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F

Friday 6 November 2015 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/01 Applications of Mathematics 2 (Foundation Tier)

4986972676

Candidates answer on the Question Paper.

OCR supplied materials:
None

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

Duration: 1 hour 30 minutes

A382 01

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 **32** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

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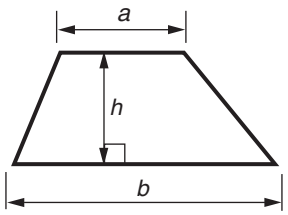
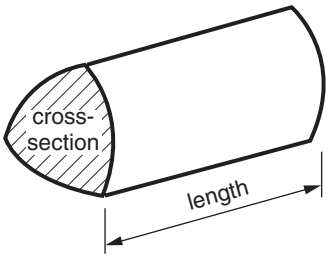
Formulae Sheet: Foundation Tier

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



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



PLEASE DO NOT WRITE ON THIS PAGE

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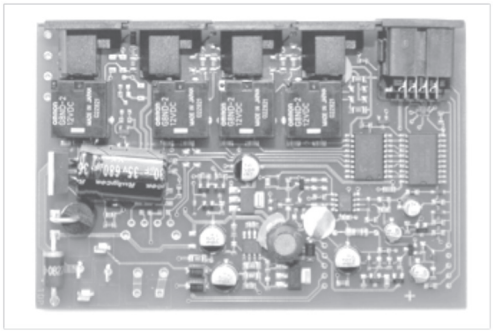
Answer **all** the questions.

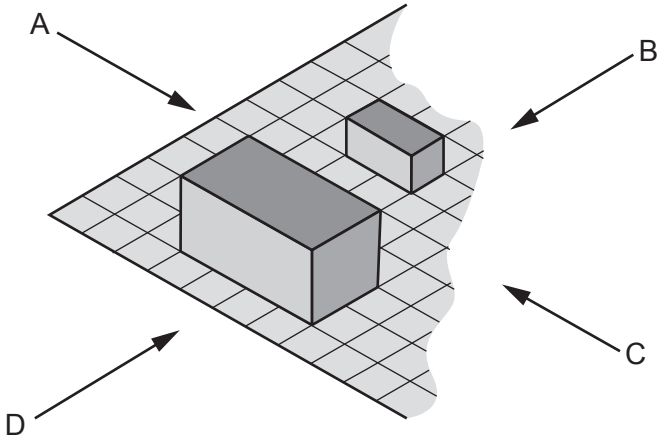
1 Mobile phones, computers and other electrical devices have microchips in them.

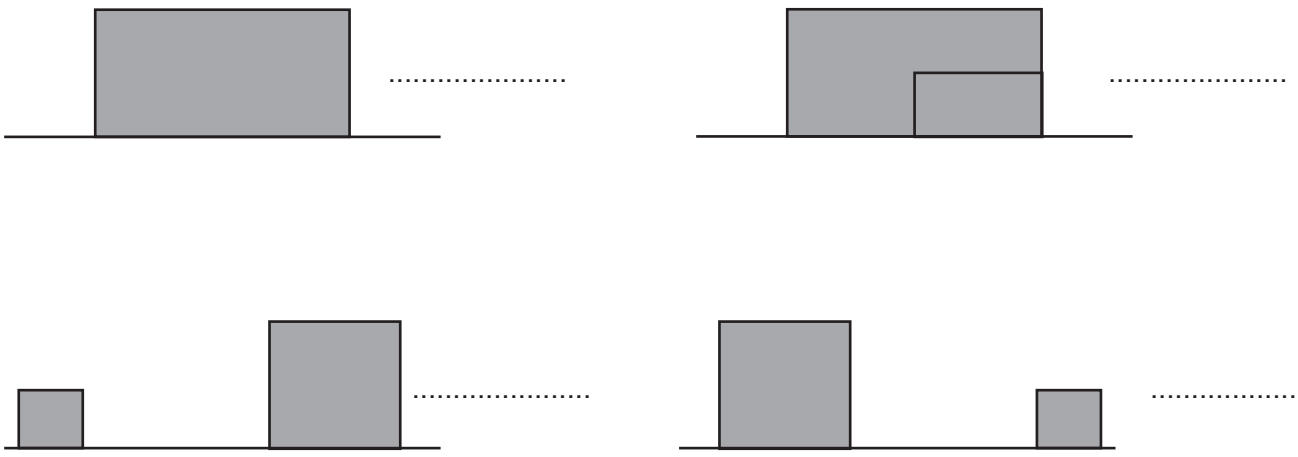


The microchips are connected by copper strips printed onto a plastic board.

These plastic boards are called printed circuit boards (PCBs).

(a) This is a sketch of two microchips on part of a PCB.
Match each of the directions A, B, C and D with one of the views below.





[2]

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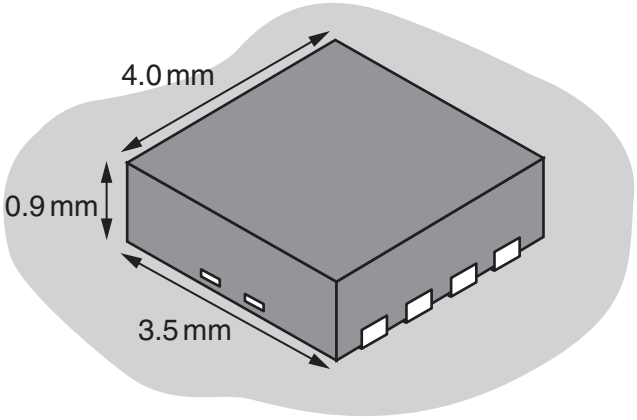
(b) This microchip is in the shape of a cuboid (ignoring the connectors).

(i) Calculate the volume of the microchip (ignore the connectors).



(b)(i) ..... mm^3 **[2]**

Microchips can get hot when working.
To keep cool they need to have a large exposed surface area.

(ii) The exposed surface area of the microchip above is

$$4 \times 3.5 + 1.8(3.5 + 4.0)\ mm^2.$$

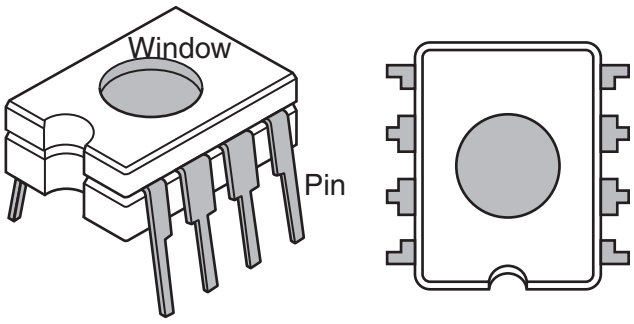
Calculate this area.

(ii) ..... mm^2 **[2]**

(c) A microchip can be sorted in two ways:

- by the total number of pins it has
- by whether or not it has a window.

These are two views of a microchip that has a window and 8 pins.



