AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

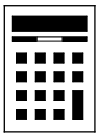
Level 2 Certificate
FURTHER MATHEMATICS

Paper 2 Calculator

Thursday 21 June 2018 Afternoon Time allowed: 2 hours

Materials

For this paper you must have:
- a calculator
- mathematical instruments.



Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

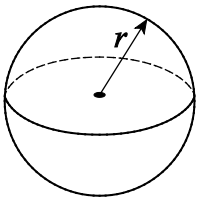
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.
- The use of a calculator is expected but calculators with a facility for symbolic algebra must **not** be used.

For Examiner's Use	
Pages	Mark
3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26–27	
28–29	
TOTAL	

Formulae Sheet

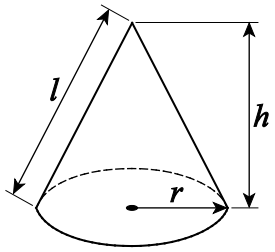
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



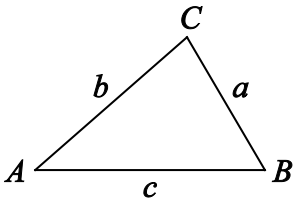
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$



In any triangle ABC

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



Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Trigonometric Identities

$\tan \theta \equiv \frac{\sin \theta}{\cos \theta}$ $\sin^2 \theta + \cos^2 \theta \equiv 1$

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

1 The nth term of a sequence is $\dfrac{1420-5n}{1420+5n}$

1 (a) Work out the **position** of the term that has the value zero.

[2 marks]

Answer _____

1 (b) Write down the limiting value of the sequence as $n \to \infty$

[1 mark]

Answer _____

Turn over for the next question

3

2 P (–3, –10) and Q (a, b) are points on a straight line with gradient 12

Work out one possible pair of integer values for a and b.

[2 marks]

$a =$ _____ $b =$ _____

3 $p = \dfrac{m+2}{m^2+1}$

3 (a) Work out the value of p when $m = -5.5$

[1 mark]

Answer _____

3 (b) Work out the values of m when $p = 2$

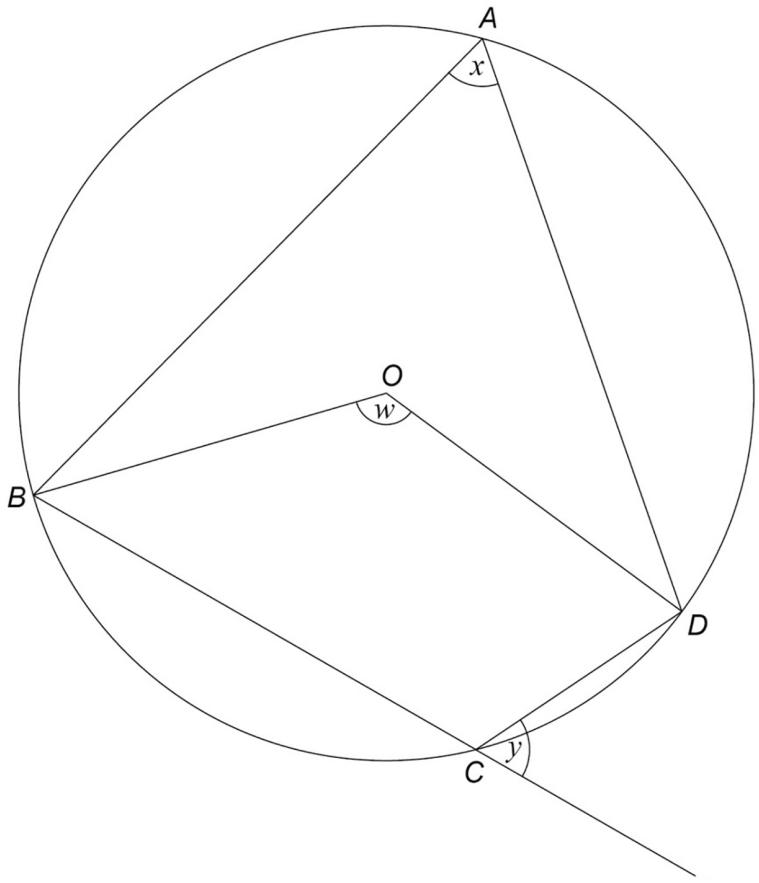
[3 marks]

Answer _____

Turn over for the next question

6

4 *A*, *B*, *C* and *D* are points on a circle, centre *O*.



