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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

Level 2 Certificate FURTHER MATHEMATICS

Paper 2

Calculator

Thursday 21 June 2018

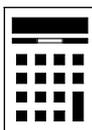
Afternoon

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	

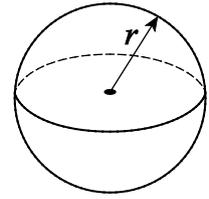


J U N 1 8 8 3 6 0 2 0 1

Formulae Sheet

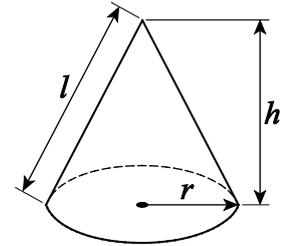
$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

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



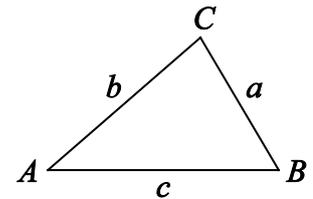
$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Curved surface area of cone} = \pi r l$$



In any triangle ABC

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



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

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

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

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

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



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

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

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 $n \rightarrow \infty$

[1 mark]

Answer _____

Turn over for the next question



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
$$p = \frac{m+2}{m^2+1}$$

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

[1 mark]

Answer _____

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

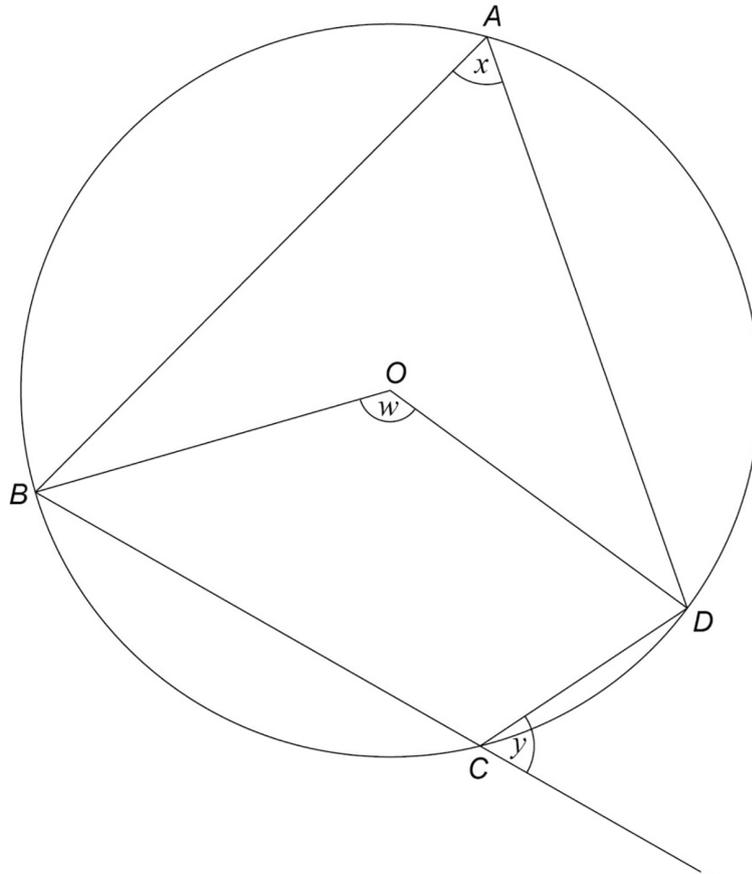
[3 marks]

Answer _____

Turn over for the next question



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



Which statement is correct?

Tick **one** box.