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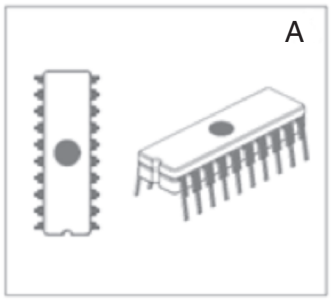
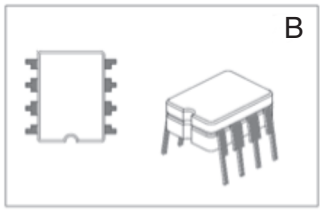
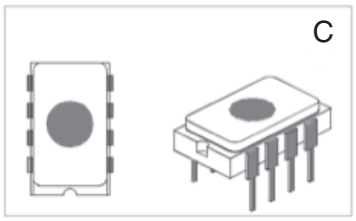
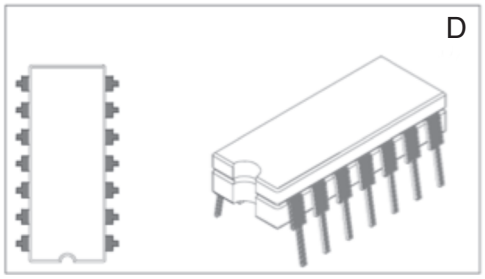
5

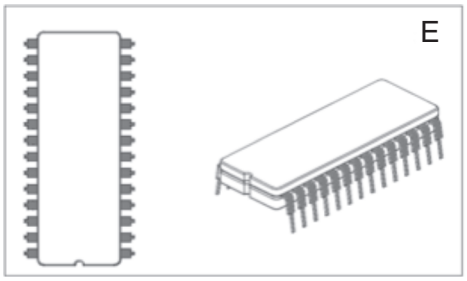
Use the flowchart to sort each chip, A to E, into the correct box.

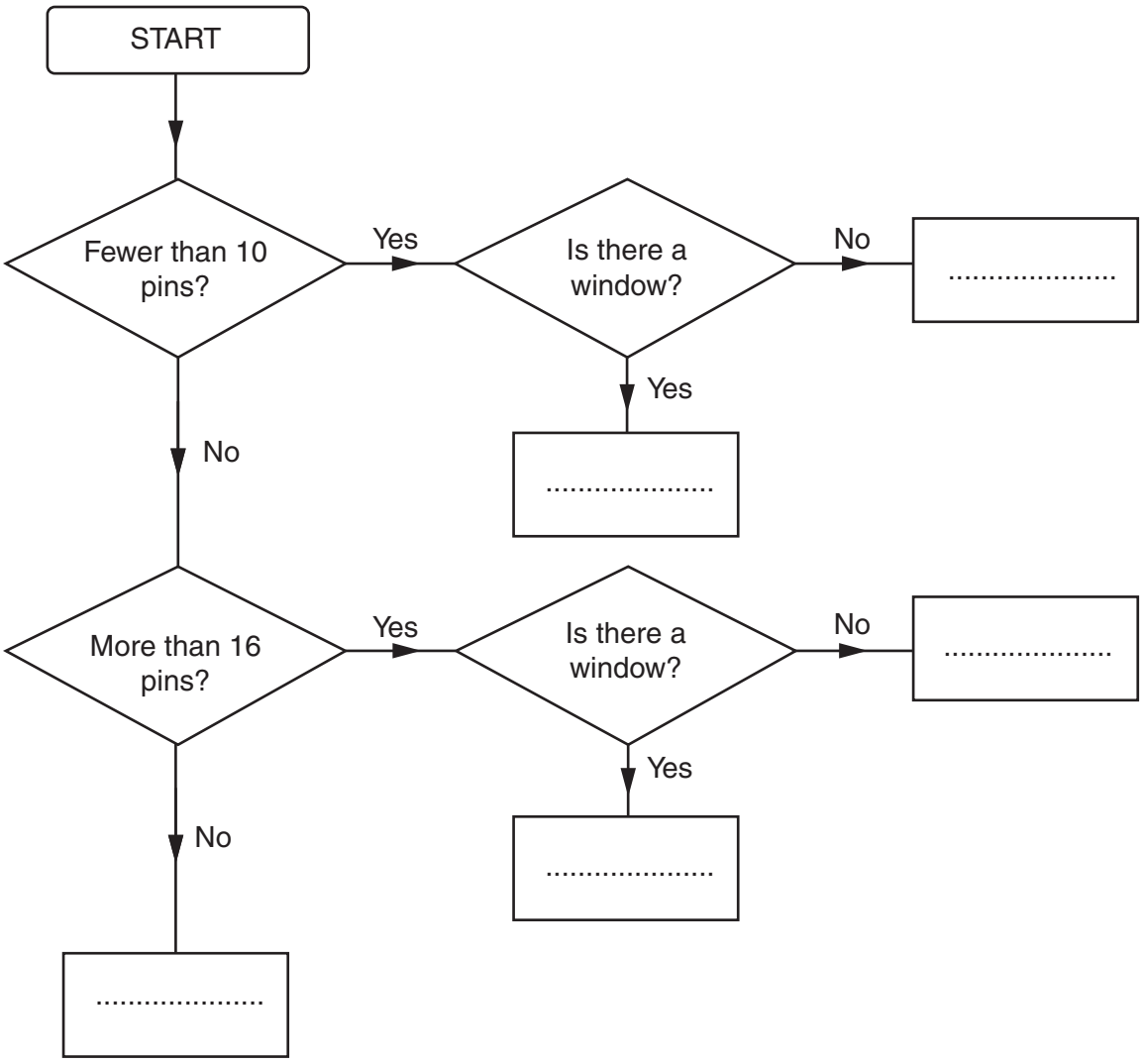












[4]

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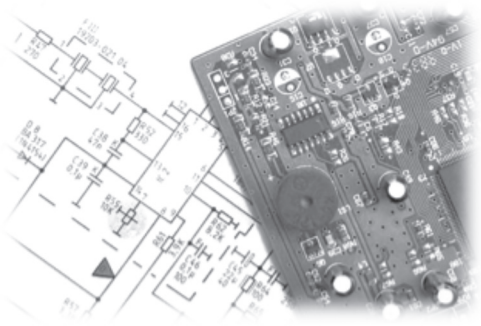
(d) Gareth designs printed circuit boards (PCBs).



This spreadsheet shows the costs of making different quantities of two PCB designs, R and S.

	A	B	C	D	E	F	G
1	PCB design	Set-up cost	Cost per unit	Total for 100 units	Price per PCB	Total for 200 units	Price per PCB
2	R	£60.00	£0.20	£80.00	£0.80	£100.00	£0.50
3	S	£60.00	£0.36	£96.00	£0.96	£132.00	£0.66

The set-up cost is the cost of preparing to manufacture PCBs.
The cost per unit is the cost of making one PCB.

(i) The formula used for cell D2 is =B2+(100*C2).
The formula used for cell E2 is =D2/100.

