



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2020

Mathematics

Paper 2

Ordinary Level

2 hours 30 minutes

300 marks

Examination Number

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Day and Month of Birth

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For example, 3rd February
is entered as 0302

Centre Stamp

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Instructions

There are **two** sections in this examination paper.

Section A	Concepts and Skills	150 marks	6 questions
Section B	Contexts and Applications	150 marks	3 questions

Answer all nine questions.

Write your Examination Number in the box on the front cover.

Write your answers in blue or black pen. You may use pencil in graphs and diagrams only.

This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write all answers into this booklet. There is space for extra work at the back of the booklet. If you need to use it, label any extra work clearly with the question number and part.

The superintendent will give you a copy of the *Formulae and Tables* booklet. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

You will lose marks if your solutions do not include relevant supporting work.

You may lose marks if the appropriate units of measurement are not included, where relevant.

You may lose marks if your answers are not given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

Section A**Concepts and Skills****150 marks**

Answer **all six** questions from this section.

Question 1**(25 marks)**

- (a) A restaurant is offering a three-course meal consisting of one starter, one main course and one dessert. There are 4 different starters, 6 different main courses and 8 different desserts to choose from.

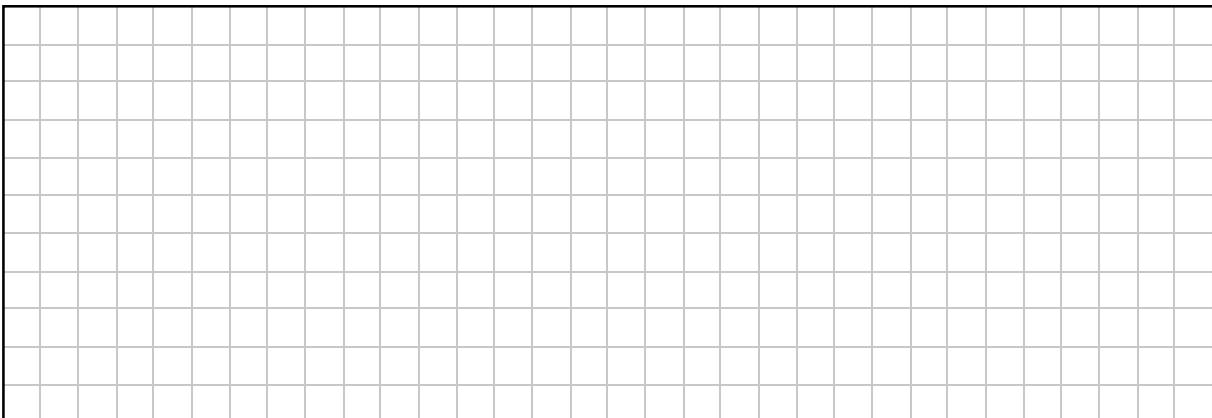
- (i) How many different three-course meal combinations are available?

- (ii) When Jack visits the restaurant he discovers that the restaurant still has the 4 starters and the 6 main courses available but is sold out of **some** of the desserts.

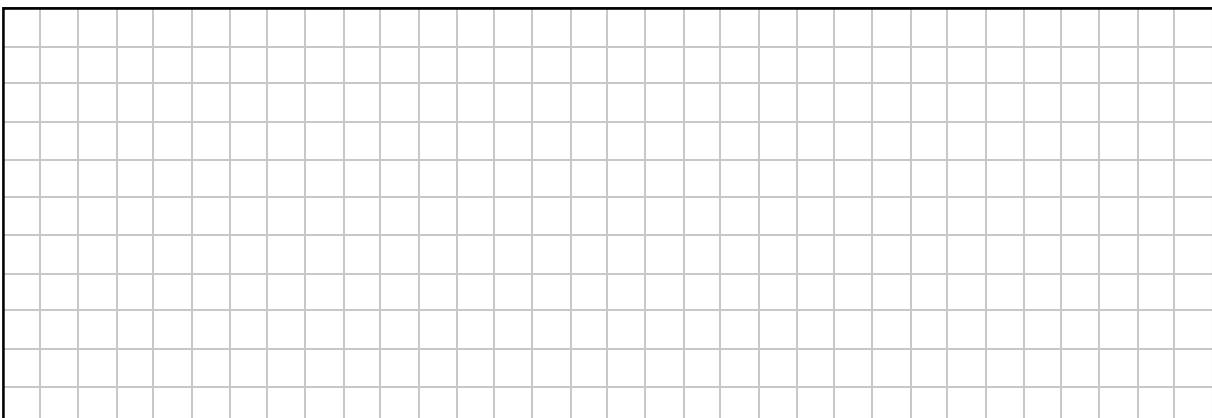
Jack now has 120 different three-course meal combinations to choose from.

How many different desserts are still available to Jack?

- (b)** In a large population 1 in 8 of the people play tennis.
- (i) Four people are chosen at random from the population.
What is the probability that the fourth person chosen is the only one to play tennis?

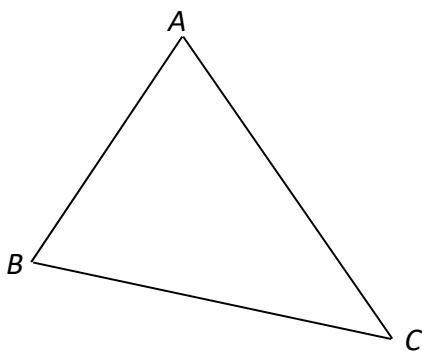
A large rectangular grid of squares, approximately 20 columns by 15 rows, intended for考生 to show their working for part (i).

- (ii) Three people are chosen at random from the population.
What is the probability that exactly two of them play tennis?

A large rectangular grid of squares, approximately 20 columns by 15 rows, intended for考生 to show their working for part (ii).

Question 2**(25 marks)**

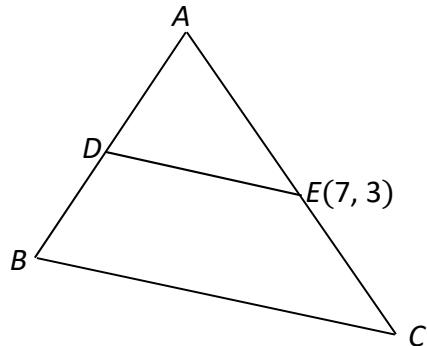
The points $A(4, 6)$, $B(-2, 2)$ and $C(10, 0)$ are the vertices of the triangle ABC shown below.



- (a) Find $|AB|$, the length of $[AB]$. Give your answer in the form $a\sqrt{b}$ units, where $a, b \in \mathbb{N}$.

- (b) (i) Find the coordinates of D , the midpoint of $[AB]$.

- (ii) In the triangle ABC , the point $E(7, 3)$ is the midpoint of $[AC]$.
Show that DE is parallel to BC .



- (c) Find the area of the triangle ABC .

Question 3

(25 marks)

- (a)** In a survey, 1000 people are selected at random and asked some questions about online shopping.

- (i) Find the margin of error of the survey.

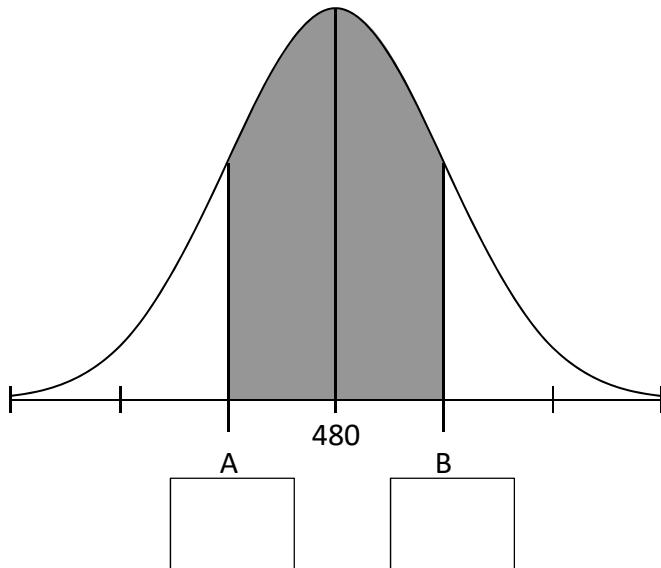
Give your answer as a percentage correct to 1 decimal place.

