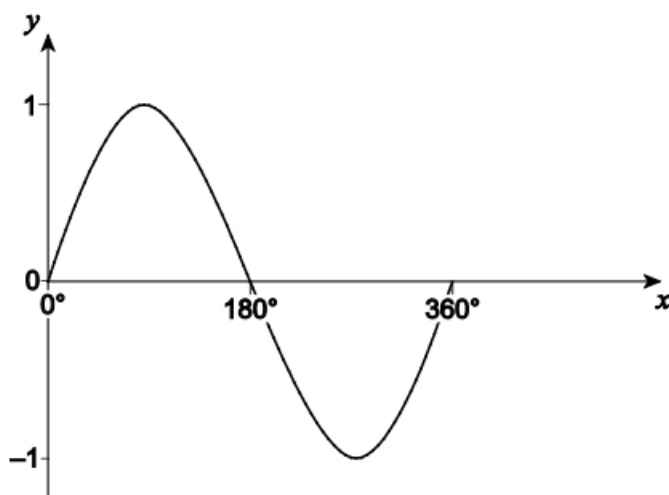
The given expressions for the measurements are in centimetres.



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

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.

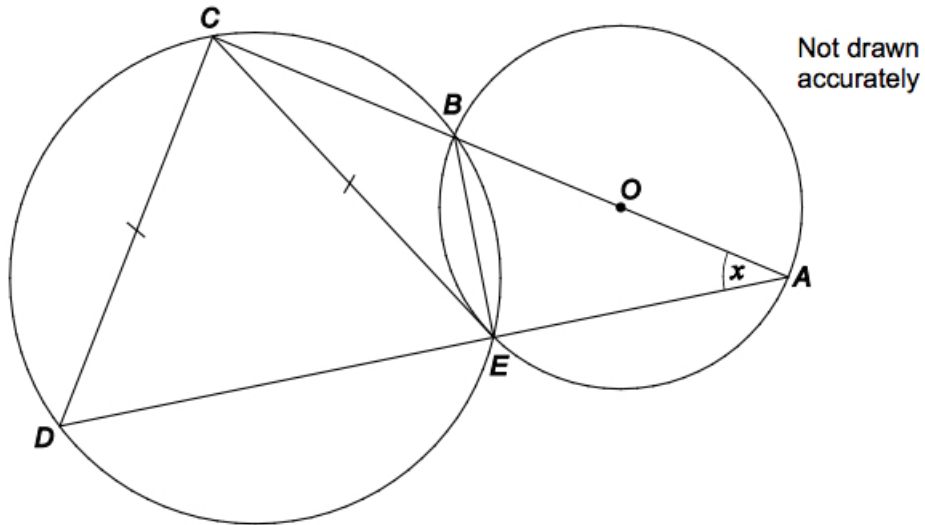
- (a)  $\sin(180 - \alpha)^\circ$ . (1)
- (b)  $\sin(360 - \alpha)^\circ$ . (1)
- (c)  $\cos \alpha^\circ$ . (2)

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  $BAE = x$ .

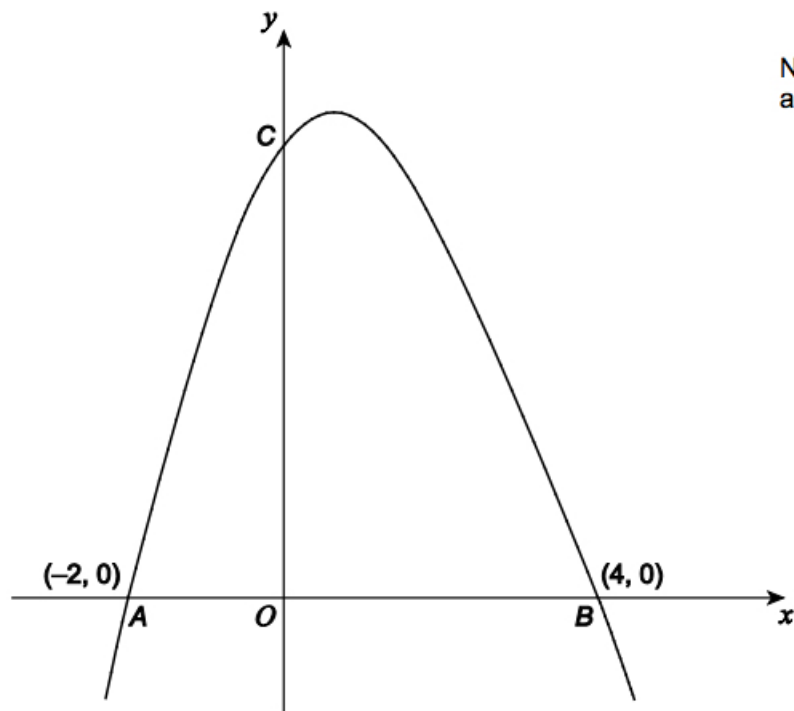


- (a) Give a reason why angle  $BEA = 90^\circ$ . (1)
- (b) Prove that angle  $DCE = 2x$ . (4)

21. Here is a sketch of

$$y = (x + 2)(4 - x).$$

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



Not drawn accurately

(a) Work out the coordinates of  $C$ . (1)

(b) Work out the gradient function of the curve. (3)

The normal to the curve at  $C$  intersects the  $x$ -axis at  $D$ .

(c) Show that (5)

$$\text{length } BD = 2 \times \text{length } AB.$$

22. The equation of a circle is (5)

$$(x - 2)^2 + (y - 1)^2 = 16.$$

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.

23. In this question,  $\tan x \neq 0$  and  $\sin x \neq 0$ . (3)

Show that

$$\frac{1}{\tan^2 x} - \frac{1}{\sin^2 x}$$

is a constant.

24. Write

(5)

in the form

$$12x^2 - 60x + 5$$

$$a(bx + c)^2 + d,$$

where  $a$ ,  $b$ ,  $c$ , and  $d$  are integers.

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