Complete the formula used for cell F3 to find the total cost of **200** of PCB design S.

(d)(i) = ... + (..... *.....) **[2]**

(ii) Explain why the price per PCB is cheaper when 200 PCBs are made.

.....

..... **[1]**

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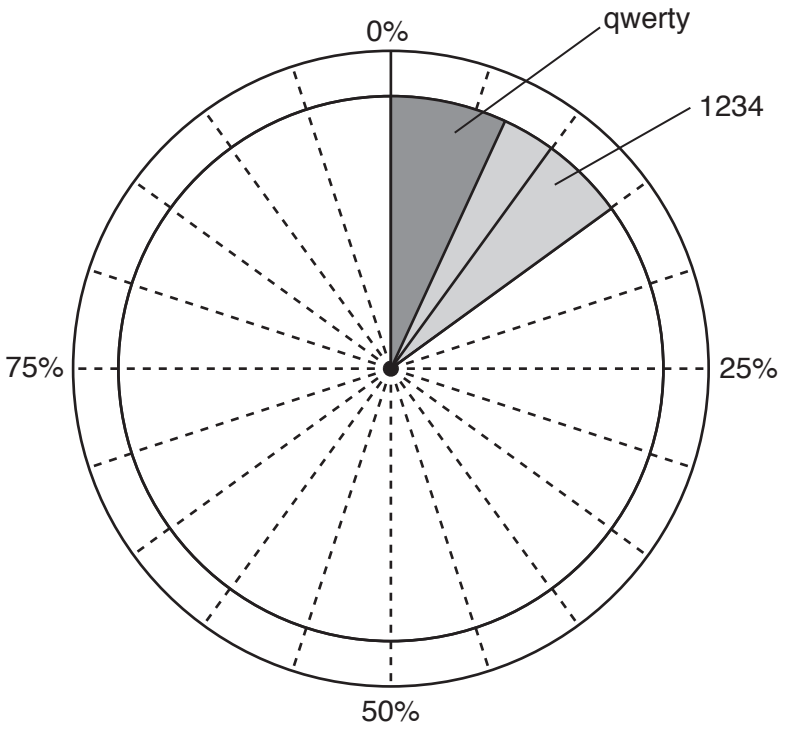
2 People are not always original when they choose passwords.

These are the five most common passwords according to an internet survey.
For these five passwords, the percentage of times they are used is given.

Password	Percentage
qwerty	7
1234	8
12345678	10
123456	35
password	40
Total	100

(a) Complete this pie chart, to show these results.



[3]

(b) Of the five most common passwords, which two together are used $\frac{3}{4}$ of the time?

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

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(c) Many people choose a word from a dictionary as a password.
Hackers can use a computer to try all the words in a dictionary one by one to find it.
This is called 'the brute force' method.

There are 600 000 words listed in the Oxford English Dictionary (OED).

(i) A hacker's computer can try 1000 words a second.

How long would it take it to try all the words listed in the OED?
Give your answer in minutes.

(c)(i) ..... minutes **[2]**

(ii) To protect against hackers some computer systems are made to slow down so that hackers can only try one password a second.

For this system how long would it take to test all the words in the OED?
Give your answer in hours.

(ii) ..... hours **[2]**

(iii) Josh's password is chosen at random from the OED.

What is the probability that a hacker can guess Josh's password on their first try?
Give your answer as a fraction.

(iii) ..... **[2]**

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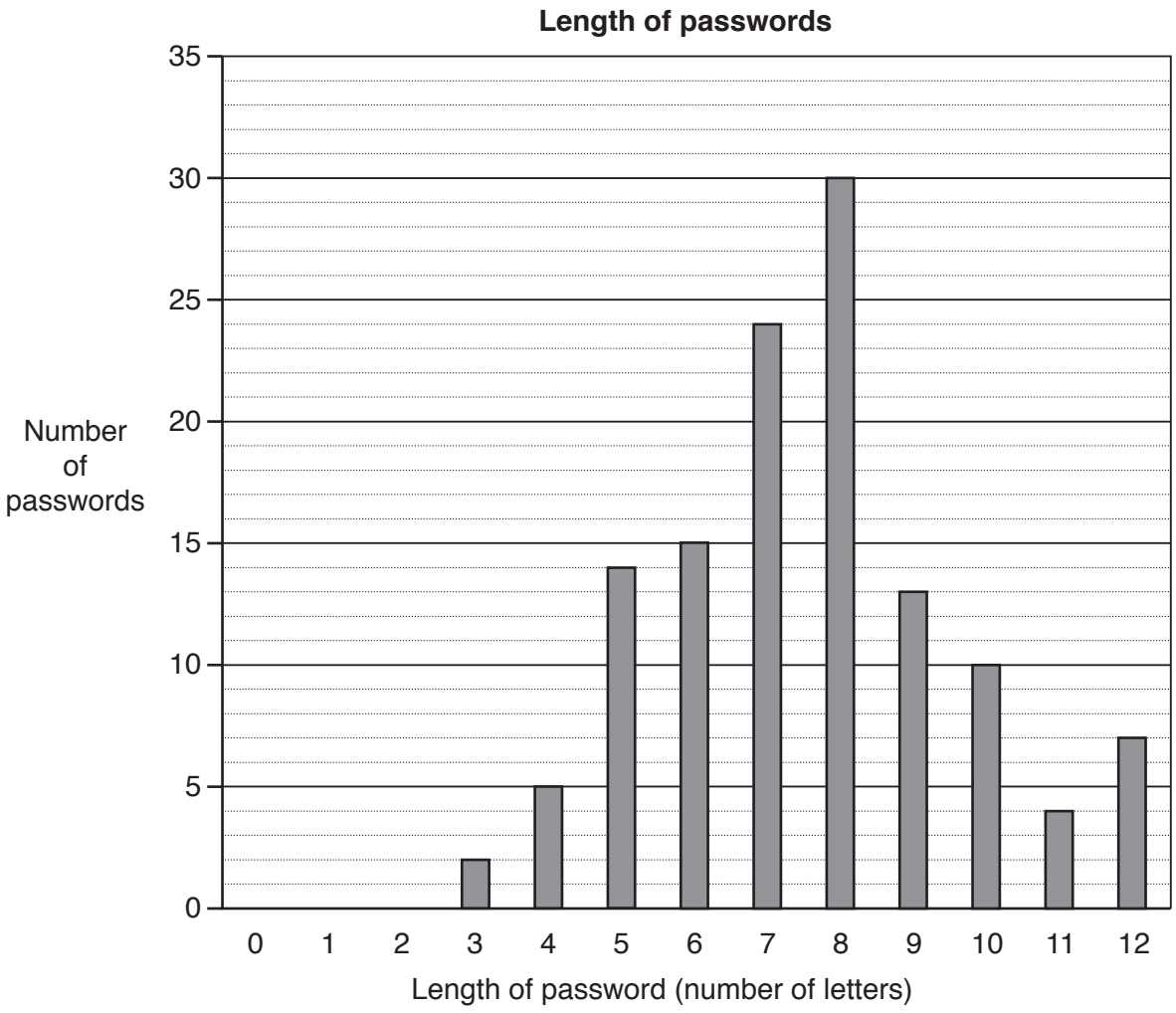
(d) Using long passwords improves security.
This bar chart shows the length of passwords collected in a survey.



