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General Certificate of Secondary Education  
June 2004



**MATHEMATICS (SPECIFICATION A) 3301/1H**  
**Higher Tier**  
**Paper 1 Non-Calculator**

Tuesday 8 June 2004 1.30 pm to 3.30 pm

**H**

<p><b>In addition to this paper you will require:</b> mathematical instruments. You must <b>not</b> use a calculator.</p>	
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Time allowed: 2 hours

**Instructions**

- Use blue or black ink or ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this booklet.

**Information**

- The maximum mark for this paper is 100.
- Mark allocations are shown in brackets.
- Additional answer paper, graph paper and tracing paper will be issued on request and must be tagged securely to this answer booklet.
- The use of a calculator is **not** permitted.

**Advice**

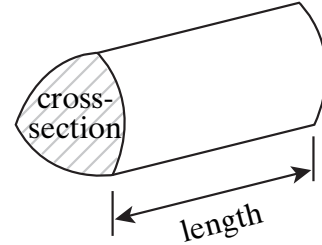
- In all calculations, show clearly how you work out your answer.

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	
TOTAL	
Examiner's Initials	

### Formulae Sheet: Higher Tier

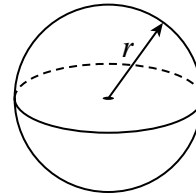
You may need to use the following formulae:

**Volume of prism** = area of cross-section  $\times$  length



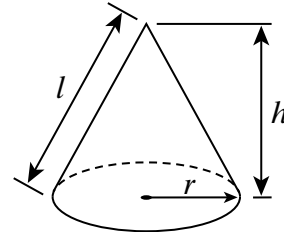
**Volume of sphere** =  $\frac{4}{3} \pi r^3$

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



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

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

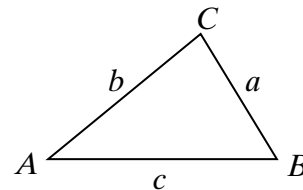


**In any triangle ABC**

**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**  $a^2 = b^2 + c^2 - 2bc \cos A$



**The Quadratic Equation**

The solutions of  $ax^2 + bx + c = 0$ , where  $a \neq 0$ , are given by

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

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

**1** Tom, Sam and Matt are counting drum beats.

Tom hits a snare drum every 2 beats.  
Sam hits a kettle drum every 5 beats.  
Matt hits a bass drum every 8 beats.

Tom, Sam and Matt start by hitting their drums at the same time.  
How many beats is it before Tom, Sam and Matt **next** hit their drums at the **same** time?

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Answer ..... beats (2 marks)

**2** Simplify

(a)  $w^6 \times w^2$

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Answer ..... (1 mark)

(b)  $x^3 \div x^5$

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Answer ..... (1 mark)

(c)  $(y^3)^2$

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Answer ..... (1 mark)

- 3 Use approximations to estimate the value of  $\frac{316 \times 4.03}{0.198}$

You **must** show your working.

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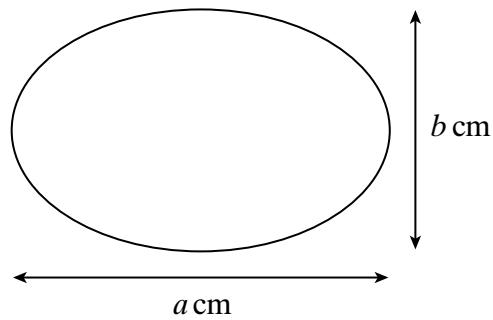
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Answer ..... (3 marks)

- 4 The diagram shows an ellipse of width  $a$  cm and height  $b$  cm.



One of the following is a formula for the area of the ellipse.

Formula 1  $\pi(a + b)$

Formula 2  $\pi ab$

Formula 3  $\pi a^2 b^2$

- (a) Which is the correct formula?

Answer ..... (1 mark)

- (b) Explain how you can tell that this formula is correct.

