

Friday 4 November 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. 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 barcodes.

INFORMATION FOR CANDIDATES

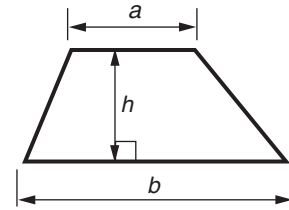
- The number of marks is given in brackets [] at the end of each question or part question.
- Your quality of written communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is **90**.
- This document consists of **24** pages. Any blank pages are indicated.



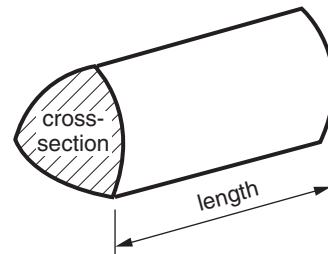
**You are permitted
to use a calculator
for this paper**

Formulae Sheet: Foundation Tier

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



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

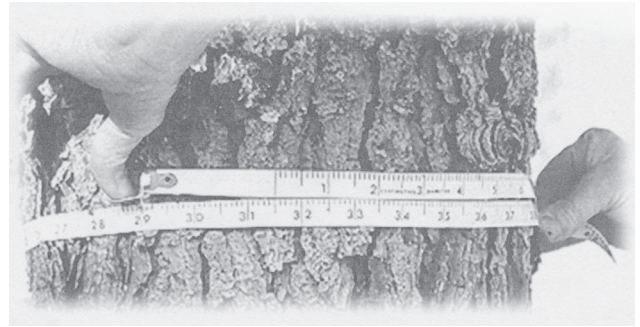


PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

- 1** The girth of a tree is the distance round the trunk measured 130cm above the ground.

This table shows the girths and heights of some trees in England.



Tree	Girth (cm)	Height (m)
Ash	880	12
Hornbeam	829	16
Lime	741	14
Lime	776	23
Lime	823	16
Lime	924	19
Oak	1216	20
Oak	1222	8
Willow	798	11
Yew	911	10
Yew	961	11
Yew	1043	15
Yew	1049	18

- (a) (i) Which type of tree has the greatest girth?

(a)(i) [1]

- (ii) Which type of tree is the tallest?

(ii) [1]

- (iii) What is the girth of the tallest lime tree in the table?

(iii) cm [1]

- (iv) Are the girths of trees proportional to their heights?
Use some figures from the table to support your answer.

.....

.....

..... [2]

The girth of many trees is measured around a circle.



This means that it is possible to calculate the diameter of a tree trunk using its girth.

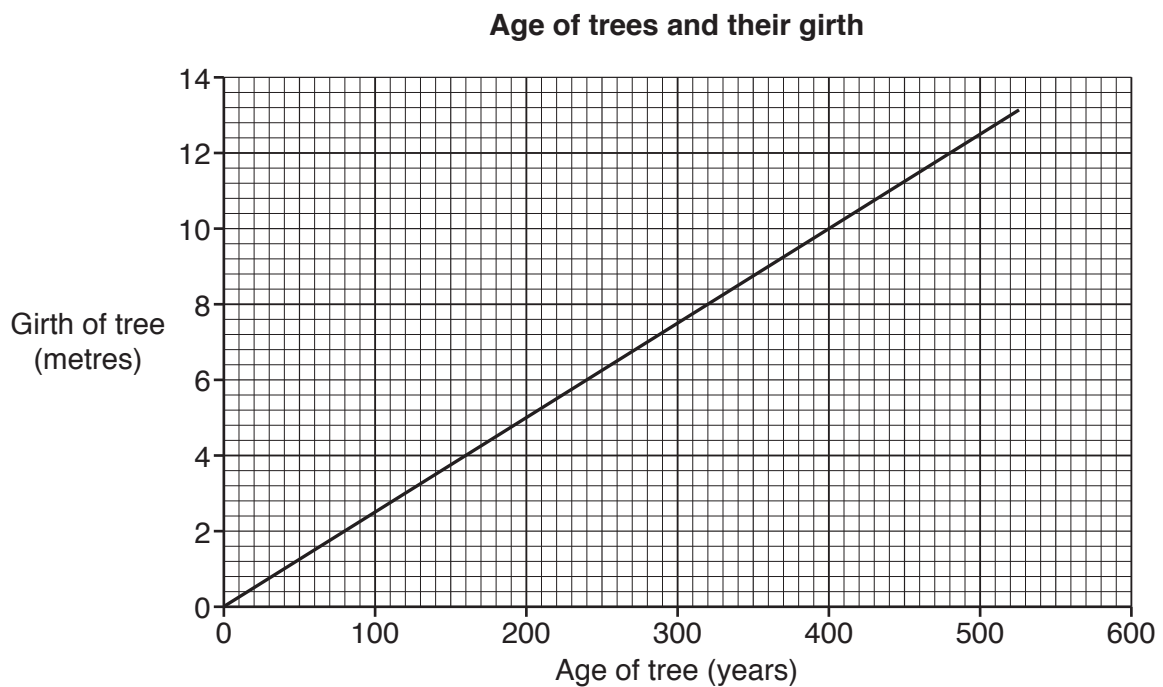
- (b) A tree has a diameter d centimetres.
Complete the formula for its girth g in centimetres.

