

Dr Oliver Mathematics
AQA Further Maths Level 2
June 2018 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

$$\frac{1420 - 5n}{1420 + 5n}.$$

(a) Work out the **position** of the term that has the value zero. (2)

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

2. $P(-3, -10)$ and $Q(a, b)$ are points on a straight line with gradient 12. (2)

Work out one possible pair of integer values for a and b .

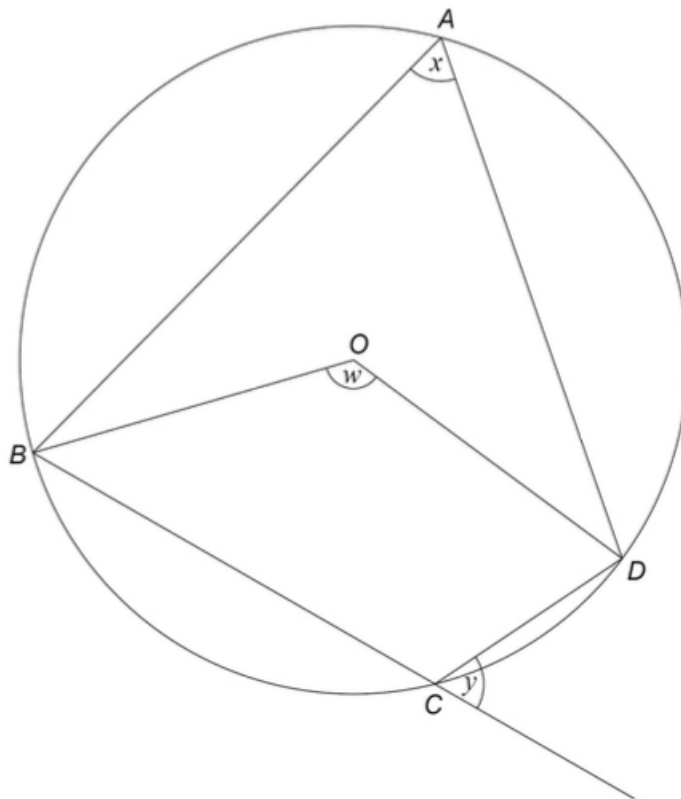
- 3.

$$p = \frac{m + 2}{m^2 + 1}.$$

(a) Work out the value of p when $m = -5.5$. (1)

(b) Work out the values of m when $p = 2$. (3)

4. A , B , C , and D are points on a circle, centre O . (1)



Which statement is correct?
Tick **one** box.

$x + y = 180^\circ$ and $w = 2x$

$x + y = 180^\circ$ and $x = 2w$

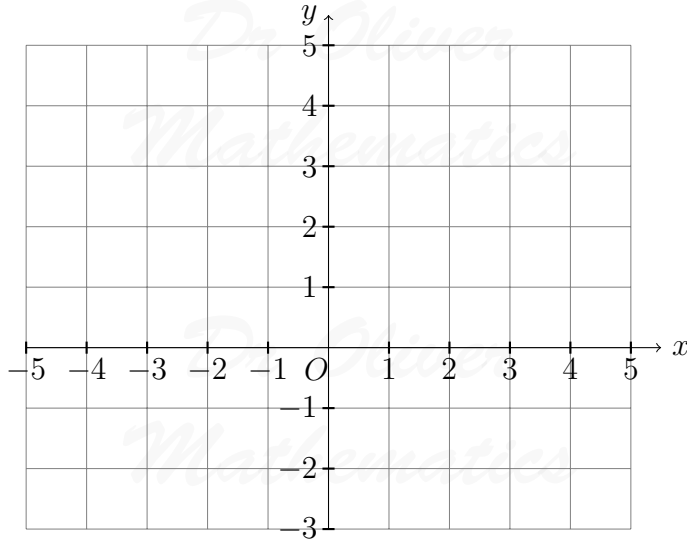
$x = y$ and $w = 2x$

$x = y$ and $x = 2w$

5. On the grid, draw the graph of $y = f(x)$:

(4)

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



6.

$$f(x) = x^2 - 7 \text{ for all values of } x$$

$$g(x) = 1 - 3x \text{ for } -4 \leq x \leq 4.$$

(a) Work out the range of $f(x)$. (1)
Give your answer as an inequality.

(b) Work out the range of $g(x)$. (2)
Give your answer as an inequality.