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(1 mark)

5 Here are six numbers written in standard form.

$$2.6 \times 10^5 \quad 1.75 \times 10^6 \quad 5.84 \times 10^0 \quad 8.2 \times 10^{-3} \quad 3.5 \times 10^{-1} \quad 4.9 \times 10^{-2}$$

(a) Write down the largest number.

Answer ..... (1 mark)

(b) Write down the smallest number.

Answer ..... (1 mark)

(c) Write  $4.9 \times 10^{-2}$  as an ordinary number.

Answer ..... (1 mark)

(d) Work out  $2.6 \times 10^5 \div 0.1$   
Give your answer in standard form.

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Answer ..... (1 mark)

6 Make  $p$  the subject of the formula  $t = 5p + 40$

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

**TURN OVER FOR THE NEXT QUESTION**

Turn over 

- 7 (a) Complete the table of values for  $y = 2x^2 - 4x - 1$

$x$	-2	-1	0	1	2	3
$y$	15		-1		-1	5

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(2 marks)

- (b) On the grid opposite, draw the graph of  $y = 2x^2 - 4x - 1$  for values of  $x$  from -2 to +3.

(2 marks)

- (c) An approximate solution of the equation  $2x^2 - 4x - 1 = 0$  is  $x = 2.2$

- (i) Explain how you can find this from the graph.

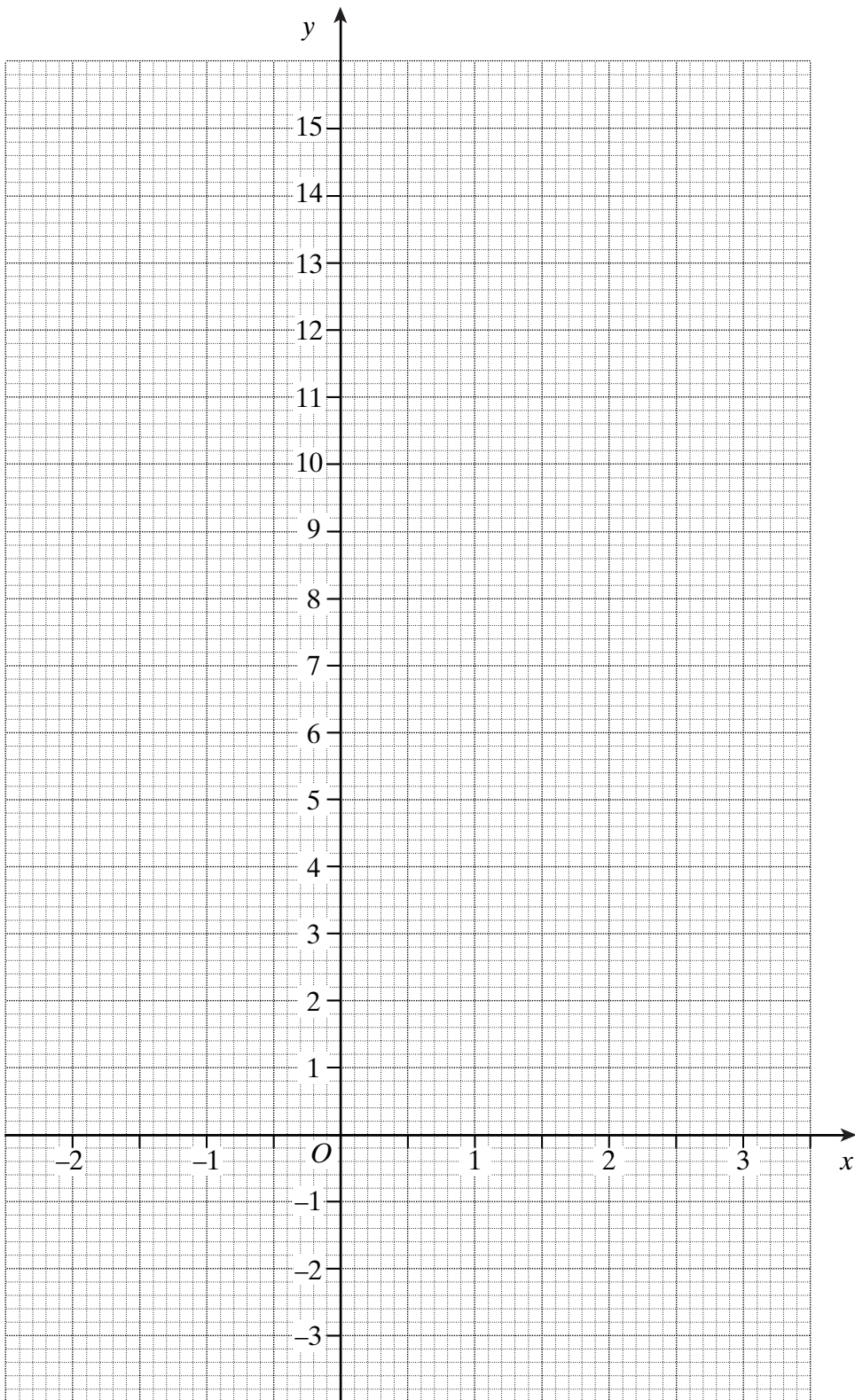
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(1 mark)