(b) $g = \dots\dots\dots$ [1]

The age of a tree can be found by counting its rings but the tree has to be cut down to do this!

The girth of a tree gives a rough estimate of its age.

This graph shows how girth changes with the age of the tree.



- (c) (i) What is the girth, in metres, of a tree that is 200 years old?

(c)(i) $\dots\dots\dots$ m [1]

- (ii) A tree has a girth of 10m.

How old is the tree?

(ii) $\dots\dots\dots$ years [1]

- (iii) How can you tell from the graph that the girth of a tree is directly proportional to its age?

..... [1]

The connection between girth and age changes when trees grow close together.
The equation is

$$g = 0.015a$$

g is the girth of the tree in metres.

a is the age of the tree in years.

- (d) (i) Use the formula to complete this table.

a (age in years)	0	200	400	600
g (girth in metres)	0			

[2]

- (ii) Plot these points onto the graph on the previous page.
Join the points up.

[1]

- (iii) The gradients of both lines have the same meaning.

What is this meaning?

..... [1]

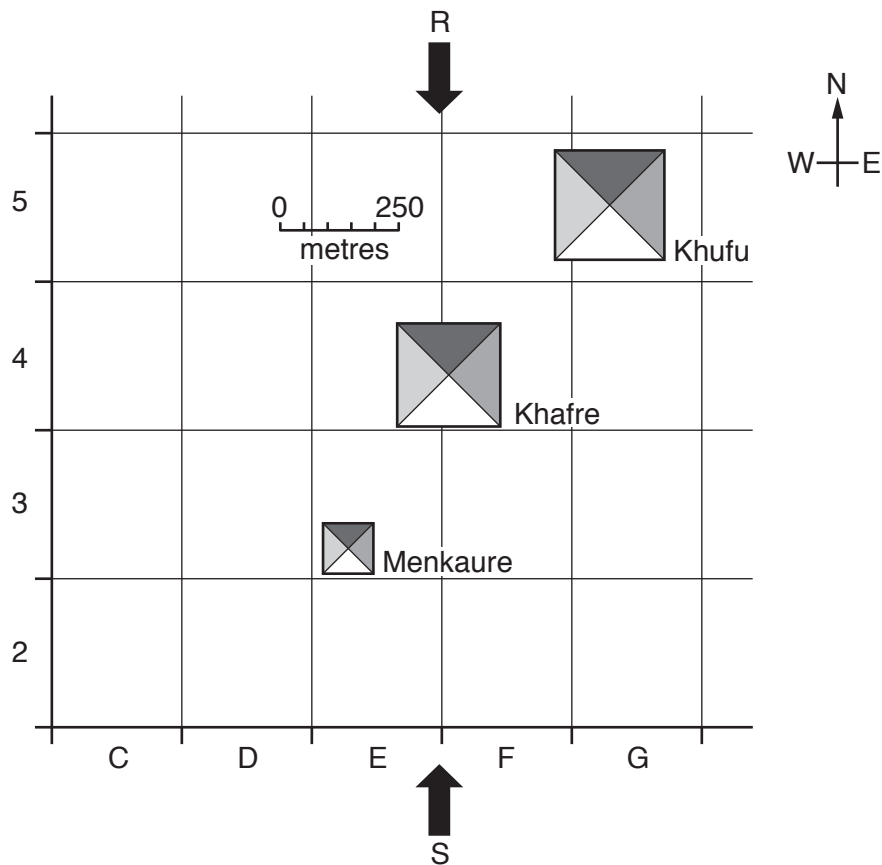
- (e) The volume of wood produced needs to be calculated before trees are cut down.
This is one calculation for an 8.2 metres tall pine tree.

