

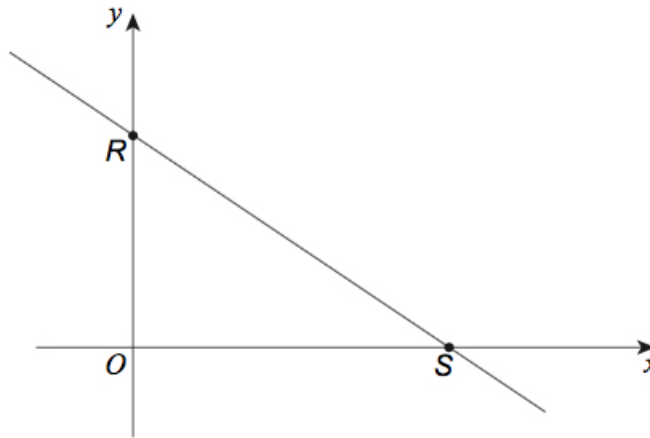
Dr Oliver Mathematics
AQA Further Maths Level 2
January 2013 Paper 2
2 hours

The total number of marks available is 105.

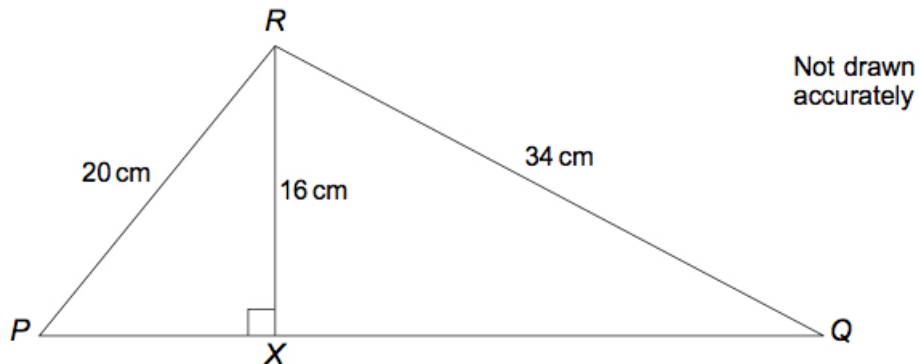
You must write down all the stages in your working.

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

1. A sketch of $2x + 3y = 12$ is shown.



- (a) Work out the coordinates of R . (1)
- (b) Work out the coordinates of the midpoint of RS . (2)
2. In triangle PQR , X is a point on PQ . (4)
- RX is perpendicular to PQ .



Work out the ratio $PX : XQ$.

Give your answer in its simplest form.

3. Solve (2)

$$5d - 3 > d + 17.$$

4. Match each statement with an equation. (3)

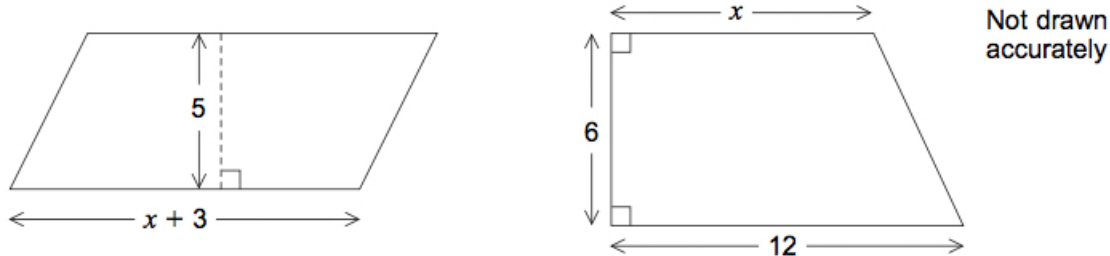
You will not use all of the equations.

One has been done for you.

A curve passing through (0, 0)	$x^2 + y^2 = 10$
A curve passing through (1, 0)	$(x + 2)^2 + (y - 1)^2 = 1$
A circle centre (2, -1)	$y = x^3$
A circle passing through (3, 1)	$y = x^3 + x - 2$
	$(x - 2)^2 + (y + 1)^2 = 1$
	$y = x^2 - 2$

5. A parallelogram and a trapezium are shown. (4)

All lengths are in centimetres.



