

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

Level 2 Certificate in Further Mathematics

FURTHER MATHEMATICS

Level 2 Paper 2 Calculator

Friday 24 June 2016

Morning

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.
- 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

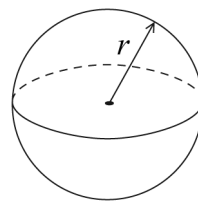
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.
- The use of a calculator is expected but calculators with a facility for symbolic algebra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



Formulae Sheet

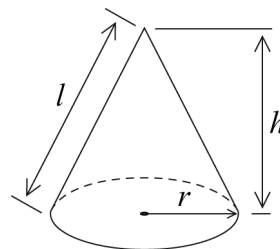
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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



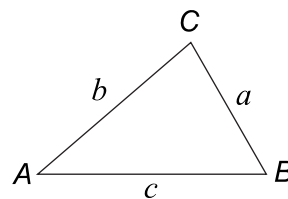
In any triangle ABC

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

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



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

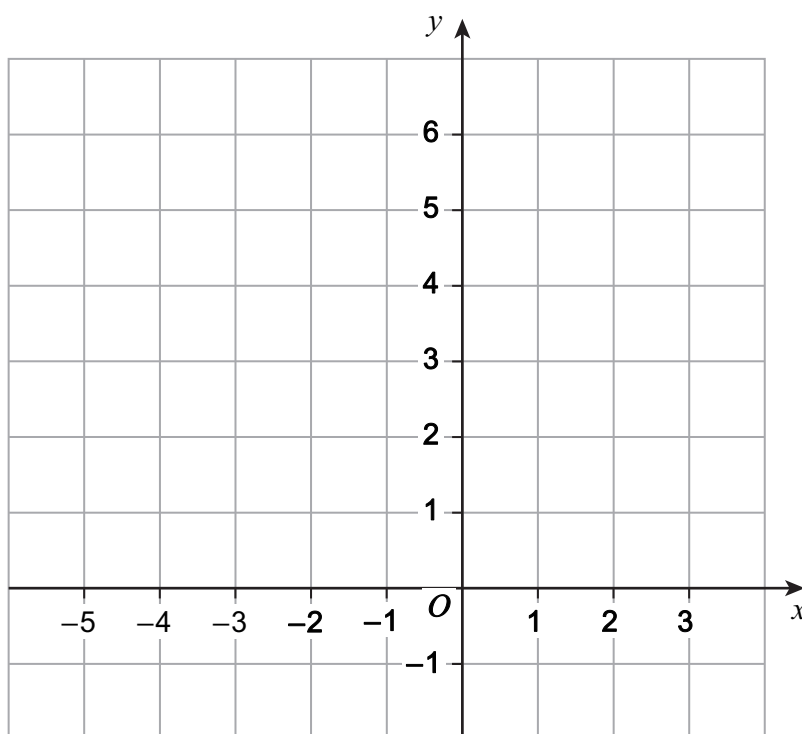
1

A triangle has vertices

$A(2, 5)$ $B(2, 0)$ and $C(-4, 3)$

Work out the area of triangle ABC .
You may use the grid to help you.

[3 marks]