Calculate the answer.

$$1.6(0.26^2 - 0.17^2) \times 8.2 \quad \text{(cubic metres)}$$

(e) cubic metres [2]

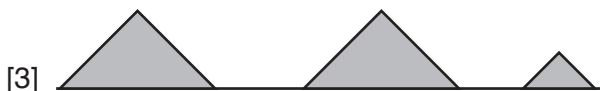
2 This is a plan of the three pyramids at Giza.



- (a) Menkaure's pyramid is in square E3.
In which two squares is Khufu's pyramid?

(a) [1]

- (b) Khufu's and Khafre's pyramids are about the same height.
Menkaure's pyramid is not as tall as these two pyramids.
Choose the correct views looking along the direction of S and along the direction of R.



View looking along S

View looking along R

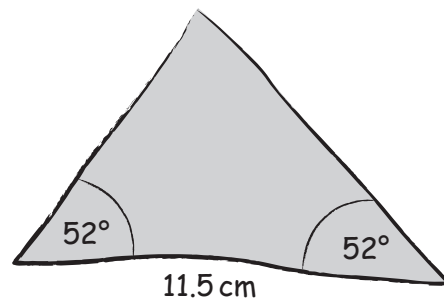
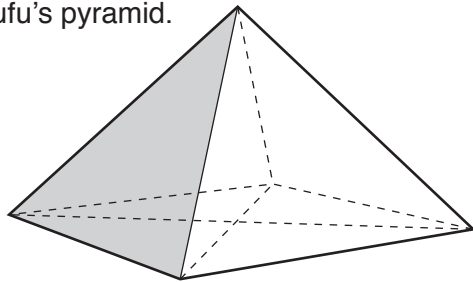
[2]

These three pyramids have square bases.

- (c) Use the plan to estimate the real length of the base of Menkaure's pyramid.

(c) [2]

- (d) Amy wants to make a scale model of Khufu's pyramid.

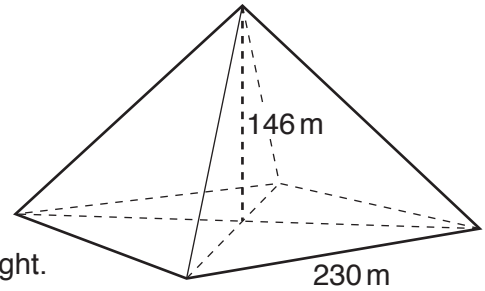


First she sketches one of the triangular faces.
The sketch shows some measurements of the face.

Complete the drawing below.
The base of the triangle has already been drawn.

[3]

- (e) Khufu's is the largest of these pyramids.
Its base sides are 230m long and it is 146m high.



- (i) Calculate the volume of the Khufu pyramid.

The volume of a pyramid is $\frac{1}{3} \times \text{area of base} \times \text{height}$.

Remember that all these pyramids have square bases.

(e)(i) cubic metres [3]

- (ii) Most of the pyramids are made from limestone.
A cubic metre of limestone weighs 1.5 tonnes.

How much does the pyramid weigh assuming it is solid limestone?

(ii) tonnes [1]

- Complete Amy's working to find how many workers it took to build Khufu's pyramid.
Give your final answer to a sensible accuracy.
Show all your working.

[illegible]

Turn over

- (f) The Ancient Egyptians were able to write and solve equations. They did not use letters. They called the unknown a heap.

Here is an Ancient Egyptian equation.



In English it says: 'The heap added to one seventh of the heap gives 4. What is the heap?'

Use trial and improvement to find the exact value of the heap.
Fill in the table to record your trials and results.
Two trials have already been done.

Value of a heap	The heap added to one seventh of the heap
3	3.428 ...
5	5.714 ...

(f) The value of the heap is [3]

Measuring was important to the Ancient Egyptians. It was needed for building and to measure land areas.



The cubit and the cord were the main units of length used in Ancient Egypt.

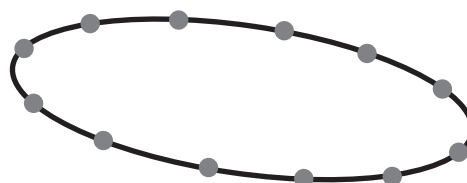
(g) A cord is 100 cubits and a cubit is 52 cm.