- (ii) Use your graph to write down another solution of this equation.

Answer  $x =$  ..... (1 mark)



8 The table shows the distances travelled to school by 50 pupils living in a town.

Distance travelled, $d$ (km)	Frequency
$0 < d \leq 2$	12
$2 < d \leq 4$	18
$4 < d \leq 6$	10
$6 < d \leq 8$	8
$8 < d \leq 10$	2

(a) Calculate an estimate of the mean distance travelled to school by these pupils.

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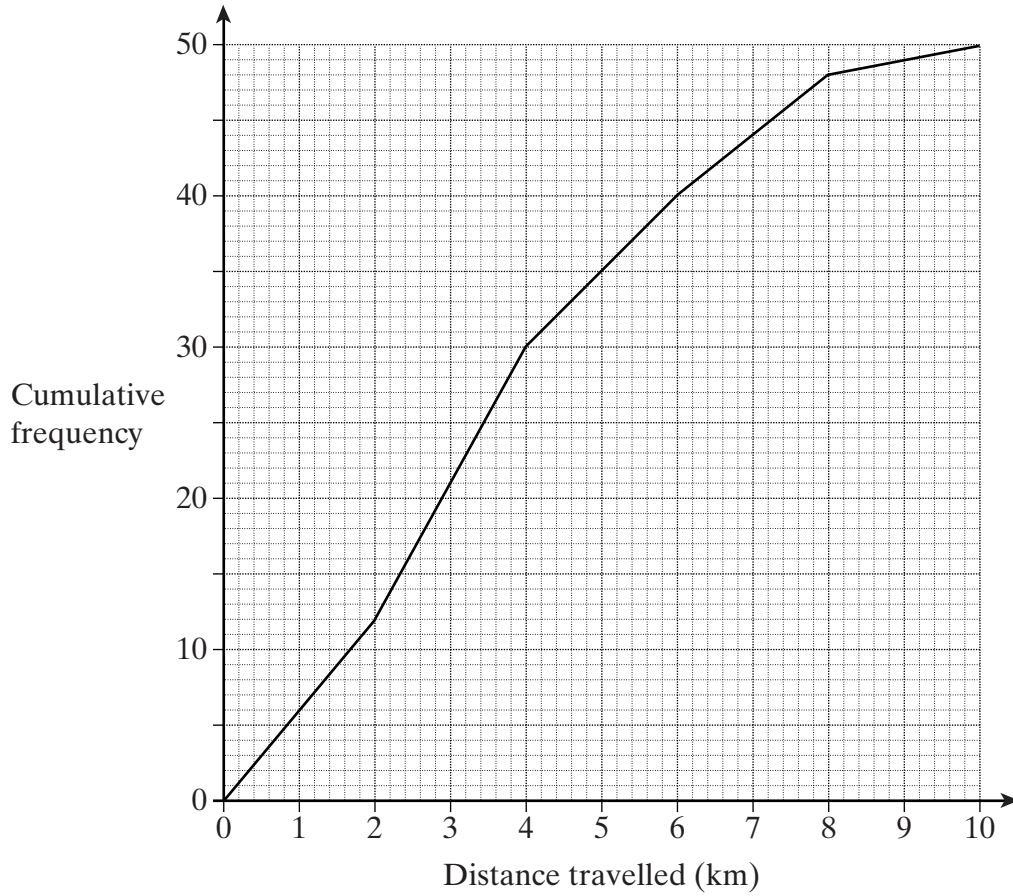
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Answer ..... (5 marks)



