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Monday 16 January 2012 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

A316920112

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Duration: 2 hours

A382O2

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

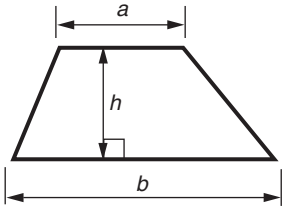
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*****).
- The total number of marks for this paper is **90**.
- This document consists of **20** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

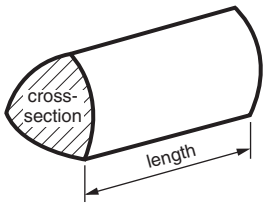
This paper has been pre modified for carrier language

Formulae Sheet: Higher Tier

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



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

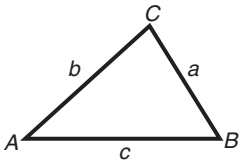


In any triangle *ABC*

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

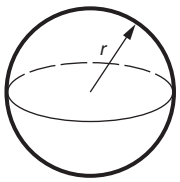
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle $= \frac{1}{2}ab\sin C$



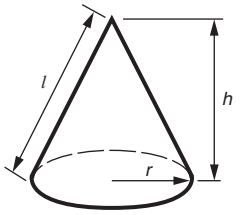
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi rl$



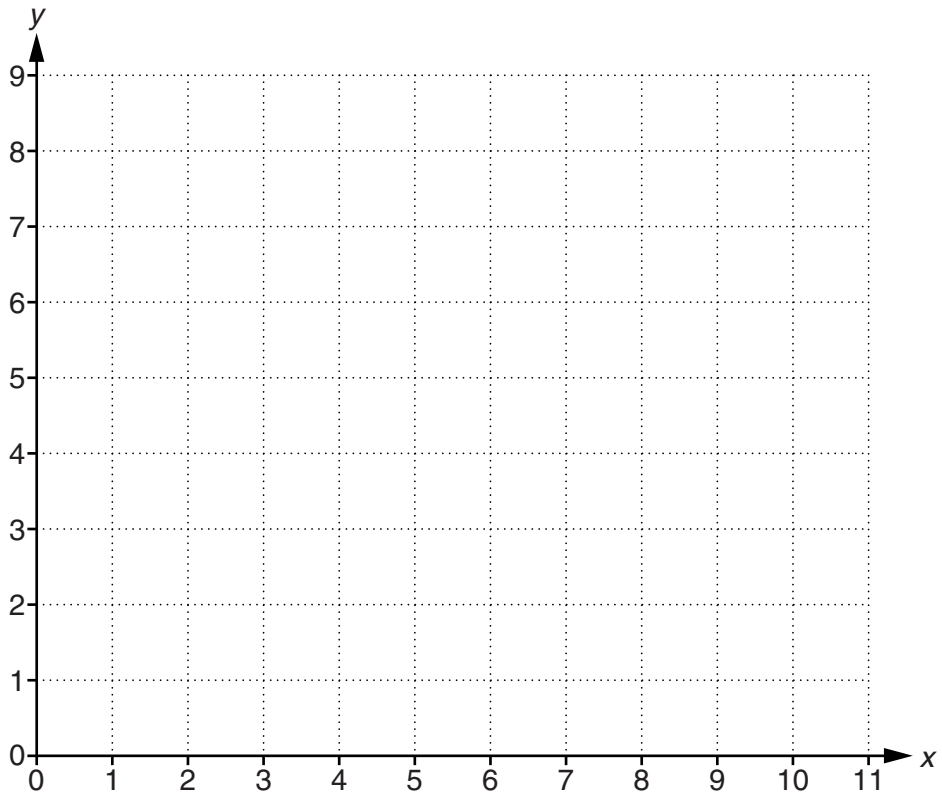
The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

1 **(a)** Draw a straight line from the origin (0, 0) to the point (4, 3) and continue the line to the edge of the grid.



[1]

(b) Show how this line may be used to find $\frac{3}{4}$ of 10.

_____

_____ **[2]**

2 The table gives the population of the United Kingdom from the census data in the 20th century. The populations are given in millions, rounded to the nearest million.