(i) How many metres are there in a cord?

(g)(i) metres [2]

The people who made measurements were called Rope Stretchers.

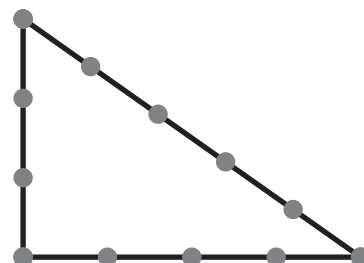
(ii) The Rope Stretchers used a rope loop with twelve equally spaced knots tied in it.



They were then able to make an exact right angle by stretching the rope out to make a triangle like this.

Many archaeologists think that this shows that the Ancient Egyptians knew about Pythagoras' theorem.

Explain, using calculations, why this is so.



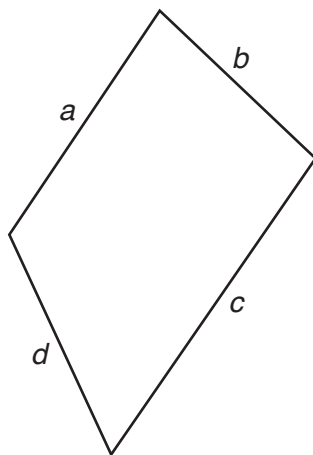
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..... [2]

- (h) The expression $\frac{(a+c)}{2} \times \frac{(b+d)}{2}$ was used by the Ancient Egyptians to find an area of a 4-sided shape.



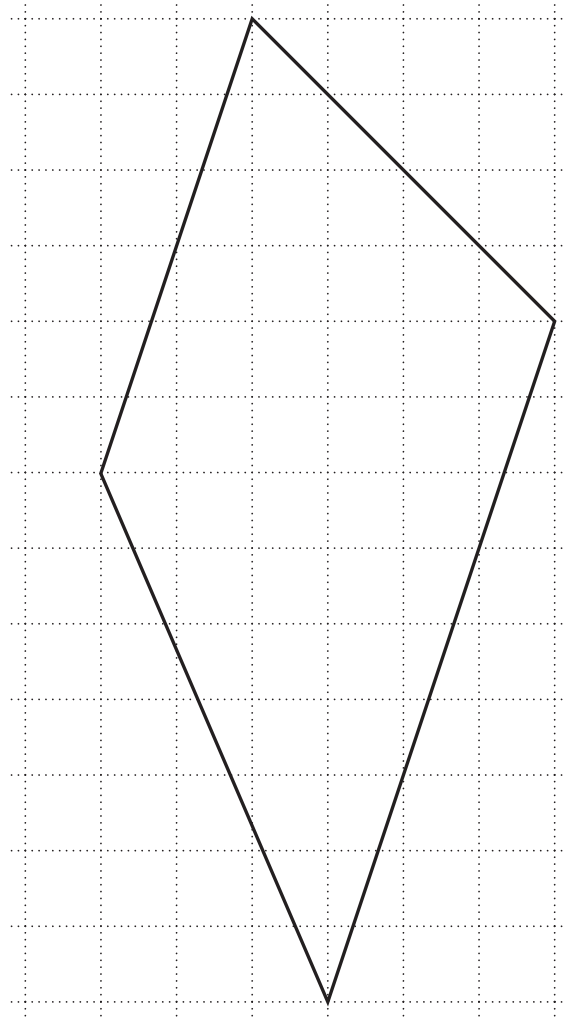
- (i) Write the formula for the area of these shapes in words. You may find using **some** of the words in the box useful.

add	difference	mean	mode
	opposite	product	sides
			sum

(h)(i)
 [1]

- (ii)* Test how accurate the formula is by using it to find the area of the 4-sided shape drawn on the opposite page. The shape is drawn on a one-centimetre grid.

13



.....

.....

.....

.....

.....

..... [6]

- 3 The Global Hunger Index (GHI) measures how poorly nourished a country's population is. It is used by the United Nations to help decide which countries need help.

GHI is calculated by working out the **mean** of these three percentages:

- percentage of population that is undernourished
- percentage of children under five years old that are underweight
- percentage of children who die under five years old.

- (a) Complete the GHI column for Eritrea and Paraguay.

Country	Percentage of population undernourished	Percentage of children under 5 underweight	Percentage of children under 5 dying	GHI
Brazil	6.9	3.0	1.6	3.8
Eritrea	65.4	32.8	6.8	
Paraguay	25.5	2.6	2.2	

[3]

The United Nations use these words to describe concerns about health.

