

# Teach Me Maths

Please write clearly in block capitals.

Name \_\_\_\_\_

Date \_\_\_\_\_

Level 2 Certificate

## FURTHER MATHEMATICS

Paper 2 Calculator

### Mock Set D

For AQA Level 2 Certificate in Further Mathematics (8365)

Time allowed: 1 hour 45 minutes

#### Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (the last page of this paper).

#### Instructions

- Write in black ink or black ball-point pen. Use a pencil for diagrams.
- Write your name and the date at the top of this page.
- Answer **all** questions.
- Write your answers in the spaces provided. If you need more room, use extra paper and write the question number next to your answer.
- Do all your rough work on this paper. Cross out any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

#### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may use extra answer paper, graph paper and tracing paper.
- The use of a calculator is expected, but calculators with a facility for symbolic algebra must not be used.

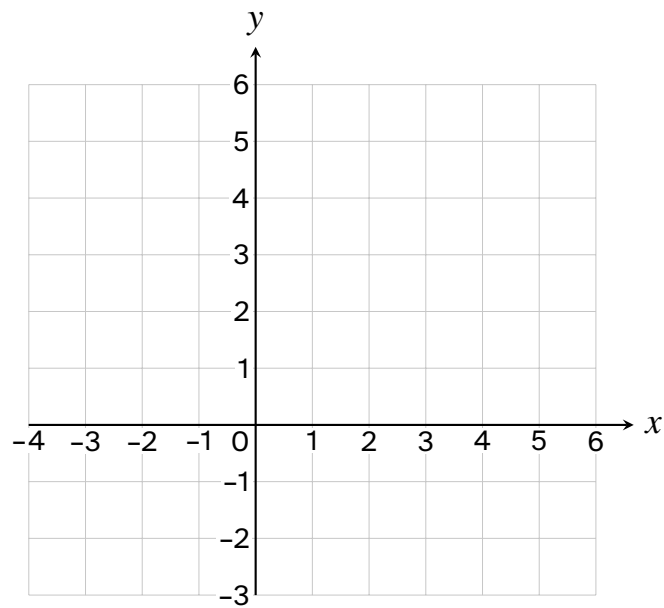
For the marker

**TOTAL** (out of 80)

*Practice paper written by Teach Me Maths in the style of AQA Level 2 Certificate in Further Mathematics (8365). Not an official AQA paper.*

Answer **all** questions in the spaces provided.

- 1** On the grid, draw the line  $3x + 4y = 11$  for values of  $x$  from  $-3$  to  $5$



**[3 marks]**

**2** Water flows into a tank.

The volume of water in the tank,  $V$  litres,  $t$  minutes after a tap is turned on is given by

$$V = 4t^3 - t^2 + 5t + 7 \quad 0 \leq t \leq 3$$

- (a) Show that, when the rate of change of  $V$  with respect to  $t$  is 11 litres per minute,

$$6t^2 - t - 3 = 0$$

**[2 marks]**

- (b) Work out the time when the rate of change of  $V$  with respect to  $t$  is 11 litres per minute.

Give your answer to 3 significant figures.

**[2 marks]**

Answer \_\_\_\_\_ minutes

**3** Here are the first four terms of a linear sequence.

48.6      46.3      44      41.7

(a) Work out an expression for the  $n$ th term.

**[2 marks]**

Answer \_\_\_\_\_

(b) Show that  $-20$  is not a term of this sequence.

**[2 marks]**

**4**  $n$  is a number such that

$$-6 < n \leq 3$$

(a) Work out the possible values of  $n^2$

Give your answer as an inequality.

**[2 marks]**

Answer \_\_\_\_\_

(b) Hence, write down the possible values of  $20 - n^2$  as an inequality.

**[1 mark]**

Answer \_\_\_\_\_

- 5 (a) Which matrix represents an enlargement, centre the origin, scale factor  $\frac{1}{2}$ ?

Circle your answer.