(i) How many letters were in the shortest password?

(d)(i) ..... **[1]**

(ii) How many passwords were 6 letters long?

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

(iii) How many passwords were 10 or more letters long?

(iii) ..... **[1]**

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(e) Passwords can be formed by combining letters to make a 'word'.
Most of these words are not proper words listed in a dictionary.
When letters are taken two at a time, 676 different 2-letter 'words' can be made.
These can be listed AA then AB etc. and finally ZZ.
This table shows the number of possible 'words' for some numbers of letters.

Number of letters in word	Number of possible words
1	26
2	676
3	17576
4	
5	11881376
6	308915776
7	8031810176

The number of possible words is increased by the same factor each time.

How many possible 4-letter words are there?
Show how you got your answer.

(e) ..... **[2]**

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(f) The number of different words is greatly increased if both capital letters (A, B, C ...) and lower case letters (a, b, c ...) are used.

The formula for the number of different words, w, is

$$w = 52^n$$

where n is the number of letters in the word.

(i) Show that there are 2704 different 2-letter words.

..... **[1]**

(ii)* Use trial and improvement to find the smallest word length to give more than 20 million (20 000 000) different words.

..... words **[3]**

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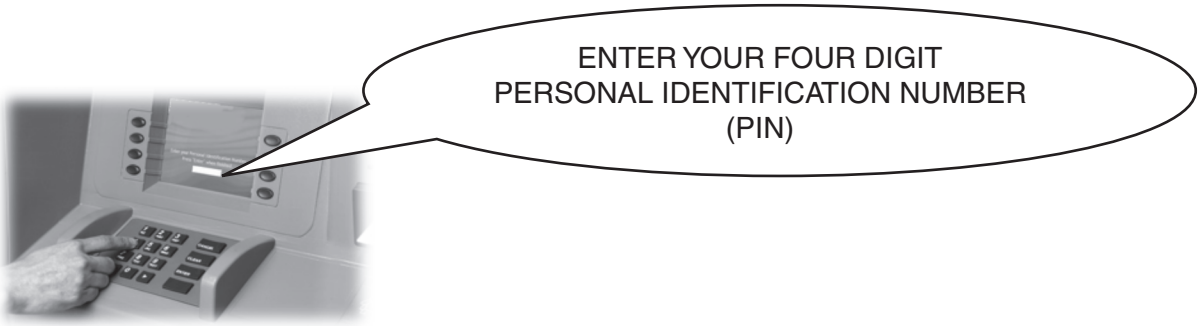
(g) To take money out from cash machines you need a PIN and your plastic card.



PINs are 4-digit numbers from 0000 to 9999.

(i) How many different 4-digit PINs are there?

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

Some people use the dates of birthdays ('birthday numbers') as their PINs.

d	d	m	m

These can be any date from the 1st of January ...

0	1	0	1

... to the 31st of December

3	1	1	2

(ii) How many 'birthday numbers' are there in a normal year?

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

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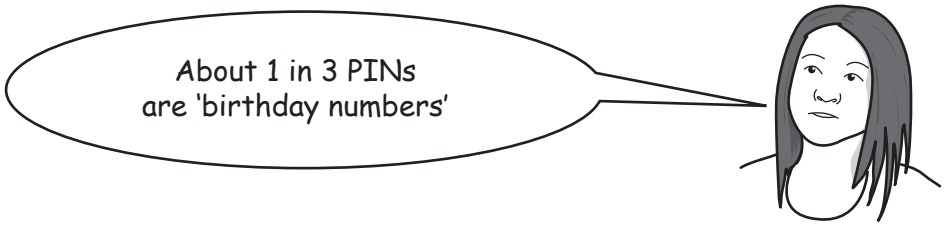
(iii) Shu says this.



Is she correct?
Show how you decide.

.....

.....

.....

.....

..... **[3]**

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3 **(a)** Mia is about to buy a new car.
A friend, Tony, shows her this article.

Best Car to Buy?

Fuel consumption is given in miles driven for each gallon of petrol used.

Pollution is measured in grams of CO_2 produced for each kilometre driven.

Here are the 8 most efficient cars in 2014 according to *The Motoring Master*.

Make of car	Fuel economy miles per gallon (mpg)	CO_2 emission grams per kilometre	Average new cost (£)
Ford Fiesta (ECOnetic)	85.6	87	16 950
Hyundai (i20 1.1 CRDi Blue)	88.3	84	13 540
Kia Rio (1 1.1 CRDi)	88.3	85	9 395
Peugeot 308 (1.6 Blue HDi)	91.1	82	18 570
Renault Clio (1.5 dCi)	88.3	83	13 200
Skoda Octavia (Greenline)	88.3	82	16 255
Vauxhall Corsa (1.3 CDTi ecoFlex)	85.6	88	11 470
VW Golf (BlueMotion)	88.3	85	22 000

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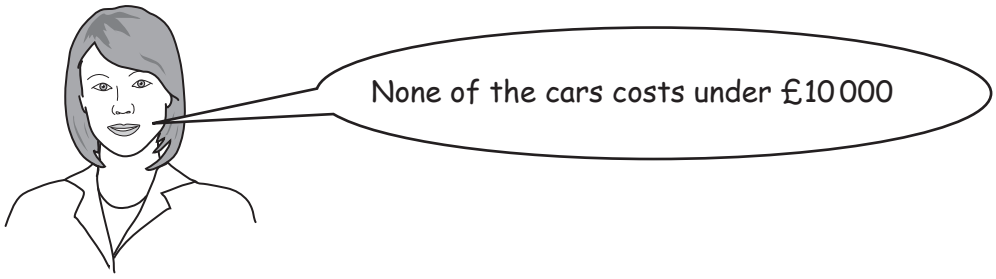
(i) Mia says this.

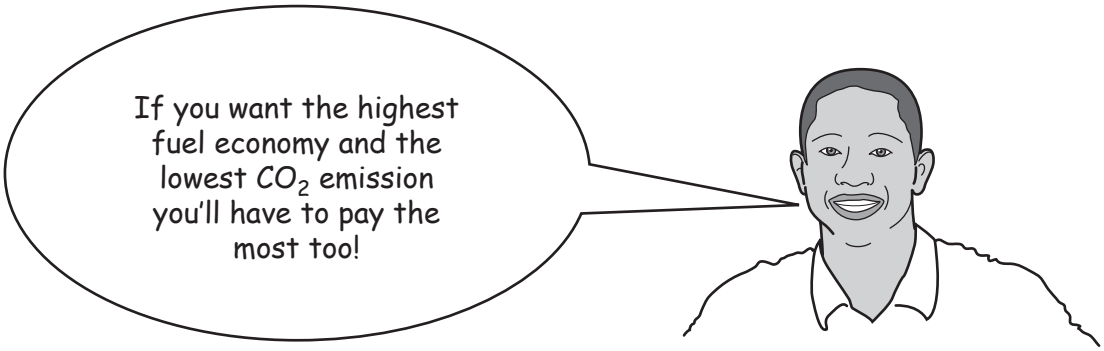


Show that Mia is wrong.

