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Wednesday 5 November 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

A38101

1308520366

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 **16** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

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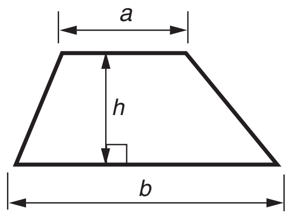
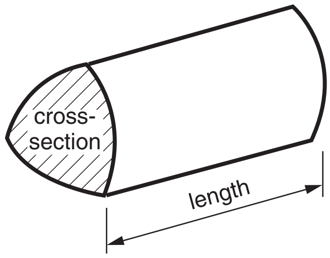
Turn over

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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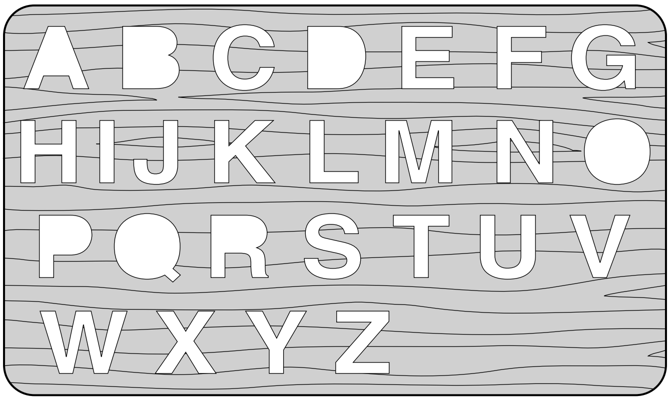
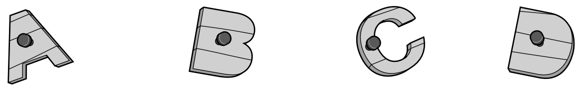
1 As a hobby Anil makes wooden puzzles for children.

In one puzzle he cuts out letters from a piece of wood.
This leaves letter shaped holes.



He sticks pins onto each of the cut out letters.



The child has to put the letters back into their correct holes.

(a) **(i)** Some of the holes have rotation symmetry.

Tick (✓) **three** of the holes that have rotation symmetry. **[3]**

(ii) Anil says that letters which have holes with rotation symmetry are easier to put in.

Why is he probably correct?

....

.... **[1]**

(iii) Which is the easiest letter to fit for a child if Anil is correct?

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

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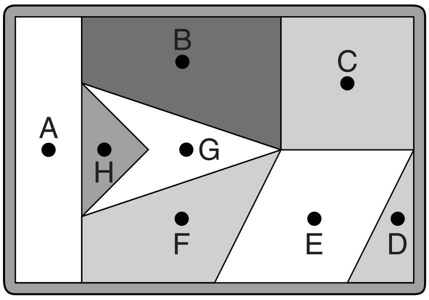
(b) **(i)** Anil makes another puzzle in which different shapes have to be put together to make a rectangle.
The shapes are cut out using a saw.



Write the letter for each shape.

An arrowhead ....

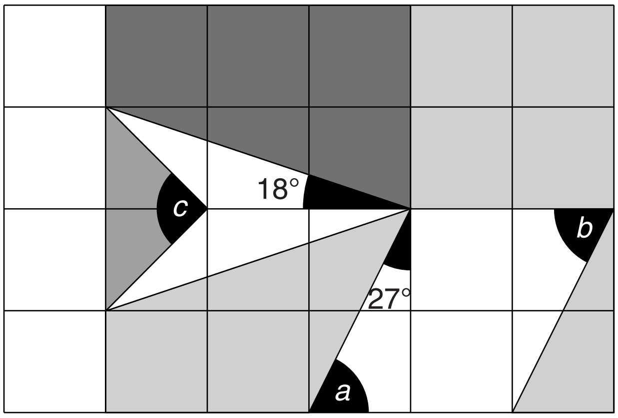
An isosceles triangle ....

A trapezium ....

A parallelogram ....

[3]

(ii) Anil draws a square grid on the wood to help him cut out the shapes.



