H

Friday 7 November 2014 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Duration: 2 hours

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

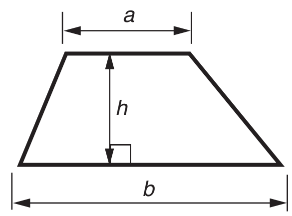
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your quality of written communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is **90**.
- This document consists of **20** pages. Any blank pages are indicated.

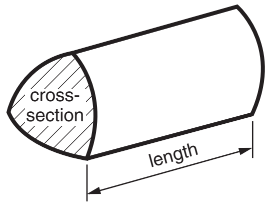
You are permitted to use a calculator for this paper

Formulae Sheet: Higher Tier

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



Volume of prism = (area of cross-section) × length

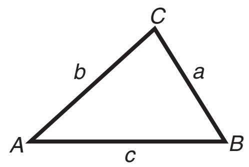


In any triangle *ABC*

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

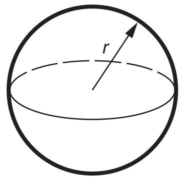
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



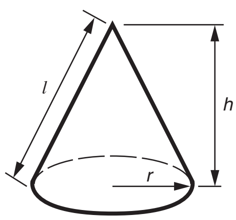
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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



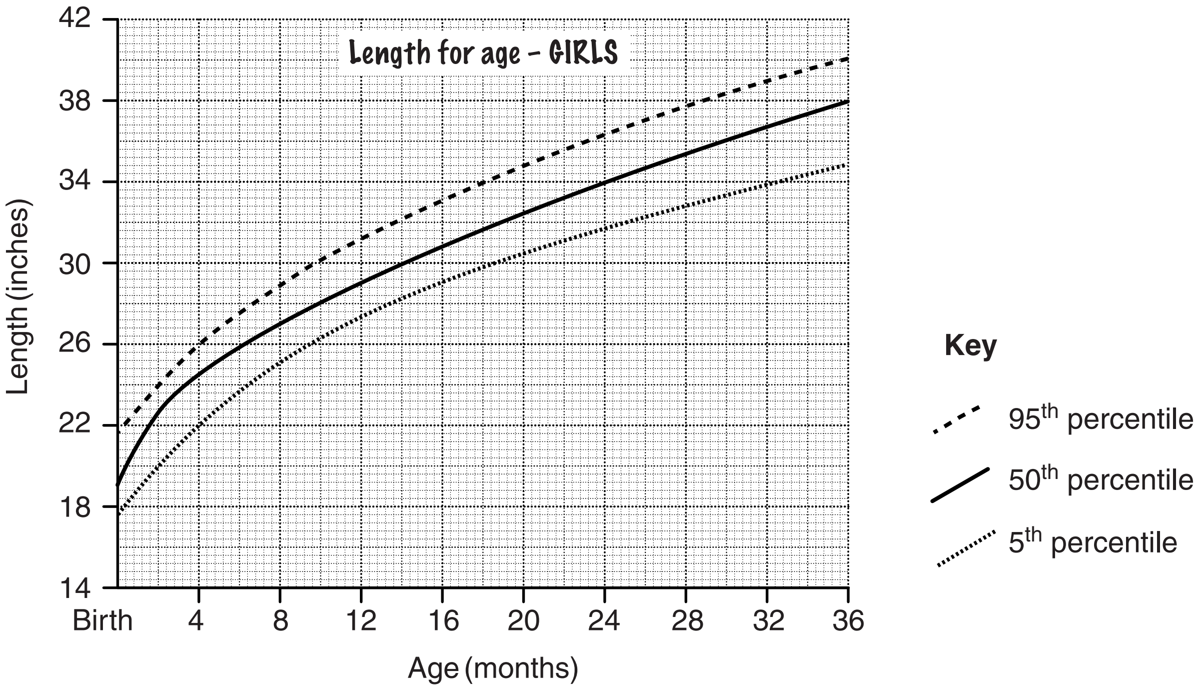
The Quadratic Equation

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

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

PLEASE DO NOT WRITE ON THIS PAGE

1 Growth charts are used to monitor the expected development of babies.
This chart shows the length of girls aged from birth to 36 months.
Length is the distance, in inches, from the top of the head to the heel.



On this graph, the percentile is the percentage of girls at or less than a length.

For example at 4 months: 95% of baby girls are 26 inches or less
5% are 22 inches or less.

(a) What is the length of a baby girl aged 24 months on the 50th percentile?

