2019.M28

2019L003G2EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2019

Mathematics

Paper 2

Ordinary Level

Monday 10 June – Morning 9:30 to 12:00

300 marks

Examination Number					

Centre Stamp

2019L003G2EL0128

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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 you do not include appropriate units of measurement, where relevant.

You may lose marks if you do not give your answers 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 business has 28 employees.
Their ages, in years, are given below.

32	41	57	64	19	21	35
18	43	54	63	65	33	22
39	58	18	42	20	34	21
49	33	55	34	57	43	63

1							
2							
3							
4							
5							
6							

KEY: 1|9 = 19 years of age.

(a) Complete the stem-and-leaf diagram, showing the ages of all 28 employees.

(b) Find the percentage of employees who are older than 40 years of age.

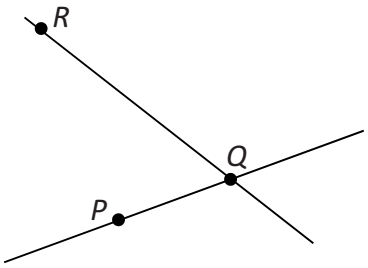
(c) One employee is chosen at random on a day when all employees are present at work.

(i) Find the probability that the employee is a teenager (<20 years of age).

(ii) Find the probability that the employee chosen is a person in their thirties whose age is even or a person in their forties whose age is odd.

Question 2 **(25 marks)**

The diagram shows the line PQ and the line QR.
The co-ordinates of the points are $P(4, 2)$, $Q(8, 5)$ and $R(2, 11)$.



(a) Find the slope of PQ.

(b) Find the equation of the line PQ.
Give your answer in the form $ax + by + c = 0$, where $a, b, c \in \mathbb{Z}$.

(c) Write down the slope of any line perpendicular to PQ.

Slope $=$

(d) Find the area of the triangle PQR.

Question 3 **(25 marks)**

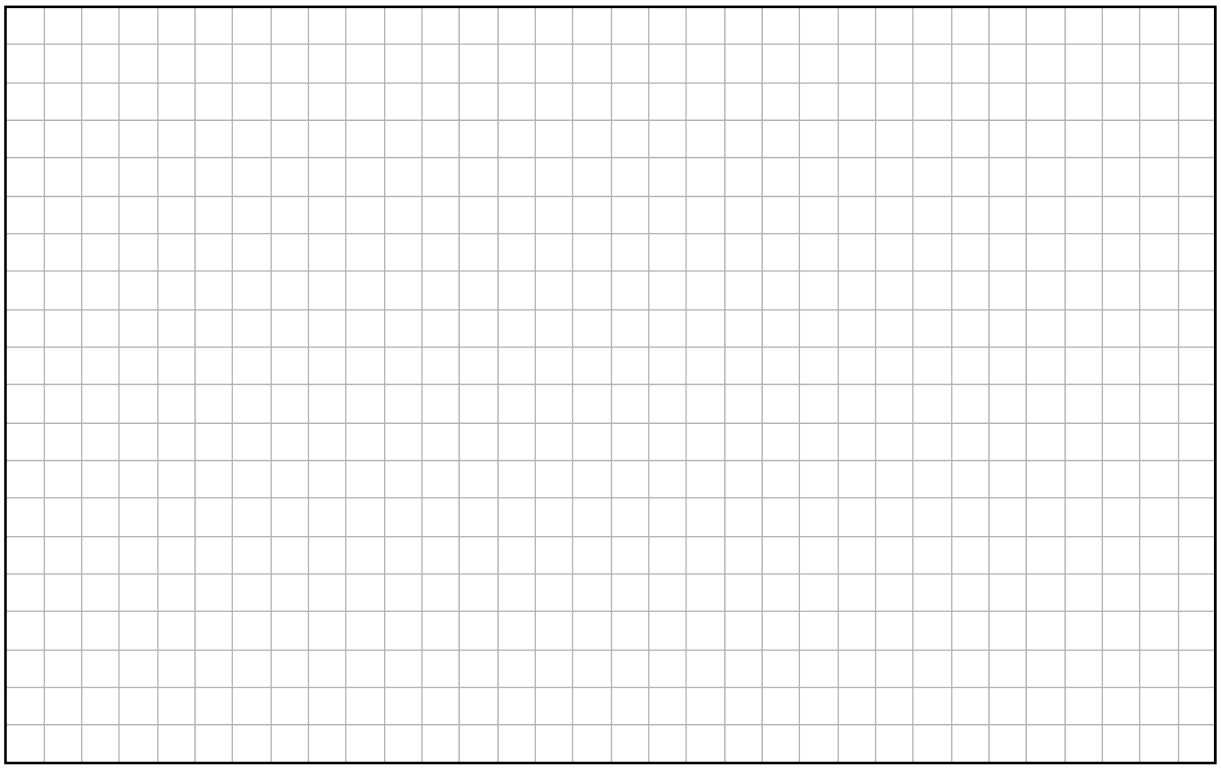
In a population, the probability that a person has blue eyes is 0·7.