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Work out the sizes of the angles labelled *a*, *b* and *c*.

a = ...° **[1]**

b = ...° **[1]**

c = ...° **[1]**

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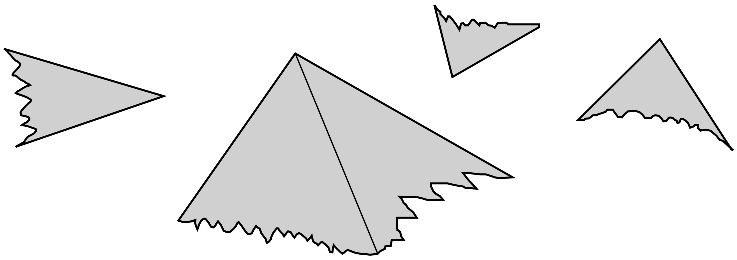
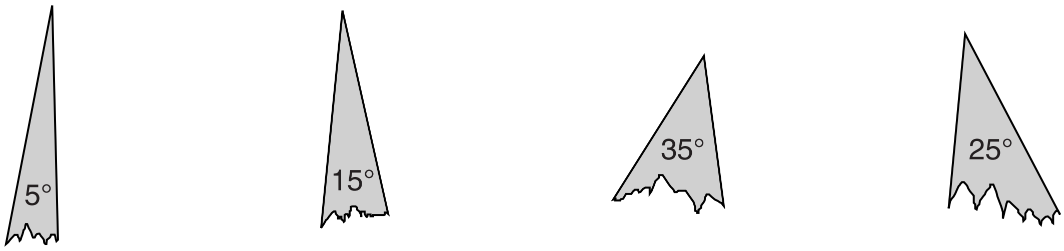
(c) Anil plans a game about fitting angles together.



He cuts out the four angles below.



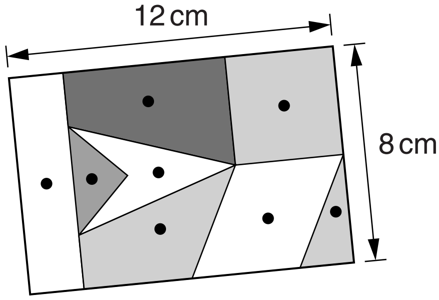
Which extra angle does he need to make, so that when all five angles are put together they form a right angle?

(c) .... ° **[2]**

(d) Anil decides to sell some of his puzzles at the local craft fair.

He needs to work out how much the materials to make one puzzle will cost.

The puzzles are made from plywood.
The puzzles are rectangular and measure 12 cm by 8 cm.



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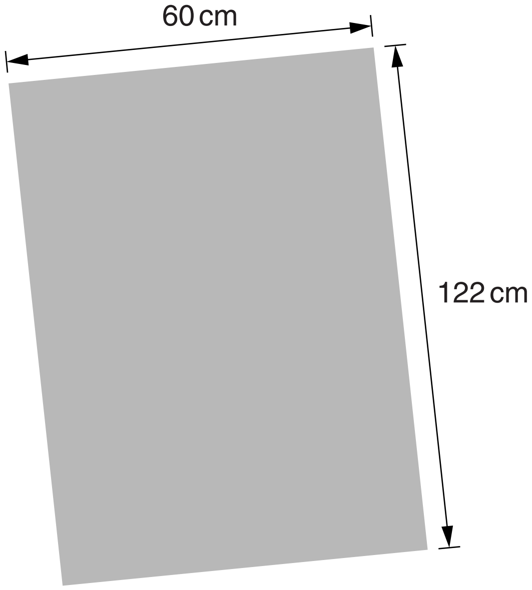
Anil buys the plywood in sheets measuring 122 cm by 60 cm.
The sheets cost £10 each.



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Anil will make as many puzzles as he can from each sheet of plywood.

The pins for each shape cost 3p each. 

How much do the plywood and pins for each puzzle cost?
Show each stage in your working clearly.

....

....

....

....

.... **[5]**

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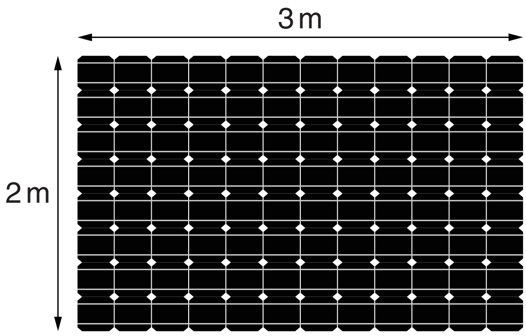
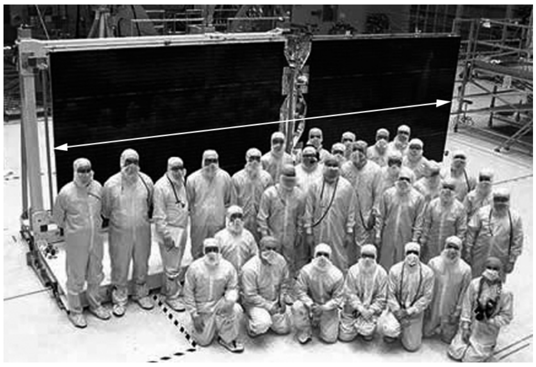
2 Satellites have solar panels to make electricity from sunlight.

