OCR

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Monday 9 June 2014 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A381/01 Applications of Mathematics 1 (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

A381/01

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.

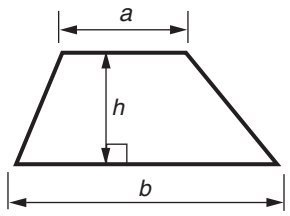
INFORMATION FOR CANDIDATES

- 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 **60**.
- This document consists of **20** pages. Any blank pages are indicated.

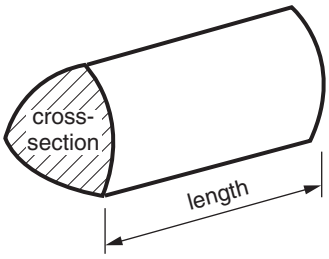
You are permitted to use a calculator for this paper

Formulae Sheet: Foundation Tier

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



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



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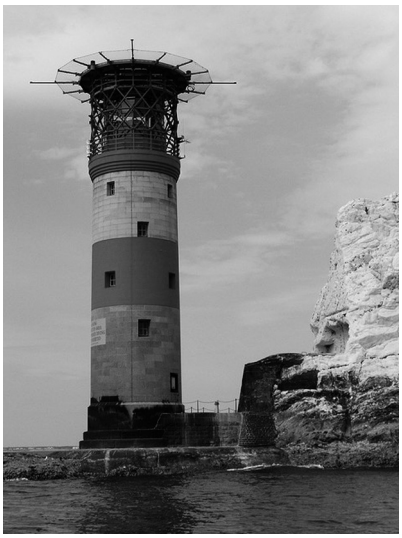
Answer **all** the questions.

1 There are 68 lighthouses around the UK coast.



(a) Some lighthouses have a circular helipad on top so that helicopters can land. These are pictures of the Needles lighthouse.



(i) What is the radius of the helipad?