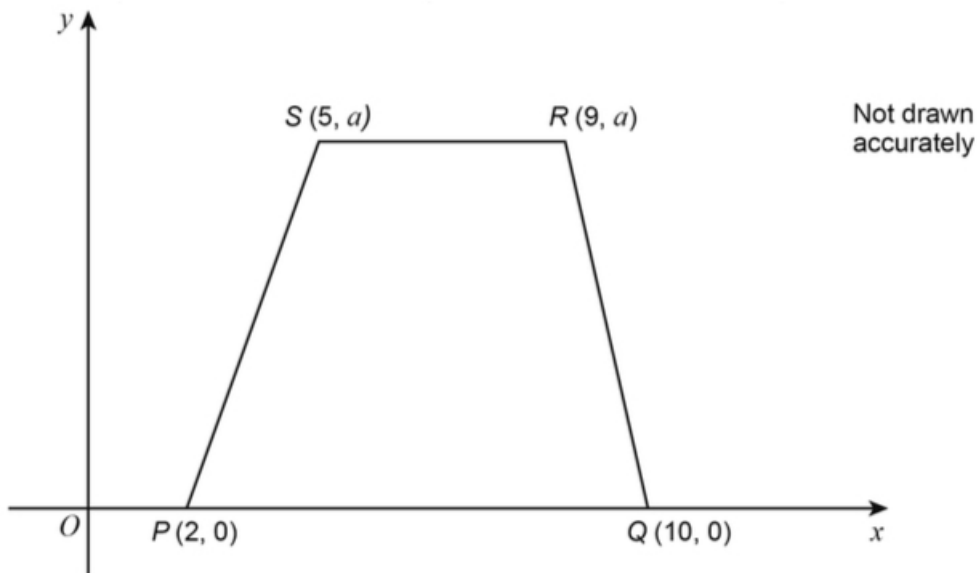
(c) Solve (4)
$$2f(x) = g(x).$$

You **must** show your working.

Give your answers to 3 decimal places.

7. PQRS is a trapezium.

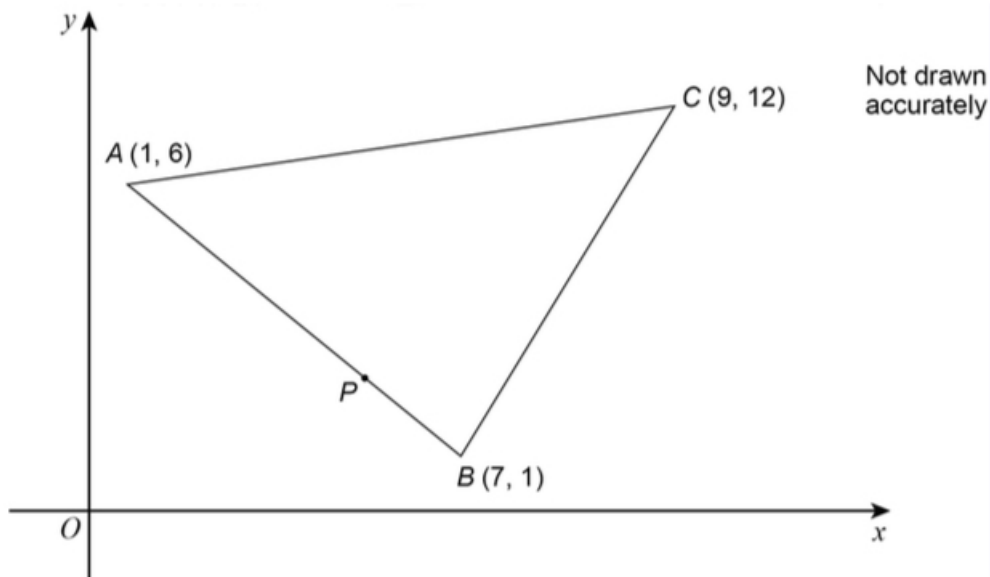
(2)



The area of the trapezium is 63 square units.
Work out the value of a .

8. Here is a sketch of triangle ABC.
 P is a point on AB.

(4)



$AP : PB$ is 3 : 1.

Work out the length PC .

Give your answer to 4 significant figures.

