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General Certificate of Secondary Education
June 2006



MATHEMATICS (SPECIFICATION A)
Higher Tier
Paper 2 Calculator

3301/2H

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Monday 12 June 2006 9.00 am to 11.00 am

<p>For this paper you must have:</p> <ul style="list-style-type: none"> • a calculator • mathematical instruments 	
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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	
22–23	
TOTAL	
Examiner's Initials	

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.
- Answer the questions in the spaces provided.
- Do all rough work in this book.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You may ask for more answer paper, graph paper and tracing paper. They must be tagged securely to this answer booklet.

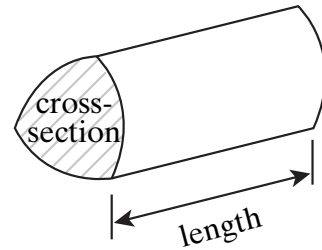
Advice

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

Formulae Sheet: Higher Tier

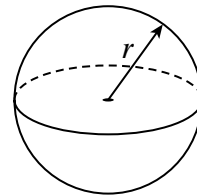
You may need to use the following formulae:

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



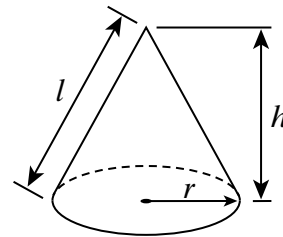
Volume of sphere = $\frac{4}{3} \pi r^3$

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



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

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

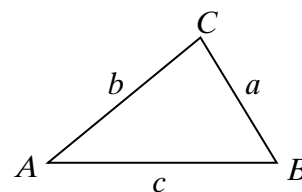


In any triangle ABC

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 Solve the inequality

$$5x + 3 > 10$$

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Answer (2 marks)

2 A form teacher records the number of times her students were late during a term. She shows the data for those who were late in a stem and leaf diagram.

Key | 2 | 6 represents late 26 times

0	1	1	2	6
1	2	4	4	
2	3	6		
3	2			
4	0	9		
5	0			

17 students were never late.

Calculate the mean number of times students were late for the whole form.

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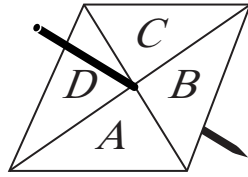
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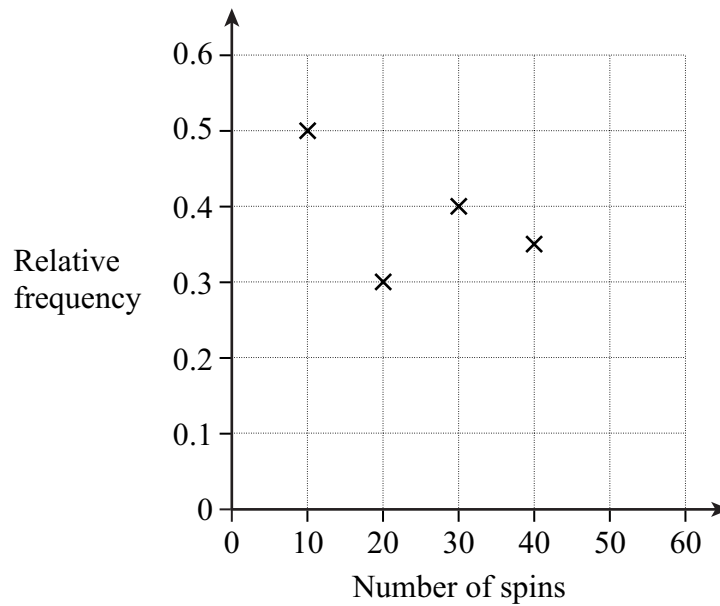
Answer (4 marks)

Turn over 

- 3 A four-sided spinner has sections labelled A,B,C,D.



The spinner is spun and the relative frequency of the letter A is recorded after every 10 spins.



- (a) After 50 spins there were 20 letter As.
Plot this relative frequency on the diagram.

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(1 mark)

- (b) The relative frequency after the first 60 spins is 0.45
How many times does the spinner land on A in the first 60 spins?