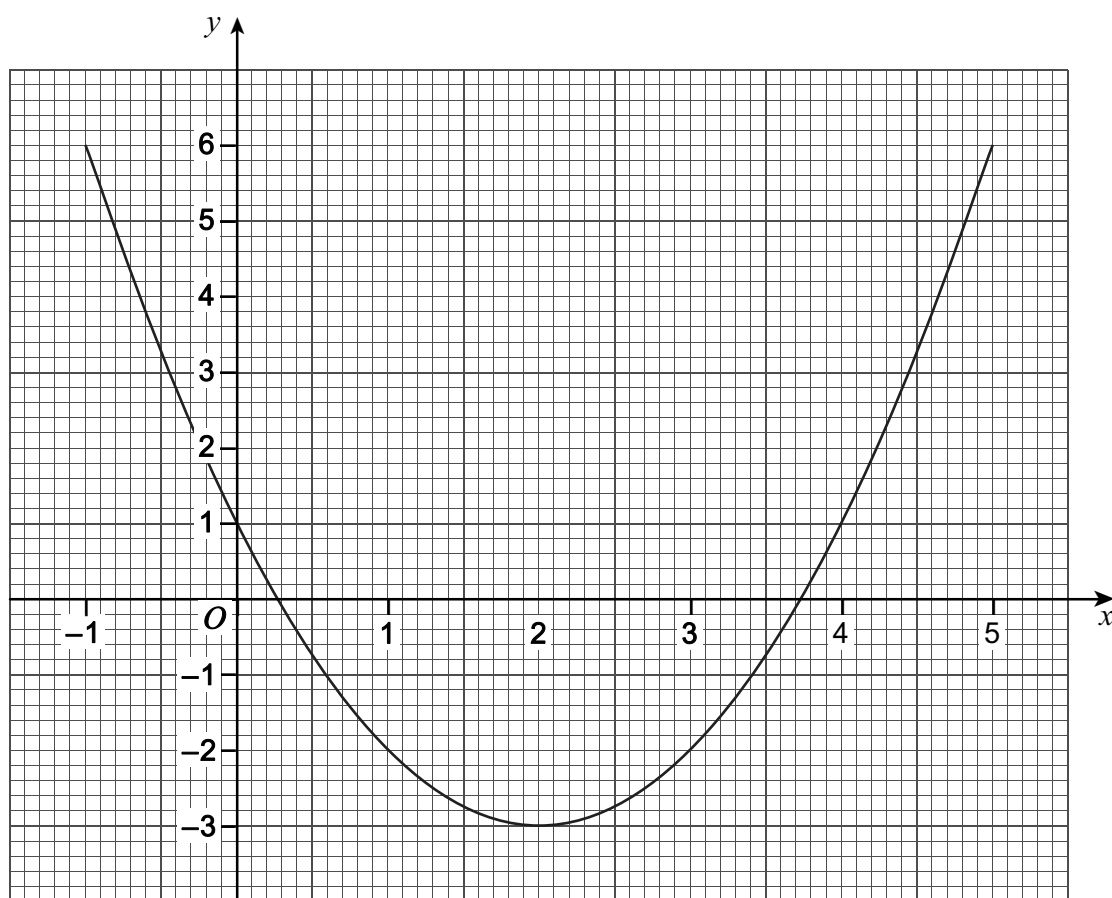


Answer _____ square units



2 The function $f(x) = x^2 - 4x + 1$ has domain $-1 \leq x \leq 5$

Here is the graph of $y = f(x)$



2 (a) Write down the equation of the line of symmetry of the graph.

[1 mark]

Answer _____

2 (b) Use the graph to work out the solutions of $x^2 - 4x + 1 = 5$

Give your answers to 1 decimal place.

[2 marks]

Answer _____



- 2 (c)** Write down the range of $f(x)$ for domain $-1 \leq x \leq 5$

[2 marks]

Answer _____

- 3** L is a straight line with equation $ax + by = c$
where a , b and c are non-zero integers.

- 3 (a)** At which point does L intersect the x -axis?
Circle your answer.

[1 mark]

$$\left(\frac{a}{c}, 0\right)$$

$$\left(\frac{c}{a}, 0\right)$$

$$\left(\frac{b}{c}, 0\right)$$

$$\left(\frac{c}{b}, 0\right)$$

- 3 (b)** What is the gradient of a line parallel to L?
Circle your answer.

[1 mark]

$$-\frac{b}{a}$$

$$\frac{b}{a}$$

$$-\frac{a}{b}$$

$$\frac{a}{b}$$

Turn over ►



4 Work out the point of intersection of the lines

$$2x + 3y = 11 \quad \text{and} \quad 2y = 13 - 3x$$

[4 marks]

Answer (_____ , _____)



5 a , b and c are numbers such that

$$a < 0$$

$$b > 1$$

$$-1 < c < 1$$

Tick the correct box for each statement.

	Always true	Sometimes true	Never true
$a^3 < 0$	☐	☐	☐
$b < 10a^2$	☐	☐	☐
$ab > 0$	☐	☐	☐
$b - c > 1$	☐	☐	☐

[4 marks]

Turn over for the next question



6 For the curve $y = f(x)$,

$$\frac{dy}{dx} = \frac{3}{2}x - kx^4 + k \quad \text{where } k \text{ is a constant.}$$

When $x = -2$ the gradient of the curve is 12

Work out the value of k .

[3 marks]

Answer _____

7

Simplify fully $\left(\frac{2}{3}x^3y\right)^3$

[2 marks]

Answer _____



8 $D(-6, 4)$ and $E(-2, 9)$ are joined by a straight line.

