**F**

# Friday 7 November 2014 – 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 bar codes.

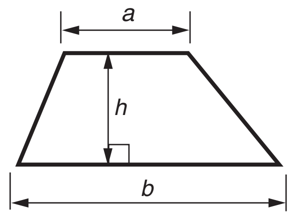
**INFORMATION FOR CANDIDATES**

- 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 **24** pages. Any blank pages are indicated.

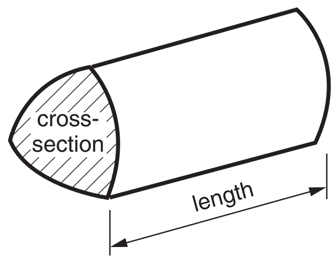
**You are permitted to use a calculator for this paper**

## Formulae Sheet: Foundation Tier

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



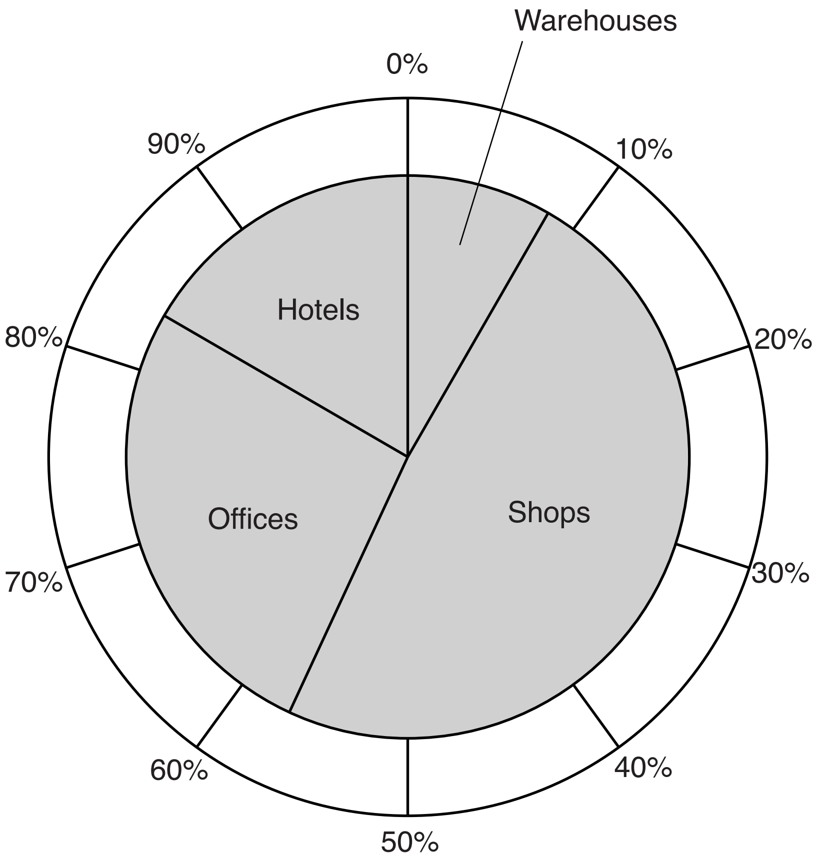

**Volume of prism** = (area of cross-section) × length




**PLEASE DO NOT WRITE ON THIS PAGE**

1 **(a)** The main users of energy for air conditioning are warehouses, shops, offices and hotels. The proportion used by each user is shown in this pie chart.

**Energy used for air conditioning by the four main users.**




Use the pie chart to answer these questions.

**(i)** Which is the **third** largest user of energy for air conditioning?

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

**(ii)** About what percentage of the total energy do warehouses use?

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

**(iii)** Which **two** users together use about 25% of the total energy?

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

**(b)** About 2 out of 5 office buildings in the UK have air conditioning.

Image removed due to third party copyright restrictions. Details: air conditioning units on top of a building.

**(i)** What fraction of office buildings in the UK has air conditioning?

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

**(ii)** What percentage of office buildings in the UK has air conditioning?

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

**(c)** Jan is a building engineer.
Her job is to work out the air conditioning power needed to cool or heat halls.
Jan uses this formula to get a rough estimate.

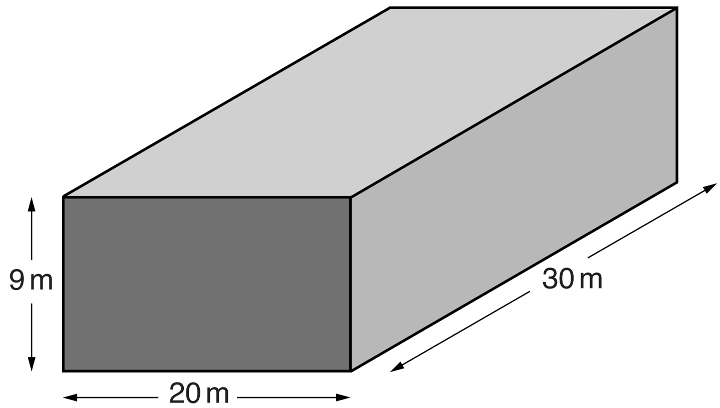
$$P = 0.003 \times T \times V$$

*P* kilowatts is the power of the air conditioners.

