For **OCR**

H

GCSE (9–1) Mathematics

Paper 6 (Higher Tier)

Churchill Paper 6D

Time allowed: 1 hour 30 minutes

You may use:

- A scientific or graphical calculator
- Geometrical instruments
- Tracing paper

Name	
Class	

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Write your name and class in the boxes above.
- Answer **all** the questions.
- Read each question carefully before you start your answer.
- Where appropriate, your answers should be supported with 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.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.

Churchill Maths

Written by Shaun Armstrong

Answer **all** the questions

1 **(a)** Solve $5x - 1 < x + 19$

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

(b) Solve $\frac{y}{2} - 7 = 5(3 - y)$

(b) ..... **[3]**

2 The sum of the first 3 terms of a Fibonacci sequence is 22.

Work out the 3rd term of the sequence.

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

3 A teacher runs a rugby club for years 7, 8 and 9.
At one meeting, the number of pupils from each year group are as follows:

Year 7	14 pupils
Year 8	11 pupils
Year 9	19 pupils

The teacher has to pick two captains but the captains must not be from the same year group.

(a) Work out the number of ways in which the teacher can pick the captains.

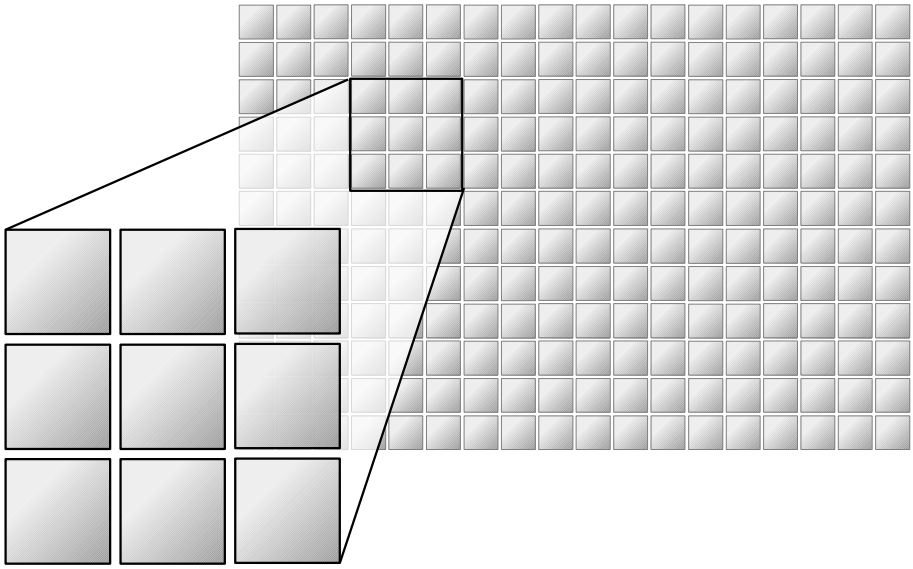
(a) ..... **[3]**

Next, they play a game of rugby between two teams of seven players.
The teacher substitutes players frequently so everyone gets a game.
They play for a total of one hour.

(b) Work out the mean amount of time for which each pupil gets to play.

(b) ..... minutes **[3]**

4



Greg and Jill are estimating the number of small square tiles on a kitchen wall.

The tiled wall is rectangular and measures 3.2 m by 1.4 m.

Greg says

Each small tile is a square of side 2 cm so there are 11 200 tiles.

(a) Greg has ignored the gaps between the tiles.

Show how he has calculated the number of tiles.

[2]

There is a 2 mm gap between adjacent tiles.

Jill decides to take account of the gaps by treating each tile as a square of side 2.2 cm.

She says

Each tile is 10% wider and 10% taller so the area of each tile will be 20% bigger.

(b) Explain why Jill is wrong.

.....

.....

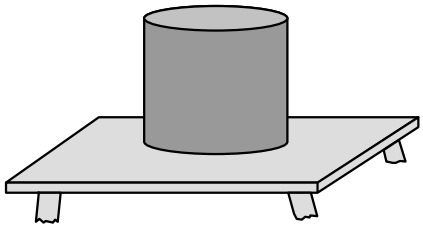
..... **[1]**

(c) Estimate the number of tiles on the wall.