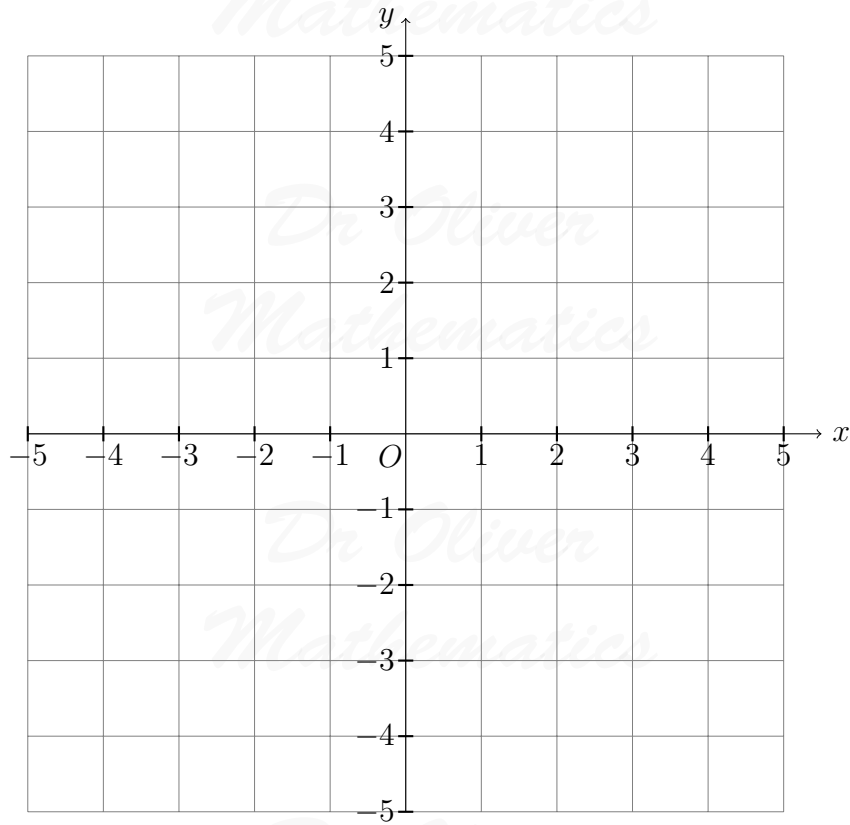
The area of the parallelogram is equal to the area of the trapezium.

Work out the value of x .

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

$$f(x) = \begin{cases} 4, & x < -2 \\ x^2, & -2 \leq x \leq 2 \\ 12 - 4x, & x > 2. \end{cases}$$

- (a) Draw the graph of $y = f(x)$ for $-4 \leq x \leq 4$. (3)



- (b) Use your graph to write down **how many** solutions there are to $f(x) = 3$. (1)
(c) Solve $f(x) = -10$. (2)
7. Here are the first four terms of a sequence: (2)

$$4a \quad 9a \quad 14a \quad 19a$$

The n th term of the sequence is

$$\frac{10n - 2}{3}.$$

Work out the value of a .

8. (a) Factorise fully (3)

$$5m^2 - 20p^2.$$

You are given that

$$p = 15 \text{ and } 5m^2 - 20p^2 = 0.$$

(b) Using your answer to part (a), or otherwise, work out the values of m . (2)

9. (a) Expand (1)

$$(x + m)(x + n).$$

$$x^2 + qx + r \equiv (x + m)(x + n).$$

(b) Use your answer to part (a) to write q and r in terms of m and n . (2)

r is an odd integer.

(c) Use your answer to part (b) to explain why q is an even integer. (2)

10.