*T* °C is the difference in temperature between the hall and the outside.

*V* cubic metres is the volume of the hall.

Jan has to estimate the air conditioning power needed for a theatre in Glasgow.
Here is a sketch of the theatre.
It is in the shape of a cuboid.




**(i)** What is the volume of the theatre?

**(c)(i)** .................................. cubic metres **[2]**

These were the lowest monthly temperatures in Glasgow for the last few years.

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. (°C) | -2 | -1 | 3 | 5 | 7 | 11 | 13 | 11 | 10 | 7 | 2 | -4 |

**(ii)** Which months had a lowest temperature below 0 °C?

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

**(iii)** The ideal temperature inside the theatre is 20 °C.

What is the difference between this temperature and the lowest monthly temperature in December?

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

**(iv)** Use Jan's formula and some of your answers to work out the air conditioning power needed for the theatre in December.
Show all your working.
Give your answer correct to the nearest kilowatt.

**(iv)** .......................................... kilowatts **[3]**

Air conditioning is used both to cool down and to warm up buildings.
August is the warmest month in Glasgow.

Jan finds the **highest** temperatures in Glasgow on 1st August for the last 19 years.
These are the temperatures in °C.

24 28 22 25 22 21 25 28 26 23

22 25 22 22 22 22 23 11 17

**(v)** What is the most likely highest temperature in Glasgow on 1st August?
Explain how you decided.

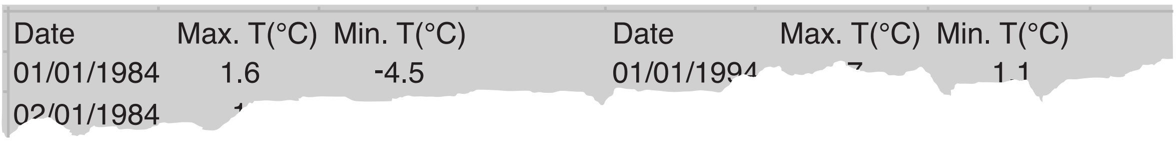
**(v)** ................... °C because ...................................................................................

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

**(vi)** Use Jan's figures to estimate the probability that the highest temperature in Glasgow will be above 20 °C on 1st August next year.

**(vi)** .......................................................... **[2]**

**(vii)** Jan wants to investigate the maximum and minimum temperatures in Glasgow.



| Date | Max. T(°C) | Min. T(°C) | Date | Max. T(°C) | Min. T(°C) |
|---|---|---|---|---|---|
| 01/01/1984 | 1.6 | -4.5 | 01/01/1994 | [illegible] | 1.1 |
| 02/01/1984 | [illegible] | | | | |

She downloads the maximum and minimum temperatures for every day for the last 30 years.

Roughly how many temperatures will she download?
Show how you decided.

**(vii)** .......................................................... **[3]**

Jan needs a spreadsheet to analyse this large number of temperatures.
She wants the spreadsheet to count the number of times the temperatures are:

- 22 °C and above
- 18 °C and below
- between 18 °C and 22 °C (but not including 18 °C or 22 °C).

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Date | T max | T min | 22°C and above | 18°C and below | Between 18°C and 22°C | |
| 2 | 01/01/1984 | 1.6 | -4.3 | | | | |
| 3 | 02 /01/1984 | 1.3 | -3.5 | | | | |
| 4 | 03/01/1984 | 4.7 | 0.5 | | | | |
| 5 | 04/01/1984 | [illegible] | | | | | |
| 2922 | 30/12/1991 | 1.6 | -4.5 | | | | |
| 2923 | 31/12/1991 | 1.3 | -4.7 | | | | |
| 2924 | 01/01/1992 | 1.1 | -5.2 | | | | |
| 2925 | 02/01/1992 | 3.2 | 0.5 | | | | |
| 2926 | 03/01/1992 | 2.7 | [illegible] | | | | |

**(viii)** In which cell is the maximum temperature for 29th December 1991?

**(viii)** ........................................................ **[1]**

**(ix)** Tick the three expressions, involving $T$ °C, that show the three conditions at the top of the page.

| | | | |
|---|---|---|---|
| $18 \geqslant T \leqslant 22$ | ☐ | $18 < T < 22$ | ☐ |
| $18 > T < 22$ | ☐ | $T > 22$ | ☐ |
| $T \leqslant 18$ | ☐ | $T < 18$ | ☐ |
| $18 > T > 22$ | ☐ | $T \geqslant 22$ | ☐ |

**[3]**

**(x)** Jan decides to look at temperatures for the last 100 years.
There is a problem. The older temperatures are in degrees Fahrenheit!

She writes this inequality for the ideal theatre temperature $F$ in degrees Fahrenheit:

$$F - 32 \geqslant 36$$

Solve the inequality and use it to find the smallest value of $F$ which is a solution.

**(x)** ..................................... °Fahrenheit **[2]**

**(d)** Jan sometimes has to calculate the heat loss through a building's walls.
Complete her calculation.
Show the values for $A$ and $U$ as well as the final answer.

