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Thursday 9 June 2016 – Morning
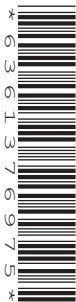
GCSE APPLICATIONS OF MATHEMATICS

A382/01   Applications of Mathematics 2 (Foundation Tier)

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

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
* 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 **28** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

OCR is an exempt Charity

Turn over
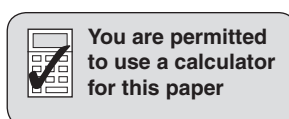
Formulae Sheet: Foundation Tier

Area of trapezium $= \frac{1}{2}(a + b)h$
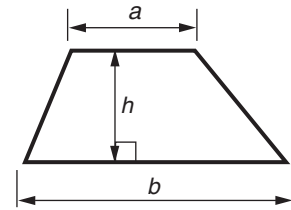
Volume of prism $=$ (area of cross-section) $\times$ length
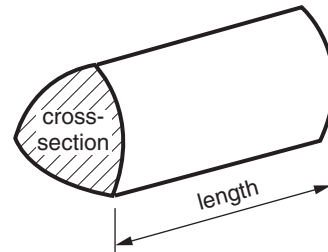
PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 **(a)** Each person in the UK uses about 150 litres of water a day.

How a person in the UK uses water
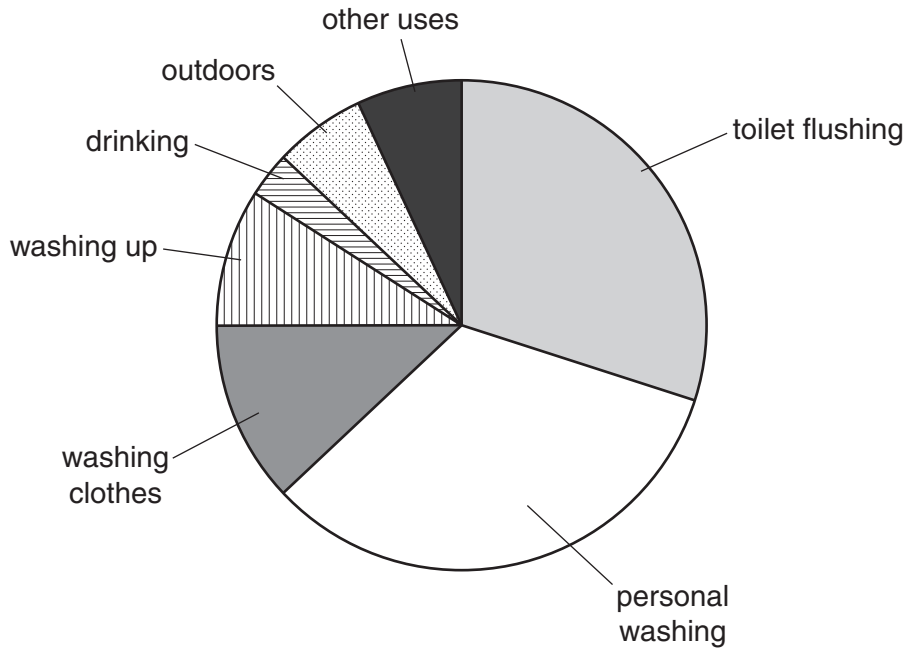
(i) Which **two** uses together account for **more** than half the water used in a day?

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

(ii) Estimate **the fraction** of the water that is used for personal washing.

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

(iii) Use your answer to part **(a)(ii)** to calculate **the amount** of water used for personal washing.

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

(b) Clean water is very scarce in some parts of the world. Icebergs are made of pure water.

Image removed due to third party copyright restrictions.

Scientists have investigated the possibility of catching and then towing icebergs to Africa! This graph shows their results.

How the percentage of iceberg left depends on the time of towing

Percentage of iceberg remaining (y-axis, 30 to 100)

Number of weeks of towing (x-axis, 0 to 30)
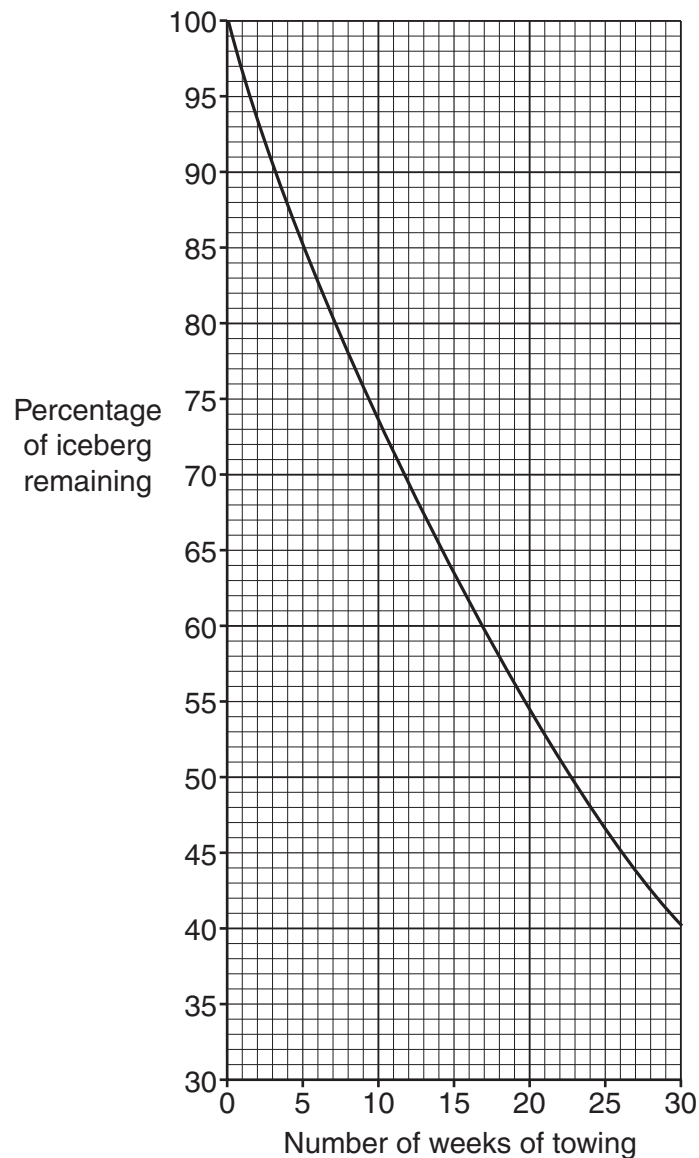
(i) After how many weeks would half the iceberg remain?