[1 mark]

$$\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$$

$$\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$$

$$\begin{pmatrix} 0 & \frac{1}{2} \\ \frac{1}{2} & 0 \end{pmatrix}$$

$$\begin{pmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$$

- (b) Transformation **S** is a rotation of  $90^\circ$  clockwise about the origin.

Transformation **T** is a reflection in the  $x$ -axis.

Work out the matrix that represents the combined transformation **S** followed by **T**.

[3 marks]

Answer  $\begin{pmatrix} & \\ & \end{pmatrix}$

**6** A council issues parking permits.

Each permit has a code made of two letters followed by three digits, for example KP 307

- The two letters are different.
- The letters I, O and Q are not used.
- The first digit cannot be 0
- The last digit must be odd.
- The digits do not have to be different.

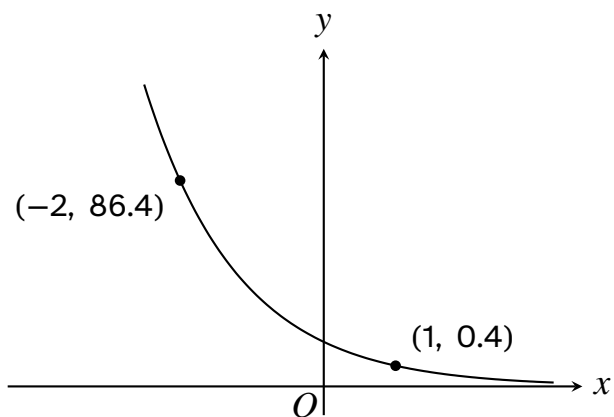
How many different codes are possible?

**[3 marks]**

Answer \_\_\_\_\_

- 7 The sketch shows the graph of  $y = a \times b^{-x}$ , where  $a > 0$  and  $b > 0$

The graph goes through  $(-2, 86.4)$  and  $(1, 0.4)$



*Not drawn accurately*

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

**[4 marks]**

$a =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

**8**  $k$  is an integer.

Prove that

$$(k + 3)^3 - (k - 3)^3$$

is a multiple of 18

**[3 marks]**

**9** Write

$$\frac{5}{x + 6} + \frac{34 - 11x}{3x^2 + 16x - 12}$$

as a single fraction in its simplest form.

**[3 marks]**

Answer \_\_\_\_\_

- 10**  $A$  is the point  $(-2.4, 8.8)$  and  $B$  is the point  $(3.6, 0.8)$

The line  $AB$  is extended to the point  $C$  so that  $AB:BC = 5:3$

Work out the equation of the line  $OC$ .

**[3 marks]**

Answer \_\_\_\_\_

- 11** A curve has equation

$$y = \frac{2x^7 - 9x^2}{6x^4}$$

Work out the value of  $x$  for which  $\frac{d^2y}{dx^2} = 0$

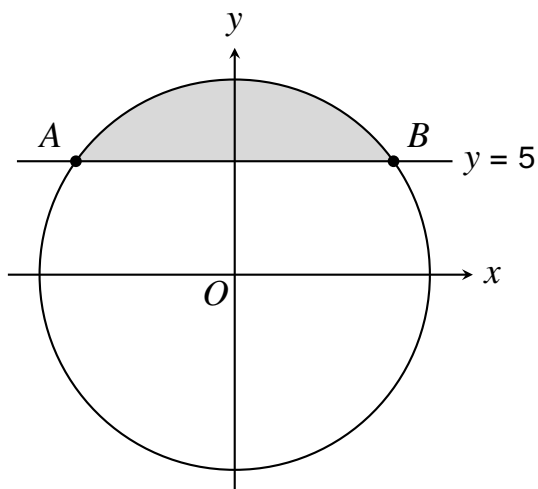
Give your answer to 3 significant figures.

**[4 marks]**

$x =$  \_\_\_\_\_

- 12 The diagram shows the circle  $x^2 + y^2 = 74$  and the straight line  $y = 5$

The line meets the circle at the points  $A$  and  $B$ .



*Not drawn accurately*

Work out the area of the shaded region.