- (ii) Of those asked, 762 said they believe it is safe to give their credit card details when shopping online. Use your answer to **Part a(i)** above to create a 95% confidence interval for the percentage of people who believe it is safe to give their credit card details when shopping online.

- (iii) An online media company claims that 80% of people believe it is safe to give their credit card details when shopping online.
Conduct a hypothesis test, at the 5% level of significance, to test the company's claim.
Give your conclusion in the context of the question and give a reason for your conclusion.

Conclusion:	
Reason:	

- (b) (i) An aptitude test was taken by 6500 candidates.
The test scores were normally distributed.
The mean score was 480 and the standard deviation was 90.
On the distribution shown below, the shaded area represents all candidates who were
within one standard deviation of the mean.
Write the value of A and the value of B into the boxes below.



- (ii) Use the Empirical Rule to estimate the number of candidates in the shaded region.

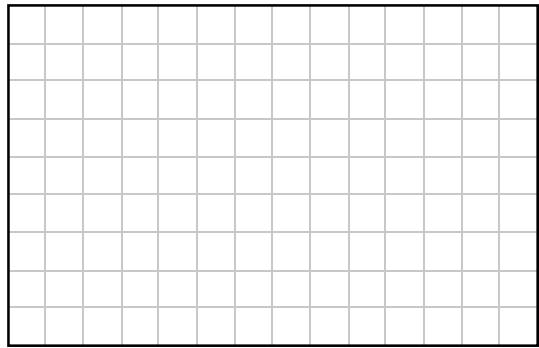
Number of candidates =	
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Question 4**(25 marks)**

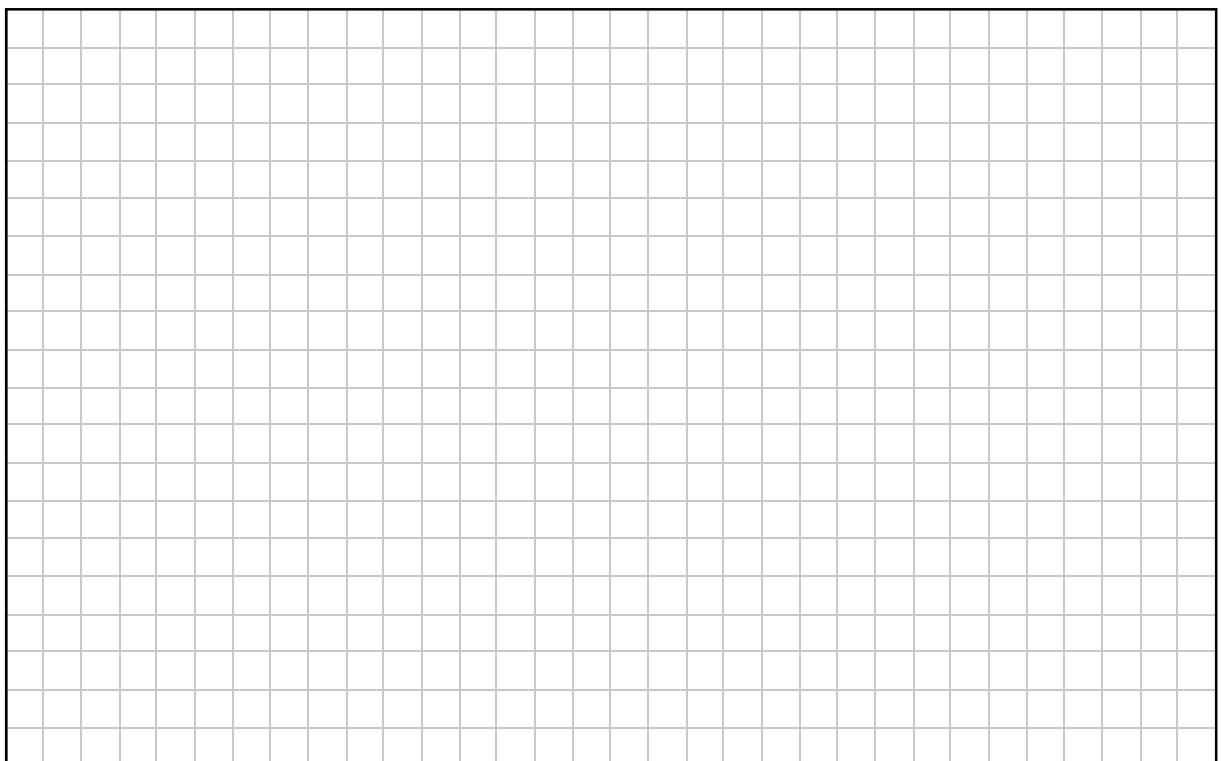
- (a) (i) The circle c has equation $(x - 1)^2 + (y + 4)^2 = 25$.
Find the centre and radius of c .

Centre: (,)

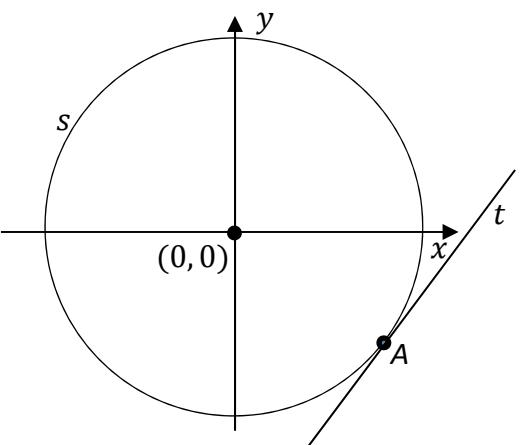
Radius: _____



- (ii) The point $(1, k)$ is on c . Find the two possible values of k .

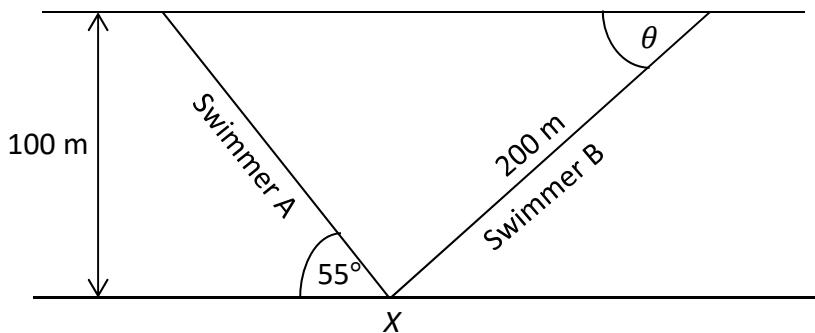


- (b) The circle s has equation $x^2 + y^2 = 13$.
The point $A(3, -2)$ is on s .
Find the equation of t , the tangent to the circle
at the point A .
Give your answer in the form
 $ax + by + c = 0$, where $a, b, c \in \mathbb{Z}$.



Question 5**(25 marks)**

Two swimmers A and B stand at the same point X , on one shore of a long, still rectangular shaped lake that is 100 m wide, as shown below. (Diagram not to scale.)
Both swim to the opposite side of the lake.



- (a) Swimmer A swims to the left, making an angle of 55° with the side of the lake as shown.
Find the distance that A swims to reach the other side.
Give your answer correct to the nearest metre.