(a) One person is chosen at random from the population.
What is the probability that this person does **not** have blue eyes?

(b) Two people are chosen at random.
What is the probability that both have blue eyes?

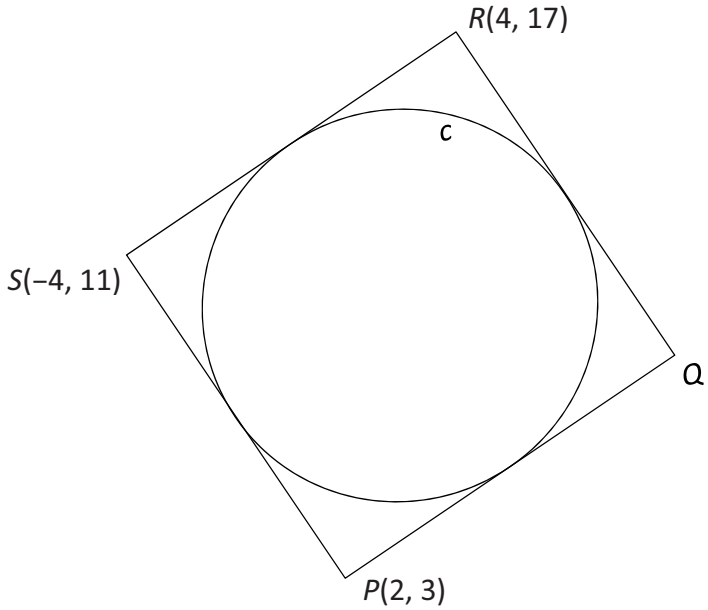
(c) Three people are chosen at random.
What is the probability that exactly two of them have blue eyes?

(d) Four people are chosen at random, one after another.
What is the probability that the fourth person of the four chosen is the only one to have blue eyes?



Question 4 **(25 marks)**

The circle *c* is enclosed in the square *PQRS* and touches all four sides, as shown in the diagram. The co-ordinates of three of the vertices are *P*(2, 3), *R*(4, 17), and S(−4, 11).



(a) Find the co-ordinates of *Q*.

(b) Find the co-ordinates of the centre of *c*.

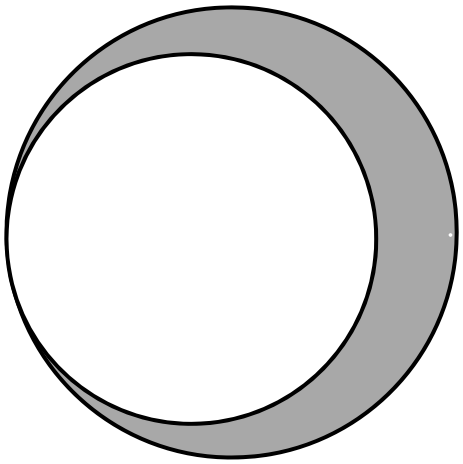
(c) Find the length of the **radius** of *c*.

(d) Find the equation of circle *c*.

Question 5 **(25 marks)**

(a) The crescent, shown in the shaded part of the diagram, was created by removing a disc of radius 2·5 cm from a disc of radius 3 cm.

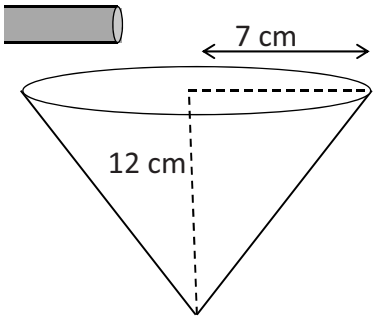
Find the **area** and the **perimeter** of the crescent. Give each answer correct to two decimal places.