$A = 3.6 \times 1450 \times (20 - 16)$

$A =$

$U = \left(\dfrac{9}{1.3} + \dfrac{1}{0.17}\right)$

$U =$

Heat loss = $A \times U$

Heat loss = ..................................................

**[3]**

**(e)** Jan has to solve this equation when the walls are made with different materials.

$$\left(\frac{1}{x-1}\right) + \left(\frac{1}{x}\right) = 0.45$$

Complete her trial and improvement solution using only whole numbers for $x$.

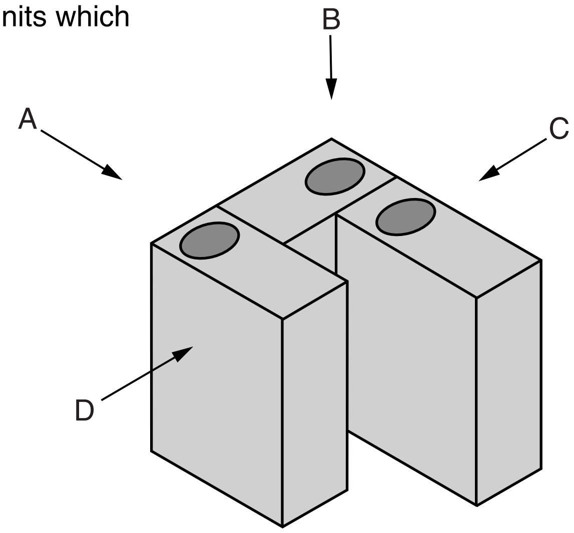
| Trial value for $x$ | Value of $\left(\frac{1}{x-1}\right) + \left(\frac{1}{x}\right)$ | Target (0.45) |
|---|---|---|
| 2 | 1.5 | Too big |
| 9 | 0.236 … | Too small |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

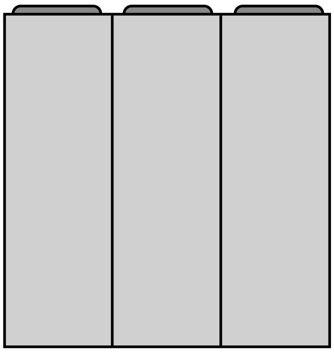
**(e)** $x =$ ........................................................ **[3]**

**(f)** Most air conditioning systems are made from units which are cuboids.

This system is made from three identical units, each unit has a circular fan opening on top.

Match each direction A, B, C or D with its correct view.



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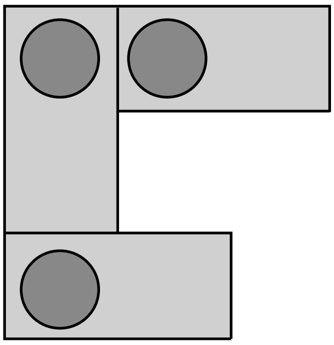

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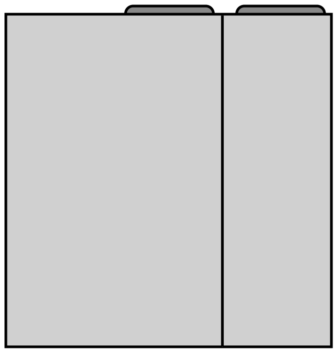

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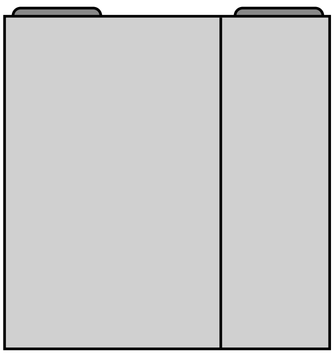

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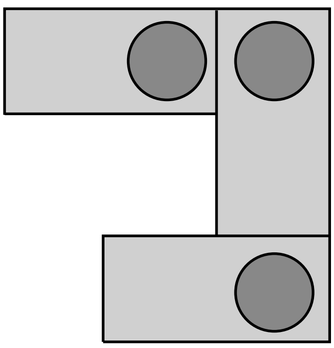

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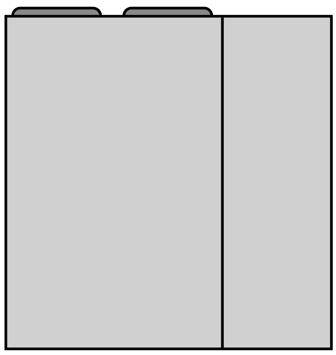
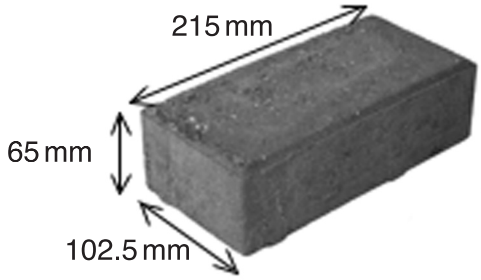


