Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

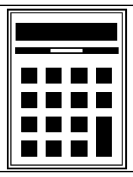
General Certificate of Secondary Education
November 2009

MATHEMATICS (SPECIFICATION A) **4306/2H**
Higher Tier
Paper 2 Calculator

H

Tuesday 10 November 2009 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. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book.

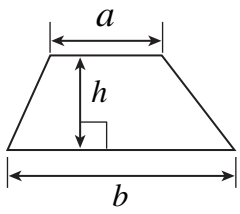
Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer booklet.

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

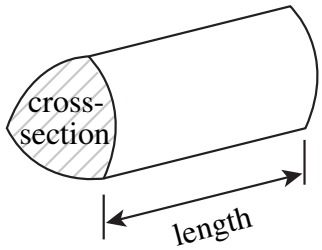
For Examiner's Use	
Pages	Mark
3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22	
TOTAL	
Examiner's Initials	

Formulae Sheet: Higher Tier

Area of trapezium = $\frac{1}{2}(a+b)h$

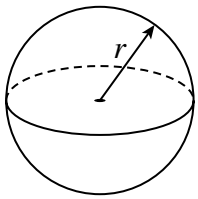


Volume of prism = area of cross-section × length



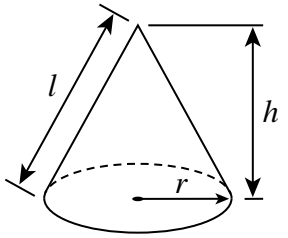
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

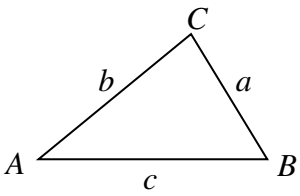
Curved surface area of cone = $\pi r l$



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 A firework display costs £32 400
The display lasts for 12 minutes.
On average 10 fireworks are set off every second.

What is the average cost of a firework?

.....

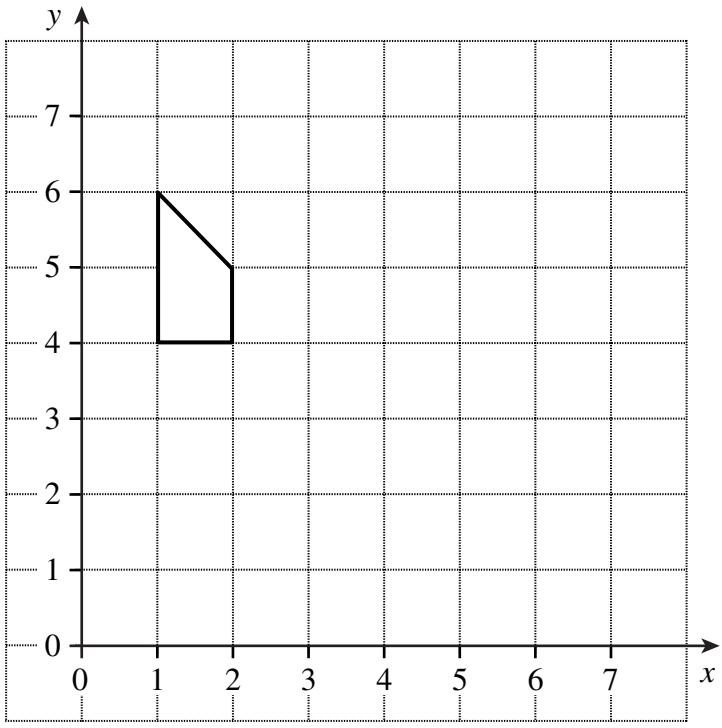
.....

.....

.....

Answer £ ..... *(3 marks)*

2 Enlarge the shape in the diagram by a scale factor of 3, centre (0, 6).



(2 marks)

5

Turn over ▶

3 The amount of money that a group of 16 teenagers earn each week is shown in the stem and leaf diagram.

0	8	8	9	
1	2	6	8	
2	5	5		
3	0	2	3	7
4	6			
5	0	6	9	

Key 1 | 8 represents £18

Calculate the mean amount of money earned by the group.

.....

.....

.....

.....

Answer £ ..... *(3 marks)*

4 Katie says that it is impossible to have an isosceles triangle with a right angle.

Draw a fully labelled diagram to show that Katie is wrong.

