

**Dr Oliver Mathematics**  
**AQA Further Maths Level 2**  
**June 2015 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. A circle, centre  $(0, 0)$ , has circumference  $12\pi$ . (2)

Work out the equation of the circle.

2. (2)

$$a : b : c = 5 : 3 : 2.$$

Work out

$$4a - c : 3b.$$

Give your answer in its simplest form.

3. The distance between the points  $(2, 5p)$  and  $(2, -10)$  is 30 units. (3)

Work out the **two** possible values of  $p$ .

4. The first term of a sequence is  $1 - a$ .

The term-to-term rule of a sequence is

add  $2a$  then multiply by 3.

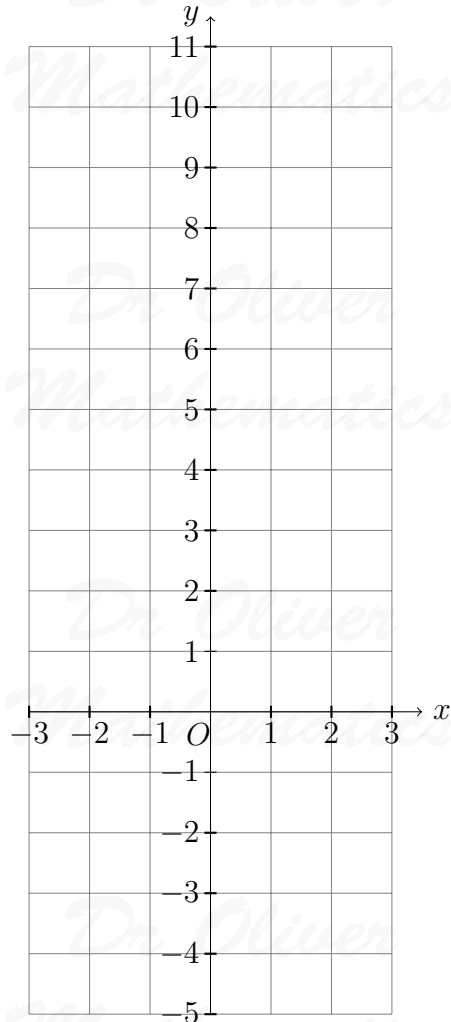
- (a) Show that the second term is  $3 + 3a$ . (1)

The third term is 16.

- (b) Work out the value of  $a$ . (3)

5. A straight line  $L$  is parallel to the straight line  $y = 1 - 2x$  and passes through  $(3, -1)$ . (4)

On the grid below, draw the straight line  $L$  for values of  $x$  from  $-3$  to  $3$ .



6. Write

$$\frac{15x^8 - 18x^7}{3x^2}$$

(2)

in the form  $ax^n - nx^a$ , where  $a$  and  $n$  are integers.

7.

$$y = \frac{2}{3}x^6 - 8x^3.$$

(3)

Work out the rate of change of  $y$  with respect to  $x$  when  $x = -1$ .

8.

$$f(x) = x^4.$$

The domain of  $f(x)$  is  $x \geq 2$

- (a) Work out the range of  $f(x)$ . (1)

$$g(x) = x^2 - 1.$$

The domain of  $g(x)$  is  $-2 \leq x \leq 3$ .

- (b) Work out the range of  $g(x)$ . (2)

$$h(x) = 5x - 3.$$

The **range** of  $h(x)$  is  $-2 < x < 1$ .