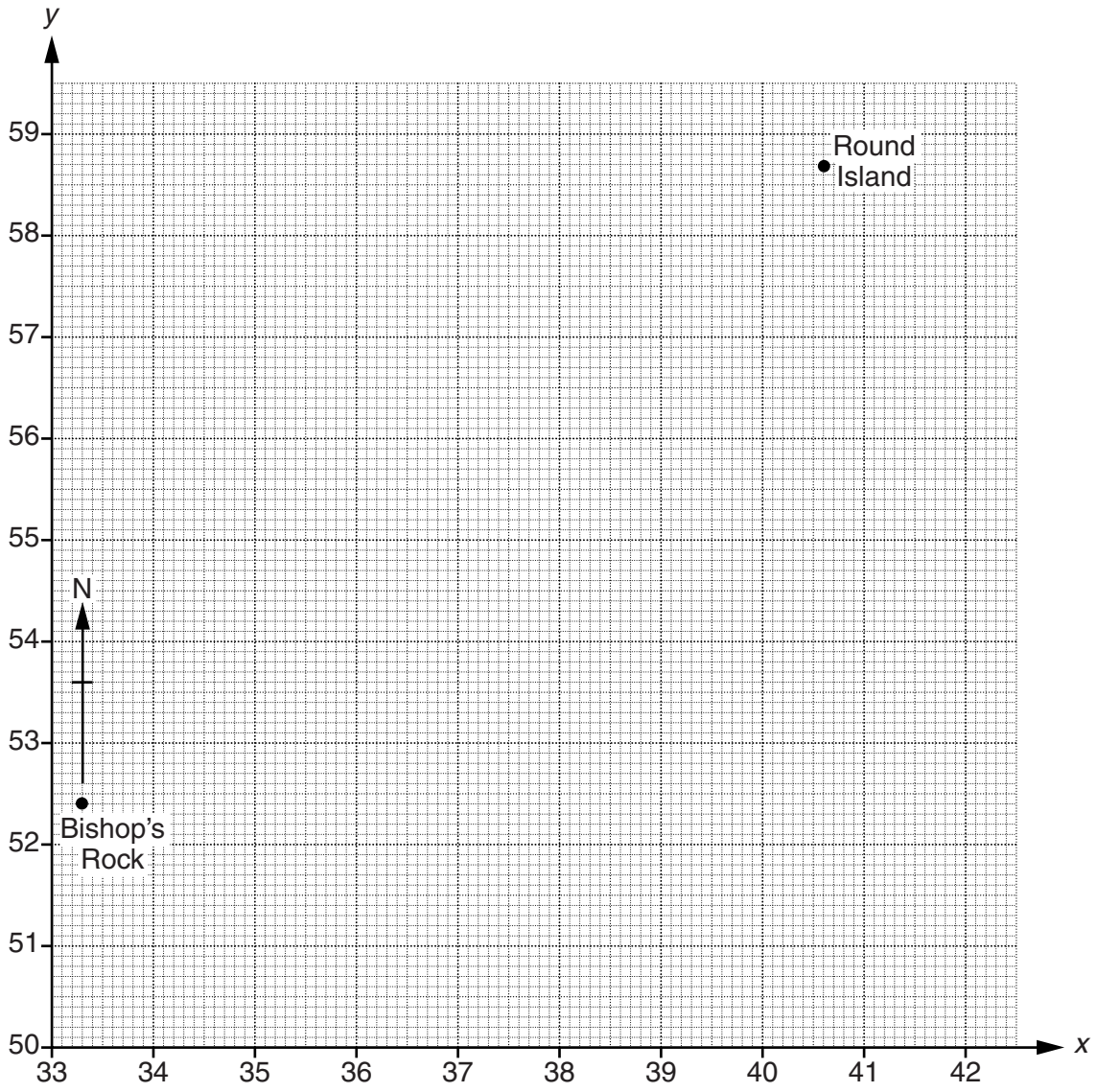
(a)(i) _____ m **[1]**

(ii) Estimate the height of the top of the Needles lighthouse above the sea.

(ii) _____ m **[1]**

(b) The grid shows part of the GPS coordinate grid for a region near Penzance.

There are three lighthouses in the region: Bishop's Rock, Peninnis and Round Island.
Bishop's Rock lighthouse is shown by a dot (•) and has coordinates (33.3, 52.4)
Round Island lighthouse is also labelled and marked with a dot (•).



(i) What are the coordinates of Round Island lighthouse?

(b)(i) (_____ , _____) **[1]**

(ii) Mark and label Peninnis lighthouse at (41.8, 54.3). **[1]**

(iii) Find the bearing of Round Island lighthouse from Bishop's Rock lighthouse. Leave in any lines you draw.

(iii) _____ ° **[2]**

(c) To help sailors most lighthouse lights flash, usually at different rates.

These are the rates for the three lighthouses.

Bishop's Rock:	1 flash every 15 seconds.
Peninnis:	1 flash every 20 seconds.
Round Island:	1 flash every 10 seconds.

(i) A small ship has lost its GPS system.
The captain can see, in front of her, the flashing lights from the three lighthouses.

She notices that the left-hand light is flashing more often than the others.
The middle light is flashing least often.

Mark on the grid a possible position for the ship. **[1]**

(ii) The three lights flash at the same time.

How long will it be before they next flash at the same time?
Show clearly how you worked out your answer.

(c)(ii) _____ seconds **[3]**

(d) Over two thousand years ago a big lighthouse was built in Alexandria, Egypt. Images of it have been found on ancient coins.

(i) People at the time stated that the lighthouse was 300 cubits high. A cubit is an old unit of length and is about half a metre.

How high, in metres, was the lighthouse at Alexandria?

(d)(i) _____ m **[1]**

(ii) Use the picture to estimate, to the nearest metre, how far a person's eyes were above the sea in ships of the time.

(ii) _____ m **[1]**

(iii) There is a rule for working out the distance at which the light from a lighthouse can first be seen.

Calculate A and B, where

$A = \sqrt{\text{distance, in metres, of the person's eyes above the sea}}$

$B = \sqrt{\text{height, in metres, of the lighthouse light above the sea}}$

The distance, in **kilometres**, from the lighthouse at which the light can first be seen is given by $3.8(A + B)$.

Use the rule and your answers to parts **(d)(i)** and **(d)(ii)** to calculate the distance at which the light from the Alexandria lighthouse could first have been seen.