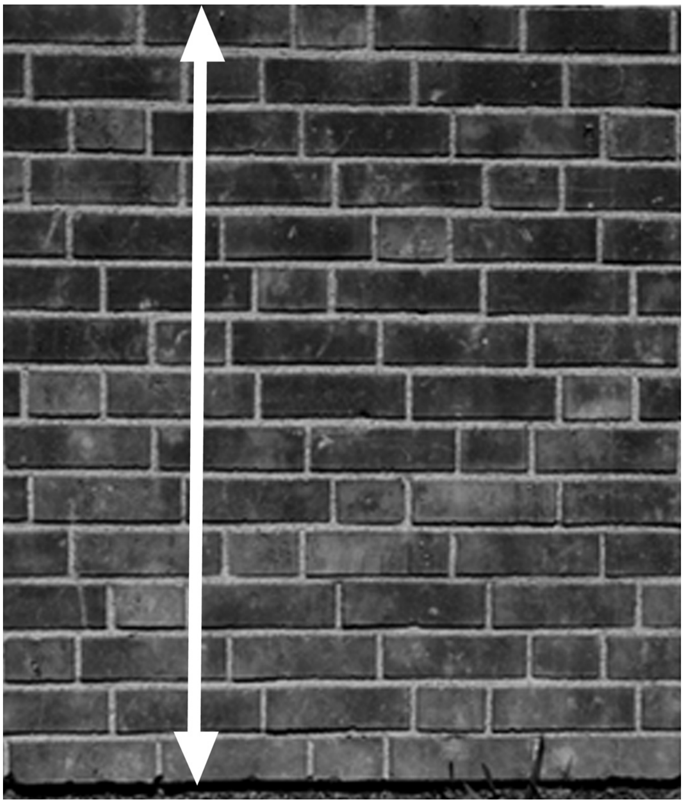
.........................

**[4]**

**(g)*** Jan sometimes has to estimate distances in buildings.
She uses the fact that bricks are the same size to help.




Estimate the height of this wall as accurately as you can.
Make your working clear.
State any assumptions you make.



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

**2** Nick is a fan of the radio programme 'Just a Minute'.
He carried out an experiment to find out if people could judge how long a minute is.
In the experiment Nick asked people to estimate one minute in each of two ways.

- Sit in silence for exactly one minute.
- Talk about their hobbies for exactly one minute.

Nick used a back to back stem and leaf diagram to display his results.
He completed the diagram for silent estimates.

| Silent estimate | | | | | | | | Talking estimate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 8 | 1 | 3 | | |
| | | | | 8 | 2 | 1 | 7 | 1 | 5 | 6 | |
| 8 | 7 | 6 | 4 | 2 | 2 | 1 | 6 | | | | |
| 9 | 7 | 7 | 7 | 2 | 1 | 1 | 5 | | | | |
| 9 | 7 | 5 | 4 | 3 | 3 | 2 | 4 | 0 | 1 | 3 | 3 |
| | | | | 9 | 6 | 4 | 3 | 9 | | | |

Key: **4** | **3** | **9** represents
a silent estimate of **34** seconds and
a talking estimate of **39** seconds

Some of the results for talking estimates have been filled in.
Here are the remaining results, in seconds, for the talking estimates.

64 48 56 52 57 67 66 47 65 45 63 52 60 57 52 64 69

**(a)** **Complete** the ordered stem and leaf diagram for the talking estimates. **[3]**

**(b)** **(i)** Complete this table.

| | **Silent estimate** | **Talking estimate** |
|---|---|---|
| **Range** | 44 | |
| **Mode** | 57 | |
| **Median** | 57 | |

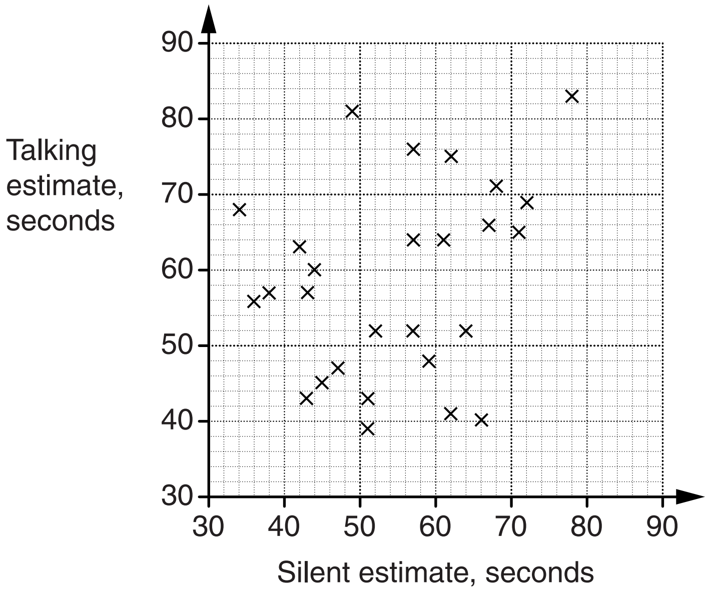
**[3]**

**(ii)** Write down one similarity between the silent and talking estimates.

.............................................................................................................................................