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Answer (1 mark)

- (c) Is the spinner biased?
Give a reason for your answer.

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(2 marks)

- (d) The spinner is spun 1000 times.
How many times would you expect the spinner to land on A?

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Answer (2 marks)

- (e) A different four-sided spinner has these probabilities.

Letter	A	B	C	D
Probability	0.2	0.3	0.4	0.1

What is the probability of getting a B or a C with one spin?

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Answer (2 marks)

- 4 The labels on two types of cereal bar show the following information.

	Fat per 100g	Bar weight	Fat per bar
Fruity bar	17.4 g	62.6 g	
Sports bar	10.3 g		3.4 g

Complete the table.

You **must** show your working.

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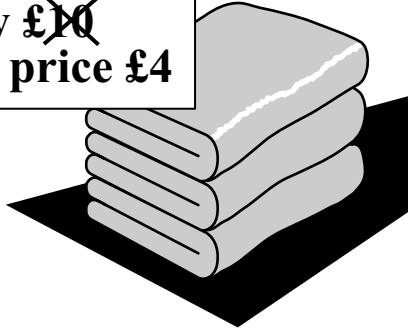
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(4 marks)

Turn over 

- 5 Jack and Jill want to buy some towels.
A store displays the following signs.

January Sales
All towels 60% off
Normally ~~£10~~
January sale price £4



Today Only
EXTRA
25% off the
January sale price

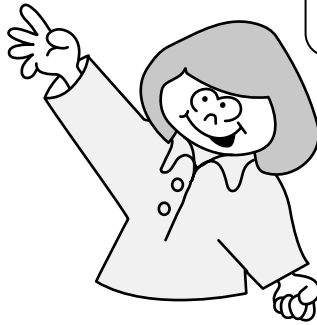
That is 85%
off the
original price

Jack



No, it is only 70%
off the
original price

Jill



Who is correct, Jack or Jill?
Explain your answer fully.

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(2 marks)

- 6 A metal bar has a volume of 250 cm^3 .
It has a mass of 1.7 kg .
Calculate the density of the metal.
State the units of your answer.

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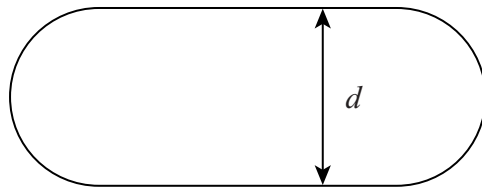
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Answer (3 marks)

- 7 A race track is made from two straights and two semicircles.
The straights are 80 m long.
The race track has a total perimeter of 400 m .



Not drawn accurately

Calculate the distance, d , between the two straights.

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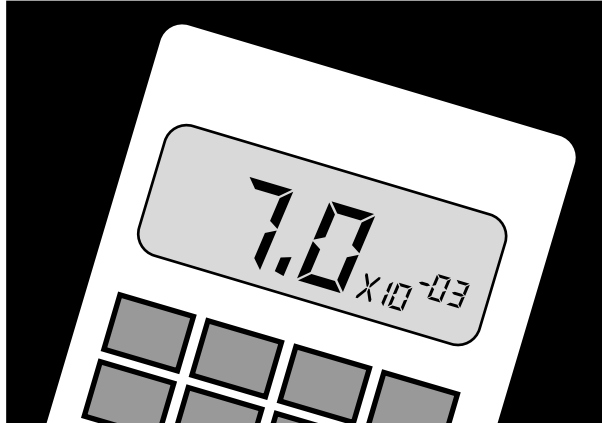
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Answer $d =$ m (4 marks)

Turn over ►

- 8 (a) A calculator displays a number in standard form as



Which of the following numbers does the display show?
Circle the correct answer.

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7000 0.700 0.007 700 0.0007

(1 mark)

- (b) Use your calculator to work out

$$\cos(\tan^{-1}0.45)$$

- (i) Give **all** the figures in your calculator display.

Answer (1 mark)

- (ii) Write your answer to an appropriate degree of accuracy.

