Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2018

Mathematics

Paper 1

Ordinary Level

Friday, 8 June – Afternoon 2:00 to 4:30

300 marks

Examination number

Centre stamp

Running total	

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. You may 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 may lose marks if your solutions do not include 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)**

When Sean joined a sales company he was offered a choice of two different salary contracts. The details of the contracts are outlined in the table below.

	Salary	End of year commission on total sales
Contract A	€35 000	2%
Contract B	€30 000	3%

(a) Find how much Sean would earn under **each** contract in a year where his total sales were €400 000.

Contract A

Contract B

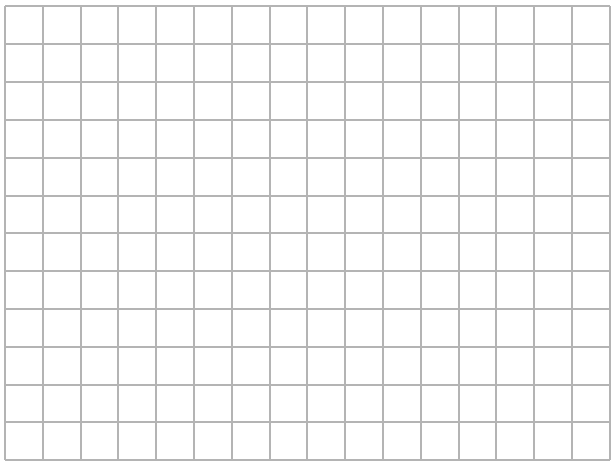
(b) Another employee, Mary, earned €50 000 in a particular year. She is on Contract A. Find her total sales for that year.

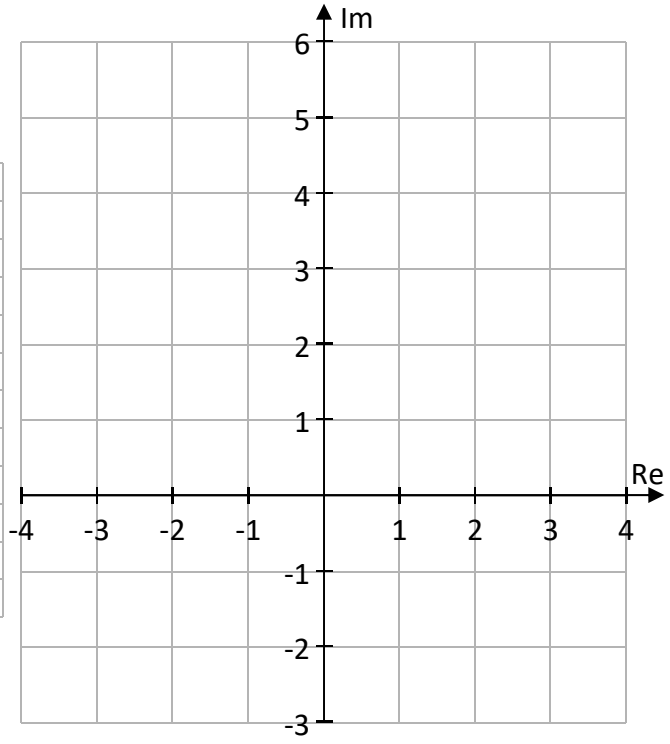
(c) Find the total sales for which a salesperson would earn the same amount of money under each contract.