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

**(c)** Nick also drew this scatter graph to display his results.




Is it always true that people who underestimate the length of a minute by the silent method also underestimate the length by the talking method?
Justify your answer.
(You may, as part of your justification, draw suitable lines on the scatter graph).

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

**3** The first jigsaw puzzle was made in 1776.
It was about countries in Europe.

Image removed due to third party copyright restrictions. Details: Jigsaw puzzle, ca. 1766.

**(a)** How many years ago was the first jigsaw puzzle made?

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

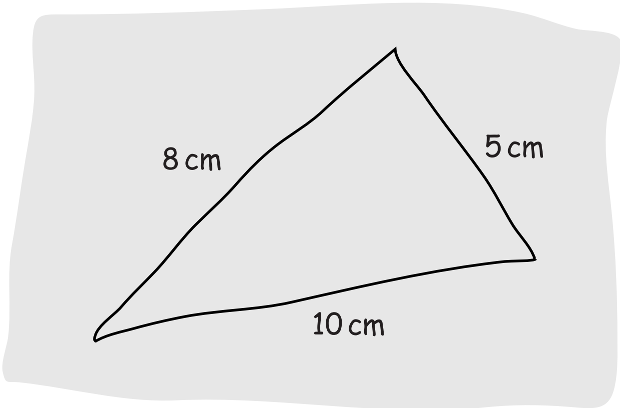
**(b)** One of the world's largest jigsaw puzzles has 40 000 pieces.

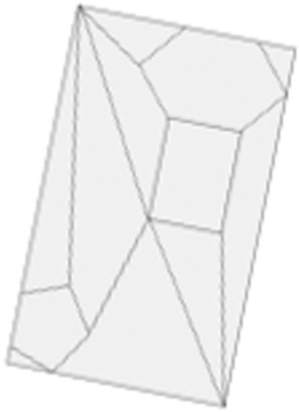
How many days would it take to complete the puzzle?
Assume that it takes a minute to find and put each piece in its right place.
State any other assumptions you make.
Show clearly how you arrive at your answer.

**(b)** ................................................. days **[4]**

**(c)** Jigsaws can be made with pieces which are polygons.

Evie has one.
She has lost one of the triangular pieces.
Here is a sketch of the missing piece with the lengths of its sides.



Use **compasses and a ruler** to make a full size drawing of the missing piece.
The longest side has already been drawn.
Leave in any construction lines.

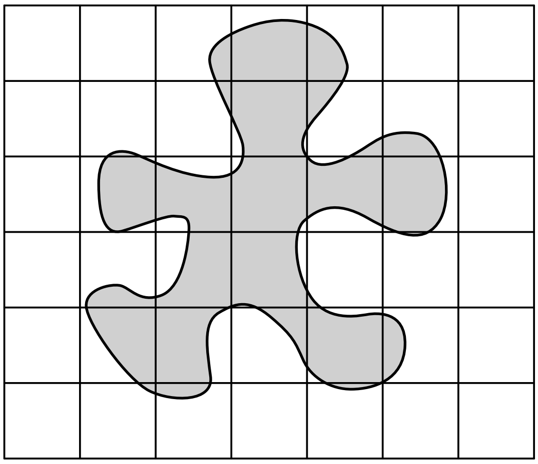
10 cm

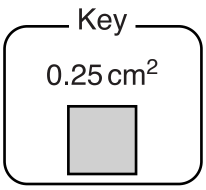
**[3]**

**(d)** Circular jigsaw puzzles are quite popular.

**(i)** Estimate the area of the jigsaw piece below.
Give your answer in small squares.

This item has been removed due to third party copyright restrictions.






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

**(ii)** Use your answer to part **(i)** to estimate the area of the real jigsaw piece.

**(ii)** .................................................. $cm^2$ **[1]**

**(iii)** A circular jigsaw is made from pieces roughly the same size as the piece above.
It has a radius of 30 cm.

Estimate the number of pieces in the complete jigsaw by calculating its area.
Show all your working and round your answer to a sensible degree of accuracy.

**(iii)** .............................................. pieces **[4]**

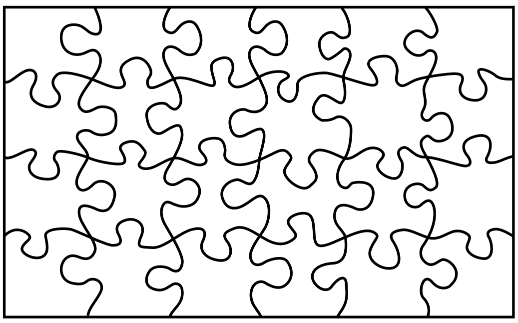
**(e)*** Many people find the outside pieces the easiest pieces of a jigsaw to put in place.

These have one or two straight edges.

A way to measure the difficulty of a normal rectangular jigsaw puzzle is to work out the ratio of the number of pieces with one or more straight edges to the number of pieces with no straight edges.

The bigger this ratio, the easier the jigsaw puzzle.

Use this rule to find which of these two jigsaw puzzles is supposed to be the easier.
Show how you decided by making sure your working is easy to follow.