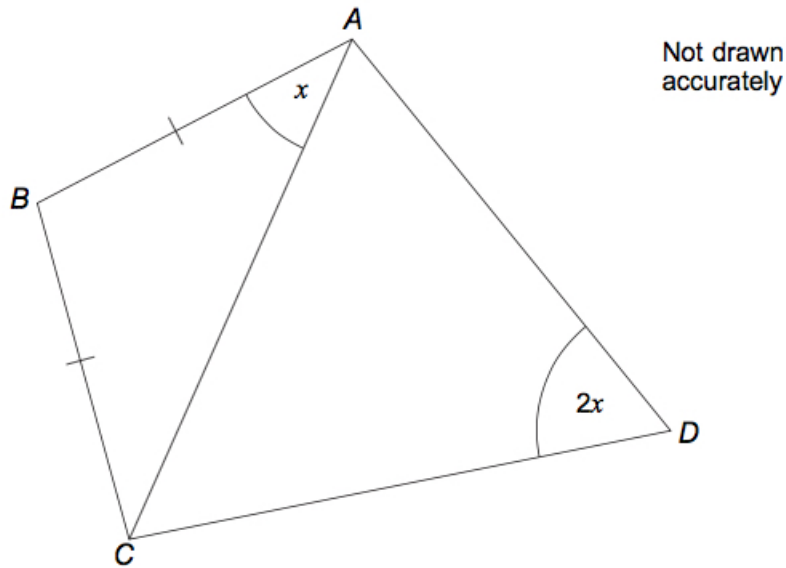
$$S = \frac{a}{1 - r}.$$

(a) Show that (3)

$$r = \frac{S - a}{S}.$$

(b) Work out the value of r when $S = 10a$. (2)

11. In the diagram, $AB = BC$. (3)



Prove that $ABCD$ is a cyclic quadrilateral.
Give reasons for any statements you make.

12.

$$f(x) = \sin x, 180^\circ \leq x \leq 360^\circ,$$

$$g(x) = \cos x, 0^\circ \leq x \leq \theta^\circ.$$

(a) Calculate the value of $f(210^\circ)$. (1)

(b) Complete this inequality for the range of $f(x)$. (2)

You are given that $0 \leq g(x) \leq 1$.

(c) Work out the value of θ . (1)

13. (a) Show that (2)

$$\frac{4}{x} + \frac{2}{x-1}$$

simplifies to

$$\frac{6x-4}{x(x-1)}.$$

(b) Hence, or otherwise, solve (5)

$$\frac{4}{x} + \frac{2}{x-1} = 3.$$

Give your solutions to 3 significant figures.

14. The value of x is 50% **more** than the value of t . (4)

The value of y is 10% **less** than the value of w .

$$x = y.$$

Work out $\frac{t}{w}$.

Give your answer as a decimal.

15. Describe fully the **single** transformation represented by the matrix (3)

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

16. (5)

$$y = (x^3 - 1)^2 + (\sqrt{x})^8.$$

Work out $\frac{dy}{dx}$.

17. (2)

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

represents a reflection in the y -axis and

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

represents a reflection in the $y = x$.

Work out the matrix that represents a reflection in the y -axis followed by a reflection in the line $y = x$.

18. Express (3)

$$1 - \tan \theta \sin \theta \cos \theta$$

in terms of $\cos \theta$.

19. A cubic function $f(x)$ has domain $-4 \leq x \leq 4$. (4)

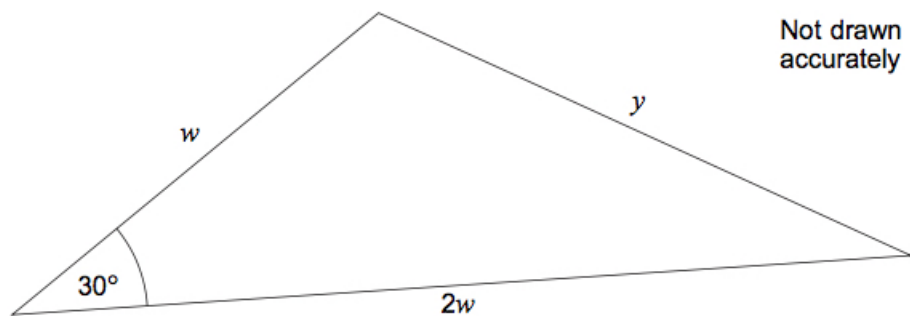
The curve $y = f(x)$

- has a minimum point at $(-2, 0)$,
- has a maximum point at $(1, 4)$, and
- meets the x -axis at $(4, 0)$.

