

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# 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

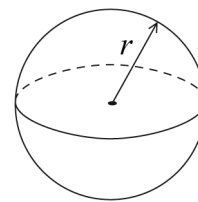
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 105.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.
- The use of a calculator is expected but calculators with a facility for symbolic algebra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



## Formulae Sheet

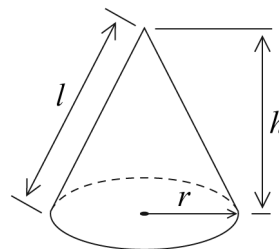
**Volume of sphere**  $= \frac{4}{3}\pi r^3$

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



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

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



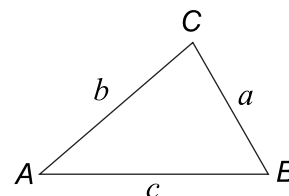
**In any triangle ABC**

**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**

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



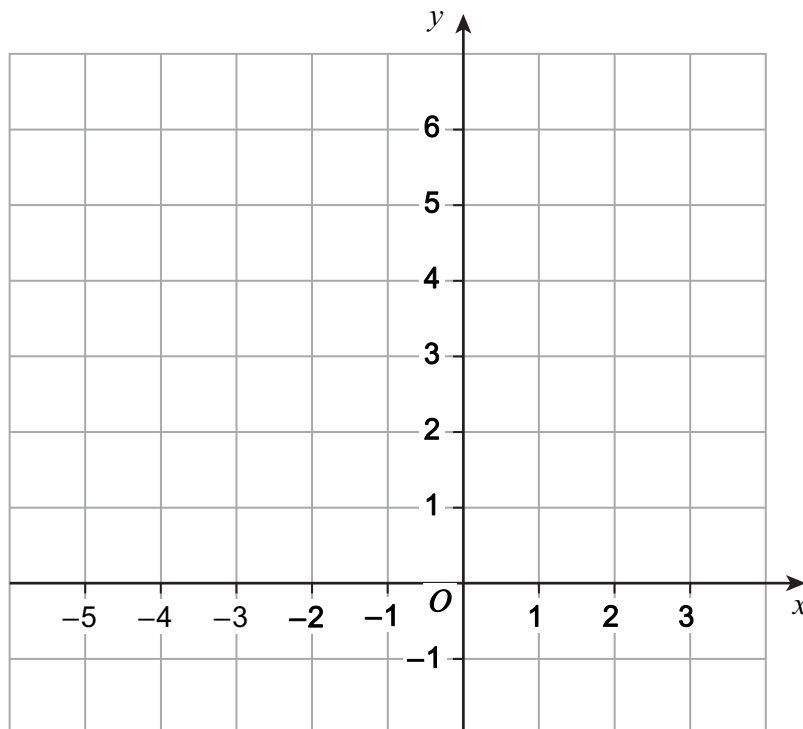
Answer **all** questions in the spaces provided.