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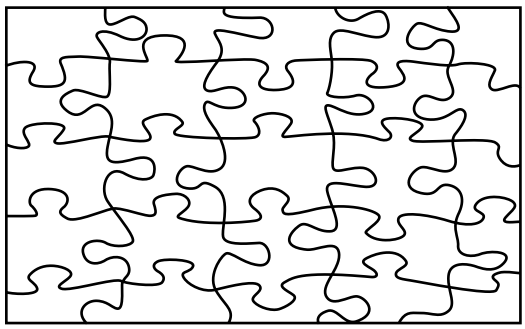

B

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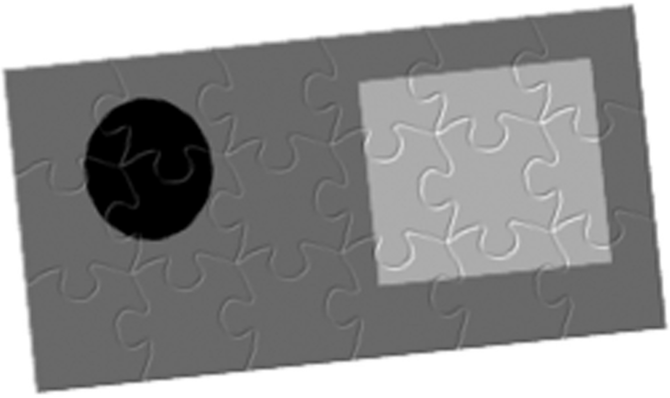
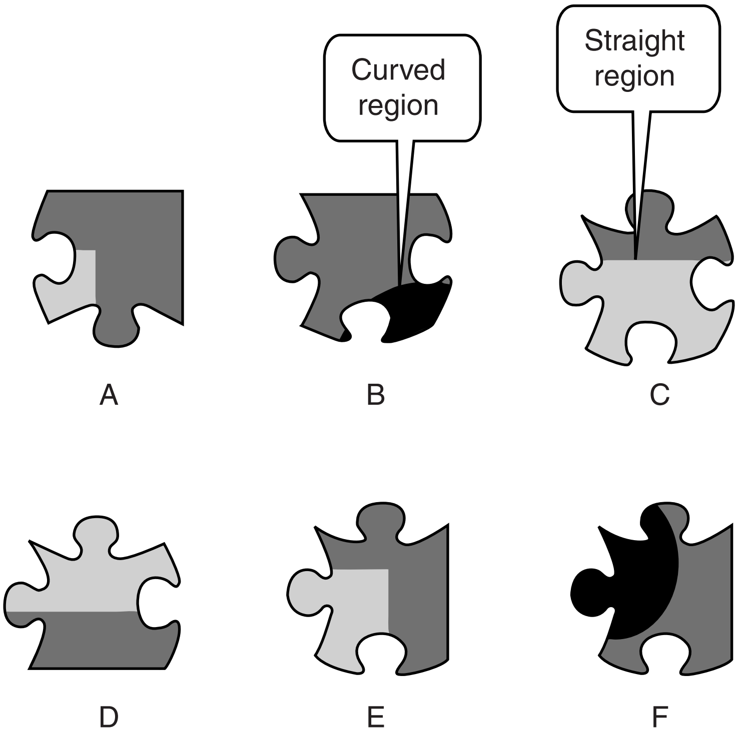
........................................................................................................................................ **[4]**