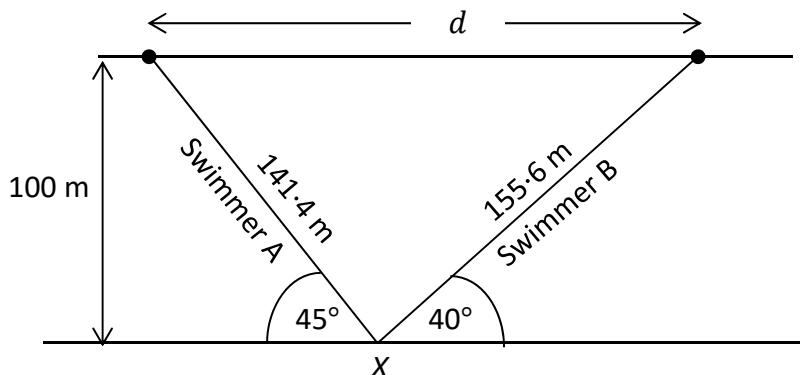
- (b) Swimmer B swims to the right and travels a distance of 200 m to reach the other side, making an angle of θ degrees with the bank on the other side of the lake, as shown.
Find the value of θ .

- (c) The next day the swimmers again swim to the opposite side of the lake but in slightly different directions.

Swimmer A swims to the left, making an angle of 45° with the side of the lake and travels 141.4 metres as shown.

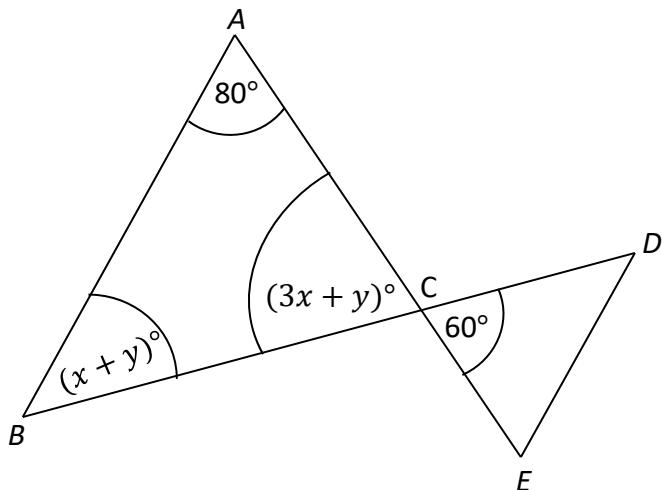
Swimmer B swims to the right, making an angle of 40° with the side of the lake and travels 155.6 metres as shown.

Find d , the distance both swimmers are apart when they reach the opposite side of the lake. Give your answer correct to the nearest metre.



Question 6**(25 marks)**

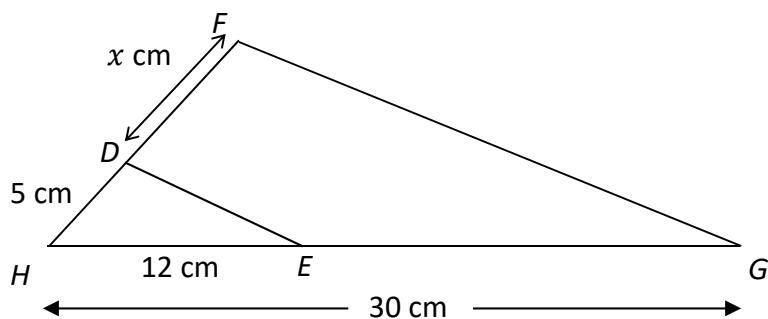
In the diagram below: $|\angle CAB| = 80^\circ$ and $|\angle DCE| = 60^\circ$.
 $|\angle ABC| = (x + y)^\circ$ and $|\angle BCA| = (3x + y)^\circ$, where $x, y \in \mathbb{N}$.



- (a) Find the value of x and the value of y .

$x =$	$y =$

- (b) In the diagram below, DE is parallel to FG . $|DH| = 5 \text{ cm}$. $|HE| = 12 \text{ cm}$. $|HG| = 30 \text{ cm}$.
The distance from D to F is $x \text{ cm}$. Find the value of x .



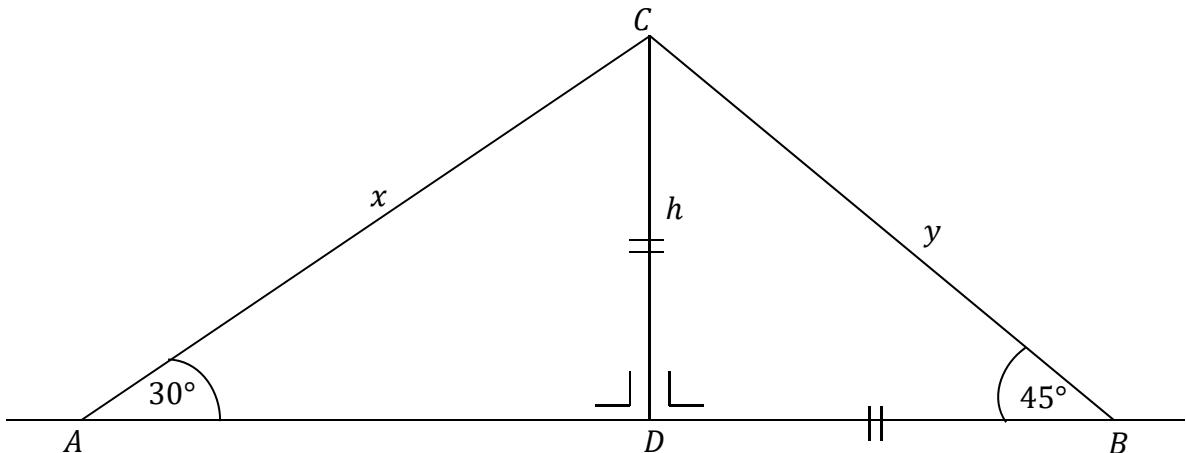
Answer all three questions from this section.

Question 7

(55 marks)

A vertical mobile phone mast, $[DC]$, of height h m, is secured with two cables: $[AC]$ of length x m, and $[BC]$ of length y m, as shown in the diagram.

The angle of elevation to the top of the mast from A is 30° and from B is 45° .



- (a) (i) Explain why $|\angle BCA| = 105^\circ$.

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- (ii) The horizontal distance from A to B is 100 m.

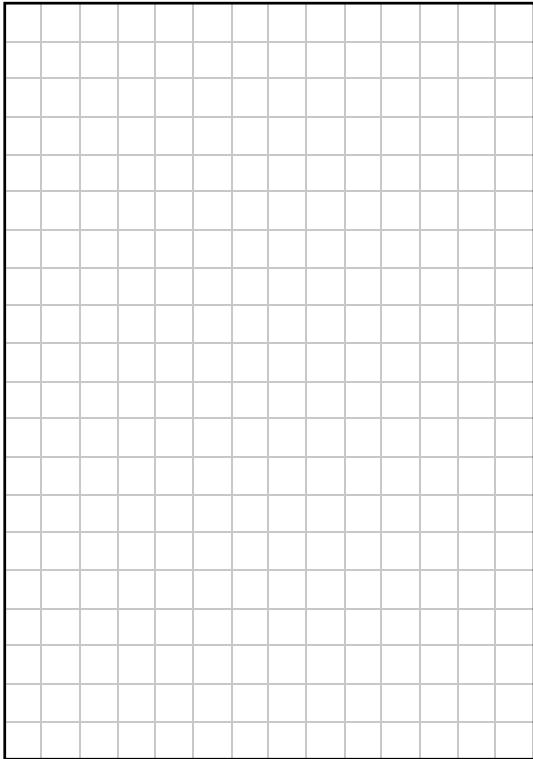
Use the triangle ABC to find the length of y .