(b) The distances travelled are shown on the cumulative frequency diagram.



Use the cumulative frequency diagram to estimate

(i) the median,

Answer ..... km (1 mark)

(ii) the interquartile range.

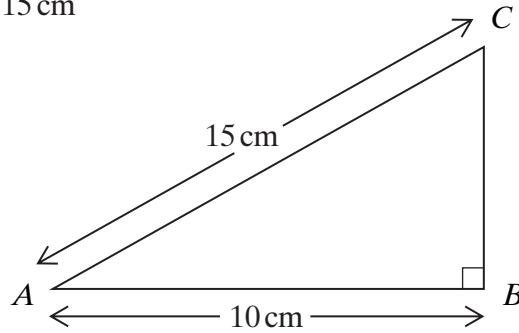
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Answer ..... km (2 marks)

- 9 (a) The diagram shows a right-angled triangle  $ABC$ .  
 $AB = 10\text{ cm}$  and  $AC = 15\text{ cm}$



Not drawn  
accurately

Calculate the length of  $BC$ .  
 Leave your answer as a square root.

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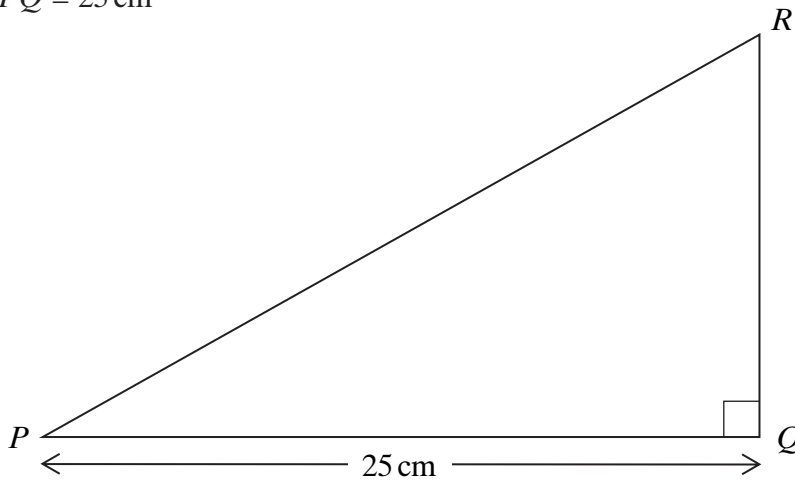
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Answer ..... cm (3 marks)

- (b) Triangle  $PQR$  is similar to triangle  $ABC$ .  
 Angle  $CAB = \text{angle } RPQ$ .  
 $PQ = 25\text{ cm}$



Not to scale

Work out the length of  $PR$ .