(2 marks)

5 A television company is to carry out a survey on the popularity of its programmes.

5 (a) The company decides to phone 10 people at home between 9 am and 4 pm.

Give **two** reasons why this may **not** give any useful data.

Reason 1 .....

.....

.....

Reason 2 .....

.....

.....

(2 marks)

5 (b) One of the questions in the survey is

Sports programmes are better than chat shows.
Do you agree?

☐ Yes ☐ Don't know

Give a reason why this is **not** a good question.

.....

.....

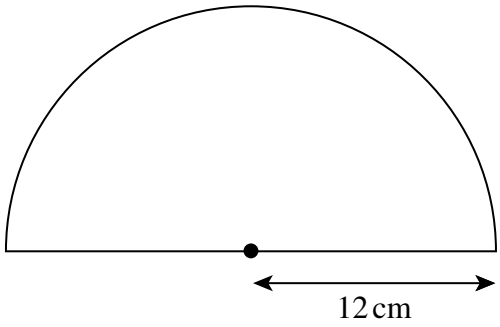
.....

(1 mark)

Turn over for the next question

8

6 (a) Calculate the area of a semicircle of radius 12 cm.



Not drawn accurately

.....

.....

.....

Answer ..... cm^2 *(2 marks)*

6 (b) The area of another semicircle is 40 000 cm^2.

Show clearly that this is equal to 4 m^2.

.....

.....

.....

.....

(2 marks)

7 (a) Solve the inequality $5x + 3 < 9$

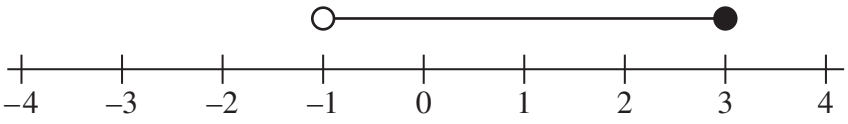
.....

.....

.....

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

7 (b)



Write down the integers that satisfy the inequality shown on the diagram above.

.....

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

7 (c) Write down a non-integer that satisfies both the inequality in part (a) and the inequality in part (b).

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

Turn over for the next question

9

8 The table shows information about two types of light bulbs, Standard and Energy Saving. Both types of light bulb give out the same amount of light.

	Standard	**Energy Saving**
A = Cost of bulb (pounds)	£0.50	£3.50
B = Power of bulb (kilowatts)	0.1 kW	0.02 kW
C = Expected lifetime of bulb (hours)	1500 h	12 000 h
D = Cost per kilowatt hour (pounds)	£0.10	£0.10

The total cost for a light bulb over its expected lifetime is given by the formula

$$\text{Total cost} = A + B \times C \times D$$

8 (a) Find the total cost, in pounds, of a Standard bulb over its expected lifetime.

.....

.....

.....

Answer £ ..... *(2 marks)*

8 (b) The expected lifetimes of Standard bulbs to Energy Saving bulbs are in the ratio 1500 : 12 000

Write the ratio 1500 : 12 000 in its simplest form.

.....

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

8 (c) One Energy Saving bulb has an expected lifetime of 12 000 hours.
How much cheaper would it be, in terms of total cost, to use one Energy Saving bulb rather than Standard bulbs?

.....

.....

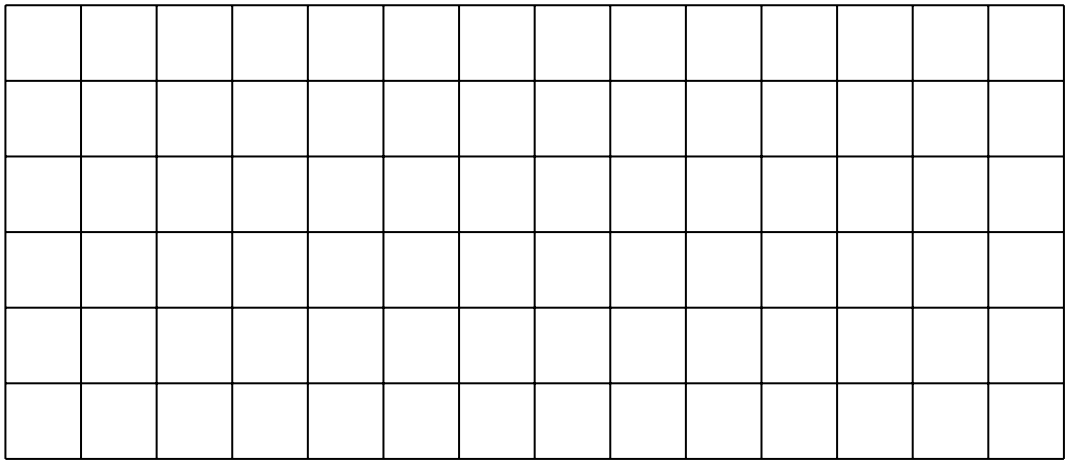
.....