Give your answer correct to one decimal place.

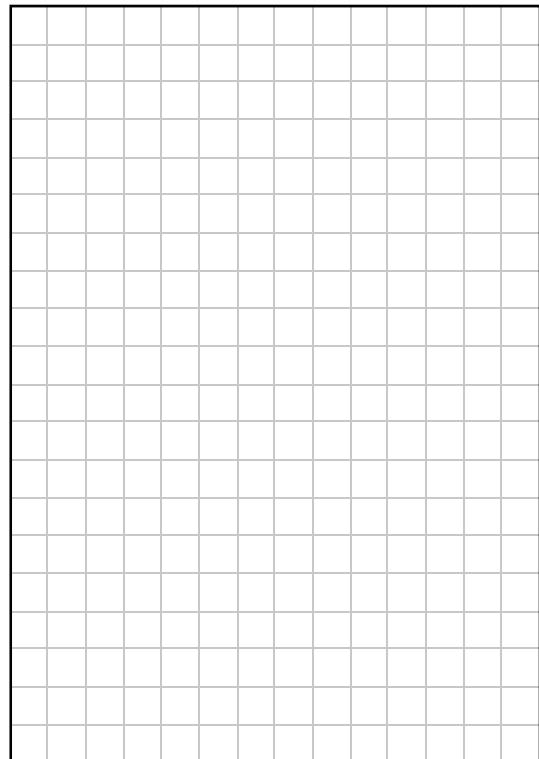
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- (iii) Using your answer to **Part (a)(ii)** or otherwise, find the value of h and the value of x .
Give your answers correct to 1 decimal place.

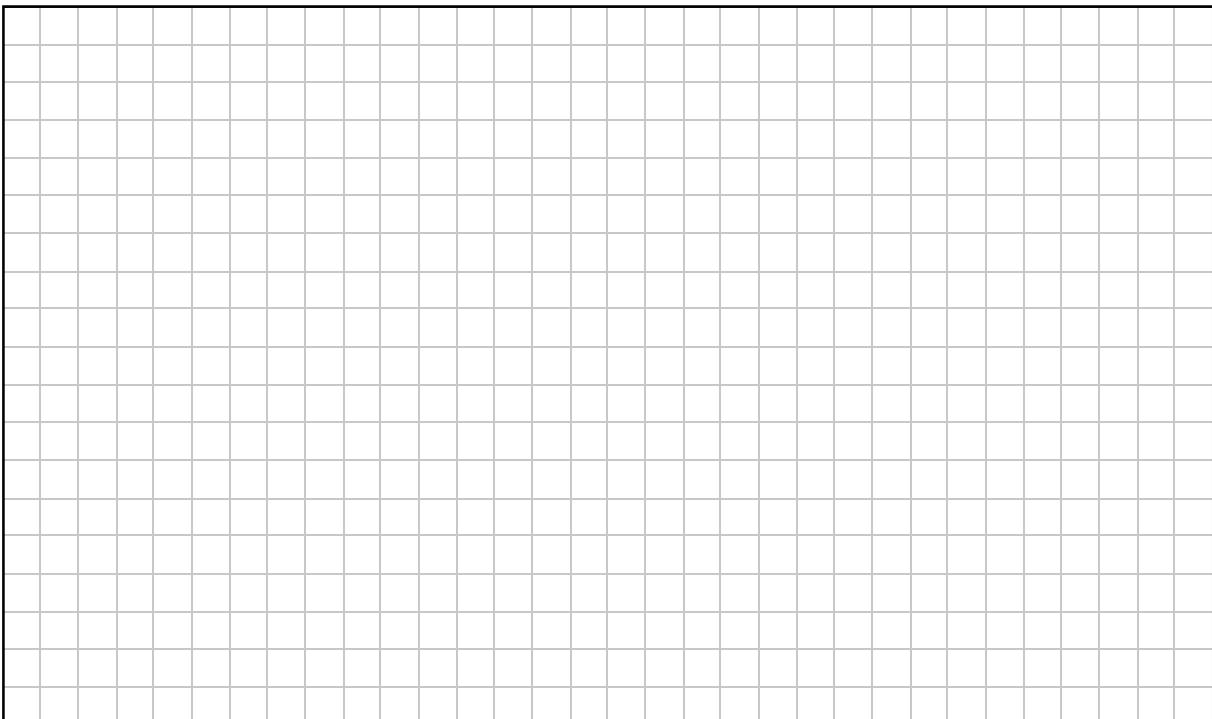
The height of the mast, h .



The length of the cable, x .

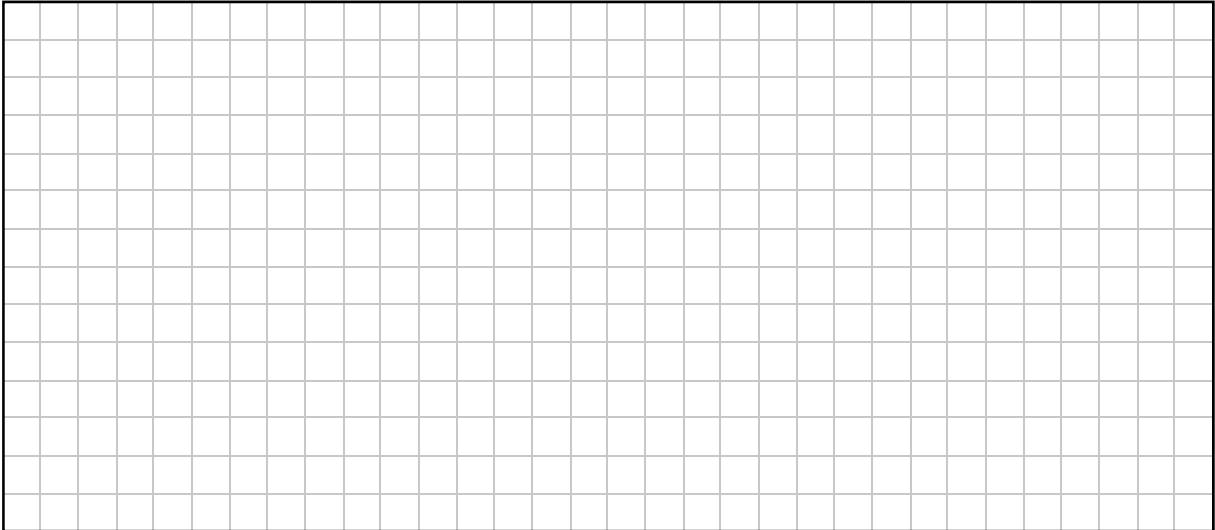
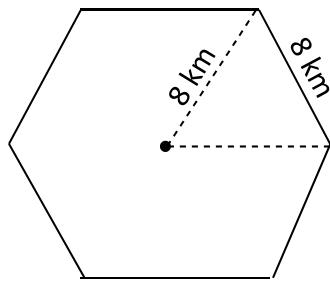


- (b) The two cables to secure the mast costs €25 per metre. The mast itself costs €580 per metre. VAT at 23% is then added in each case.
Calculate the total cost of the cables and mast after VAT is included.