P is a point on DE .

$$DP : PE = 3 : 5$$

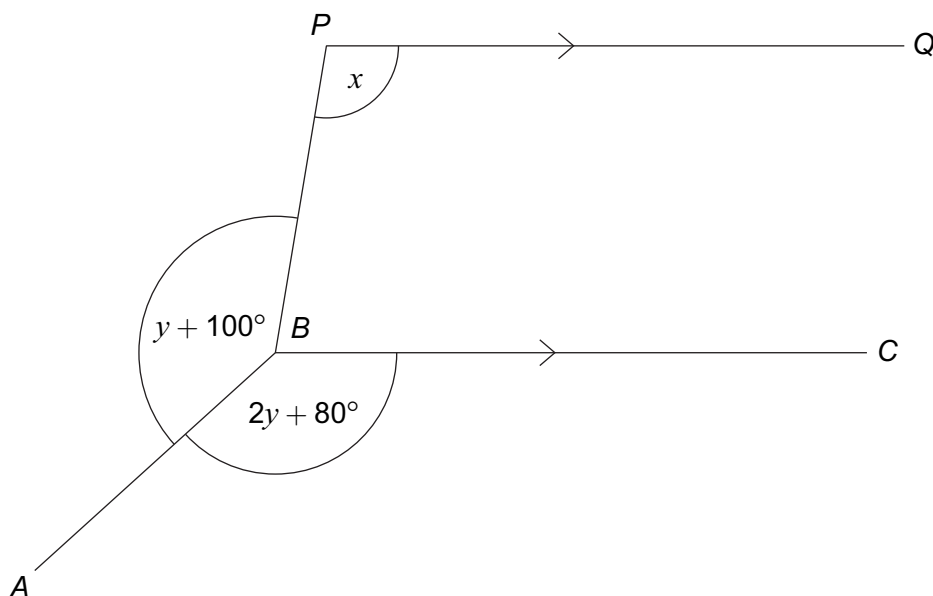
Work out the coordinates of P .

[3 marks]

Answer (_____ , _____)



9

 PQ is parallel to BC .Not drawn
accuratelyProve that $x = 3y$ **[4 marks]**



10 (a) Simplify $\frac{x^2 - 7x + 10}{x^2 - 2x - 15}$

[2 marks]

Answer _____

10 (b) Factorise fully $w^5x^3y^2 + w^2x^6y^3$

[2 marks]

Answer _____

Turn over for the next question

Turn over ►



- 11** The x^2 term in the expansion of $(3x + 4)(x^2 + px + 5)$ is $-23x^2$

Work out the value of p .

[3 marks]

Answer _____

- 12** Here are the first four terms of linear sequences X and Y and quadratic sequence Z .

Sequence X	7	9	11	13	
Sequence Y	2	5	8	11	
Sequence Z	14	45	88	143	

- 12 (a)** Work out the n th term of sequence X .

[2 marks]

Answer _____

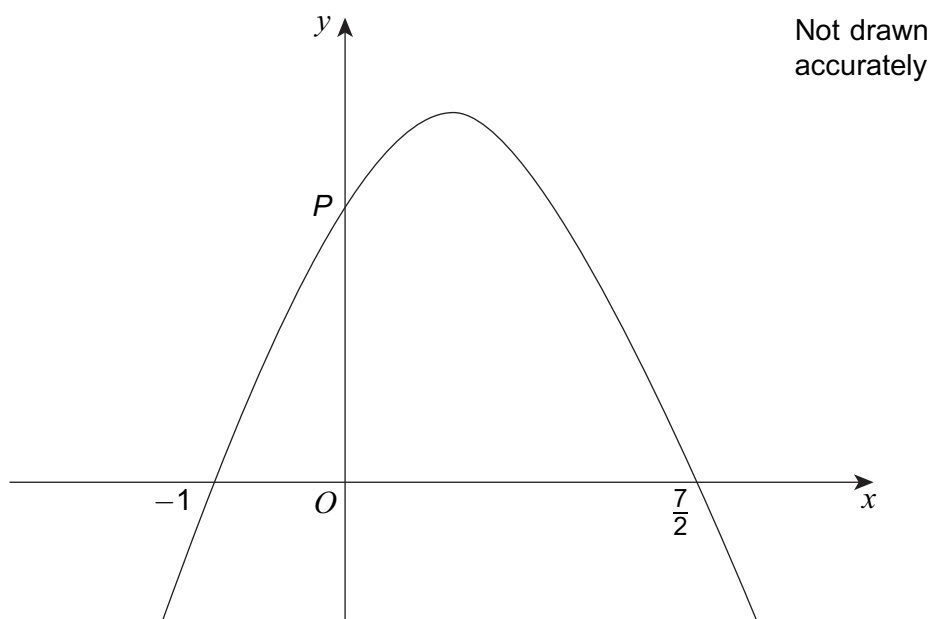


Using your answer to part (a), or otherwise, work out the n th term of sequence Z. Give your answer in the form $an^2 + bn + c$ where a , b and c are integers.

