



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2016

Mathematics

Paper 2

Higher Level

Monday 13 June Morning 9:30 – 12:00

300 marks

Examination number

Centre stamp

Running total	
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For examiner	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Grade

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 answers in the spaces provided in this booklet. You may lose marks if you do not do so. There is space for extra work at the back of the booklet. You may also ask the superintendent for more paper. 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 you do not show all necessary 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:

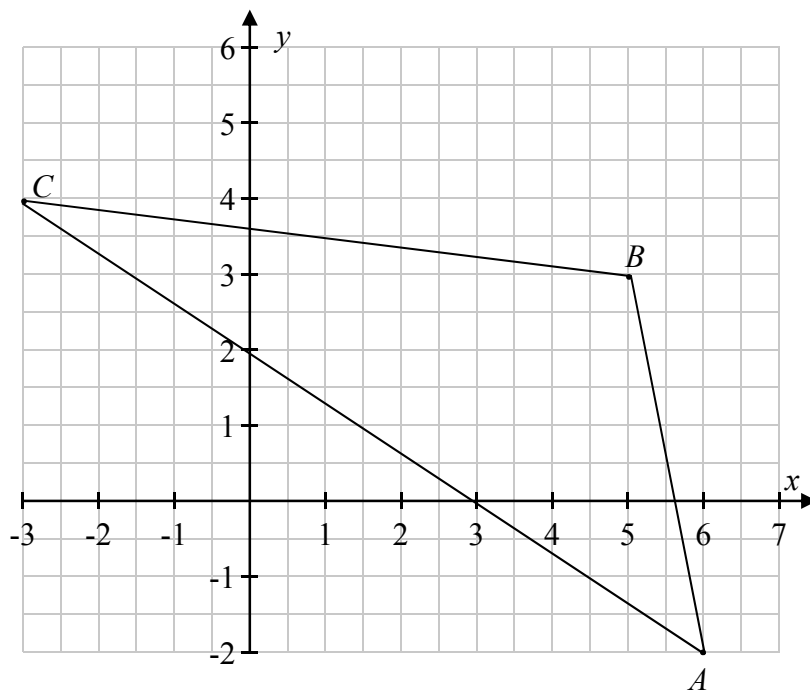
Answer **all six** questions from this section.

Question 1

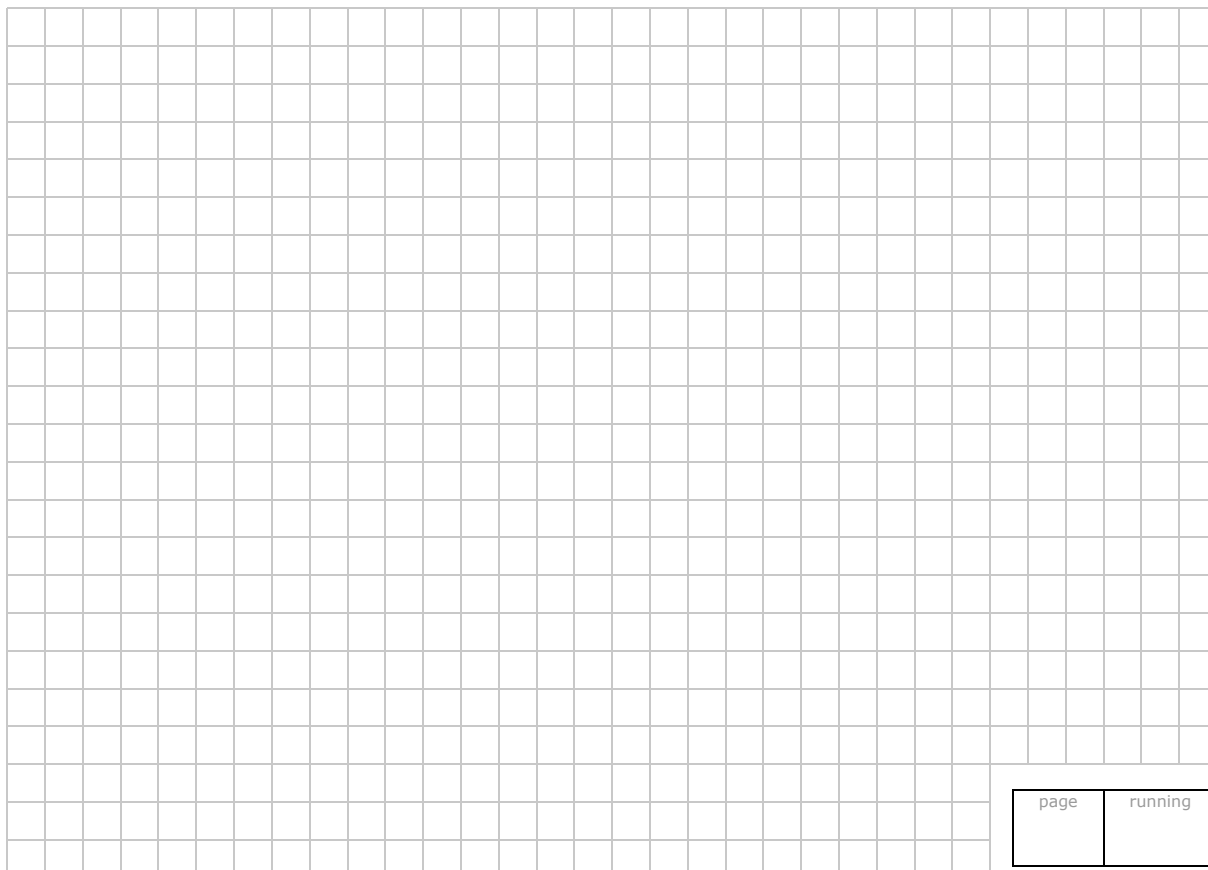
(25 marks)

The points $A(6, -2)$, $B(5, 3)$ and $C(-3, 4)$ are shown on the diagram.