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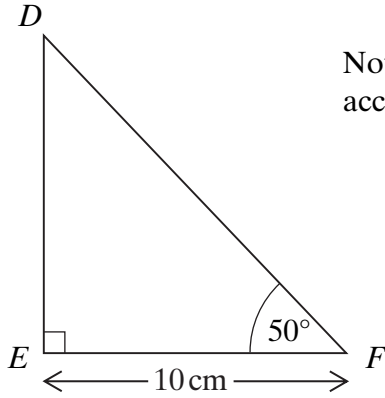
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Answer ..... cm (3 marks)

- (c) The diagram shows a right-angled triangle  $DEF$ .  
 $EF = 10$  cm  
 Angle  $F = 50^\circ$



Not drawn accurately

Angle	Sine	Cosine	Tangent
$40^\circ$	0.643	0.766	0.839
$50^\circ$	0.766	0.643	1.192

Use the table of data to work out the length of  $DE$ .

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Answer ..... cm (3 marks)

**TURN OVER FOR THE NEXT QUESTION**

10 Each of the graphs represents one of the following equations.

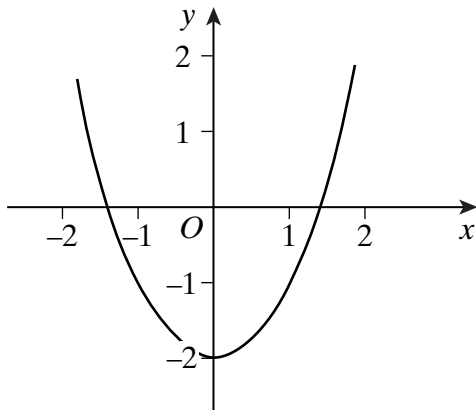
A  $y = 3x + 4$

B  $2x + 3y = 12$

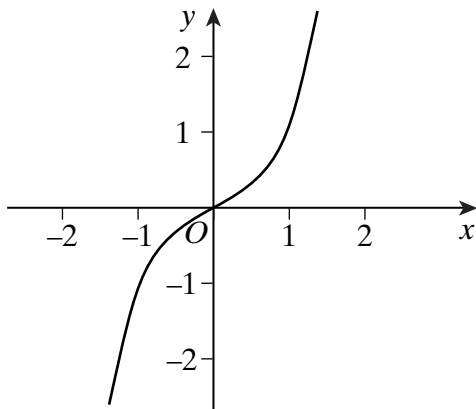
C  $y = x^2 - 2$

D  $y = x^3$

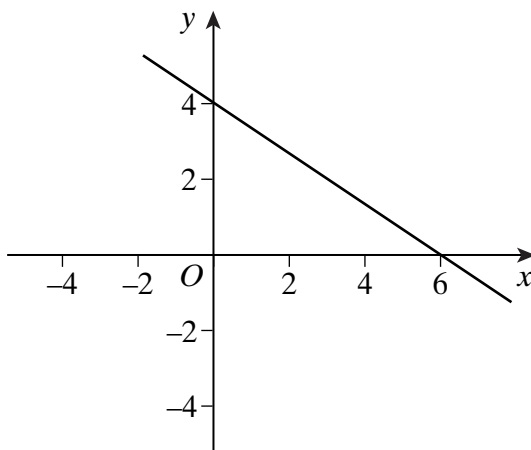
Write down the letter of the equation represented by each graph.



Equation ..... (1 mark)



Equation ..... (1 mark)



Equation ..... (1 mark)

11 Find the equation of the straight line passing through the point (0, 5) which is perpendicular to the line

$$y = \frac{2}{3}x + 3$$

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Answer ..... (2 marks)

12 (a) Prove that  $0.\dot{5}\dot{8} = \frac{58}{99}$

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(2 marks)

(b) Hence, or otherwise, express  $0.1\dot{5}\dot{8}$  as a fraction.