.....

.....

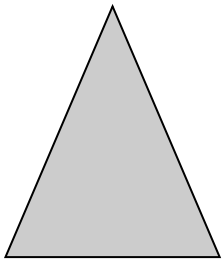
Answer £ ..... *(3 marks)*

9 (a) On the centimetre grid draw a triangle with an area of $6\,cm^2$.

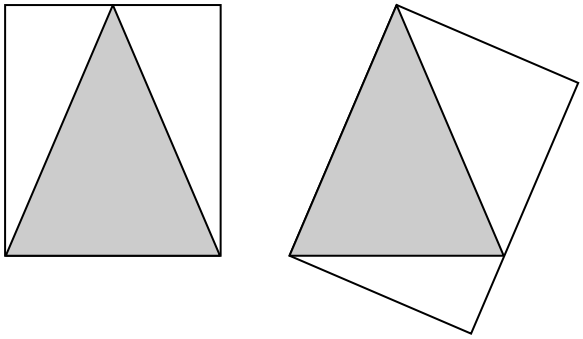


(1 mark)

9 (b) The triangle shown is isosceles.



Two different rectangles are drawn so that one side of each rectangle is a side of the triangle and the rectangle passes through the other vertex of the triangle.



Explain clearly why both rectangles have the same area.

.....

.....

.....

.....

.....

(2 marks)

9

Turn over ▶

10 (a) In 2002, an average household threw away 5.5 kg of recycled waste each week. 1.7 kg of this was paper.

Work out 1.7 as a percentage of 5.5
Give your answer to the nearest whole number.

.....

.....

.....

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

10 (b) In 2005, on average, each household in Barnsley recycled 232 kg of glass. This is a 45% increase on the amount of glass recycled in 2002.

What was the average amount of glass recycled per household in 2002?

.....

.....

.....

.....

.....

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

11 Ali says that for any number x, x^2 is always less than x^3.

For example, when $x = 3$, $3^2 < 3^3$ as $9 < 27$

Find an example to show that Ali is wrong.

.....

.....

.....

