

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

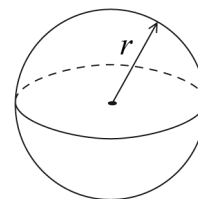
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.
- The use of a calculator is expected but calculators with a facility for symbolic algebra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



Formulae Sheet

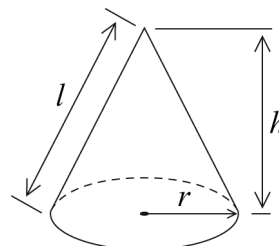
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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



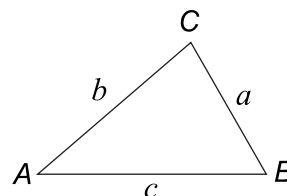
In any triangle ABC

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

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



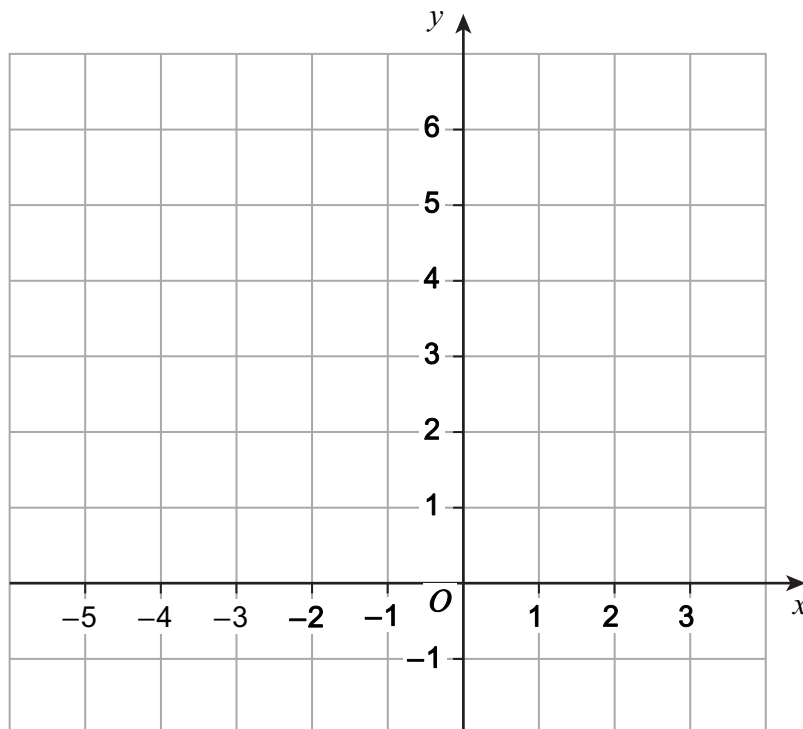
Answer **all** questions in the spaces provided.

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]