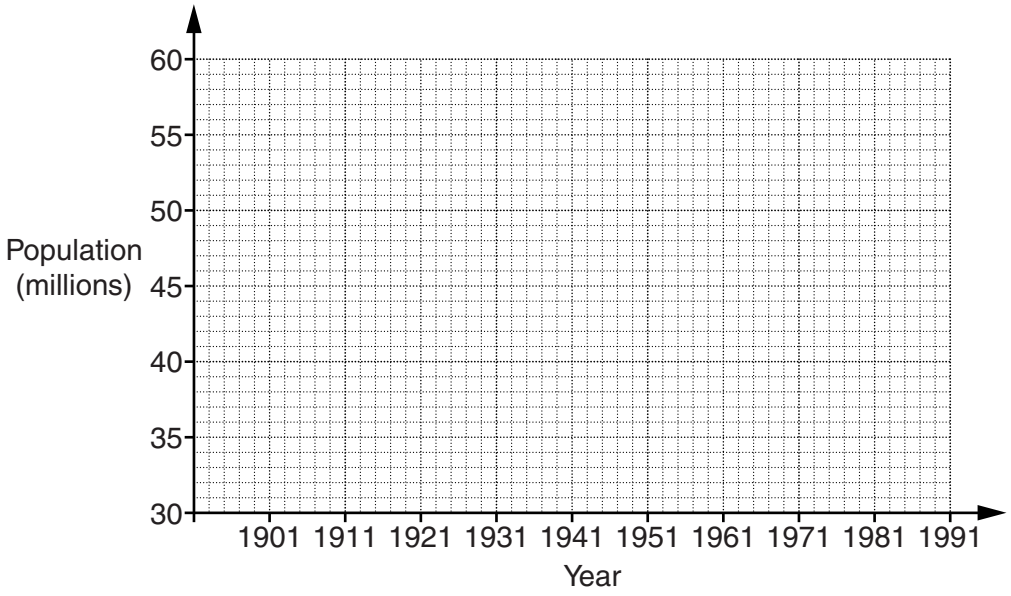
Year	United Kingdom	England & Wales	Scotland	Northern Ireland
1901	38	33	4	1
1911	42	36	5	1
1921	44	38	5	1
1931	46	40	5	1
1941	48	42	5	1
1951	50	44	5	1
1961	53	46	5	1
1971	56	49	5	2
1981	56	50	5	2
1991	58	51	5	2

(a) Explain why the population data for England and Wales, Scotland and Northern Ireland does not always add up to the population for the United Kingdom. (1961 is an example of this.)

_____

_____ **[1]**

(b) Draw a time series graph to show the population of the **United Kingdom** from 1901 to 1991.



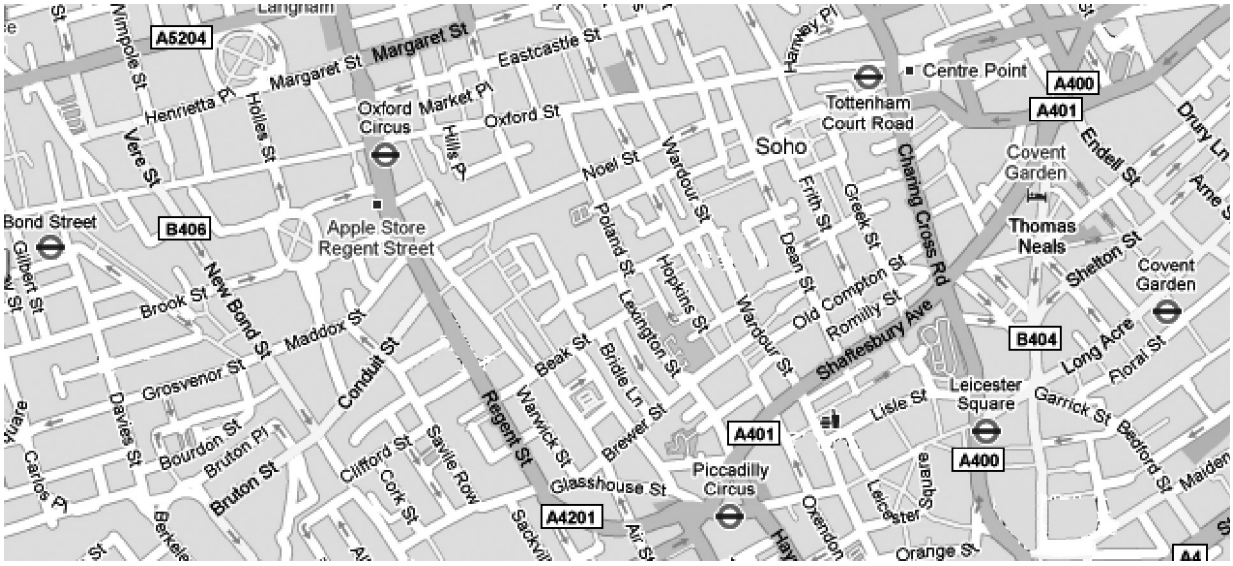
[2]