Which statement is correct?

Tick **one** box.

[1 mark]

$x + y = 180°$ and $w = 2x$ ☐

$x + y = 180°$ and $x = 2w$ ☐

$x = y$ and $w = 2x$ ☐

$x = y$ and $x = 2w$ ☐

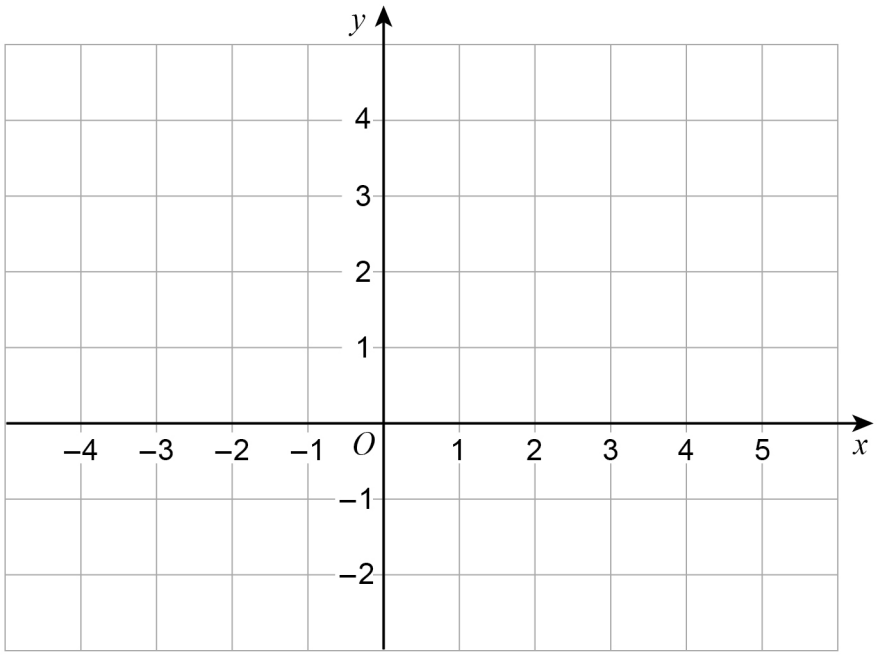
5 On the grid, draw the graph of $y = f(x)$

$$f(x) = x + 4 \qquad -4 \leqslant x < 0$$

$$= 4 - 3x \qquad 0 \leqslant x < 2$$

$$= -2 \qquad 2 \leqslant x \leqslant 5$$

[4 marks]



Turn over for the next question

5

6 $f(x) = x^2 - 7$ for all values of x

$g(x) = 1 - 3x$ for $-4 \leqslant x \leqslant 4$

6 (a) Work out the range of $f(x)$.

Give your answer as an inequality.

[1 mark]

Answer _____

6 (b) Work out the range of $g(x)$.

Give your answer as an inequality.

[2 marks]

Answer _____

6 (c) Solve $2f(x) = g(x)$

You **must** show your working.

Give your answers to 3 decimal places.

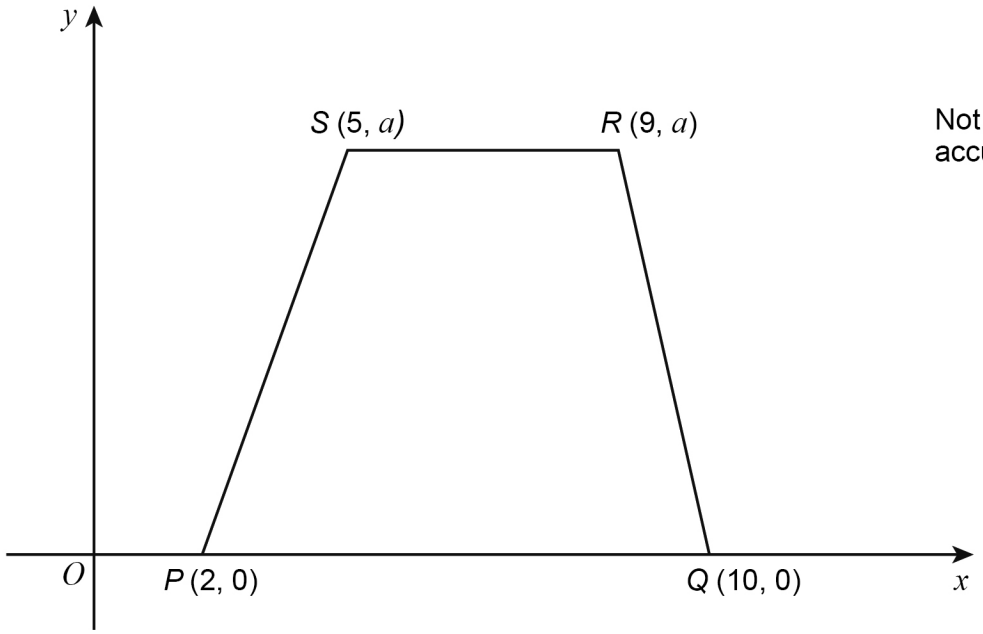
[4 marks]

