

**Dr Oliver Mathematics**  
**AQA Further Maths Level 2**  
**June 2022 Paper 2**  
**1 hour 45 minutes**

The total number of marks available is 80.

You must write down all the stages in your working.

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

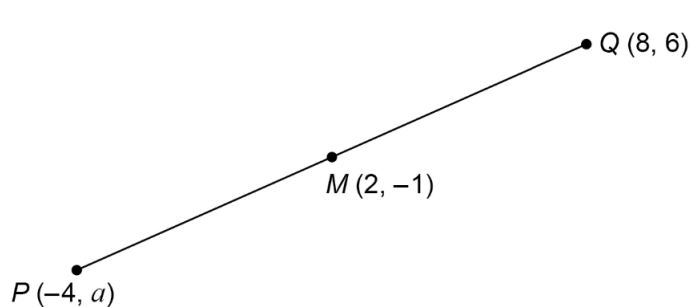
1. Factorise fully

$$12w + 18w^2.$$

(2)

2.  $M$  is the midpoint of  $PQ$ .

(2)



Not drawn  
accurately

Work out the value of  $a$ .

3. (a) Work out

$$3 \begin{pmatrix} 4 & 2 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 & 0 \\ -1 & 5 \end{pmatrix}.$$

(3)

Give your answer as a single matrix.

- (b)

$$\begin{pmatrix} 7 & a^2 \\ b & -5 \end{pmatrix} \begin{pmatrix} 2 \\ a \end{pmatrix} = \begin{pmatrix} 78 \\ 12 \end{pmatrix}.$$

(3)

Work out the values of  $a$  and  $b$ .

4. Line  $A$  has equation

$$y + 4x = 6.$$

(4)

Line  $B$  is parallel to line  $A$  and passes through the point  $(2, 1)$ .

The point  $(d, 2d)$  lies on line  $B$ .

Work out the value of  $d$ .

5. Work out all the **negative** integer values of  $x$  for which (3)

$$3x^2 < 48.$$

6. Prove algebraically that, when  $n$  is an integer, (3)

$$\frac{(2n + 1)^2 - (2n + 1)^2}{4}$$

is always even.

7. How many integers between 200 000 and 400 000 can be formed using only the digits (2)

1 2 3 5 8 9

with no repetition of any digit?

8. A curve has equation

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

At two points on the curve, the rate of change of  $y$  with respect to  $x$  is 4.

- (a) Work out an equation, in terms of  $x$ , to represent this information. (2)

Give your answer in the form

$$ax^2 + bx + c = 0,$$

where  $a$ ,  $b$ , and  $c$  are integers.

- (b) Hence, work out the two possible values of  $x$ . (2)  
Give your answers to 3 significant figures.

9. The first three terms of a linear sequence are

$$30 \quad 30 + 4k \quad 30 + 8k,$$

where  $k$  is a constant.