(iii) _____ km **[4]**

2 A TV company makes a TV talent show called “Half-as-good” (*HAG*).

The series starts with 16 acts.
Each week half the acts are eliminated.
The series lasts for 4 weeks.

(a) Complete this table showing the number of acts each week.

Week	**1st**	**2nd**	**3rd**	**4th**
Number of acts	16			2

[1]

(b) Here are the numbers of viewers, in millions, for *HAG* each week.

Week	**1st**	**2nd**	**3rd**	**4th**
Number of viewers (millions)	3.4	4.2	2.1	0.8

(i) How many more viewers watched *HAG* in the 2nd week than in the 1st week?

(b)(i) _____ million **[1]**

(ii) Between which two weeks did the number of viewers drop by half?

(ii) _____ **[1]**

(iii) Was *HAG* a successful show?
Support your answer with some numbers.

_____ because _____

_____ **[1]**

For the second series of *HAG* the TV company decide to start with more acts.
This will mean having more shows.

(c) If the second series started with 64 acts, how many shows would there be?

(c) _____ **[2]**

(d)* The TV company also decide to audition more acts to select the final 64.

This is part of the advert for the show.

Before the new series the panel will audition over 20000 acts!

The new series starts in five weeks.

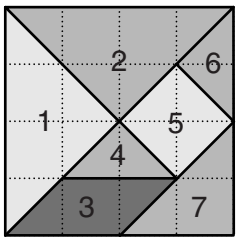
Amy decides to complain to the Advertising Standards Authority about the advert.

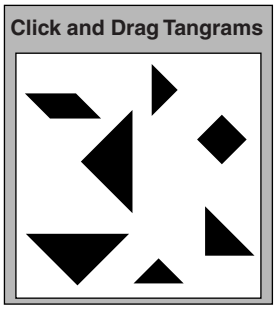
Complete her letter with clear working, and write down any assumptions you make.

To whom it may concern,
The advert for Half-as-good is untrue.
As you can see from my calculations there is not enough time.

[3]

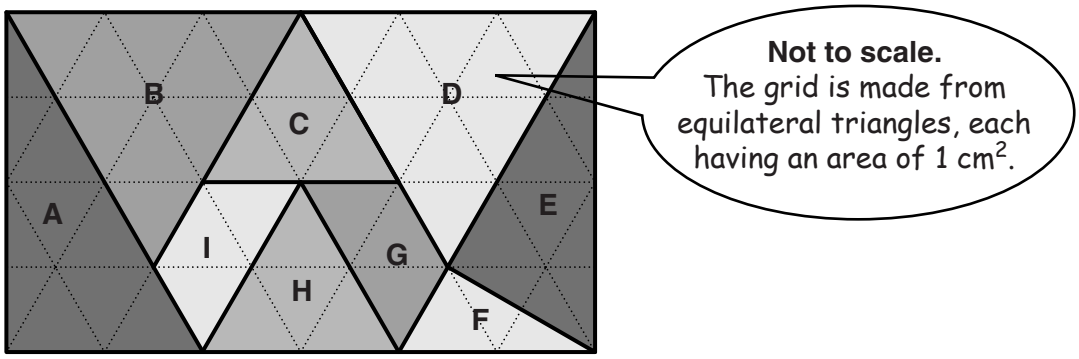
3 Safiq writes educational computer programs.
He wrote a program about moving shapes on the screen.





Then Safiq decided he wanted to use different shapes on a triangular grid.

He made this sketch.



(a) Which of the lettered shapes has the smallest area?
What is its area?

(a) Shape _____ which has area _____ cm^2 **[2]**

(b) Which shapes are similar to triangle **B** but **not** congruent to it?