Answer _____

Turn over for the next question

7

7 *PQRS* is a trapezium.



The area of the trapezium is 63 square units.

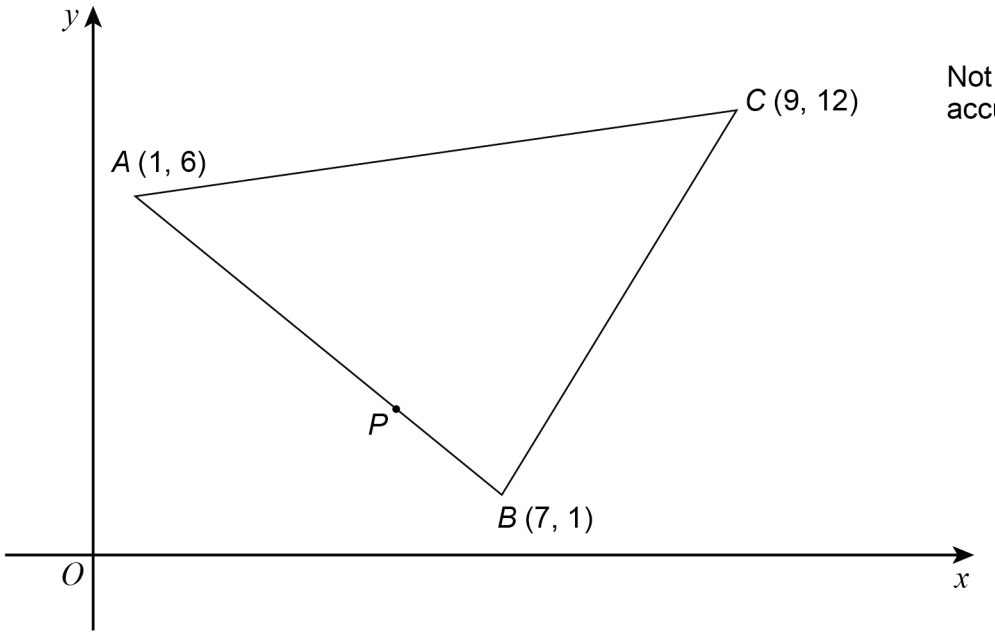
Work out the value of a.

[2 marks]

Answer _____

8 Here is a sketch of triangle *ABC*.

P is a point on *AB*.



Not drawn accurately

AP : *PB* is 3 : 1

Work out the length *PC*.

Give your answer to 4 significant figures.

[4 marks]

Answer _____ units

6

Turn over ►

9 $y = \dfrac{2x^7 + 15x^2}{3x}$

Work out the value of x when $\dfrac{dy}{dx} = 133$

[4 marks]

Answer _____

10 The transformation matrix $\begin{pmatrix} a & b \\ 2a & 3b \end{pmatrix}$ maps the point (1, –3) onto the point (1, 4)

Work out the values of a and b.

You **must** show your working.

[5 marks]

$a =$ _____ $b =$ _____

Turn over for the next question

9

11 Expand and simplify fully $(x + 2)(x + 3)(x + 4)$

[3 marks]

Answer _____

12 (a) Write $\frac{7}{9x} + \frac{2}{3x^2}$ as a single fraction in its simplest form.