Question 2 **(25 marks)**

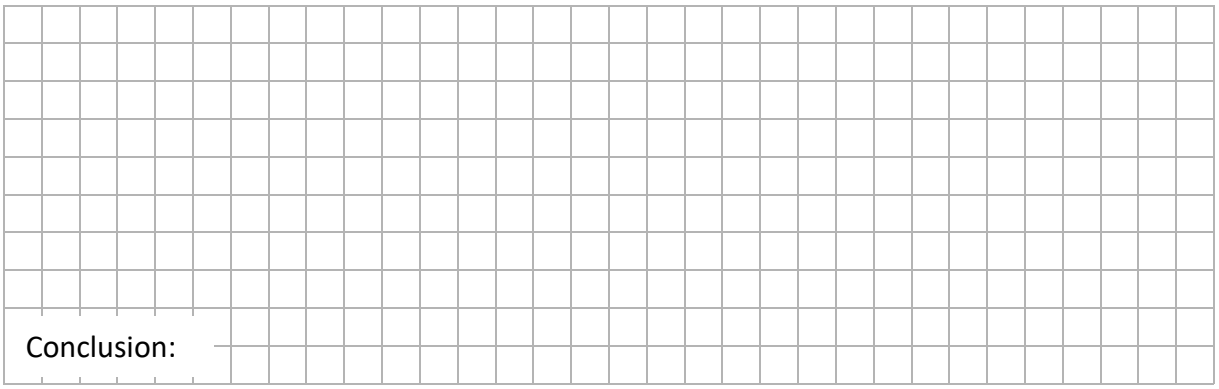
$z_1 = -2 + 3i$ and $z_2 = -3 - 2i$, where $i^2 = -1$.
$z_3 = z_1 - z_2$.

(a) Plot z_1, z_2, and z_3 on the Argand Diagram. Label each point clearly.

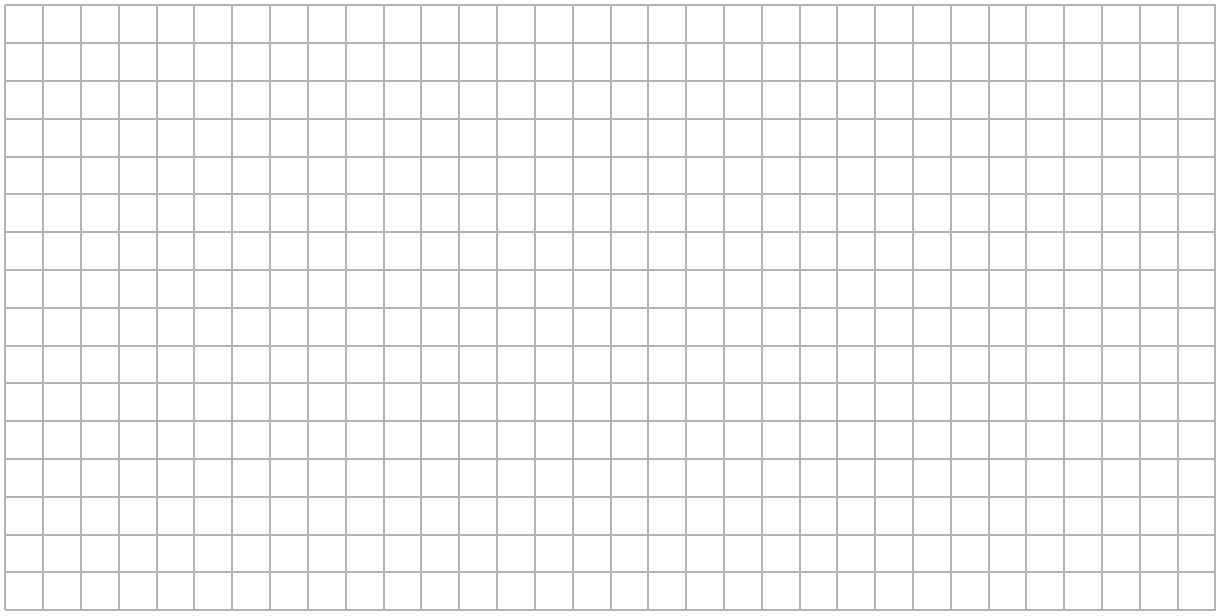




(b) Investigate if $|z_3| = |z_1| + |z_2|$.



(c) $z_4 = \dfrac{z_1}{z_2}$. Write z_4 in the form $x + yi$, where $x, y \in \mathbb{R}$.