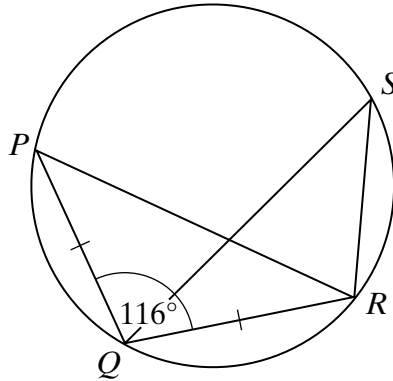
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Answer ..... (2 marks)



Turn over ►

- 13 (a) Points  $P, Q, R$  and  $S$  lie on a circle.  
 $PQ = QR$   
 Angle  $PQR = 116^\circ$



Not drawn accurately

Explain why angle  $QSR = 32^\circ$ .

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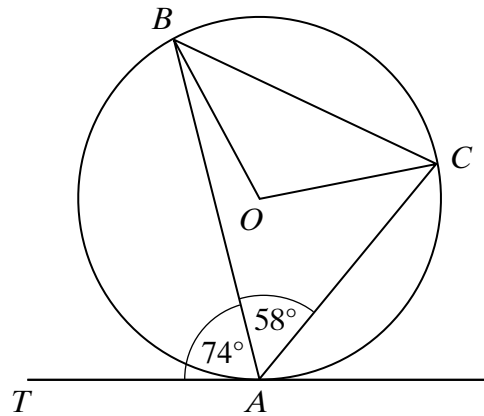
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(2 marks)

- (b) The diagram shows a circle, centre  $O$ .  
 $TA$  is a tangent to the circle at  $A$ .  
 Angle  $BAC = 58^\circ$  and angle  $BAT = 74^\circ$ .



Not drawn accurately

- (i) Calculate angle  $BOC$ .

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Answer Angle  $BOC = \dots\dots\dots$  degrees (1 mark)

(ii) Calculate angle  $OCA$ .

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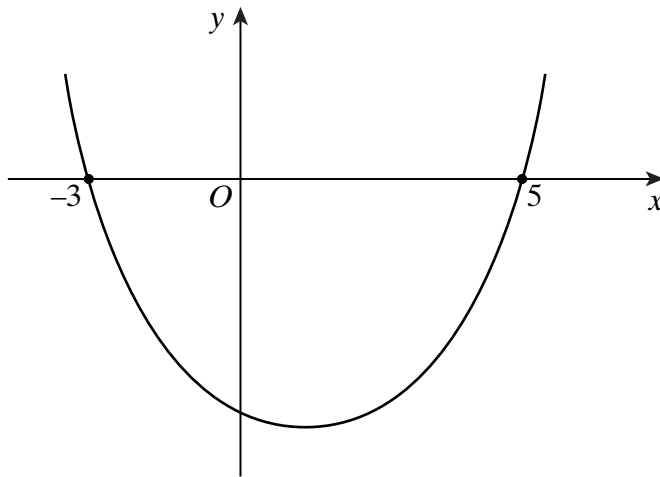
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Answer Angle  $OCA = \dots\dots\dots$  degrees (3 marks)

14 The diagram shows the graph of an equation of the form  $y = x^2 + bx + c$



Not drawn accurately

Find the values of  $b$  and  $c$ .  
You **must** show your method.

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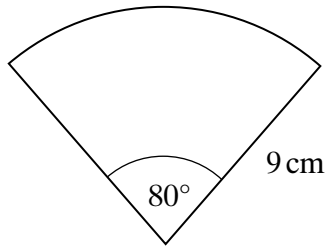
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Answer  $b = \dots\dots\dots$ ,  $c = \dots\dots\dots$  (3 marks)

Turn over

15 The diagram shows a sector of a circle of radius 9 centimetres.



Not drawn accurately

Find the perimeter of the sector.  
Give your answer in terms of  $\pi$ .

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Answer ..... cm (3 marks)

16 (a) Factorise  $2n^2 + 5n + 3$

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Answer ..... (2 marks)

(b) Hence, or otherwise, write 253 as the product of two prime factors.