[3 marks]

Answer _____

12 (b) Show that $\frac{x^4}{x+4} \times \frac{x+2}{x} \div \frac{x^2}{3x+12}$

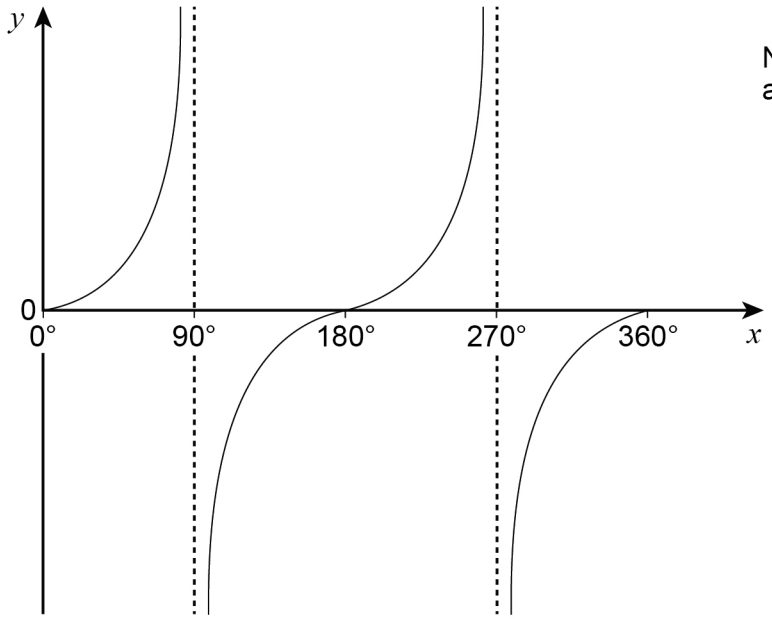
simplifies to the form $ax^2 + bx$ where a and b are integers.

[4 marks]

Turn over for the next question

10

13 (a) Here is a sketch of $y = \tan x$ for $0° \leqslant x \leqslant 360°$



Not drawn accurately

How many solutions of $\tan x = k$ where $k > 0$ are between 90° and 360° ?

[1 mark]

Answer _____

13 (b) $0 < p < 1$

How many solutions of $\sin x = p - 1$ are between 0° and 180° ?

You may use a sketch graph to help you.

[1 mark]

Answer _____

13 (c) State the coordinates of each point where the graph

$y = \cos x$ for $0° \leqslant x \leqslant 360°$

meets or intersects an axis.

[2 marks]

Answer _____

4

14 (a) Factorise fully $12pq^3r - 18pq^2r^2 + 24pq^2r$

[2 marks]

Answer _____

14 (b) Factorise fully $6(y + 3)^5 + 4(y + 3)^4$

Give your answer in its simplest form.

Do **not** attempt to expand $(y + 3)^5$ or $(y + 3)^4$

[3 marks]

Answer _____

14 (c) Factorise fully $48 - 75x^2$

[2 marks]

Answer _____

15 Work out the rate of change of y with respect to x at the point on the curve

$y = x^2(x^2 - 9)$ where $x = -2$

You **must** show your working.

[4 marks]

Answer _____

Turn over for the next question

11

16 $A = 2 - 5x$ $B = 3x - 1$ $C = x^2$

Show that $(2A + 3B)^2 \equiv A + B + C$

[4 marks]

17 A circle has equation $x^2 + y^2 = 29$

P is the point (–5, 2)

17 (a) Show that *P* is on the circle.

[1 mark]

17 (b) The tangent to the circle at P intersects the x-axis at point Q.

Work out the x-coordinate of Q.

You **must** show your working.

[4 marks]

Answer _____

9

Turn over ►

18 (a) Work out all the **integer** values of x for which

$$-5 < 4x + 3 \leqslant 13$$

[3 marks]

Answer _____

18 (b) Work out the range of values of x for which

$$x^2 - 11x + 28 > 0$$

You **must** show your working.

[3 marks]

Answer _____

19 Use **matrix multiplication** to show that, in the x–y plane,

- a reflection in the line $y = -x$, followed by
- a rotation, 90° anticlockwise about the origin, followed by
- a reflection in the x-axis

is equivalent to a transformation by the identity matrix.