(a) .... inches **[1]**

As babies grow they are expected to remain on the same percentile.

(b) How many months should it take for a baby girl on the 5th percentile at age 4 months to grow to the same length as a baby girl on the 95th percentile was at age 4 months?

(b) .... months **[1]**

(c) At birth Thelma is on the 5th percentile and Louise is on the 95th percentile.
Louise is 4 inches longer than Thelma.

Will the difference between their lengths stay the same as they grow?
Support your answer with an example from this graph.

....

.... **[1]**

2 A medical tourist is someone who chooses to travel abroad for health care.

(a) The table shows the number of medical tourists travelling from the UK (outbound) and to the UK (inbound) from 2002 to 2010.

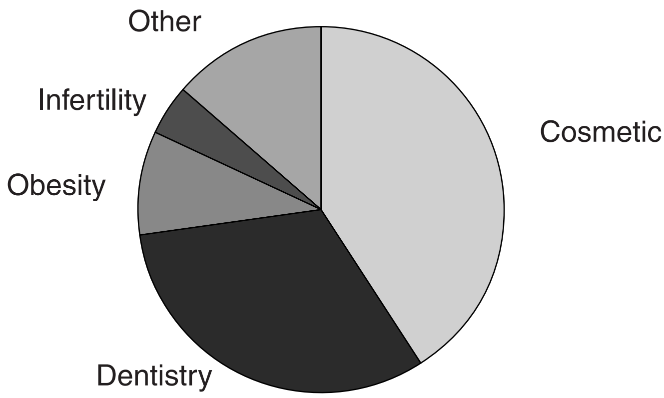
Removed due to third party copyright restrictions. Details: Big Mac Index, The Economist, 2013.

Describe the trend in medical tourism **to** the UK (inbound) from 2002 to 2010.

....

.... **[1]**

***(b)** The pie chart shows the medical reasons UK residents travelled abroad for in 2010.



How many travelled abroad for cosmetic reasons?

....

....

....

....

.... **[4]**

3 The table gives some information about the price of a Big Mac and the exchange rates of some countries in **July 2010**.

Removed due to third party copyright restrictions. Details: Big Mac Index, The Economist, 2013.

All numbers are given correct to 2 decimal places.

(a) The price of a Big Mac in **dollars** for each country was calculated using the **dollar**, **$**, **exchange rate**.

Show how the price of a Big Mac in dollars in China was calculated.

....

.... **[1]**

(b) The Big Mac exchange rate for each country was calculated using this method.

$$\frac{\text{Price of a Big Mac in local currency}}{\text{Price of a Big Mac \textbf{in the USA}}}$$

Calculate the Big Mac exchange rate for South Africa.

(b) \$1 = ... Rand **[2]**

(c) This table gives the price of a Big Mac in local currency in **July 2011**.

Country	**Price of a Big Mac in local currency**	**Big Mac exchange rate**
USA	4.07 Dollars	
Sweden	48.4 Krona	\$1 = 11.89 Krona
Turkey	6.5 Lira	\$1 = 1.60 Lira

Refer to the figures from **both** tables.

(i) Explain fully why the Big Mac exchange rate for Sweden has gone down from 2010 to 2011.

....

....

.... **[2]**

(ii) Explain fully why the Big Mac exchange rate for Turkey has stayed the same from 2010 to 2011.

....

....

.... **[2]**

4 Nick is a fan of the radio programme 'Just a Minute'.
He carried out an experiment to find out if people could judge how long a minute is.
In the experiment Nick asked people to estimate one minute in each of two ways.

- Sit in silence for exactly one minute
- Talk about their hobbies for exactly one minute

(a) Write down one piece of equipment that the people taking part should **not** have during the experiment.

(a) .... **[1]**

Nick used a back to back stem and leaf diagram to display his results.
He completed the diagram for silent estimates.

Silent estimate		Talking estimate
	8	1 3
8 2 1	7	1 5 6
8 7 6 4 2 2 1	6	
9 7 7 7 2 1 1	5	
9 7 5 4 3 3 2	4	0 1 3 3
9 6 4	3	9

Key: **4** | **3** | **9** represents
a silent estimate of **34** seconds and a talking estimate of **39** seconds

Some of the results for talking estimates have been filled in.
Here are the remaining results, in seconds, for the talking estimates.