- (c) Work out the domain of  $h(x)$ . (2)

9. (a) Solve (3)

$$6(2y - 3) - 10 = 2y.$$

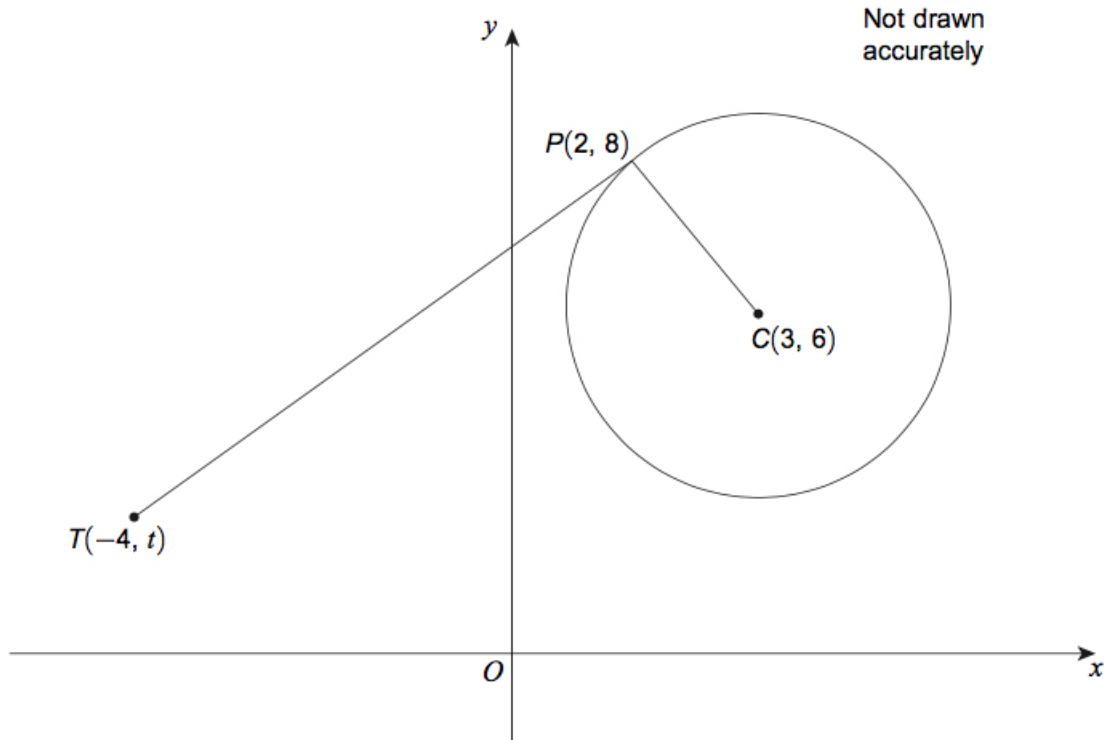
- (b) Solve (3)

$$\frac{\sqrt{w+4}}{2} = 6.$$

- (c) Solve (2)

$$3m^{\frac{1}{5}} + 9 = 0.$$

10. The diagram shows a circle, centre  $C$ . (4)  
 $TP$  is a tangent to the circle at  $P$ .

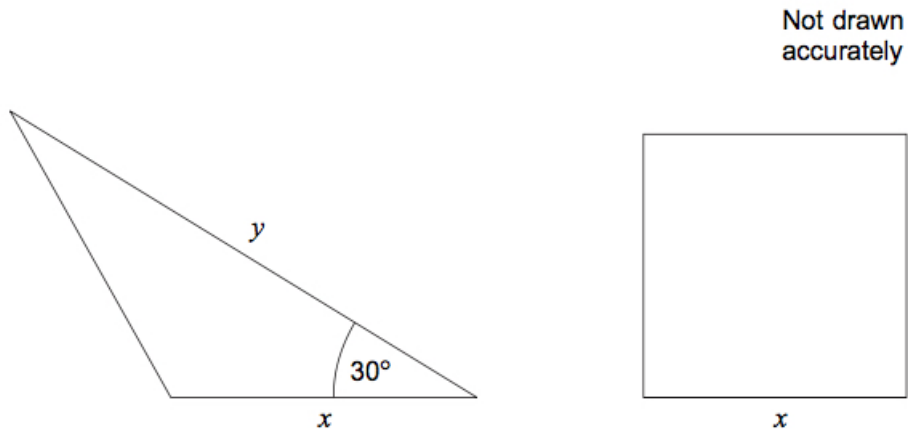


Work out the value of  $t$ .

