

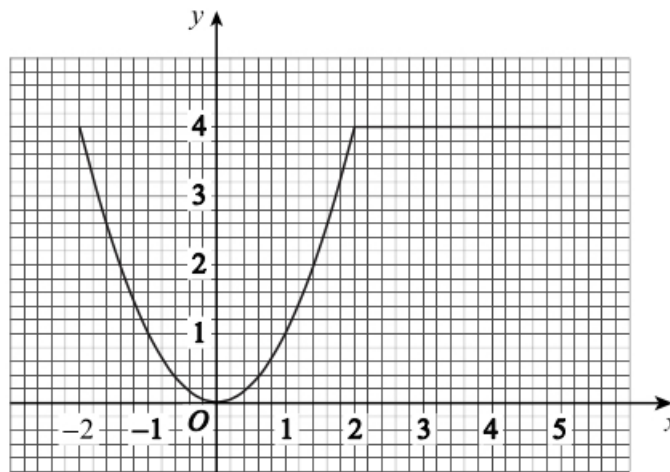
Dr Oliver Mathematics
AQA Further Maths Level 2
June 2014 Paper 2
2 hours

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.

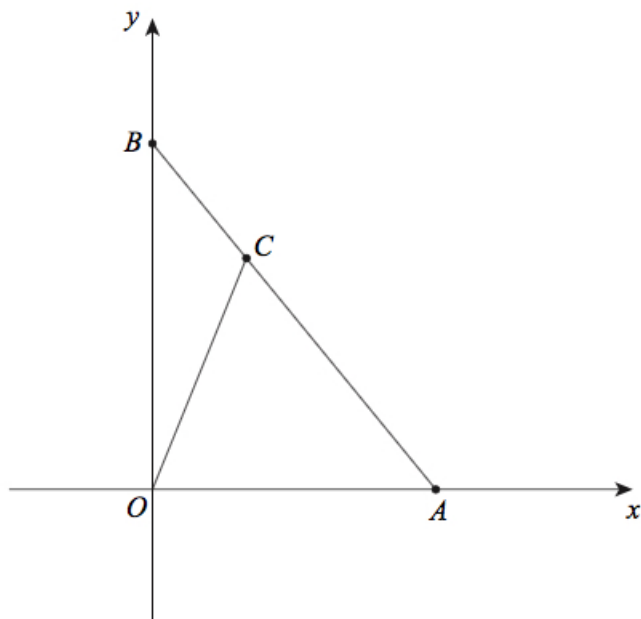
1. The graph of $y = f(x)$ for the full domain is shown. (3)
The graph consists of a quadratic curve and a straight line.



Complete the boxes to describe $f(x)$:

$$f(x) = \begin{cases} \quad , & -2 \leq x \leq 2, \\ \quad , & 2 < x \leq \end{cases}$$

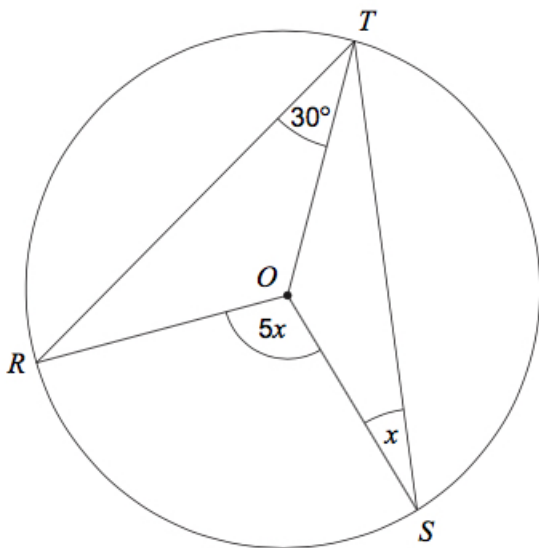
2. The equation of line AB is $y = 12 - 2x$. (5)
The area of triangle OCA is 24 square units.



Not drawn accurately

Work out the coordinates of C .

3. R , S , and T are on the circumference of a circle, centre O .



Not drawn accurately

- (a) Give a reason why angle $OTS = x$. (1)
(b) Work out the value of x . (3)

4. (a) Expand

(2)

$$x^2(x - 2).$$

A curve has equation

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

(b) Work out the gradient of the curve at the point (3, 9).