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

(ii) The time taken to tow an iceberg from Antarctica to Africa is planned to be about 140 days.

What percentage of an iceberg would be left after this journey?

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

(iii) A million people need about 3000 tonnes of fresh drinking water a day.
A medium-sized iceberg holds about 200 000 tonnes of fresh water.

Could the following headline about towing a medium-sized iceberg to Africa be true?

NEWS an' THAT
www.newsanthat.com   World News   - Since 1979

Iceberg water: a month's fresh water for a million!!

Show clearly with working how you decided.
You will need to use your answer to part **(b)(ii)**.

....

....

.... **[3]**

Turn over

(c) Tabular icebergs have the shape of a cuboid.

The dimensions of a tabular iceberg are shown in this sketch.

10 m

18 m

14 m
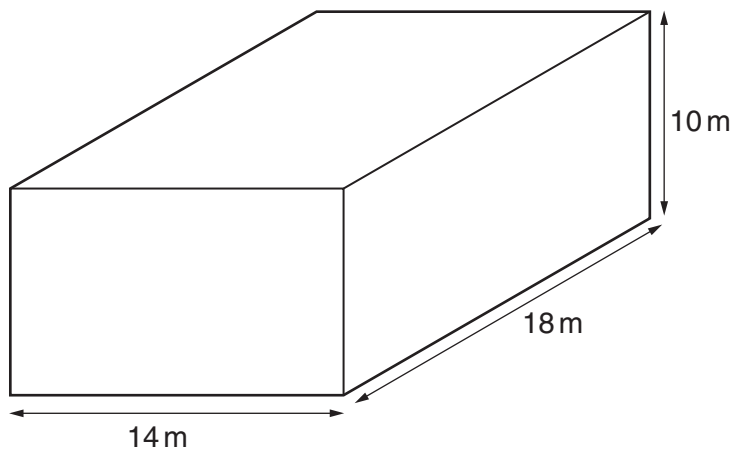
(i) Calculate the volume of this iceberg.

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

(ii) A cubic metre of iceberg holds 900 litres of pure water.

How many **million** litres of pure water does this iceberg hold?

(ii) .... million litres **[2]**

(d) Icebergs are named by their height seen above water.

Name	Height above water (*h* metres)
Growler	Less than 1
Bergy bit	From 1 to less than 5
Small	From 5 to less than 15
Medium	From 15 to less than 45
Large	From 45 to 75
Very large	More than 75

(i) What name is given to an iceberg with height 10 metres above water?

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

(ii) Tick the inequality in *h* that fits Large icebergs of height *h* metres.

$45 \leqslant h < 75$ .... $45 \geqslant h \geqslant 75$ ....

$45 < h > 75$ .... $45 \leqslant h \leqslant 75$ ....

$45 < h \leqslant 75$ .... $45 > h \geqslant 75$ ....

[1]

Turn over

(e) The tops of tabular icebergs are flat.
One of the largest tabular icebergs is shown in white on this satellite photo.
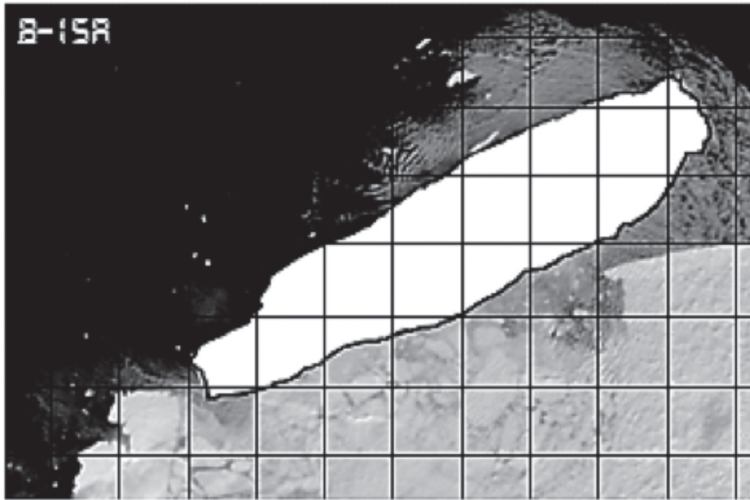
Each square represents an area of 1000 square kilometres.
Estimate the area in square kilometres of this iceberg.

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

(f) Temperatures inside an iceberg can be as low as ⁻20 °C.