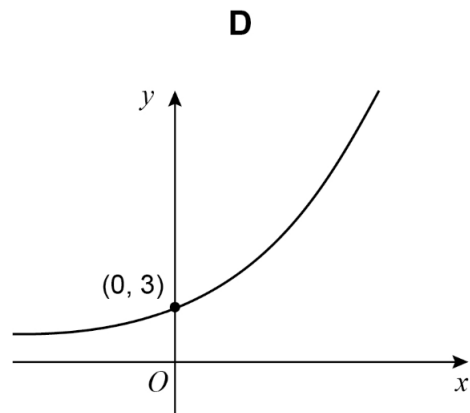
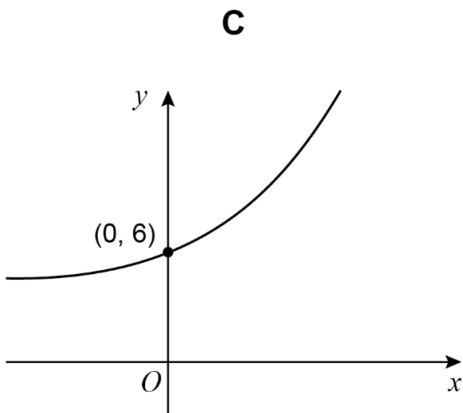
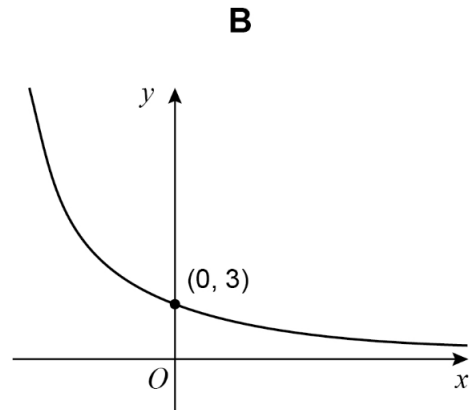
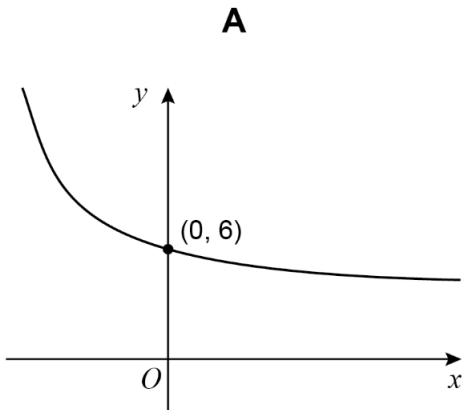
- (a) Work out an expression, in terms of  $k$ , for the 4th term. (1)  
Give your answer in its simplest form.

- (b) The 100th term of the sequence is 525. (3)

Work out the value of  $k$ .

10. Here are four sketch graphs.

(1)

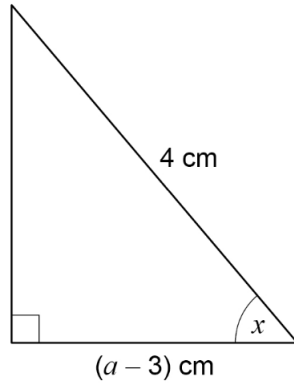


Circle the letter of the sketch graph that represents

$$y = 3 \times 2^x.$$

11. Here is a right-angled triangle.

(2)



Not drawn accurately

You are given that  $a > 5$

Use trigonometry to work out the range of values of  $x$ .

12. Work out the gradient of the curve (5)

$$y = \frac{12x^3 - 8x + 3}{4x^2}$$

at the point where  $x = -1$ .

You **must** show your working.

13.  $A(-2, 5)$  and  $B(4, 13)$  are points on a circle. (3)  
 $AB$  is a diameter.

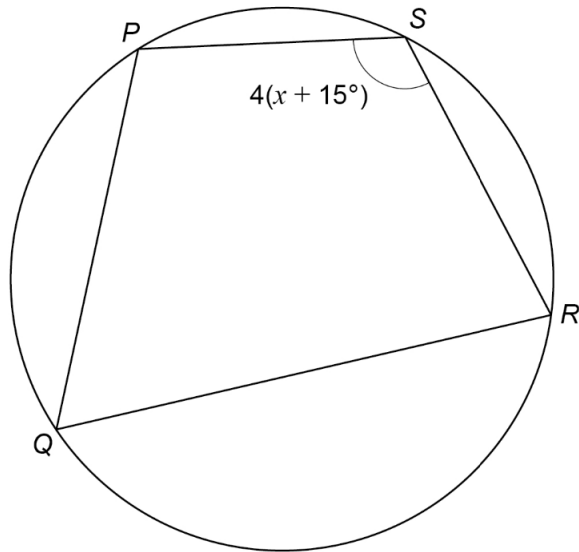
Work out the equation of the circle.

Give your answer in the form

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

where  $a$ ,  $b$ , and  $c$  are integers.

14.  $PQRS$  is a cyclic quadrilateral. (3)



Not drawn accurately

- Angle  $PSR = 4(x + 15)^\circ$ .
- Angle  $PQR$  is  $40^\circ$  smaller than angle  $PSR$ .

Work out the value of  $x$ .

