Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
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	
TOTAL	

AQA

Level 2 Certificate in Further Mathematics
June 2013

Further Mathematics 8360/2

Level 2

Paper 2 Calculator

Friday 21 June 2013 9.00 am to 11.00 am

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

Time allowed
- 2 hours

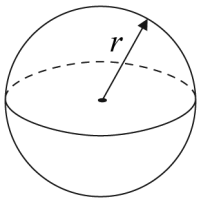
Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- In all calculations, show clearly how you work out your answer.
- If your calculator does not have a π button, take the value of π to be 3.14 unless another value is given in the question.

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

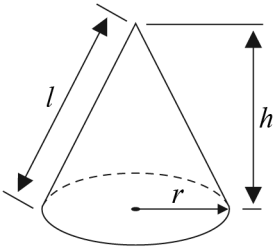
Volume of sphere $= \frac{4}{3}\pi r^3$

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



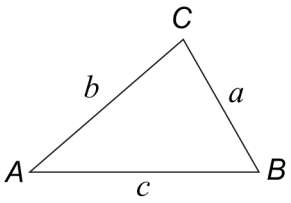
Volume of cone $= \frac{1}{3}\pi r^2 h$

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



In any triangle ABC

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



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

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

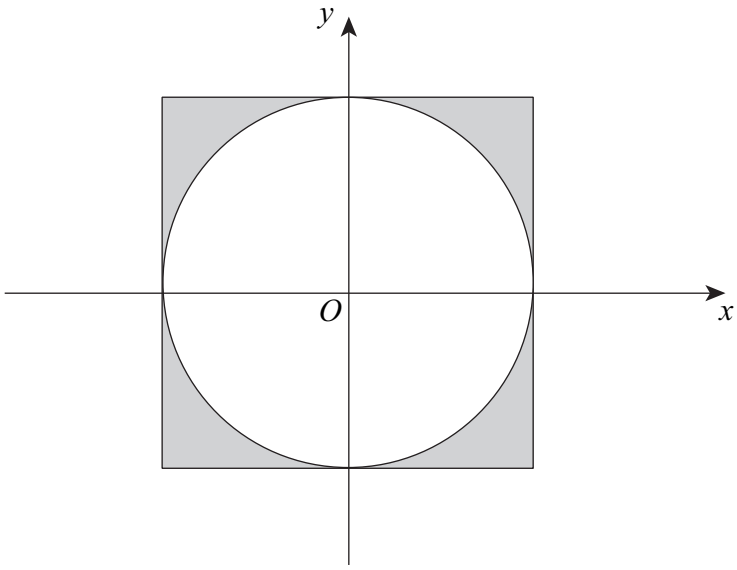
$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

Trigonometric Identities

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

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

1 The circle $x^2 + y^2 = 25$ touches each side of the square as shown.



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Work out the total shaded area.

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Answer..... *(3 marks)*

3

2 w is an integer such that $6 \leqslant 3w < 18$
x is an integer such that $-4 \leqslant x \leqslant 3$

2 (a) Work out **all** the possible integer values of w.

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Answer..... *(3 marks)*

2 (b) Write down the **highest** possible value of x^2

Answer..... *(1 mark)*

2 (c) Work out the **lowest** possible value of $w - x$

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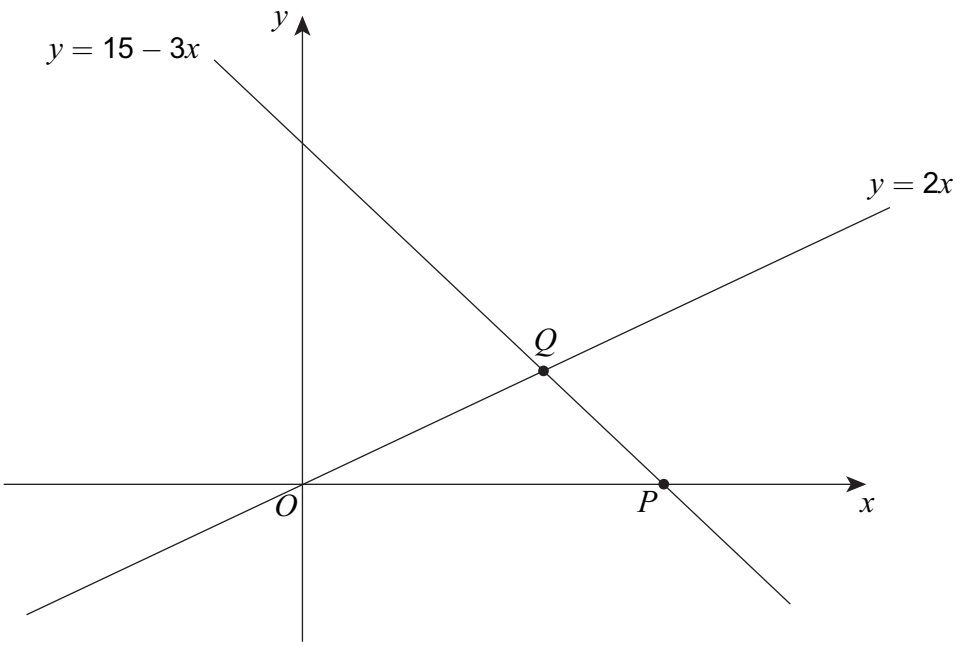
Answer..... *(2 marks)*

