

Dr Oliver Mathematics
AQA Further Maths Level 2
June 2012 Paper 2
2 hours

The total number of marks available is 105.

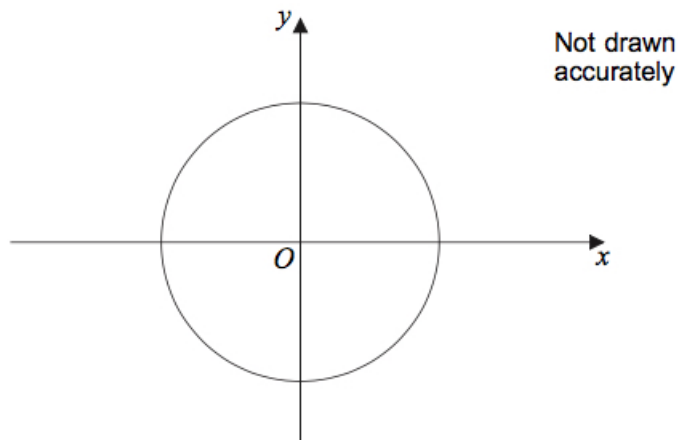
You must write down all the stages in your working.

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

1. Here is a sketch of the circle

$$x^2 + y^2 = 36.$$

(3)



Work out the circumference of the circle.

- 2.

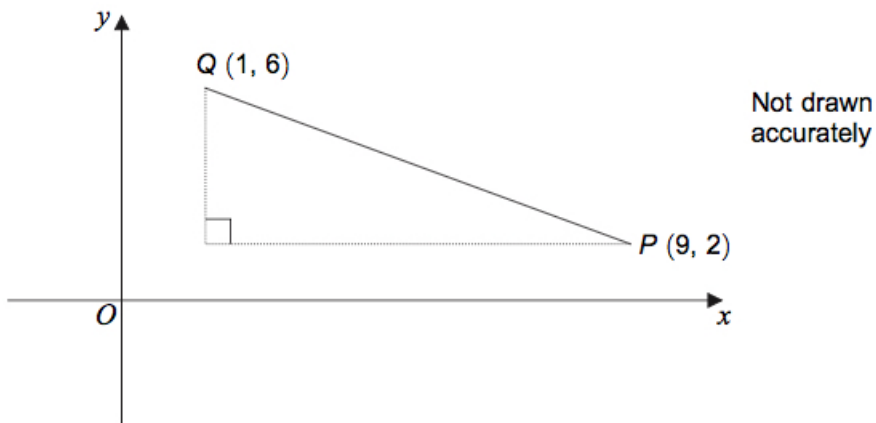
$$y = 5x^3 - 4x^2.$$

(2)

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

3. Here is a picture.

(4)

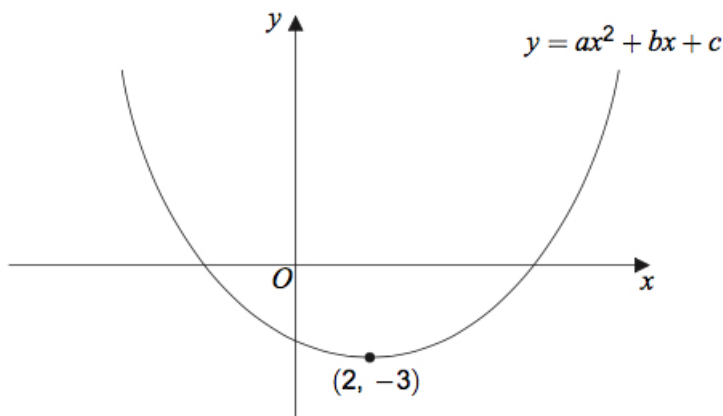


Work out the length of PQ .
Give your answer to 3 significant figures.

4. A sketch of

$$y = ax^2 + bx + c$$

is shown. The minimum point is $(2, -3)$.



For the sketch shown, circle the correct answer in each of the following.