64 48 56 52 57 67 66 47 65 45 63 52 60 57 52 64 69

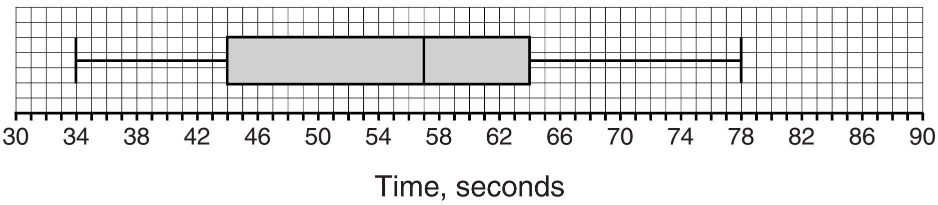
(b) **Complete** the ordered stem and leaf diagram for the talking estimates. **[3]**

(c) Complete this table.

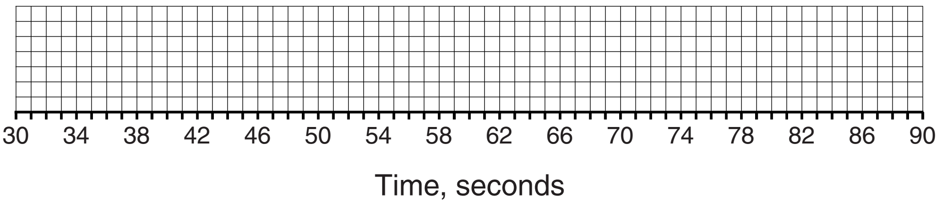
	Silent estimate	**Talking estimate**
Range	44	
Mode	57	
Median	57	
Lower quartile	44	
Upper quartile	64	
IQR	20	

[6]

(d) Nick drew this box and whisker plot for the silent estimates.



(i) Use your answers to parts **(b)** and **(c)** and draw a box and whisker plot for talking estimates.



[2]

(ii) Write down **two** comparisons of people's ability to estimate one minute.

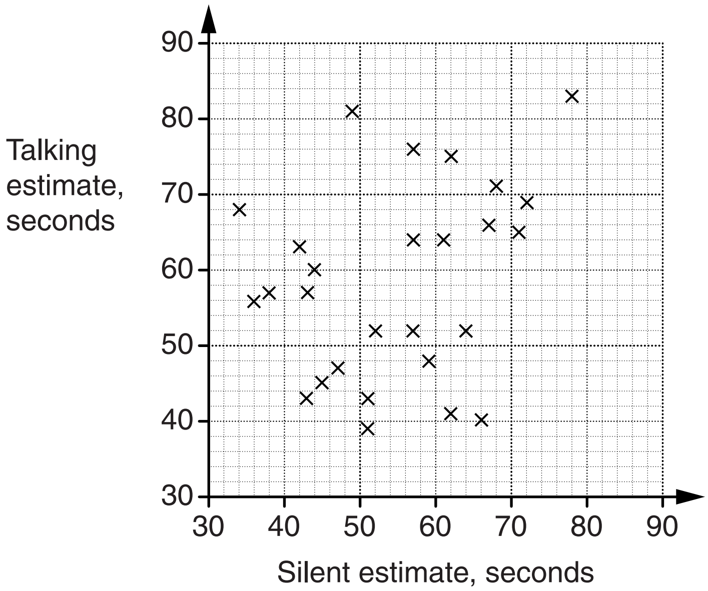
....

....

....

.... **[2]**

(e) Nick also drew this scatter graph to display his results.



Is it always true that people who underestimate the length of a minute by the silent method also underestimate the length by the talking method?

Justify your answer.
(You may, as part of your justification, draw suitable lines on the scatter graph).

....

....

.... **[2]**

5 This information is given on a pack of rolls of toilet paper.

241 sheets per roll
sheet size 124 mm × 104 mm
roll length 29.88 m
total area in the pack 49.72 m^2

(a) Show that the pack contains 16 rolls of toilet paper.

....

....

....

.... **[4]**

(b) The 16 rolls are packaged in an array 4 by 4 by 1.
The pack has dimensions 464 mm × 416 mm × 116 mm.

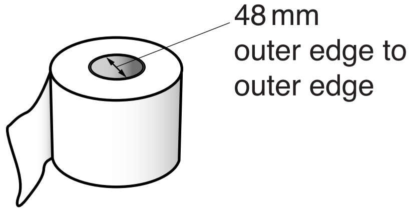
(i) Show that the height of one toilet roll is 104 mm and its radius is 58 mm.
You may assume the packaging has negligible thickness.