3 The sketch graphs of two straight lines are shown.



3 (a) Work out the coordinates of P.

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Answer (..... , ...) *(1 mark)*

3 (b) Work out the coordinates of Q.

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Answer (..... , ...) *(3 marks)*

3 (c) Use your answers to parts (a) and (b) to work out the area of triangle OPQ.

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Answer..... *(2 marks)*

12

Turn over ▶

4 You are given that $m : n = 2 : 5$

4 (a) Write m in terms of n.

$m =$ ..... *(1 mark)*

4 (b) You are also given that $a : b = 10m : 3n$

Work out $a : b$ where a and b are integers.

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Answer ..... : ..... *(2 marks)*

5 $y = (5x - 3)^2$

Work out $\frac{dy}{dx}$

Give your answer in the form $a(bx - c)$ where a, b and c are integers > 1

$\frac{dy}{dx} =$ ..... *(4 marks)*

Turn over for the next question

7

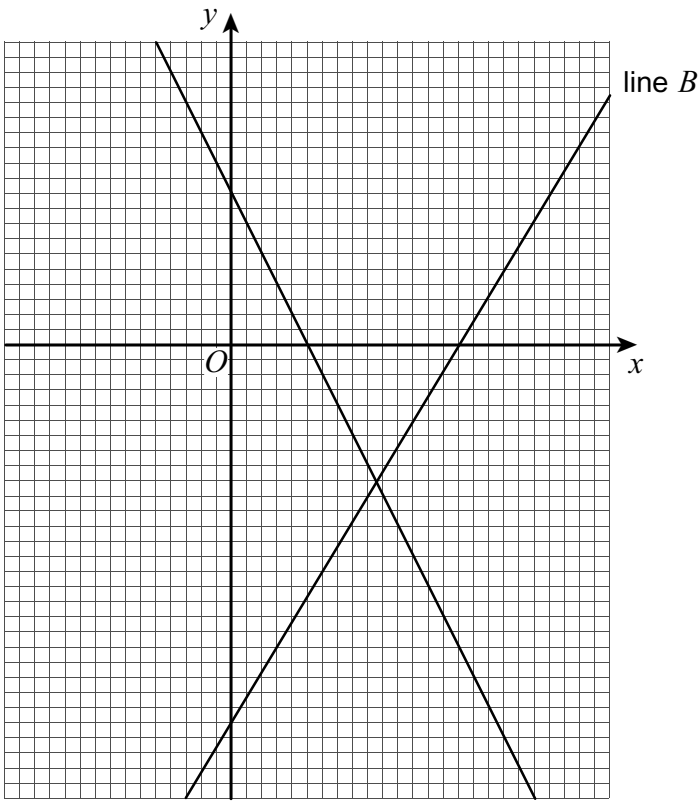
6 (a) Show that $\dfrac{c^2 + 5c + 4}{3c + 3}$ simplifies to $\dfrac{c + 4}{3}$

(2 marks)

6 (b) Hence, or otherwise, simplify fully $\dfrac{c^2 + 5c + 4}{3c + 3} + \dfrac{3 - 2c}{6}$

Answer..... *(3 marks)*

7 The graph shows two straight lines.



The equation of line A is $y = 2 - x$

Work out the equation of line B.

