Dr Oliver Mathematics
AQA Further Maths Level 2
June 2018 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. (2)
$$y = \tfrac{1}{2}x^6 + \tfrac{1}{4}x^4.$$

   Work out $\dfrac{\mathrm{d}y}{\mathrm{d}x}$.
   Simplify your answer.

2. P is the point $(-12, b)$. (3)
   Q is the point $(a, 4)$.
   R is the point $(6, -2)$.
   Q is the midpoint of PR.

   Work out the values of a and b.

3. (2)
$$\mathbf{A} = \begin{pmatrix} 2 & 4 \\ 3 & -1 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} -2 & 6 \\ 2 & 1 \end{pmatrix}.$$

   Work out $\mathbf{AB}$.

4. $P = 4x$ and $Q = 7x$. (4)
   P increases by 25%.
   Q decreases by 40%.
   Now, P is 28 greater than Q.

   Work out the value of x.

5. In the expansion and simplification of (3)
$$(x - 3)(x^2 + 5x + k),$$

   the coefficient of x^2 is equal to the coefficient of x.
   k is a constant.

   Work out the value of k.

6. A circle has centre $(-1, 2)$ and radius 5. (1)
   Which of these is the equation of the circle?
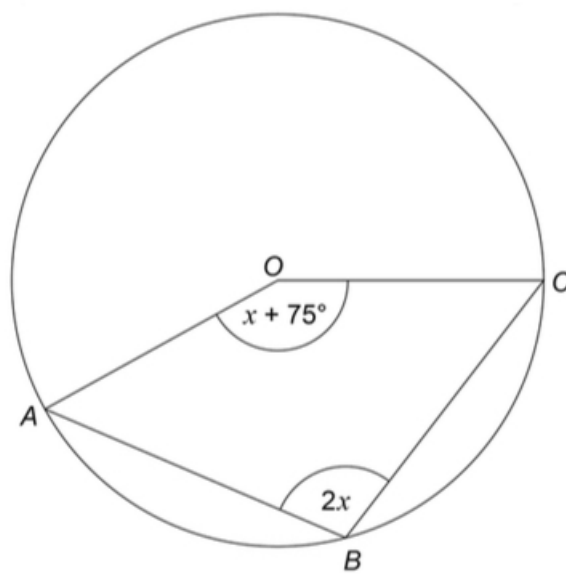   Tick **one** box.

   $(x + 1)^2 + (y - 2)^2 = 5$ ☐

   $(x - 1)^2 + (y + 2)^2 = 5$ ☐

   $(x + 1)^2 + (y - 2)^2 = 25$ ☐

   $(x - 1)^2 + (y + 2)^2 = 25$ ☐

7. Points A, B, and C lie on a circle, centre O. (3)
   Angle $AOC = (x + 75)^\circ$.
   Angle $ABC = (2x)^\circ$.

   Not drawn accurately

   Work out the value of x.

8. Write (2)

$$(1 + 2\sqrt{5})(4 - \sqrt{5})$$

in the form $a + b\sqrt{5}$, where a and b are integers.

9. (4)

$$f(x) = 14 - x^2,$$

for all real values of x.

Solve

$$f(2x) = 5.$$

You **must** show your working.

10. Rearrange (3)

$$\frac{1}{xy} = 4 - \frac{3}{y}$$

to make x the subject.

11. A curve has equation (4)

$$y = 2x^2 + 3x - 9.$$

At a point P on the curve, the tangent is parallel to the line
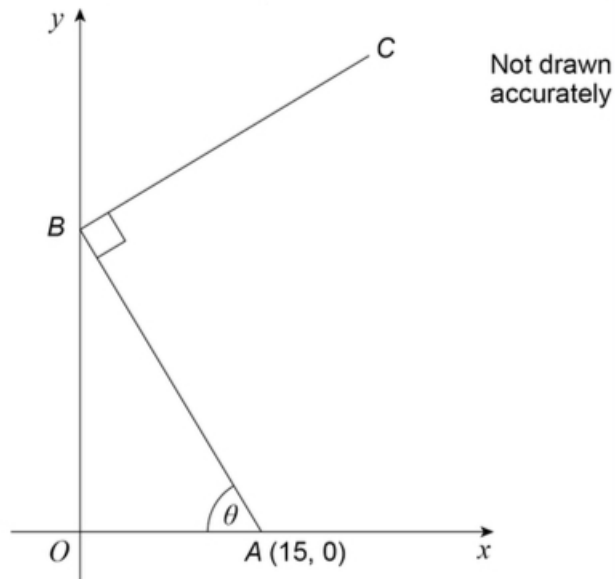
$$y = 4 - 5x.$$

Work out the coordinates of P.
You **must** show your working.

