

**MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA**

**MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER (SUPPLEMENTARY) SESSION 2003**

Subject Title	BIOLOGY
Paper No./Title	Paper 3
Date	September 2003
Time	4:00 p.m. to 5:30 p.m.

Directions to Candidates

- *Write your index number in the space at the top right-hand corner of this page.*
 - *Answer ALL questions. Write all your answers in the spaces provided in this booklet.*
 - *The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.*
 - *You are reminded of the necessity for good English and orderly presentation in your answers.*
 - *In calculations you are advised to show all the steps in your working, giving your answer at each stage. Unless otherwise specified, you are advised to list results to one decimal place.*
 - *The use of electronic calculators is permitted.*
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For examiners' use only:

Question	1	2	3	Total
Score				
Maximum	34	33	33	100

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1. A researcher is investigating the distribution of four species of woodlice in the woodland at Buskett by constructing a 15m x 1m belt transect that traverses various parts of the habitat. The number of woodlice present along the transect was recorded at 1m intervals during daytime. The woodlice are labelled Species A, B, C and D for convenience. The following results were obtained.

Interval	Habitat	Species A	Species B	Species C	Species D
0m-1m	Open woodland	25	10	2	1
1m-2m	Open woodland	15	5	2	2
2m-3m	Open woodland	10	10	0	1
3m-4m	Grass	20	22	0	0
4m-5m	Grass	18	12	1	0
5m-6m	Grass	10	11	1	0
6m-7m	Grass	25	8	0	0
7m-8m	Grass	19	7	1	0
8m-9m	Grass	8	8	0	0
9m-10m	Grass	6	7	1	0
10m-11m	Grass	5	6	1	0
11m-12m	Grass	5	5	1	0
12m-13m	Dense woodland	35	10	2	2
13m-14m	Dense woodland	6	2	48	3
14m-15m	Dense woodland	5	7	50	2

- 1.1 Using the same scale and axes, plot the distribution of each species along the transect. Use the squared paper at the end of this answer booklet.

[twelve marks]

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1.2 Compare the distribution of Species A, B and C:

[six marks]

1.3 Suggest reasons for the distribution of Species D.

[three marks]

1.4 Name TWO environmental factors, other than light intensity, that may be influencing the distribution of woodlice.

[two marks]

1.5 The researcher decided to carry out a further experiment to determine whether the observed distribution of woodlice was significantly influenced by the presence of shrews, small mammalian predators of woodlice, that had been observed close to the transects. The number of woodlice collected from an area where shrews were known to be present was compared with the number collected from another area from which shrews were deliberately excluded. Sampling was carried out over a number of weeks and no distinction between different species of woodlice was made. The following results were obtained:

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Week	Number of woodlice collected		Differences (O-E)
	Area with shrews (O)	Area without shrews (E)	
1	820	800	
2	780	840	
3	650	700	
4	590	640	
5	620	660	

1.6 Suggest a null hypothesis for this part of the investigation.

[two marks]

1.7 Calculate the differences (O-E) and insert the values in the above table.

[one mark]

1.8 Use the following formula to calculate the value of the Chi-squared statistic. All steps in your working must be shown.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

[four marks]

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- 1.9 A Chi-squared value of 9.49 would indicate a 5% possibility that the presence of shrews does not affect the abundance of woodlice, whilst a Chi-squared value of 5.99 would represent a possibility of 20% for the same observation. Use your calculated value of the Chi-squared statistic to determine whether the presence of shrews has had a statistically-significant effect on the abundance of woodlice.

[four marks]

[Total: thirty-four marks]

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2. A researcher is investigating how the human body responds to an increase in air temperature. Measurements were made on three unclothed male subjects in still air with low relative humidity. The subjects stayed still and were relaxed throughout the experiment. The mean of three results was taken and the results are recorded in the tables below:

Air Temperature (°C)	Metabolic rate (KJ per unit area body surface)	Heat loss by evaporation (KJ per unit area body surface)
12	260	23
16	225	23
20	168	23
24	170	23
28	170	42
32	172	63
36	172	99
40	173	170
44	190	240
48	195	320