- (a) Find the equation of the line through B which is perpendicular to AC .



- (b) Use your answer to part (a) above to find the co-ordinates of the orthocentre of the triangle ABC .



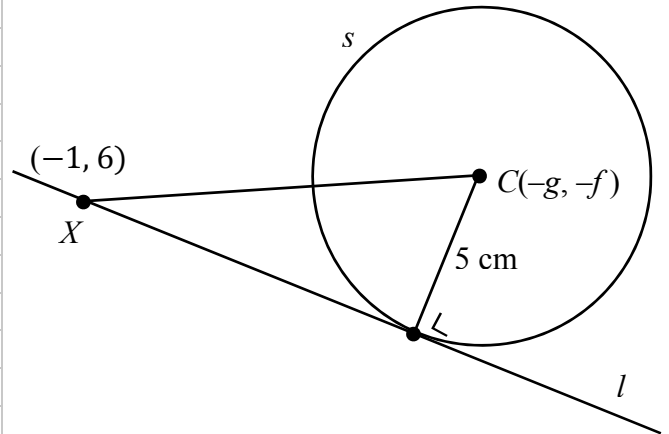
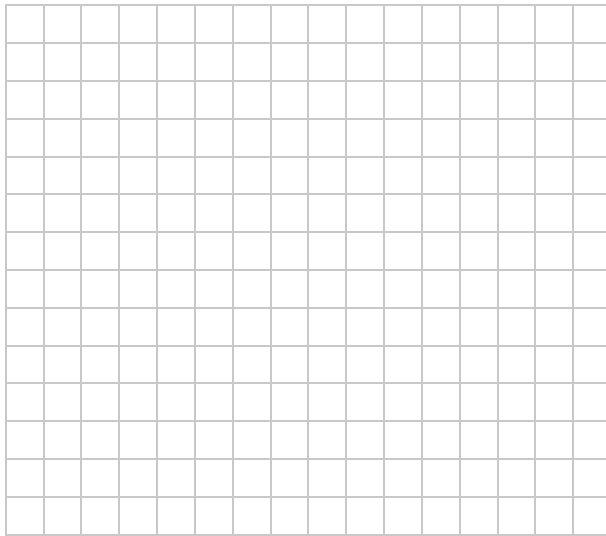
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Question 2

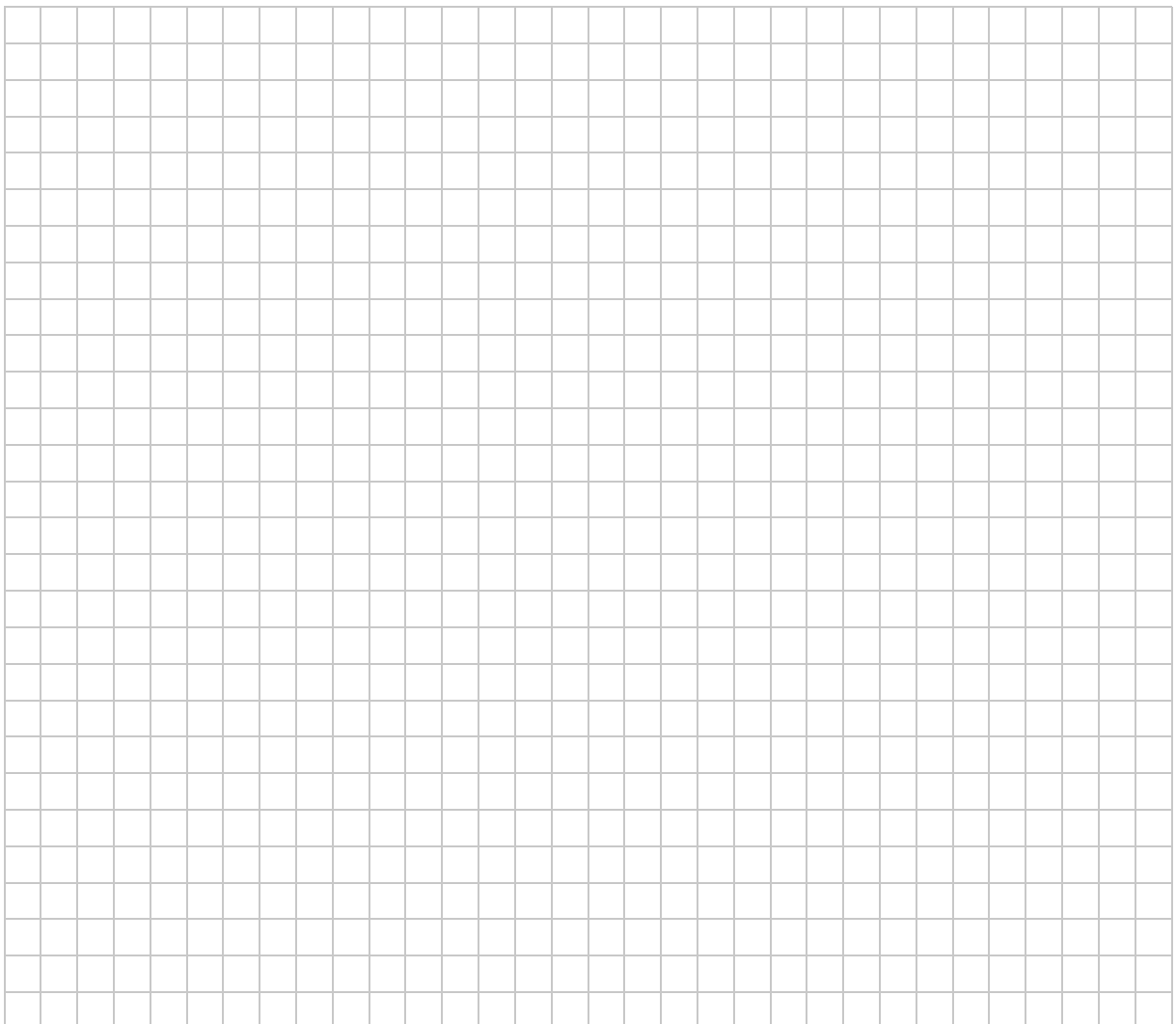
(25 marks)