Answer (1 mark)

- (c) Use your calculator to work out


$$\frac{(3.45 \times 10^4) \times (4.9 \times 10^{-2})}{(2.1 \times 10^5)}$$

Answer (1 mark)

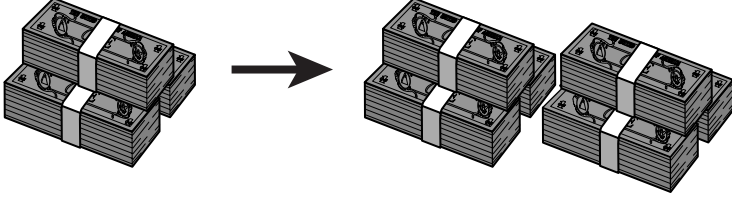
- 9 John has £2000 to invest.
He sees this advert.

SureFire Investments

Don't see your money
go up in smoke!



Double your money in 10 years!



The average annual growth of our investment
account is **7.2%**

Will John double his money in ten years with SureFire Investments?
You **must** show your working.

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(4 marks)

Turn over 

10 (a) Solve the equation

$$4(x + 3) = 9(x - 2)$$

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Answer $x =$ (3 marks)

(b) Solve these simultaneous equations

$$5x + 3y = 6$$

$$3x - 7y = 19$$

You **must** show your working.

Do **not** use trial and improvement.

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Answer $x =$, $y =$ (4 marks)

11 (a) Find the values of a and b such that

$$x^2 + 8x - 5 \equiv (x + a)^2 + b$$

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

(b) Hence, or otherwise, solve the equation

$$x^2 + 8x - 5 = 0$$

Give your answers to 2 decimal places.

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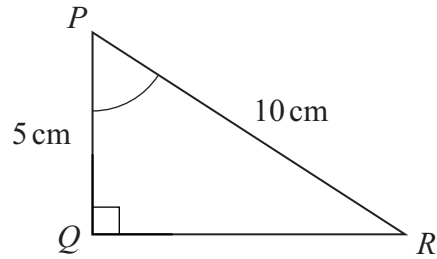
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Answer (2 marks)

Turn over 

- 12 (a) PQR is a right-angled triangle.
 $PR = 10$ cm and $PQ = 5$ cm



Not drawn accurately

- (i) Calculate the length QR .

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Answer cm (3 marks)

- (ii) Calculate the size of angle QPR .

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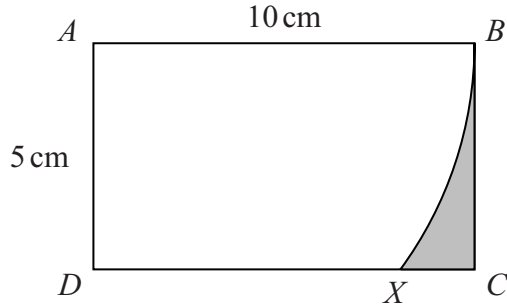
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Answer degrees (3 marks)

- (b) $ABCD$ is a rectangle.
 $AB = 10$ cm and $AD = 5$ cm.
 An arc of a circle of radius 10 cm is drawn with centre A .
 The arc starts at B and meets the side CD at X .



Not drawn accurately

Using your answers to part (a), or otherwise, calculate the shaded area.

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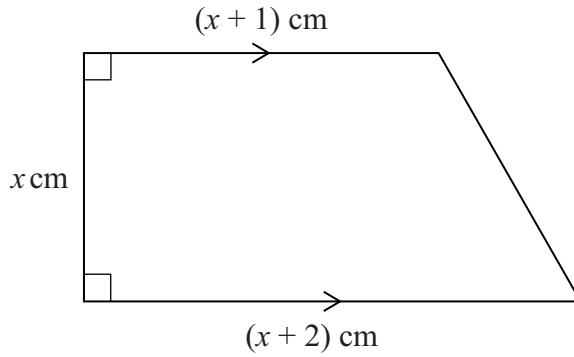
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Answer cm^2 (5 marks)

Turn over ►

- 13 A trapezium has parallel sides of length $(x + 1)$ cm and $(x + 2)$ cm.
The perpendicular distance between the parallel sides is x cm.
The area of the trapezium is 10 cm^2 .