Air Temperature (°C)	Internal body temperature (°C)	Average skin temperature (°C)
12	36.8	26.8
16	36.7	29.5
20	36.6	30.8
24	36.6	32.3
28	36.6	33.1
32	36.8	34
36	36.9	34.5
40	37	35.0
44	37.2	35.5
48	37.4	35.9

- 2.1 Using the same scale and axes plot graphs of air temperature with metabolic rate and with heat loss by evaporation. **Use the squared paper at the end of this answer booklet.**
[six marks]
- 2.2 Using the same scale and axes plot graphs of air temperature with internal body temperature and average skin temperature. **Use the squared paper at the end of this answer booklet.**
[six marks]

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2.3 Comment on the shape of the graphs you plotted in your answer to Question 2.1.

[five marks]

2.4 Comment on the shape of the graphs you plotted in your answer to Question 2.2.

[five marks]

2.5 Name TWO processes, not including evaporation of sweat, through which heat may be lost by the skin.

[two marks]

2.6 Name ONE factor that could decrease heat loss from evaporation of sweat and ONE factor that could increase such heat loss.

[two marks]

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2.7 Suggest one precaution that may be taken before starting the experiment.

[two marks]

2.8 Outline the principal shortcomings of the method used in this investigation.

[five marks]

[total: thirty-three marks]

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3. The rate of activity of enzymes is sensitive to temperature. Design a SIMPLE experiment that would enable you to determine the approximate temperature at which a given digestive enzyme is inactivated.

3.1 Suggest a suitable enzyme and substrate for this investigation.

[two marks]

3.2 What would the stated objectives of your investigation be?

[one mark]

3.3 Give a BRIEF outline the materials and methods you would use. You may use any of the blank pages within this booklet for diagrams of apparatus.

[twenty marks]

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3.4 Suggest ways in which your results may be presented meaningfully.

[six marks]

3.5 Suggest ONE precaution that you would take before starting the experiment.

[two marks]

3.6 Suggest ONE possible source of error that may influence the results you would obtain.

[two marks]

[Total: thirty-three marks]