Surface water temperatures near Africa can be as high as 30 °C.

(i) How many degrees warmer is this surface water temperature than the lowest temperature inside an iceberg?

(f)(i) .... °C **[1]**

Most of an iceberg is underwater.

Tabular icebergs are the best icebergs to be towed.
Their sides are vertical above and below the water.

(ii) For a tabular iceberg, the ratio of its height above the water to its height below the water is 1 to 7.

The total height of a tabular iceberg is 56 m.

What is the height of the iceberg below water?
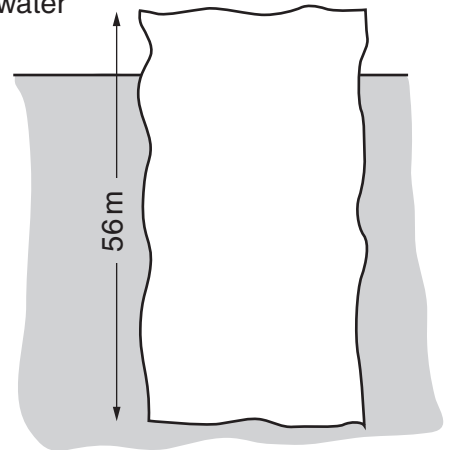
Not to scale

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

(g) In order to stay in cooler water it may be better to steer East and then steer North.
In other words, go from A to B and then B to C, rather than go directly from A to C.

Not to scale
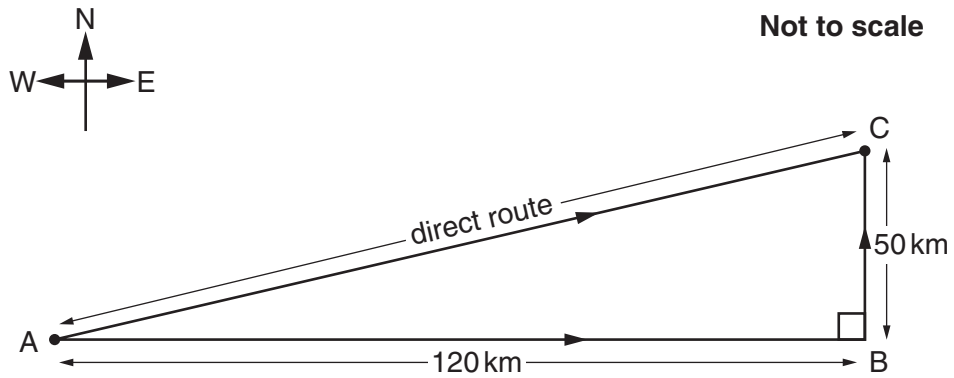
The only problem is that the direct route (A to C) is shorter.

Complete the scale diagram below to help you work out how much shorter the direct route is.

1 cm represents 10 km

A   B
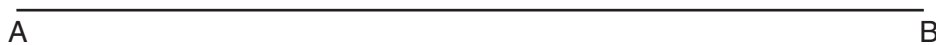
(g) .... km **[3]**

2 Frank uses this formula to add fractions when the numerators of the two fractions are 1.

$$\frac{1}{a} + \frac{1}{b} = \frac{a+b}{a \times b}$$

(a) Use Frank's formula to work out

$$\frac{1}{3} + \frac{1}{5}.$$

(a) .... [2]

(b) Frank uses a spreadsheet to work out $\frac{1}{5} + \frac{1}{11}$.

	A	B	C	D	E	F	G	H
1								
2		1	+	1	=	16		
3		5		11		55		
4								
5								

Frank's Fraction

Write down

(i) the number that is in cell B3,

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

(ii) the cell which contains the number 55,

(ii) .... [1]

(iii) the formula that Frank has written in cell F2.

(iii) .... [2]

Turn over

3 Extreme poverty in a country is measured by the percentage of its people living on less than $1.25 a day.

(a) Here are the World Bank figures for the percentage of people living in extreme poverty in Armenia each year from 2005 to 2012.

Armenia								
Year	2005	2006	2007	2008	2009	2010	2011	2012
%	4.22	3.17	3.37	1.41	1.56	2.5	2.45	1.75

(i) In which year was the extreme poverty rate **lowest** in Armenia?

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

(ii) Describe, in no more than two sentences, how the extreme poverty rate has changed in Armenia from 2005 to 2012.

....

....

....

.... **[2]**

(iii) Comparing year-on-year is easier if an index is used.
Taking 2005 as the base year and the extreme poverty rate 4.22 as 100 gives this table.