Not drawn accurately

Find the value of x .

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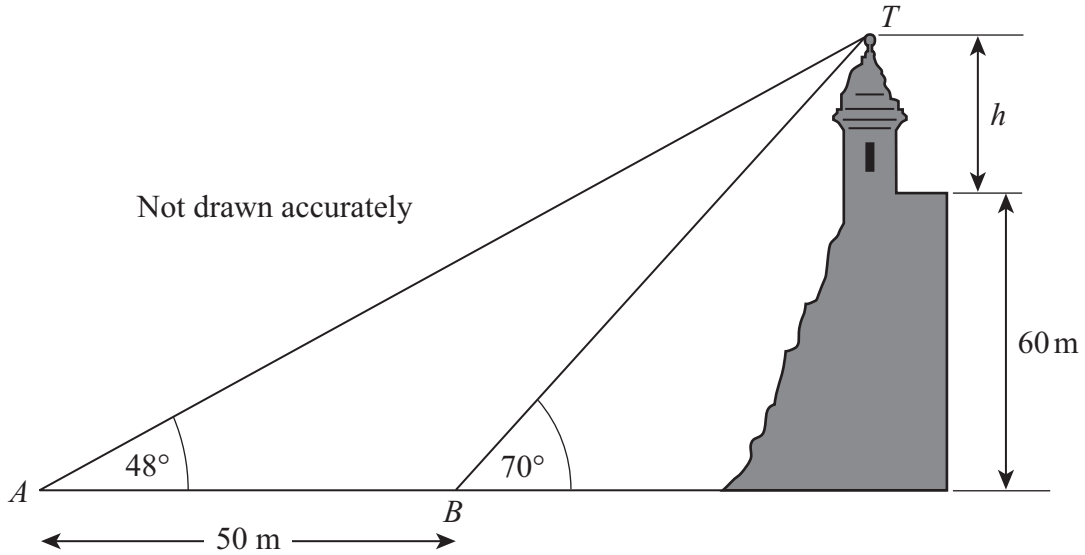
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Answer $x = \dots\dots\dots$ cm (5 marks)

- 14 Zoe wants to find the height of a tower on top of a cliff.
From point A she measures the angle of elevation of the top of the tower, T , as 48° .
She then walks 50 metres horizontally towards the tower to a point B , where
the angle of elevation of T is 70° .
The height of the cliff is 60 metres.



Calculate the height, h , of the tower.

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Answer $h = \dots\dots\dots$ m (6 marks)

Turn over

15 (a) Factorise $5x^2 + 20x$

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Answer (1 mark)

(b) Factorise $x^2 - 49$

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Answer (1 mark)

(c) Factorise fully $(3x + 4)^2 - (2x + 1)^2$

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Answer (3 marks)

16 Rearrange $y = \frac{xy + 2}{3x - 4}$

to make x the subject.
Simplify your answer as much as possible.