11. (a) Expand and simplify  $(3w + 2y)(w - 4y)$ . (3)

- (b) Expand and simplify  $\frac{3}{x^2} \left( \frac{x}{3} + 3x^2 - 1 \right)$ . (3)

12. The area of the triangle is equal to the area of the square. All dimensions are in centimetres. (2)

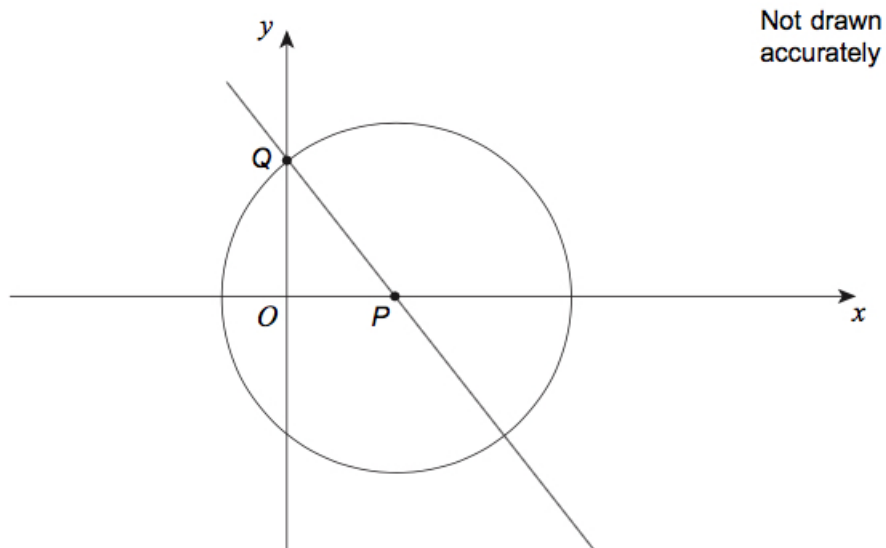


Write  $y$  in terms of  $x$ .

13. The diagram shows a circle, centre  $P$ , and a straight line passing through points  $P$  and  $Q$ .  $Q$  lies on the  $y$ -axis and on the circumference of the circle. The equation of the circle is (4)

$$(x - 3)^2 + y^2 = 25.$$

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Work out the equation of the straight line through  $P$  and  $Q$ .

Give your answer in the form  $ax + by + c = 0$ , where  $a$ ,  $b$ , and  $c$  are integers.

14.  $PQR$  is a straight line.

$PQ : QR$  is  $2 : 3$ .