(c) Describe the trend shown by your graph.

_____

_____ **[1]**

3 Here is a street map of an area in central London.
It is drawn to scale.



Key: underground station

Here is part of the map for the London Underground.
It shows the underground lines that link the stations shown in the first map.

Is the London Underground Tube map drawn to scale?
Use measurements to justify your answer.

_____

_____

_____

_____

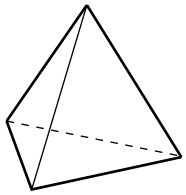
_____

_____

_____

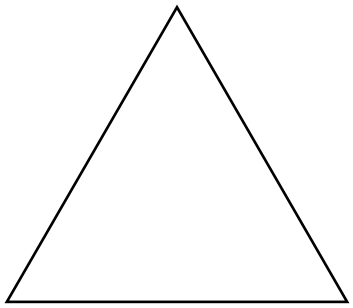
_____ **[4]**

4 Sapna is making a money box in the shape of a regular tetrahedron.



(a) Sapna begins to construct a full-size net of a regular tetrahedron.

Complete the construction of the net.
Leave all your construction lines on the diagram. **[3]**

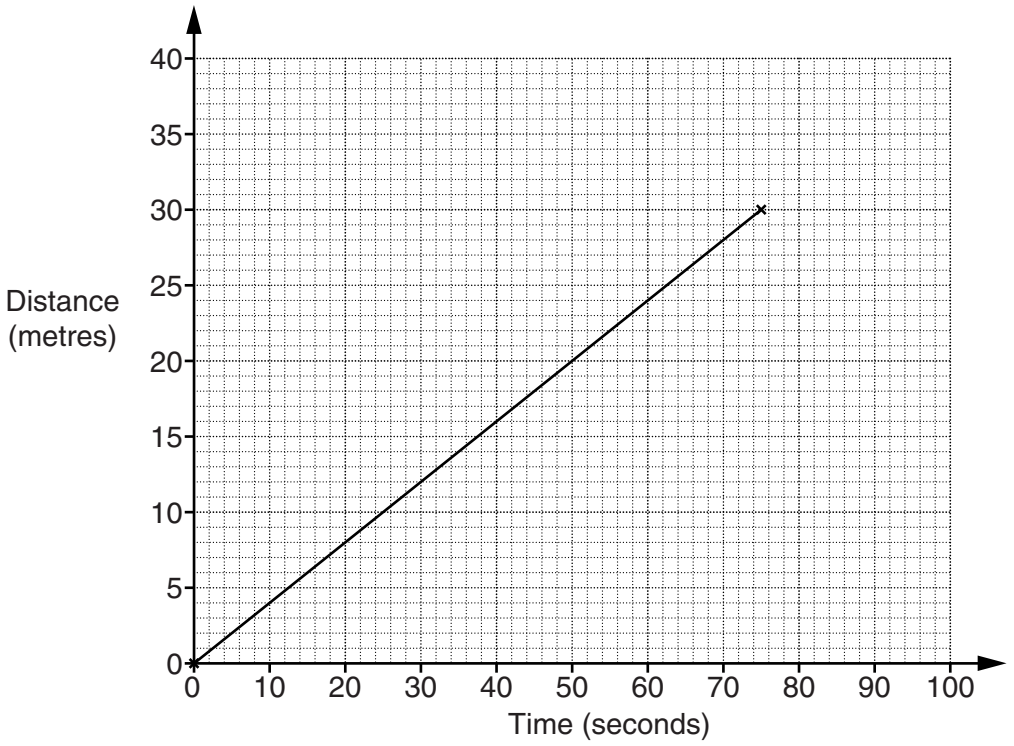


(b) Sapna makes the money box from card.

Work out the total surface area of the money box.

(b) _____ **[4]**

5 A tortoise and a hare had a race.
The graph shows the whole race for the tortoise.



(a) How far was the race?

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

(b) What was the speed of the tortoise?

(b) _____ m/s **[2]**

The hare started the race 20 seconds after the tortoise started.

- He ran 15 m in 10 seconds, then
- he stopped for a rest for 40 seconds, then
- he finished the race 5 seconds after the tortoise finished.