(3)

Line L is the tangent to the curve

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

at the point (3, 9).

(c) Work out the equation of L . Give your answer in the form $y = mx + c$.

(2)

5. Solve

(4)

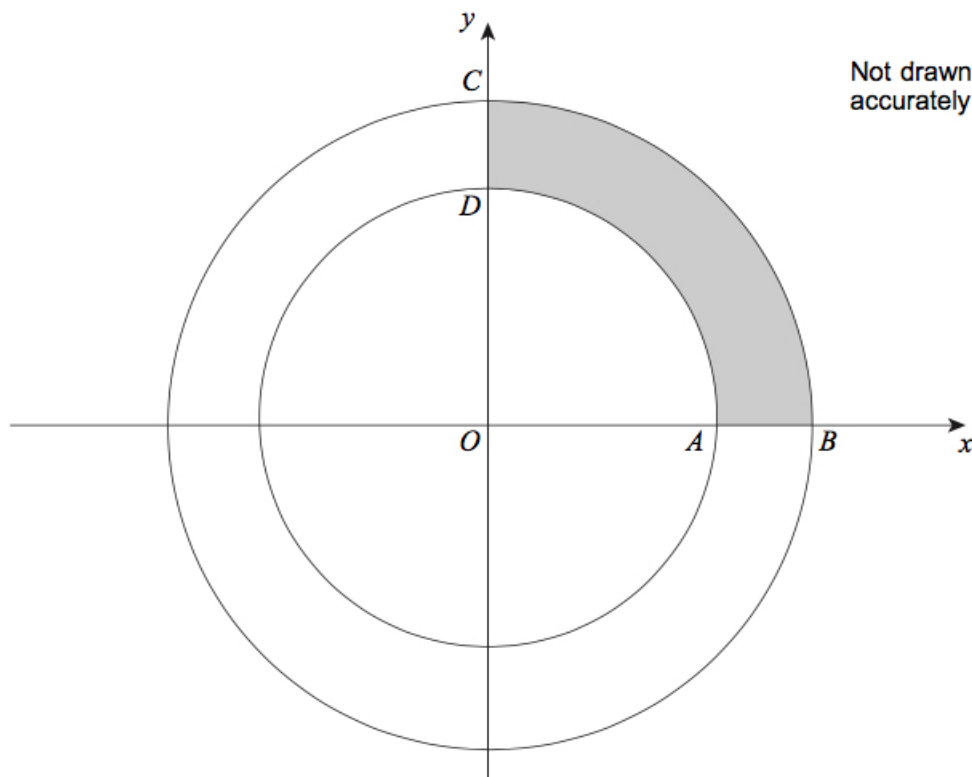
$$\frac{4c + 3}{2} + \frac{c - 8}{5} = 1.$$

6. Two circles, each with centre O , are shown.

(5)

The equations of the circles are

$$x^2 + y^2 = 289 \text{ and } x^2 + y^2 = 121.$$



Work out the **perimeter** of the shaded section $ABCD$.

7. (a) Simplify

$$\sqrt{x^5 \times x^9}.$$

(2)

Give your answer in the form x^p where p is an integer.

- (b) Solve

$$y^{-3} = 125.$$

(2)

- 8.

$$\mathbf{M} = \begin{pmatrix} -2 & -1 \\ 3 & 1 \end{pmatrix}.$$

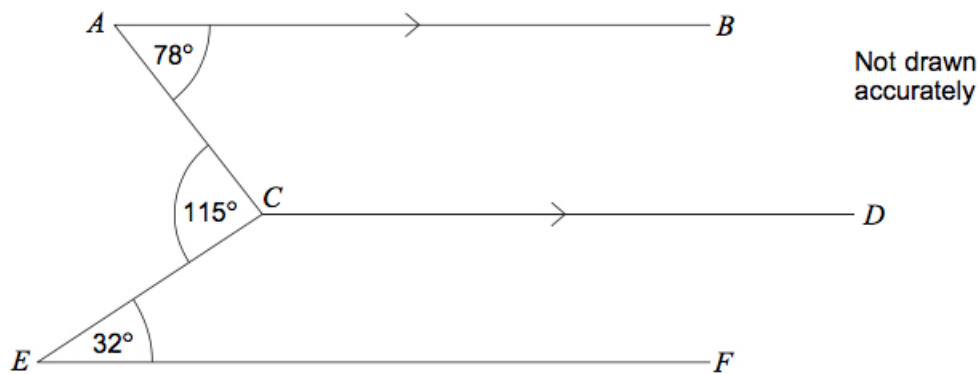
(4)