[1 mark]

$x + y = 180^\circ$ and $w = 2x$

$x + y = 180^\circ$ and $x = 2w$

$x = y$ and $w = 2x$

$x = y$ and $x = 2w$



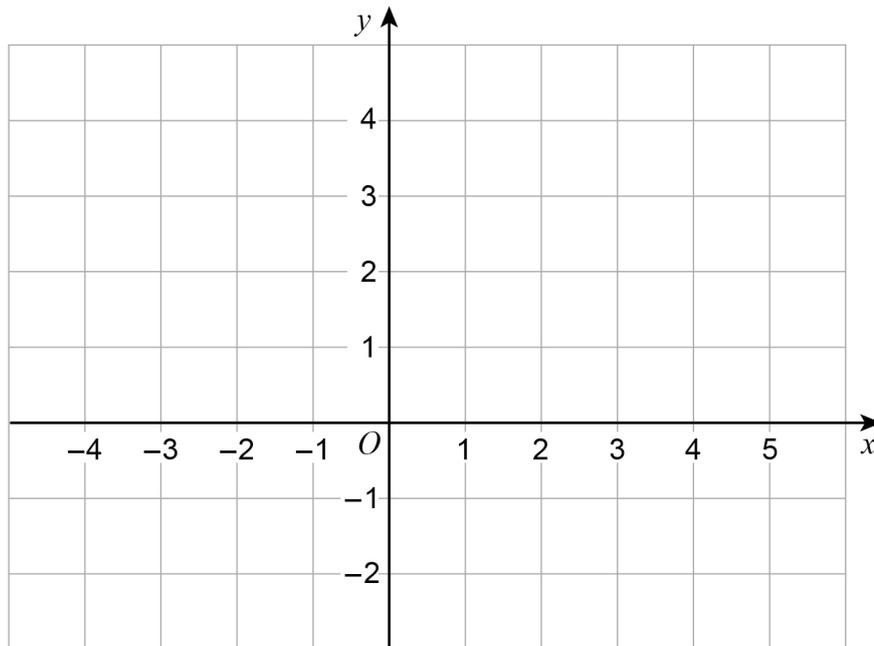
5 On the grid, draw the graph of $y = f(x)$

$$f(x) = x + 4 \quad -4 \leq x < 0$$

$$= 4 - 3x \quad 0 \leq x < 2$$

$$= -2 \quad 2 \leq x \leq 5$$

[4 marks]