Height ....

Radius .... **[2]**

(ii) The toilet roll cardboard inner has **diameter** 48 mm.

Work out the thickness of each sheet.
You must show how you calculated your answer.



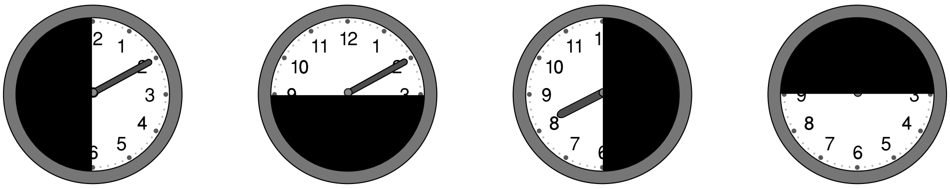
(b) (ii) .... mm **[6]**

6 There are four clocks on the wall in Warwick Arts Centre.

Removed due to third party copyright restrictions. Details: Richard Wentworth, The Warwick Dials, 1999. Located at the Warwick Arts Centre, Coventry, UK.

Each clock has an hour hand (the short hand) and a minute hand (the long hand).
Each clock has a different half covered.
This means on each clock you can see both hands, only one hand or neither hand.

These clocks show the time in four cities, New York, Moscow, Beijing and London.



New York   Moscow   Beijing   London

The time shown for London is Greenwich Mean Time (GMT).
The time in New York is 5 hours behind GMT.
The time in Moscow is 4 hours ahead of GMT.
The time in Beijing is 8 hours ahead of GMT.

(a) What time is it in London?

(a) .... **[3]**

The difference between the times in New York, Beijing, Moscow and London are a whole number of hours. Not all time differences across the world are a whole number of hours.

Bela is travelling from London to Kathmandu. She finds these flights that pass through New Delhi.
The times shown are **local** times at the place where the flight lands or takes off.
(+1) means the flight arrives the next day.

Outbound flights		
London	19:55	Flight time 8 hours 20 minutes
New Delhi	09:45 (+1)	
		Wait in airport 3 hours 50 minutes
New Delhi	13:35	Flight time 1 hour 35 minutes
Kathmandu	15:25	

(b) **(i)** Show that the time in New Delhi is 5 hours 30 minutes ahead of London.

....

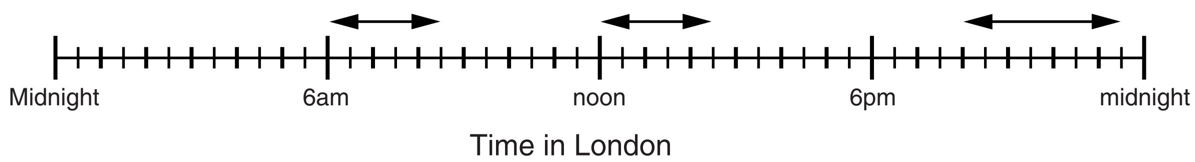
....

.... **[3]**

(ii) Work out the time difference between London and Kathmandu.
State whether the time in Kathmandu is ahead of or behind the time in London.

(b) (ii) .... **[3]**

(c) Bela wants to telephone Janak each day while she is in Kathmandu. Janak is in London.
The arrowed times on the diagram are the times Janak can be contacted by telephone each day.