[illegible]

8

The graph intersects the x -axis at $(-1, 0)$ and $(\frac{7}{2}, 0)$ and the y -axis at point P .



[4 marks]

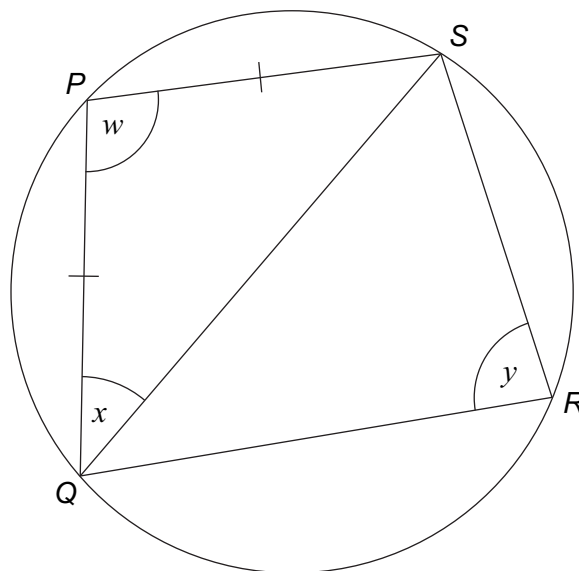
This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Answer (_____ , _____)



P, Q, R and S are points on the circumference of a circle.

$$PQ = PS$$



Not drawn accurately

Work out the size of angle x .

[4 marks]

[illegible]

Answer _____ degrees



15 (a) Solve $\frac{2}{5}\sqrt{x} = 1$

[2 marks]

$x =$ _____

15 (b) Solve $x^3 = 5x^2$

[2 marks]

Answer _____



16

Rearrange

$$y = \frac{8(w-x)}{x}$$

to make x the subject.**[4 marks]**

Answer _____

Turn over for the next question**Turn over ►**

17

A cylinder has base radius x cm and height y cm

A hemisphere has radius $6y$ cm

The cylinder and hemisphere have equal volumes.

Work out the value of $\frac{x}{y}$

You **must** show your working.

[3 marks]

Answer _____



18 Angle y is acute.

$$\tan y = \frac{p+1}{p-1} \quad \text{where } p \text{ is a constant greater than } 1$$

18 (a) Which of the statements below is correct?
Circle your answer.

[1 mark]

$y = 45^\circ$

$y < 45^\circ$

$y > 45^\circ$

y could be any acute angle

18 (b) Work out the expression for $\sin y$

Give your answer in the form $\frac{ap+b}{\sqrt{cp^2+d}}$ where a , b , c and d are integers.

You may use a diagram to help you.

[4 marks]

Answer _____



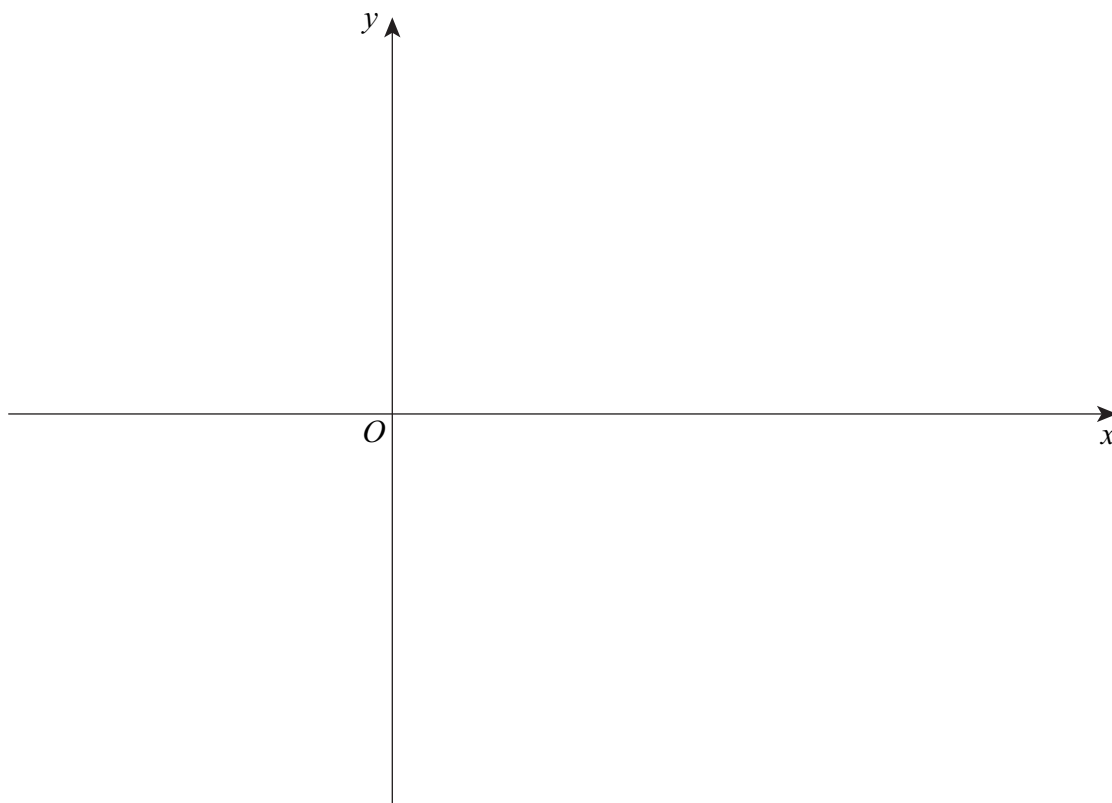
19 The continuous curve $y = g(x)$ has exactly two stationary points.