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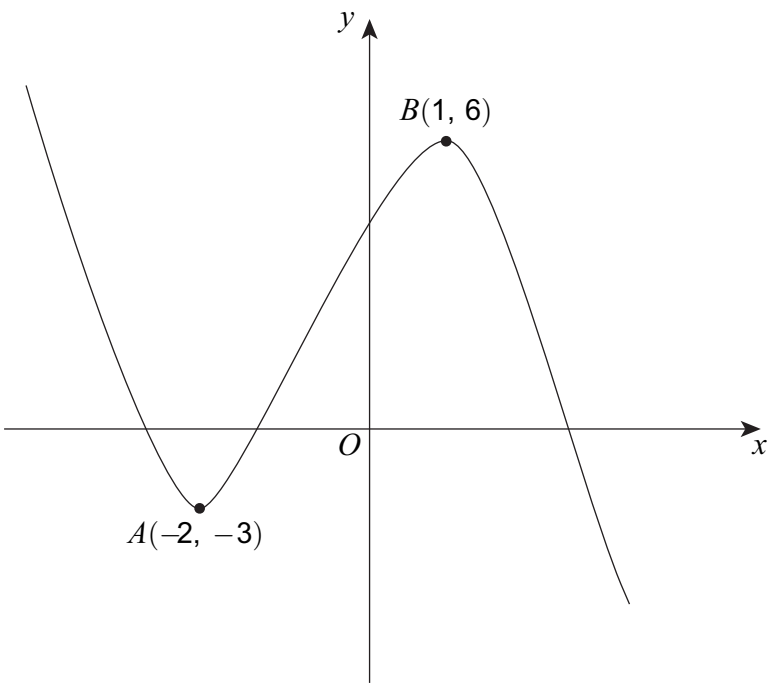
Answer..... *(4 marks)*

Turn over ▶

8 A sketch of $y = f(x)$ is shown.
There are stationary points at A and B.



8 (a) Write down the equation of the tangent to the curve at A.

Answer..... *(1 mark)*

8 (b) Write down the equation of the normal to the curve at B.

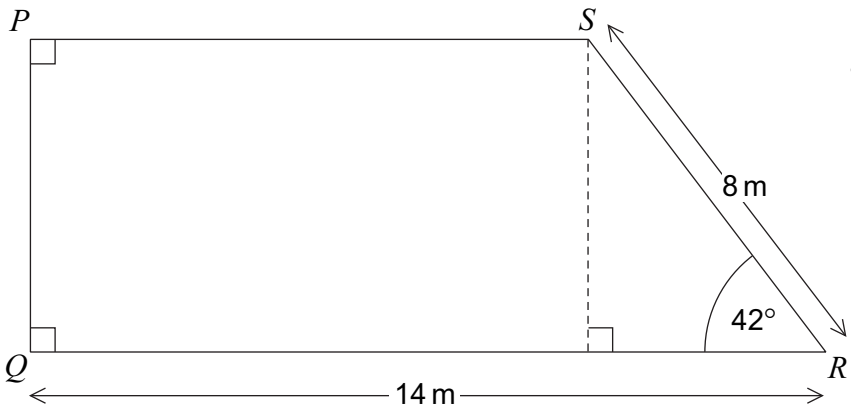
Answer..... *(1 mark)*

8 (c) Circle the range of values of x for which $f(x)$ is an increasing function.

$x < -2$ $\quad -2 < x < 1$ $\quad -3 < x < 6$ $\quad x > 1$

(1 mark)

9 $PQRS$ is a trapezium.



Work out the perimeter of $PQRS$.

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Perimeter = ... m *(5 marks)*