In your estimate, count each part of a tile as a tile.

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

5



Not to scale

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

A tin in the shape of a cylinder is placed with its circular end on a table.

The tin exerts a force of 55 newtons on the table.

The pressure on the table is 2100 newtons/m^2.

Work out the radius of the base of the tin in centimetres.

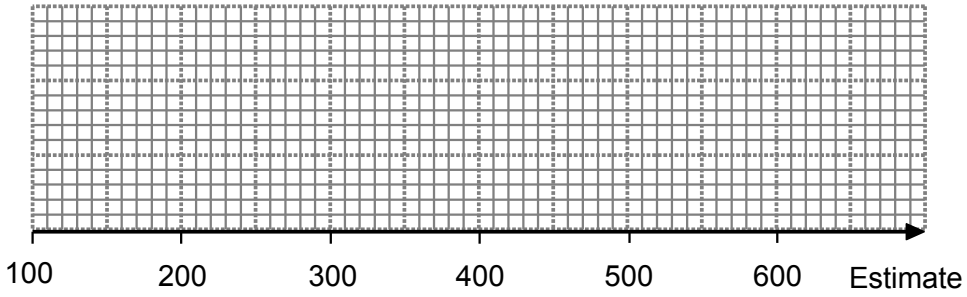
..... cm **[4]**

6 A group of students are asked to guess how many coins are in a jar.

Here are the guesses for the 19 boys in the group.

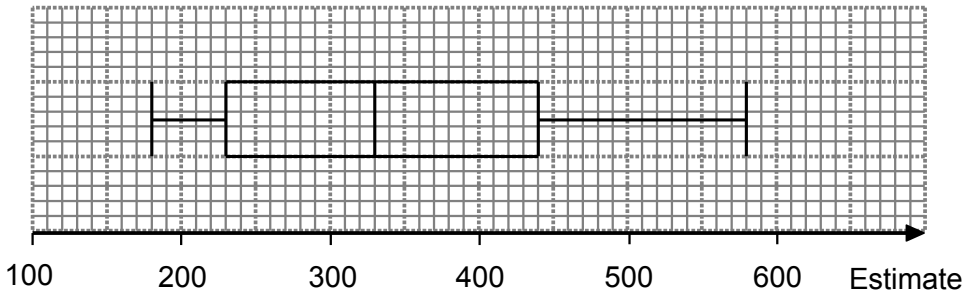
120	192	200	225	230	247	250	250	280	296
300	320	350	371	384	400	401	450	500	

(a) Draw a box plot for this information.



[4]

Here is a box plot for the girls in the group.



(b) For each of the following statements EITHER say whether you agree or disagree with the statement OR say that you cannot comment without more information.

If you agree or disagree you must justify your answer.

(i) There were more girls than boys in the group.

.....

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

(ii) The boys' guesses were more closely grouped.

.....

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

(iii) More than half the girls guesses were under 300.

.....

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

(iv) The girls' guesses were more accurate.

.....

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

7 Margaret takes three different medicines, Alezin, Betadon and Cannezole.

Alezin comes in packets of 48 tablets and she has to take 4 tablets each day.
Betadon comes in packets of 15 tablets and she has to take 3 tablets each day.
Cannezole comes in packets of 20 tablets and she has to take 2 tablets each day.

On the 10th May, she opens a new packet of each of the three medicines.

On what date will Margaret next have to open a new packet of all three medicines on the same day?

..... **[5]**

8 Factorise fully

(a) $6ab^2 - 9b^3$

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

(b) $p^2 - 8p + 12$

(b) ..... **[2]**

9 There are x men at a meeting when it begins.
The ratio of women to men at the meeting is 5 : 4

8 people leave the meeting.
The people who leave are **not** all women.
The ratio of women to men at the meeting is now 1 : 1

(a) Waqar says

The number of men that left the meeting must be 1, 2 or 3.