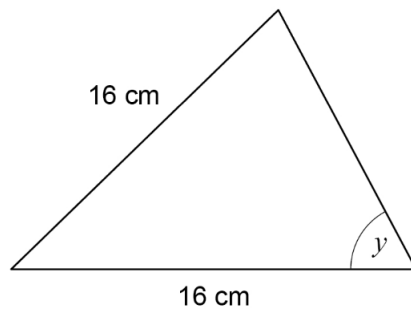
15. Simplify fully

(5)

$$\left(\frac{1}{2}x + \frac{3}{5}x\right) \div \sqrt{\frac{x^6}{4}}$$

16. Here is an isosceles triangle.  
All the angles are acute.

(4)



Not drawn accurately

The area of the triangle is  $120 \text{ cm}^2$ .

Work out the size of angle  $y$ .

17. Solve the simultaneous equations

(5)

$$\begin{aligned}a + 3b - 2c &= 4 \\4a - 3b + 5c &= -5 \\2a + b + 3c &= 9.\end{aligned}$$

Do **not** use trial and improvement.  
You **must** show your working.

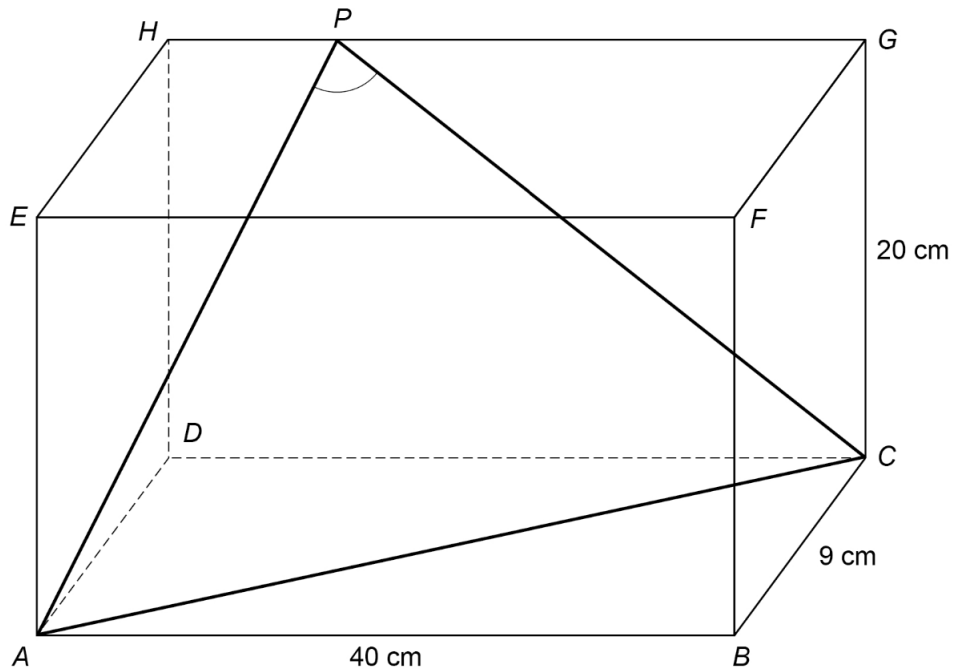
18.  $ABCDEFGH$  is a cuboid.

(5)

- $AB = 40$  cm.
- $BC = 9$  cm.
- $CG = 20$  cm.
- $P$  is a point on  $HG$  such that

$$HP : PG = 3 : 7.$$

- $AP = 25$  cm.



Work out the size of angle  $APC$ .

19. Expand and simplify fully

(3)

$$(3x + 4)(2x - 3)(5x - 2).$$

20.

$$f(x) = 2x^3 + 11x^2 + 12x - 9.$$

(a) Use the factor theorem to show that  $(2x - 1)$  is a factor of  $f(x)$ . (2)

(b) Show that  $f(x) = 0$  has **exactly two** solutions. (4)

21. Work out the values of  $x$  between  $0^\circ$  and  $360^\circ$  for which (4)

$$2 \tan^2 x = 3.$$

Give your answers to 1 decimal place.

You **must** show your working.

22. Using powers of 2 or otherwise, work out the non-zero value of  $x$  for which (4)

$$(16^x)^x = \frac{1}{2^{3x}}.$$

You **must** show your working.