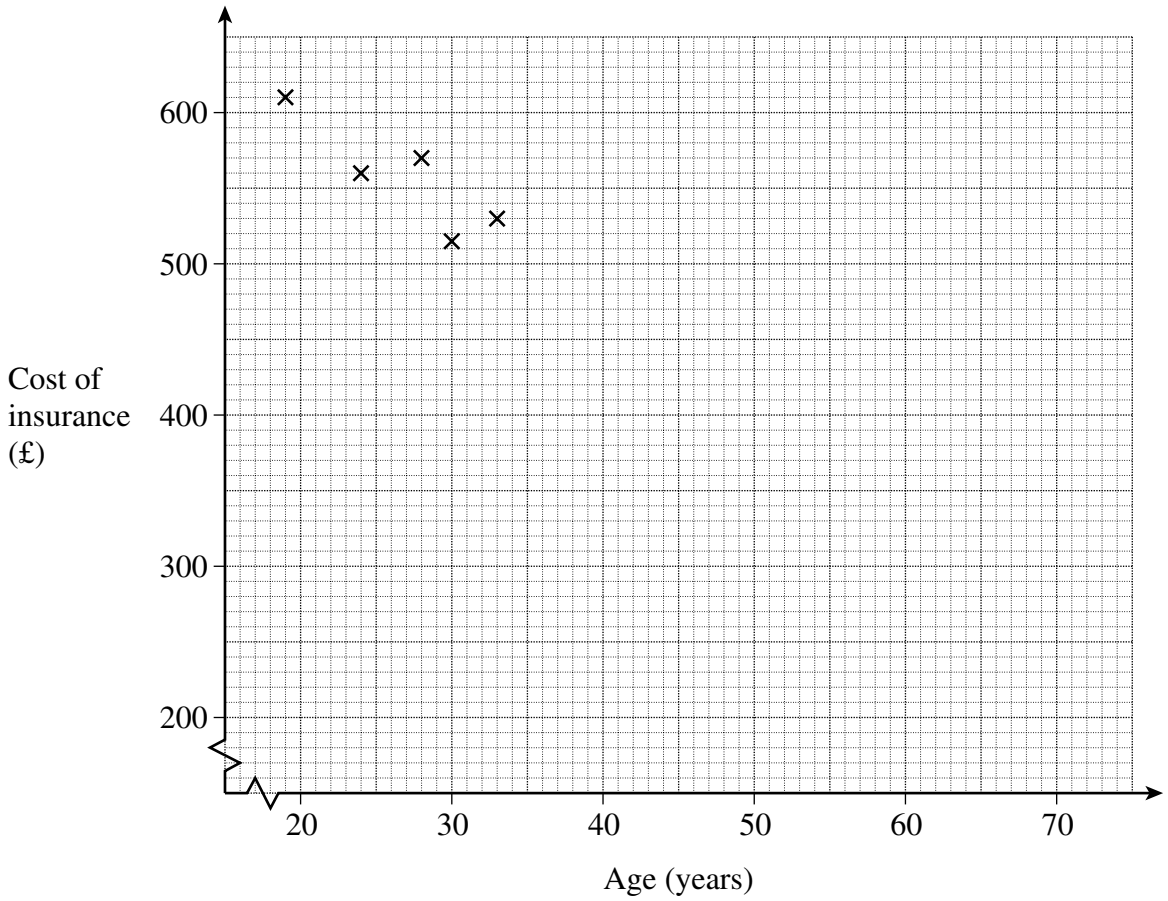
.....

(2 marks)

12 The data shows the age of 10 drivers and the annual cost of their car insurance.

Person	A	B	C	D	E	F	G	H	I	J
Age (years)	19	24	28	30	33	47	51	54	59	65
Cost of insurance (£)	610	560	570	515	530	450	410	360	360	340

The first five values have been plotted on the scatter diagram below



12 (a) Plot the other five values on the scatter diagram. *(2 marks)*

12 (b) Draw a line of best fit through the data. *(1 mark)*

12 (c) Describe the relationship between the cost of insurance and the age of the drivers.

.....

.....

(1 mark)

12 (d) Estimate the cost of insurance for a driver who is 40 years old.

Answer £ ..... *(1 mark)*

13

13 Solve the following equations.

13 (a) $3x - 7 = x + 5$

.....

.....

.....

Answer $x =$ ..... *(2 marks)*

13 (b) $5(x - 3) = 3(x + 1)$

.....

.....

.....

Answer $x =$ ..... *(3 marks)*

13 (c) $\frac{x + 1}{2} - \frac{x - 3}{5} = 2$

.....

.....

.....

.....

.....

.....

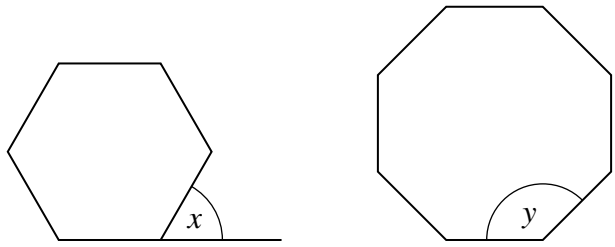
.....

.....

.....

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

14 A regular octagon and a regular hexagon have sides of the same length.



Not drawn accurately

14 (a) Write down the size of the exterior angle, *x*, of the hexagon.

.....

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

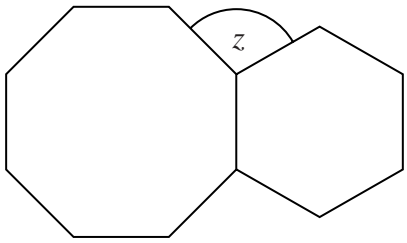
14 (b) Work out the size of the interior angle, *y*, of the octagon.

.....

.....

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

14 (c) The octagon and the hexagon are placed together as shown.