(a) **(i)** Calculate the area of this solar panel. Give the units of your answer.



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

(ii) Estimate the width of the solar panel shown below.



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

(iii) Solar panels work in temperatures from about $^{-}170\,°C$ to about $160\,°C$.

What is the difference between these two temperatures?

(iii) .... °C **[1]**

(iv) Near to the Earth sunlight has a power of 1400 watts per square metre.
The latest solar panels can only collect 20% of this.

How much sunlight (solar) power can the latest solar panels collect?

(iv) .... watts per square metre **[2]**

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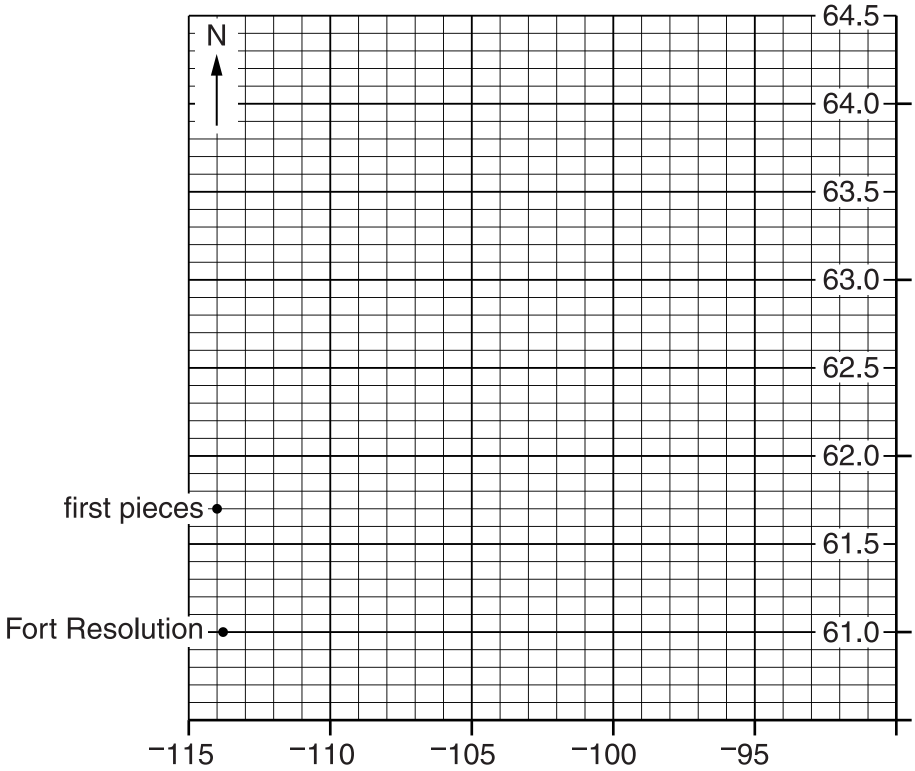
(b) In 1978 the Soviet satellite Cosmos 954 crashed in Canada.
It contained radioactive materials and did not use solar panels.

This map shows the GPS coordinates of the place where the first pieces landed.
It also shows the town of Fort Resolution, which has GPS coordinates ($^{-}113.8$, 61.0).



(i) What are the GPS coordinates of the place where the first pieces landed?

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

(ii) The last piece of Cosmos 954 was found at Baker Lake at ($^{-}96$, 64.3).