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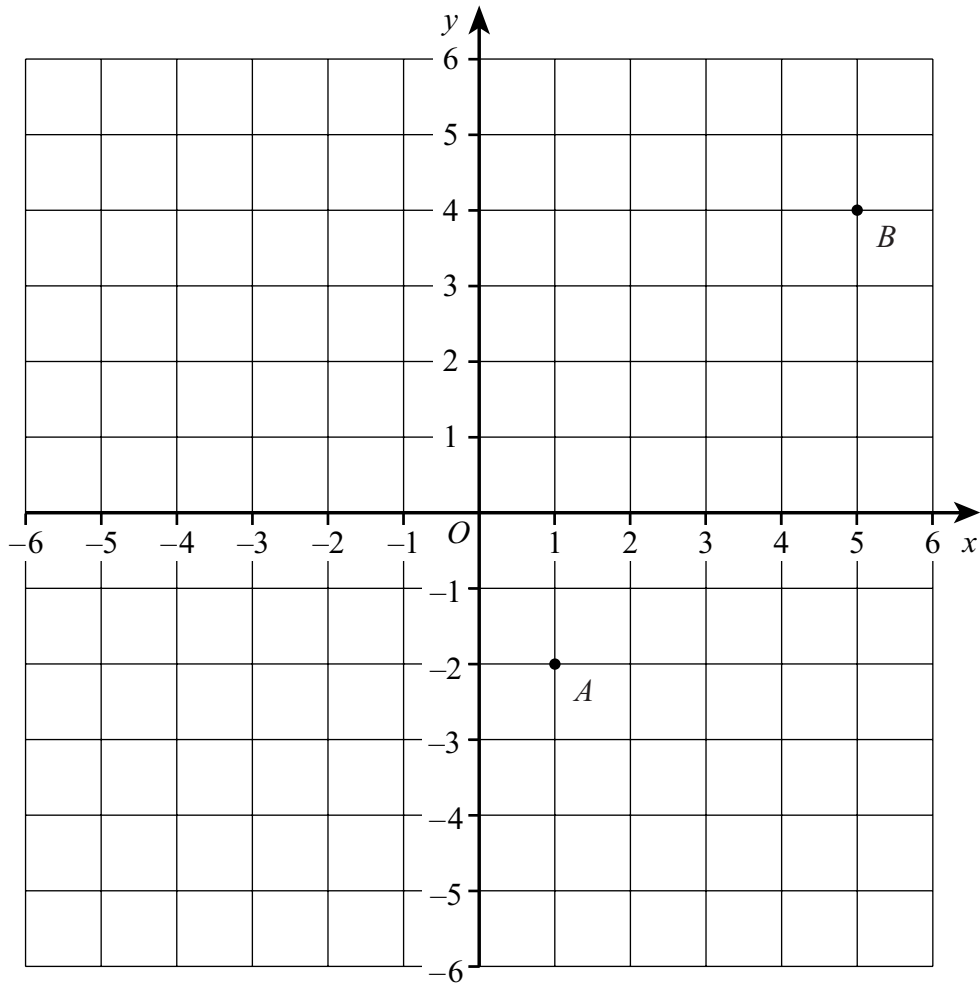
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Answer (4 marks)

Turn over for the next question

- 17 A is the point $(1, -2)$.
 B is the point $(5, 4)$.



Find the equation of the line perpendicular to AB , passing through the mid-point of AB .

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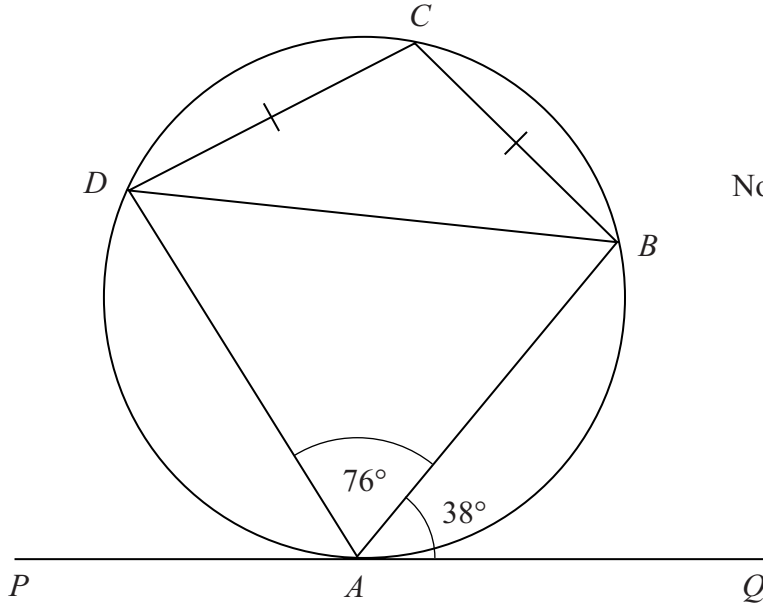
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Answer (4 marks)

- 18 $ABCD$ is a cyclic quadrilateral.
 PAQ is a tangent to the circle at A .
 $BC = CD$
 Angle $QAB = 38^\circ$ and angle $BAD = 76^\circ$



Not drawn accurately

Show that AD is parallel to BC .
 Give reasons to justify any values you write down or calculate.