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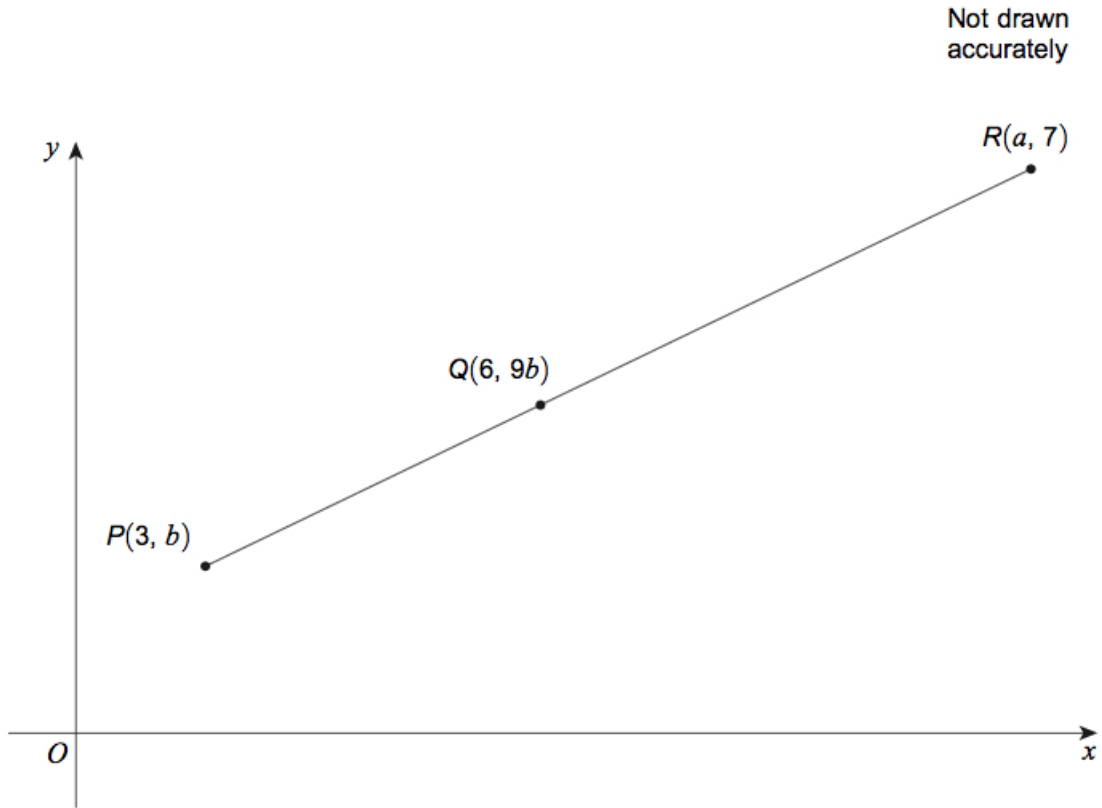
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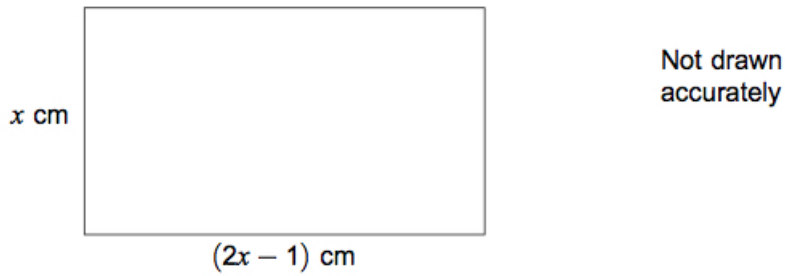
- (a) Show that  $a = 10 : 5$ . (2)
- (b) Work out the value of  $b$ . (3)

15. Use algebra to prove that the value of (3)

$$\frac{8c^2 + 16}{3c^2 + 6} + \frac{1}{3}$$

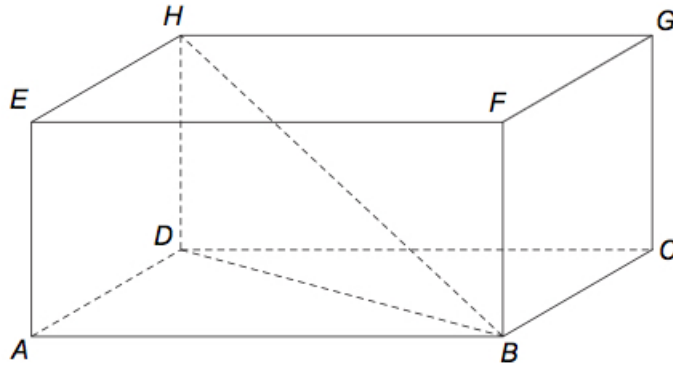
is an integer for all values of  $c$ .

16. The diagram shows a rectangle with area  $9 \text{ cm}^2$ . (5)



Set up and solve an equation to work out the value of  $x$ .  
Give your answer to 3 significant figures.