(b) _____ **[1]**

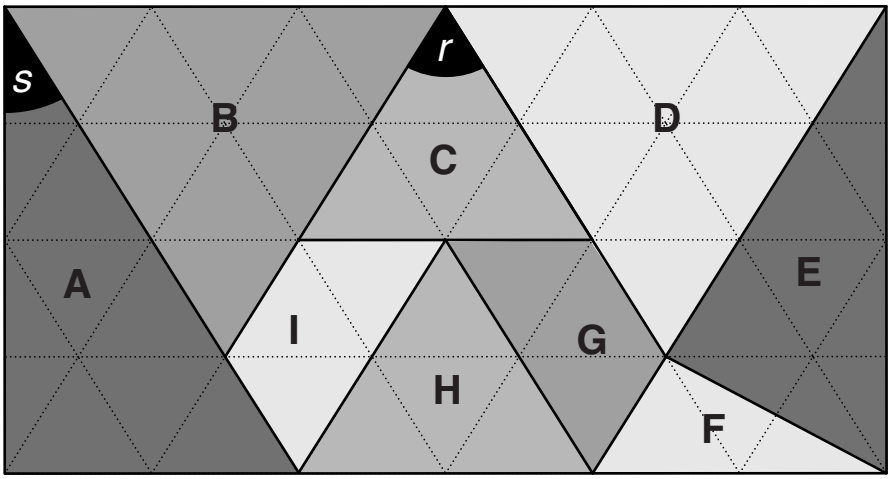
(c) Which shapes are right-angled triangles?

(c) _____ **[1]**

(d) Which shapes are trapeziums?

(d) _____ **[1]**

(e) **Calculate** the size of the two lettered angles, *r* and *s*.

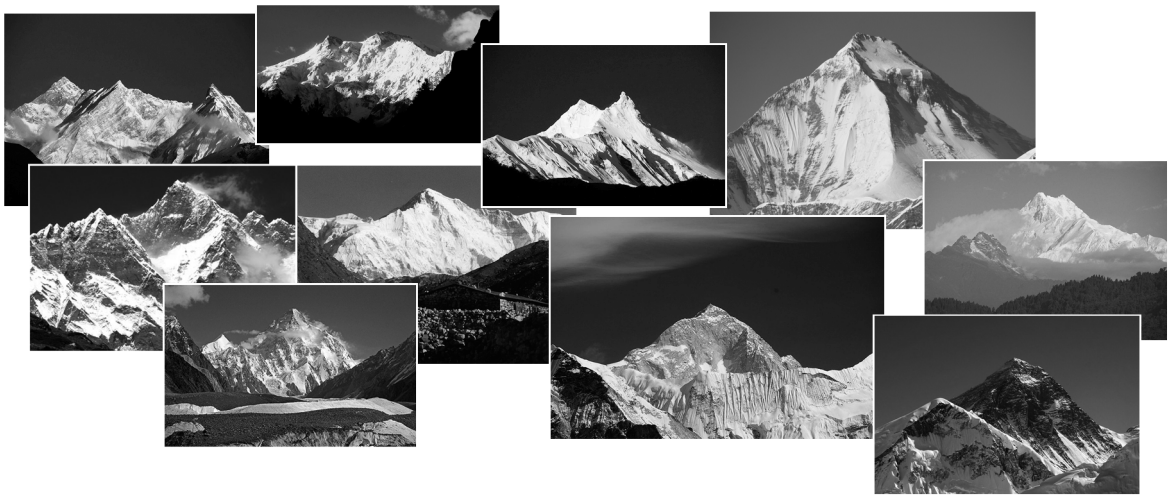


Not to scale

r = _____ ° **[1]**

s = _____ ° **[1]**

4 The table shows the ten highest mountains in the world and their mountain ranges.



Ten highest mountains in the world in order of height

Mountain	Height (metres)	Mountain Range
Mount Everest	8850	Himalayas
K2	8611	Karakoram
Kanchenjunga	8586	Himalayas
Lhotse 1	8516	Himalayas
Makalu 1	8463	Himalayas
Cho Oyu	8201	Himalayas
Dhaulagiri	8167	Himalayas
Manaslu 1	8163	Himalayas
Nanga Parbat	8125	Himalayas
Annapurna	8091	Himalayas

(a) (i) How much higher is Mount Everest than K2?

(a)(i) _____ m **[1]**

(ii) Which two of the mountains are closest in height?

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

(iii) What percentage of the ten highest mountains in the world are in the Himalayas mountain range?

(iii) _____ % **[1]**

(iv) A mile is approximately 1600 m.