12. In the diagram, (4)

- A is the point $(15, 0)$ and B lies on the y-axis.
- Angle $ABC = 90°$ and $\tan\theta = \frac{5}{3}$.

Not drawn accurately

Work out the equation of the line BC.

13. Solve the simultaneous equations (6)

$$xy = 2 \text{ and } y = 3x + 5.$$

Do **not** use trial and improvement.
You **must** show your working.
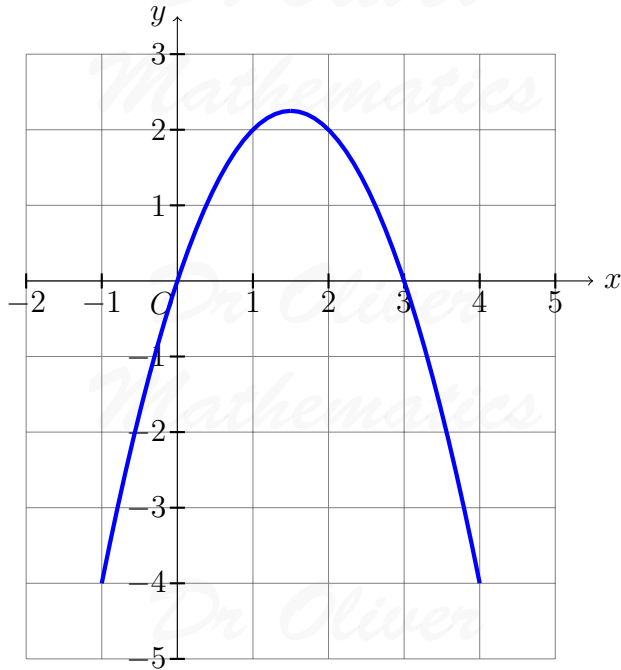
14. Work out the value of (3)

$$\left(3^{\frac{1}{2}} + 3^{\frac{3}{2}}\right)^2.$$

You **must** show your working.

15. Here is the graph of (4)

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

for values of x from -1 to 4.

By drawing a suitable **linear** graph on the grid, work out approximate solutions to

$$x^2 - 4x + 2 = 0.$$

16. $y = \mathrm{f}(x)$ is a cubic curve with a maximum and a minimum stationary point. (4)

   - $\dfrac{\mathrm{d}y}{\mathrm{d}x} = x^2 + 2x - 3.$
   - The y-coordinate of the minimum point is $2\frac{1}{3}$.
   - The y-coordinate of the maximum point is 13
   - $(0, 4)$ is a point on the curve.
   - The tangent at $(0, 4)$ has a negative gradient.

Sketch the curve on the grid below.
Show the coordinates of the stationary points.
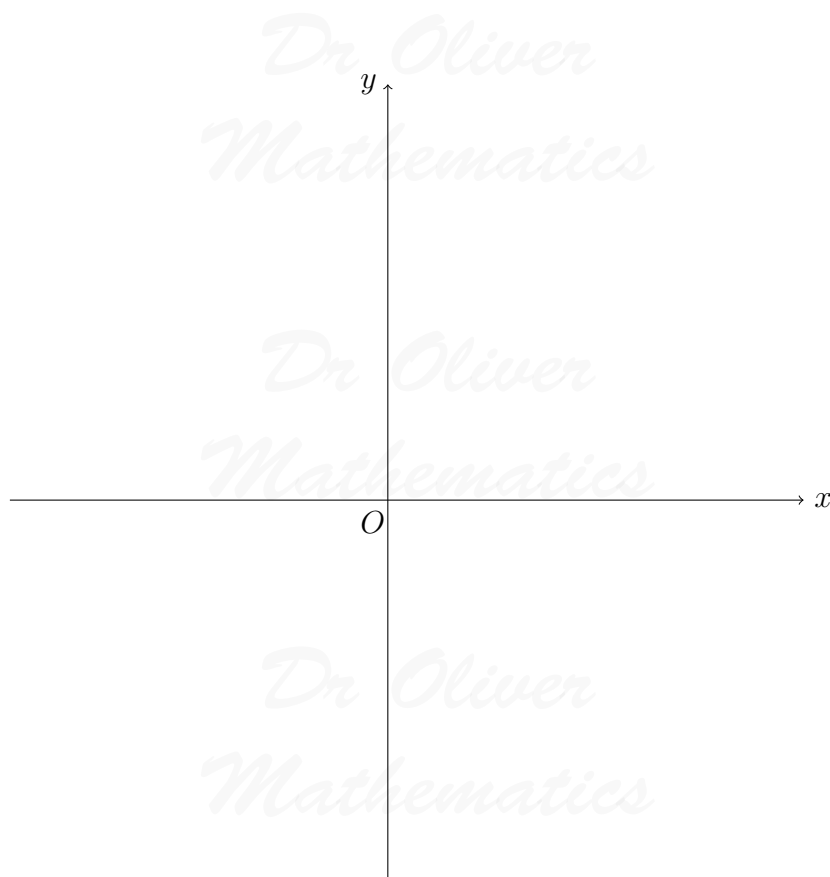
17. (a) Use the factor theorem to show that $(x - 2)$ is a factor of (1)