Mark this spot on the map above. **[1]**

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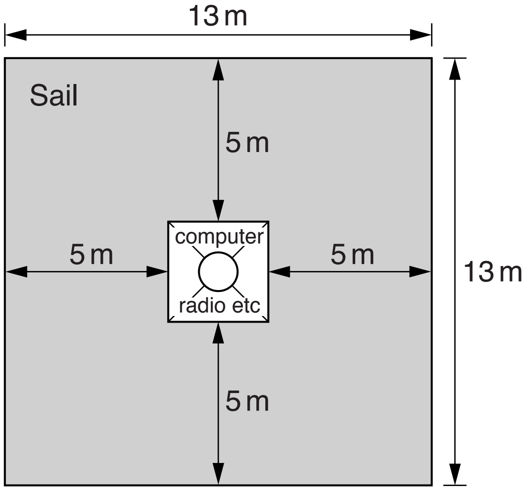
(c) A method to power spacecraft uses the force of sunlight.
The force acts like the wind on sailing ships.

This diagram shows the sail that was tested in 2010. The grey part of the diagram is the sail.
The test was successful.



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(i) Calculate the area of the sail.

(c)(i) .... m^2 **[3]**

(ii) The force of sunlight is very small.
The sails need to be very large and have a very small mass.

It is planned to make sails with an area of $10^7\,m^2$.
Write 10^7 as a 'normal number'.

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

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(d) This calculation gives the number of days it would take a spacecraft driven by sunlight, with a sail area of 1 square kilometre and a payload of 100 kg, to travel 400 000 km. (400 000 km is about the distance from the Earth to the Moon).

$$\frac{\sqrt{0.035 \times 400\,000}}{8.65}$$

(i) Complete the calculation.
Write down the answer from your calculator.

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

(ii) Round your answer to the nearest whole number of days.

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

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Another way to use light to power rockets in space is the photon motor.
A bright beam of light pushes the rocket forwards.

Small experimental photon motors have been built.

(e) For a planned rocket the connection between the velocity, *v* miles per hour, and the number of days, *d,* that the motor has been running is given by the following formula.

$$v = 50d$$

(i) What is the velocity of the rocket if the motor has been running for 10 days?

(e)(i) .... miles per hour **[1]**

(ii) A velocity of 50 000 miles per hour is needed to explore the outer planets.

How many **years** would it take the rocket to reach this velocity?

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

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3 **(a)** When Evie was born the nurse said she weighed:

Three kilograms three hundred grams

The next day she weighed 3.26 kg.

(i) By how much did Evie's weight change?

(a)(i) .... kg **[2]**

(ii) Had Evie lost or gained weight?

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

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(b) Evie weighed 9.250 kg when she was one year old.

When Evie's mum Kate was one year old she weighed $20\frac{1}{2}$ pounds.

(i) Who was heavier when they were one year old, Evie or Kate, and by how much?
Remember 1 pound is the same as 0.45 kg.

(b)(i) .... by .... kg **[3]**

(ii) Kate weighed $6\frac{3}{4}$ pounds when she was born and $20\frac{1}{2}$ pounds when she was one year old.

How much weight had Kate gained in her first year?

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

(iii) This is a record of Evie's weight at the end of each month.

Month	Weight (kg)
1	3.875
2	4.450
3	5.265
4	5.860
5	6.495
6	7.630

Between which two months did Evie gain the most weight and how much did she gain?

Between month .... and month .... she gained .... kg **[3]**

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(c) Kate and her partner Kwami wonder how tall their daughter Evie will be as she gets older.

They find this formula.

$h = 6a + 77$
h is the height of the child, in centimetres
a is the age of the child, in years
The formula should only be used for children aged between 2 and 12 years.

(i) Use the formula to work out how tall Evie should be when she is 10.

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

(ii)* Show that the formula can't possibly work for all adults.

....

....

....

....

.... **[3]**

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(d) Kate drew this chart using some information from a baby book.
She plotted one point incorrectly.

(i) What is the expected height of an adult who was 90 cm tall when two years old?

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

(ii) Draw a circle round the point Kate has plotted incorrectly. **[1]**

(iii) What expected adult height should she have plotted?

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

(iv) Write the rule connecting a baby's height at two years old with their expected height as an adult.

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

(e) Kate and Kwami also find this more reliable formula on the internet.

$$A = \frac{m + f - 13}{2}$$

m is the mother's height, in cm.
f is the father's height, in cm.

A is the baby's expected adult height, in cm.

Kate is 1.62 m tall and Kwami is 1.79 m tall.

What height does the formula predict Evie will be when she grows up?

(e) .... cm **[3]**

END OF QUESTION PAPER

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