Question 3 **(25 marks)**

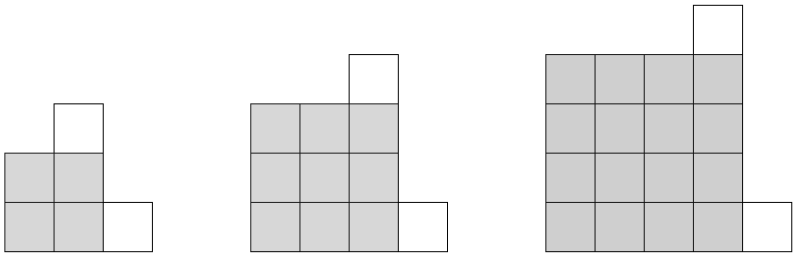
(a) Solve the equation $2x^2 - 7x - 3 = 0$. Give each answer correct to 2 decimal places.

(b) Solve the simultaneous equations below to find the value of a and the value of b.

$$\begin{aligned} 2a + 3b &= 15 \\ 5a + b &= -8 \end{aligned}$$

Question 4 **(25 marks)**

The first three stages in a pattern of grey and white tiles are shown in the diagram below.



Stage 1 Stage 2 Stage 3 Stage 4

(a) Draw the next stage of tiles (Stage 4) onto the diagram above.

(b) Based on the pattern shown, complete the table below.

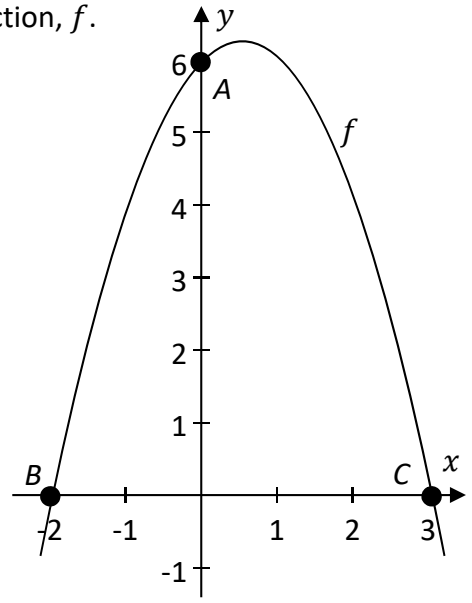
Stage (n)	Number of Grey Tiles	Number of White Tiles	Total
1	4		6
2			
3			
4			
5			

(c) Assuming the pattern continues, the total number of tiles in stage n (T_n) is given by the formula $T_n = n^2 + bn + c$, where b and $c \in \mathbb{N}$.
Find the value of b and the value of c.

(d) Find the number of the stage which has 443 tiles in total.

Question 5 **(25 marks)**

The diagram on the right shows the graph of a quadratic function, f.



(a) Write down the co-ordinates of *A, B,* and *C*.

$A = (\quad , \quad)$

$B = (\quad , \quad)$

$C = (\quad , \quad)$

(b) Show that the function can be written as $f(x) = -x^2 + x + 6$.

(c) Show, **using calculus**, that the maximum point of $f(x)$ is $(0{\cdot}5, 6{\cdot}25)$.

Question 6 **(25 marks)**

(a) Solve for x.

$$(x+5)(3x-4)-3(x^2+2)+4=0$$

(b) Find the solutions of

$$\frac{5}{x+3}-\frac{1}{x}=\frac{1}{2} \text{ where } x \neq -3, 0, x \in \mathbb{R}.$$

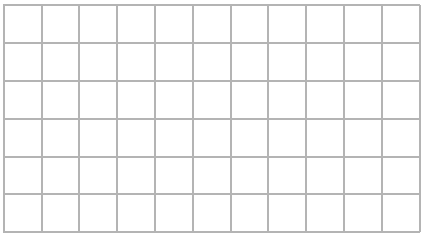
Section B — Contexts and Applications — 150 marks

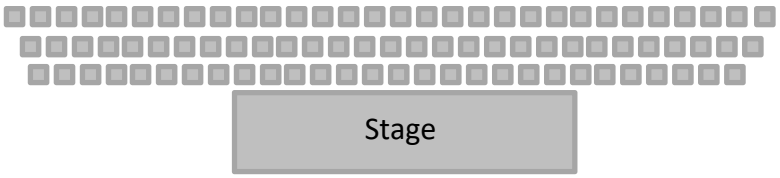
Answer **all three** questions from this section.