ADVANCED BIOLOGY III

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ADVANCED BIOLOGY III

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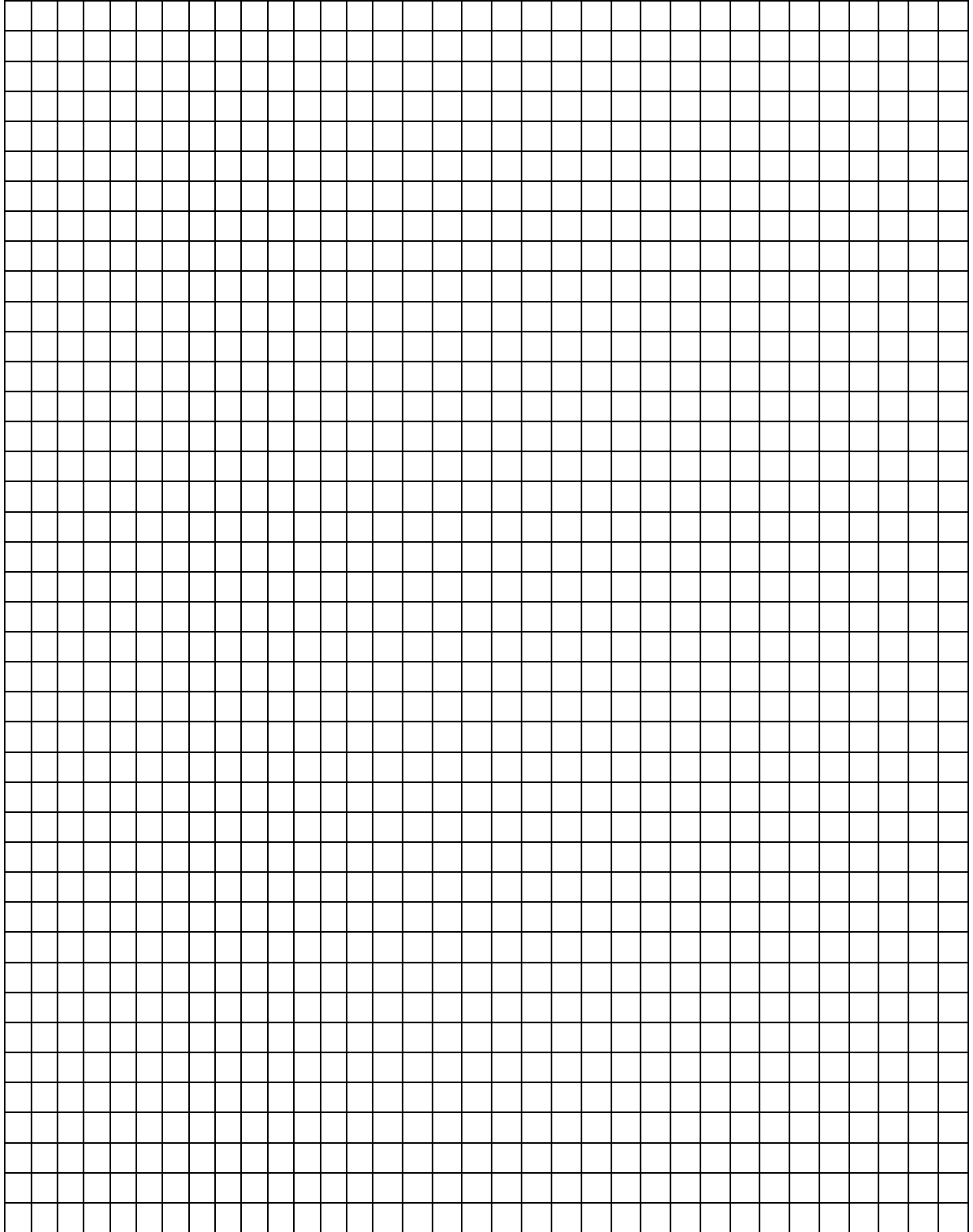
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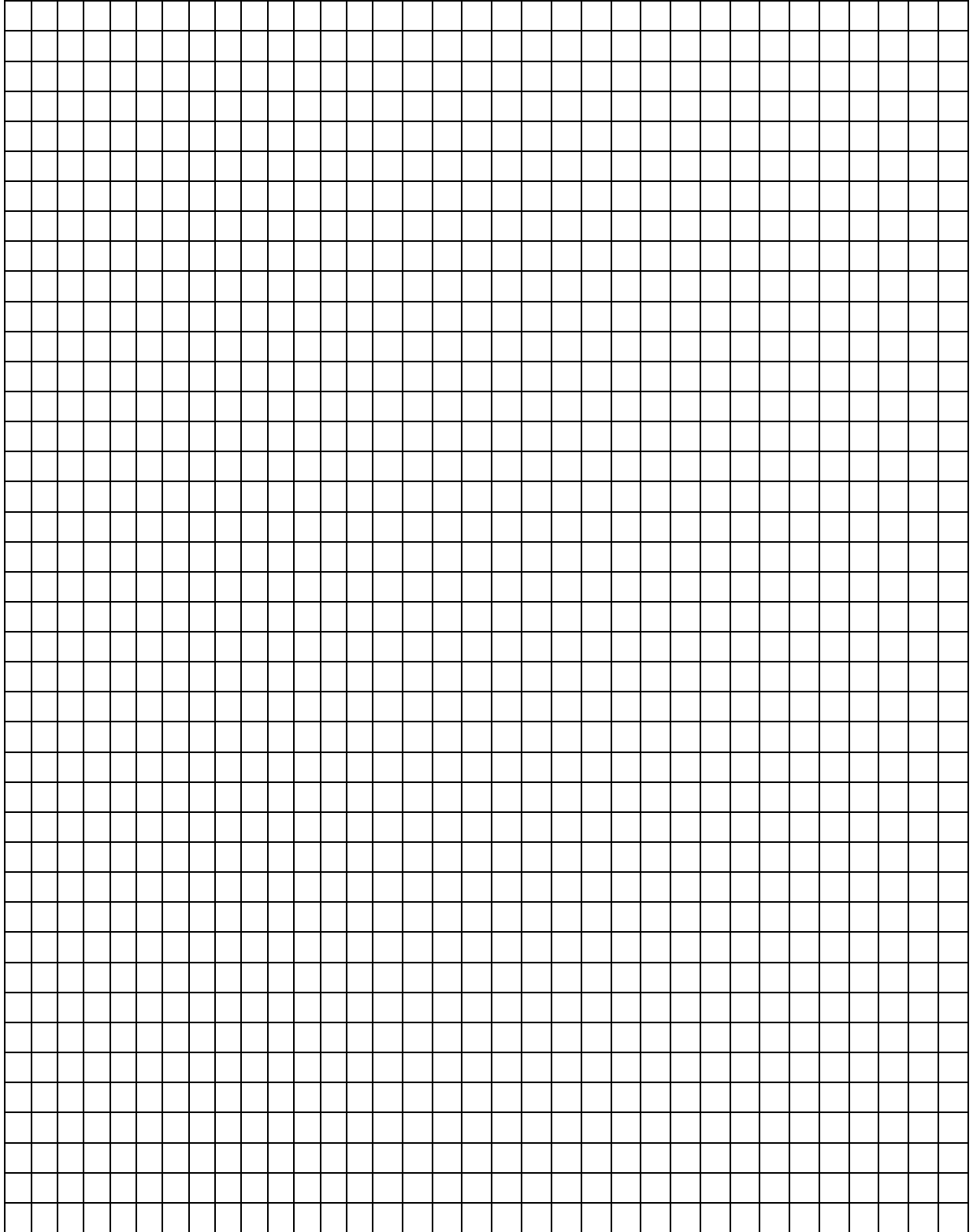