Show that

$$\mathbf{M}^3 = \mathbf{I}.$$

9. AB is parallel to CD .

(3)



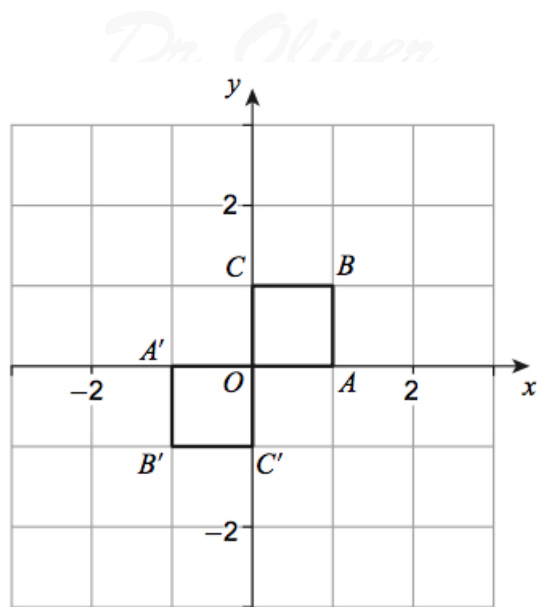
Is EF parallel to CD ?

You **must** show your working.

10. The unit square $OABC$ has vertices $O(0,0)$, $A(1,0)$, $B(1,1)$, and $C(0,1)$.

- (a) $OABC$ is mapped to $OA'B'C'$ under transformation matrix \mathbf{M} .

(2)

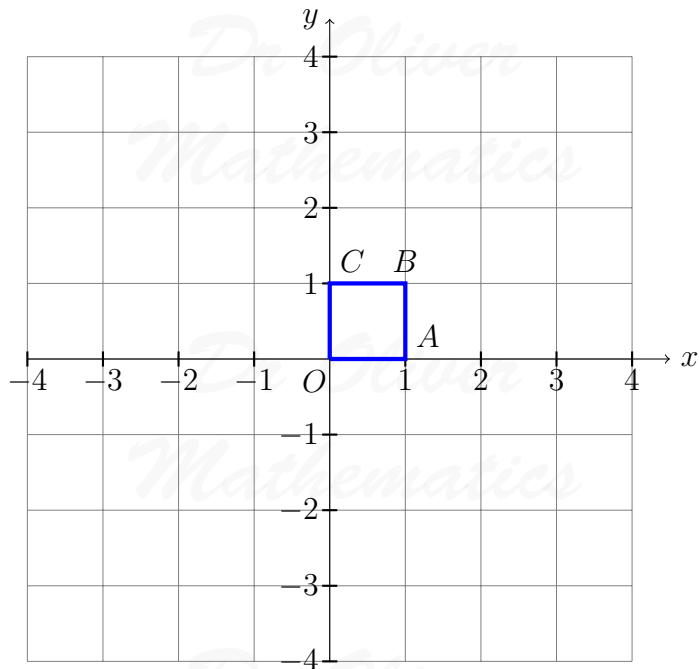


Work out matrix M .

(b) $OABC$ is mapped to $OA''B''C''$ under transformation matrix

(3)

$$M = \begin{pmatrix} -3 & 0 \\ 0 & -3 \end{pmatrix}.$$



Draw and label $OA''B''C''$ on the diagram below.