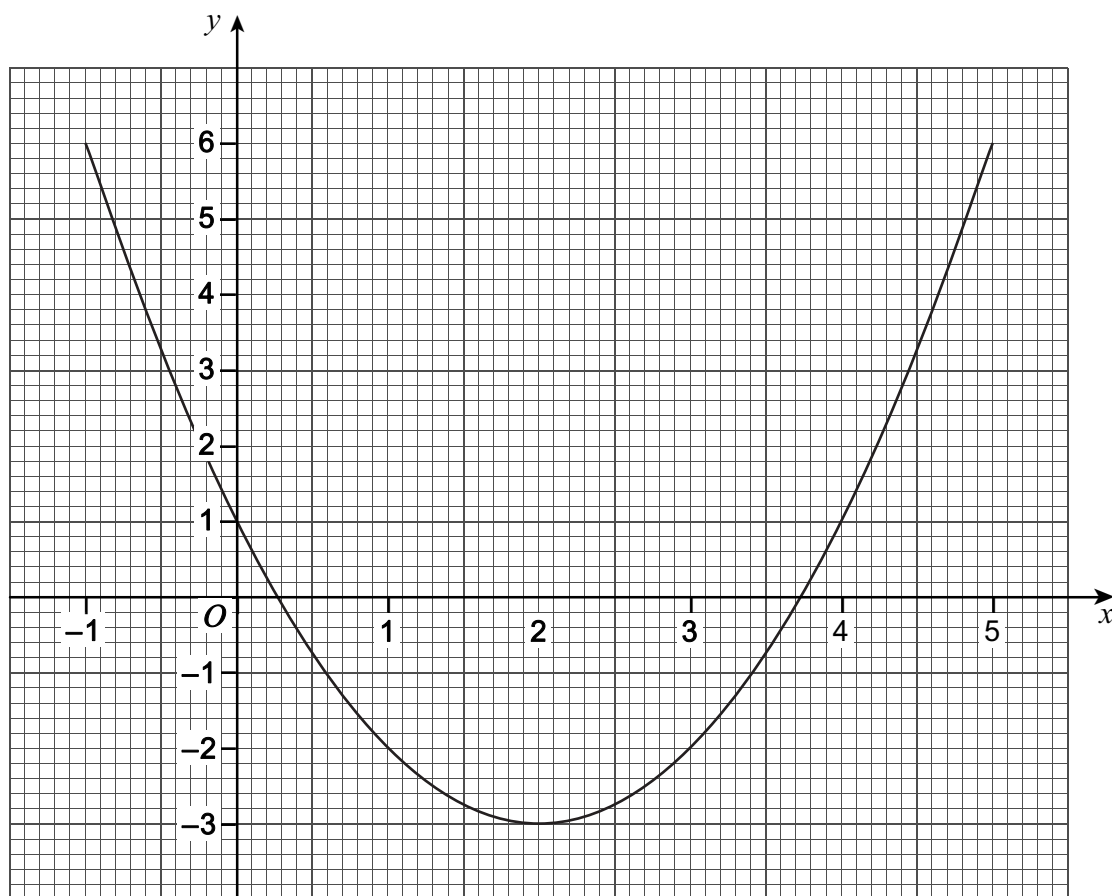


Answer _____ square units



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]

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

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

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

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



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
$a^3 < 0$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$b < 10a^2$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$ab > 0$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$b - c > 1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[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 (_____ , _____)



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]

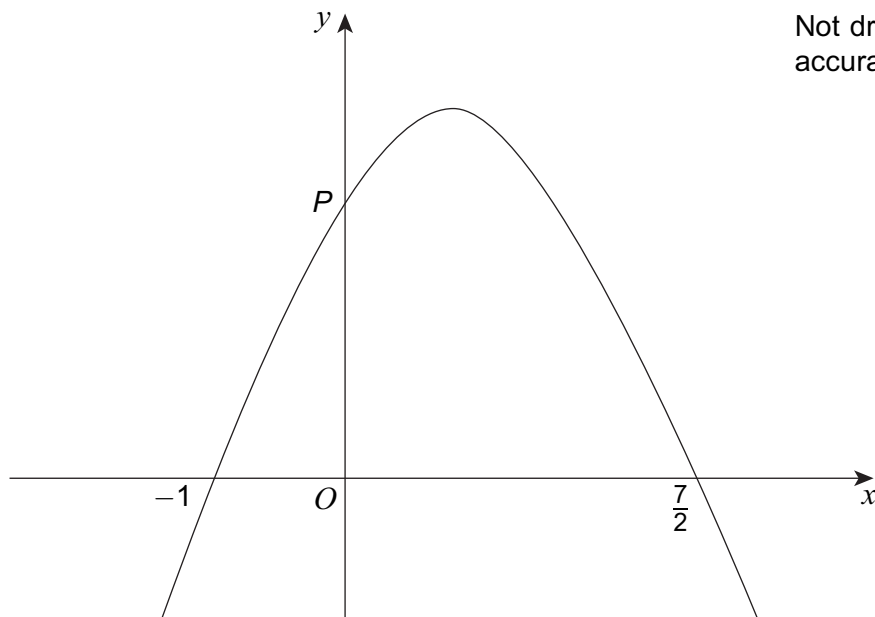
Answer _____



13

Here is a sketch of $y = a + bx - 2x^2$ where a and b are constants.