(a) The value of a is zero positive negative (1)

(b) The value of c is zero positive negative (1)

(c) The solutions of $ax^2 + bx + c = 0$ (1)

are

both zero both positive both negative one positive and one negative

(d) The **number** of solutions of (1)

$$ax^2 + bx + c = -6$$

is

0 1 2 3

(e) The equation of the tangent to (1)

$$y = ax^2 + bx + c$$

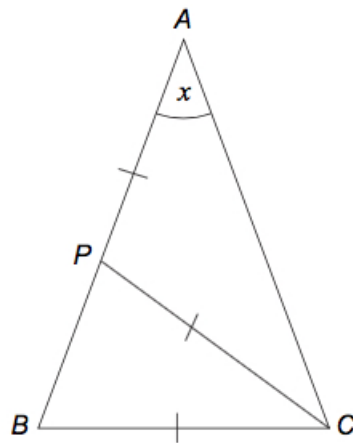
at $(2, -3)$ is

$$x = 2 \quad y = 2 \quad x = -3 \quad y = -3$$

5. ABC is a triangle.

P is a point on AB such that $AP = PC = BC$.

Angle $BAC = x$.



Not drawn accurately

(a) Prove that angle $ABC = 2x$. (3)

You are also given that $AB = AC$.

(b) Work out the value of x . (3)

6. (a) Expand (2)

$$3x(2x - 5y).$$

(b) Expand (3)

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

(c) Work out the ratio

$$(3x + 2y)(3x - 4y) : 3x(2x - 5y)$$

(2)

when $y = 0$.

Give your answer as simply as possible.

7.

$$1 \leq m \leq 5 \text{ and } -9 \leq n \leq 2.$$

(a) Work out an inequality for $m + n$.

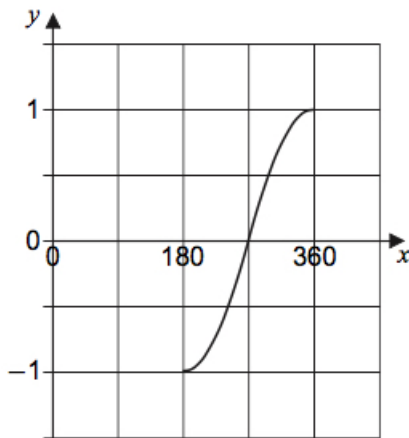
(2)

(b) Work out an inequality for $(m + n)^2$.

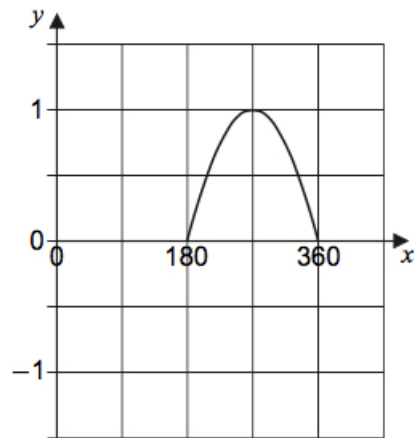
(2)

8. Four graphs are shown for $180^\circ \leq x \leq 360^\circ$.

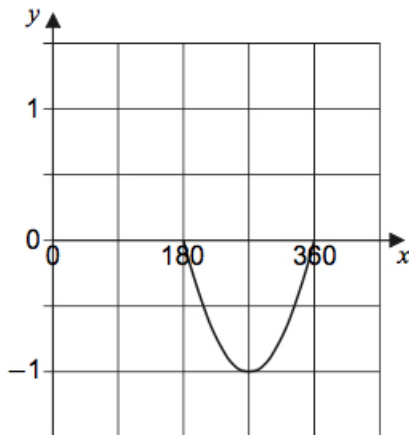
Graph A



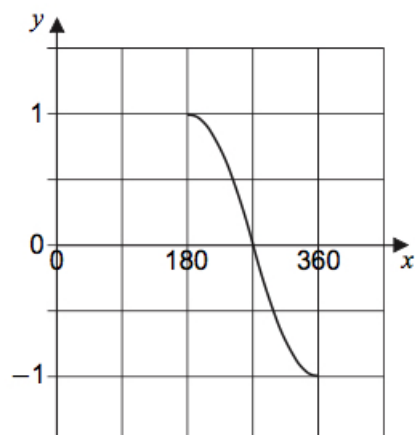
Graph B



Graph C



Graph D



(a) Which graph is $y = \sin x$?

