

Dr Oliver Mathematics
AQA Further Maths Level 2
January 2013 Paper 1
1 hour 30 minutes

The total number of marks available is 70.

You must write down all the stages in your working.

You are **not** permitted to use a scientific or graphical calculator in this paper.

1. The line $y = mx + c$ passes through the point $(4, 3)$. (3)
It is parallel to the line $y = 5x + 6$.

Work out the values of m and c .

2. The matrix (4)

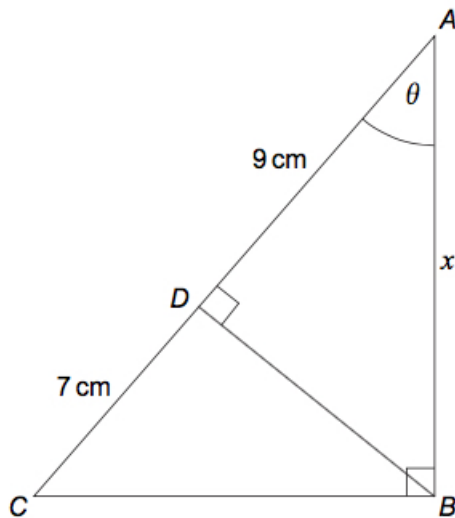
$$\begin{pmatrix} 5 & b \\ 4 & -1 \end{pmatrix}$$

maps the point $(a, 2)$ onto the point $(28, 18)$ such that

$$\begin{pmatrix} 5 & b \\ 4 & -1 \end{pmatrix} \begin{pmatrix} a \\ 2 \end{pmatrix} = \begin{pmatrix} 28 \\ 18 \end{pmatrix}.$$

Work out the values of a and b .

3. ABC is a right-angled triangle.
 D is a point on AC .
 BD is perpendicular to AC .



Not drawn
accurately

(a) Use triangle ABC to write $\cos \theta$ in terms of x . (1)

(b) By writing another expression for $\cos \theta$ in terms of x , or otherwise, work out the value of x . (2)

4. $w \blacktriangledown h$ is defined as

$$5w^2 - 8w + h^2 - 2h.$$

For example,

$$\begin{aligned} 1 \blacktriangledown 6 &= (5 \times 1^2) - (8 \times 1) + 6^2 - (2 \times 6) \\ &= 5 - 8 + 36 - 12 \\ &= 21. \end{aligned}$$

(a) Work out $2 \blacktriangledown 4$. (2)

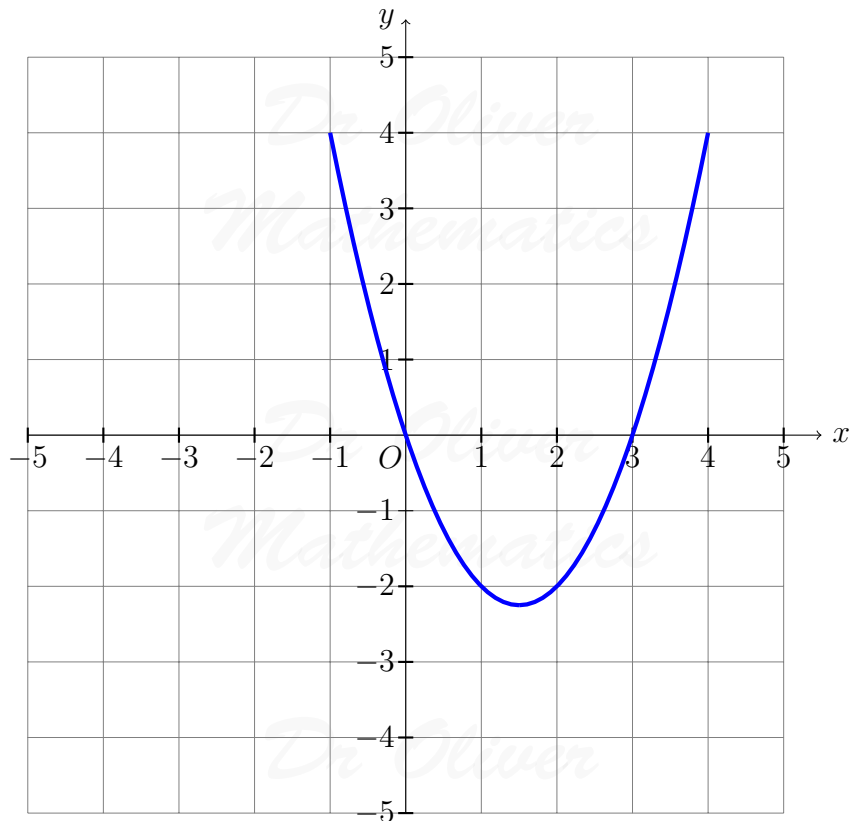
(b) Solve $x \blacktriangledown 3 = 0$. (4)