(c) On the grid, draw the graph for the hare's race. **[3]**

(d) At what time did the **tortoise** pass the **hare**?

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

6 Marge rents out one room in her house.
She is allowed an income from the rent of £4250 each year without paying any tax on it.
If the rental income is greater than £4250 then tax is payable by one of these methods.

Method A: Pay tax at 20% on (total rental income less rental expenses)

Method B: Pay tax at 20% on (total rental income less £4250)

One tax year Marge rented the room for £92 per week for 52 weeks.
Her rental expenses were £2590.

(a) Without doing any calculations, explain how you can tell that Marge pays less tax using Method B.

_____

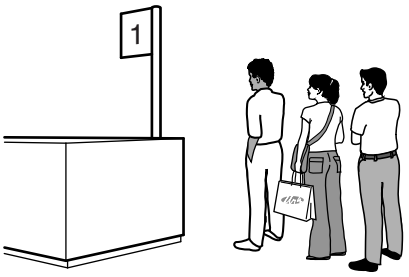
_____ **[1]**

(b) Work out the amount of tax Marge pays for that year using Method B.

(b) £ _____ **[4]**

7 Henry is a store manager. He wants to find out what difference it would make to waiting times if his customers queued

in separate lines or in a single line.



Henry carried out a simulation of different waiting times.
Here are his results, rounded to the nearest minute, for 25 people.

Separate lines	
Waiting time, minutes	Frequency
0	5
1	4
2	5
3	4
4	4
7	1
9	2

Single line	
Waiting time, minutes	Frequency
0	3
1	4
2	2
3	8
4	3
5	3
6	2

(a) Work out the median, mean and range for waiting times in **separate lines**.