A point X has co-ordinates $(-1, 6)$ and the slope of the line XC is $\frac{1}{7}$.

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



- (b) C is the centre of a circle s , of radius 5 cm. The line $l: 3x + 4y - 21 = 0$ is a tangent to s and passes through X , as shown. Find the equation of one such circle s .



Question 3

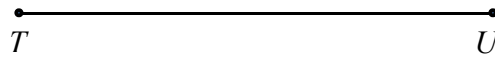
(25 marks)

(a) Show that $\frac{\cos 7A + \cos A}{\sin 7A - \sin A} = \cot 3A$.

(b) Given that $\cos 2\theta = \frac{1}{9}$, find $\cos \theta$ in the form $\pm \frac{\sqrt{a}}{b}$, where $a, b \in \mathbb{N}$.

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- (b) Use your result from part (a)(ii) to **construct** a line segment equal in length (in centimetres) to the square root of the length of the line segment $[TU]$ which is drawn below.



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

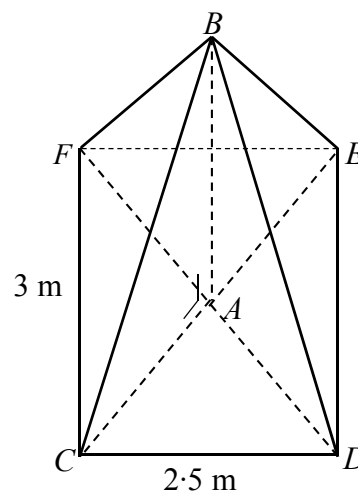
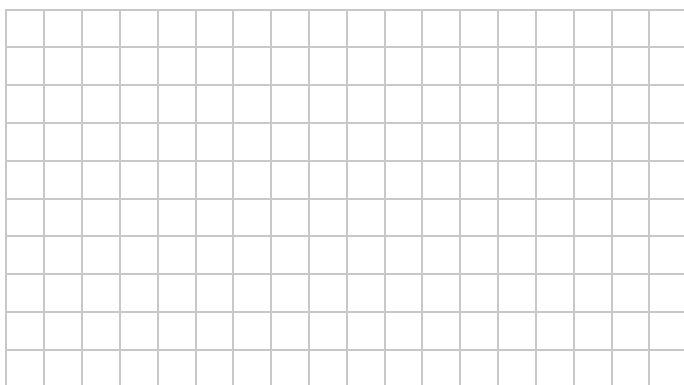
Question 7

(55 marks)

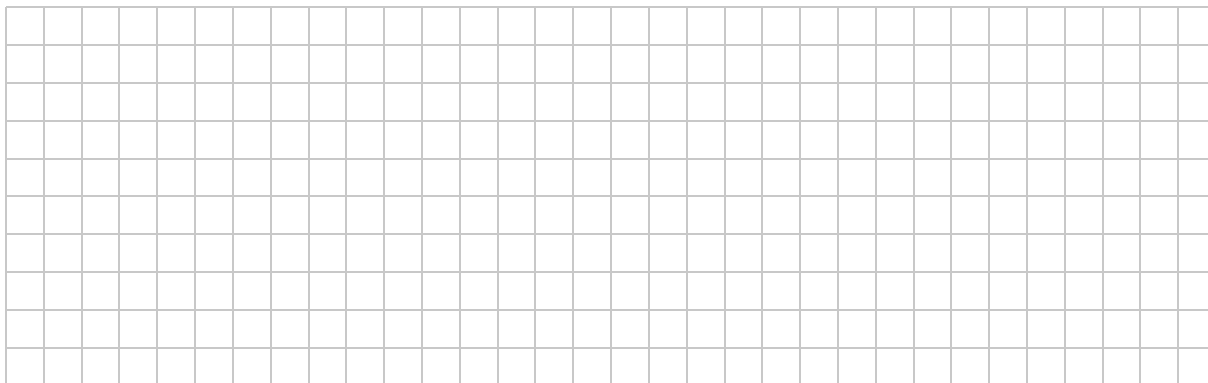
A glass Roof Lantern in the shape of a pyramid has a rectangular base $CDEF$ and its apex is at B as shown. The vertical height of the pyramid is $|AB|$, where A is the point of intersection of the diagonals of the base as shown in the diagram.