Value of GHI	How serious the concern about health
Less than 5	Low
5 to less than 10	Moderate
10 to less than 20	Serious
20 to less than 30	Alarming
30 or more	Extremely alarming

- (b) Write down an inequality involving X , the GHI, for

- (i) low concern,

(b)(i) [1]

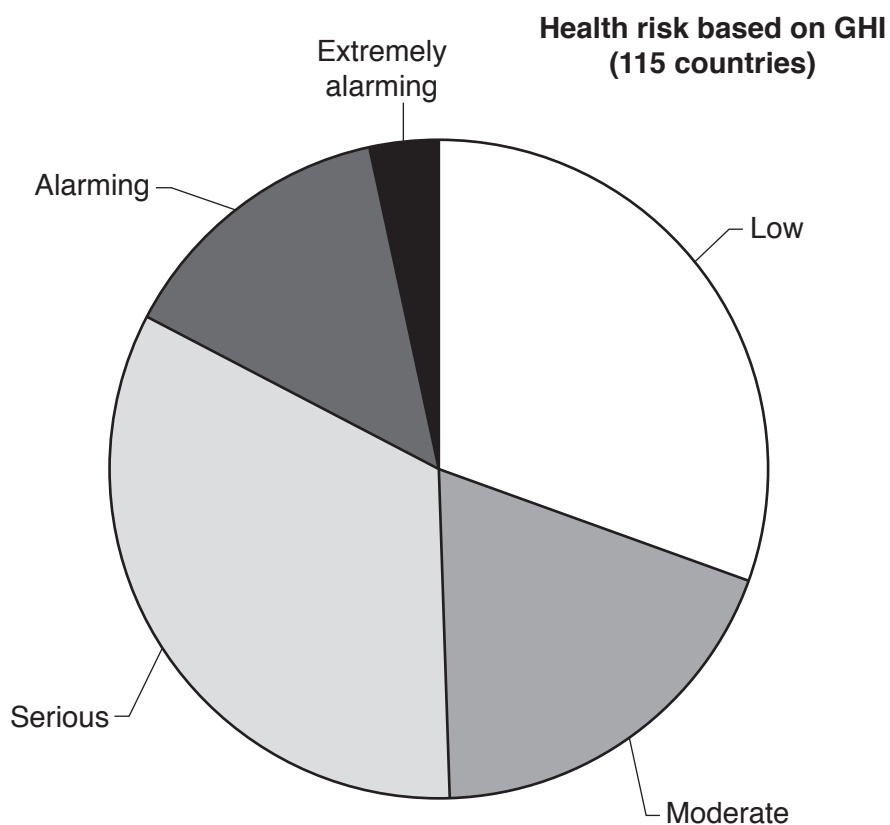
- (ii) serious concern,

(ii) [1]

- (iii) extremely alarming concern.

(iii) [1]

- (c) This pie chart shows the level of concern about health based on GHI for 115 countries in the United Nations.



- (i) For about how many countries is the risk level 'serious'?
Show how you got your answer.

(c)(i) [2]

- (ii) Tick each correct statement.

About half of the countries have a low or moderate risk.

☐

About 25% of the countries have an alarming risk.

☐

About 20% of the countries have an extremely alarming risk.