Explain why Waqar is correct.

.....

.....

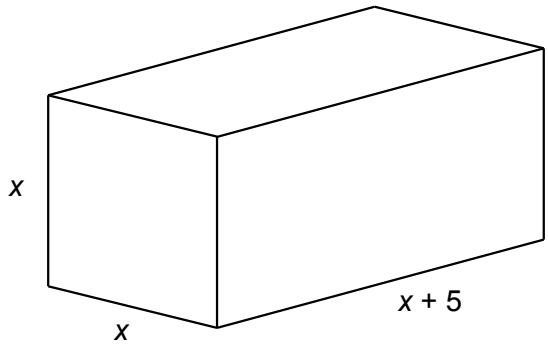
.....

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

(b) Work out the largest possible number of people at the meeting when it begins.

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

10



Not to scale

A box of crackers is in the shape of a square prism.
The cross-section of the box is a square of side x cm.
The length of the box is $(x + 5)$ cm.

The volume of the box is 500 cm^3.

(a) Write down an equation in x.

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

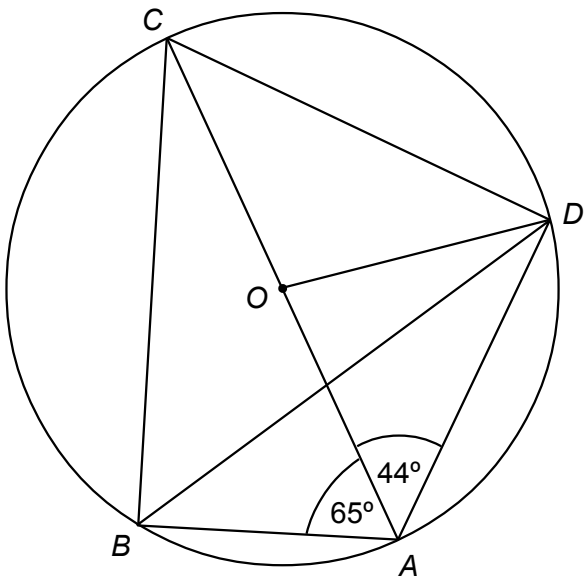
(b) Show that your equation has a solution in the interval $5 < x < 10$.

[2]

(c) Find the value of x correct to 1 decimal place.

(c) ..... **[3]**

11



Not to scale

The points *A*, *B*, *C* and *D* lie on the circumference of a circle, centre *O*.

AOC is a straight line.

Angle *BAC* = 65° and angle *CAD* = 44°.

Giving reasons for your answers, find the size of

(a) angle *BDC*,

.....° Reason: .....

.....

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

(b) angle *ACB*,

.....° Reason: .....

.....

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

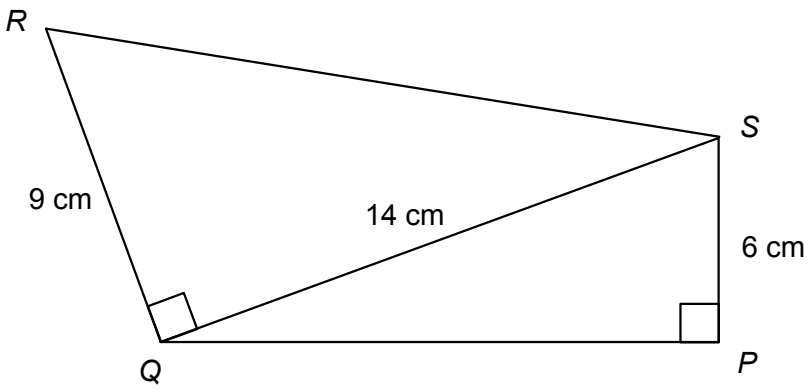
(c) angle *AOD*.

.....° Reason: .....

.....

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

12



Not to scale

Find the size of angle *PSR*.

..... ° **[5]**

13 A box contains yellow, blue and green pencils in the ratio 3 : 2 : 5
There is nothing else in the box.

6 yellow pencils are added to the box.