.....

..... **[1]**

(ii) Tony says this.



Show clearly, quoting figures from the table, that Tony is also wrong.

.....

.....

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.....

.....

..... **[3]**

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(b)* In a fuel economy competition teams compete to use the least amount of fuel.
These are the competition rules.

- Complete 7 laps of a 1.5 mile circuit.
- Travel at an average speed of at least 15 miles per hour (mph) over the whole 7 laps.

These are the times, in minutes, for each lap by Team Orange.

4.5 3.0 6.3 5.7 5.1 4.4 4.6

Show that Team Orange competed within the competition rules.

.....

.....

.....

.....

.....

..... **[4]**

(c) At one competition Team Blue had six entries.
Each entry used the same car, but with different drivers.
After each driver had driven the 7 laps, the fuel used was measured.
The results were used to calculate the fuel economy.

The table shows each driver's average speed in mph, correct to the nearest 0.1, and fuel economy in miles per gallon (mpg), correct to the nearest 100, for each attempt.

Driver	Alvita	Barney	Choy	Dilip	Evie	Fatima
Average speed (mph)	18.7	14.5	16.3	21.4	15.6	17.0
Fuel economy (mpg)	4100	5900	5300	4000	5200	4700

(i) Which driver drove within the competition rules **and** had the best fuel economy?

(c)(i) ..... **[1]**

(ii) What does the table tell you about the relationship between speed and fuel economy?

.....

..... **[1]**

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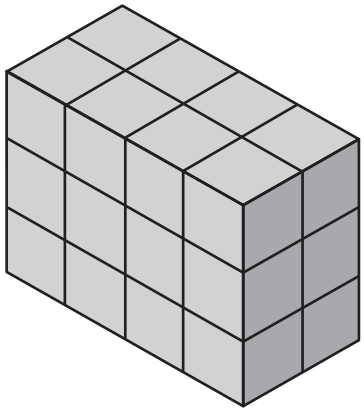
4 Richard makes some wooden play bricks for his daughter Ellie.
The bricks are cubes. Each cube has sides of length 5 cm.
All the bricks fit together to make a cuboid like this one.



(a) How many bricks make up the cuboid?

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

(b) Give the dimensions of the real cuboid.

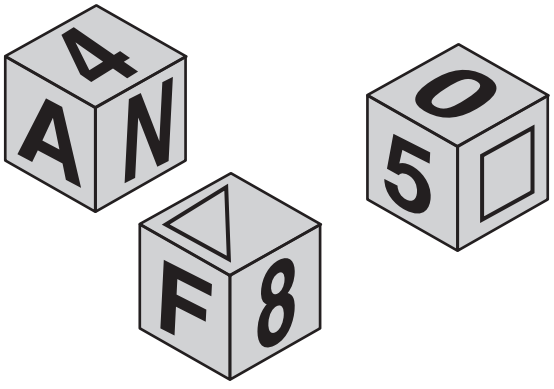
(b) ..... cm by ..... cm by ..... cm **[2]**

(c) Give the dimensions of another cuboid that could be made using **all** the bricks.

(c) ..... cm by ..... cm by ..... cm **[2]**

(d) Richard wants to stick a number, a letter or a shape on **every** face of each brick.

How many faces has he got to stick these onto in **total**?



(d) .....faces **[2]**

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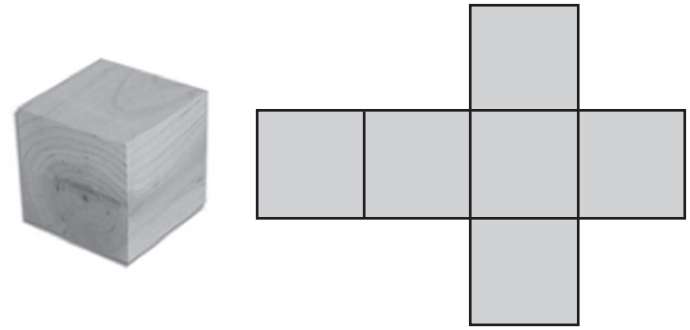
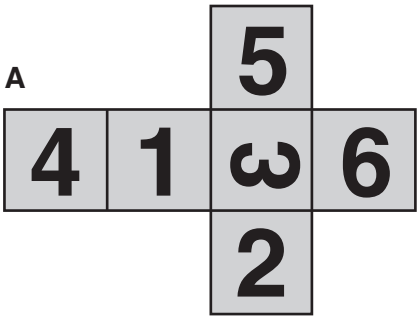
(e) Richard labels the faces of the bricks using a single piece of sticky paper for each brick.

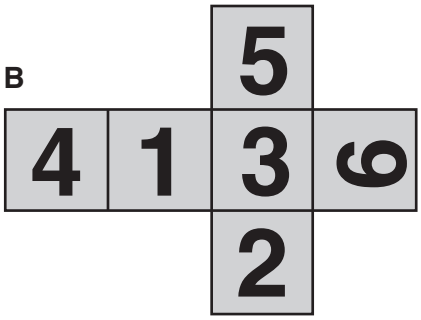


Match a piece of sticky paper (**A** to **E**) to each labelled brick on the next page.

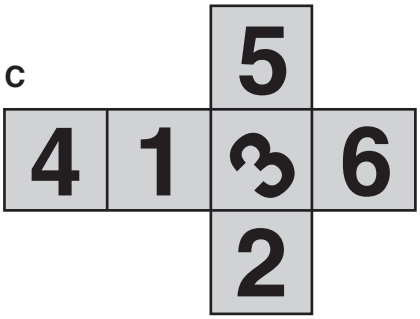
A



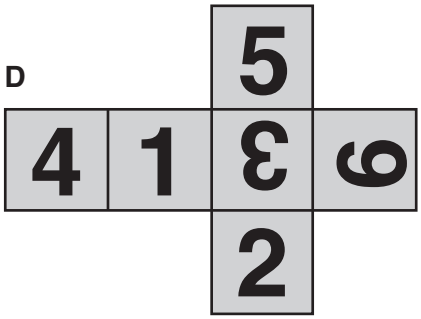
B



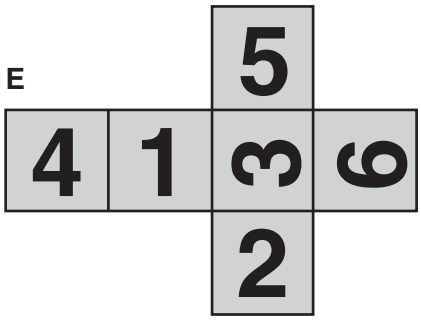
C



D



E



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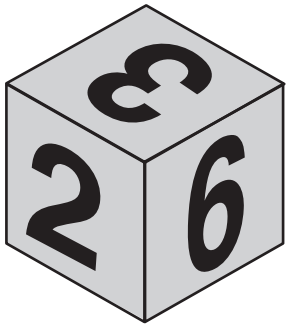