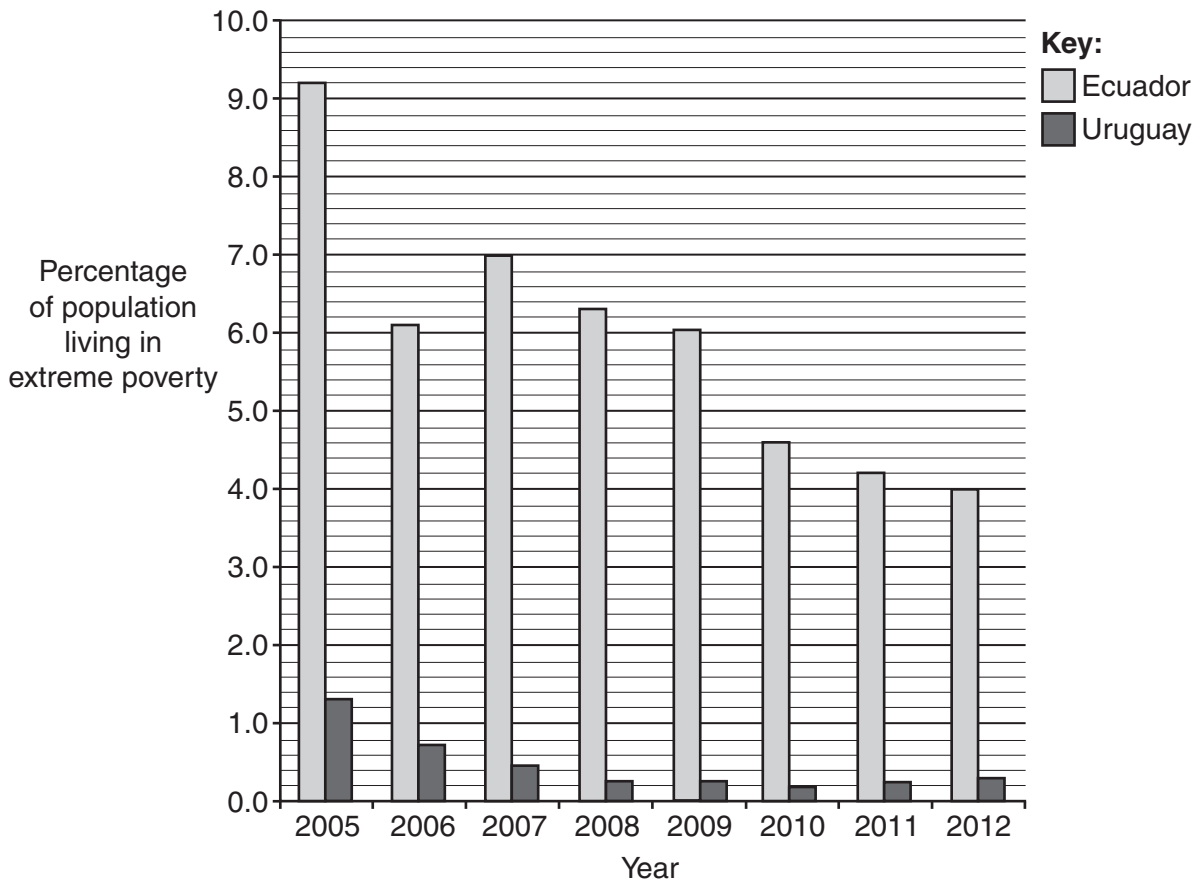|	Year							
Country	2005	2006	2007	2008	2009	2010	2011	2012
Armenia (index*)	100	75	80	33	37	59	58	41

* rounded to the nearest whole number

The percentage of people living in extreme poverty in 2013 was 1.68.

What index value does this give?

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

This graph shows the extreme poverty figures for Ecuador and Uruguay from 2005 to 2012.

(iv) What percentage of people in Ecuador lived in extreme poverty in 2011?

(iv) .... % **[1]**

(v) For Uruguay, between which two consecutive years did the percentage of people living in extreme poverty rate drop the most?

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

(vi) Describe one difference and one similarity between extreme poverty in Ecuador and Uruguay from 2005 to 2012.

A difference is

....

.... **[1]**

A similarity is

....

.... **[1]**

Turn over

(b) A one-person household with a net income of £300 a week is better off than a household of two adults and a child also with a net income of £300 a week.

The government adjusts net weekly incomes for this.
This adjustment is called **equivalisation**.

Net weekly income is adjusted by dividing net income by E.
The value of E depends on the household size.

Size of household	E
1 adult	0.67
1 adult and 1 child	0.87
1 adult and 2 children	1.07
1 adult and 3 children	1.27
2 adults	1.0
2 adults and 1 child	1.2
2 adults and 2 children	1.4
2 adults and 3 children	1.6
3 adults	1.33
3 adults and 1 child	1.53
3 adults and 2 children	1.73
3 adults and 3 children	1.93

> For example
> A household of 3 adults and 3 children with a net income of £386 will have an **adjusted income** after **equivalisation** of £386 ÷ 1.93 = £200.

(i) What is the value of E for a household of 1 adult and 2 children?

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

(ii) A household of 1 adult and 2 children has a net income of £267.50 a week.

What is this household's adjusted income after equivalisation?

(ii) £ .... **[1]**

(iii) What is the likely value of *E* for a household of 2 adults and 4 children?
Explain how you decided.

E = ... because ....

.... **[2]**

EU governments, including the UK, set the poverty line as 60% of the median household adjusted net income.

In the UK, the median household adjusted net income was £450 per week in 2011.

(iv) Work out 60% of £450.

(iv) £ .... **[2]**

(v) In 2011, John lived with his partner Frank.
They had two children.
The net household income **before** being adjusted was £400 per week.

Is the household below the poverty line?
Support your answer with clear calculations.

....

....

....

....

.... **[3]**

(vi) Household income data is gathered from a survey of about 25 000 households.

Why would an internet survey **not** be the best survey method?

....

....

.... **[1]**

Turn over

(c) This table shows the distribution of incomes based on tax returns in the UK for 2013/14.

Income per year	Number (thousands)
less than £10 000	500
£10 000 to less than £15 000	6700
£15 000 to less than £20 000	5800
£20 000 to less than £30 000	7400
£30 000 to less than £50 000	6300
£50 000 to less than £100 000	2470
£100 000 to less than £150 000	400
£150 000 to less than £200 000	120
£200 000 to less than £500 000	150
£500 000 to less than £1 000 000	30
above £1 000 000	15

Total = 29 885

Use the table to answer these questions.