**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]**




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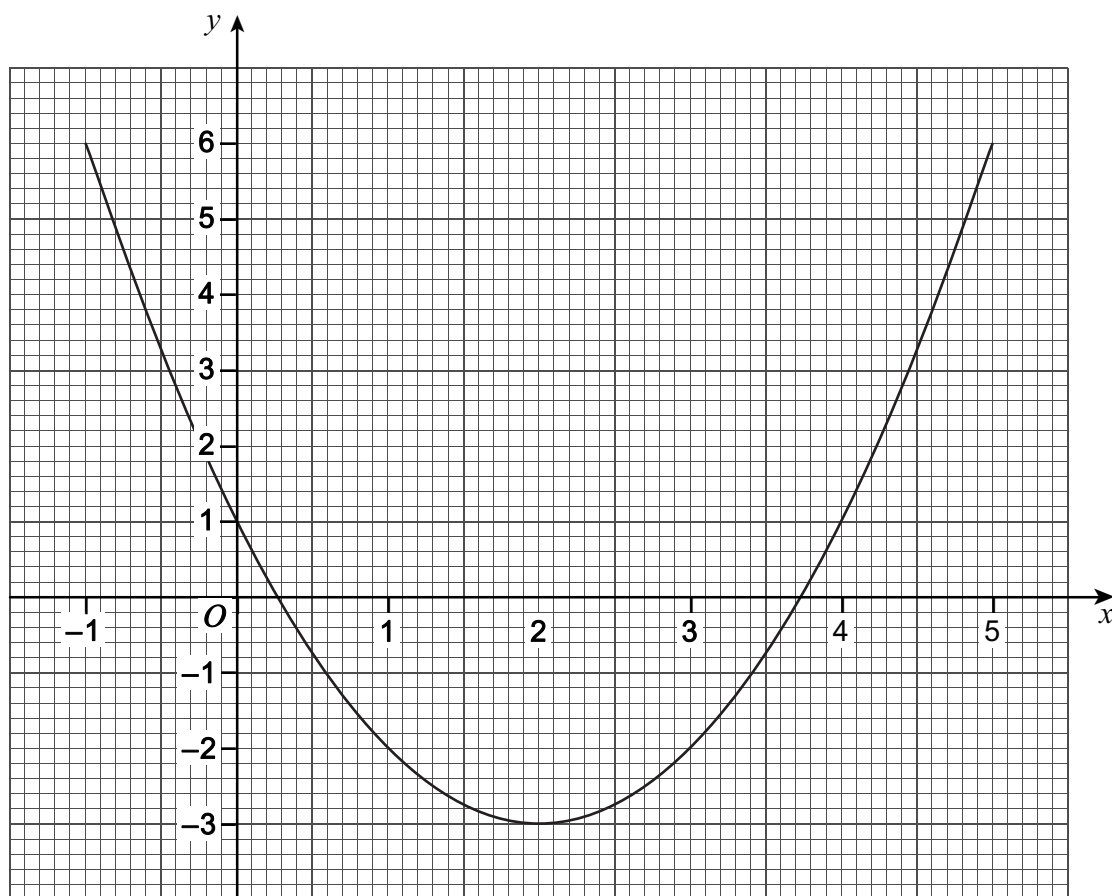
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Answer \_\_\_\_\_ square units



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]

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Answer \_\_\_\_\_

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

[2 marks]

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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]**

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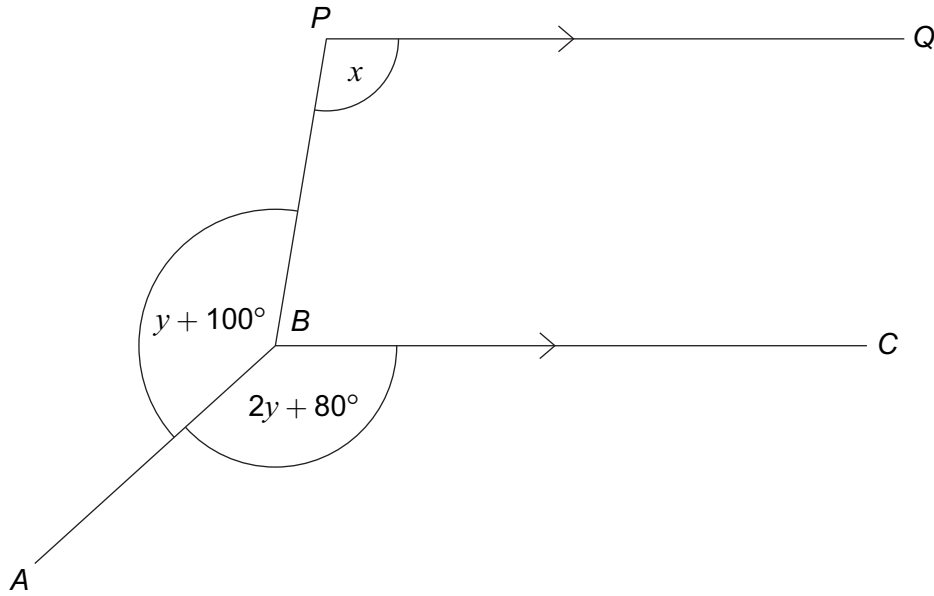
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Answer ( \_\_\_\_\_ , \_\_\_\_\_ )



9

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


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

[2 marks]

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Answer \_\_\_\_\_

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

[2 marks]

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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]**

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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]**