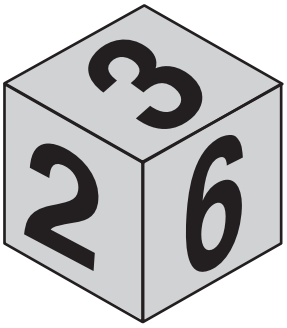

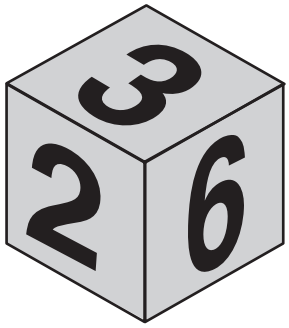

.... **[3]**

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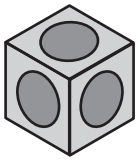
(f) Richard thinks that Ellie can recognise hexagons.



To test this he puts 9 bricks in front of her.
Each brick has the same shape on every face.
He asks Ellie to pick a brick with a hexagon on.

(i) What is the probability that Ellie picks a hexagon by chance?
Give your answer as a fraction.

(f)(i) ..... **[2]**

(ii) Richard tests Ellie a total of 18 times.
She picks a hexagon 6 times.

Does this show that Ellie knows anything about hexagons or is it by chance?
Use probability to support your answer.

.....

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

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(g) Richard is making a circle of bricks around Ellie.
He wants the diameter of the circle to be 2 metres.

How many bricks will he need in total?
Remember the bricks are cubes of sides 5 cm.
You must show how you get your answer.

Not to scale

.....

.....

.....

.....

..... **[4]**

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5 Some of the first coins are from Lydia, part of modern Turkey.
They are almost 3000 years old.
The coins were made of electrum.
This is a mixture of gold and silver.

(a) One of these coins is made from gold and silver in the ratio 2 : 3 by weight.
The coin weighs 4.7 g.

What weight of this coin is gold and what weight is silver?

(a) gold ..... g

silver ..... g
[3]

(b) The unit of money in Lydia was called the Stater.
Coins were made which were worth these fractions of a Stater.

$$\frac{1}{2} \quad \frac{1}{3} \quad \frac{1}{6} \quad \frac{1}{12} \quad \frac{1}{24} \quad \frac{1}{48} \quad \frac{1}{96} \quad \frac{1}{192}$$

(i) How many $\frac{1}{6}$ of a Stater coins are worth $\frac{1}{2}$ of a Stater?

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

(ii) All but one of the fractions make a sequence.

Which fraction is this?

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

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(c) The highest percentage of gold in electrum was 57%.
The lowest percentage of gold in electrum was 30%.

Tick the inequality for g, the possible percentage of gold in an electrum coin.

$30 \geqslant g \geqslant 57$ ..... $30 \geqslant g \leqslant 57$ .....

$30 \leqslant g \leqslant 57$ ..... $30 < g < 57$ .....

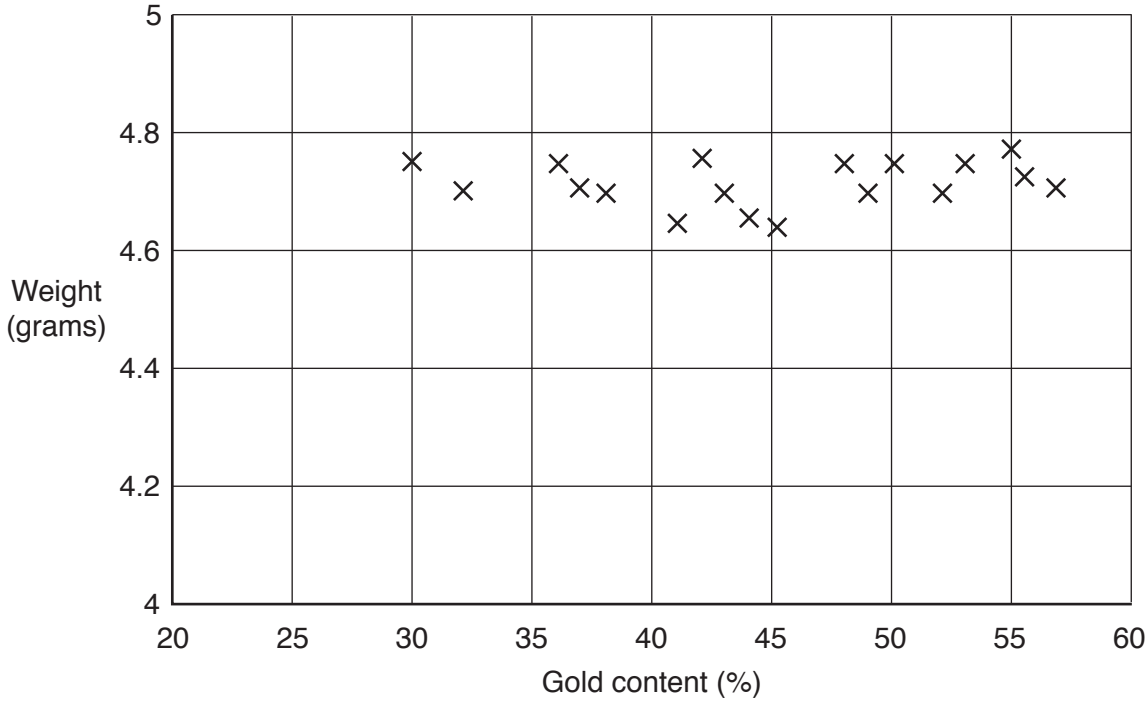
$30 < g > 57$ ..... $30 \leqslant g \geqslant 57$ .....

[1]

(d) Historians have investigated the percentage of gold in Lydian coins like this one.

Their results are shown on this scatter graph.

Lydian coins of the type 'Lion's head facing right'



(i) How many coins were investigated altogether?

(d)(i) ..... **[1]**

(ii) What does the scatter graph show about any connection between a coin's weight and its gold content?

.....

..... **[1]**

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6 Andy likes sailing.
He finds this simple method to estimate angles at sea.