(i) How many thousand people earned less than £20 000 per year?

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

(ii) How many thousand people earned £100 000 or more a year?

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

(iii) What is the modal income group?

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

(d) Economists measure the inequality of incomes.

Here is some information collected by the World Bank about thirteen countries.

Country	Percentage share of the total income for the richest 10% A	Percentage share of the total income for the poorest 10% B	Inequality factor (correct to 1 d.p.) A ÷ B
Argentina	25	4	6.3
Australia	25	2	12.5
Brazil	42	1	42.0
Canada	26	3	8.7
Finland	23	4	5.8
Iceland	22	4	5.5
Iran	30	3	10
Nigeria	33	2	16.5
Russia	31	3	10.3
Spain	25	1	25.0
Turkey	31	2	15.5
UK	29	2	
USA	30	1	30

(i) Complete the table for the UK.

[1]

(ii) Name one of the countries in which a **quarter** of the total income is earned by the richest 10% of people in that country.

(d)(ii) .... [1]

(iii) Which country in the list has the highest inequality factor?

(iii) .... [1]

(e) This scatter graph shows the inequality factor plotted against the percentage of people living in extreme poverty for some countries in 2010.
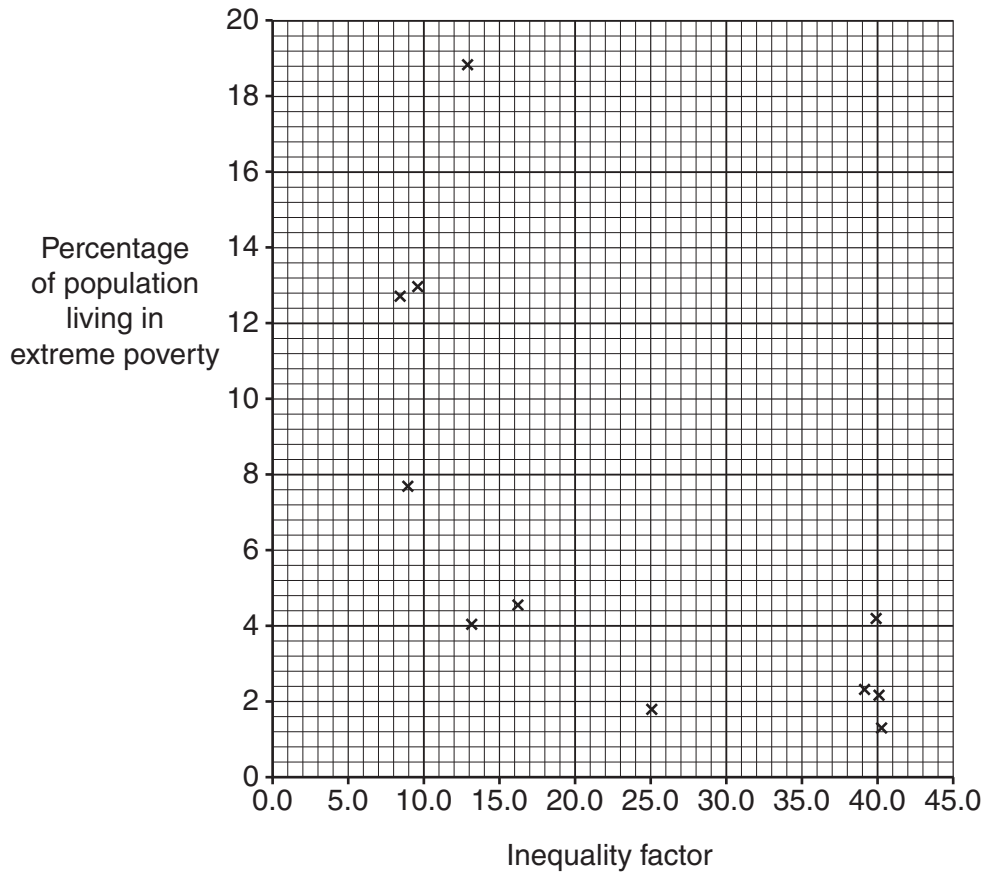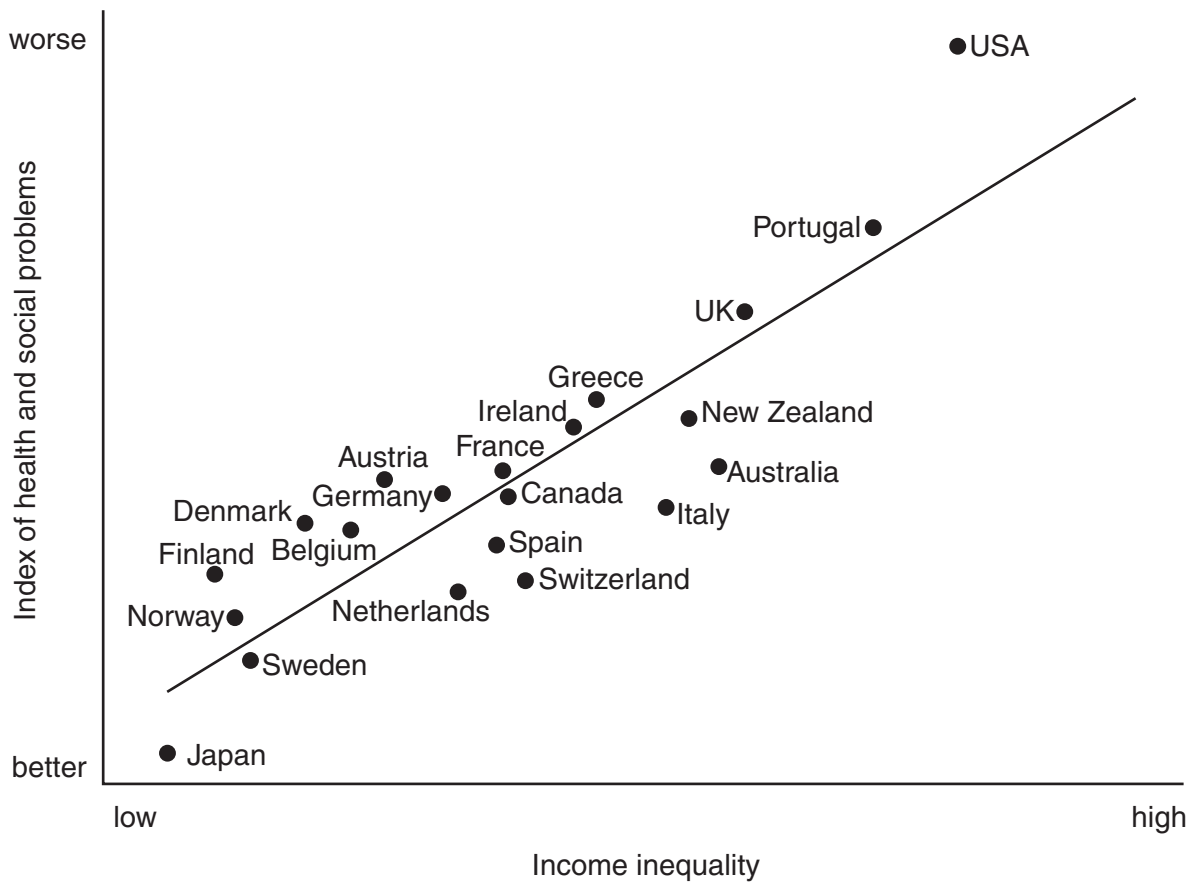