One pencil is picked at random from the box.

The probability of it being yellow is $\frac{3}{8}$.

Show that the probability of it being blue is $\frac{5}{28}$.

[5]

14 In July 2015 the number of bats living in a cave was estimated to be 6500.
In July 2016 the number was estimated to be 5700.

In a model, it is assumed that the number of bats living in the cave will decrease by the same percentage each year.

Using this model, estimate

(a) how many bats will be living in the cave in July 2017,

(a) ..... **[3]**

(b) the first year in which the number of bats living in the cave in July is less than half the number living there in 2015.

(b) ..... **[3]**

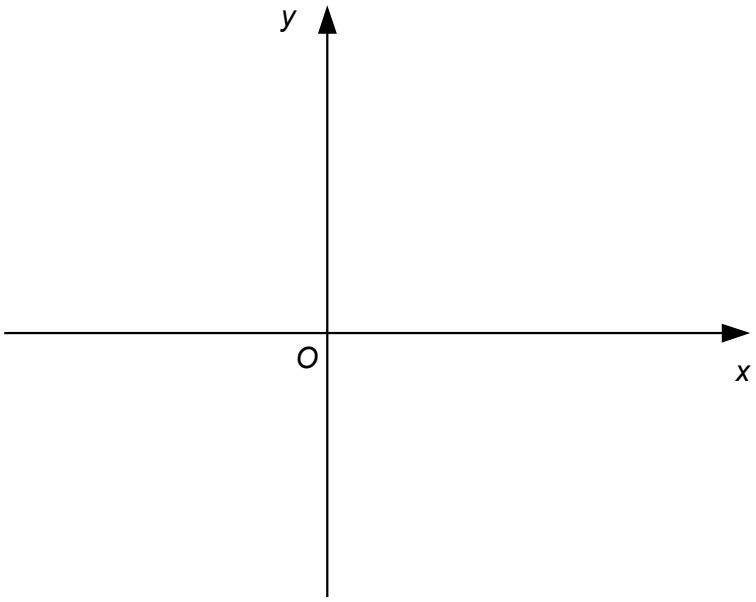
15 Function P is given by $y = 2x + 4$

Function Q is given by $y = \frac{1}{4}x - 3$

Prove that the inverse of Function P is the same as the composite function "Function P followed by Function Q".

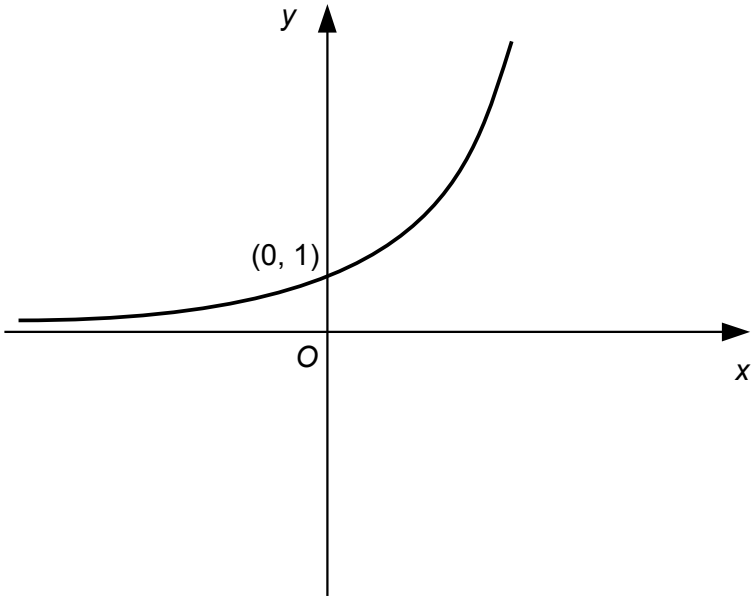
[4]

16 **(a)** On the axes below, sketch the graph of $y = \frac{1}{x}$.