11. (a) Simplify fully

(3)

$$\frac{8c^7}{15d^6} \div \frac{6c^2}{5d^3}$$

(b) Write as a single fraction

(4)

$$\frac{5}{m+1} + \frac{6}{m-4}$$

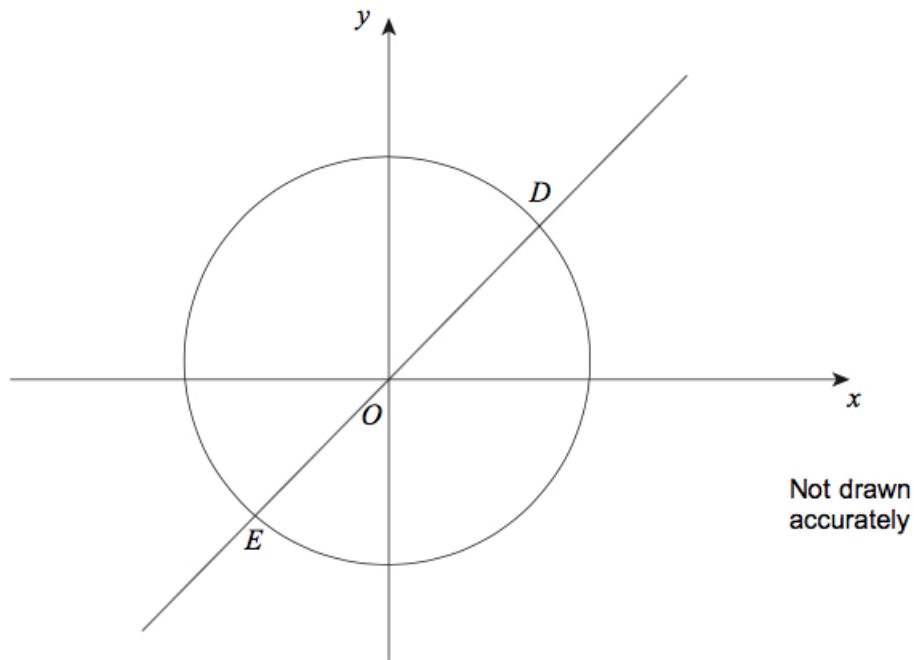
Give your answer in its simplest form.

12. The circle

(5)

$$x^2 + y^2 = 20 \text{ and the line } y = 2x$$

intersect at points D and E .



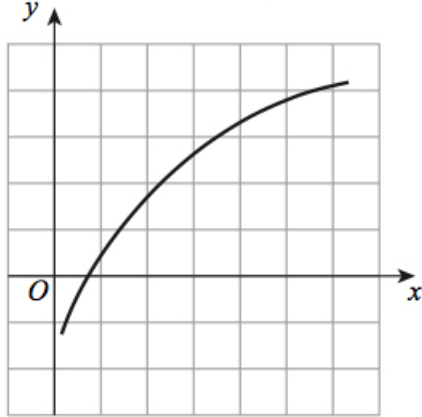
Work out the coordinates of D and E .

Do **not** use trial and improvement.

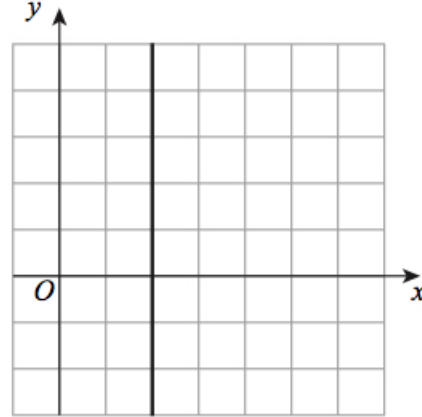
You **must** show your working.