(i) Bolivia has an inequality factor of 39.9 with 4.2% of its population living in extreme poverty.

Circle the cross that represents Bolivia.   **[1]**

(ii) Use the scatter graph to describe the correlation between inequality factor and extreme poverty.

  ....

  .... **[1]**

(f) This scatter graph and its straight line of best fit appeared in a book about income inequality.

(i) Name a country that has a higher income inequality than the UK.

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

(ii) The graph shows correlation.
What does this tell you about income inequality and health and social problems?

....

.... **[1]**

(iii) Some people have criticised the book for some carelessly drawn scatter graphs.
Write down one fact about the scatter graph that supports this view.

....

.... **[1]**

Turn over

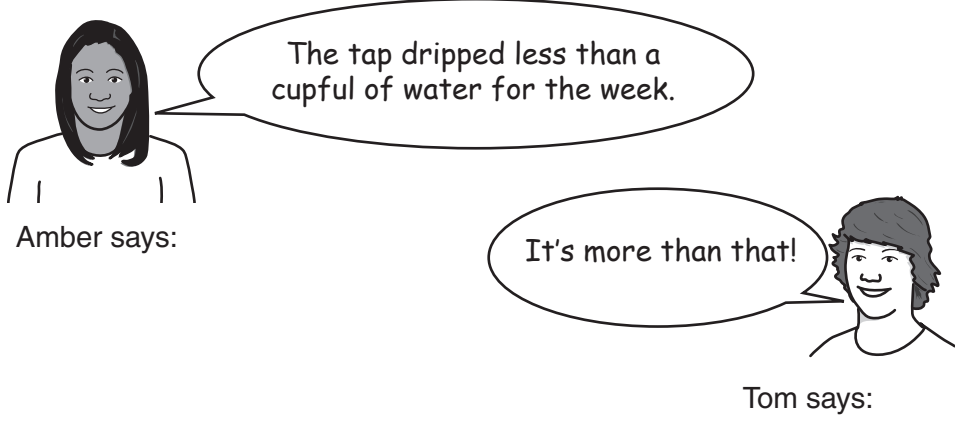**4*** Amber left her garden tap dripping when she was away on holiday.

It dripped about 1 drop every minute.

Amber got back after a week.

Amber looked on the internet site *Any Questions*.

Q: What is the volume of one drop of water?

A: A single drop is about 0.1 millilitres.

Amber says: The tap dripped less than a cupful of water for the week.

It's more than that!
Tom says:

Who is right?
Show all your working and any assumptions you need to make.

....

....

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....

....

.... **[5]**

5 **(a)** Environmental engineers need to plan for possible river flooding.
They use past water flow rates in rivers to help.
Water flow rate is measured in cubic metres per second.