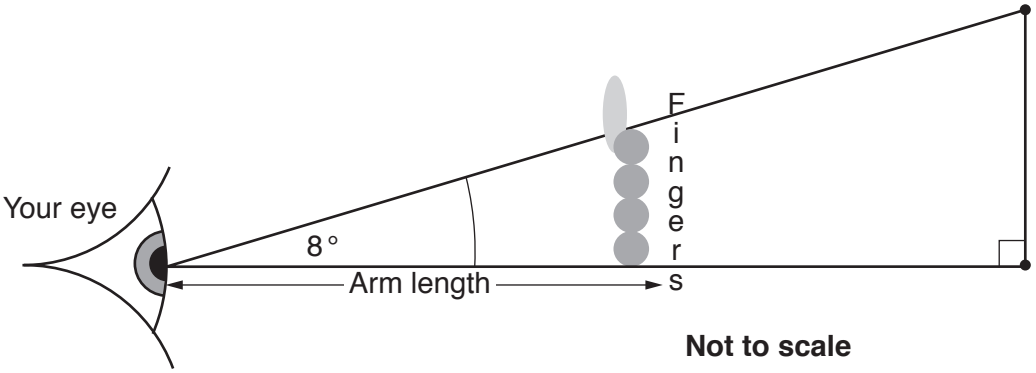
Estimating Angles At Sea

- Turn your fingers at right-angles to your arm.

- Stretch your arm out straight.

Points which make an angle of about 8° with your eyes are just covered by your four fingers.

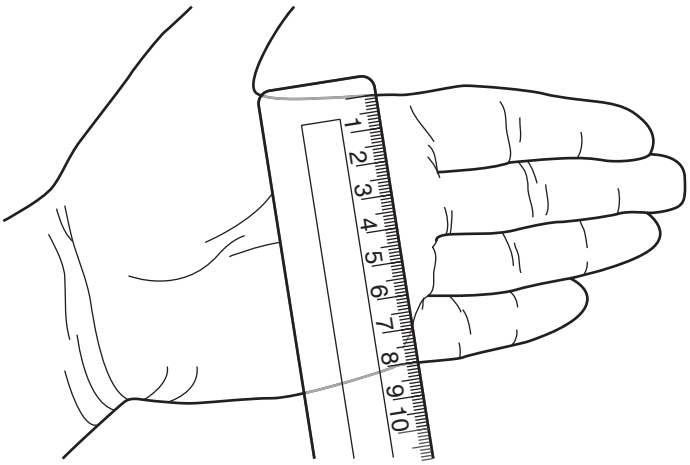
Three fingers cover 6° and so on.



Not to scale

Andy wants to test the method.
He uses a scale drawing and his own body measurements.

- His arm length is 60 cm.
- He measures the distance across his fingers with a ruler, as shown in the picture.
- He decides to use a scale of 2 mm to represent 1 cm.



(a) Do Andy's fingers cover 8°?
Draw a labelled scale diagram on the grid and justify your conclusion.

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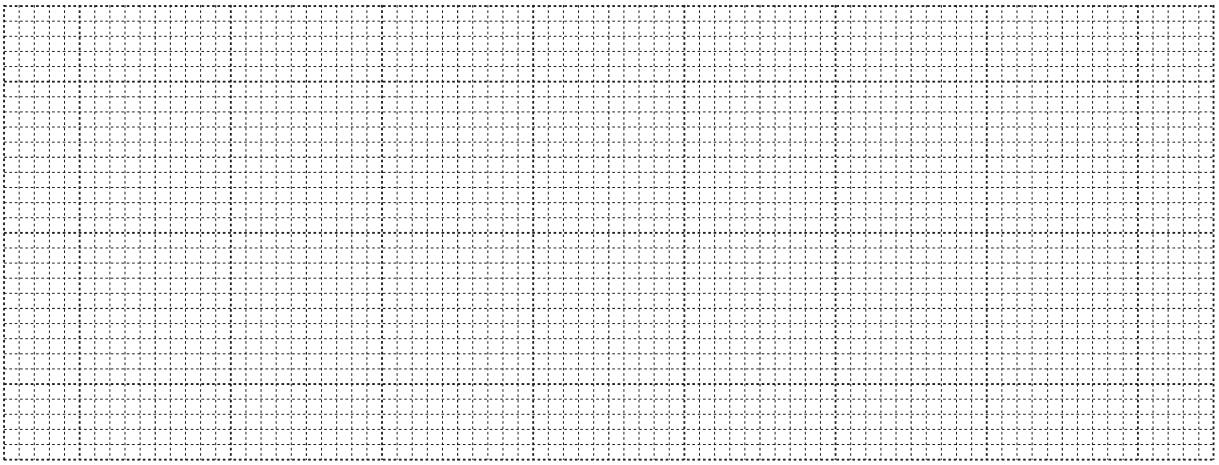

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..... **[5]**

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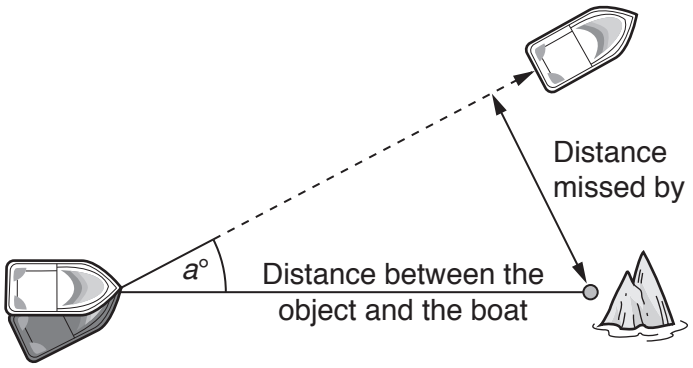
(b) Andy finds another rough rule.

The Rule of 60 – how to miss an object

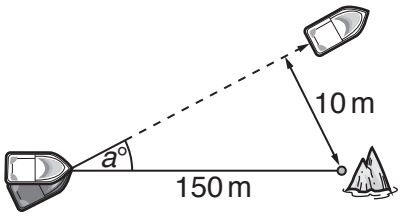
Method



To calculate the angle, a°, needed to turn to miss an object:

- *Calculate 60 multiplied by the 'distance missed by'*
- *Divide this answer by the 'distance between the boat and the object'*
- *The result is the angle, a°*

Example



For the above situation:

$60 \times 10 = 600$

$600 \div 150 = 4$

$a = 4$

The angle to turn is 4°.

Andy wonders how accurate the rule is.
He finds some accurate values of *a* for which a boat will miss an object by 10 m.

He makes a graph showing this. It is shown on the next page.

(i) Use The Rule of 60 to find the angle to steer, at a distance of 75 m, in order to miss a rock by 10 m.