Also $|CD| = 2.5$ m and $|CF| = 3$ m.

- (a) (i) Show that $|AC| = 1.95$ m, correct to two decimal places.



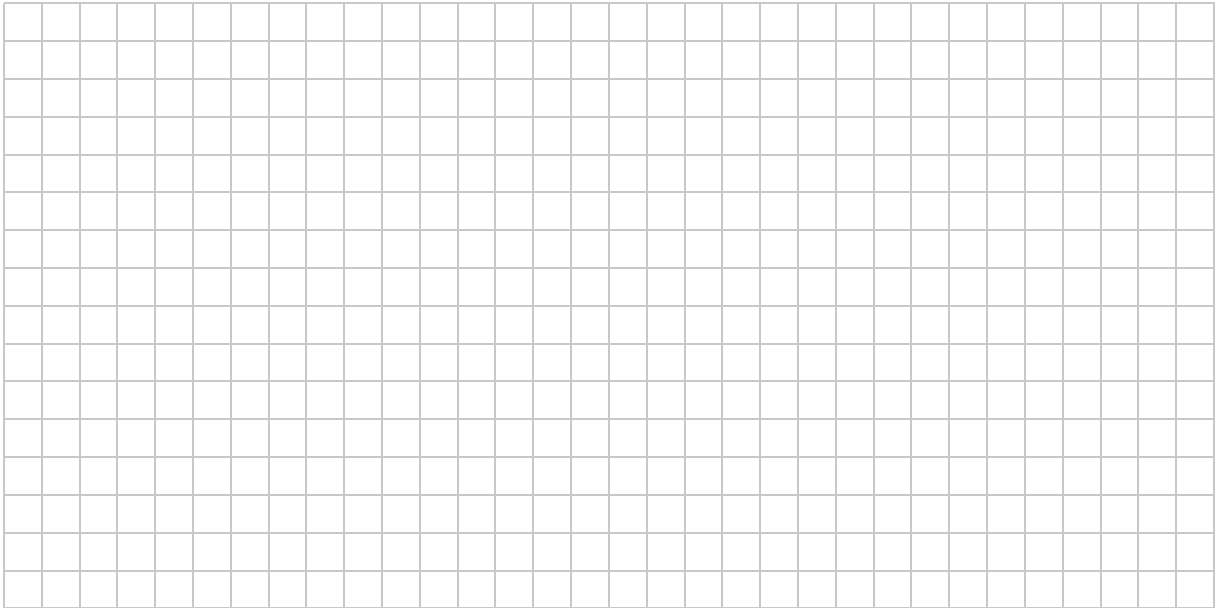
- (ii) The angle of elevation of B from C is 50° (i.e. $|\angle BCA| = 50^\circ$). Show that $|AB| = 2.3$ m, correct to one decimal place.



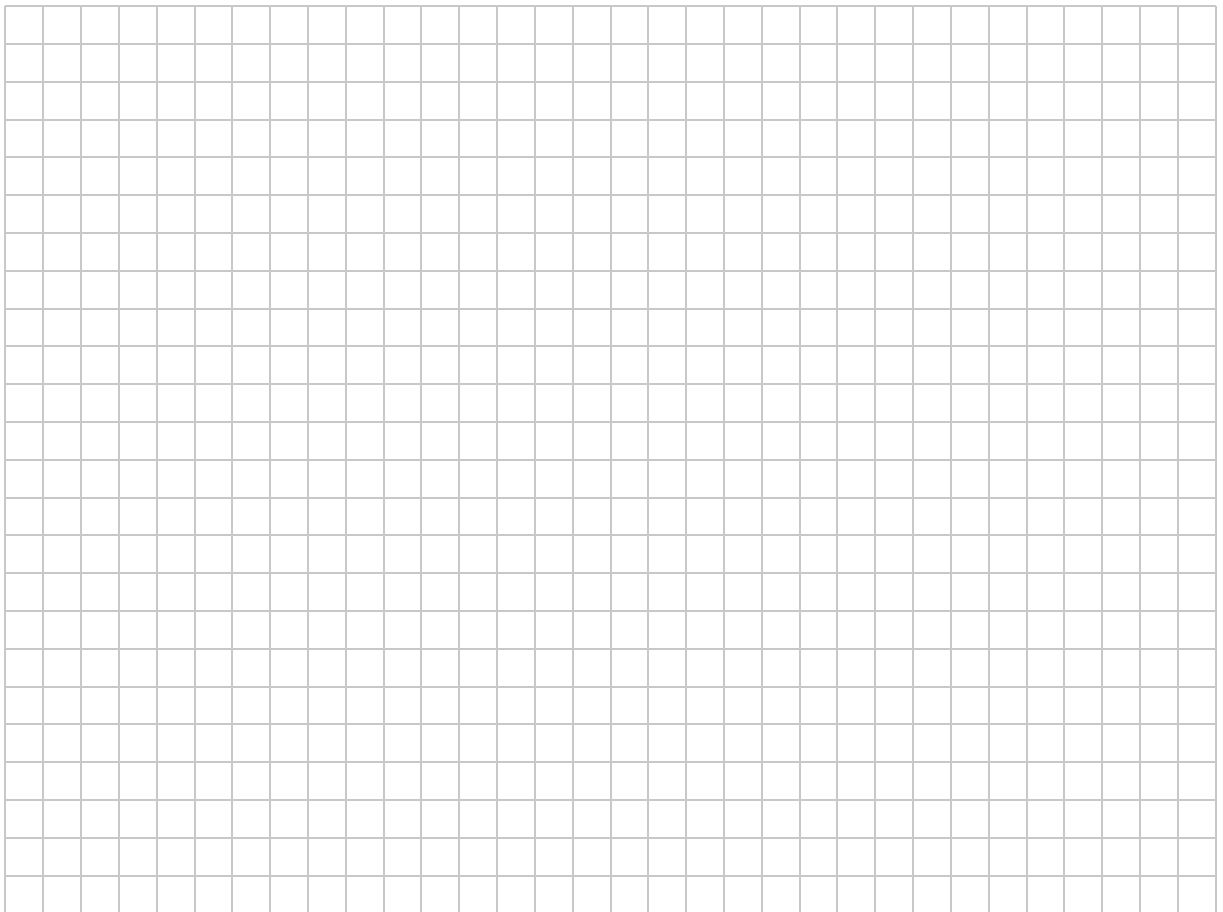
- (iii) Find $|BC|$, correct to the nearest metre.