Turn over for the next question

Turn over ►



6 $f(x) = x^2 - 7$ for all values of x
 $g(x) = 1 - 3x$ for $-4 \leq x \leq 4$

- 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 _____

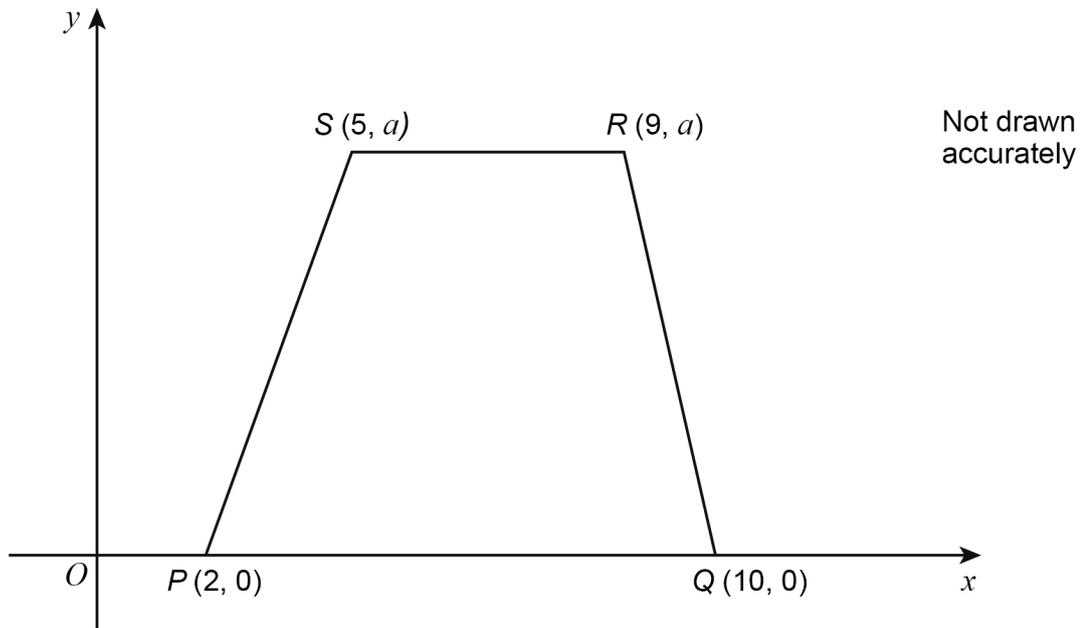
Turn over for the next question

7

Turn over ►



7 PQRS is a trapezium.



The area of the trapezium is 63 square units.

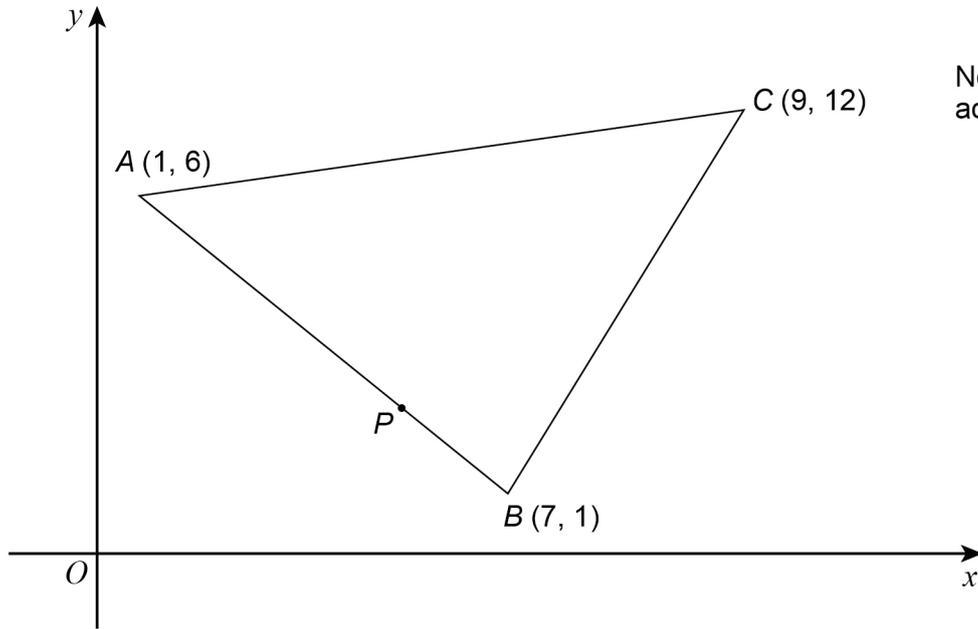
Work out the value of a .

[2 marks]

Answer _____



- 8 Here is a sketch of triangle ABC .
 P is a point on AB .



$AP : PB$ is $3 : 1$

Work out the length PC .

Give your answer to 4 significant figures.

[4 marks]

Answer _____ units

6

Turn over ►



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

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

[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]

$$a = \underline{\hspace{2cm}} \qquad b = \underline{\hspace{2cm}}$$

Turn over for the next question

Turn over ►



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.