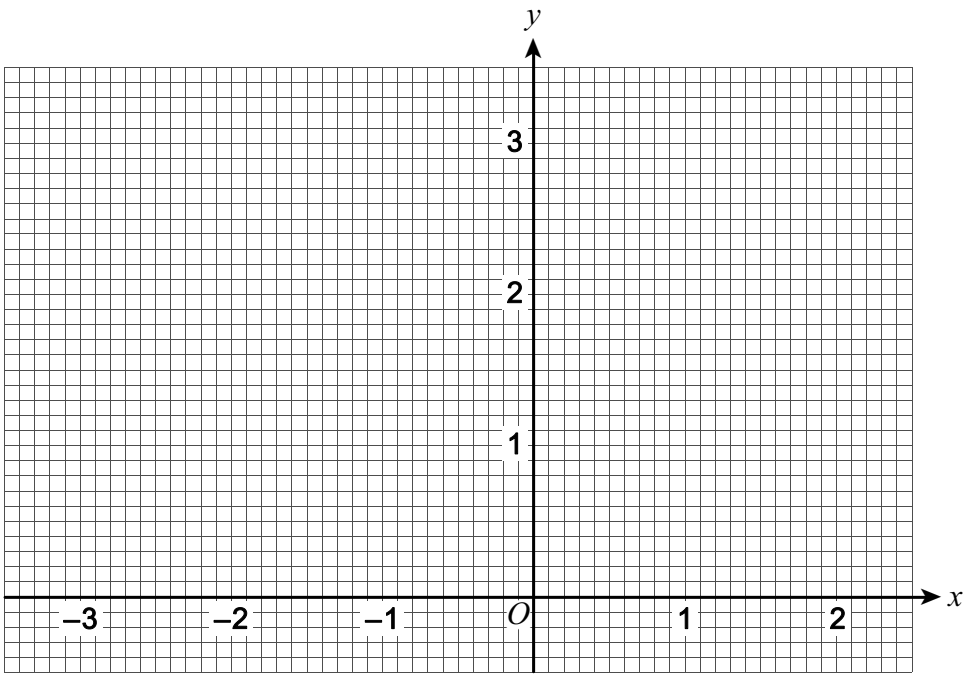
8

Turn over ▶

10 A function $f(x)$ is defined as

$$\begin{aligned} f(x) &= x + 3 && -3 \leqslant x < 0 \\ &= 3 && 0 \leqslant x < 1 \\ &= 5 - 2x && 1 \leqslant x \leqslant 2 \end{aligned}$$

Draw the graph of $y = f(x)$ for $-3 \leqslant x \leqslant 2$



(3 marks)

11 (a) Work out $\begin{pmatrix} 2 & -1 \\ \frac{1}{3} & 0 \end{pmatrix}\begin{pmatrix} 0 & b \\ a & c \end{pmatrix}$

Give your answer in terms of a, b and c.

Answer $\begin{pmatrix} \ldots\ldots\ldots & \ldots\ldots\ldots \\ \ldots\ldots\ldots & \ldots\ldots\ldots \end{pmatrix}$ *(2 marks)*

11 (b) You are given that $\begin{pmatrix} 2 & -1 \\ \frac{1}{3} & 0 \end{pmatrix}\begin{pmatrix} 0 & b \\ a & c \end{pmatrix} = \mathbf{I}$ where **I** is the identity matrix.

Work out the values of a, b and c.

$a =$ ..... , $b =$ ..... , $c =$ ..... *(3 marks)*

8

Turn over ▶

12 Prove that $(5n + 3)(n - 1) + n(n + 2)$ is a multiple of 3 for all integer values of n.

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(4 marks)

13 The graph of $y = f(x)$ is a straight line.

The domain of $f(x)$ is $1 \leqslant x \leqslant 5$

The range of $f(x)$ is $3 \leqslant f(x) \leqslant 11$

Work out **one** possible expression for $f(x)$.

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$f(x) =$ ..... *(4 marks)*

14 Work out an expression for the nth term of the quadratic sequence

11 15 21 29 39 .....

nth term = ... *(4 marks)*

12

15 (a) $a^{11} \times b^6 \times c = a^9 \times b^{10}$

Write c in terms of a and b.
Give your answer in its simplest form.

$c =$ ..... *(3 marks)*

15 (b) $p^{-2} = q^6 \times r^4$

Write p in terms of q and r.
Give your answer in its simplest form.