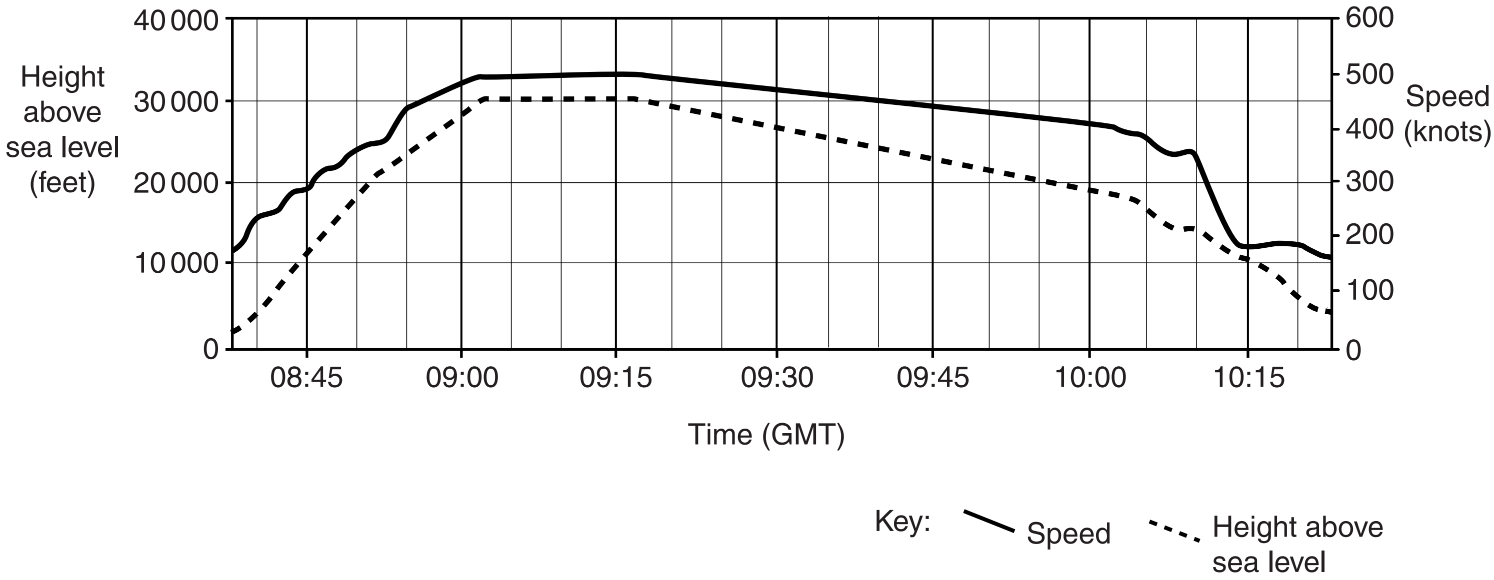
Bela can only telephone from 6pm to 11pm **Kathmandu** time.

(i) Draw an arrowed line on the diagram to show the **London** times when Bela can telephone Janak. **[2]**

(ii) Between which London times will Janak and Bela be able to talk on the telephone?

(c) (ii) .... and .... **[1]**

(d) This graph shows the height in feet above sea level and the speed in knots from the moment the plane is in the air to the moment it touches down, of a flight from New Delhi to Kathmandu.



New Delhi is 700 feet above sea level.

(i) How many feet does the plane climb to its maximum height?

(d) (i) .... ft **[2]**

(ii) Between which times is the plane travelling at a constant speed?

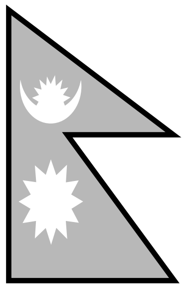
(ii) .... and .... **[1]**

***(iii)** The area under a **speed-time** graph represents distance.
Airspeed is measured in knots. A knot = 0.031 km per minute, to 2 significant figures.

Estimate the distance travelled, in km, from New Delhi to Kathmandu.

(d) (iii) .... km **[5]**

(e) Kathmandu is the capital of Nepal.
The national flag of Nepal is the only national flag in the world that is not rectangular.
It is formed from two overlapping triangles with a border.



These are instructions to draw the overlapping triangles.

(1) Draw a horizontal line AB.
(2) From A draw a line AC perpendicular to AB. AC = $1\frac{1}{3}$ AB.
(3) Mark point D on AC. AD = AB. Join BD.
(4) On BD mark point E. BE = AB.
(5) Draw line FG; point F lies on AC, FG is equal to and parallel to AB and passes through E.
(6) Join CG.

The horizontal line AB has been drawn below.
Using this line AB, follow instructions (2) to (6) and draw the overlapping triangles.

A B

[4]

7 The rate at which radioactive material decays is measured by its half life.
The half life is the time it takes for one half of the atoms of a radioactive material to disintegrate.

Marie models the radioactive decay of 1 gram of carbon-14.

She uses the equation $y = 0.886^t$.
y is the proportion of grams of carbon-14 remaining after a period of time, t.
t is measured in thousands of years, so for a period of 3000 years $t = 3$.

(a) Write down the value of y after 1000 years.

(a) .... g **[1]**

(b) Use Marie's equation to check that the half life of carbon-14 is approximately 5720 years.

....

....

.... **[2]**

The half life of carbon-14 is used in carbon dating to find the approximate age of certain objects.

(c) A shell containing 1 g of carbon-14 is buried in sand.

Use trial and improvement to work out how many years it would take for there to be 0.6 g of carbon-14 remaining.
Give your answer to the nearest 10 years.