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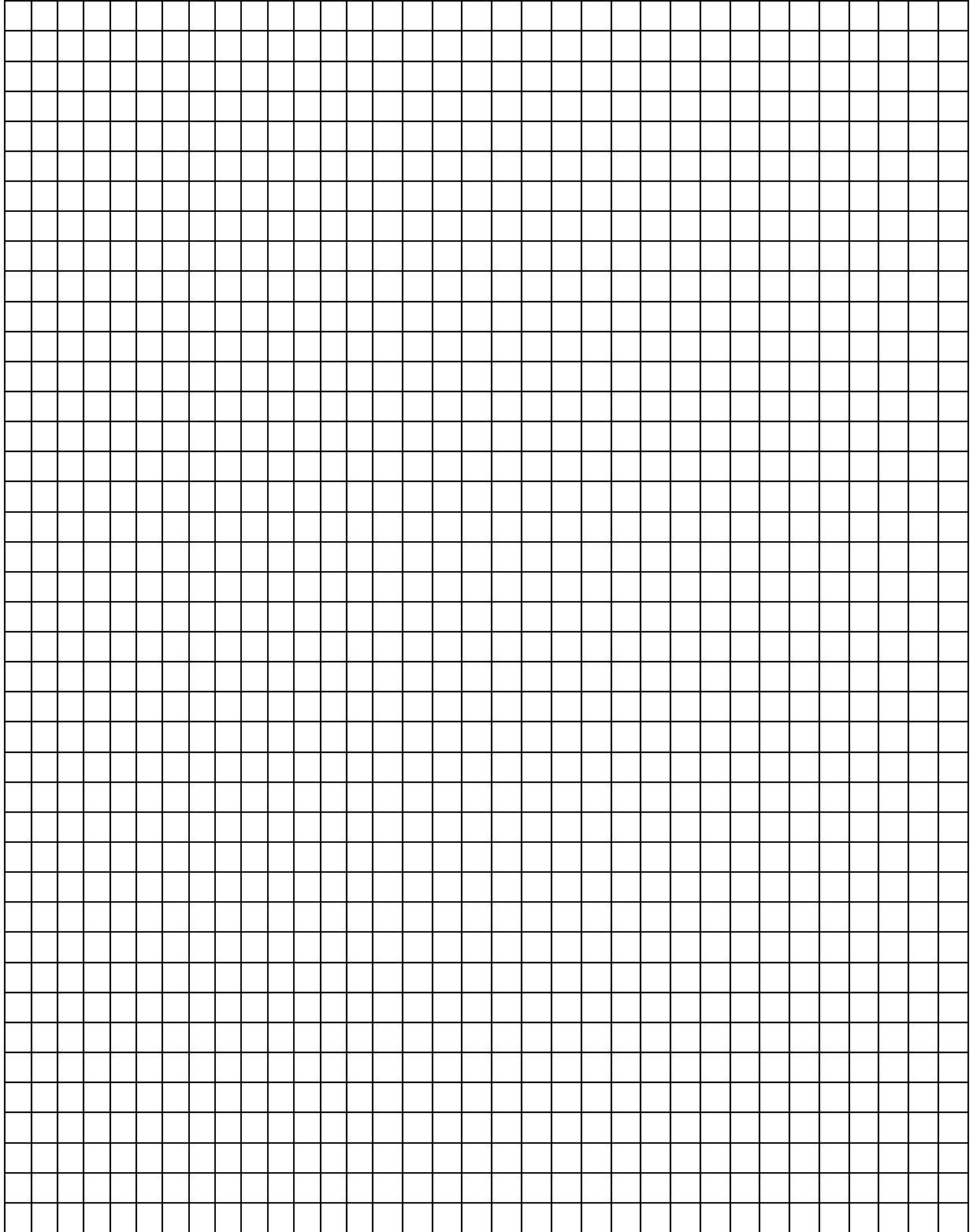
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