5. n is a positive integer.

(a) Write down the **next** odd number after $2n - 1$. (1)

(b) Prove that the product of two consecutive odd numbers is **always** one less than a multiple of 4. (3)

6. The diagram shows a sketch of $y = x^2 - 3x$.



(a) Sketch the line $y = \frac{1}{2}(x - 3)$ on the diagram. (2)

Mark the value where this line crosses the y -axis.

(b) By factorising $x^2 - 3x$, or otherwise, work out the smaller solution of (2)

$$x^2 - 3x = \frac{1}{2}(x - 3).$$

7. (4)

$$y = \frac{2x^2(3x^3 - 7x)}{x}.$$

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

8. $f(x)$ is a decreasing function. (4)

$$f(x) = b - ax \text{ for } 4 \leq x < 8.$$

The range of $f(x)$ is $5 < f(x) \leq 7$.

Work out the values of a and b .

9. Bag A contains $7x$ counters.

Bag B contains $2x$ counters.

Five counters are taken from bag A and put in bag B .

(a) Write an expression, in terms of x , for the number of counters now in bag B . (1)

The ratio of counters in bag A to bag B is now $8 : 3$.

(b) Use algebra to work out the **total** number of counters in the bags. (4)

10. Solve the simultaneous equations (5)

$$\begin{aligned} \frac{x-1}{y-2} &= 3 \\ \frac{x+6}{y-1} &= 4. \end{aligned}$$

Do **not** use trial and improvement.

You **must** show your working.

11. Write (2)

$$\sqrt{500} - 2\sqrt{45}$$

in the form $a\sqrt{5}$ where a is an integer.

12. Simplify fully (5)

$$\frac{4x^2 + 19x - 5}{9x^2 - 16} \div \frac{x+5}{3x-4}.$$

13.

$$y = 2x^3 - 12x^2 + 24x - 11.$$

- (a) Work out $\frac{dy}{dx}$. (3)

Give your answer in the form $\frac{dy}{dx} = a(x - b)^2$, where a and b are integers.

- (b) Hence, or otherwise, work out the coordinates of the stationary point of (2)

$$y = 2x^3 - 12x^2 + 24x - 11.$$

- (c) Explain how you know that this stationary point is a point of inflection. (1)

14. (5)

$$x^2 - 2x + y^2 - 6y = 0$$

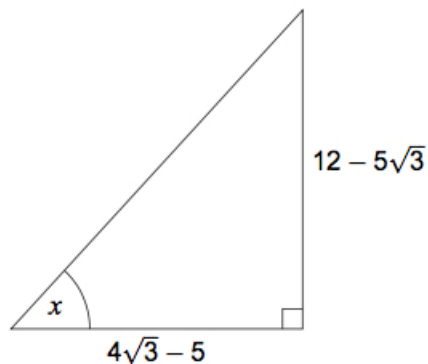
is the equation of a circle.

By writing the equation in the form

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

work out the centre and radius of the circle.