[5 marks]

Turn over for the next question

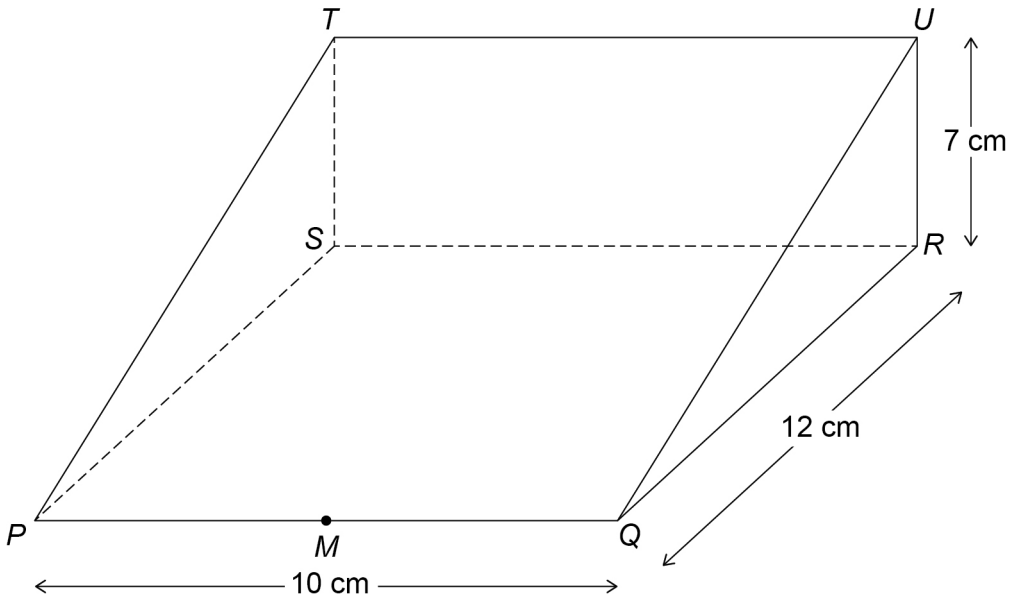
11

20 *PQRSTU* is a triangular prism.

PQRS is a rectangle and angle *QRU* = 90°

PQ = 10 cm *QR* = 12 cm *UR* = 7 cm

M is the midpoint of *PQ*.



20 (a) Calculate the size of the angle between the line *UM* and the plane *PQRS*.

[4 marks]

Answer _____ degrees

20 (b) Calculate the size of the angle between the planes *UMR* and *UQR*.

[2 marks]

Answer _____ degrees

Turn over for the next question

6

21 The continuous curve $y = f(x)$ has exactly two stationary points.

Here is some information about the curve.

$x < -1$	$x = -1$	$-1 < x < 2$	$x = 2$	$x > 2$
$\frac{dy}{dx}$ is positive	$\frac{dy}{dx}$ is zero	$\frac{dy}{dx}$ is negative	$\frac{dy}{dx}$ is zero	$\frac{dy}{dx}$ is negative

$f(-1) = 3$ and $f(2) = 1$

State the coordinates **and** the nature of each of the stationary points.

[3 marks]

stationary point (_____ , _____) nature _____

stationary point (_____ , _____) nature _____

22 (a) $8 \cos x + 5 \sin x = 0$ where $90° < x < 180°$

Work out the size of angle x.

[3 marks]

Answer _____ degrees

22 (b) $6 \sin^2 x + 4 \cos^2 x \equiv A + B \cos^2 x$ where A and B are integers.

Work out the values of A and B.

You **must** show your working.

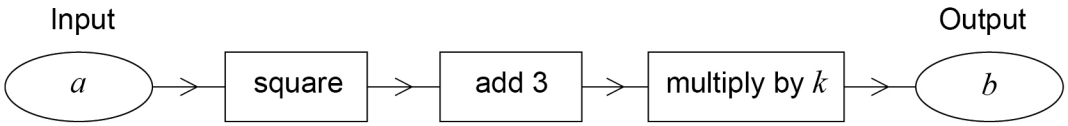
[2 marks]

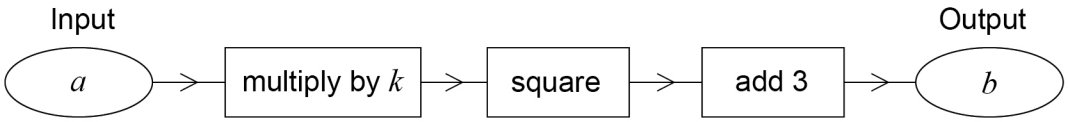
A = _____ B = _____

8

23 For each of these two function machines, when the input is a the output is b.

$k > 0$ and $k \neq 1$ and $a > 0$





Work out an expression for a in terms of k.

Give your answer in its simplest form.

[6 marks]

Answer _____

24 Work out the value of p when

$$9^{0.5p} \times 81 = 27^{2p-1}$$

[4 marks]

Answer _____

END OF QUESTIONS

10

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