Area:

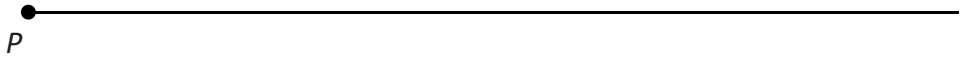
Perimeter:

(b) An empty inverted cone of vertical height 12 cm and radius 7 cm is filled with water from a pipe.
The water flows from the pipe at a steady rate of 0·5 litres per minute.
Find the time it takes to fill the cone.
Give your answer correct to the nearest **second**.



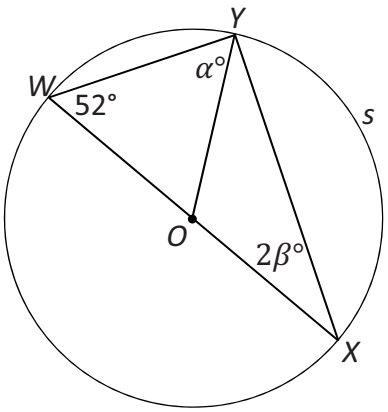
Question 6 **(25 marks)**

(a) **(i)** Construct the parallelogram *PQRS*, where $|PQ| = 9$ cm, $|PS| = 5$ cm and $|\angle SPQ| = 65°$.
The point *P* has been marked in for you.
Show all your construction lines, arcs and labels clearly.



(ii) Find the area of the parallelogram *PQRS*.
Give your answer correct to 2 decimal places.

(b) In the diagram O is the centre of the circle s.
Find the value of α and the value of β.



$\alpha =$ $\beta =$

Section B Contexts and Applications 150 marks

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

Question 7 **(50 marks)**

Table A below shows the price index for thirteen countries in four food categories for the year 2015. (*Source: Central Statistics Office*.)
It shows, for example, that if you paid €132 for meat in Austria, then the same quantity of similar meat would cost you €117 in Germany, €106 in Ireland, €63 in Lithuania and so on.
The description is the same for the other food categories.

Table A (€)

Country	Meat	Fish	Milk, Cheese and Eggs	Fruits, Vegetables and Potatoes
Austria	132	125	105	125
Germany	117	109	91	111
Ireland	106	108	128	136
Lithuania	63	73	85	77
Macedonia	56	59	71	48
Netherlands	111	99	93	104
Norway	157	117	175	150
Poland	54	64	65	62
Spain	85	89	96	95
Sweden	131	115	116	137
Switzerland	254	177	148	172
Turkey	78	105	122	86
United Kingdom	112	105	118	116

(a) Complete **Table B** below, to show the maximum value, the minimum value and the range of the data for the four food categories.

Table B (€)

	Meat	Fish	Milk, Cheese and Eggs	Fruits, Vegetables and Potatoes
Maximum	254			
Minimum	54			
Range	200			

(b) Write the data for the **Fruits, Vegetables and Potatoes** category in increasing order and hence find the median for that food category.

(c) **(i)** Find the mean of the data in the **Meat** category.

This question continues on the next page.

Table A (€) (Repeat)				
Country	Meat	Fish	Milk, Cheese and Eggs	Fruits, Vegetables and Potatoes
Austria	132	125	105	125
Germany	117	109	91	111
Ireland	106	108	128	136
Lithuania	63	73	85	77
Macedonia	56	59	71	48
Netherlands	111	99	93	104
Norway	157	117	175	150
Poland	54	64	65	62
Spain	85	89	96	95
Sweden	131	115	116	137
Switzerland	254	177	148	172
Turkey	78	105	122	86
United Kingdom	112	105	118	116