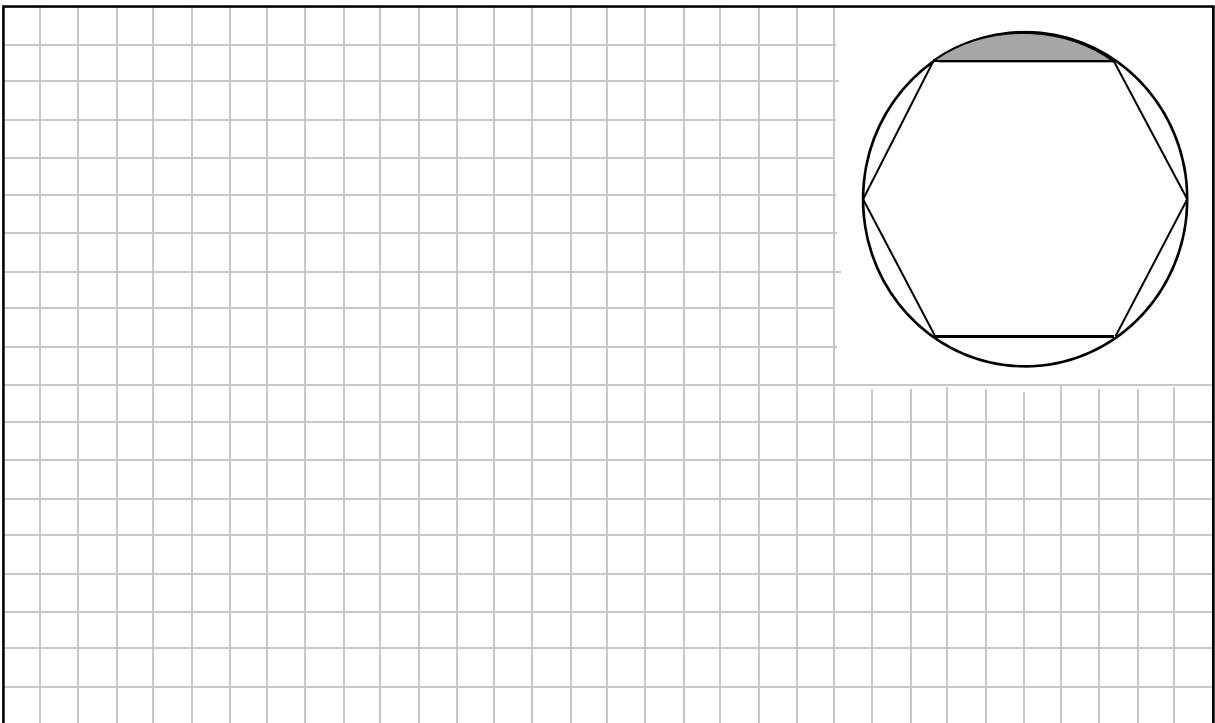


This question continues on the next page.

- (c) (i) The mast can provide a strong signal for an area in the shape of a regular hexagon of side 8 km, as shown in the diagram.
Find the area of the hexagon.
Give your answer in km^2 , correct to 2 decimal places.



- (ii) A circle which touches all vertices of the hexagon can show areas where the signal is weak. One of these areas is shaded in the diagram.
Find this shaded area.
Give your answer in km^2 , correct to 1 decimal place.



Question 8**(55 marks)**

- (a) The table below shows data (measured in kilotonnes) on how municipal waste was dealt with in Ireland from 2005 to 2011.

Year	Total Waste Collected (Kilotonnes)	Waste Sent to Landfill (Kilotonnes)
2005	2779	1833
2006	3100	1981
2007	3175	2015
2008	3104	1939
2009	2825	1724
2010	2580	1496
2011	2547	1344

Source: Environmental Protection Agency

- (i) Find the **difference** between the percentage of the waste collected which was sent to landfill in 2005 and the percentage of waste sent to landfill in 2011.
Give your answer correct to 1 decimal place.

difference =

- (ii) Find the mean amount of waste collected each year, from 2005 to 2011.
Give your answer correct to 1 decimal place.

- (iii) The mean amount of **waste sent to landfill** in the 4 years from 2009 to 2012 was 1398 kilotonnes. Find the amount of waste sent to landfill in 2012.

This question continues on the next page.

- (b)** The table below shows the percentages of all the different types of energy sources used in each of 13 European countries during 2014.

% of total energy						
Country	Renewable	Oil	Solid Fuel	Gas	Electricity	Other
Austria	25	31	8	17	13	6
Bulgaria	8	19	28	11	11	23
Cyprus	5	82	0	0	13	0
Denmark		31	11	13	12	13
France	7	26	3	11	12	41
Germany	10	29	22	17	12	10
Greece	9	43	24	9	15	0
Ireland	6	42	13	24	15	0
Latvia	31	26	1	20	11	11
Luxembourg	4	61	1	19	12	3
Malta	2	82	0	0	16	0
Netherlands	4	38	10	33	10	5
Portugal	21	38	10	13	15	3

Source: Eurostat

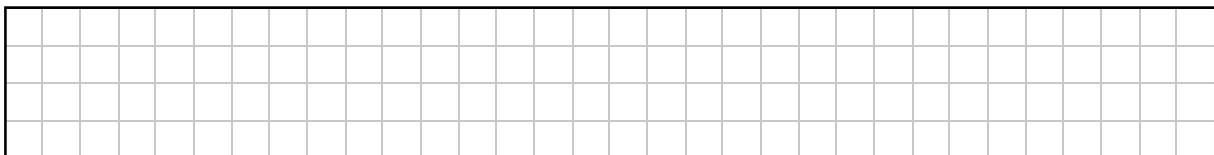
- (i) What percentage of the energy used in Denmark in 2014 was renewable?

- (ii) Name the four countries that used a lower percentage of renewable energy than Ireland.

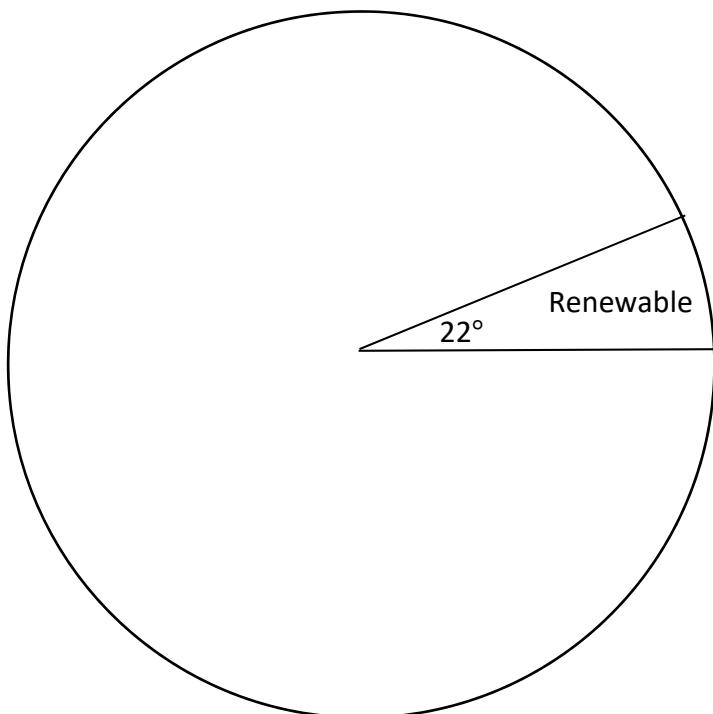
- (iii) Name a country which did **not** use gas as a fuel source.

- (iv) The table below shows the percentage of the different types of energy that were used in Ireland during 2014.
It also shows one of the angles in a pie chart to represent this data.
The angle for renewable energy (6%) is 22° .
Complete the table to show the angle for each energy type.
Give each angle correct to the nearest degree.