$$x^3 + 8x^2 + 5x - 50.$$
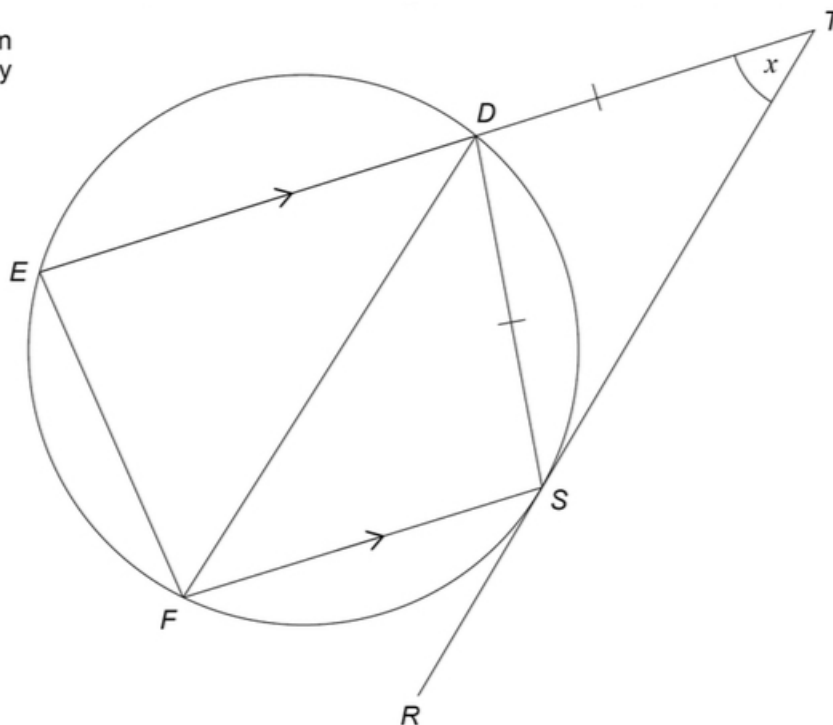
(b) Hence, factorise fully (3)

$$x^3 + 8x^2 + 5x - 50.$$

18. D, E, F, and S are points on a circle. (5)
    RST is a tangent.
    The straight line EDT is parallel to FS.
    $DS = DT$.

Not drawn
accurately

Prove that FD is parallel to RST.
Use angle DTS as x to help you.

19. Write (4)
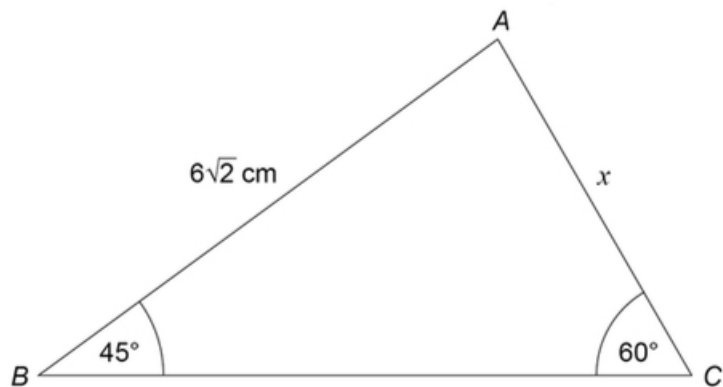$$2x^2 - 16x + 13$$
in the form
$$a(x + b)^2 + c,$$
where a, b, and c are integers.

20. In triangle ABC, (5)

- $AB = 6\sqrt{2}$ cm,
- angle $ABC = 45°$, and
- angle $ACB = 60°$.

Not drawn accurately

Work out the value of x.
Give your answer in the form $a\sqrt{b}$, where a and b are integers.
You must show your working.