$p =$ ..... *(2 marks)*

16 A, B and C are points on the circumference of a circle.

- BC is a diameter
- BCP is a straight line
- AP is a tangent to the circle
- $PC = CA$

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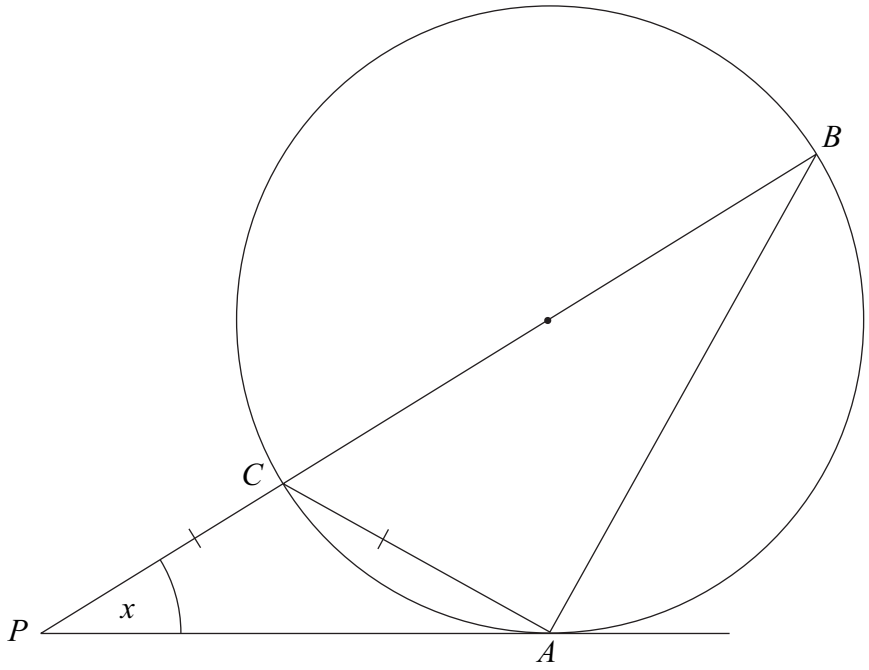

Work out the value of angle CPA, marked x on the diagram.

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$x =$ ..... degrees *(5 marks)*

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Turn over ▶

17 Solve $\dfrac{4}{x-2}+\dfrac{1}{x+3}=5$

Answer..... *(7 marks)*

18 The curve $y = x^3 + bx + c$ has a stationary point at $(-2, 20)$.

Work out the values of b and c.

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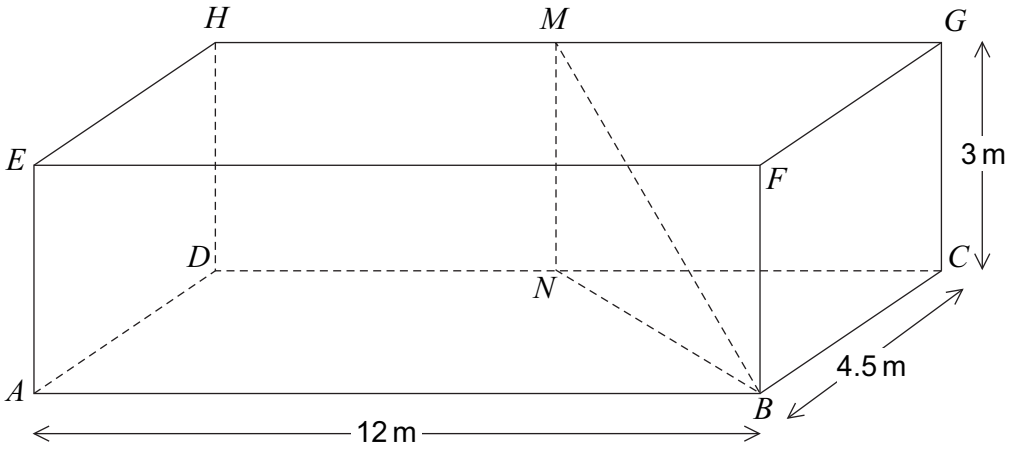
$b =$ .....

$c =$ ..... *(5 marks)*

Turn over for the next question

19 $ABCDEFGH$ is a cuboid.
M is the midpoint of HG.
N is the midpoint of DC.



19 (a) Show that $BN = 7.5\,\text{m}$

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(2 marks)

19 (b) Work out the angle between the line MB and the plane $ABCD$.

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Answer ..... degrees *(2 marks)*

19 (c) Work out the **obtuse** angle between the planes MNB and $CDHG$.