☐

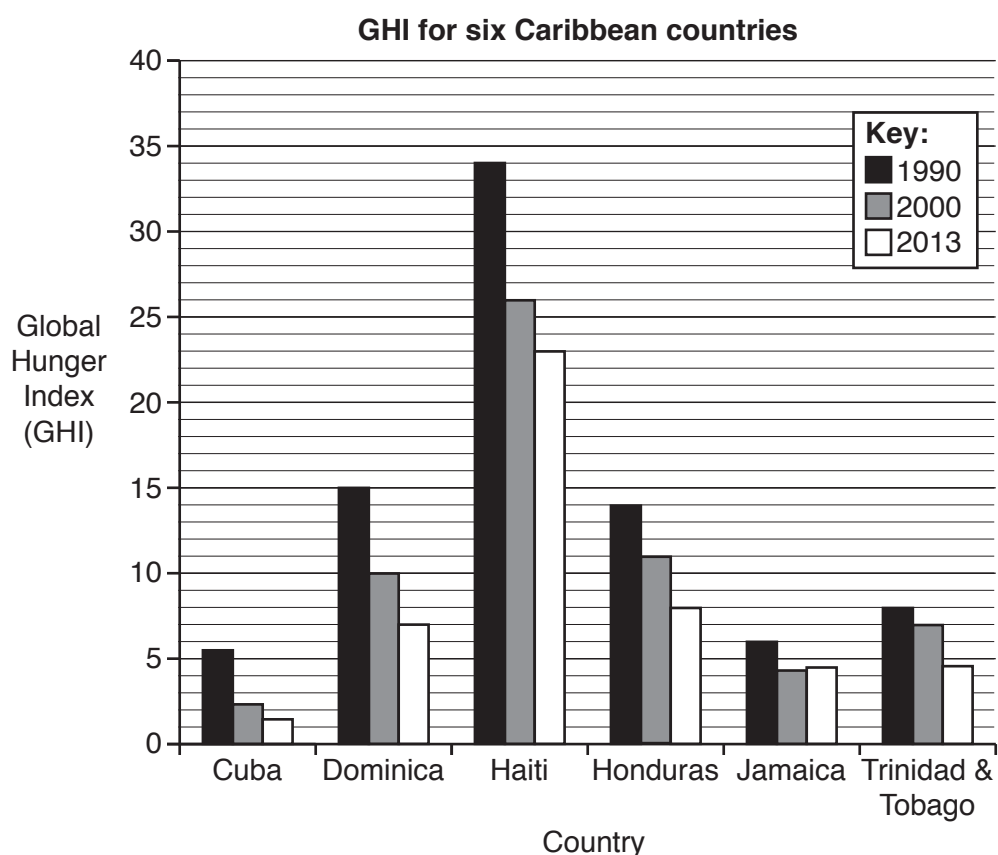
About 4 countries have an extremely alarming risk.

☐

[2]

(d) The bar chart shows the GHI for six Caribbean countries in 1990, 2000 and 2013.

Value of GHI	How serious the concern about health
Less than 5	Low
5 to less than 10	Moderate
10 to less than 20	Serious
20 to less than 30	Alarming
30 or more	Extremely alarming



(i) Circle any country in the list whose GHI was extremely alarming in 1990.

Cuba Dominica Haiti Honduras Jamaica Trinidad & Tobago

[1]

(ii) Circle the country in the list that had the lowest GHI in 2013.

Cuba Dominica Haiti Honduras Jamaica Trinidad & Tobago

[1]

- (iii) Write two bullet points summing up the change in GHI for the six countries from 1990 to 2013.

-
-

[2]

This table shows the Food Production Index, from 2001 to 2010, for the world and its five regions.

Region	Year									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Africa	84	88	93	96	100	105	103	110	111	113
Americas	90	91	95	99	100	101	107	108	107	110
Asia	88	90	93	96	100	103	108	112	114	115
Europe	99	99	97	107	100	100	98	103	103	99
Oceania	97	89	97	95	100	91	94	99	97	97
The world	90	91	94	98	100	102	105	109	110	111

- (e) (i) Which was the base year for food production?

(e)(i) [1]

- (ii) In which year did Europe produce its most food?

(ii) [1]

- (iii) Which region showed the largest increase in food production from 2005 to 2010 and by how much?

(iii) increased by [2]

This table shows the price of corn and the price index for corn from 2003 to 2010.

	Year							
	2003	2004	2005	2006	2007	2008	2009	2010
Price (dollars per bushel*)	2.42	2.06	2.00	3.04	4.20	4.06	3.55	5.30
Price Index (2005 = 100)		103	100	152	210	203	178	

*bushel is a measure of corn volume

(f) Complete the table.

[2]

- 4 Most medicines have side effects.
Makers of medicines have to give possible side effects and their risk.

This table shows the words used to describe how common these risks are.

How common	Proportion of people affected
Very common	More than 1 in 10
Common	More than 1 in 100
Uncommon	More than 1 in 1000
Rare	Equal to or more than 1 in 10000
Very rare	Less than 1 in 10000

SatCap is a new drug for pain relief. It is tested on 100 people.

Here are the side effects and the numbers of people affected.

Side effect	Numbers of people affected
Drowsiness	3
Dry mouth	11
Feeling sick	33
Mood changes	0

- (a) Which of the side effects is most likely?

(a) [1]

- (b) Which words from the first table should be used to describe the risk, when taking SatCap, of:

- (i) drowsiness,

(b)(i) [1]

- (ii) a dry mouth?