Type	Percentage	Angle
Renewable	6	22°
Oil	42	
Solid Fuel	13	
Gas	24	
Electricity	15	



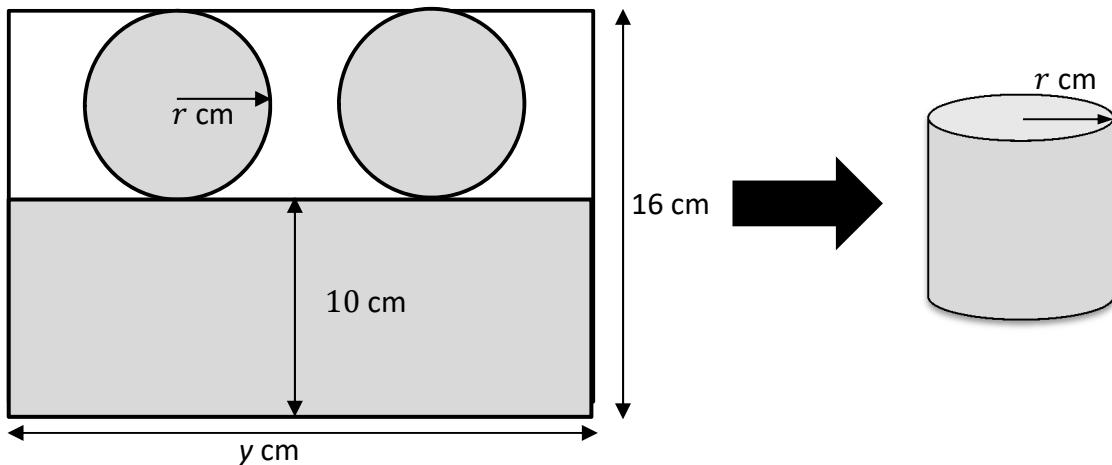
- (v) Complete the pie chart below to show the energy types used in Ireland in 2014.
Label each section clearly.



Question 9

(40 marks)

A rectangular sheet of aluminium is used to make a cylindrical can of radius r cm and height 10 cm, as shown below. The aluminium does not overlap in the finished can.

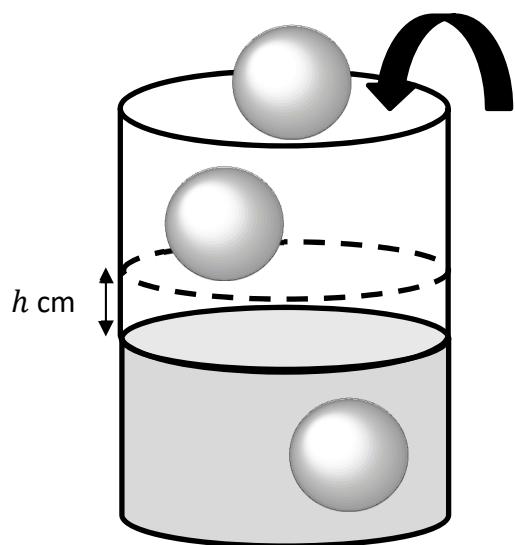
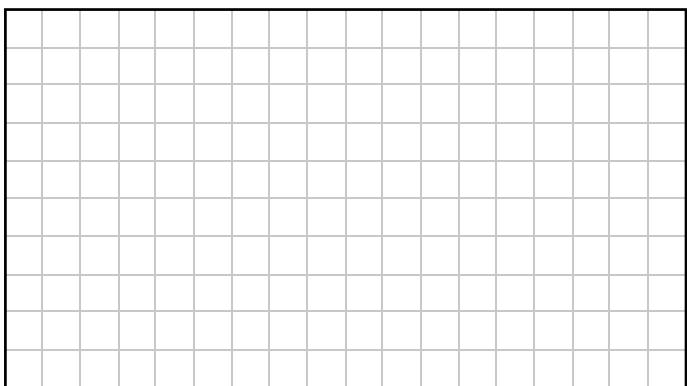


- (a) (i) Show that r , the radius of the cylinder, is 3 cm.

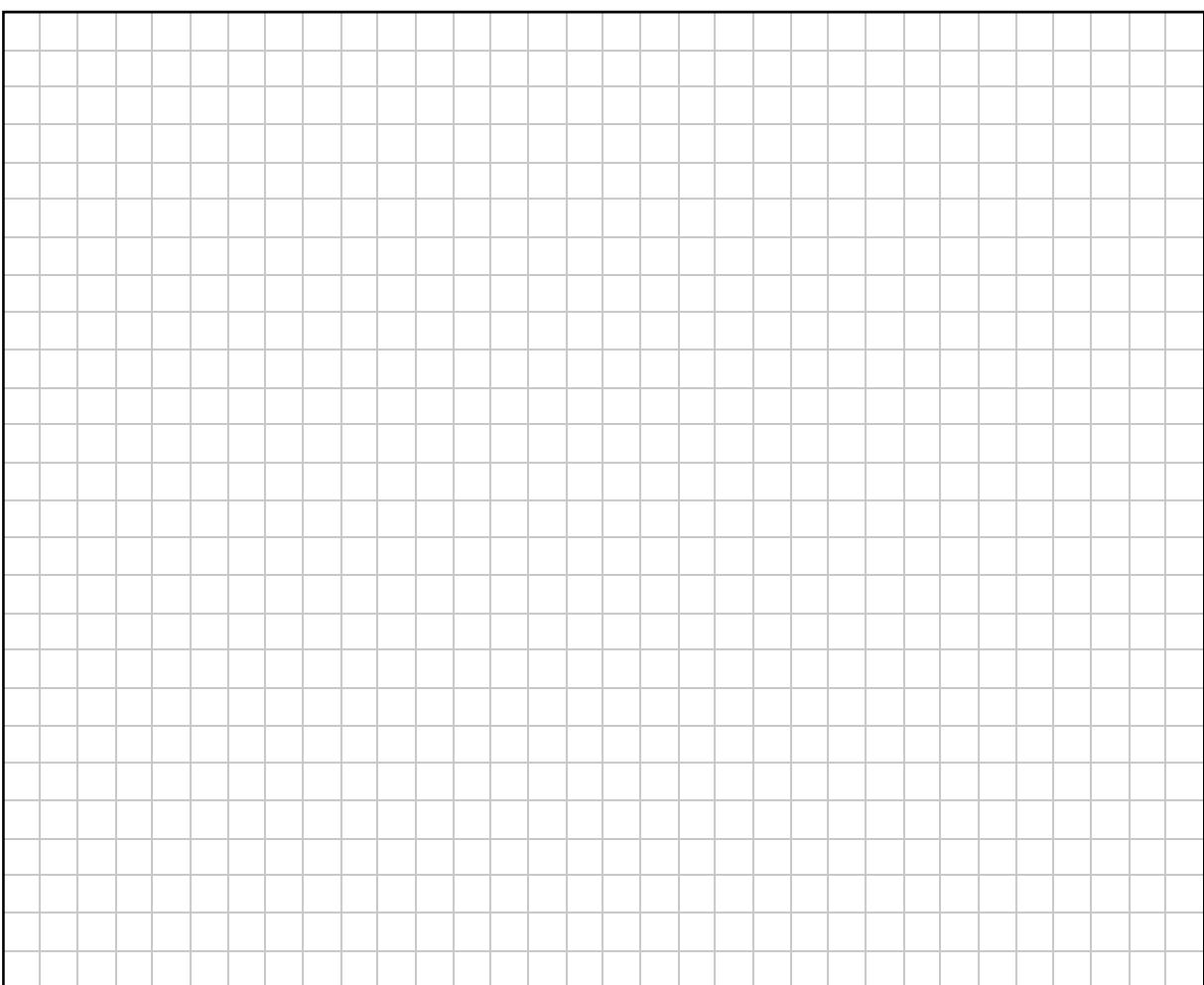
- (ii) Find the distance y . Give your answer correct to the nearest centimetre.

- (iii) Find the area, in cm^2 , of the waste aluminium after the top, bottom and side of the cylindrical can have been removed from the rectangular sheet.
Give your answer correct to the nearest cm^2 .

- (b) (i) Find the volume of a spherical ice cube of radius 1.5 cm.
Give your answer in terms of π .