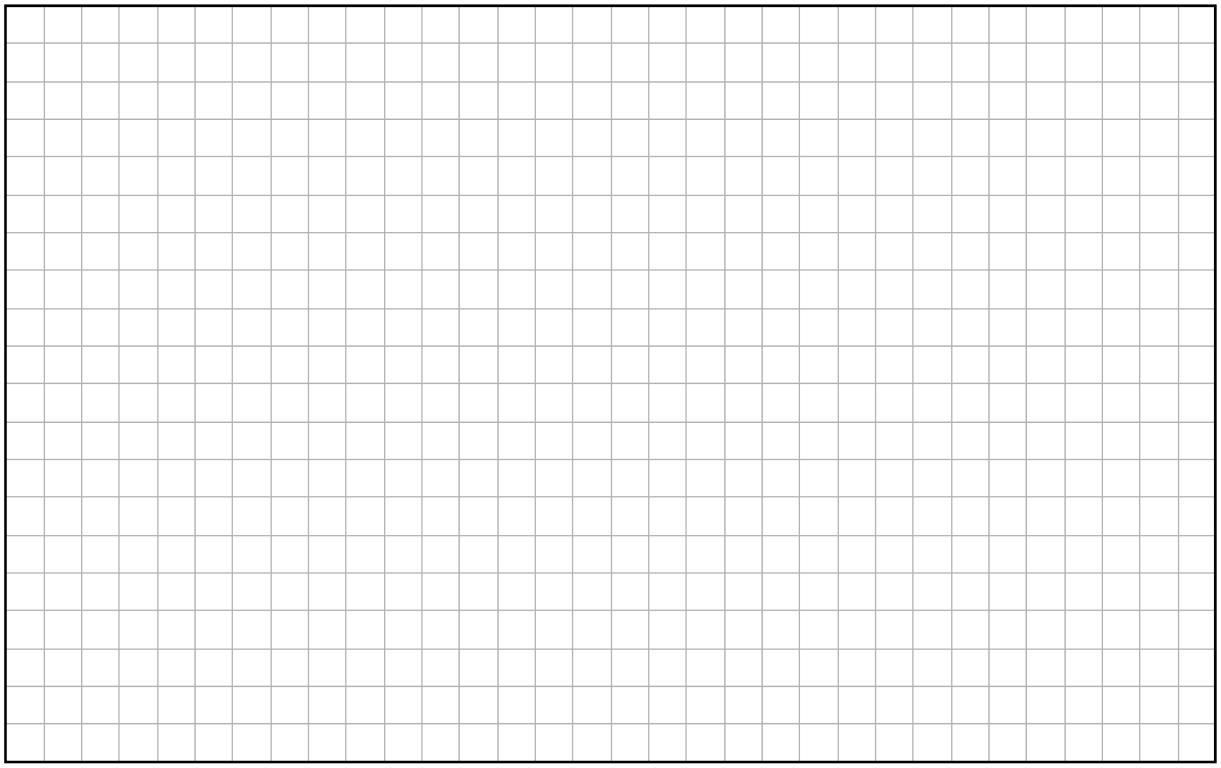
(ii) Use your calculator to find the standard deviation for the data in the **Meat** category. Give your answer correct to the nearest whole number.

Standard deviation:

(iii) List all the countries in the **Meat** category that are **not** within one standard deviation of the mean.

(d) A customer in Ireland buys some meat, fish, milk, cheese, eggs, fruits, vegetables and potatoes as detailed in **Table C**.
A customer in Poland buys the same items in the same quantities.
Complete **Table C**.

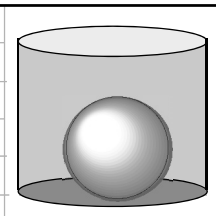
Table C (€)					
Country	Meat	Fish	Milk, Cheese and Eggs	Fruits, Vegetables and Potatoes	Total Cost
Ireland	36·04	31·32	24·32	31·28	122·96
Poland	18·36				



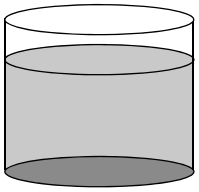
Question 8 **(45 marks)**

(a) A solid sphere of radius 3 cm is placed inside a cylinder and then water is poured into the cylinder until it is full, as shown in the diagram.

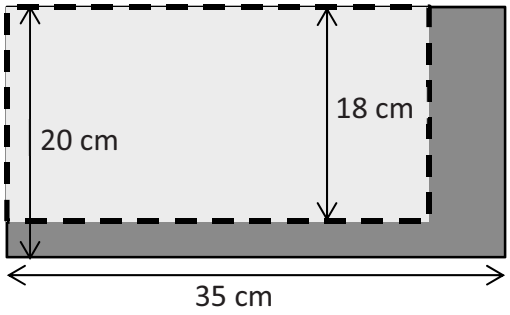
(i) Find the volume of the sphere, in terms of π.