17.  $ABCDEFGH$  is a cuboid.



$$HB = 34 \text{ cm.}$$

$$HD = 16 \text{ cm.}$$

$$AD = 18 \text{ cm.}$$

(a) Work out the length of  $AB$ .

(3)

(b) Work out the angle between  $HB$  and  $ABCD$ .

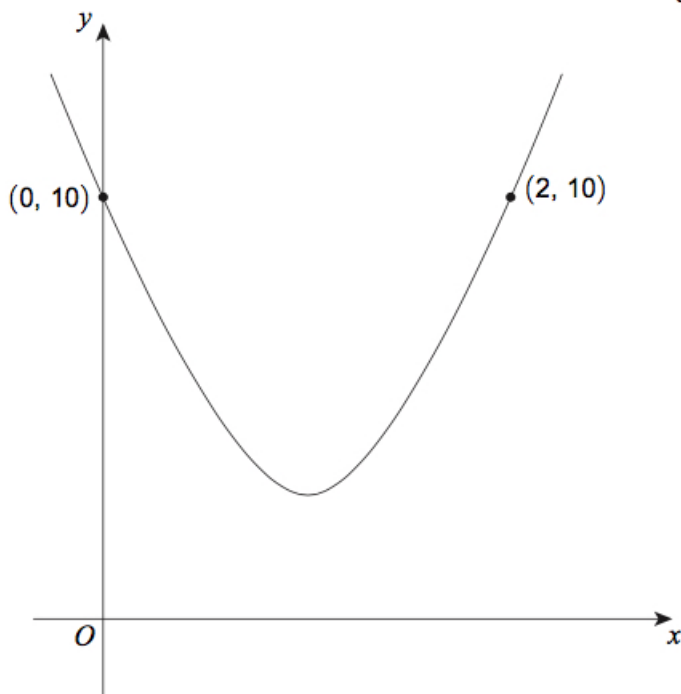
(2)

18. The sketch shows the quadratic curve

$$y = 4(x - a)^2 + b.$$

The curve passes through  $(0, 10)$  and  $(2, 10)$ .

Not drawn accurately



- (a) Give reasons why the value of  $a$  is 1. (2)
  - (b) Work out the value of  $b$ . (2)
  - (c) Write the equation of the curve in the form  $y = px^2 + qx + r$ . (2)
19. Use the factor theorem to show that  $(x - 3)$  is not a factor of (2)
- $$x^3 - 10x - 3.$$

20. The transformation matrix  $\mathbf{P}$  represents a  $90^\circ$  anti-clockwise rotation about the origin. (2)
- (a) Describe fully the **single** transformation represented by the matrix  $\mathbf{P}^3$ . (2)

The transformation matrix  $\mathbf{Q}$  is

$$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}.$$

The transformation matrix  $\mathbf{R}$  is

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}.$$



(b) Describe fully the **single** transformation represented by the matrix **QR**. (2)

21. A cubic curve has (3)

- a maximum point at  $A(-4, 10)$ .
- a minimum point at  $B(2, -26)$ .

The tangent to the curve at  $A$  and the normal to the curve at  $B$  intersect at point  $C$ .

Work out the area of triangle  $ABC$ .

You may sketch a diagram to help you.

22. A quadratic sequence starts

302      600      894      1 184

(a) Work out an expression for the  $n$ th term. (3)

A term in the sequence has value 0.

(b) Find the position of this term. (2)

23. The continuous curve  $y = f(x)$  has exactly two stationary points. (1)

$P$  is a maximum point when  $x = a$ .

$Q$  is a stationary point of inflection when  $x = b$ .

$a < b$ .

Which of these is correct?

Tick one box only.