**(f)** This is a simple jigsaw puzzle.



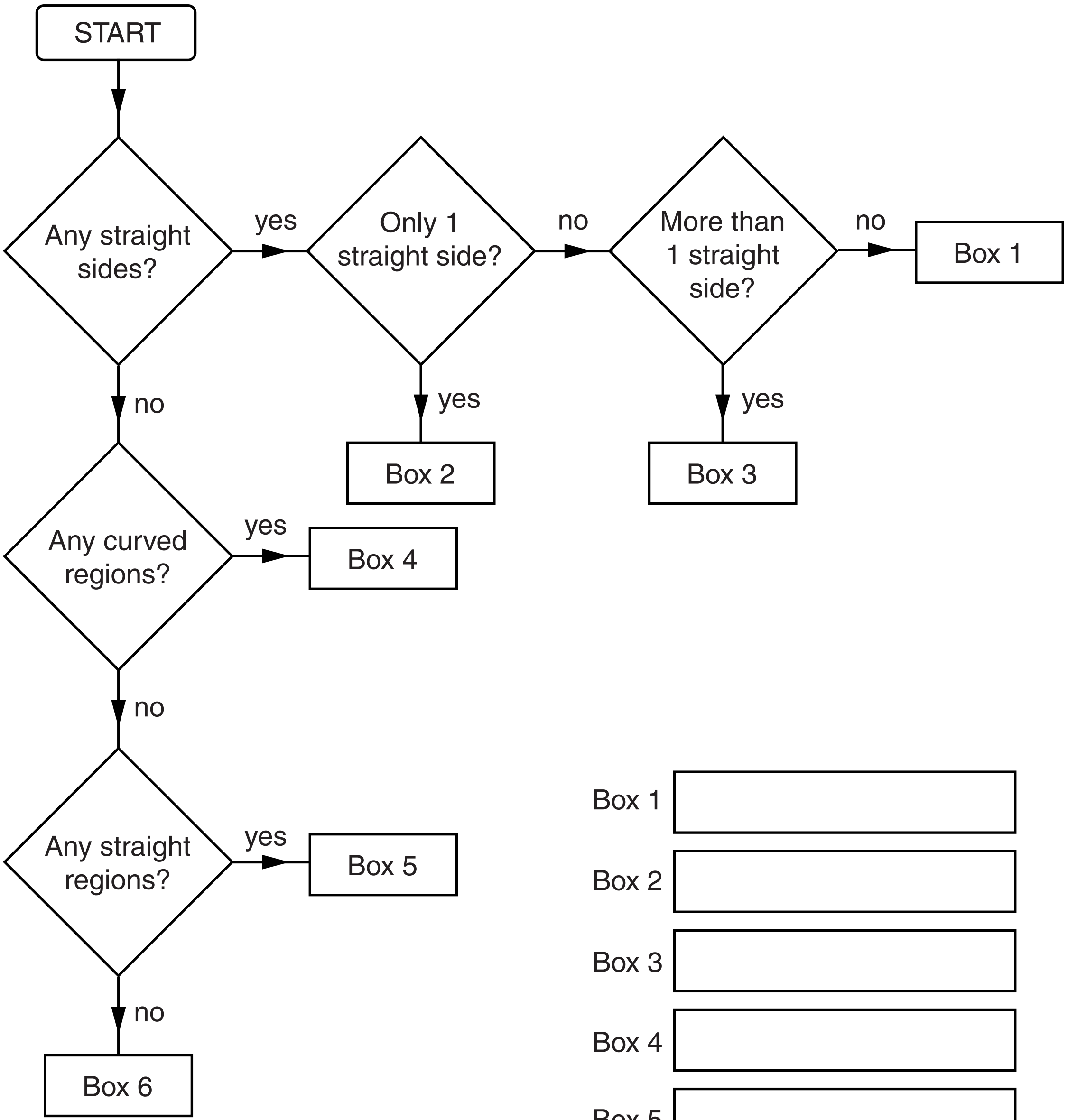
Some of its pieces are shown below.




Many people sort the jigsaw pieces before they start.
They use the number of straight sides and the shapes of the regions shown on the pieces.

This is the first step used in some computer programs to solve jigsaw puzzles.

**(i)** Use the flow chart on the opposite page to put each of these pieces into the correct box.




| | |
|---|---|
| Box 1 | |
| Box 2 | |
| Box 3 | |
| Box 4 | |
| Box 5 | |
| Box 6 | |

**[4]**

**(ii)** Which box will **always** be empty?
Why is this?

Box .................. because ........................................................................................ **[2]**

**(g)** Andy has an old jigsaw puzzle. It belonged to his grandmother.

Image removed due to third party copyright restrictions. Details: classic jigsaw puzzle.

He looks on the internet to see how much similar jigsaws are selling for.

These are the prices.

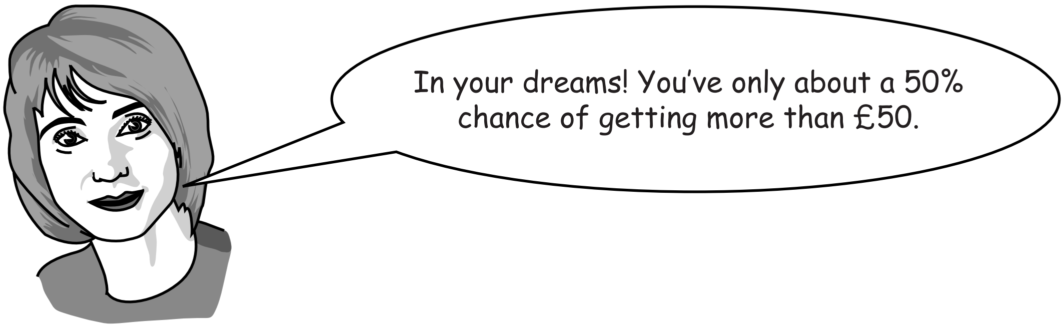
| | | | | | |
|---|---|---|---|---|---|
| £70 | £54 | £45 | £49 | £90 | £45 |
| £90 | £480 | £45 | £85 | £47 | |

**(i)** What is the mean of these prices?

**(g)(i)** £ ........................................................ **[3]**

**(ii)**


Andy




Jan

Who is right Andy or Jan – or perhaps neither of them?
Use the prices that Andy found to show how you decide.

**[3]**

**(h)** Andy wants to sell the jigsaw using an on-line auction site.
He decides to be careful and assume he will get £75.
He sets a starting price of £50.
He can't decide between *Emart* and *Electric Auction House*.