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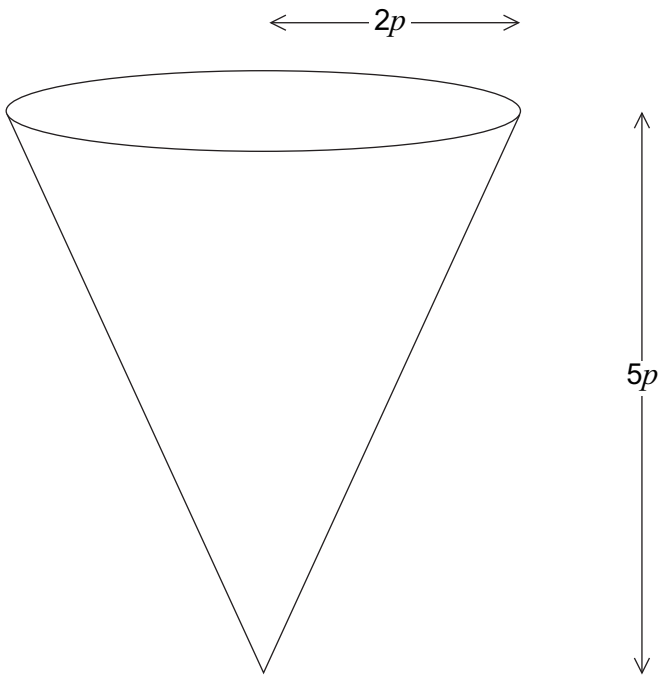
Answer ..... degrees *(2 marks)*

6

20 This right circular cone has radius $2p$ and height $5p$.
The dimensions are in centimetres.



The volume of the cone is $22\,500\pi$ cm^3.

Work out the value of p.

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$p =$ ..... cm *(4 marks)*

21 $(x - a)$ is a factor of $2x^3 - 7ax + 3a$

Work out the **largest** possible value of a.

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Answer..... *(4 marks)*

22 Solve $\tan^2\theta + 3\tan\theta = 0$ for $0° < \theta < 360°$

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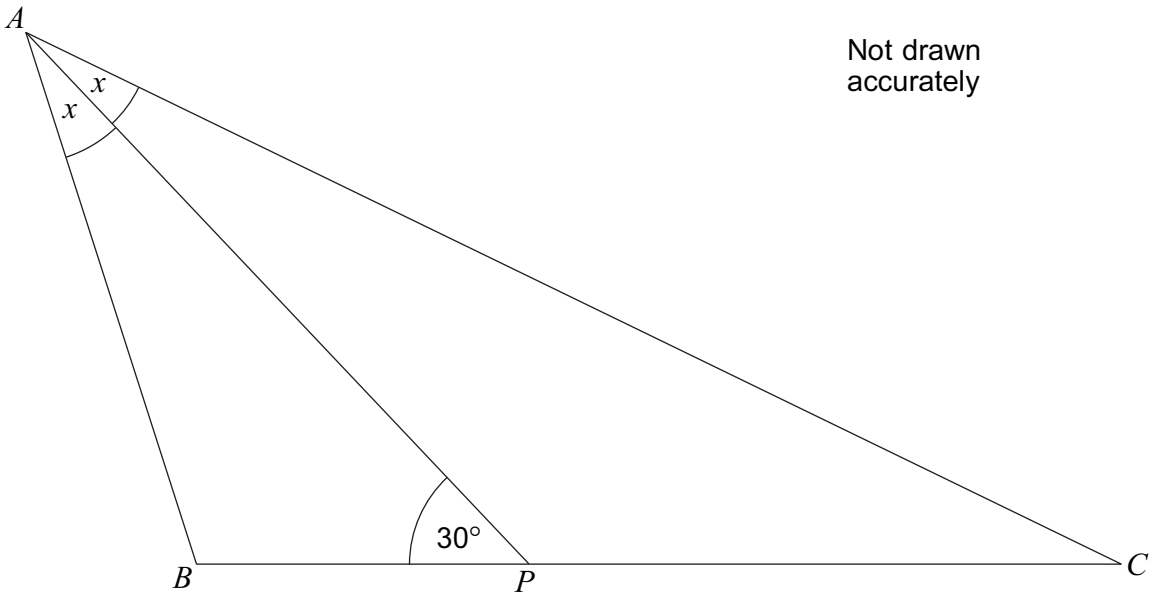
Answer..... *(5 marks)*

13

23 In triangle ABC, AP bisects angle BAC.



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Use the sine rule in triangles ABP and ACP to prove that $\frac{AB}{AC} = \frac{BP}{PC}$

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(5 marks)

END OF QUESTIONS

5

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