The stationary points are

- a point of inflection at $P(1, 2)$
- a minimum point at $Q(a, b)$ where $a > 1$ and $b < 0$

On the axes below, sketch the curve.
Label points P and Q on your sketch.

[3 marks]



20

Under the transformation represented by $\begin{pmatrix} -1 & -3 \\ 2 & 4 \end{pmatrix}$,

the image of point $P(a, 2)$ is point Q .

Can point Q be the same as point P ?

You **must** show your working.

[4 marks]

Turn over for the next question



21

Solve $\frac{3}{x-2} + \frac{2}{x-1} = 5$

Do **not** use trial and improvement.
Write your solutions to 3 significant figures.

[6 marks]

Answer _____

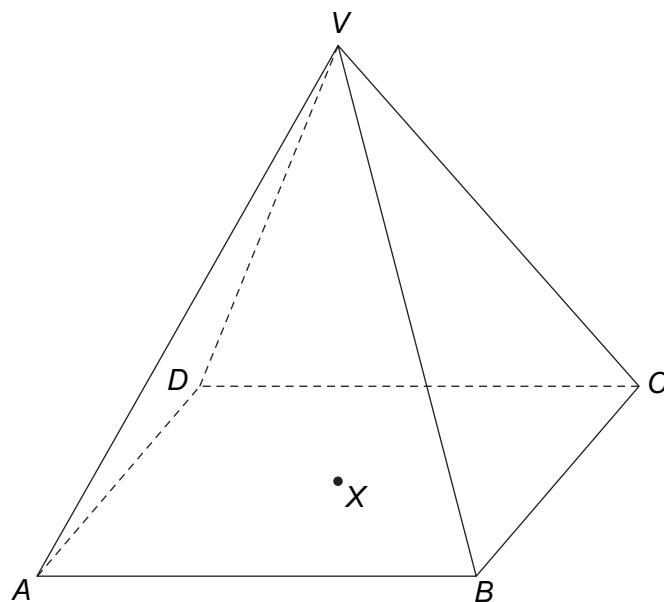


22Pyramid $VABCD$ has a horizontal rectangular base. X is the centre of the base. V is vertically above X .

$VB = VC = 17 \text{ cm}$

$AB = 22 \text{ cm}$

$BC = 16 \text{ cm}$

Work out the angle between the planes VBC and $ABCD$.**[4 marks]**

Answer _____ degrees

Turn over ►

23

Shape A maps to shape B by an enlargement, scale factor 3, centre the origin.
Shape B maps to shape C by a rotation through 180° , centre the origin.

Shape A can be mapped to shape C by a **single** transformation.

Use matrices to show that the single transformation is an enlargement, centre the origin.

State the scale factor of the enlargement.

[5 marks]

24

$$f(x) = \frac{x}{2x+1} \quad \text{for positive values of } x.$$

Work out $f(x+1) - f(x)$

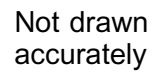
Give your answer as a fraction in its simplest form.
You **must** show your working.

[5 marks]

Turn over for the next question



The tangent to the curve at $P(2, 11)$ intersects the y -axis at D .



[6 marks]

[illegible]

Answer _____ units



26 (a) Prove that $\sin^2 x - 3 \cos^2 x \equiv 4 \sin^2 x - 3$

[2 marks]

26 (b) Hence, or otherwise, work out the values of x between 0° and 360° for which
 $\sin^2 x - 3 \cos^2 x = 0$

[4 marks]

Answer _____

END OF QUESTIONS



There are no questions printed on this page

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