(c) .... years **[5]**

(d) Pierre also models the radioactive decay of 1 gram of carbon-14.

Pierre uses the equation $y = 1.129^{-t}$.
y is the proportion of grams of carbon-14 remaining after a period of time, t.
t is measured in thousands of years, so for a period of 3000 years $t = 3$.

Do Marie's and Pierre's equations give approximately the same value of y?
Justify your answer.

....

....

....

....

....

....

....

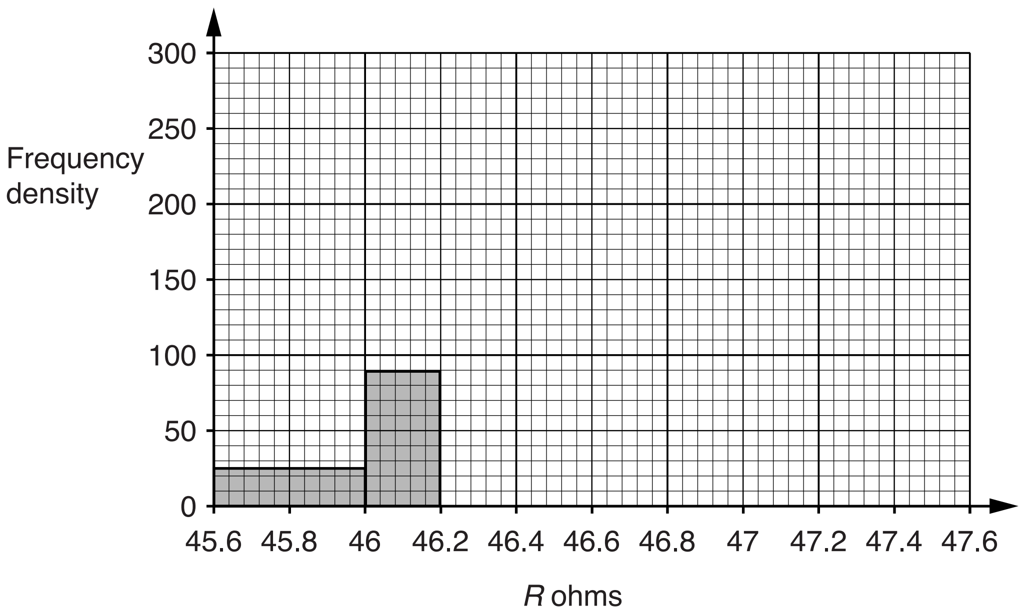
.... **[3]**

8 Gareth bought a pack of 1000 resistors.
He tested some of the resistors to see how close they came to the manufacturer's specified resistance of 47 ohms.
These are the results.

Resistance, *R* ohms	Frequency	Frequency density
$45.6 \le R < 46.0$	10	25
$46.0 \le R < 46.2$	18	90
$46.2 \le R < 46.4$	40	
$46.4 \le R < 46.5$	28	
$46.5 \le R < 46.6$	25	
$46.6 \le R < 46.8$	25	
$46.8 \le R < 47.2$	18	
$47.2 \le R < 47.6$	6	

(a) **(i)** Complete the frequency density column. **[3]**

(ii) Complete the histogram.



[3]

(b) Gareth knows that any sample he tests from a pack of resistors is likely to be typical of all the resistors in the pack.

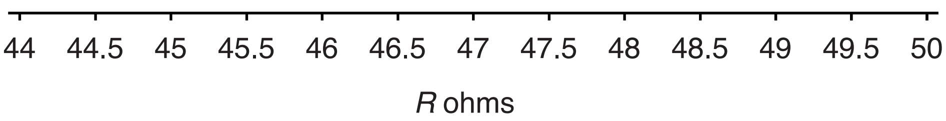
Describe the resistors in the pack that Gareth bought with respect to the manufacturer's specified resistance of 47 ohms.

....

.... **[1]**

(c) The resistors in the pack Gareth bought were described as having a tolerance of 5%.
This means that the resistance should be in the range $44.65 \leq R \leq 49.35$.
(5% of 47 = 2.35)

Represent this inequality on the number line.



[1]

(d) For a new circuit, Gareth required more precise 47 ohm resistors.
He needed 47 ohm resistors with a tolerance of 1%.

Work out an estimate of the number of resistors in the pack that Gareth bought that are within this range.

(d) .... **[4]**

END OF QUESTION PAPER