9.

$$y = \frac{2x^7 + 15x^2}{3x}.$$

(4)

Work out the value of x when

$$\frac{dy}{dx} = 133.$$

10. The transformation matrix

$$\begin{pmatrix} a & b \\ 2a & 3b \end{pmatrix}$$

(5)

maps the point $(1, -3)$ onto the point $(1, 4)$.

Work out the values of a and b .

You must show your working.

11. Expand and simplify fully

$$(x + 2)(x + 3)(x + 4).$$

(3)

12. (a) Write

$$\frac{7}{9x} + \frac{2}{3x^2}$$

(3)

as a single fraction in its simplest form.

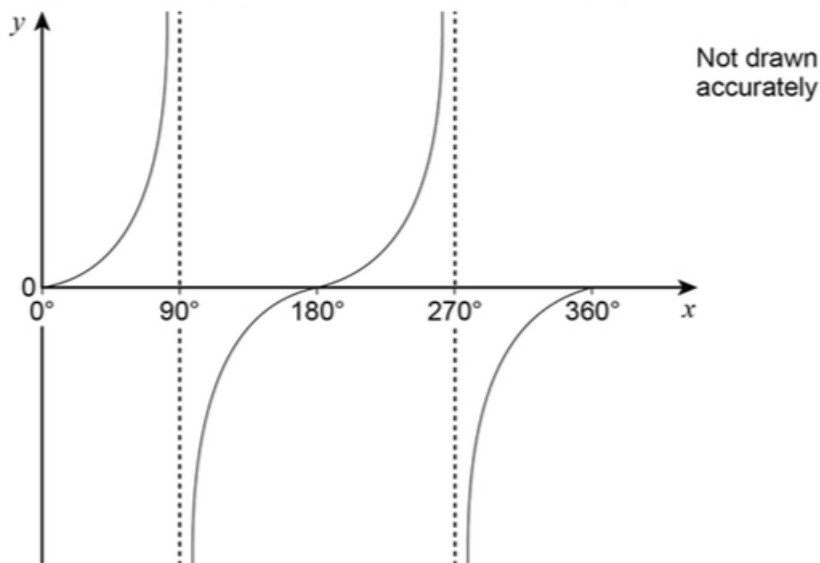
(b) Show that

$$\frac{x^4}{x + 4} \times \frac{x + 2}{x} \div \frac{x^2}{3x + 12}$$

(4)

simplifies to the form $ax^2 + bx$ where a and b are integers.

13. Here is a sketch of $y = \tan x$ for $0^\circ \leq x \leq 360^\circ$.



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(a) **How many** solutions of $\tan x = k$ where $k > 0$ are between 90° and 360° ? (1)

$0 < p < 1$,

(b) **How many** solutions of $\sin x = p - 1$ are between 0° and 180° ? (1)
You may use a sketch graph to help you.

(c) State the coordinates of each point where the graph (2)

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$$y = \cos x$$

for $0^\circ \leq x \leq 360^\circ$ meets or intersects an axis.

14. (a) Factorise fully (2)

$$12pq^3r - 18pq^2r^2 + 24pq^2r.$$

(b) Factorise fully (3)

$$6(y + 3)^5 + 4(y + 3)^4.$$

Give your answer in its simplest form.

Do **not** attempt to expand $(y + 3)^5$ or $(y + 3)^4$.

(c) Factorise fully (2)

$$48 - 75x^2.$$

15. Work out the rate of change of y with respect to x at the point on the curve (4)

$$y = x^2(x^2 - 9)$$

where $x = -2$.

You must show your working.

16. (4)

$$A = 2 - 5x \quad B = 3x - 1 \quad C = x^2.$$

Show that

$$(2A + 3B)^2 \equiv A + B + C.$$

17. A circle has equation

$$x^2 + y^2 = 29.$$

P is the point $(-5, 2)$.

(a) Show that P is on the circle. (1)

The tangent to the circle at P intersects the x -axis at point Q .

(b) Work out the x -coordinate of Q . You **must** show your working. (4)

18. (a) Work out all the integer values of x for which (3)

$$-5 < 4x + 3 \leq 13.$$

(b) Work out the range of values of x for which (3)

$$x^2 - 11x + 28 > 0.$$

You **must** show your working.

19. Use matrix multiplication to show that, in the $x - y$ plane, (5)

- a reflection in the line $y = -x$, followed by
- a rotation, 90° anticlockwise about the origin, followed by
- a reflection in the x -axis

is equivalent to a transformation by the identity matrix.