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Answer \_\_\_\_\_

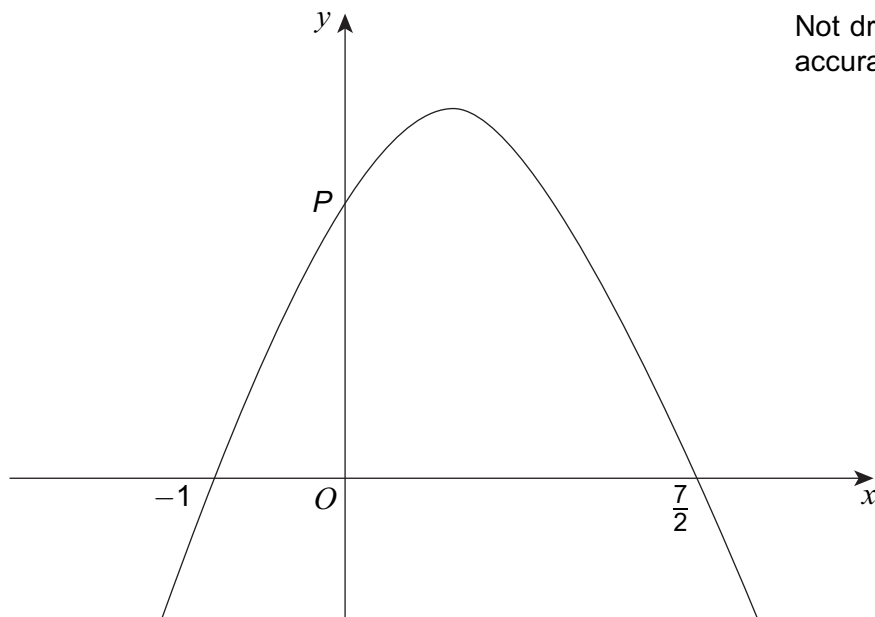




13

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]

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Answer ( \_\_\_\_\_ , \_\_\_\_\_ )

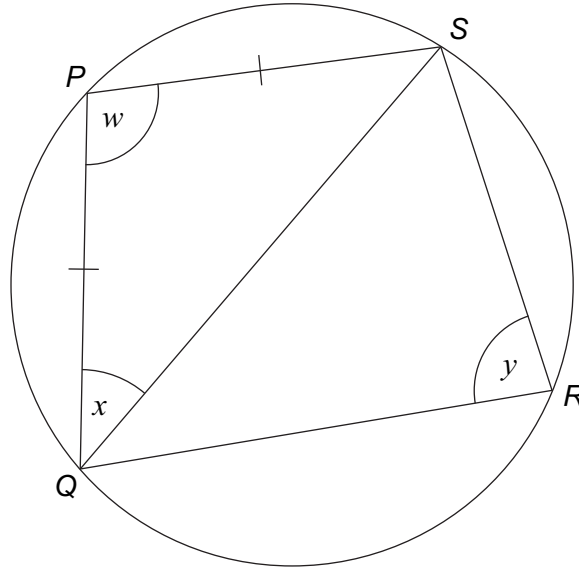


14

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

$$w : y = 7 : 5$$

$$PQ = PS$$



Not drawn  
accurately

Work out the size of angle  $x$ .

[4 marks]

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Answer \_\_\_\_\_ degrees

8
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Turn over ►



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

[2 marks]

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

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

[2 marks]

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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]