Greatest water flow rate each year for the Red River
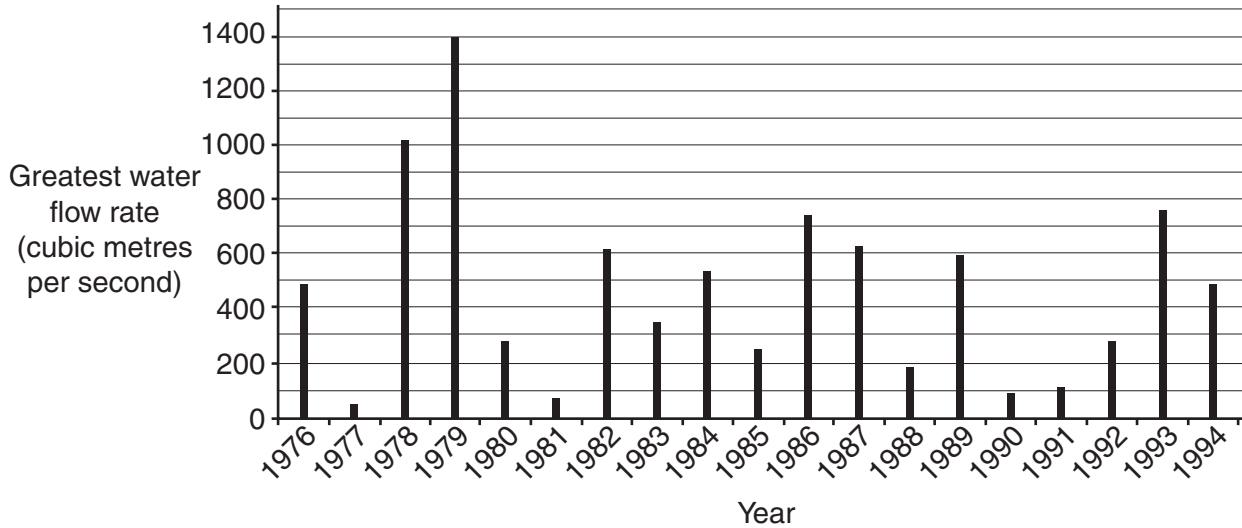
Use the chart to answer these questions.

(i) What was the greatest flow rate in 1989 for the Red River?

(a)(i) .... cubic metres per second **[1]**

(ii) In how many years was the greatest flow rate above
650 cubic metres per second?

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

(iii) Estimate the probability that the greatest flow rate will be greater than
700 cubic metres per second in a year.
Give your answer as a fraction.

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

(iv) Roughly, what is the typical greatest flow rate for the Red River?
You must justify your answer.

.... cubic metres per second

because ....

.... **[2]**

Turn over

(b) Waves breaking on the shore cause damage because of their power.
The power, *P*, in kilowatts is given by:

$$P = 4 \times h^2 \times w$$

where *h* metres is the wave height and *w* metres is the wave width.

(i) A beach is 50 m wide.

A wave 1.5 m high breaks along the whole beach.

wave height
(*h* metres)

width of wave
(*w* metres)
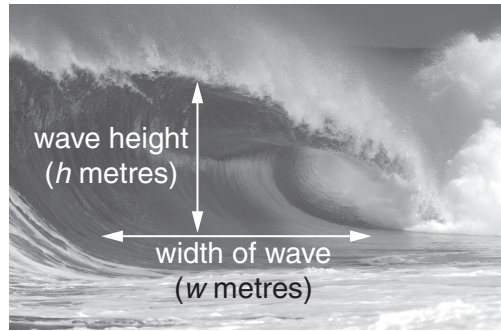
What is the power of this wave?

(b)(i) .... kilowatts **[3]**

One way to protect beaches from waves is to use breakwaters.

Image removed due to third party copyright restrictions.

A cheaper way is to use wire cages containing rocks.

The cages are in the shape of cubes.

They are called gabions.

(ii) Complete this net of a gabion.

[2]