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



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

[4 marks]

Answer (_____ , _____)



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

[2 marks]

$x =$ _____

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

[2 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 _____

8

Turn over ►



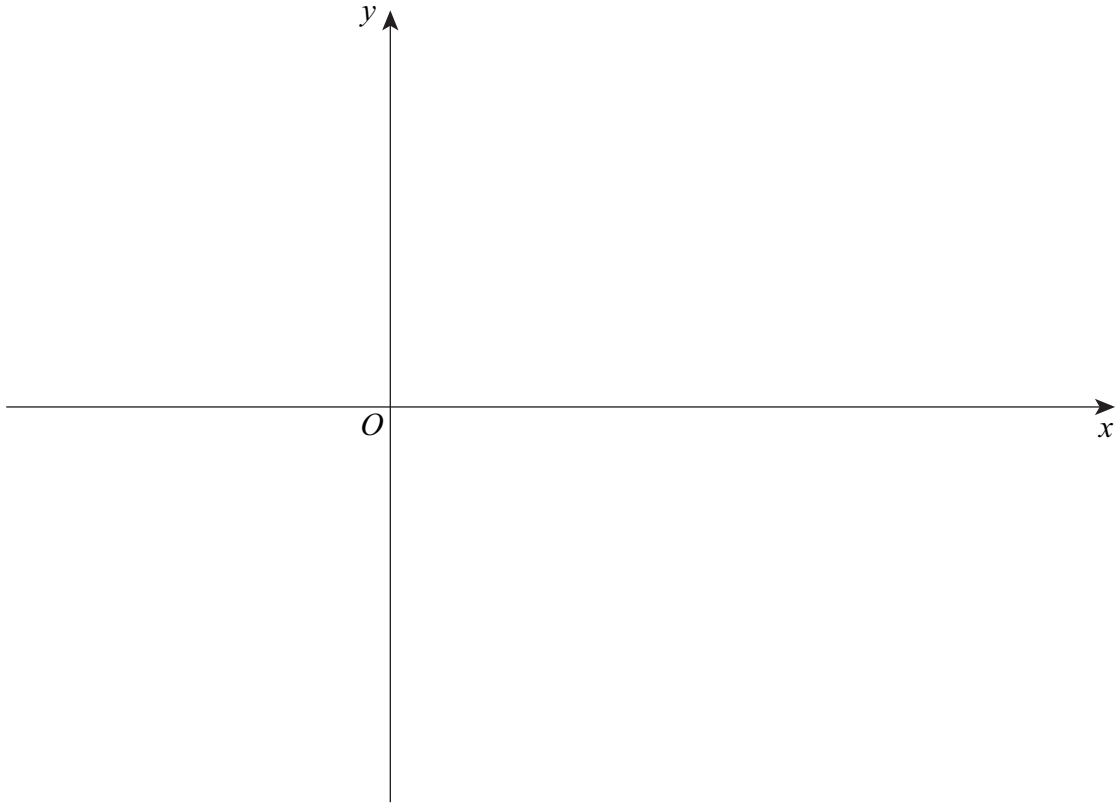
19 The continuous curve $y = g(x)$ has exactly two stationary points.

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

7

Turn over ►

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 _____



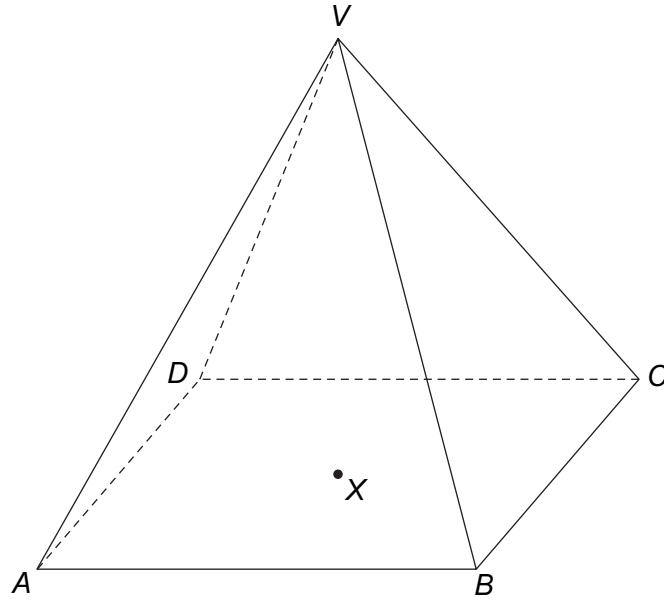
22

Pyramid $VABCD$ has a horizontal rectangular base.

X is the centre of the base.

V is vertically above X .

$$VB = VC = 17 \text{ cm} \quad AB = 22 \text{ cm} \quad BC = 16 \text{ cm}$$



Work out the angle between the planes VBC and $ABCD$.

[4 marks]

Answer _____ degrees

10

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 $f(x) = \frac{x}{2x+1}$ 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



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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