(ii) [1]

A company has several stages for testing of a new drug.

Testing stage	Reason	Number* of people the drug is tested on
0	Low dose given to check for serious problems including side effects.	10 to 15
1	Check for side effects while taking full dose.	20 to 80
2	Testing for effectiveness and side effects.	100 to 300
3	Safety check and comparison with similar drugs already used including side effects.	1000 to 3000
4	Drugs on sale, information from patients using the drug, including side effects.	Could be any number

* the drug is never tested on the same person more than once

Use the table to answer these questions.

- (c) What is the lowest and highest number of people a drug could have been tested on by the end of stage 3?

(c) Lowest [1]

Highest [1]

- (d) A particular drug has no side effects by the end of stage 3.
It was tested on the maximum number of patients.
It was then used by 10000 patients at stage 4.
Three of these patients reported side effects.

- (i) What is the experimental probability that the next patient who takes the drug has **no** side effects?

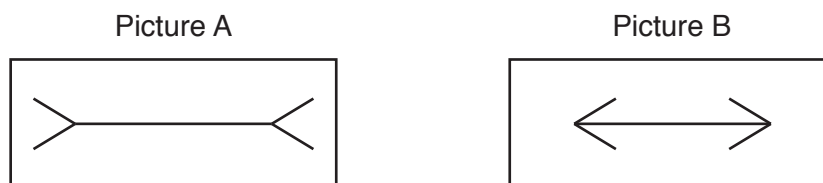
(d)(i) [2]

- (ii) The drug company states that the new drug has only a one in a million chance of causing any problems.

Is this true? Justify your answer with some numbers or calculations.

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

- 5 Manda wants to see if the way in which a picture is presented changes the way in which a person understands it. She carries out a survey. People in her survey are shown these two pictures.



Each person is told that the horizontal line in Picture A has length 26 mm. The person estimates the length of the horizontal line in Picture B.

Manda surveys 80 people and summarises the results in this table.

Estimate (mm)	Frequency
20	15
23	4
24	5
25	30
26	18
30	8

- (a) (i) Manda says, 'The median estimate of the line length is 25 mm.' This is correct.

Describe fully how Manda could have found the median.

.....

 [2]

- (ii) Work out the mean estimate of the line length.
 Do **not** round your answer.

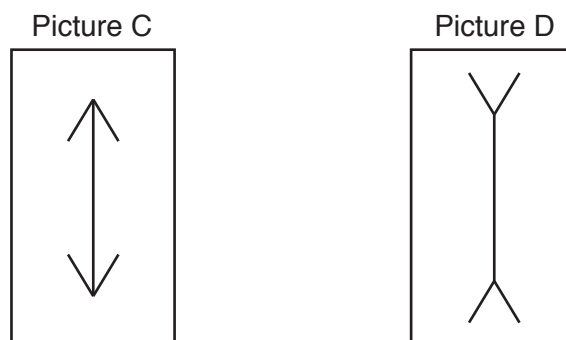
(a)(ii) mm [3]

- (iii) The horizontal lines in Picture A and Picture B are actually the same length.

Write one general comment about people's estimates for the length of the horizontal line in Picture B.