***Emart*** charge an insertion fee which is based on the starting price and also a commission of 5% of the final selling price.

| Starting price | 0 to 99p | £1 to £4.99 | £5 to £14.99 | £15 to £29.99 | £30 to £99.99 | £100 or more |
|---|---|---|---|---|---|---|
| Insertion fee | Free | 25p | 50p | £2 | £4 | £5 |

***Electric Auction House*** doesn't charge an insertion fee.
It charges a flat commission of 10% of the selling price.

**(i)** What is the insertion fee on *Emart* for something with a starting price of £10?

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

**(ii)** Assuming he sells the jigsaw for £75, which site would give Andy the better deal?
Support your answer with numbers.

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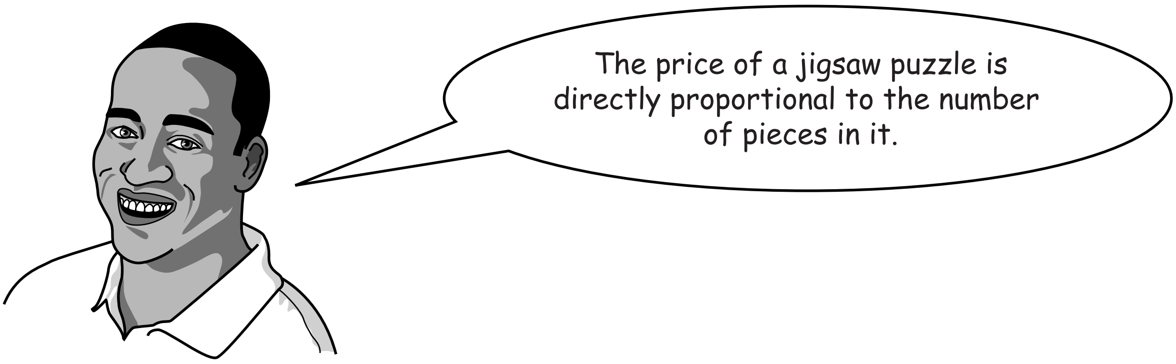
.......................................................................................................................... **[4]**

**(i)** Andy says




He collects these prices on the internet.

Do the figures support what Andy says?
Show clearly with some numbers how you decided.

| Number of pieces | Price (£) |
|---|---|
| 100 | £7.99 |
| 25 | £6.99 |
| 300 | £9.99 |
| 2000 | £22.99 |
| 1500 | £19.99 |
| 3000 | £24.99 |
| 350 | £14.99 |
| 250 | £8.99 |
| 4000 | £29.99 |

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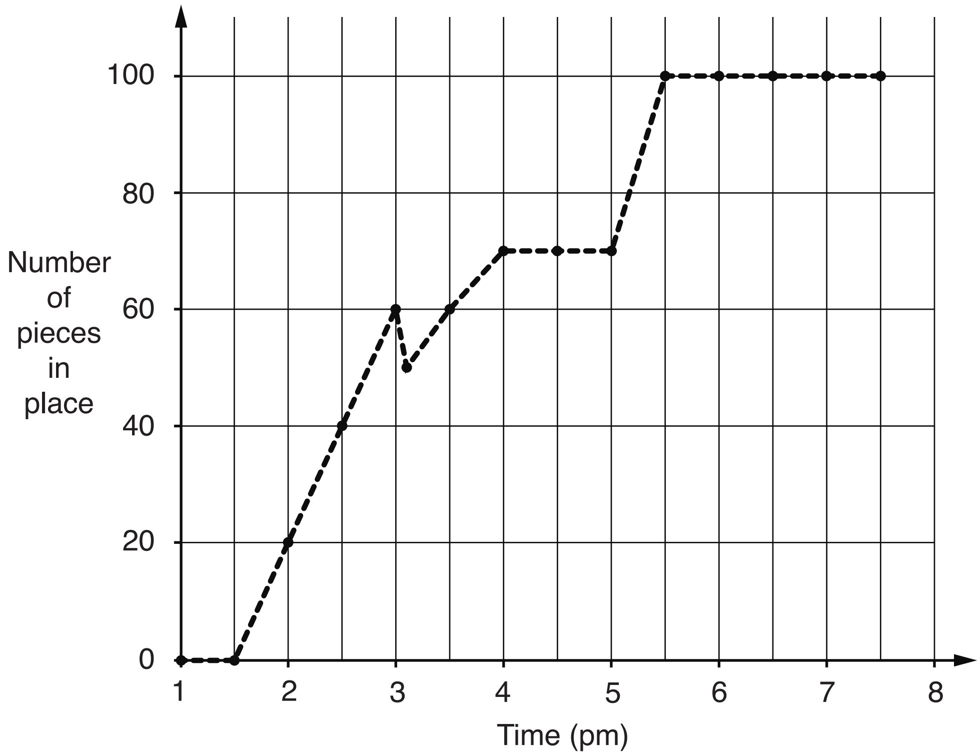
.............................................................................................................................. **[3]**

**(j)** This graph shows someone completing a very difficult 100-piece jigsaw.
The time of day is shown along the x-axis.




Use the graph to answer these questions.

**(i)** At what time was the jigsaw finished?

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

**(ii)** How many pieces were put into place between 2 pm and 3 pm?

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

**(iii)** What **could** have happened just after 3 pm?

..........................................................................................................................

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

**END OF QUESTION PAPER**