(iv) Find $|\angle BCD|$, correct to the nearest degree.



(v) Find the area of glass required to glaze all four triangular sides of the pyramid.
Give your answer correct to the nearest m^2 .



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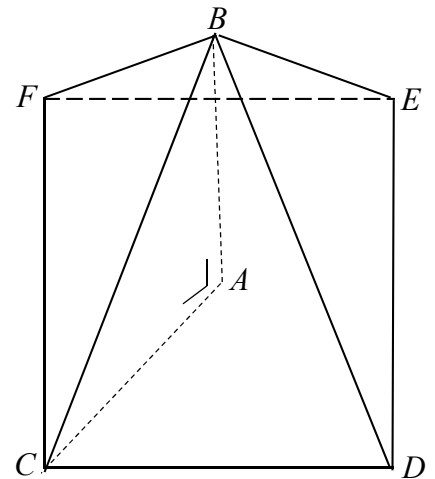
- (b) Another Roof Lantern, in the shape of a pyramid, has a square base $CDEF$. The vertical height $|AB| = 3$ m, where A is the point of intersection of the diagonals of the base as shown.

The angle of elevation of B from C is 60°

(i.e. $|\angle BCA| = 60^\circ$).

Find the length of the side of the square base of the lantern.

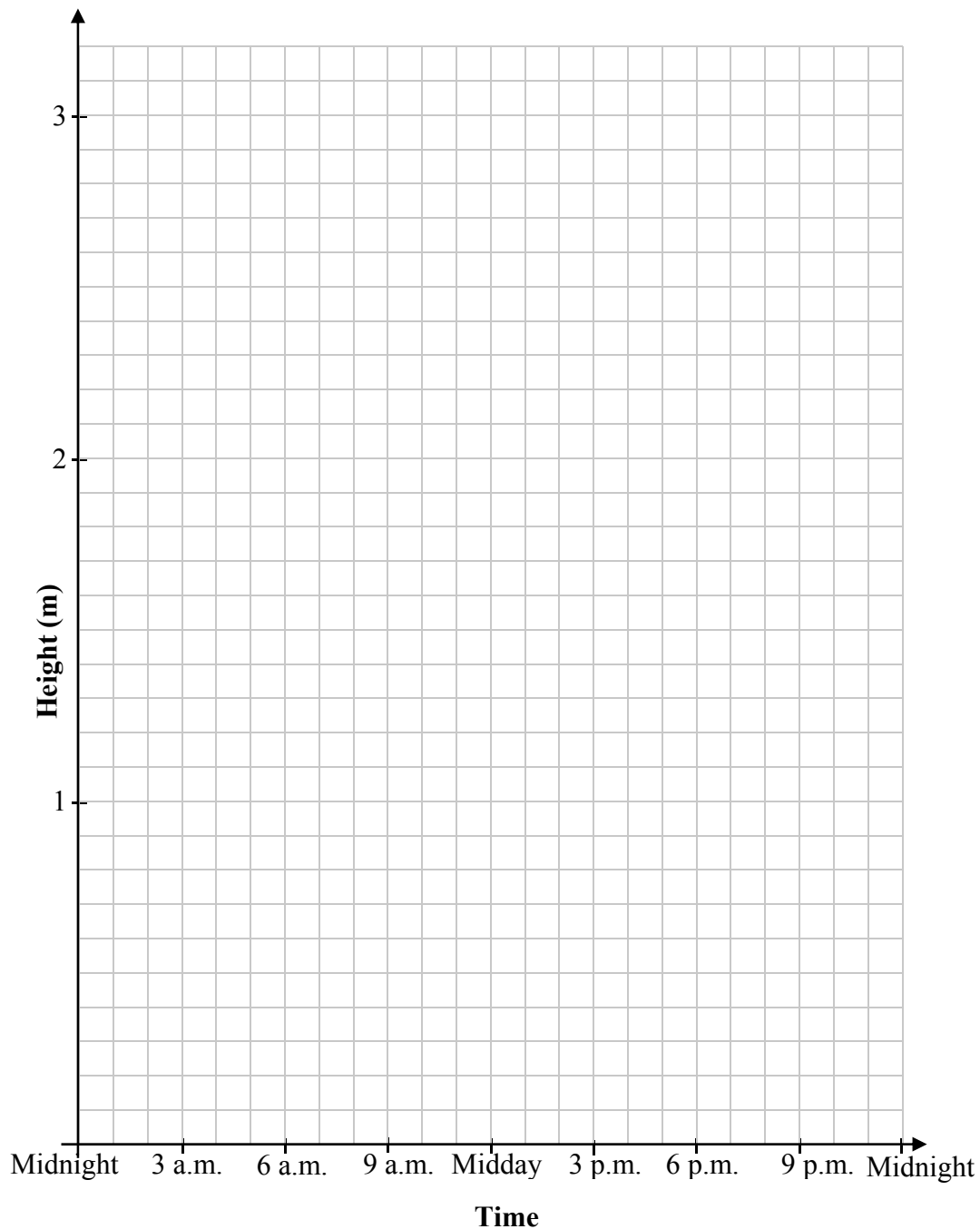
Give your answer in the form \sqrt{a} m, where $a \in \mathbb{N}$.