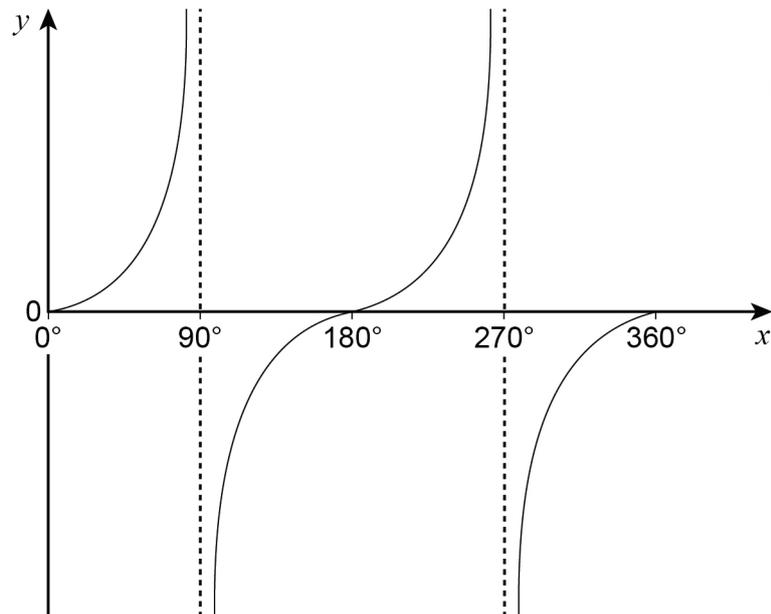
[4 marks]

Turn over for the next question

Turn over ►



13 (a) Here is a sketch of $y = \tan x$ for $0^\circ \leq x \leq 360^\circ$



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

$$y = \cos x \quad \text{for } 0^\circ \leq x \leq 360^\circ$$

meets or intersects an axis.

[2 marks]

Answer _____



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

$$y = x^2(x^2 - 9) \quad \text{where} \quad x = -2$$

You **must** show your working.

[4 marks]

Answer _____

Turn over for the next question



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

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

[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

Turn over ►



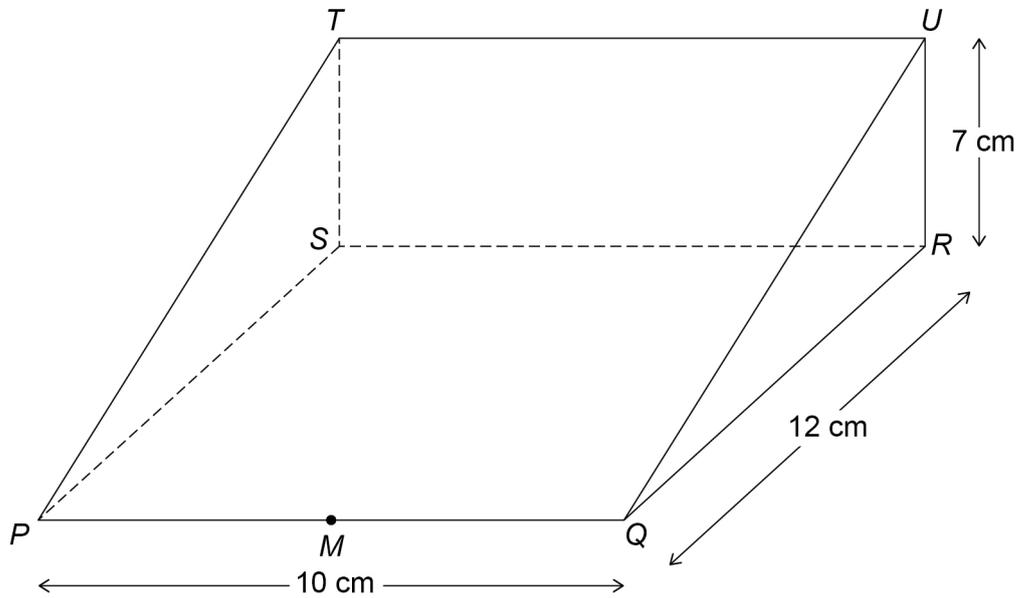
20

$PQRSTU$ is a triangular prism.

$PQRS$ is a rectangle and angle $QRU = 90^\circ$

$PQ = 10 \text{ cm}$ $QR = 12 \text{ cm}$ $UR = 7 \text{ cm}$

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

Turn over ►



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

$$f(-1) = 3 \quad \text{and} \quad f(2) = 1$$

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 $90^\circ < x < 180^\circ$

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 = _____



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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