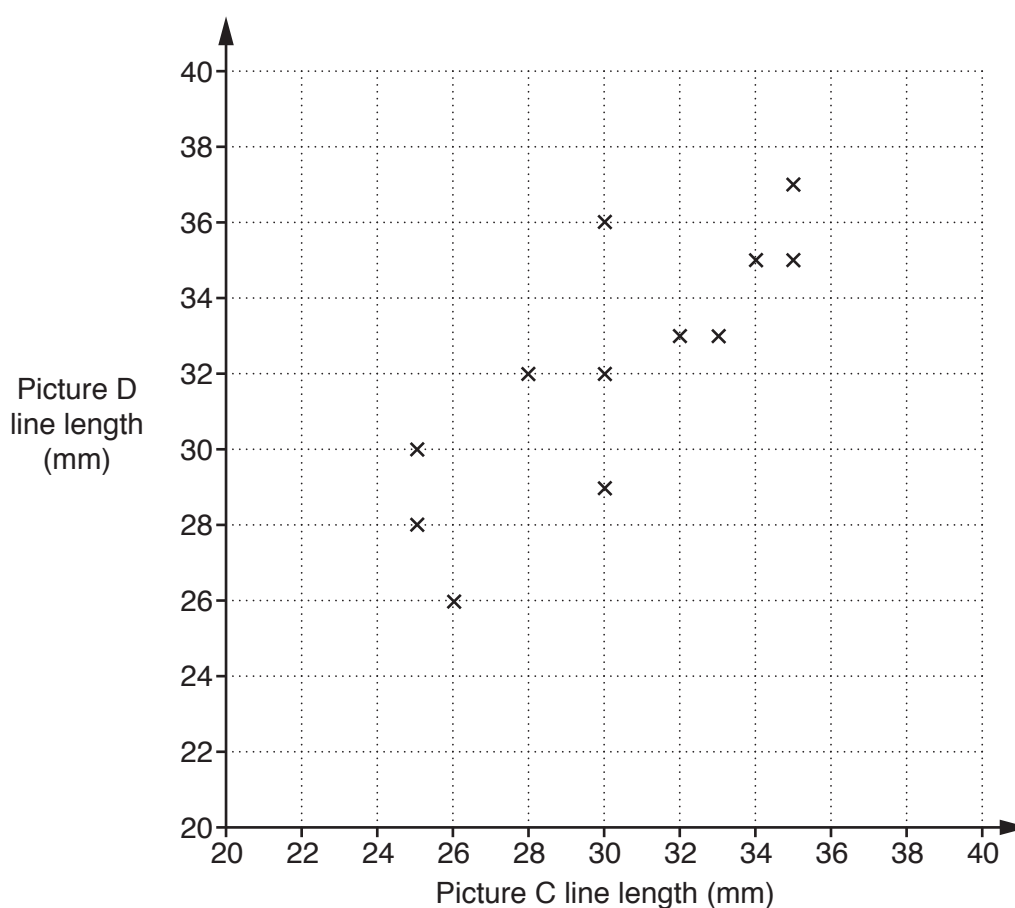
.....
 [1]

Twelve men and six women estimated the length of the line in Picture B correctly at 26mm. Manda shows Picture C and Picture D to these eighteen people.



Each person estimates the length of the vertical line, in mm, in Picture C and Picture D.

Manda draws this scatter graph to show the estimate of line lengths for the twelve **men**.



The vertical line in Picture C is actually longer than the vertical line in Picture D.

- (b) Write one comment about how the way in which the vertical line is presented in these pictures affects the estimates of these men.

.....

..... [1]

These are the estimates, in mm, made by the six women.

Picture C	29	31	28	29	26	36
Picture D	28	34	30	29	25	38

(c) Plot these results on the scatter graph. [2]

(d) Manda said,
'There is no difference between the ability of men and women to estimate the line length.'

Referring to the graph, give one reason why Manda may have said this.

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

(e) (i) Draw a line on your graph that shows equal estimates of line length for C and D. [1]

(ii) Describe how Manda can use this line to find which estimates came from people who think the line in Picture C is longer than the line in Picture D.

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

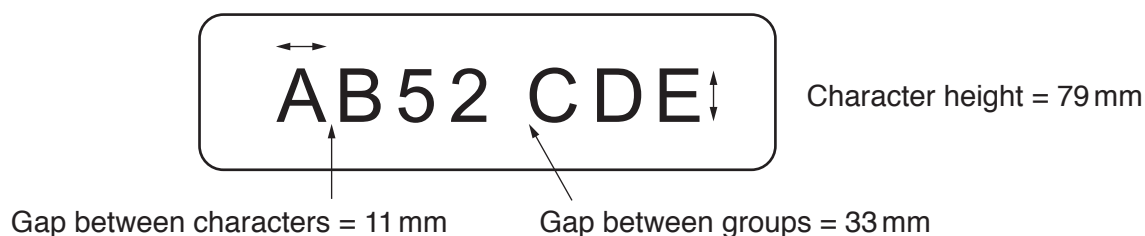
(iii) Is this line a good line of best fit for your graph?
Explain your answer.

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

- 6 The current vehicle number plate system consists of seven characters in two groups. The first group is two letters and two numbers and the second group is three letters.

These are the number plate rules for cars registered after September 2001.

Character width = 50 mm (except the number 1 or letter I)



The width of a line of a character is 14 mm.
So, the width of the letter I is 14 mm.

This is a number plate for a car registered in November 2015.

LV65 JKI
 \xleftrightarrow{x}

What is the value of x ?

..... mm [3]

END OF QUESTION PAPER