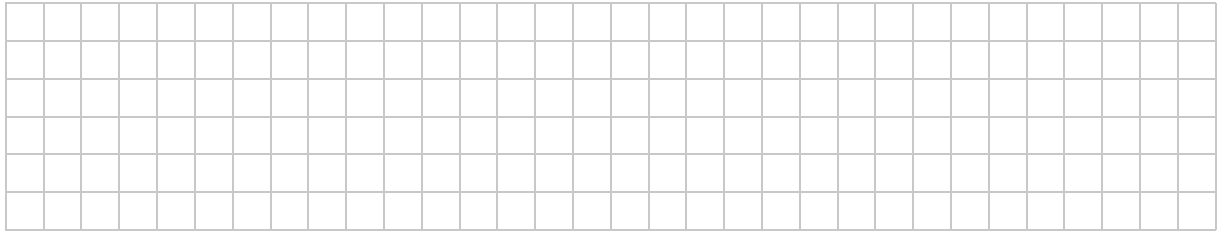
- (d) (i) On a particular day the high tide occurred at midnight (i.e. $t = 0$). Use the function to complete the table and show the height, $h(t)$, of the water between midnight and the following midnight.

$h(t) = 1.6 + 1.5 \cos\left(\frac{\pi}{6}t\right)$									
Time	Midnight	3 a.m.	6 a.m.	9 a.m.	12 noon	3 p.m.	6 p.m.	9 p.m.	Midnight
t (hours)	0	3							
$h(t)$ (m)									

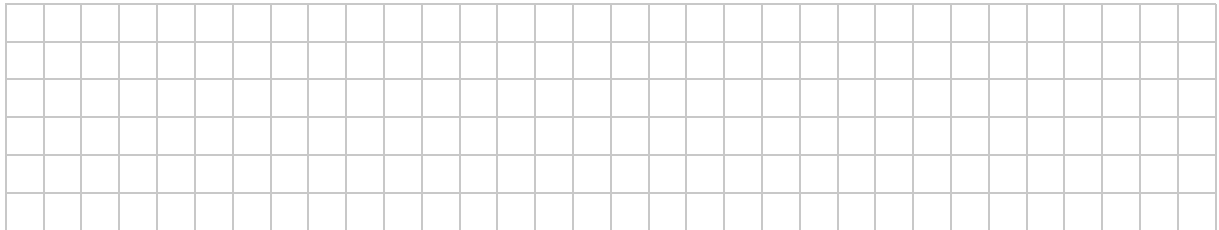
- (ii) Sketch the graph of $h(t)$ between midnight and the following midnight.



- (e) Find, from your sketch, the difference in water height between low tide and high tide.