(b)(i) .....° **[1]**

(ii) Plot the method example for 150 m and your answer from part **(i)** on Andy's graph. **[1]**

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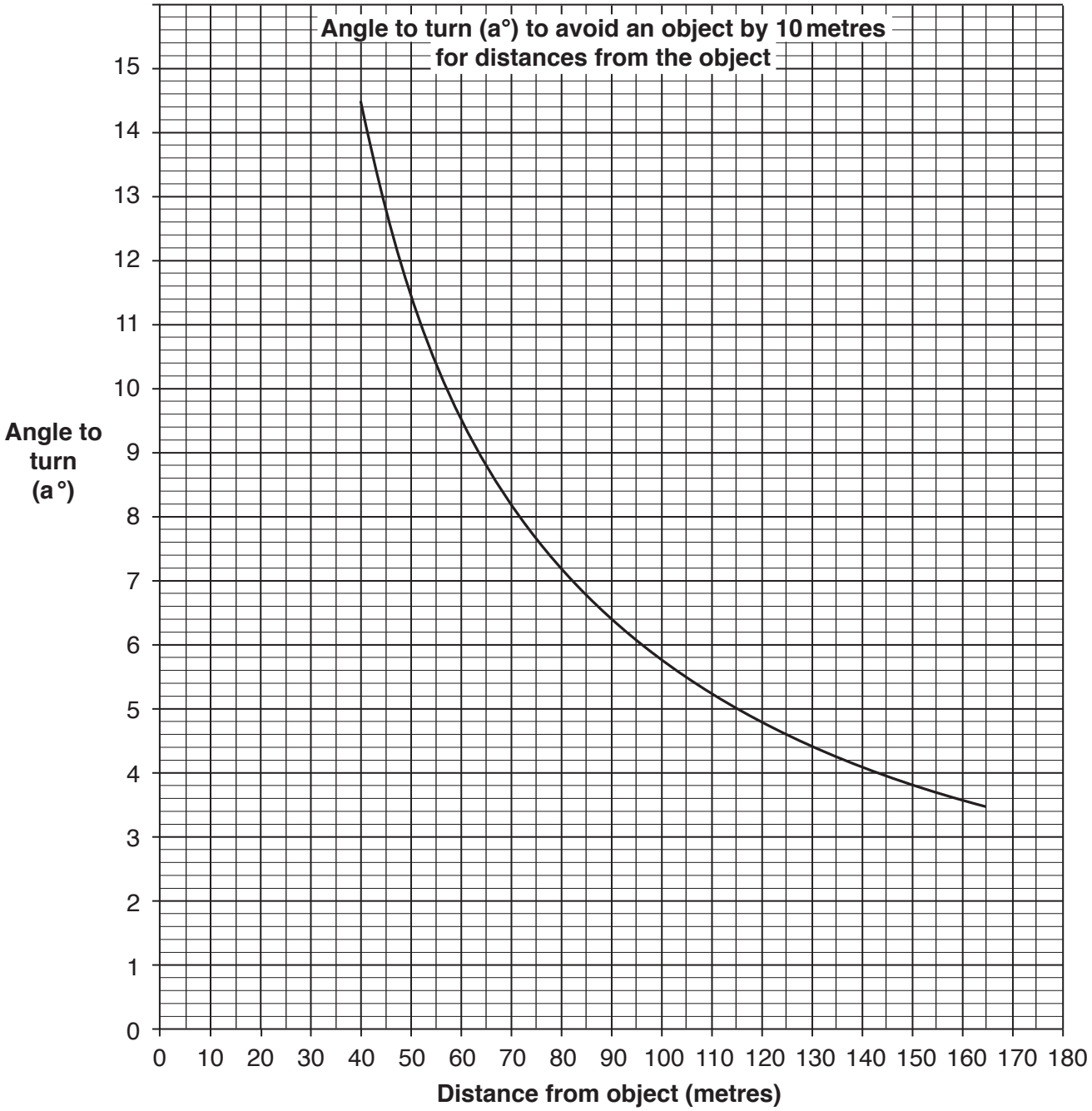

(iii) Is it safe to use The Rule of 60?
Use the graph to support your answer.

.....

.....

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

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7 **(a)** Tim is on the phone to his friend Hassan.
There is a thunder and lightning storm.

I'm worried about the new cat. I wonder where the storm is.

When you see the lightning **flash** you start counting the seconds until you hear the thunder. Divide this time by 3. That's how far away the storm is in kilometres.

Tim counts 24 seconds and calculates that the storm is 8 km away.

Hassan also counts the seconds from flash to thunder for the same flash.
It is 27 seconds.

The map on the next page shows where Tim and Hassan live.

Mark where the storm might be.
Leave in the arcs you draw.

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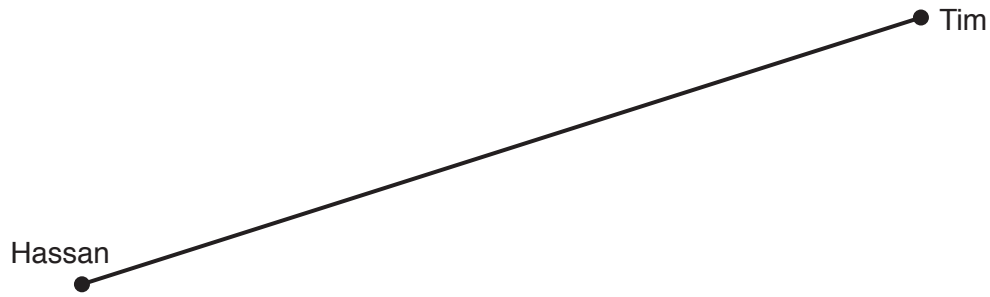

1 cm represents 1 km

[5]

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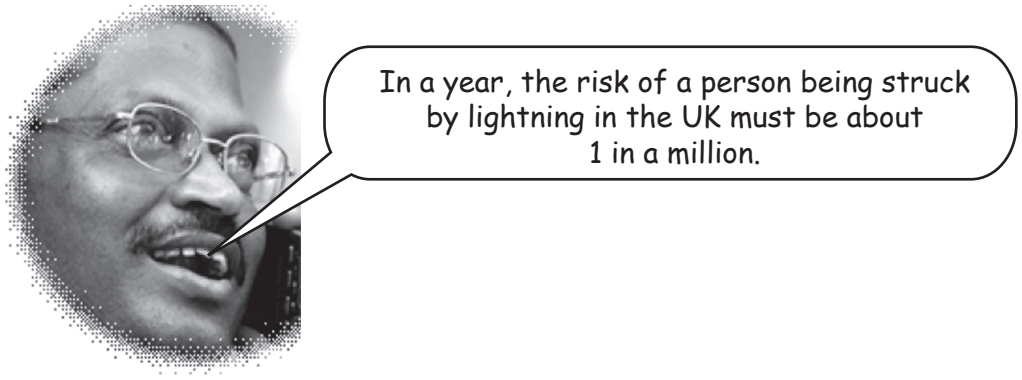
(b) Hassan finds out about the numbers of people struck by lightning.

- There are about 300 000 lightning strikes every year in the UK.
- Each year in the UK between 30 and 60 people are struck by lightning.
- A man, Roy 'lightning conductor' Sullivan, was struck 7 times by lightning between 1942 and 1977!
- The population of the UK is about 60 million.

He says this.



Is Hassan's estimate about right?
Use some of his notes to support your answer.

.....

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.....

.....

..... **[3]**

END OF QUESTION PAPER

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