Question 7 **(55 marks)**

Part of the seating arrangement in a theatre is shown in the diagram below. The seats are arranged in rows. Row 1 is nearest the stage and has 28 seats. Each subsequent row behind that contains one more seat. i.e. row 2 has 29 seats, row 3 has 30 seats, and so on.

(a) Find the number of seats in row 10.





(b) There are 50 seats in the last row. How many rows of seats are there in the theatre?

(c) Find the total number of seats in the theatre.

(d) On a particular night 600 people are at a show in the theatre. Assume that people are seated only in the rows closest to the stage, i.e. they have filled the first n rows and there are some people seated in the next row.
Find the value of n **and** find the number of people seated in the next row.

Value of n = Number of people in next row =

(e) For a particular show, adult tickets cost €25 each and children's tickets cost €12 each.
Find the total income from ticket sales if 276 adult tickets and 212 children's tickets were sold.

(f) **(i)** For a different show 752 tickets were sold.
The ratio of adult tickets sold to children's tickets sold is 3 : 1.
Find how many adult tickets **and** how many children's tickets were sold for that show.

Number of adult tickets =

Number of children's tickets =

(ii) For the show referred to in part **f(i)** an adult ticket cost $2\frac{1}{2}$ times as much as a children's ticket. The income was €17 578. Find the cost of a children's ticket for this show.

Cost of a children's ticket =

Question 8 **(65 marks)**

The amount, in appropriate units, of a certain medicinal drug in the bloodstream t hours after it has been taken can be estimated by the function:

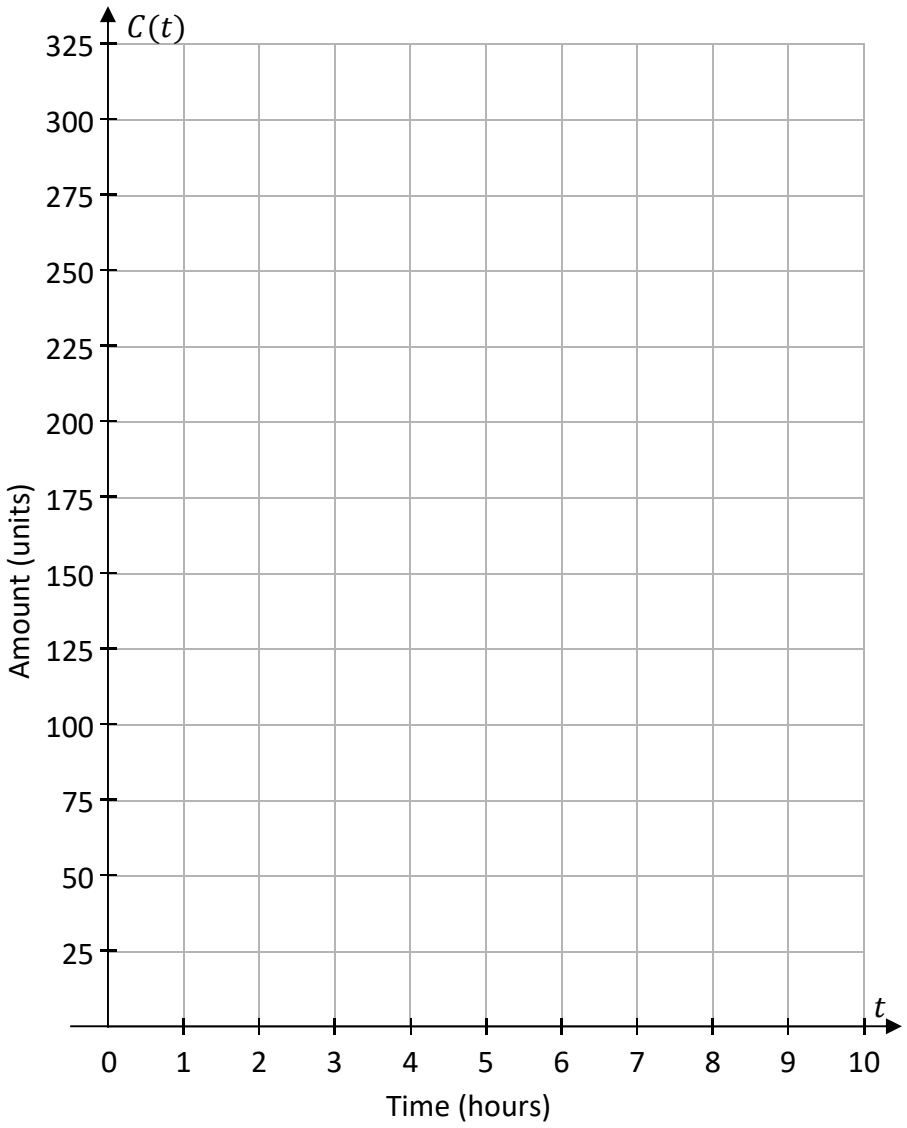
$$C(t) = -t^3 + 4{\cdot}5t^2 + 54t, \text{ where } 0 \leq t \leq 9,\ t \in \mathbb{R}.$$