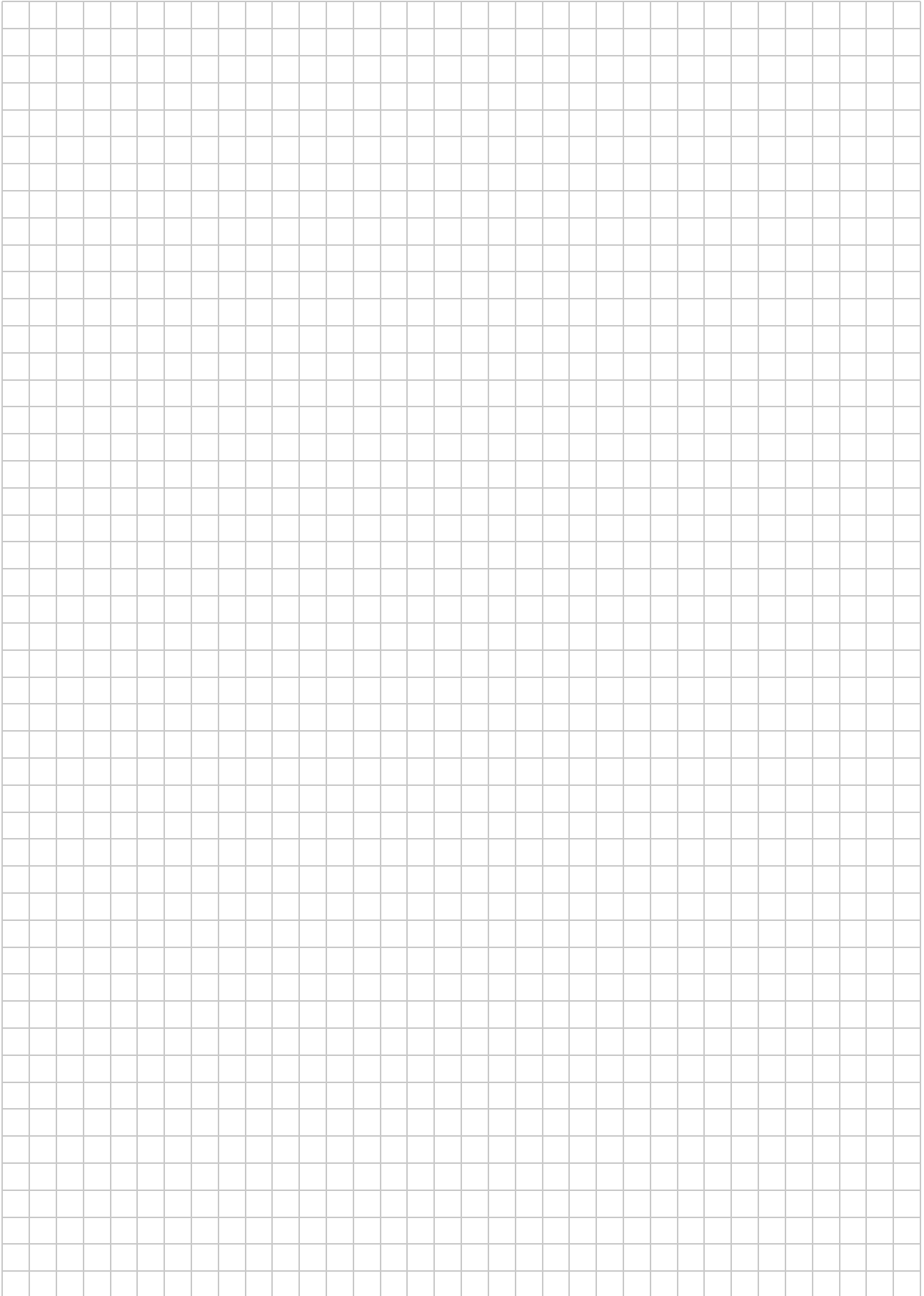


- (f) A fully loaded barge enters the port, unloads its cargo and departs some time later. The fully loaded barge requires a minimum water level of 2 m. When the barge is unloaded it only requires 1.5 m. Use your graph to estimate the **maximum** amount of time that the barge can spend in port, without resting on the sea-bed.