13. Here are five graphs.

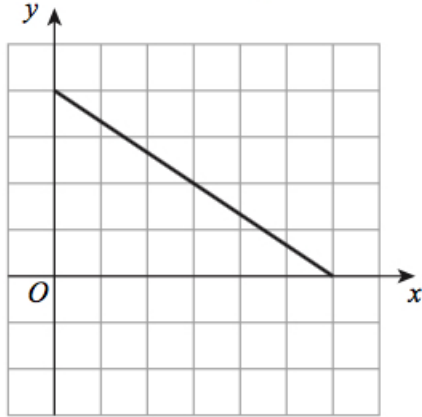
Graph A



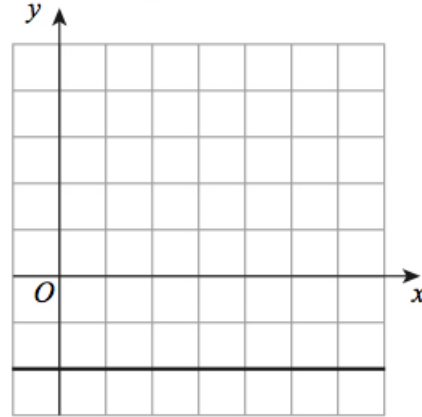
Graph B



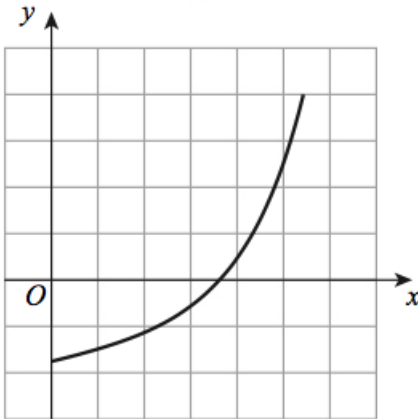
Graph C



Graph D



Graph E



For each of the following statements, decide which graph is being described.

Circle your answer each time.

- (a) The rate of change of y with respect to x is always negative. (1)

A B C D E

- (b) The rate of change of y with respect to x is always zero. (1)

A B C D E

- (c) The rate of change of y with respect to x is always decreases. (1)

A B C D E

14. Rearrange (4)

$$x = \frac{2w + 1}{5 - 3w}$$

to make w the subject.

15. The n th term of a sequence is

$$n^2 + 12n + 27.$$

- (a) By factorising, or otherwise, show that the 20th term can be written as the product of two prime numbers. (2)

The n th term of a different sequence is

$$n^2 - 6n + 14.$$

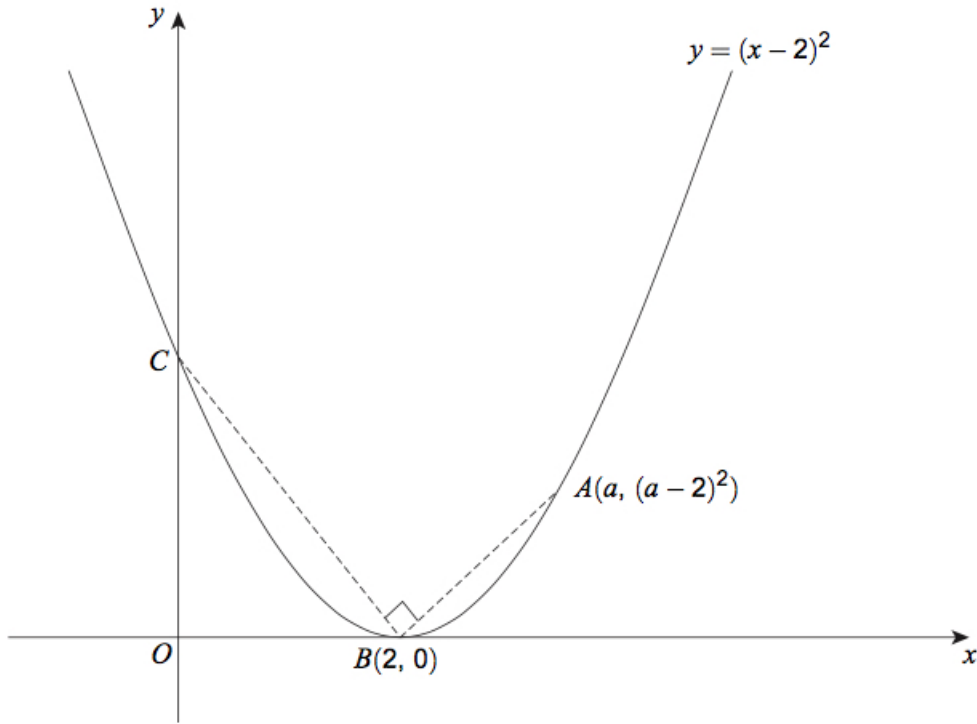
- (b) By completing the square, or otherwise, show that every term is positive. (3)

16. (a) Simplify (1)

$$\frac{(a - 2)^2}{a - 2}.$$

Here is a sketch of the curve

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



- The curve touches the x -axis at B and intersects the y -axis at C .
- Angle ABC is 90° .
- The curve passes through $A(a, (a - 2)^2)$.