(a) Use the drug amount function, $C(t)$, to show that the amount of the drug in the bloodstream 4 hours after the drug has been taken is 224 units.

(b) Use the function $C(t)$ to complete the table below.

t (Hours)	0	1	2	3	4	5	6	7	8	9
$C(t)$ (Units)	0	57·5			224					

(c) Draw the graph of the function $C(t)$ for $0 \leq t \leq 9$ where $t \in \mathbb{R}$.



(d) Use your graph to estimate each of the following values.
In each case show your work on the graph above.

(i) The amount of the drug in the bloodstream after $3\frac{1}{2}$ hours.

(ii) How long after taking the drug will the amount of the drug in the bloodstream be 100 units?

This question continues on the next page

(e) **(i)** Use the drug amount function $C(t) = -t^3 + 4{\cdot}5t^2 + 54t$ to find, in terms of t, the rate at which the drug amount is changing after t hours.

(ii) Use your answer to part **e(i)** to find the rate at which the drug amount is changing after 4 hours.

(iii) Use your answer to part **e(i)** to find the maximum amount of the drug in the bloodstream over the first 9 hours.

(iv) Use your answer to part **e(i)** to show that the drug amount in the bloodstream is decreasing 7 hours after the drug has been taken. Explain your reasoning.

Show:

Explanation:

Question 9 **(30 marks)**

When earthquakes occur under the sea, they can cause large tidal waves called tsunamis.
Scientists can estimate the arrival times of tsunamis to nearby countries.
The average speed at which a tsunami travels is given by the formula:

$$s = \sqrt{g \times d}$$

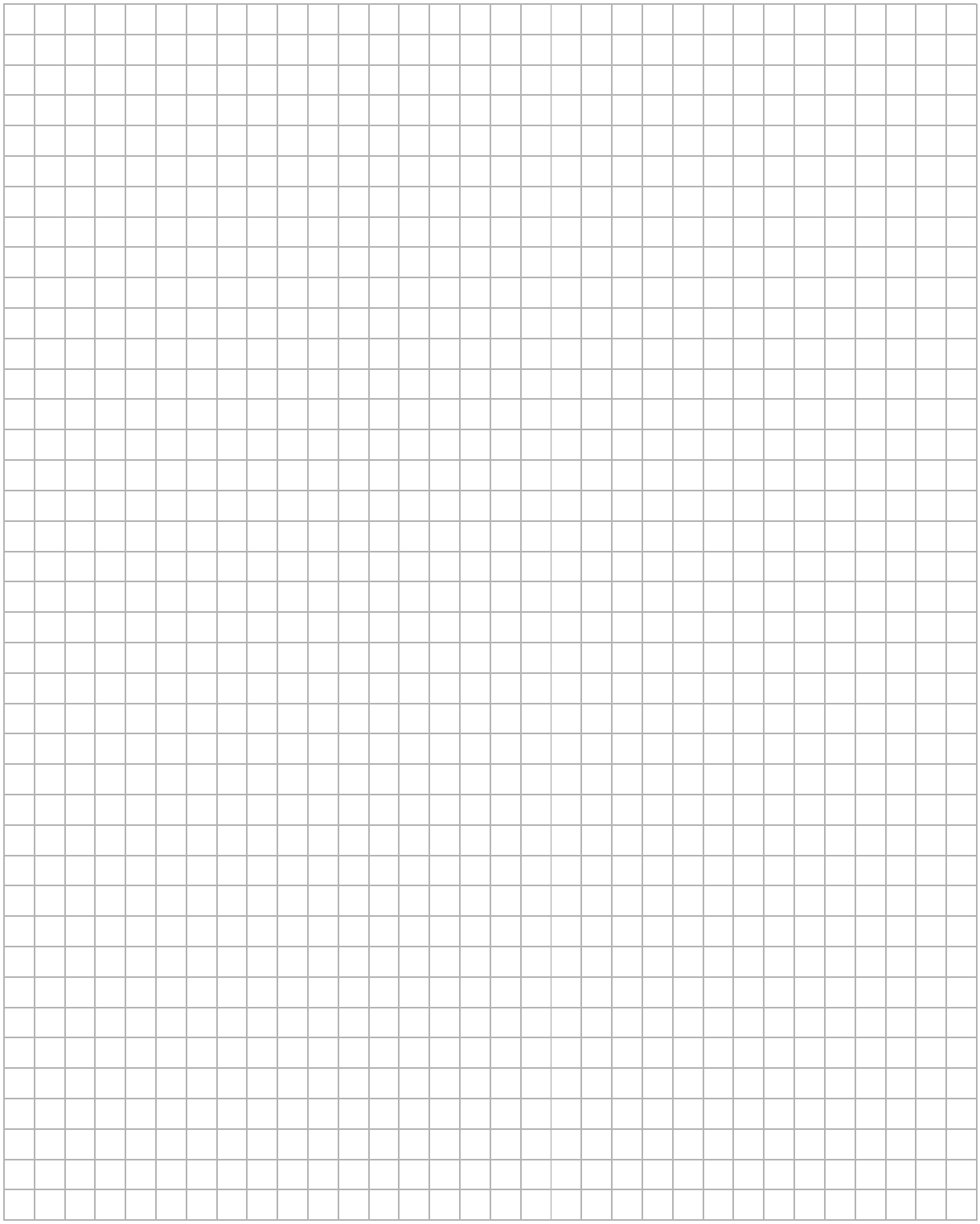
where s is the speed of the tsunami (in metres per second),
d is the depth of the ocean (in metres) at the location where the earthquake occurred,
and $g = 9{\cdot}8$ metres per second^2.

(a) **(i)** Find s, the speed of a tsunami when the an earthquake occurs at a depth of 2000 m.
Give your answer in metres per second.

(ii) A tsunami has been identified as beginning 400 km from land.
The depth of the ocean at that point is 2000 m.
Find how long it will take this tsunami to reach land.
Give your answer correct to the nearest minute.

(b) **(i)** Rearrange the formula to give d in terms of g and s.

(ii) Hence, or otherwise, find the depth of the ocean at the place where an earthquake occurred, if the resulting tsunami has a speed of 55 metres per second.
Give your answer correct to the nearest metre



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