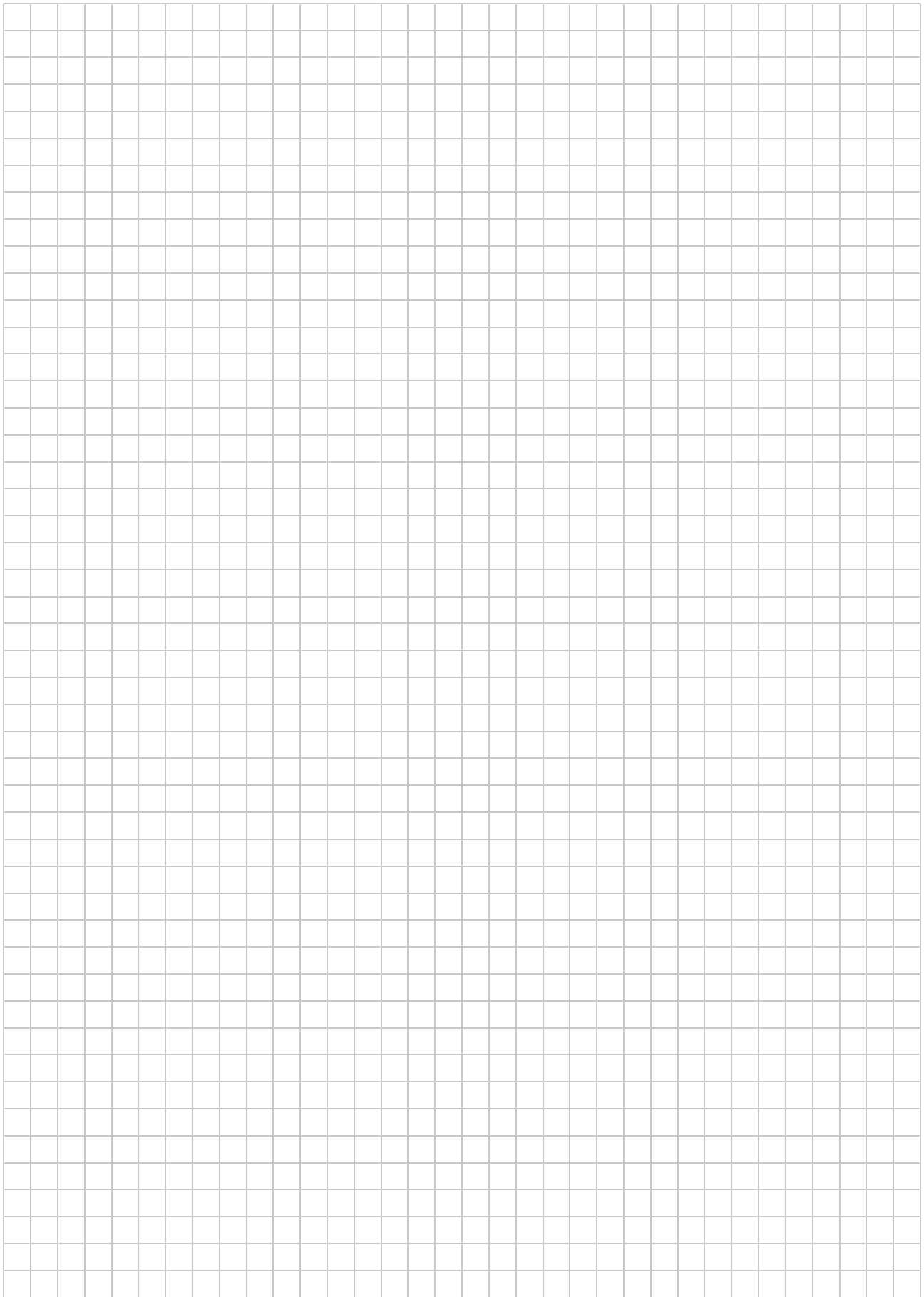


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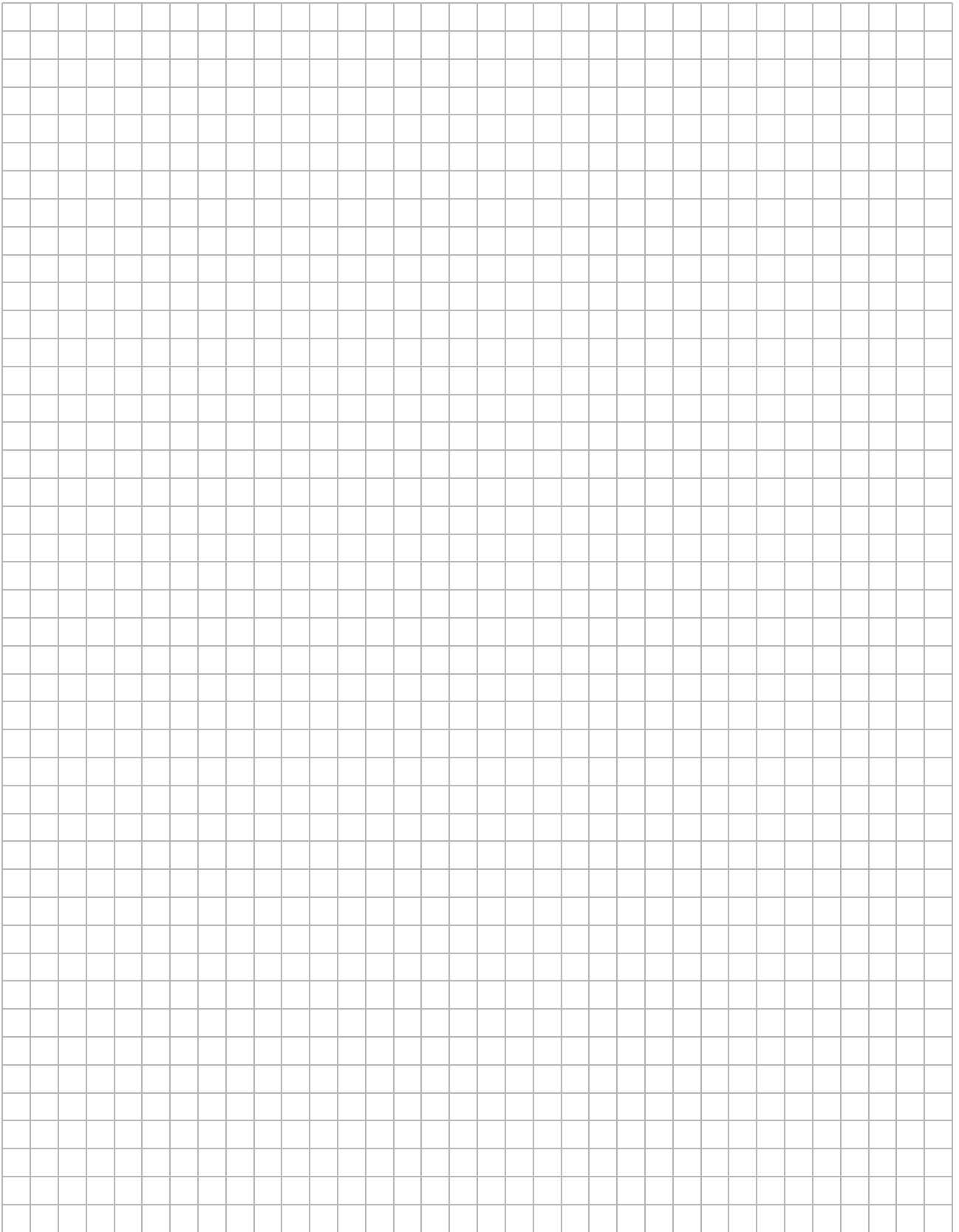
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