Not drawn accurately

Work out the size of the angle marked *z*.

.....

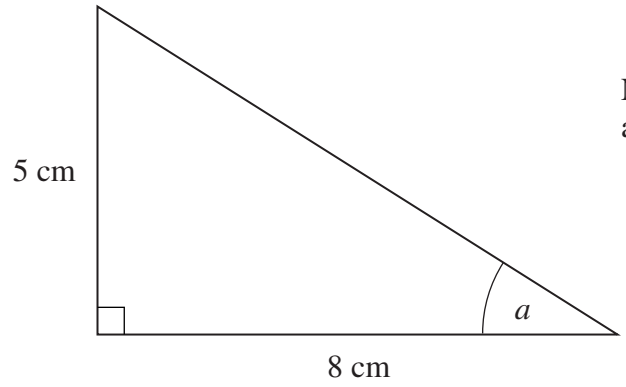
.....

.....

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

14

15 Work out the size of the angle *a*.



.....

.....

.....

.....

.....

.....

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

16 This is part of Zoë's test on probability.
Some of the table has been covered by spilt ink.

A bag contains red, blue, green and white counters.
The table shows the probability of taking each colour, at random, from the bag.

Colour	Red	Blue	Green	White
Probability	0.25			

(a) A counter is taken at random from the bag.
The colour is noted and the counter is replaced.
This is repeated 20 times.

How many counters would you expect to be red ?

Answer ..... 5 ✓ .....

(b) A counter is taken at random from the bag.

What is the probability that it is blue or green ?

Answer ..... 0.45 ✓ .....

(c) A counter is taken at random from the bag.
The colour is noted and the counter is replaced.
This is repeated 100 times.

How many counters would you expect to be green or white ?

Answer ..... 40 ✓ .....

Use Zoë's answers to complete the table of probabilities.

.....

.....

.....

.....

Colour	Red	Blue	Green	White
Probability	0.25			

(4 marks)

7

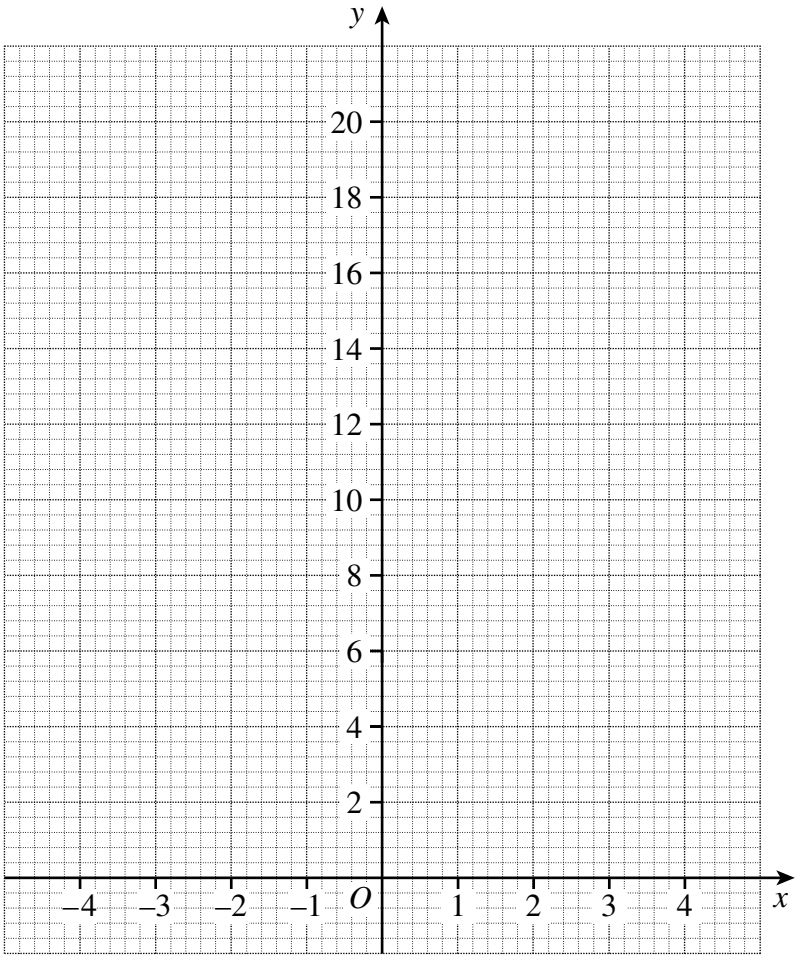
Turn over ▶

17 (a) Complete the table of values for the graph $y = x^2 + 3$

x	–4	–3	–2	–1	0	1	2	3	4
y	19	12		4		4	7	12	19

(1 mark)

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



(2 marks)

17 (c) Explain how you can tell from the graph that the equation $x^2 + 3 = 0$ has no solutions.