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Answer ..... (1 mark)



17 (a) State **two** conditions that must be satisfied when collecting data for a stratified sample.

Condition 1 .....  
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(1 mark)

Condition 2 .....  
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(1 mark)

(b) A small village has a population of 400.  
The population is classified by age as shown in the table below.

Age (years)	0-12	13-24	25-40	41-60	61+
Number of people	35	58	125	103	79

A stratified sample of 50 is planned.  
Calculate the number of people that should be sampled from each age group.

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Answer 0-12 years .....  
13-24 years .....  
25-40 years .....  
41-60 years .....  
61+ years .....  
(3 marks)

Turn over ►

18 (a) (i) Factorise  $x^2 - 10x + 25$

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Answer ..... (2 marks)

(ii) Hence, or otherwise, solve the equation

$$(y - 3)^2 - 10(y - 3) + 25 = 0$$

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Answer  $y =$  ..... (2 marks)

(b) Simplify  $\frac{x^2 - 9}{x^2 + 3x}$

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Answer ..... (3 marks)

19 (a)  $n$  is a positive integer.

(i) Explain why  $n(n + 1)$  must be an even number.

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(1 mark)

(ii) Explain why  $2n + 1$  must be an odd number.

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(1 mark)

(b) Expand and simplify  $(2n + 1)^2$

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Answer ..... (2 marks)

(c) Prove that the square of any odd number is always 1 more than a multiple of 8.

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(3 marks)

20 (a) Find the values of  $a$  and  $b$  such that

$$x^2 + 6x - 3 = (x + a)^2 + b$$

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Answer  $a =$  ..... ,  $b =$  ..... (2 marks)

(b) Hence, or otherwise, solve the equation

$$x^2 + 6x - 3 = 0$$

giving your answers in surd form.

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Answer ..... (3 marks)

- 21** A crane has a cable with a breaking strain of 5300 kg measured to 2 significant figures. It is used to lift crates which weigh 100 kg measured to the nearest 10 kg.

What is the greatest number of crates that can be lifted at one time so that the cable does not break?

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Answer ..... (4 marks)

- 22** In Britain the probability of a 17 year old passing the driving test at the first attempt is 0.6 Three people are chosen at random from the population of 17 year olds in Britain who are about to take their driving test.

What is the probability that exactly two of them pass the driving test at the first attempt?

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Answer ..... (3 marks)

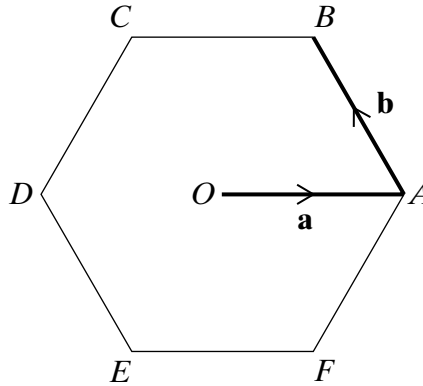


Turn over ►

23  $ABCDEF$  is a regular hexagon with centre  $O$ .

$\vec{OA} = \mathbf{a}$  and  $\vec{AB} = \mathbf{b}$

Diagram drawn accurately



(a) Find expressions, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , for

(i)  $\vec{OB}$

Answer ..... (1 mark)

(ii)  $\vec{AC}$

Answer ..... (1 mark)

(iii)  $\vec{EC}$

Answer ..... (1 mark)

(b) The positions of points  $P$  and  $Q$  are given by the vectors

$\vec{OP} = \mathbf{a} - \mathbf{b}$        $\vec{OQ} = \mathbf{a} + 2\mathbf{b}$

(i) Draw and label the positions of points  $P$  and  $Q$  on the diagram.

(2 marks)

(ii) Hence, or otherwise, deduce an expression for  $\vec{PQ}$ .

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Answer ..... (1 mark)

**END OF QUESTIONS**

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