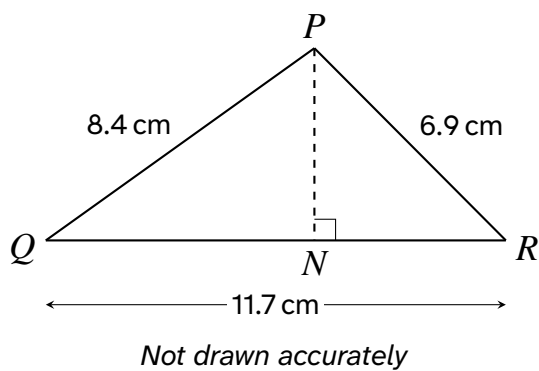
Give your answer to 3 significant figures.

**[4 marks]**

Answer \_\_\_\_\_ units<sup>2</sup>

**13**  $PQR$  is a triangle.

$N$  is the point on  $QR$  such that  $PN$  is perpendicular to  $QR$ .



Work out the length  $PN$ .

**[4 marks]**

Answer \_\_\_\_\_ cm

- 14** The straight line  $2x + y = 7$  and the circle  $(x - 3)^2 + (y + 1)^2 = 18$  intersect at the points  $P$  and  $Q$ .

(a) Show that the  $x$ -coordinates of  $P$  and  $Q$  satisfy the equation

$$5x^2 - 38x + 55 = 0$$

**[3 marks]**

(b) Work out the distance between  $P$  and  $Q$ .

Give your answer to 3 significant figures.

**[3 marks]**

Answer \_\_\_\_\_ units

**15** In the expansion of  $(a + 3x)^6$ , where  $a$  is a positive constant,

$$\text{coefficient of } x^2 : \text{coefficient of } x^3 = 5:8$$

Work out the value of  $a$ .

**[4 marks]**

$a =$  \_\_\_\_\_

**16** The functions  $f$  and  $g$  are given by

$$f(x) = x^2 - 4 \quad x \geq 0$$

$$g(x) = \sqrt{2x + 10} \quad x \geq -5$$

(a) Work out  $f^{-1}(x)$

**[2 marks]**

$$f^{-1}(x) = \underline{\hspace{10cm}}$$

(b) Solve  $gf(x) = 5$

Give your answer to 3 significant figures.

**[2 marks]**

$$x = \underline{\hspace{10cm}}$$

**17** Solve

$$4x - 9x^{\frac{1}{2}} = 2$$

Give your answer to 3 significant figures.

Do not use trial and improvement.

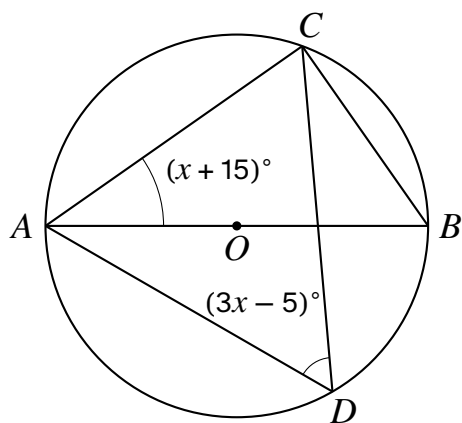
You must show your working.

**[4 marks]**

$x =$  \_\_\_\_\_

- 18** The points  $A$ ,  $B$ ,  $C$  and  $D$  lie on a circle with centre  $O$ .

The line  $AB$  is a diameter.



*Not drawn accurately*

Work out the size of angle  $ADC$ .