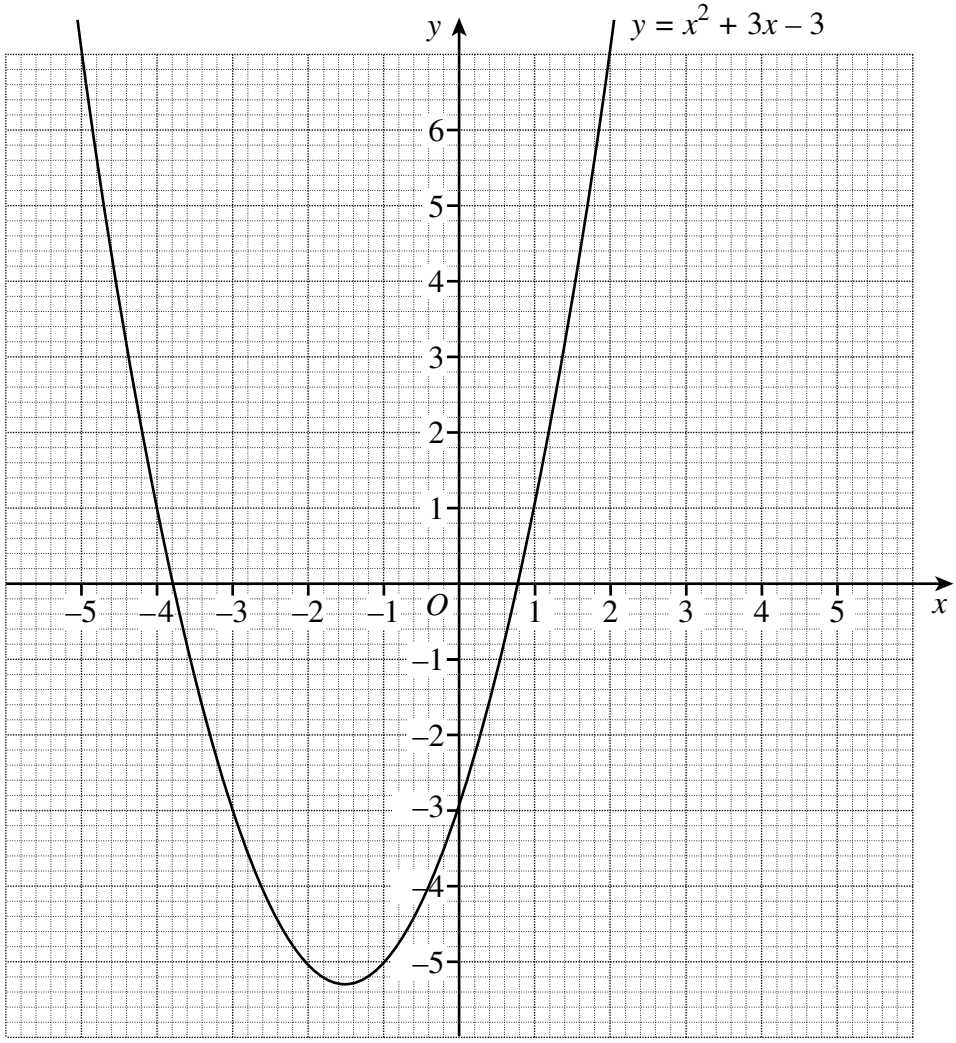
.....

.....

.....

(1 mark)

17 (d) The graph of $y = x^2 + 3x - 3$ is shown below.



17 (d) (i) Write down the solutions of $x^2 + 3x - 3 = 0$

.....

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

17 (d) (ii) By drawing a suitable straight line find the solutions of the equation

$$x^2 + 2x - 4 = 0$$

.....

.....

.....

.....