(1)

(b) Which graph is $y = \cos x$? (1)

9. Here is a formula:

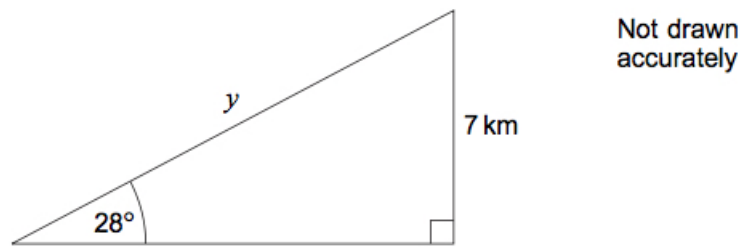
$$5t + 3 = 4w(t + 2).$$

(a) Rearrange the formula to make t the subject. (4)

(b) Work out the exact value of t when $w = -\frac{1}{8}$. (3)

Give your answer in its simplest form.

10. An aircraft flies y kilometres in a straight line at an angle of elevation of 28° .
The gain in height is 7 kilometres. (3)



Work out the value of y .

11. A sphere has radius x centimetres. (3)

A hemisphere has radius y centimetres.

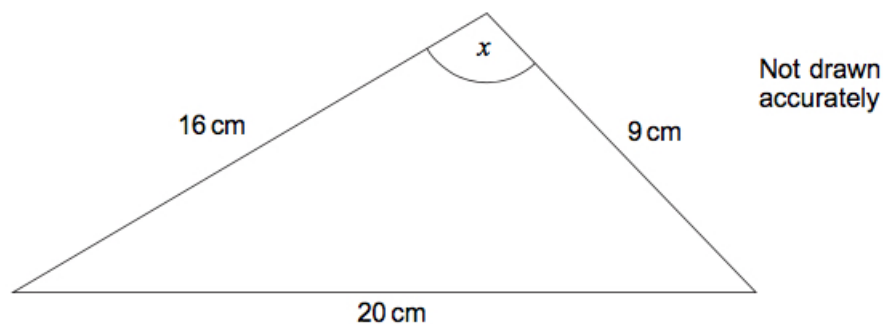
The shapes have equal volumes.

Work out the value of $\frac{y}{x}$.

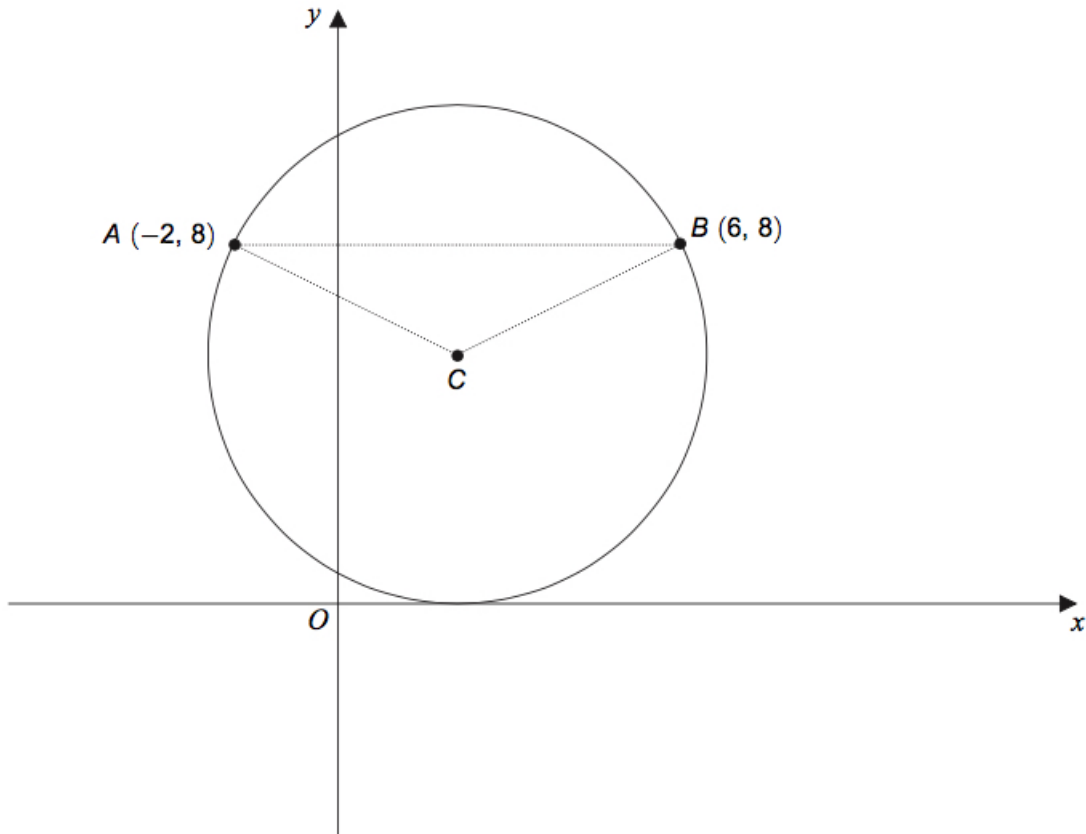
Give your answer in the form $a^{\frac{1}{3}}$ where a is an integer.