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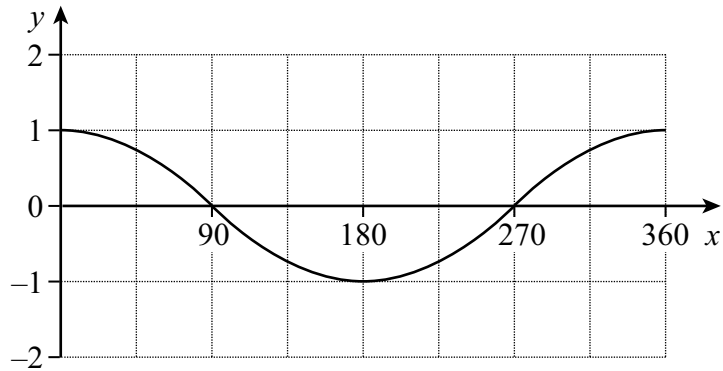
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(4 marks)

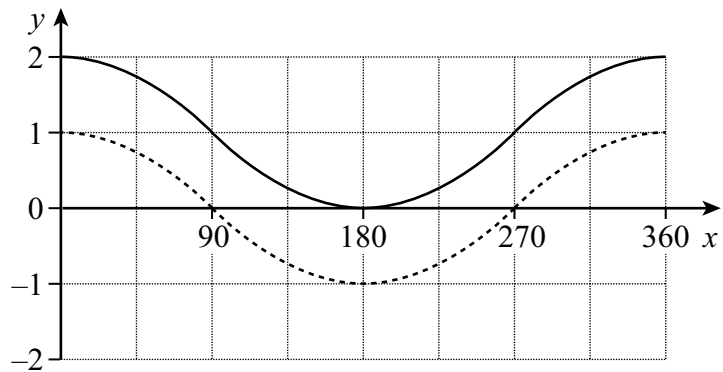
Turn over

19 This is the graph of $y = \cos x$ for $0^\circ \leq x \leq 360^\circ$



Write the equation of each of the transformed graphs.
In each case the graph of $y = \cos x$ is shown dotted to help you.

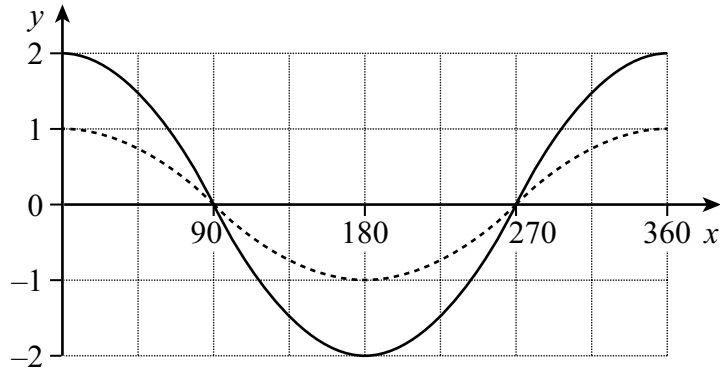
(a)



Equation $y = \dots\dots\dots$

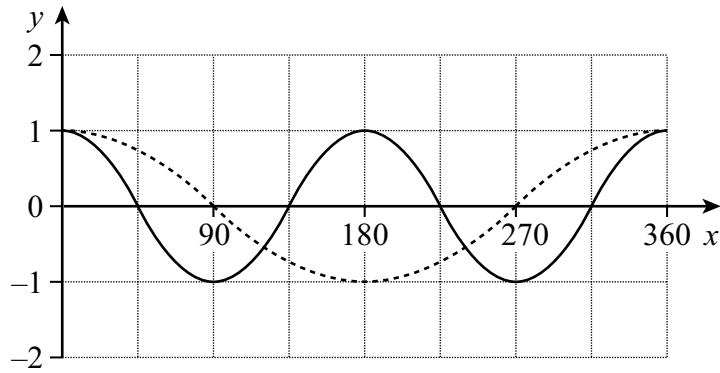
(1 mark)