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

8

Turn over ▶

18 The formula

$$d = u + \frac{u^2}{20}$$

gives the safe distance in feet that drivers should leave between themselves and the car in front when driving on a motorway at u miles per hour.

A road safety campaign uses this rule for drivers travelling on motorways.

Drivers should leave a 3 second time gap between themselves and the car in front

You are given that 1 mile = 5280 feet

When a car is travelling at 70 mph, show that the distance calculated by the 3-second rule differs from that found by the formula by less than 2.5%

.....

.....

.....

.....

.....

.....

.....

.....

.....

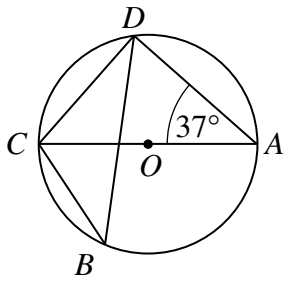
.....

.....

.....

(6 marks)

19 (a) *ABCD* are points on the circumference of a circle centre *O*.
Angle *DAC* = 37°



Not drawn accurately

Write down the value of

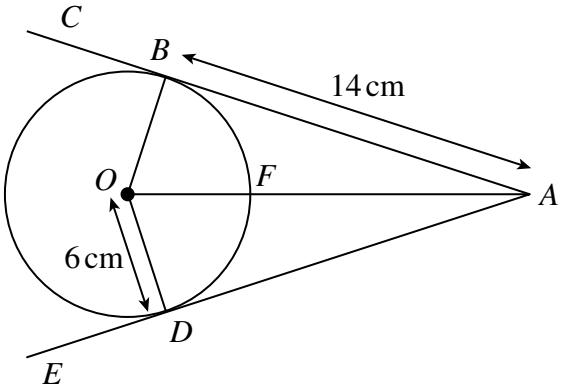
19 (a) (i) Angle *DBC*

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

19 (a) (ii) Angle *ACD*

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

19 (b) In the diagram below *ABC* and *ADE* are tangents to the circle centre *O*, radius 6 cm.
The distance *AB* = 14 cm.
F is the point where *AO* meets the circumference.



Not drawn accurately

Work out the distance *AF*.

.....

.....

.....

.....

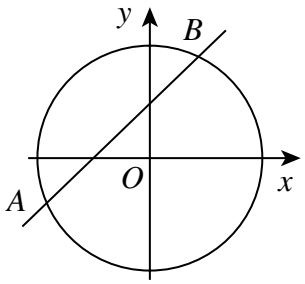
.....

.....

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

12

20 The circle $x^2 + y^2 = 16$ and the line $y = x + 2$ intersect at the points A and B.



Not drawn accurately

20 (a) Show algebraically that the x-coordinates of points A and B satisfy the equation

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

.....

.....

.....

.....

.....

(3 marks)

20 (b) Write the equation $x^2 + 2x - 6 = 0$ in the form $(x + a)^2 - b = 0$

.....

.....

.....

.....

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

20 (c) Hence, or otherwise, solve the equation $x^2 + 2x - 6 = 0$
Give your answers in surd form.

.....

.....

.....