12. Expand and simplify $(t + 4)^3$. (3)

13. Work out angle x . (3)



14. The sketch shows a circle, centre C , radius 5. (4)
The circle passes through the points $A(-2, 8)$ and $B(6, 8)$.
The x -axis is a tangent to the circle.



Work out the equation of the circle.

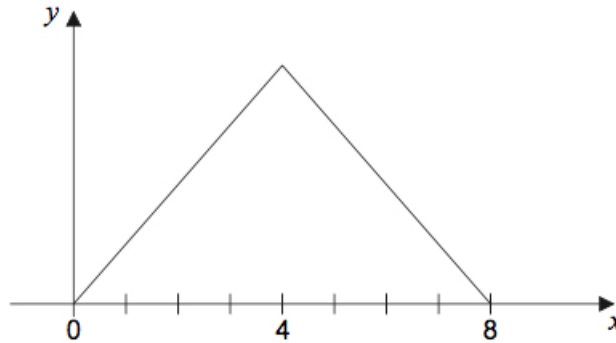
15. (a) (4)

$$f(x) = 3x - 5 \text{ for all values of } x.$$

Solve

$$f(x^2) = 43.$$

A sketch of $y = g(x)$ for domain $0 \leq x \leq 8$ is shown.



The graph is symmetrical about $x = 4$.

The range of $g(x)$ is $0 \leq g(x) \leq 12$.

(b) Work out the function $g(x)$.

(5)

16. (a) Use the factor theorem to show that $(x - 1)$ and $(x - 4)$ are factors of

(2)

$$x^3 - 21x + 20.$$

(b) Show that $(x - 1)$ and $(x - 4)$ are also factors of

(2)

$$x^3 - 10x^2 + 29x - 20.$$

(c) Hence, simplify fully

(3)

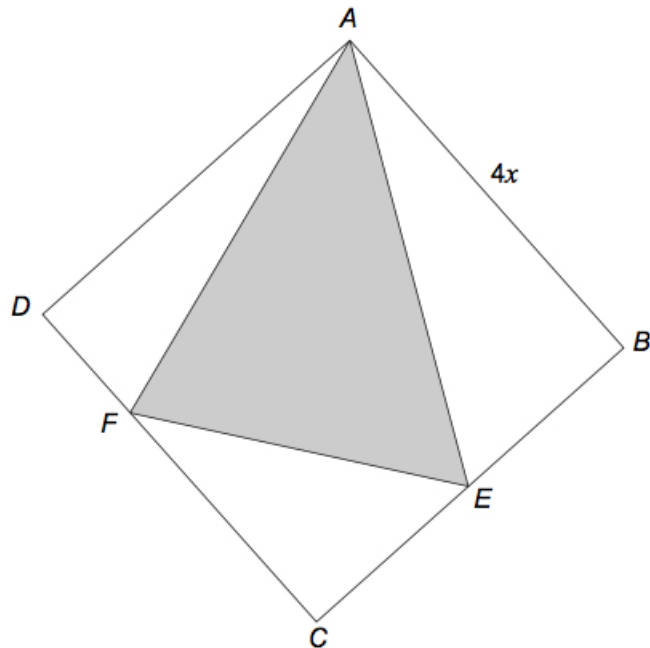
$$\frac{x^3 - 21x + 20}{x^3 - 10x^2 + 29x - 20}.$$

17. $ABCD$ is a square of side length $4x$.

(5)

E is the midpoint of BC .

$DF : FC = 1 : 3$.



Not drawn accurately

You are given that

$$\text{area of triangle } AEF = kx^2.$$

Work out the value of k .

18.

$$(x - 5)^2 + a \equiv x^2 + bx + 28.$$

(3)

Work out the values of a and b .

19. Solve the simultaneous equations:

(6)

$$\begin{aligned} x + y &= 4 \\ y^2 &= 4x + 5. \end{aligned}$$

Do **not** use trial and improvement.