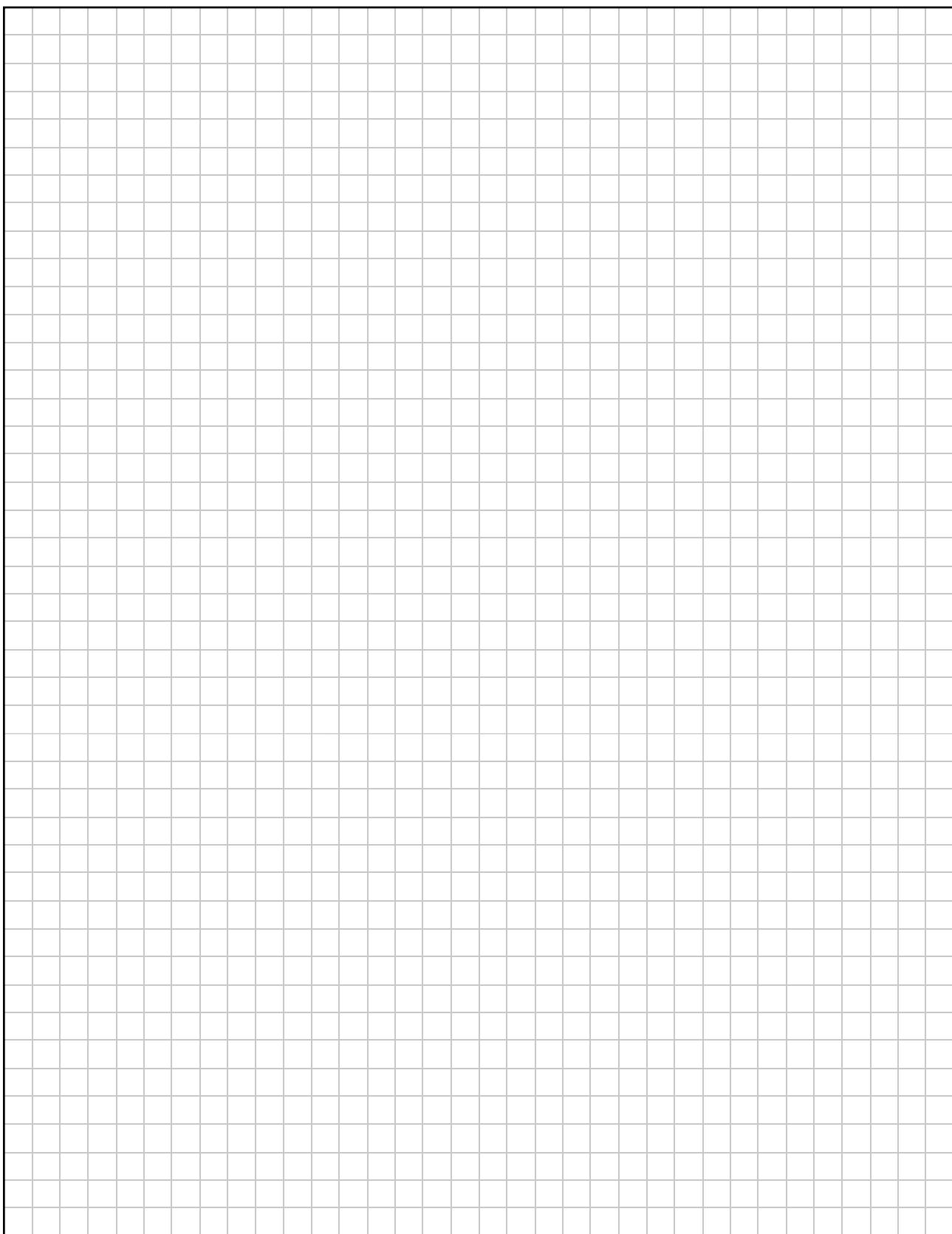


- (ii) Three of the spherical ice cubes of radius 1.5 cm are added to a cylinder of internal radius 3.5 cm which is partially filled with water.
All of the ice cubes are completely submerged in the water and the water does not overflow.
Find the rise, h cm, in the water level. Give your answer correct to 1 decimal place.