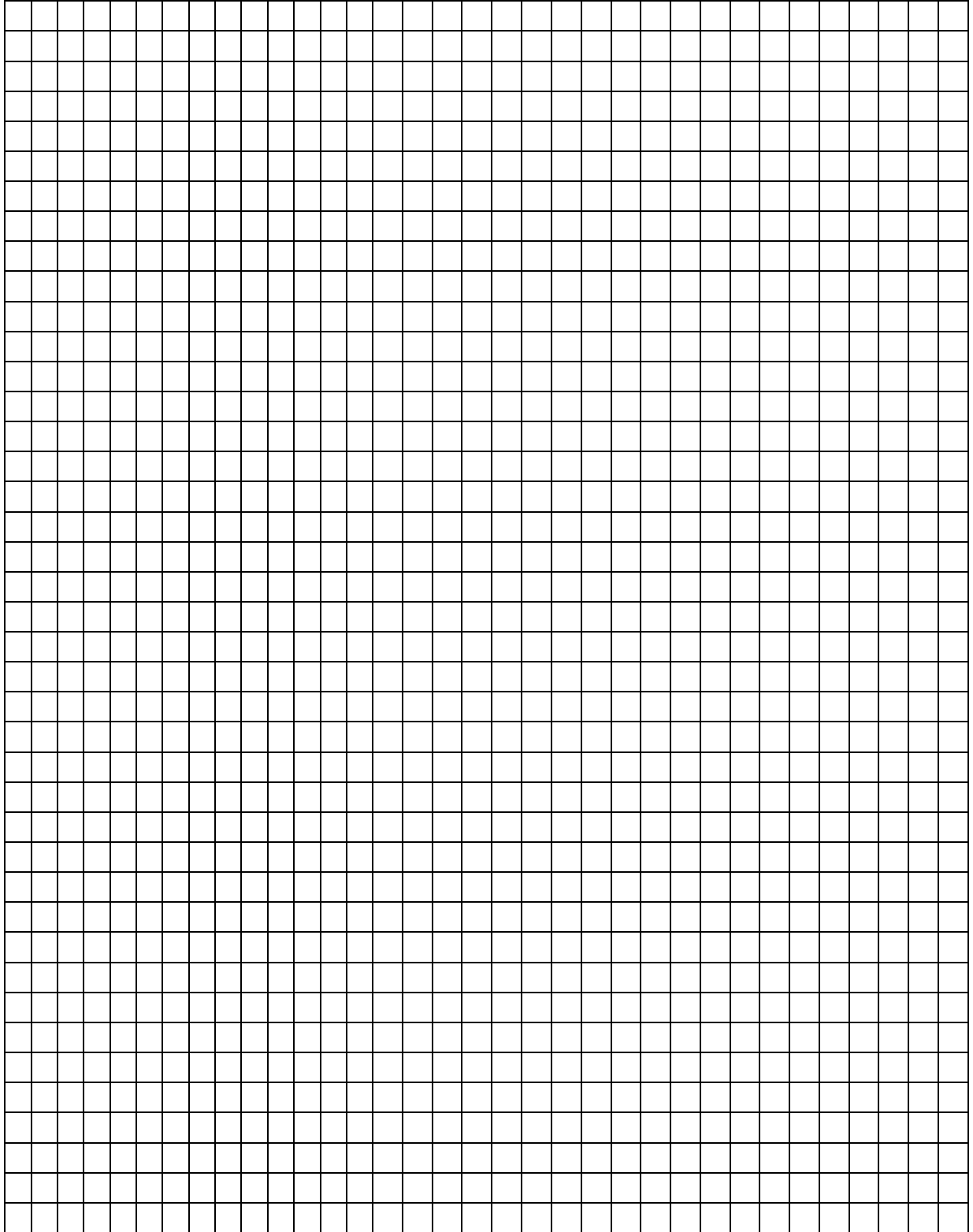
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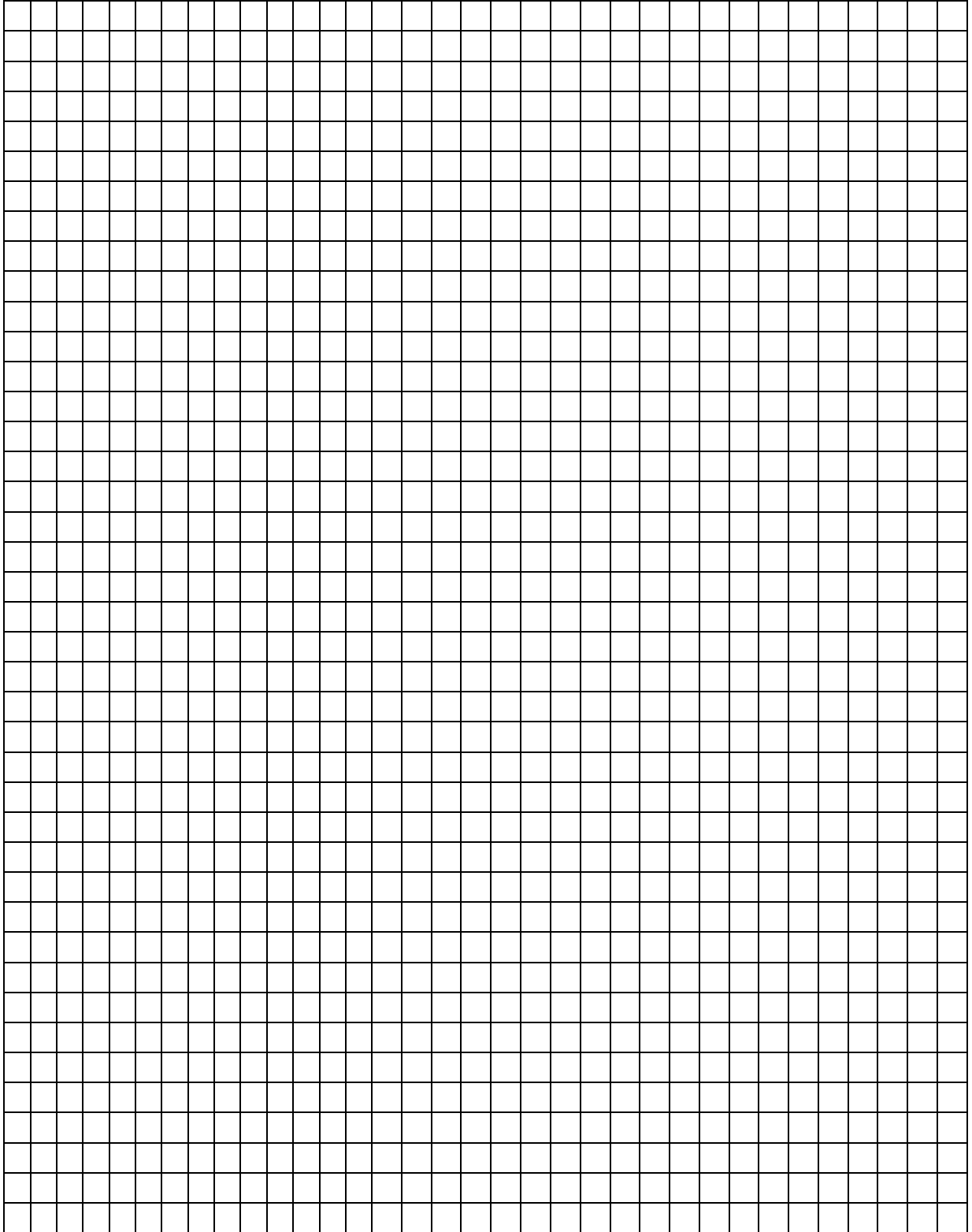