20. For what values of x is

(4)

$$y = 150x - 2x^3$$

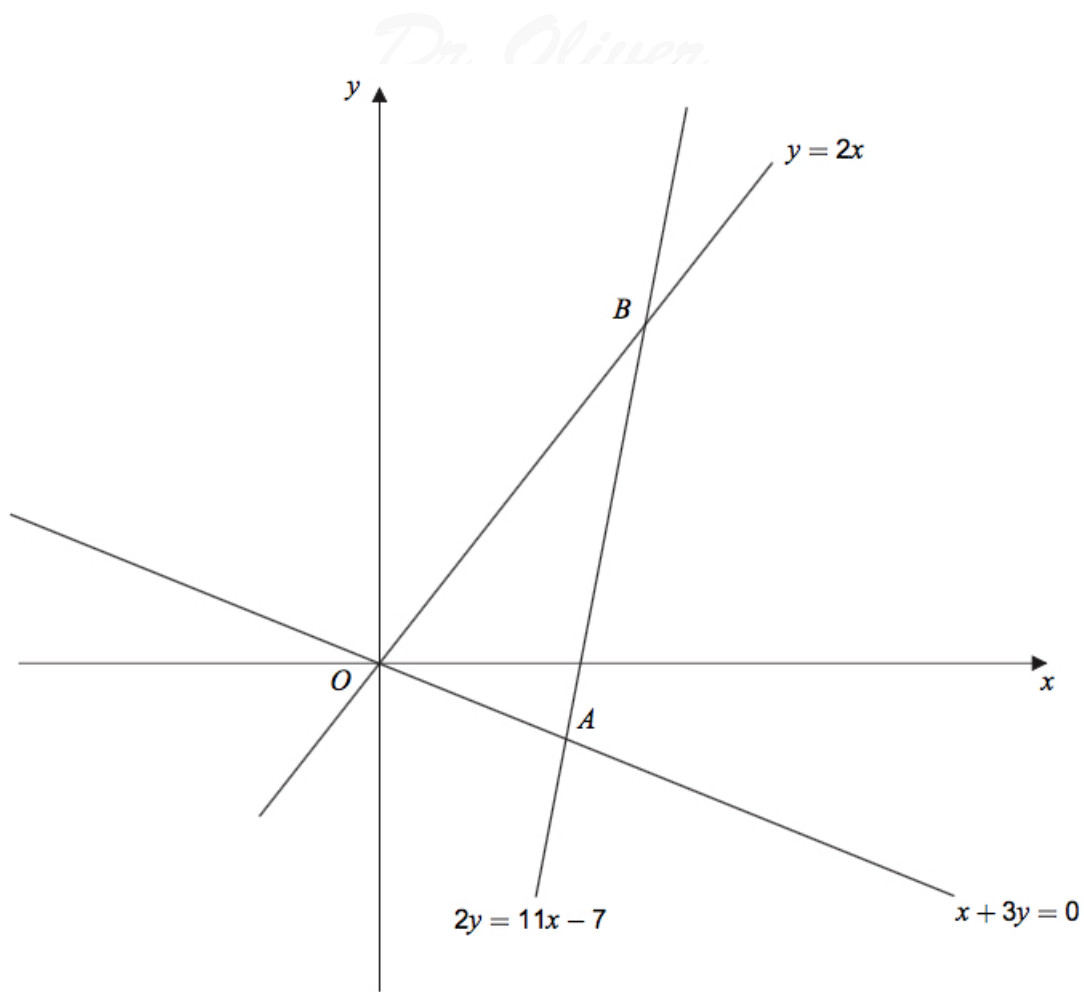
an increasing function?

21. The equations of three straight lines are

(6)

$$y = 2x \quad x + 3y = 0 \quad 2y = 11x - 7.$$

The lines intersect at the points O , A , and B as shown on this sketch.



Show that

$$\text{length } OB = \text{length } AB.$$

22. The transformation matrix

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

maps point P to point Q .

The transformation matrix

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

maps point Q to point R .

Point R is $(-4, 3)$.

Work out the coordinates of point P .

23. The curve $y = f(x)$ is such that

$$\frac{dy}{dx} = -x(x-2)^2.$$

The stationary points of the curve are at $(0, \frac{4}{3})$ and $(2, 0)$.
Determine the nature of each stationary point.
You **must** show your working.

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