(ii) The sphere is now removed. The internal radius of the cylinder is 5 cm. Find the drop, in cm, in the height of the water.



(iii) The cylinder has a height of 18 cm. The curved surface of the cylinder is cut from a rectangular piece of metal measuring 35 cm by 20 cm, as shown. Find how much metal will be left over when the curved surface of the cylinder is cut out.
Give your answer correct to 1 decimal place.



(b) In September 2018 a European Commission report stated that it is considering a proposal to abolish daylight saving time. This would mean that the clocks would not go forward one hour in March and then not go back one hour the following October. A Transition Year class carried out a survey to find out local people's views on the proposal.

(i) The class surveyed a random sample of 800 people in the local area.
Find the margin of error of the survey.
Give your answer as a **percentage**, correct to 2 decimal places.

(ii) In the survey 350 people said they supported the EU proposal to abolish daylight saving time. Use your answer to **part (b)(i)** above to create a 95% confidence interval for the percentage of the population who supported the EU proposal.

(iii) A local newspaper had reported that 50% of people in the area supported the EU proposal. Use your answer to **part (b)(ii)** above to conduct a hypothesis test, at the 5% level of significance, to test the newspaper's claim. Clearly state your conclusion in the context of the question **and** give a reason for your conclusion.

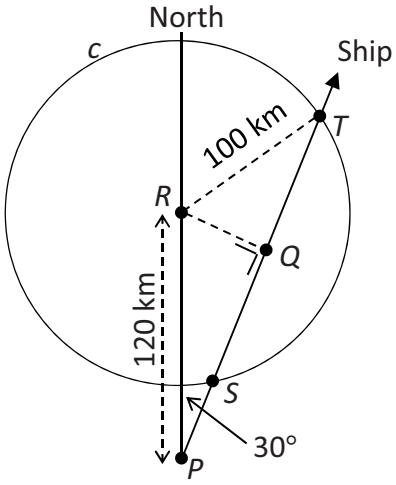
Conclusion:

Reason:

Question 9 **(55 marks)**

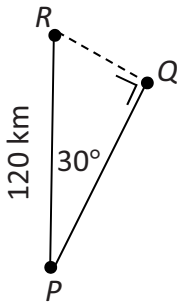
R is a radar station located 120 km north of a port *P*.
The circle *c*, centred at *R* and with radius 100 km shows the detection range of the radar. When a ship enters the circle it will be detected by the radar station at *R*.
Figure 1 shows a ship leaving port *P* and sailing in the direction north 30° east.
The ship enters the circle *c* at *S* and exits at *T*.
At *Q*, the ship is closest to *R* and $|\angle PQR| = 90°$.

Figure 1



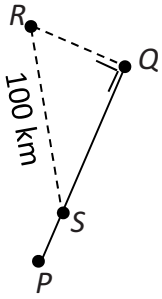
(a) The triangle *PQR* taken from **Figure 1** is shown in **Figure 2**.
Find $|QR|$, the length of $[QR]$.

Figure 2



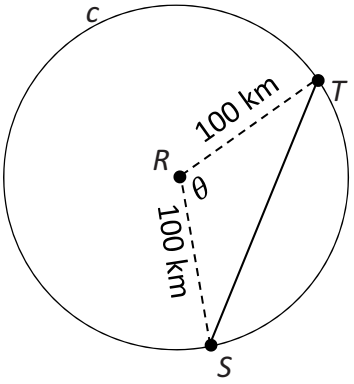
(b) The triangle *QRS* taken from **Figure 1** is shown in **Figure 3**.
Use your answer from **part (a)** to find $|QS|$.

Figure 3



(c) Find $|PS|$. Give your answer correct to the nearest km.

(d) **(i)** Consider the triangle *RST*.
Use the Cosine Rule to find an expression for $\cos\theta$, where θ is the measure of the angle *TRS*.
Hence show that $\theta = 106°$, correct to the nearest degree.