(a) Median _____ minutes

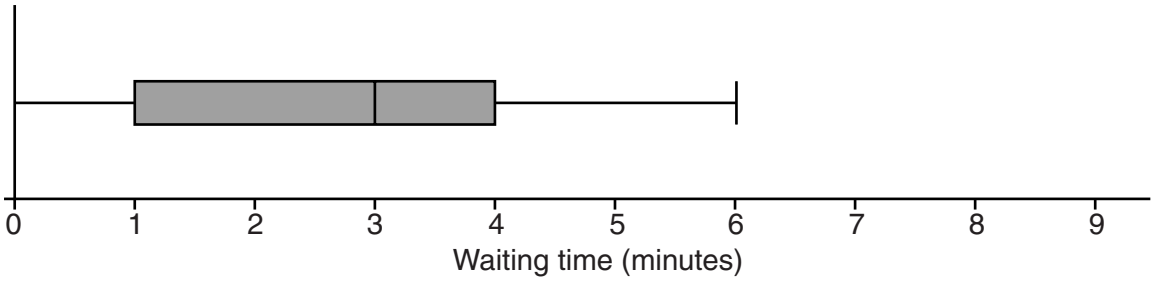
Mean _____ minutes

Range _____ minutes **[6]**

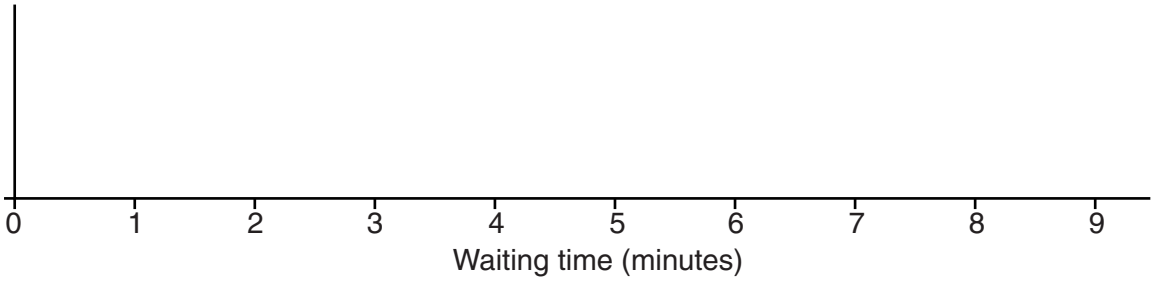
(b) Henry worked out the following summary values for waiting times in a single line.

Median 3 Mean 2.84 Range 6 Lower quartile 1 Upper quartile 4

Henry drew this box and whisker plot for waiting times in a single line.



Draw a box and whisker plot for waiting times in **separate lines**.



[4]

(c) Use the information about types of queuing to explain why Henry may prefer

(i) separate lines,

_____

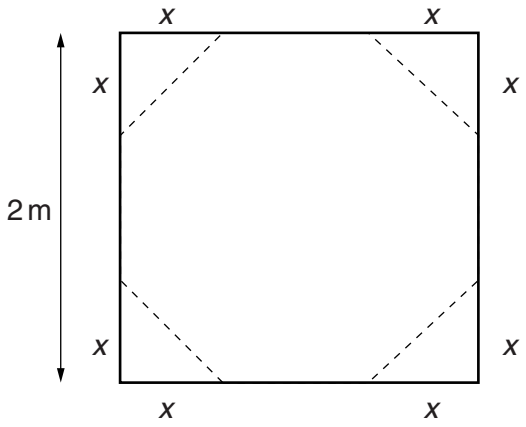
_____ **[1]**

(ii) a single line.

_____

_____ **[1]**

8 A carpenter has a 2 m square piece of wood.
He wants to make a table top that is a regular octagon.
He cuts off each corner of the square as shown in the diagram.



Not to scale

Calculate x.
Give your answer correct to the nearest mm.

_____ mm **[5]**

9 Here are the results of a survey about hockey injuries.

	No injury	Injury	Total
Women	375	25	400
Men	510	90	600

(a) Write down the risk of a man receiving an injury.

(a) _____ **[1]**

(b) Work out the risk ratio, the ratio of men receiving an injury to the risk of women receiving an injury.
Give your answer in the form n:1.

(b) _____ :1 **[3]**

Men and women can buy insurance for sports injuries.
The table shows the average amount paid out for a hockey injury.

	Average paid out per claim
Women	£360
Men	£220

(c) Using both tables of information, justify why the cost of insurance is likely to be cheaper for women than for men.

_____

_____

_____

_____ **[3]**

10 Money can be borrowed for up to one month from companies offering 'payday loans'. Swiftquid, Dosh-4-U and Payday Xpress are companies offering payday loans.

Swiftquid
Loans repayable on your next payday. Interest £25 per £100 borrowed.

Dosh-4-U
Borrow for up to 4 weeks. Repay loan at just 9%, simple interest, each week or part week; interest starts on the day you borrow the money.

Payday Xpress
Borrow what you need. We charge 1% per day, compound interest. Interest is charged for the day you borrow the money, the day you pay it back and each day in between.

(a) Tommy wants to borrow £100 on January 26th.
Tommy will repay the loan on his payday, January 28th.

Calculate the cost of borrowing £100 from each of these three companies.