(b)



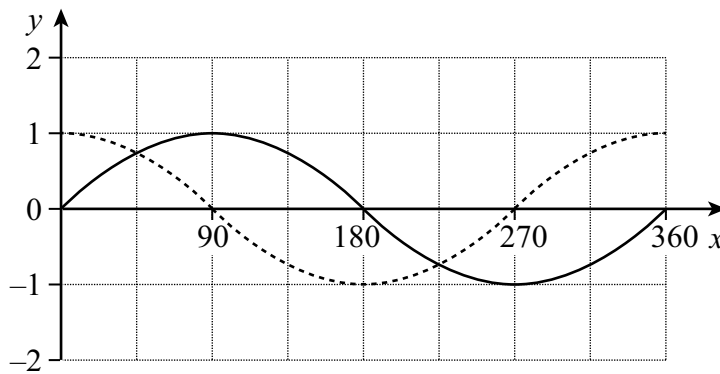
Equation $y = \dots\dots\dots$ (1 mark)

(c)



Equation $y = \dots\dots\dots$ (1 mark)

(d)



Equation $y = \dots\dots\dots$ (1 mark)

Turn over

20 A floodlight tower is marked with the following sign.

**WATTAGE NOT TO EXCEED
400 000 WATTS**

The spotlights on the tower are rated at 2500 watts each.
The manufacturer can only guarantee that the wattage of these spotlights is accurate to the nearest 100 watts.

(a) What is the maximum number of spotlights that can **safely** be put on the tower?

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Answer (3 marks)

(b) The formula $W = I^2R$
connects W (watts), I (amps) and R (ohms).

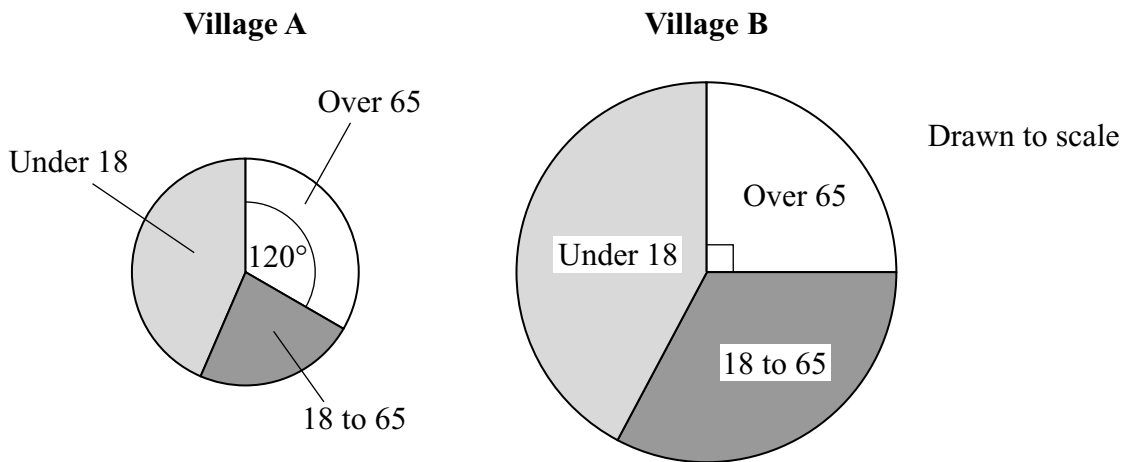
For one of the spotlights, the value of I is 25 amps measured to 2 significant figures.

What is the minimum possible value of R ?

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Answer ohms (3 marks)

- 21 The pie charts show the age distribution in two villages A and B.
The population of the villages is proportional to the **area** of the pie charts.
There are 660 people over 65 in village A.



How many people are over 65 in village B?
Show clearly any measurements or assumptions that you make.
Show your method clearly.

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Answer (5 marks)

END OF QUESTIONS

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