$\cos\theta =$

$\theta =$

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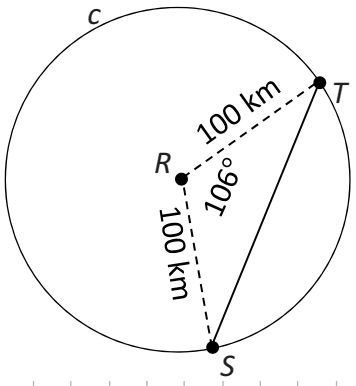
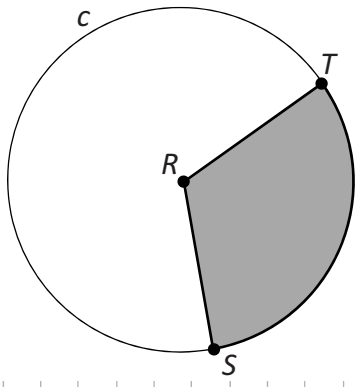
(ii) John sails directly from *S* to *T*. Mary sails from *S* to *T* along the minor arc *ST*.
Find the **difference** between the distance that John sails and the distance that Mary sails. Give your answer correct to the nearest km.



(iii) The sea in this region is estimated to have an average of 1 ship per 25 square kilometres at any time.
Use this estimate to find the number of ships in the **sector** *RST*.
Give your answer correct to the nearest whole number.



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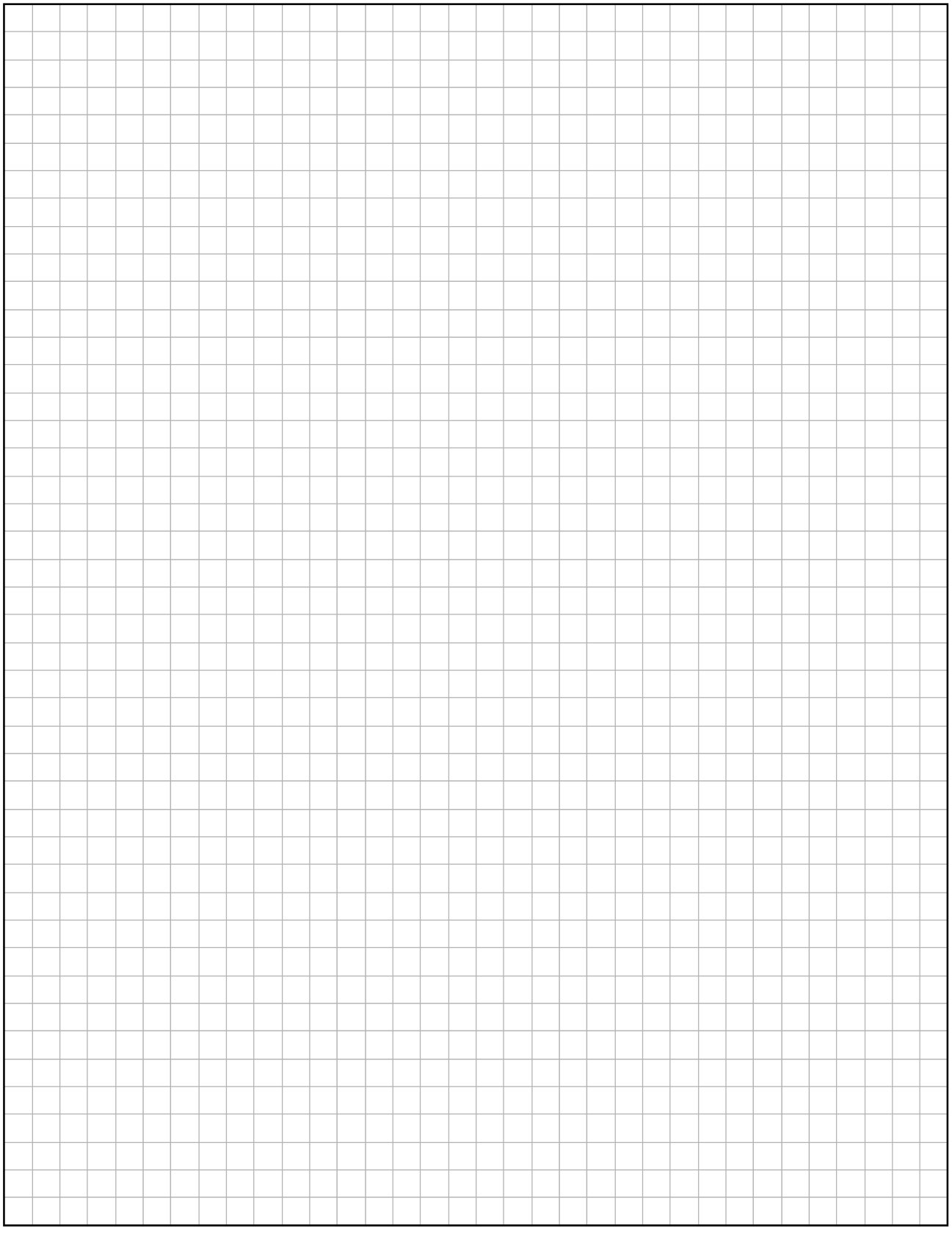