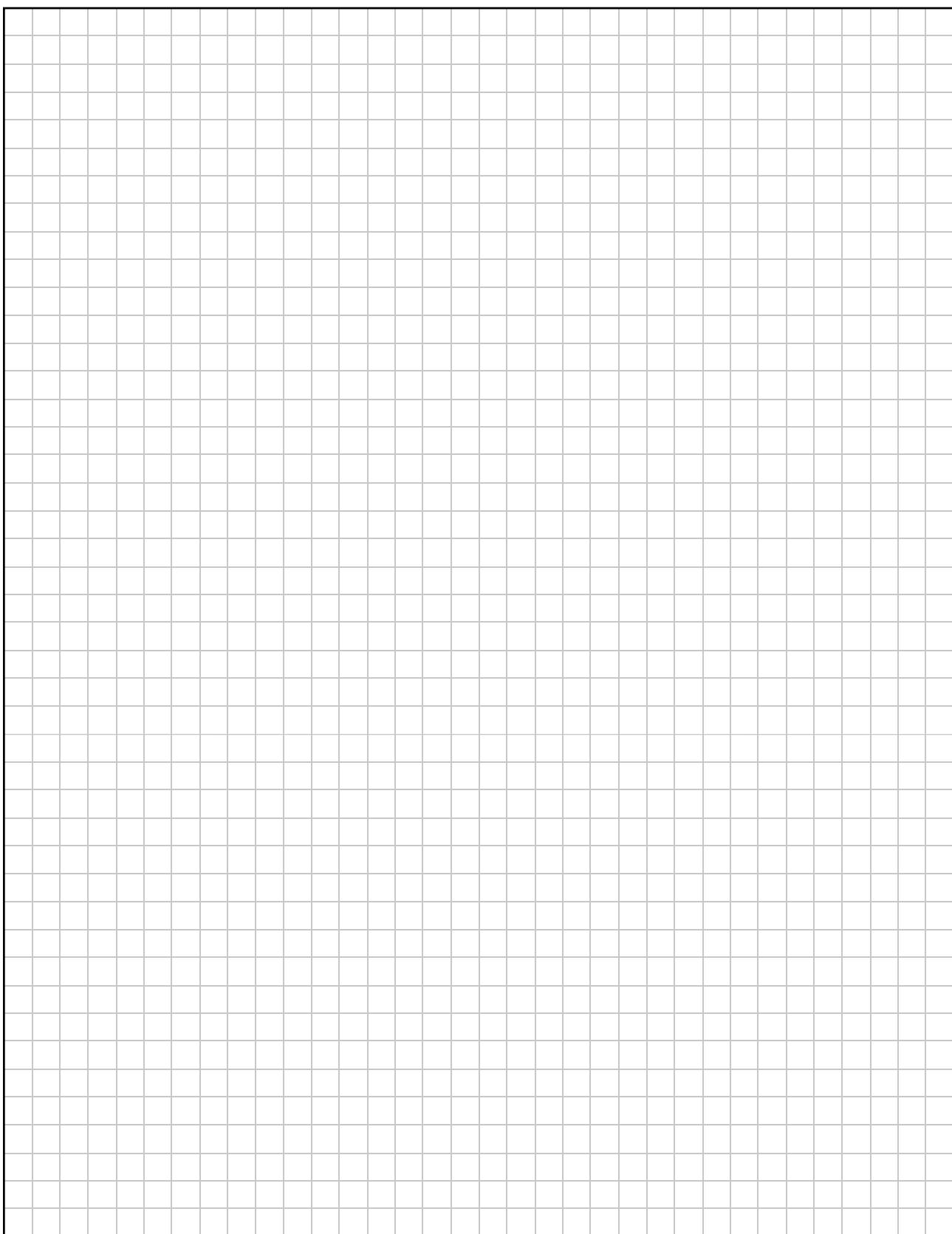
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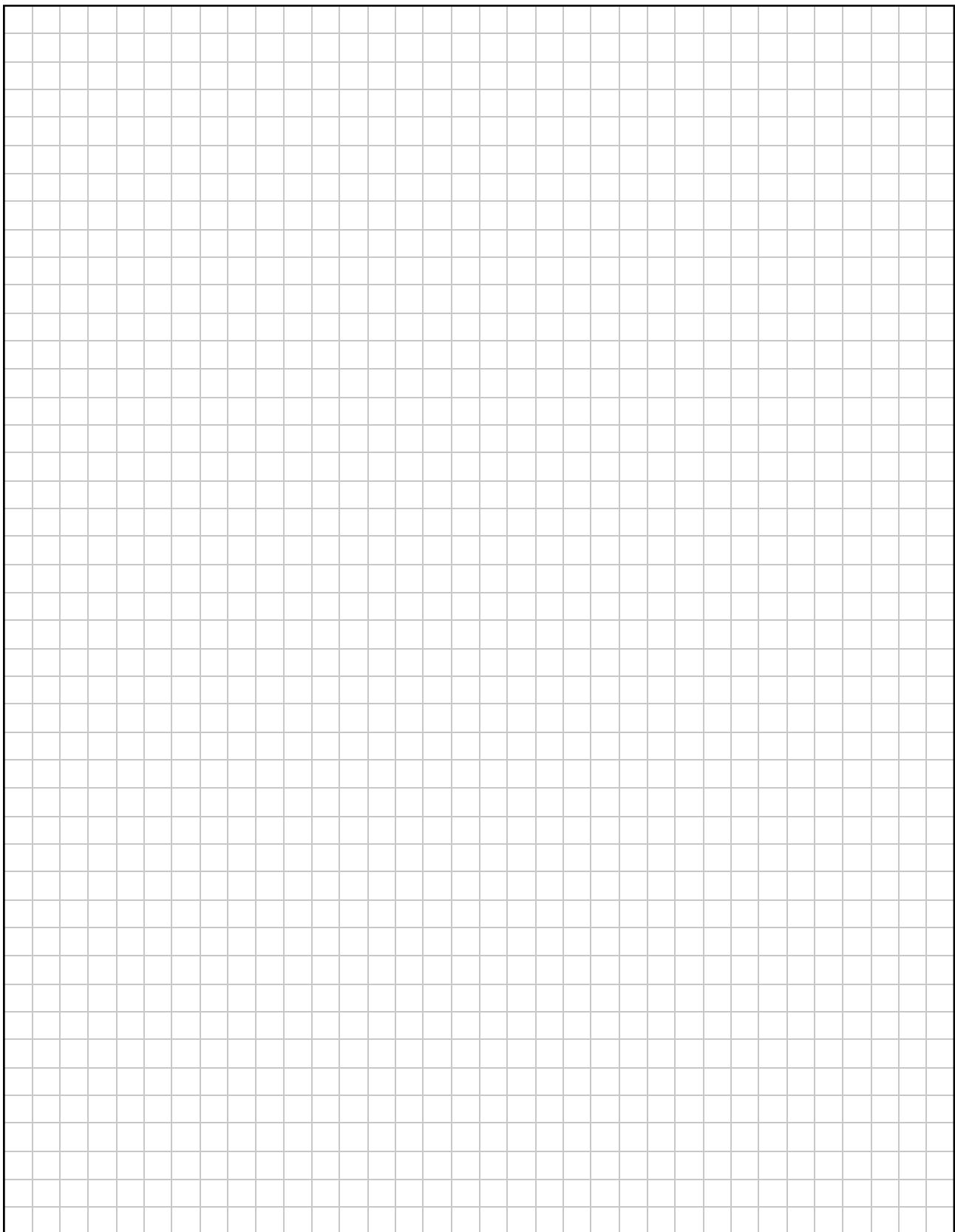
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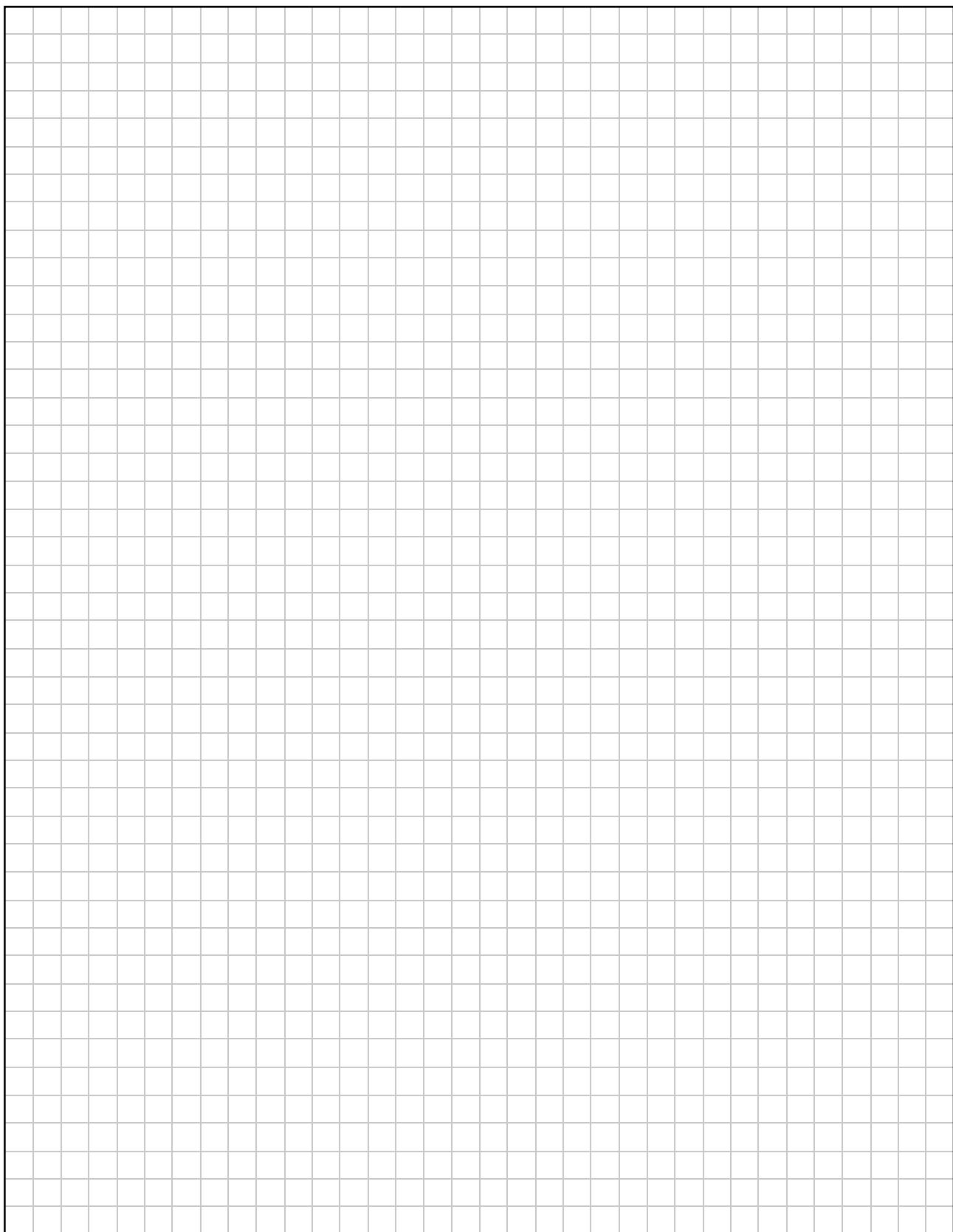
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Leaving Certificate – Ordinary Level

Mathematics Paper 2

2 hours 30 minutes