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Answer \_\_\_\_\_

8
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Turn over ►



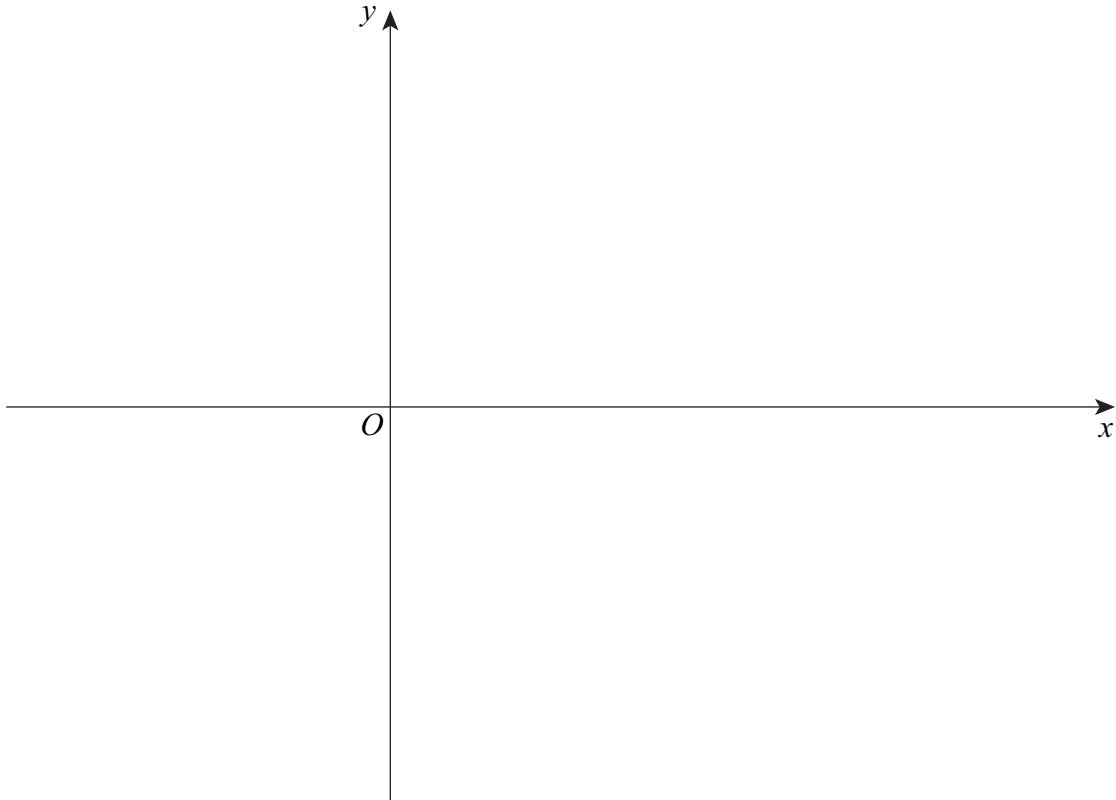
19 The continuous curve  $y = g(x)$  has exactly two stationary points.

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



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.

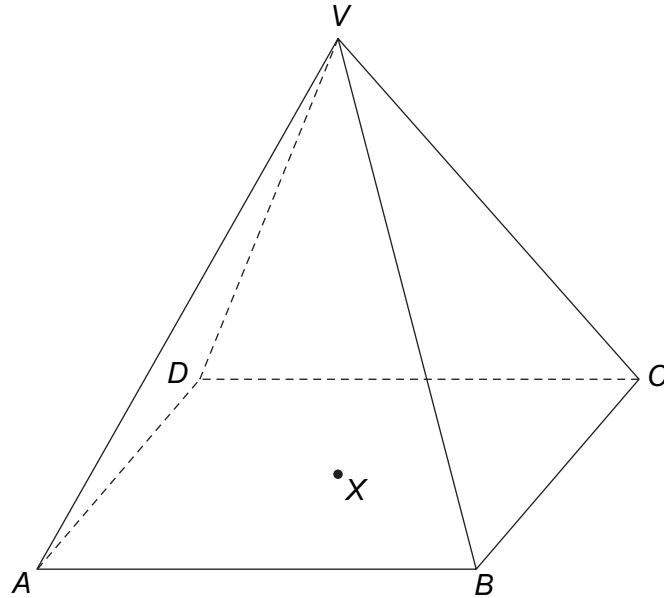
$X$  is the centre of the base.

$V$  is vertically above  $X$ .

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

$$AB = 22 \text{ cm}$$

$$BC = 16 \text{ cm}$$



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

[4 marks]

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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  $180^\circ$ , 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

10
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**Turn over ►**



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

**[2 marks]**

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**26 (b)** Hence, or otherwise, work out the values of  $x$  between  $0^\circ$  and  $360^\circ$  for which

$$\sin^2 x - 3 \cos^2 x = 0$$

**[4 marks]**

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Answer \_\_\_\_\_

**END OF QUESTIONS**



**There are no questions printed on this page**

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