15. Show that angle $x = 60^\circ$. (4)



Not drawn accurately

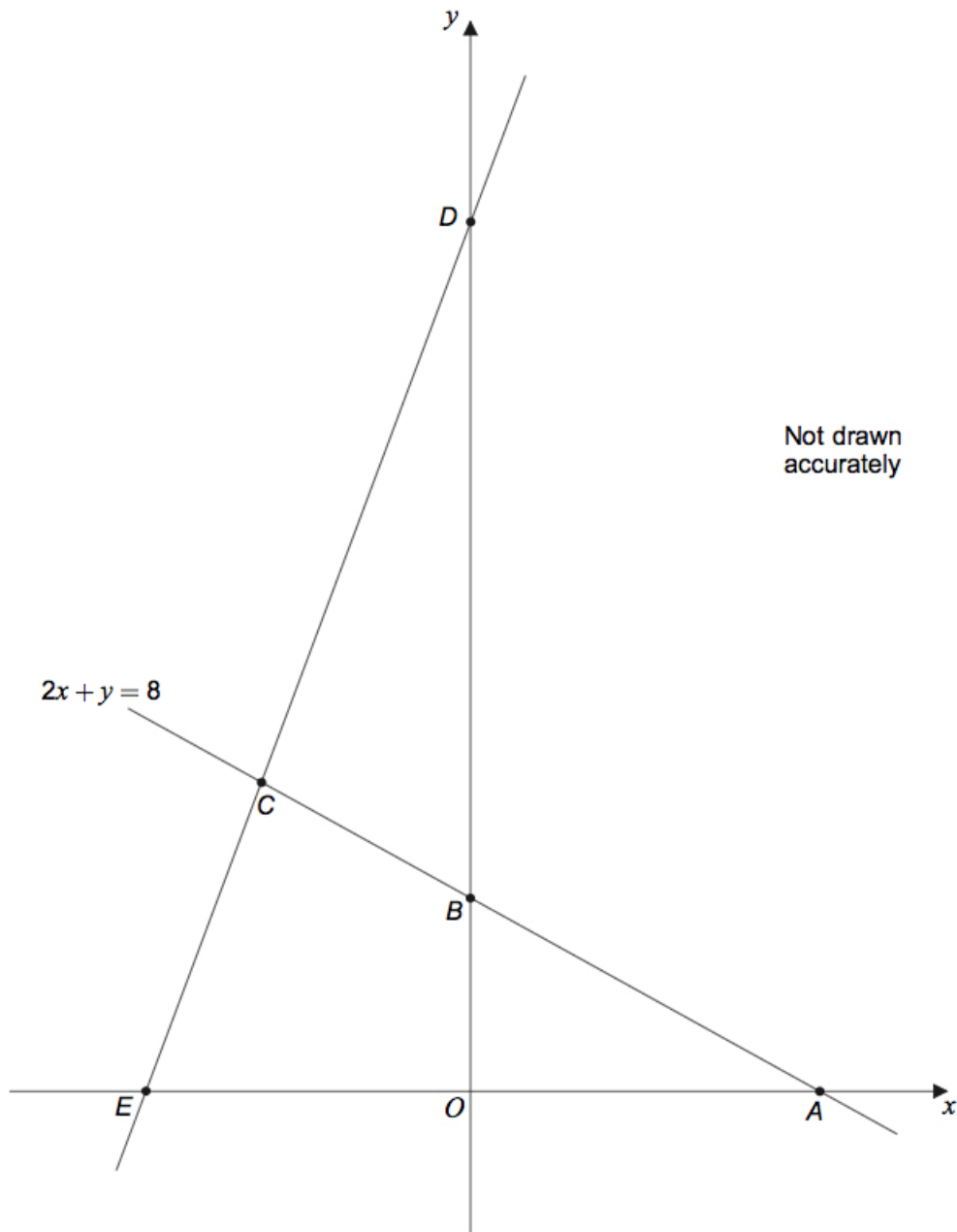
You **must** show your working.

16. A , B , and C are points on the line $2x + y = 8$. (6)

DCE is a straight line.

$$AB : BC = 2 : 1.$$

$$EC : CD = 1 : 2.$$



Work out the ratio

area of triangle AEC : area of triangle BCD .

Give your answer in its simplest form.