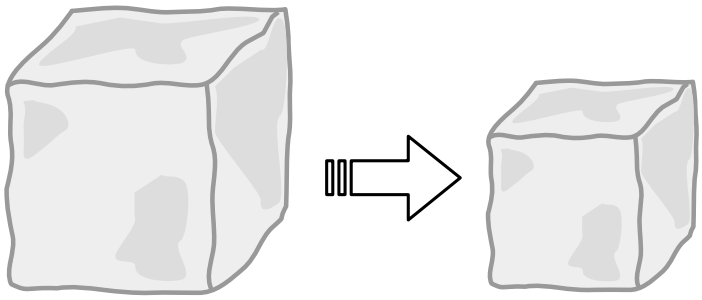
[2]

(b) Write down a **possible** equation for the graph sketched below.



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

17



Not to scale

A block of ice in the shape of a cube is allowed to melt.

After 10 minutes, the volume of the block of ice has reduced by 60%.

(a) Work out the percentage reduction in the surface area of the block of ice.

(a) ..... % **[4]**

(b) **(i)** State an assumption you have made in your calculation in part **(a)**.

.....

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

(ii) Explain whether your assumption means that your answer is an overestimate or an underestimate.

.....

.....

.....

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

18 Q is inversely proportional to P^n, where n is a constant.

When $P = 3$, $Q = 36$ and when $P = 9$, $Q = 4$.

State the value of n and justify your answer.

.....

.....

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

19 The formula

$$V = IR$$

is used in physics.

Miriam records these values:

$V = 10.6$ $I = 3.27$

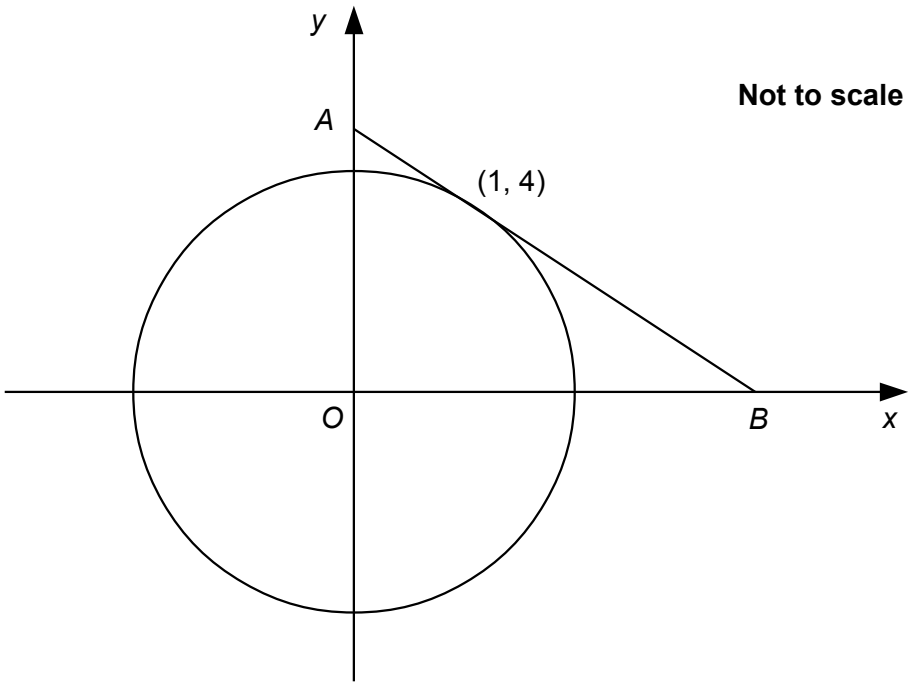
Both values are correct to 3 significant figures.

Work out the upper and lower bounds for the value of R.
Give your answers correct to 4 significant figures.

Upper bound .....

Lower bound ..... **[4]**

20



Not to scale

The point A lies on the y-axis and the point B lies on the x-axis.
AB touches a circle, centre (0, 0) at the point (1, 4).

Show that the area of triangle OAB is $36\frac{1}{8}$.

[5]