(b) Work out the value of a . (5)

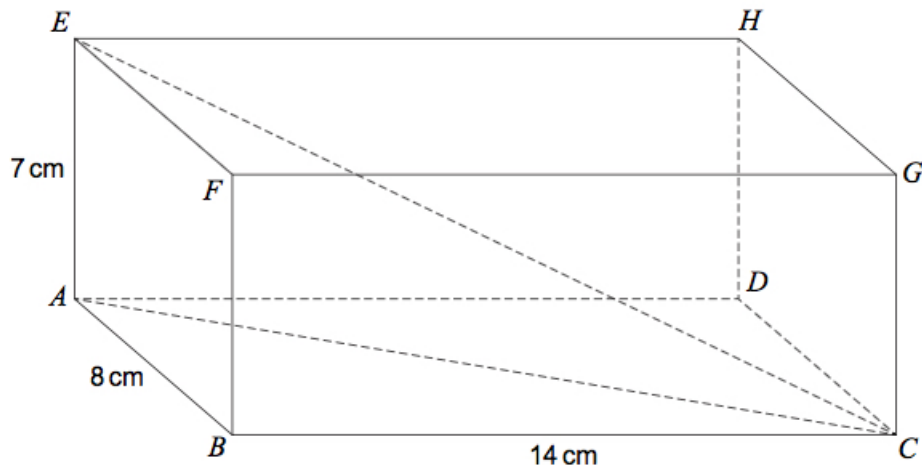
17. (a) Factorise fully (2)

$$12c^2d - 9d^2.$$

(b) Factorise fully (3)

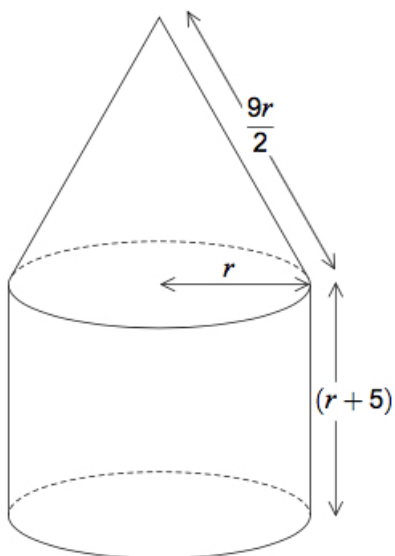
$$(w + 4)^3 - (w + 4)^2(w + 1).$$

18. $ABCDEFGH$ is a cuboid. (3)



Work out the angle between EC and $ABCD$.

19. On this diagram all lengths are given in centimetres.
 A cylinder and cone are joined together to make a solid.
 The cylinder has radius r and height $(r + 5)$.
 The cone has radius r and slant height $\frac{9r}{2}$.



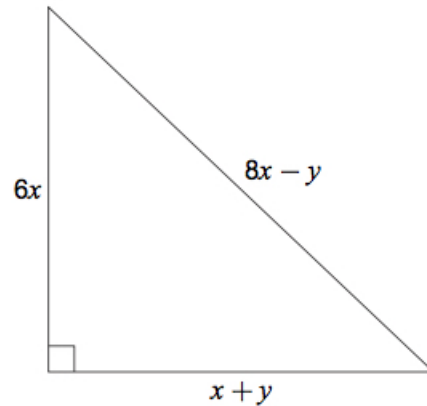
- (a) Show that the **total** surface area of the solid, in cm^2 , is (4)

$$\frac{5}{2}\pi r(3r + 4).$$

The total surface area of the solid is $1200\pi \text{ cm}^2$.

(b) Work out the value of r . (5)

20. The diagram shows a right-angled triangle. (6)



Prove algebraically that

$$x : y = 2 : 3.$$

21. Solve (5)

$$16 \sin^2 x = 1$$

for $0^\circ \leq x \leq 270^\circ$.

22. The curve $y = f(x)$ has (3)

$$\frac{dy}{dx} = kx(x - 3)^3,$$

where k is a **negative** constant.

There is a stationary point at $x = 3$.

Determine the nature of this stationary point.

You **must** show your working.