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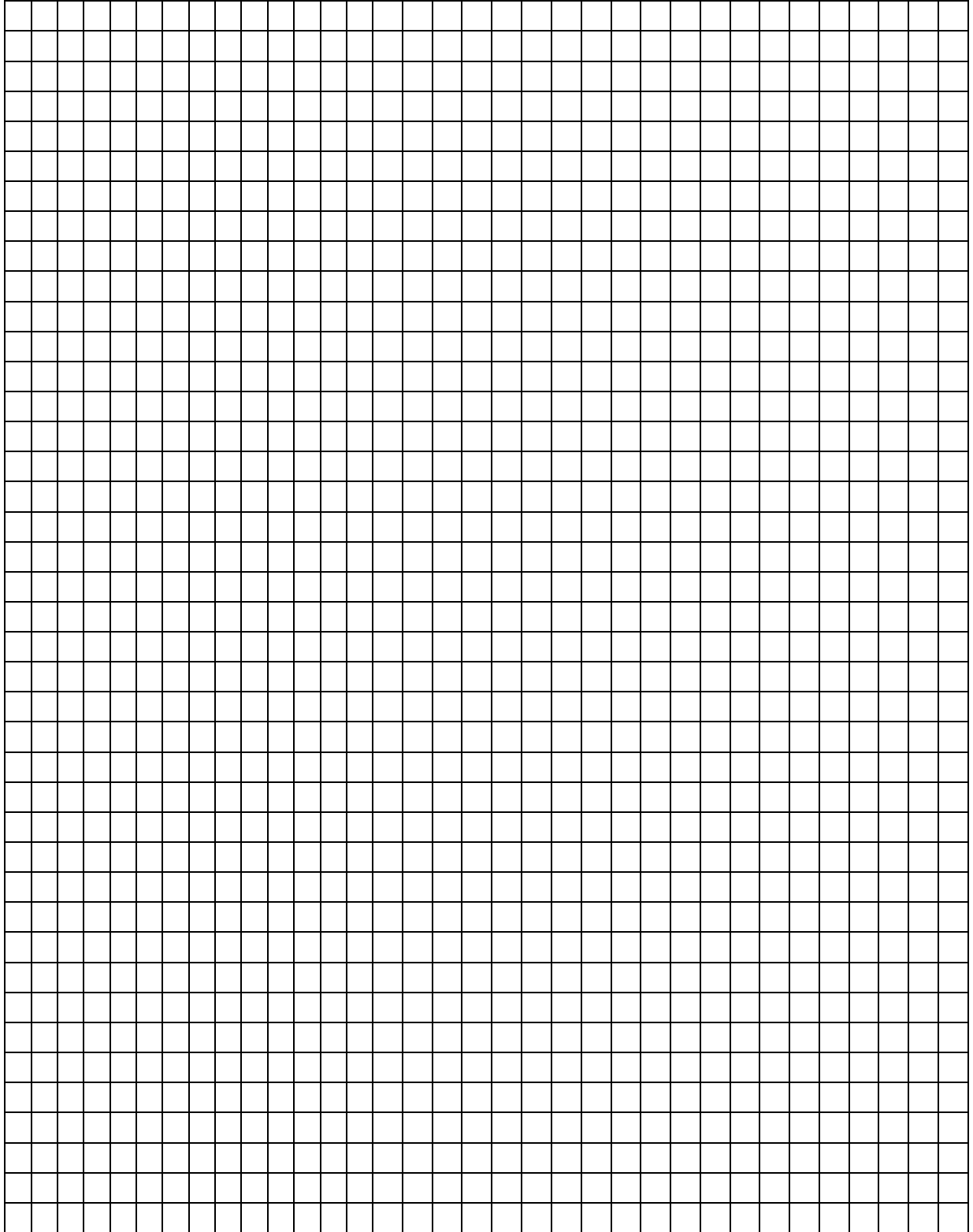
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