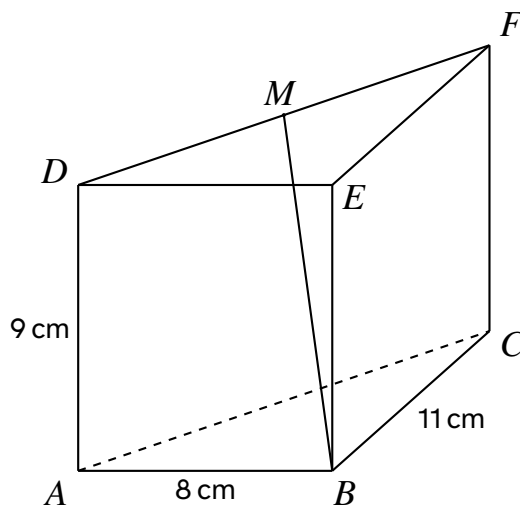
You must show your working.

**[3 marks]**

Answer \_\_\_\_\_<sup>°</sup>

19  $ABCDEF$  is a triangular prism.

- The base  $ABC$  is horizontal and angle  $ABC = 90^\circ$
- $AD$ ,  $BE$  and  $CF$  are vertical edges.
- $AB = 8\text{ cm}$        $BC = 11\text{ cm}$        $AD = 9\text{ cm}$
- $M$  is the midpoint of  $DF$ .



*Not drawn accurately*

Work out the size of the angle between  $MB$  and the plane  $ABC$ .

**[5 marks]**

Answer \_\_\_\_\_<sup>°</sup>

**20** A curve has equation  $y = kx^3 + 3x^2$  where  $k$  is a constant.

The point  $P(-2, 8)$  lies on the curve.

Work out the equation of the normal to the curve at  $P$ .

Give your answer in the form  $ax + by = c$  where  $a$ ,  $b$  and  $c$  are integers.

**[4 marks]**

Answer \_\_\_\_\_

**21** Solve

$$7\cos^2 x - 9\sin x = 8 \quad \text{for } 0^\circ \leq x \leq 360^\circ$$

Give your answers to 1 decimal place.

You must show your working.

**[4 marks]**

Answer \_\_\_\_\_

**END OF QUESTIONS**

# Formulae Sheet

For AQA Level 2 Certificate in Further Mathematics (8365)

## Perimeter, area and volume

Where  $a$  and  $b$  are the lengths of the parallel sides and  $h$  is their perpendicular separation:

$$\text{Area of a trapezium} = \frac{1}{2}(a + b)h$$

Volume of a prism = area of cross section  $\times$  length

Where  $r$  is the radius and  $d$  is the diameter:

$$\text{Circumference of a circle} = 2\pi r = \pi d$$

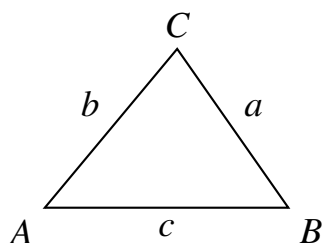
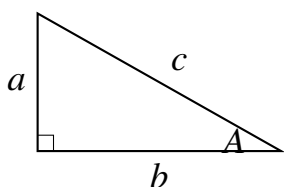
$$\text{Area of a circle} = \pi r^2$$

## Quadratic formula

The solution of  
 $ax^2 + bx + c = 0$   
where  $a \neq 0$ :

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

## Pythagoras' Theorem and Trigonometry



In any right-angled triangle where  $a$ ,  $b$  and  $c$  are the lengths of the sides and  $c$  is the hypotenuse:

$$a^2 + b^2 = c^2$$

In any right-angled triangle  $ABC$  where  $a$ ,  $b$  and  $c$  are the lengths of the sides and  $c$  is the hypotenuse:

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$

In any triangle  $ABC$  where  $a$ ,  $b$  and  $c$  are the lengths of the sides:

$$\text{sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{cosine rule: } a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of triangle} = \frac{1}{2}ab \sin C$$

For any angle  $\theta$ :

$$\tan \theta = \frac{\sin \theta}{\cos \theta} \quad \text{and} \quad \sin^2 \theta + \cos^2 \theta = 1$$

## Coordinate Geometry

Equation of a straight line passing through  $(x_1, y_1)$  with gradient  $m$ :

$$y - y_1 = m(x - x_1)$$

The general equation of a circle, centre  $(a, b)$ , radius  $r$ :

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