How many of the ten highest mountains in the world are more than 5 miles high?
Show clearly how you arrived at your answer.

(iv) _____ **[2]**

(v) When Sir George Everest measured the height of Mount Everest he found it to be 29 000 feet. It is said he added 2 feet to give 29 002 feet.
This made his measurements seem more accurate.
Why does 29 002 seem more accurate than 29 000?

_____

_____ **[1]**

(vi) Mount Everest is rising in height by 5 mm per year!

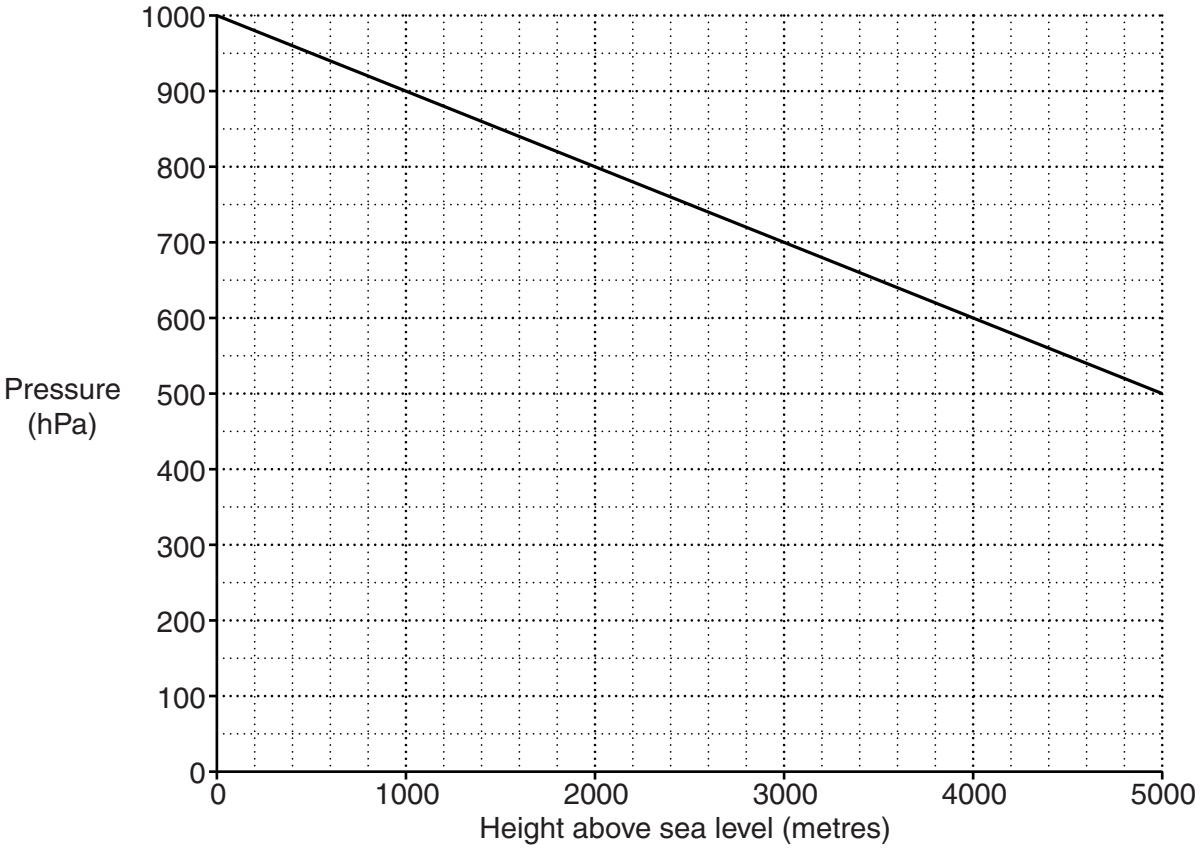
At this rate, how many years will it take Mount Everest to rise by 1 metre in height?