Turn over
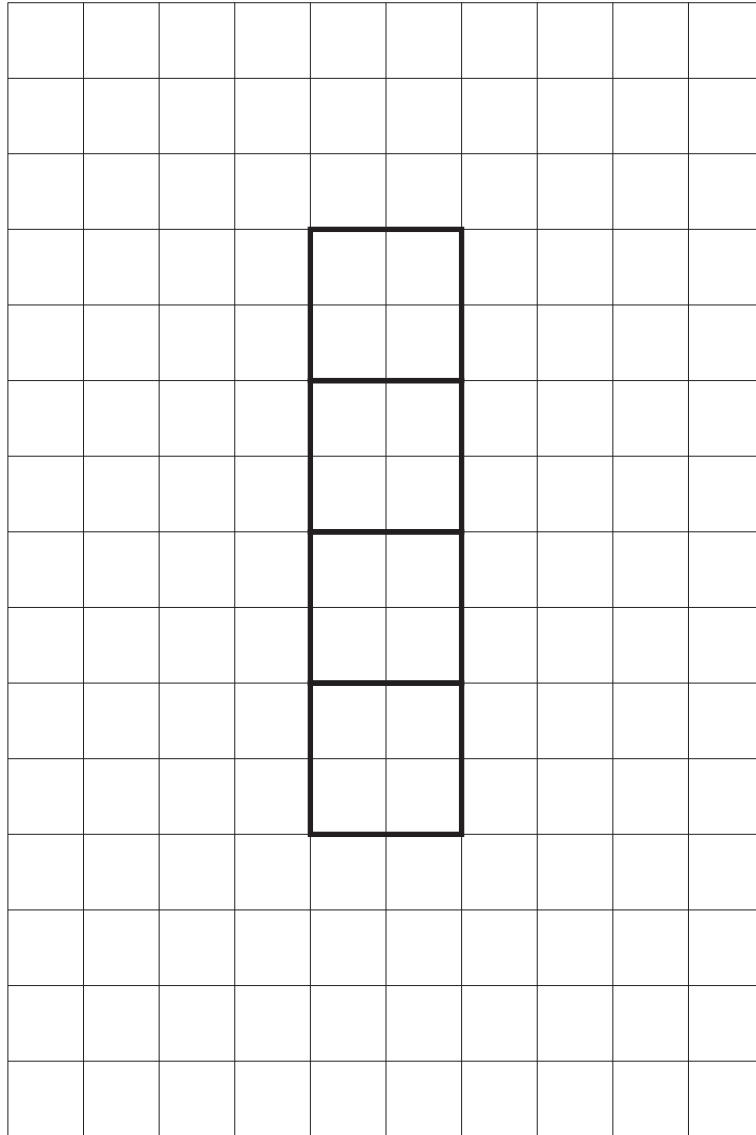
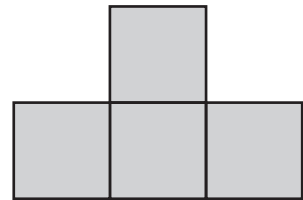**(iii)** Six gabions are put together to make this.
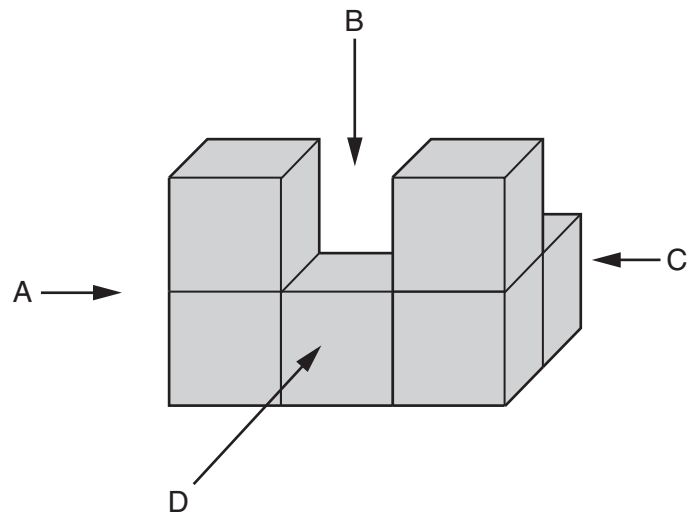
Match each of the viewing directions A, B, C and D to one of the views below.
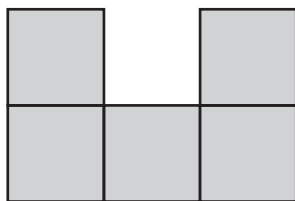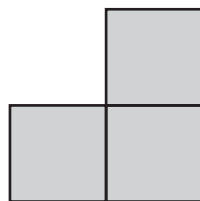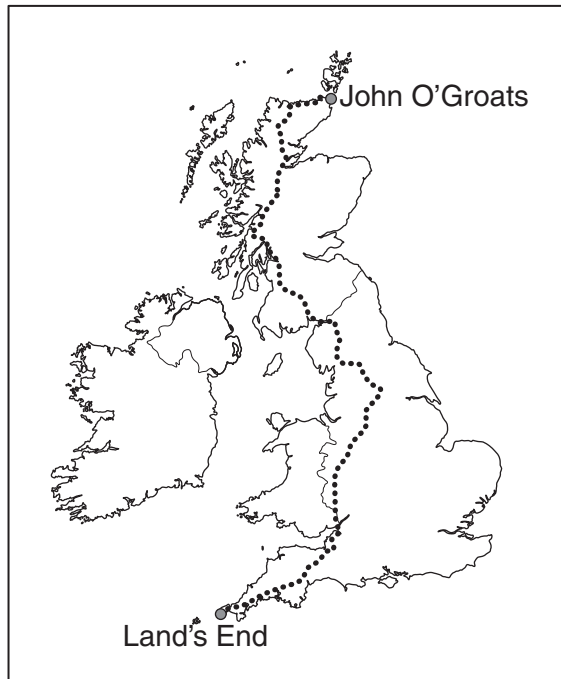Write the correct letter beneath **four** of these views.

....

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....
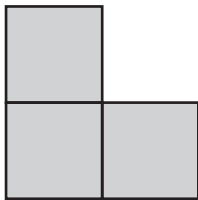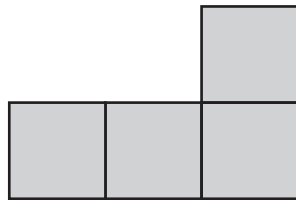
[3]

6 This map shows a 969 mile cycle route from Land's End to John O'Groats.

In 2013, Sean Conway swam from Land's End to John O'Groats up the west coast of Great Britain. Sean swam 1440 kilometres in 90 days.

(a) Which distance is further, the cycle route or the swimming route, and by how much? Use the conversion 8 kilometres = 5 miles.

(a) .... **[4]**

(b) The number of swimming strokes made by Sean was reported to be 3 million.

Why is 3 million **unlikely** to be the **exact** number of strokes Sean made?

....

.... **[1]**

(c) Madina decides to cycle the 969-mile route from Land's End to John O'Groats.
Her bicycle wheel has diameter 70 cm.

How many times will this wheel rotate over the 969-mile route?
Give your answer to a sensible degree of accuracy and show all your working.

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

(d)* A charity organiser says the cycle route can be completed in just 9 days.

Writing down any assumptions you make, work out the average speed in miles per hour (mph) to complete the cycle route in just 9 days.

....

....

....

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....

....

....

....

.... **[3]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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