20. $PQRSTU$ is a triangular prism.

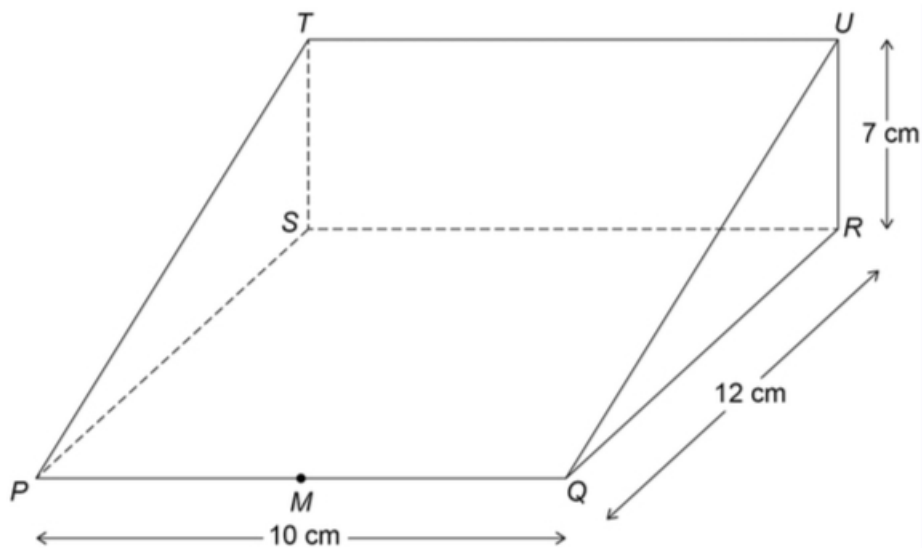
$PQRS$ is a rectangle and angle $QRU = 90^\circ$.

$PQ = 10$ cm.

$QR = 12$ cm.

$UR = 7$ cm.

M is the midpoint of PQ .



- (a) Calculate the size of the angle between the line UM and the plane $PQRS$. (4)
- (b) Calculate the size of the angle between the planes UMR and UQR . (2)
21. The continuous curve $y = f(x)$ has exactly two stationary points. (3)
Here is some information about the curve.

$x < -1$	$x = -1$	$-1 < x < 2$	$x = 2$	$x > 2$
$\frac{dy}{dx}$ is positive	$\frac{dy}{dx}$ is zero	$\frac{dy}{dx}$ is negative	$\frac{dy}{dx}$ is zero	$\frac{dy}{dx}$ is negative

$$f(-1) = 3 \text{ and } f(2) = 1.$$

State the coordinates and the nature of each of the stationary points.

22.

$$8 \cos x + 5 \sin x = 0$$

where $90^\circ < x < 180^\circ$.

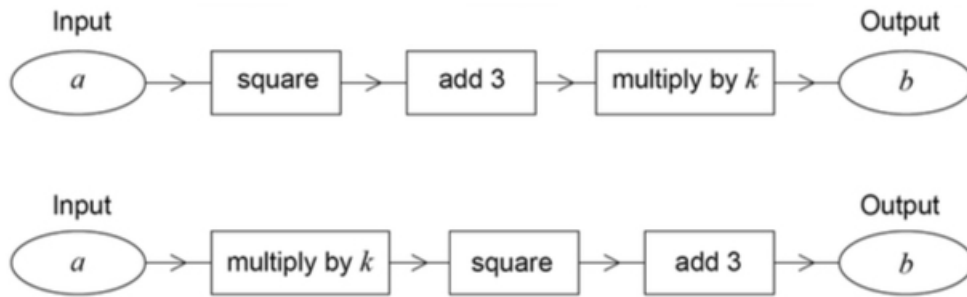
- (a) Work out the size of angle x . (3)

$$6 \sin^2 x + 4 \cos^2 x \equiv A + B \cos^2 x,$$

where A and B are integers.

- (b) Work out the values of A and B . (2)
You must show your working.

23. For each of these two function machines, when the input is a the output is b .
 $k > 0$ and $k \neq 1$ and $a > 0$. (6)



Work out an expression for a in terms of k .
Give your answer in its simplest form.

24. Work out the value of p when (4)

$$9^{0.5p} \times 81 = 27^{2p-1}.$$