Sketch the graph of $y = f(x)$.

Label any points where the graph meets the x -axis.

20. The area of this triangle is 18 cm^2 . (5)



Work out y .

21. Work out the equation of the normal to the curve (5)

$$y = x^2 + 4x + 5$$

at the point where $x = -3$

22.

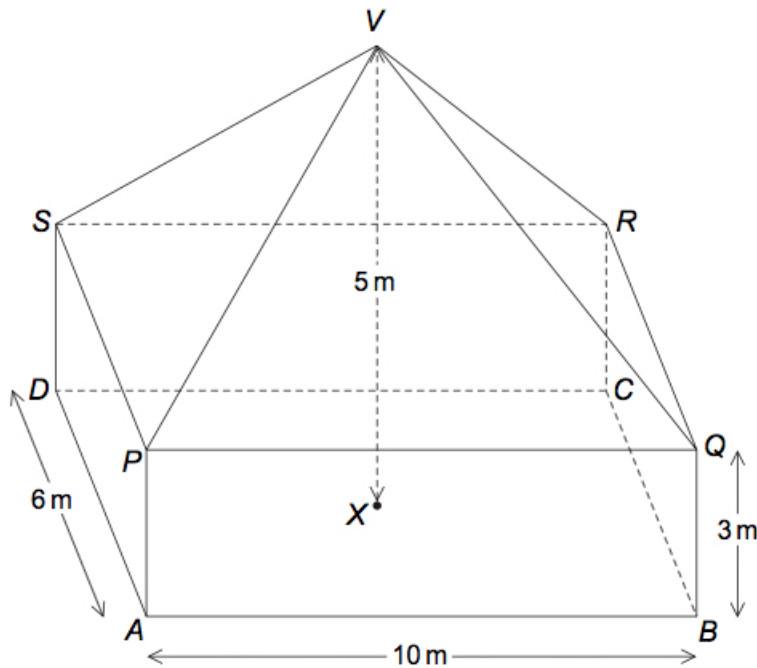
$$f(x) = x^3 + ax^2 + bx + 24 \text{ for all values of } x.$$

(5)

Two of the factors of $f(x)$ are $(x - 2)$ and $(x + 3)$.

Work out the values of a and b .

23. The diagram shows a cuboid $ABCDPQRS$ and a pyramid $PQRSV$.
 V is directly above the centre, X , of $ABCD$.



The total height, VX , is 5 metres.

(a) Work out the angle between the line VA and the plane $ABCD$.

(4)

(b) Work out the angle between the planes VQR and $PQRS$.

(2)

24. Solve

$$3 \cos^2 y - 1 = 0$$

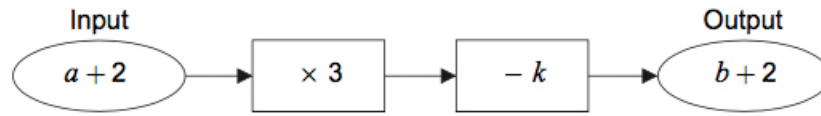
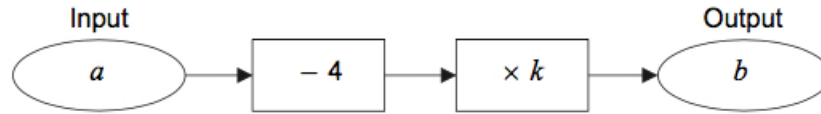
(4)

for $0^\circ \leq y \leq 180^\circ$.

25. Here are two number machines.

(6)

Dr. Oliver



Mathematics

Work out a in terms of k .

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