(a) Swiftquid £ _____

Dosh-4-U £ _____

Payday Xpress £ _____ **[4]**

***(b)** In February Tommy borrows £100. His next payday is February 28th.

Which is the latest date in February on which Swiftquid will be the cheapest of the three companies?

[5]

11 The maximum possible power, P kilowatts, developed by an engine is given by the formula

$$P = \frac{3}{4} r^2 (8 - r) \text{ for values of } r \geqslant 0$$

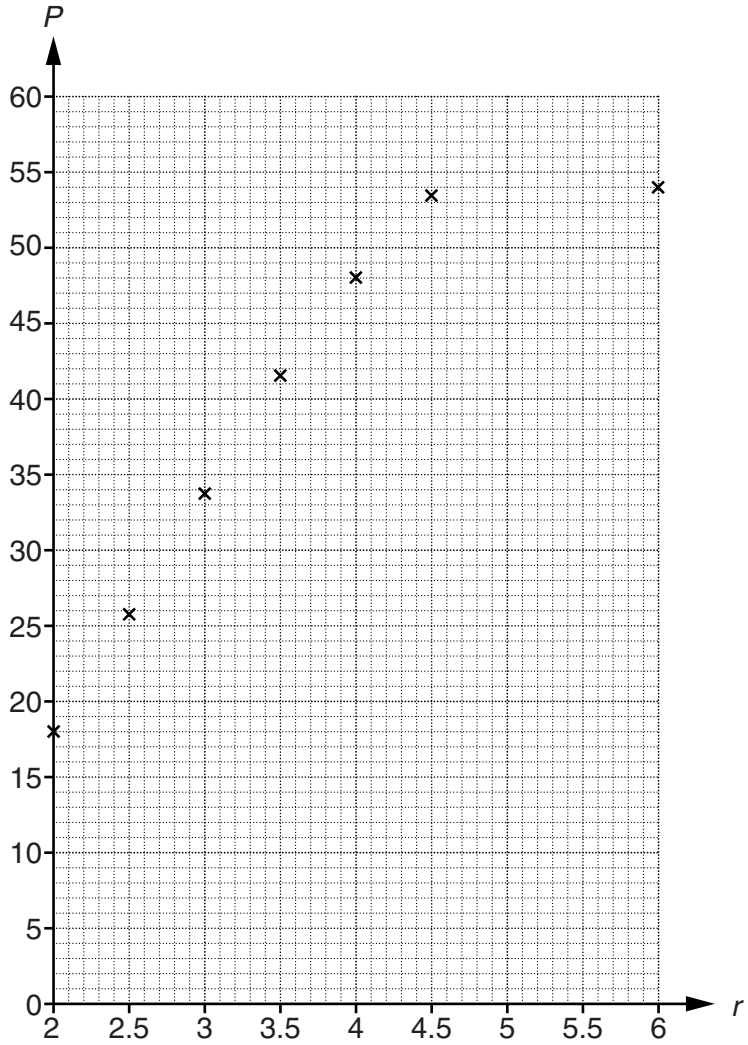
where r is the speed of the engine in thousands of revolutions per minute.

(a) (i) Complete this table for $P = \frac{3}{4} r^2 (8 - r)$.

r	2	2.5	3	3.5	4	4.5	5	5.5	6
P	18	25.78	33.75	41.34	48	53.16			54

[2]

(ii) Complete the graph of $P = \frac{3}{4} r^2 (8 - r)$ for $2 \leqslant r \leqslant 6$.



[2]

(b) From your graph find the value of r which gives the maximum value of P.

(b) _____ **[1]**

(c) Use trial and improvement to find the value of r, correct to two decimal places, when $P = 30$.

(c) _____ **[4]**

12 A café buys a sack of flour weighing 12 kg measured to the nearest 100 g.
It is used to make cakes.
Each cake needs 170 g of flour measured to the nearest 10 g.