When  $a < x < b$ ,  $\frac{dy}{dx}$  is positive

and

when  $x > b$ ,  $\frac{dy}{dx}$  is positive

When  $a < x < b$ ,  $\frac{dy}{dx}$  is positive

and

when  $x > b$ ,  $\frac{dy}{dx}$  is negative

When  $a < x < b$ ,  $\frac{dy}{dx}$  is negative

and

when  $x > b$ ,  $\frac{dy}{dx}$  is positive

When  $a < x < b$ ,  $\frac{dy}{dx}$  is negative

and

when  $x > b$ ,  $\frac{dy}{dx}$  is negative

24.

$$a^2 < 4 \text{ and } a + 2b = 8.$$

(4)

Work out the range of possible values of  $b$ .

Give your answer as an inequality.

25. Work out the values of  $x$  between  $0^\circ$  and  $360^\circ$  for which

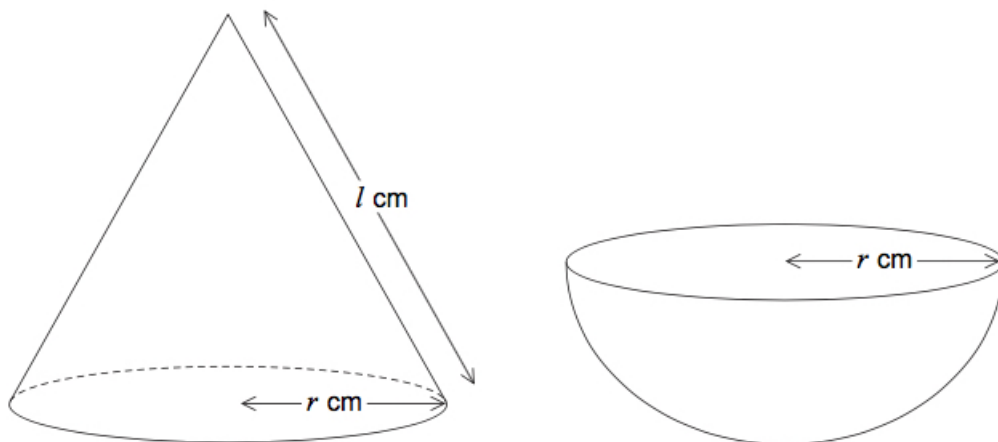
$$25 \cos^2 x = 9.$$

(4)

Give your answers to 1 decimal place.

26. A cone has base radius  $r$  cm and slant height  $l$  cm.

A hemisphere has radius  $r$  cm.



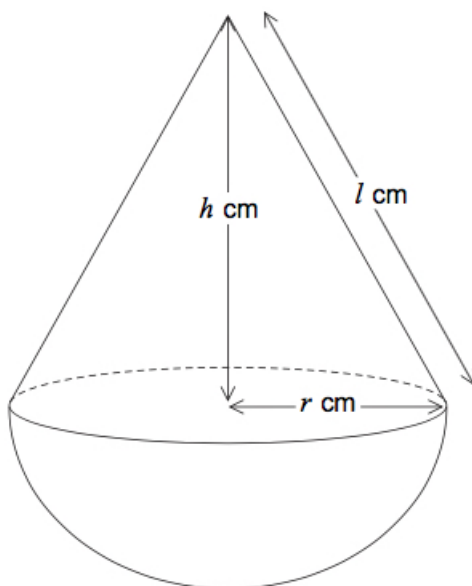
The curved surface area of the cone equals the curved surface area of the hemisphere.

(a) Show that  $l = 2r$ .

(1)

The cone has vertical height  $h$  cm.

The cone and hemisphere are joined to make the shape shown below.



(b) Show that the volume of the shape can be written as

(4)

$$\frac{1}{3}\pi r^3(a + \sqrt{b}) \text{ cm}^3,$$

where  $a$  and  $b$  are integers.

27. Work out the values of  $a$  when

$$2^{a^2} = 8^a \times 16.$$

(4)

Do **not** use trial and improvement.

You must show your working.

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