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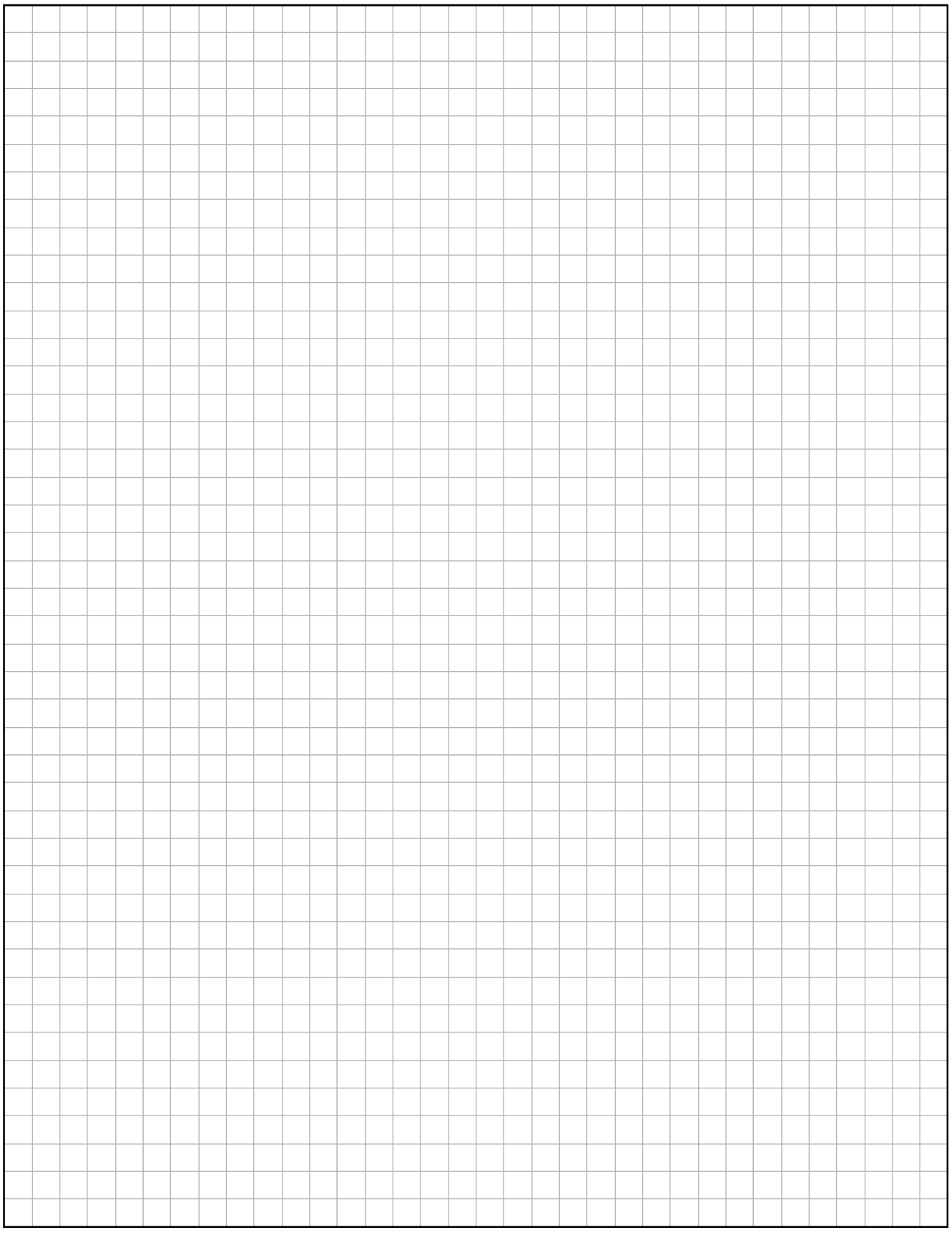

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