(iv) _____ years **[2]**

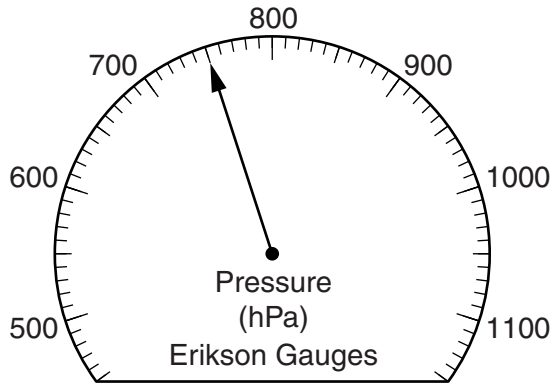
(b) A method to measure height uses atmospheric pressure.

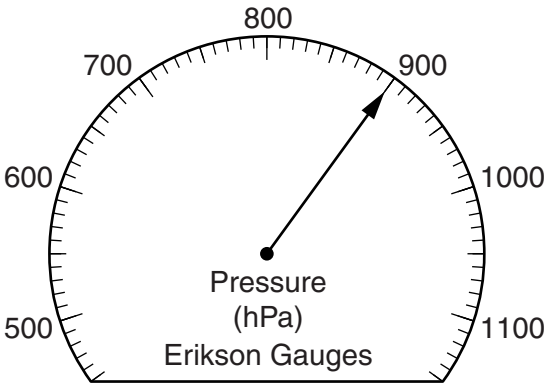
Atmospheric pressure is measured in hPa.
This graph shows how atmospheric pressure changes with height above sea level.

How atmospheric pressure changes with height above sea level



These are the atmospheric pressures at two points on a mountain.





Use the graph to find the **difference** in height between the two points.

(b) _____ m **[3]**

(c) The boiling point of water drops the higher up you go.
This drop in temperature can also be used to estimate heights above sea level.

> The height, h metres, above sea level when the boiling point of water is t °C is given by:
>
> $$h = 295(100 - t)$$

(i) On the top of a mountain water boils at 88°C.

How high is the mountain above sea level?

(c)(i) _____ m **[2]**

(ii) Give your answer to part **(c)(i)** correct to the nearest 100 metres.

(ii) _____ m **[1]**

(d) Here are the average monthly temperatures at the top of Mount Everest.

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Temp. (°C)	−36	−35	−32	−31	−25	−20	−18	−18	−21	−27	−30	−34

(i) Which is the coldest month?

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

(ii) How much warmer is August than December?

(ii) _____ °C **[1]**

(e)

Mountains are made of rock and are very, very heavy.

(i) A 3000 m high mountain weighs about 10^{18} tonnes.
1 tonne = 10^3 kg.

Write the weight, in kg, of a 3000 m high mountain as a power of 10.

(e)(i) 10 ☐ kg **[1]**

Mountains above a certain height will collapse under their own weight.
This formula gives the approximate maximum height, h metres, that a mountain can reach.

$$h = \frac{s}{dg}$$

For most rocks, s (strength) = 10^8,
d (density) = 10^3,
g (the acceleration due to gravity) = 10.
All these values are approximate and are in the correct units.

(ii) Work out, **as a power of ten**, the value of dg.

(ii) 10 ☐ **[1]**

(iii) Use the formula to calculate the maximum height that a mountain can reach.
Give your answer in **kilometres**.

(iii) _____ km **[2]**

(f) Temperature drops the higher up a mountain you go.
A group of friends are walking up a mountain.
They use this formula to estimate the temperature at a particular height on the mountain.

$$T = 18 - \frac{h}{200}$$

T is the temperature in degrees Celsius
h is the height in metres

Work out an estimate of the temperature on the mountain at a height of 800 m.

(f) _____ °C **[2]**

5 **(a)** **(i)** Measure the length and width of the question booklet you are now writing in.
Give your answers correct to the nearest centimetre.

(a)(i) Length _____ cm

Width _____ cm

[1]

(ii) Write the length and width above in metres.

(ii) Length _____ m

Width _____ m

[1]

Paper quality is measured by how many grams each square metre weighs.

This booklet is made from paper that weighs 80 g a square metre.

(b)* Calculate the weight of your question booklet using all the information above.
Ignore the weight of the staples.

(b) _____ g **[4]**

END OF QUESTION PAPER

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