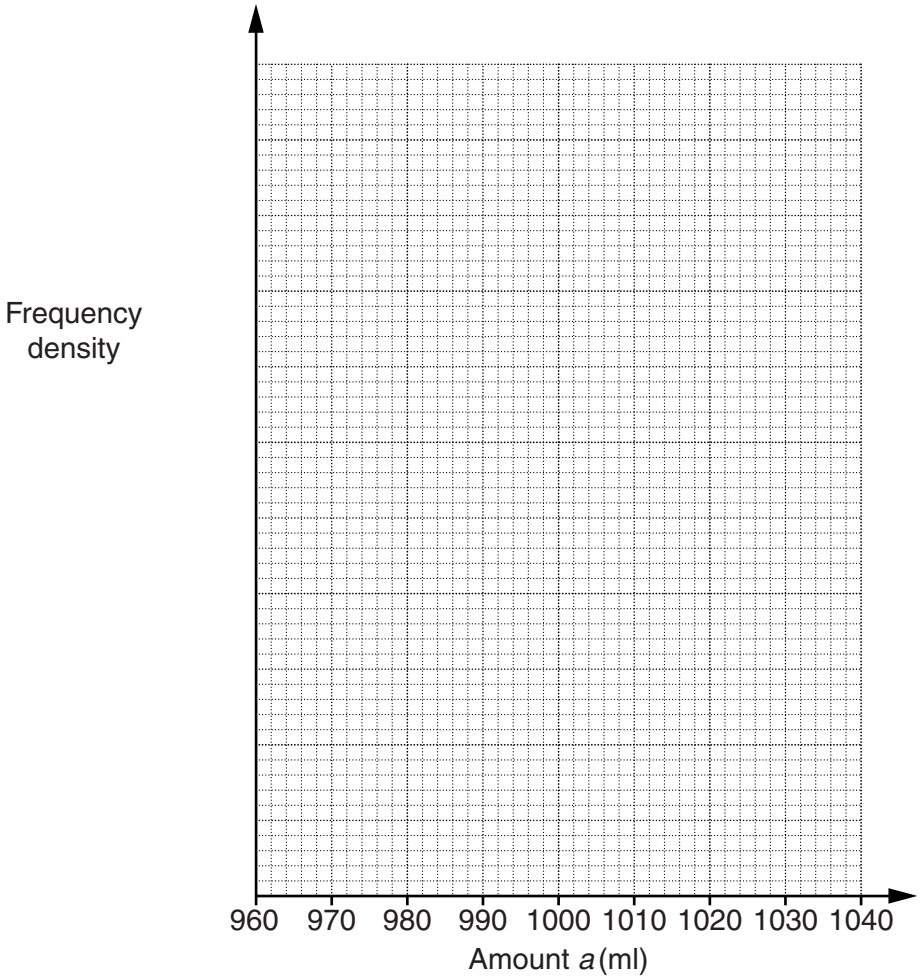
Find the maximum possible number of cakes that could be made.
Show clearly how you reached your answer.

_____ **[4]**

13 A company produces one-litre bottles of apple juice.
They check the amount of apple juice in 180 of these bottles.
The results are summarised in the table.

Amount, a ml	Frequency
$960 \leqslant a < 980$	6
$980 \leqslant a < 995$	12
$995 \leqslant a < 1010$	108
$1010 \leqslant a < 1015$	44
$1015 \leqslant a < 1040$	10

(a) Draw a histogram to represent these data.



[3]

(b) Estimate the number of bottles that contained less than 1 litre.

(b) _____ **[2]**

14 During a thunderstorm you see lightning and hear thunder.

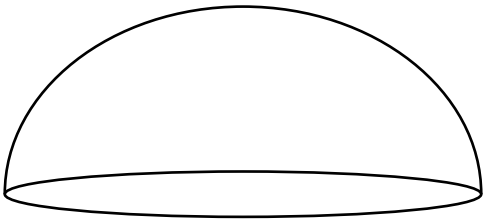
- Light travels at 3×10^8 m/s.
- Sound travels at 343 m/s.

Reuben was 2 km away from a thunderstorm.

How long after Reuben saw lightning did he hear the thunder?

_____ s **[4]**

15 The volume of a hemispherical tent is 4.5 m^3.



Calculate the floor area inside the tent.

_____ m^2 **[5]**

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