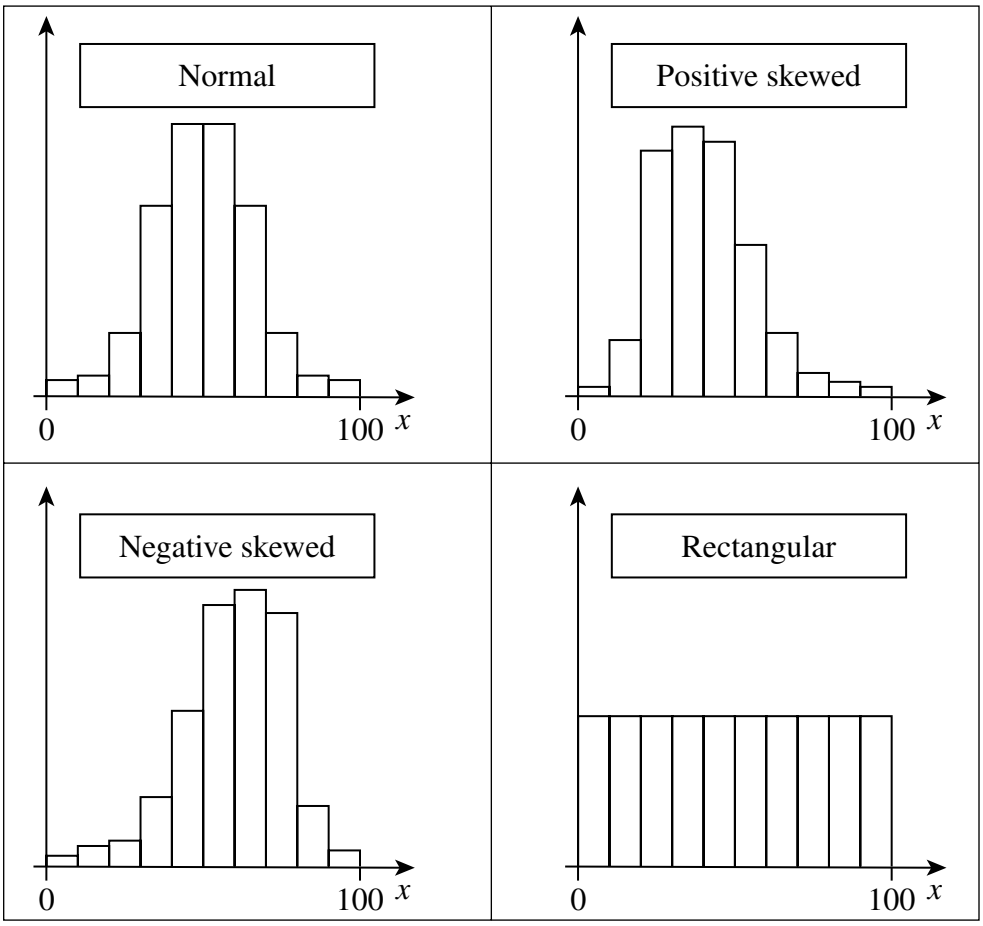
.....

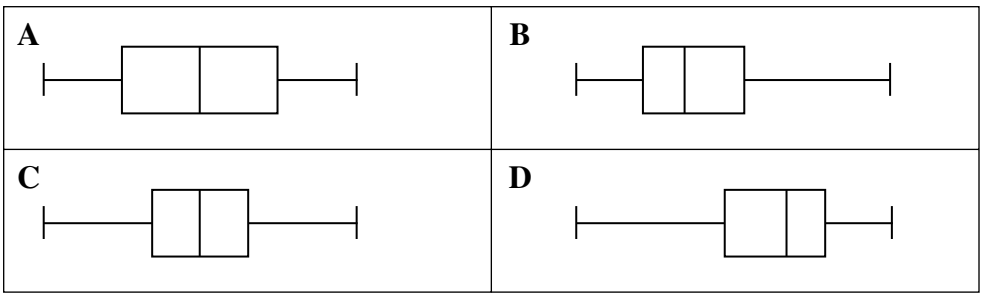
Answer ..... *(2 marks)*

21 Four histograms for a variable x with values from 0 to 100 are shown below.

Four box plots for the same histograms are also shown.

Match each histogram to the correct box plot.





Normal histogram is shown by box plot .....

Positive skewed histogram is shown by box plot .....

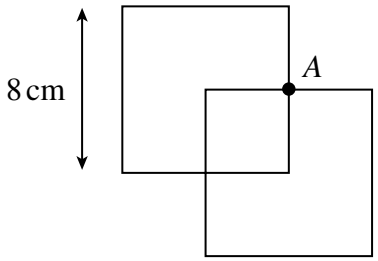
Negative skewed histogram is shown by box plot .....

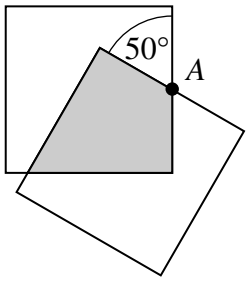
Rectangular histogram is shown by box plot .....

(3 marks)

10

22 Two squares with sides 8 cm overlap so that the corner of one square is at the centre of the other square, as shown in the first diagram.





Not drawn accurately

The lower square is rotated about the point *A* until the angle between the sides is 50° as shown in the second diagram.
The shaded area is a kite.

Calculate the shaded area.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Answer ..... cm^2 *(5 marks)*

END OF QUESTIONS

5

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED