2025.M27

2025L003G1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2025

Mathematics

Paper 1

Ordinary Level

Friday 6 June Afternoon 2:00 - 4:30

300 marks

Examination Number

Date of Birth

For example, 3rd February 2005 is entered as 03 02 05

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	4 questions

Answer questions as follows:

- any **five** questions from Section A – Concepts and Skills
- any **three** questions from Section B – Contexts and Applications.

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.

In general, diagrams are not to scale.

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 **any five questions** from this section.

Question 1 **(30 marks)**

(a) Seán is buying a power bank and a USB-C cable.

(i) One power bank costs €30 **before** VAT at 23% has been added.
Find the cost of the power bank **after** VAT has been added.

(ii) Seán is going to buy a different power bank that costs €26, and a USB-C cable that costs €9.
Seán sees a special offer to buy the power bank and USB-C cable together for €28.

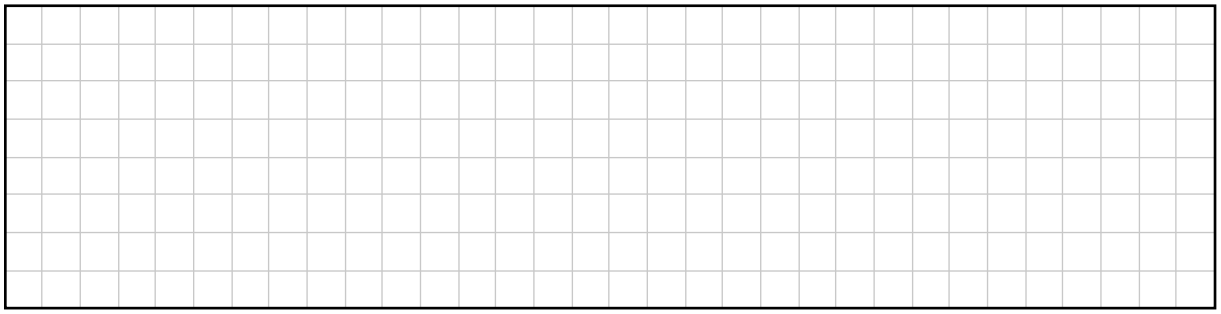
Work out the percentage discount of this special offer.

(b) Máiréad and Diarmuid own a window cleaning business.

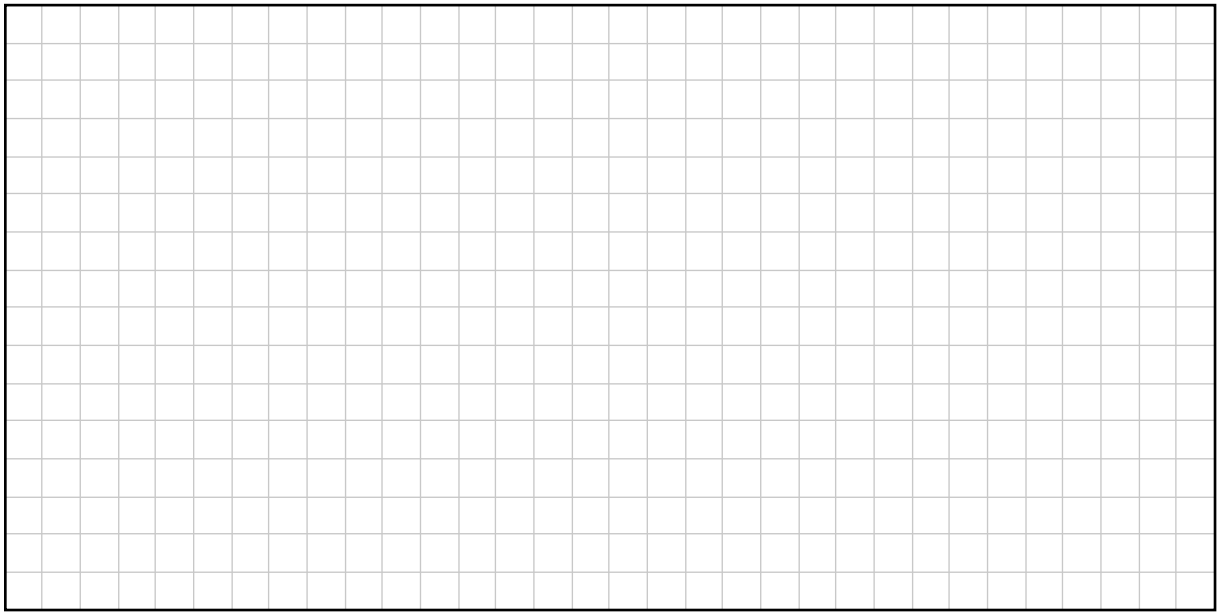
Máiréad can clean a standard window in 9 minutes
Diarmuid can clean a standard window in 12 minutes.

(i) Máiréad and Diarmuid both start cleaning standard windows at the same time.
They both finish cleaning a window at the same time.

After how many minutes will this **first** happen?



(ii) A building has 35 standard windows.
Work out how long it would take Máiréad and Diarmuid to clean the 35 windows if they work together.



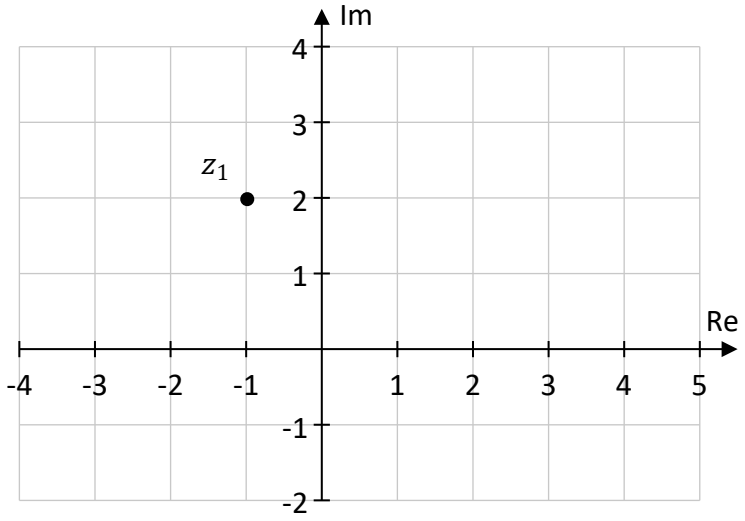
Question 2 **(30 marks)**

In this question, $i^2 = -1$.

(a) z_1, z_2 and z_3 are three complex numbers.

$$z_1 = -1 + 2i \qquad z_2 = 2 + 3i \qquad z_3 = 4 - i$$

(i) The complex number z_1 is shown on the Argand diagram below.
Plot and **label** z_2 and z_3 on the same Argand diagram.



(ii) Work out the modulus of z_1. That is, find $|z_1|$.
Give your answer in surd form.

z_4 is a complex number with:

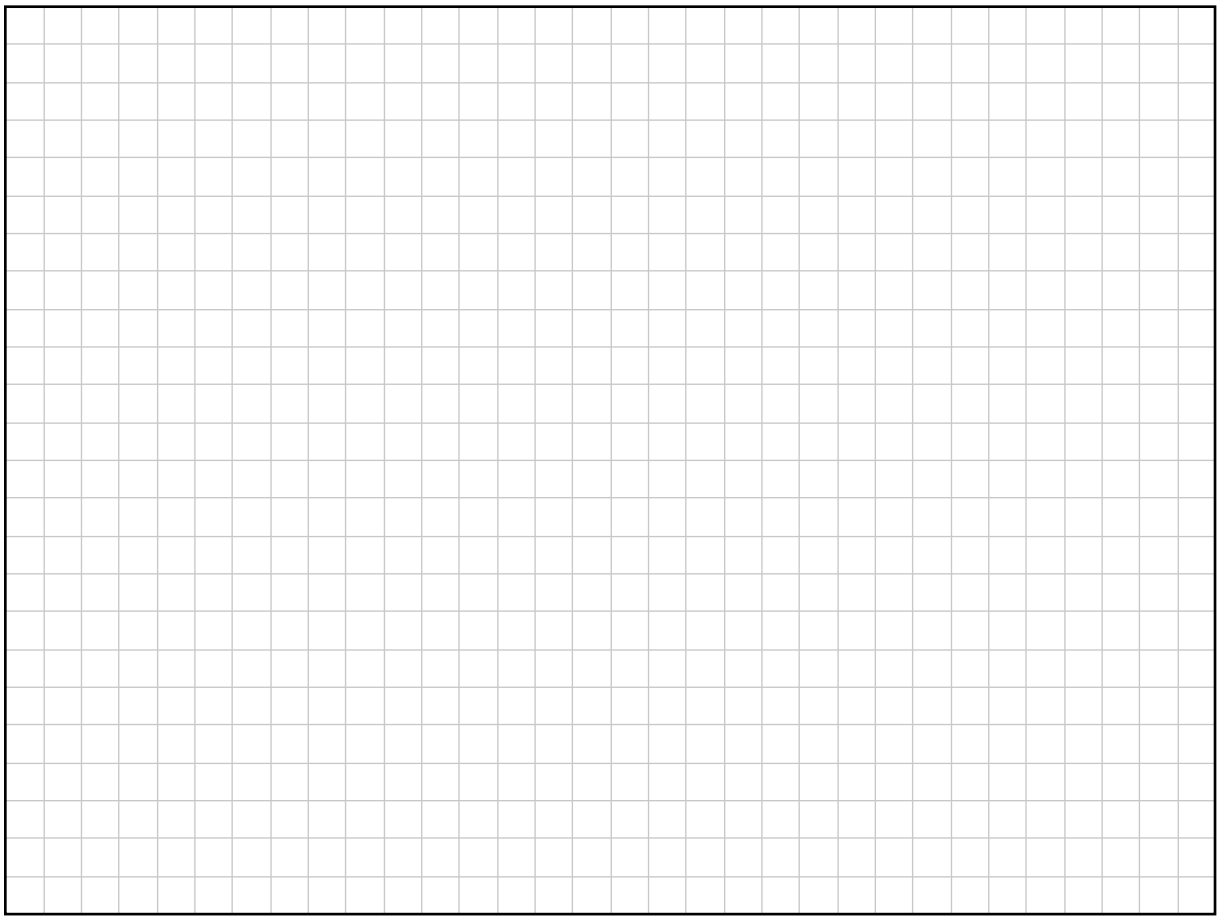
$$|z_4| < |z_1|$$

(iii) Write down one possible value of z_4.
Give your answer in the form $a + bi$, where $a, b \in \mathbb{Z}$.

(b) u and v are two complex numbers.

$$u = 4 - 6i$$
$$v = 1 + i$$

Write $\frac{u}{v}$ in the form $a + bi$, where $a, b \in \mathbb{Z}$.



Question 3 **(30 marks)**

(a) Rickie is buying protein bars.

The cost of a single protein bar is €3·30.
A shop has the following two special offers:

Offer A	**Offer B**
3 bars for the price of 2 bars	12 pack of the same bar for €29·99

Which offer is **cheaper** per bar?
Use calculations to support your answer.

Cheaper offer: (Tick (✓) **one** box only) Offer A ☐ Offer B ☐

Calculations:

(b) Solve the inequality for $x \in \mathbb{R}$:

$$2x + 4 \geq 6x - 8$$

(c) $k \times t = 12$, where $k, t \in \mathbb{Z}$.

(i) Write down a possible value of k and the corresponding value of t.

$k =$ $t =$

(ii) Use your values for k and t from part **(c)(i)** to find the value of b in the equation below.

$$(x + k)(x + t) = x^2 + bx + 12$$

$b =$

Question 4 **(30 marks)**

(a) Solve the following equation in $a \in \mathbb{R}$:

$$5(a-3) = 2a + 7$$

(b) The function $f(x)$ is defined as $f(x) = x^3 - 3x^2 + 4x - 8$, where $x \in \mathbb{R}$.

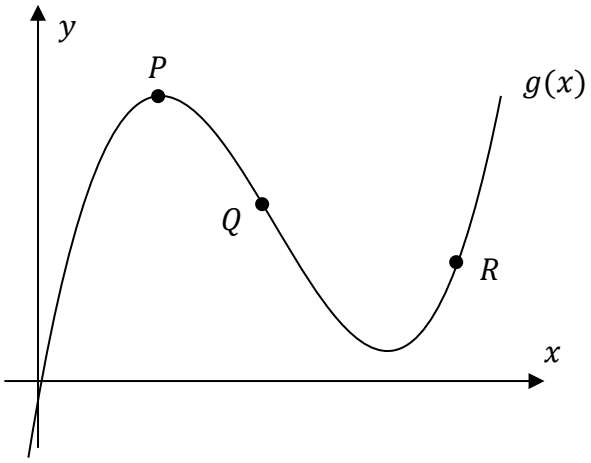
Find $f'(x)$, the derivative of $f(x)$.
Hence, find the slope of the tangent to $f(x)$ at the point $(2, -4)$.

$f'(x) =$

Slope of tangent $=$

(c) The diagram below shows the graph of a cubic function $g(x)$.
P, Q, and R are points on the graph of g.

(i) Write each of the letters P, Q, and R in the correct place in the table so that each point matches the description of the derivative at that point, where $g'(x)$ is the derivative of $g(x)$.



Point (P, Q, or R)	**Derivative**
	$g'(x) < 0$
	$g'(x) = 0$
	$g'(x) > 0$

(ii) For the point that you matched to $g'(x) = 0$, give a reason for your answer.

Reason:

Question 5 **(30 marks)**

(a) Use algebra to solve the simultaneous equations:

$$3x + 2y = 11$$
$$x - 4y = -1$$

$x =$ $y =$

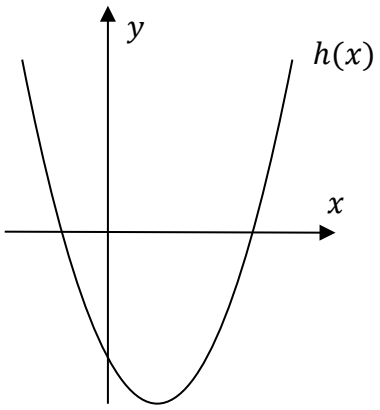
(b) Solve the following equation in $x \in \mathbb{R}$:

$$3x^2 - 2x - 4 = 0$$

Give each answer correct to 2 decimal places.

(c) The graph of a **quadratic** function $h(x)$ is shown in the diagram below (**drawn to scale**).

The graph is symmetrical about a vertical line.



(i) Based on the graph, which of the following pairs of values of x is a possible set of roots of $h(x)$, that is, values of x for which $h(x) = 0$?

Tick (✓) **one** box only.

☐ $x = 2$ and $x = 8$

☐ $x = -2$ and $x = -8$

☐ $x = -2$ and $x = 8$

☐ $x = -8$ and $x = 2$

(ii) Find the value of x, at which $h(x)$ is a minimum.

Question 6 **(30 marks)**

(a) Tara buys a coat for €90.
She then sells the coat at a profit of 25%.

(i) Find the selling price of the coat.

(ii) The margin on the coat is the **profit** as a **percentage** of the **selling** price.
Write down the profit for this coat **and** hence find the margin.

Profit =

Margin =

(b) Write each of the following numbers in the form $a \times 10^n$, where $1 \leq a < 10, n \in \mathbb{Z}$.

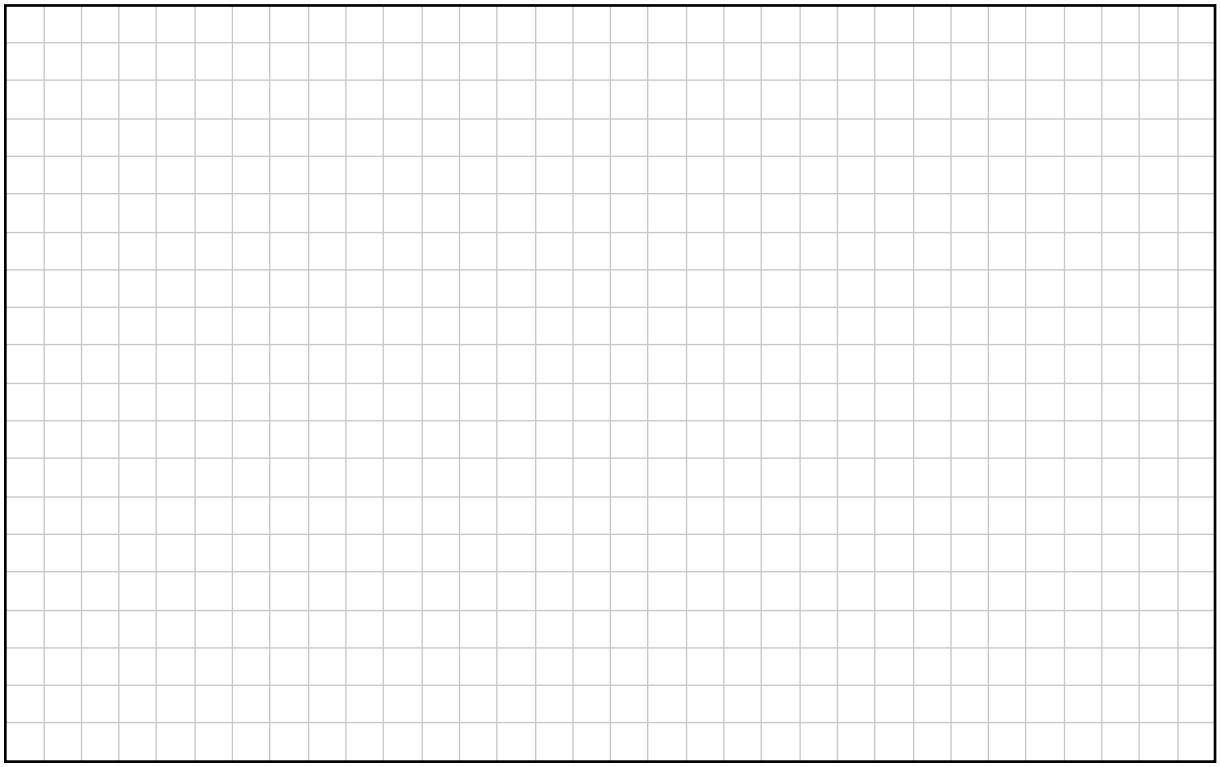
$58\,000$ =

$0{\cdot}036$ =

(c) Light travels at a **speed** of approximately 3×10^5 km/second.
A light year is the distance travelled by light in 1 year.

Find the **distance** travelled by light in 1 year.
(You may assume there are 365 days in a year.)

Give your answer, in km, in the form $a \times 10^n$, where $1 \leq a < 10, n \in \mathbb{Z}$.

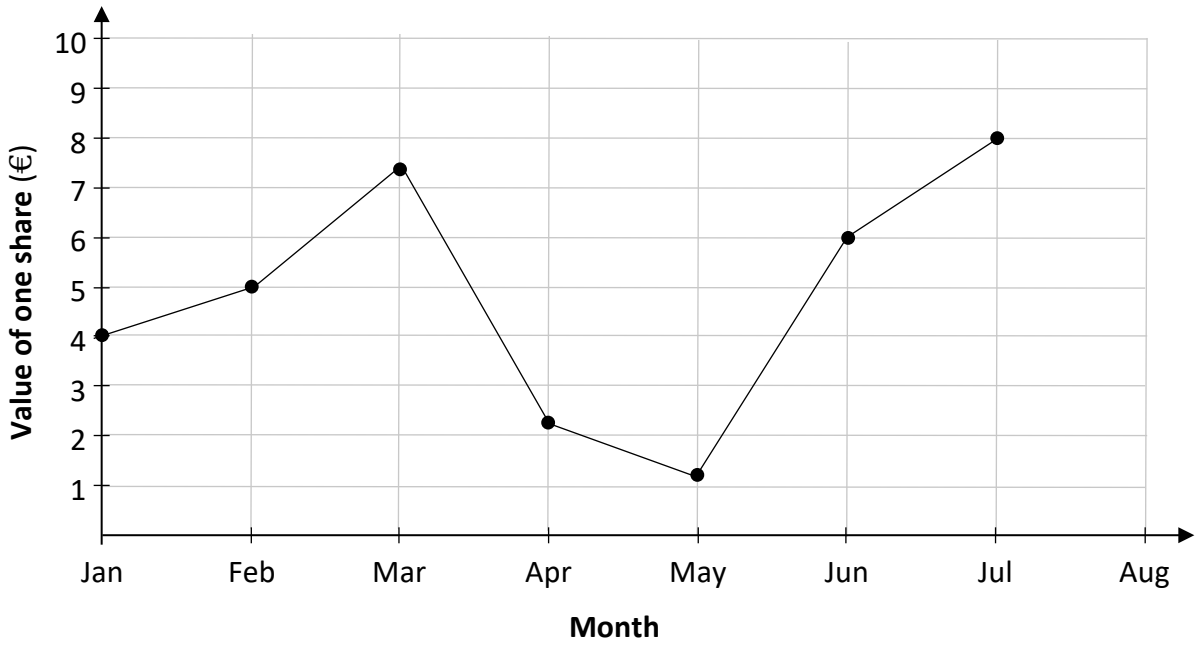


Section B — Contexts and Applications — 150 marks

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

Question 7 **(50 marks)**

The diagram below shows the value of one share for Company A, in euro, on the 1st day of each month from 1st January to 1st July.



(a) **(i)** Use the graph to estimate the value of one share on 1st March.

(ii) Use the graph to identify the month **during which** the value of one share increased by the greatest amount.

(b) On 1st August the value of one share was 15% lower than it was on 1st of July.
By reading from the graph and doing calculations, estimate the value of one share on 1st of August as accurately as possible **and** hence plot that point on the diagram on the previous page.

Calculations:

(c) Later in the year, Liam predicts the value of one share.
The error in his prediction is $€1{\cdot}50$, which is a percentage error of $16{\cdot}3\%$.

Find the value of one share at this time.
Give your answer correct to the nearest cent.

This question continues on the next page.

(d) The value of one share for Company B can be modelled by the function:

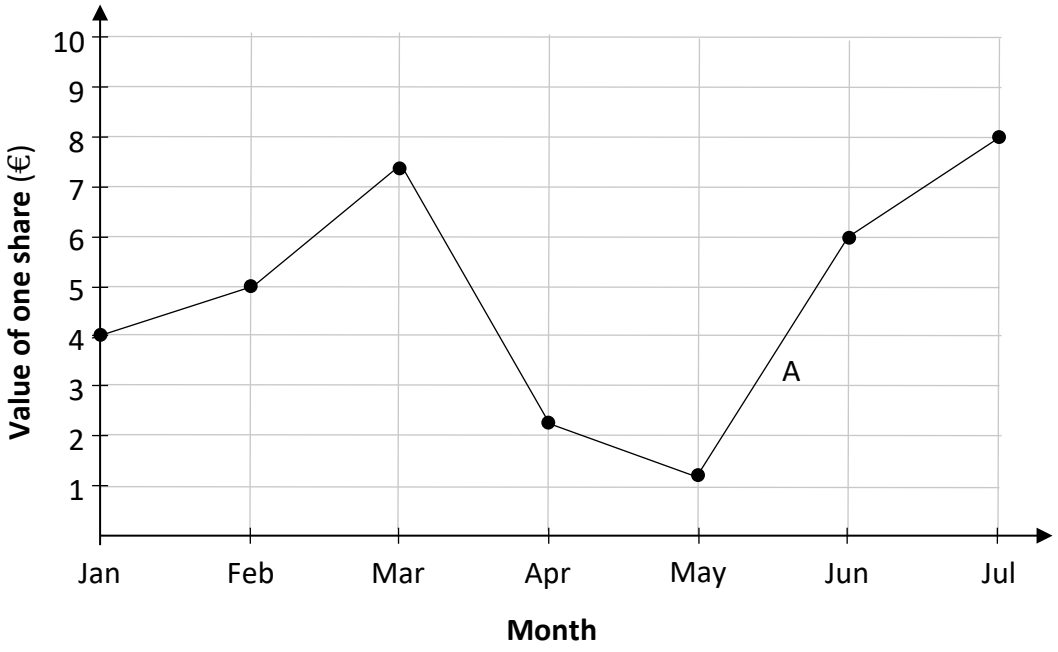
$$P(m) = 2 \times 1{\cdot}29^m$$

where $P(m)$ is the value of one share, in euro, and m is the time, in months, since 1st January, with $0 \leq m \leq 6, m \in \mathbb{R}$.

(i) Complete the table below to show the values of $P(m)$ for the given values of m. Give each value of $P(m)$ correct to 2 decimal places where relevant.

Month (1st of)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**
$\boldsymbol{m}$	0	1	2	3	4	5	6
$\boldsymbol{P(m)}$	2		3·33				9·22

(ii) The graph of Company A is shown again below.
On the same diagram, **draw the graph** of $P(m)$, for $0 \leq m \leq 6, m \in \mathbb{R}$.



(iii) At **only one** point in the time period shown, the value of one share for Company A is equal to the value of one share for Company B, according to the function $P(m)$.
In which month must this have happened?

(e) According to the model, the value of one share for Company B reaches its highest value on 1st July, and from then onwards it declines at a steady linear rate of 30 cent per month.

A new function is created to model this decline, where $Q(n)$ is the value of one share n months **after** the time the share reaches its highest value ($n \in \mathbb{N}$).

Part of the function is shown below:

$$Q(n) = \boxed{} \; -0{\cdot}3n$$

(i) Fill in the missing number in the box above to complete the expression for $Q(n)$.

(ii) Using your expression, or otherwise, find how many months it takes for the value of one share for Company B to fall below its value on 1st January, according to the model. Remember that $n \in \mathbb{N}$.

Question 8 **(50 marks)**

A company launches a new phone.
The company's profit each year will depend on the number of phones it produces, x.
The company's profit for the first year can be modelled by the function:

$$P(x) = -1{\cdot}5x^2 + 10{\cdot}5x - 4$$

where $P(x)$ is the profit for the first year (in millions of euro) and x is the number of phones (in tens of thousands) it produces in the first year, with $0 \leq x \leq 7, x \in \mathbb{R}$.

(a) **(i)** Find $P(0)$ **and** explain what it means in the context of the question.

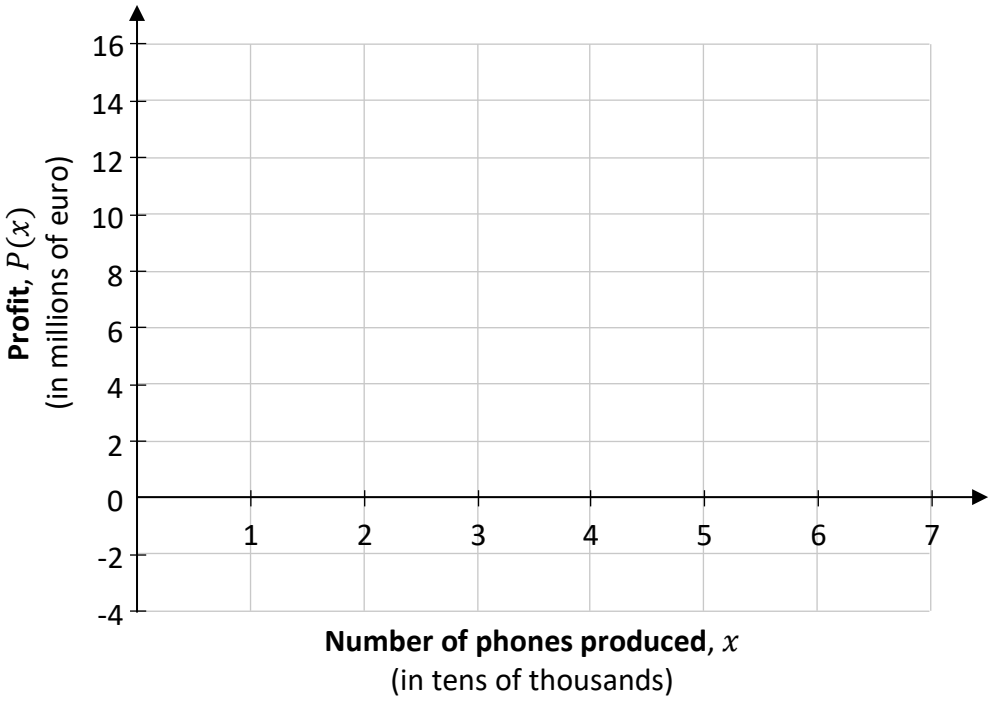
$P(0) =$

Explanation:

(ii) Complete the table below to show the values of $P(x)$ for the given values of x.

Number of phones produced, x (in tens of thousands)	0	1	2	3	4	5	6	7
Profit, $P(x)$ (in millions of euro)		5				11		

(iii) Draw the graph of $P(x)$ on the axes below for $0 \leq x \leq 7, x \in \mathbb{R}$.



(iv) Use your graph on the previous page to estimate the range of values of x for which the company will have a profit of at least €6 million. Show your work on the graph.

(b) The profit of the company for the **second** year can be modelled by the function:

$$Q(x) = -1{\cdot}5x^2 + 9{\cdot}6x - 3{\cdot}5$$

where $Q(x)$ is the profit for the second year (in millions of euro) and x is the number of phones (in tens of thousands) it produces in the second year, with $0 \leq x \leq 7$, $x \in \mathbb{R}$.

(i) Find $Q'(x)$, **and** hence find the value of x which will give the maximum value of $Q(x)$.

$Q'(x)$:

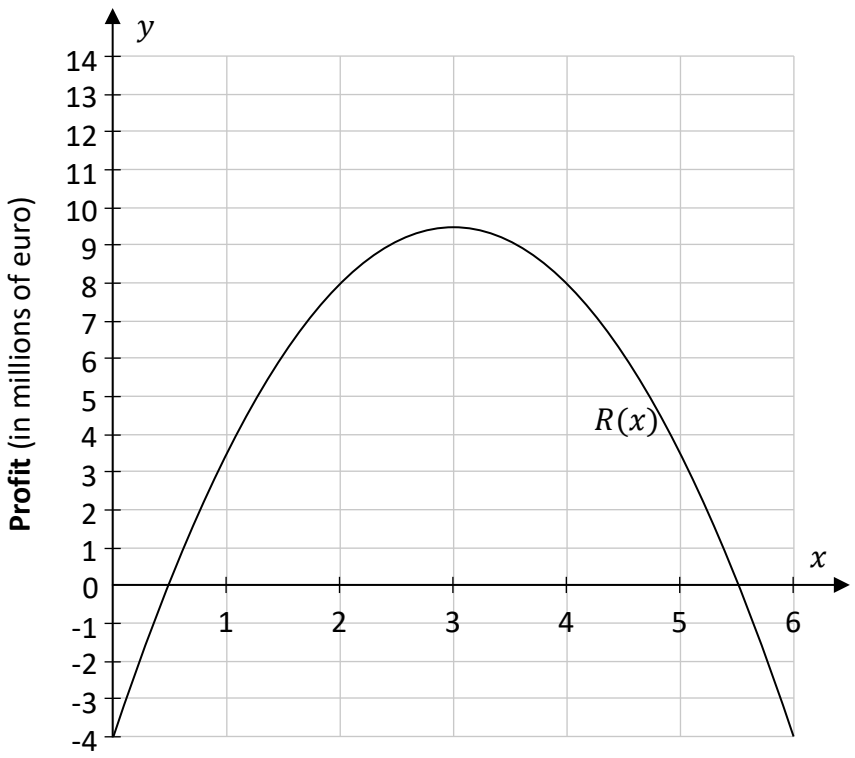
Value of x:

(ii) Hence, find the maximum value of $Q(x)$.

This question continues on the next page.

(c) The profit for the third year can be modelled by the function $R(x)$, where $R(x)$ is the profit for the third year (in millions of euro) and x is the number of phones (in tens of thousands) it produces in the third year, with $x \in \mathbb{R}$.

The graph of $R(x)$ is shown below for $0 \leq x \leq 6$, $x \in \mathbb{R}$.



At the start of the third year, the company receives €3 million in additional funding.
As a result, the profit for the third year can actually be modelled by:

$$\text{Profit} = R(x) + 3$$

(i) From the graph, estimate $R(2)$ **and** hence work out the value of $R(2) + 3$.

$R(2) =$ $R(2) + 3 =$

(ii) On the diagram above, draw the graph of $y = R(x) + 3$ for $0 \leq x \leq 6, x \in \mathbb{R}$, using the same axes and scales.

Question 9 **(50 marks)**

(a) Evan has €4500 saved.
He put this money in a savings account with a rate of 2·8% per annum compound interest.

(i) Find how much money will be in the account after 1 year.

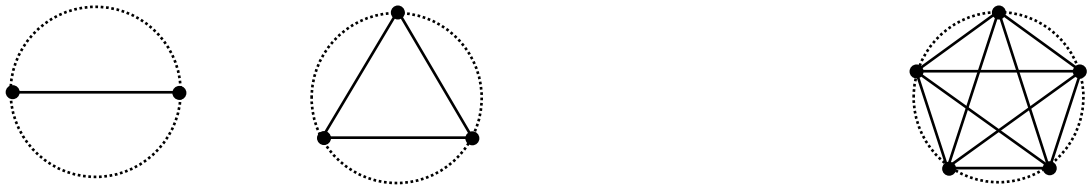
(ii) Hence, or otherwise, find how much money will be in the account at the end of 3 years using the rate of 2·8% per annum compound interest.
Give your answer correct to the nearest cent.

This question continues on the next page.

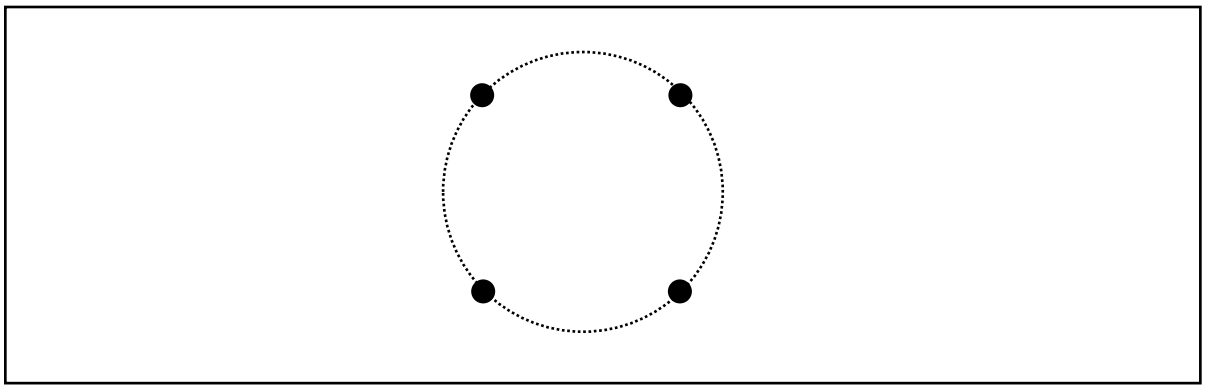
(b) A pattern is made up of dots and line segments.
The dots are evenly spaced on a circle.
Each pair of dots is joined by a line segment.
The first pattern has two dots and a line segment joining them.
Each pattern has one more dot than the previous pattern.

The diagram below shows pattern 1, pattern 2 and pattern 4 in the sequence.

Pattern 1 **Pattern 2** **Pattern 3** **Pattern 4**



(i) The dots for pattern 3 are drawn below. Complete pattern 3.



(ii) Complete the table below to show the number of dots and line segments in the first five patterns of the sequence.
The number of line segments in each pattern is in a quadratic sequence.

Pattern	1	2	3	4	5
Number of dots	2	3			
Number of line segments	1			10	

(iii) Write down the number of **dots** in the 1000th pattern.

(iv) S_n is the **total** number of dots required to make the first n patterns, where $n \in \mathbb{N}$. Write S_n in terms of n.

(v) Hence, or otherwise, find the total number of complete patterns in the sequence that can be made using 740 dots.

(vi) The formula for the number of **line segments** in term n is of the form:

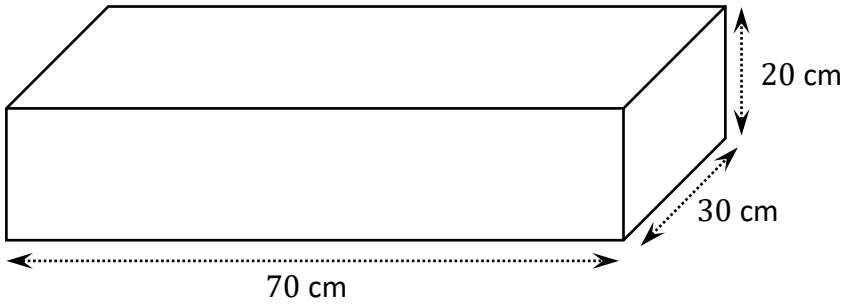
$$T(n) = 0{\cdot}5n^2 + bn$$

Find the value of b, where $b \in \mathbb{Q}$.

$b =$

Question 10 **(50 marks)**

(a) A factory makes closed boxes.
The lengths of the sides of one of the boxes are shown in the diagram below.



(i) Draw a scaled diagram of a net of the box in the grid below.
Use the scale $1:10$.
The length of each small square in the grid is 1 cm.

(ii) Work out the surface area of this box, in cm^2.

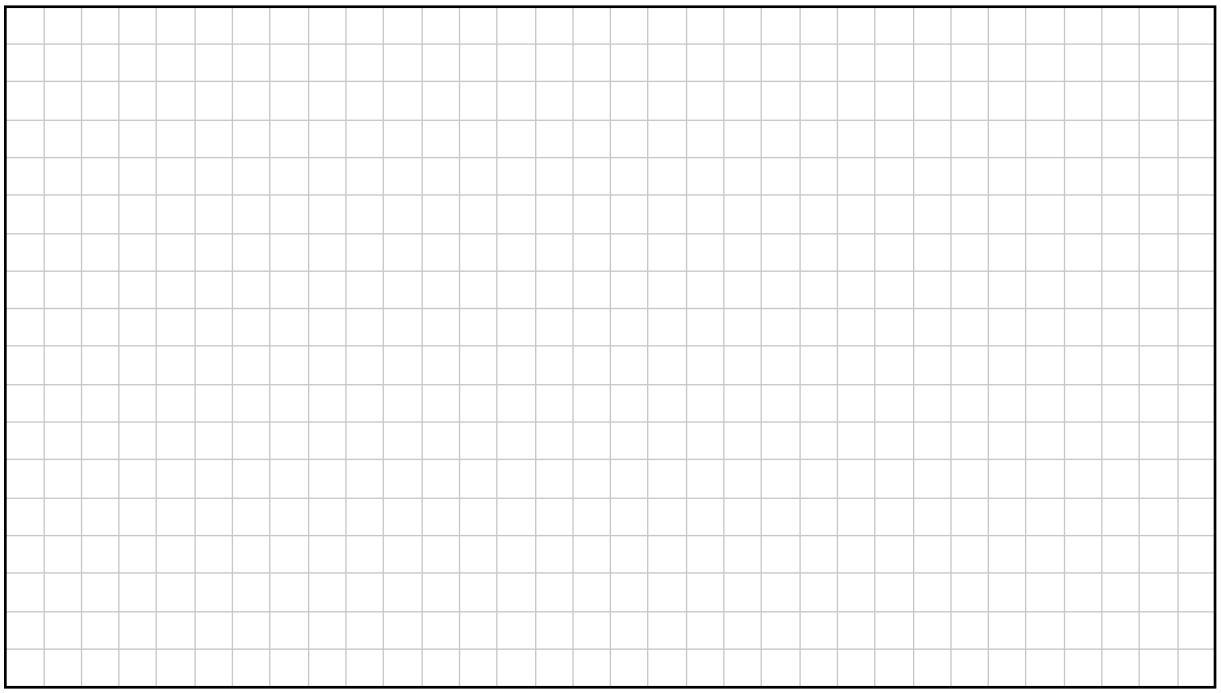
(iii) The factory owner buys a machine from China for making the boxes.
The machine costs $353\,819{\cdot}34$ Chinese Yuan, including shipping.
The factory owner must also pay $€1890$ in customs duty.

Using the exchange rate $€1 = 7{\cdot}61$ Chinese Yuan, find the **total** cost of the machine, in euro, including the customs duty.

This question continues on the next page.

(b) Ciara gets paid a wage of $€780$ per week for working 40 hours.
Ciara gets paid an hourly rate for any hours worked over the 40 hours.
This rate is 50% more than the hourly rate for the first 40 hours.

On a particular week, Ciara works her regular 40 hours, plus an additional n hours.
Her total wage is $€1043{\cdot}25$.
Work out the value of n.



(c) A shop repairs clothes. The charge for a repair is given by the formula:

$$C = \frac{20h + xh}{d}$$

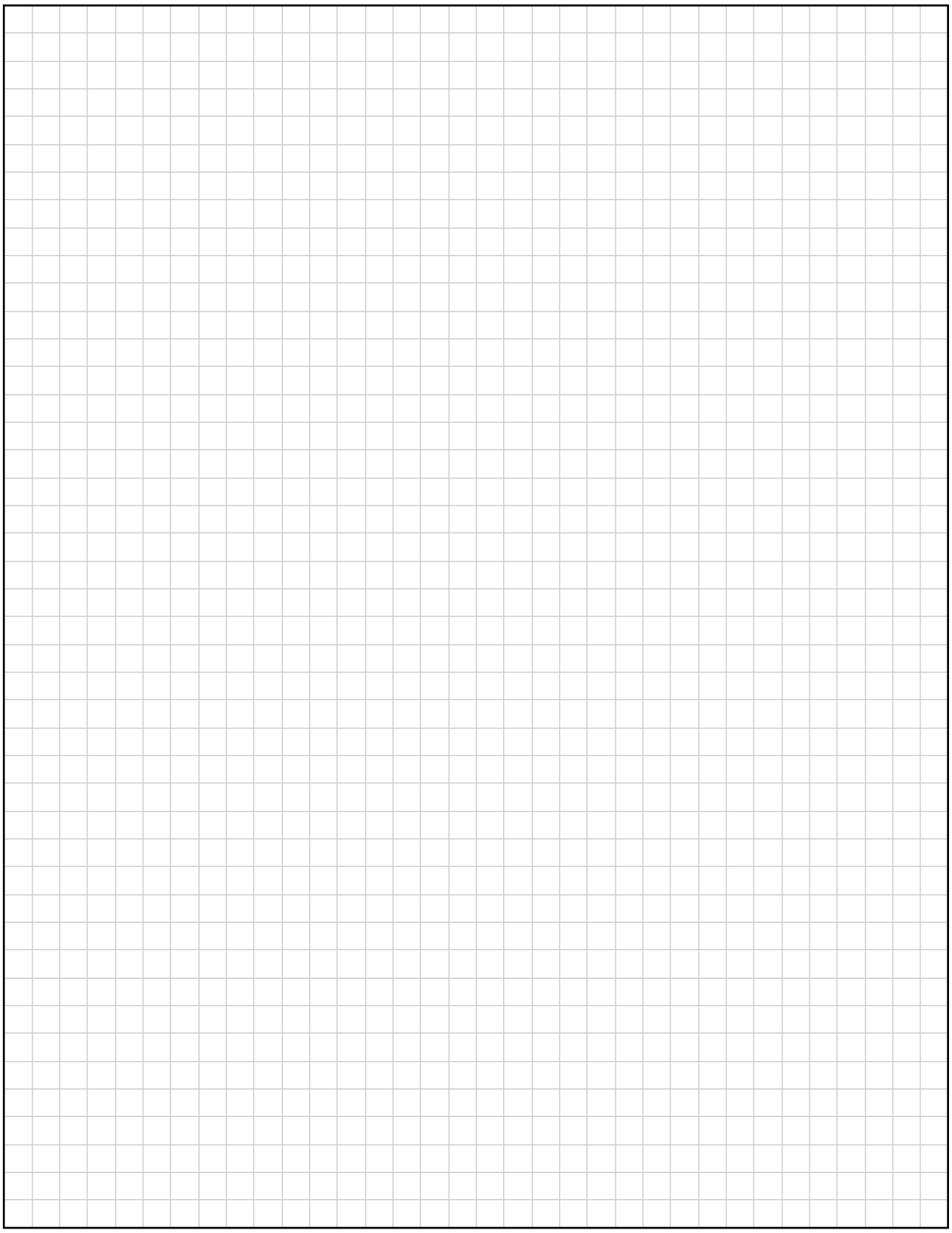
where C is the charge for the repair, in euro, h is the number of hours it took to do the repair, x is an extra hourly charge based on the level of difficulty of the work and d is a discount rate, with $d \geq 1$.

(i) Find the charge for a repair when it takes 3 hours to do the repair, the extra hourly charge, x, is $3{\cdot}5$, and the discount rate, d, is $1{\cdot}1$. Give your answer correct to 2 decimal places.

(ii) Find the value of x when the charge for the repair is €76, the repair takes 4 hours, and the discount rate is $1{\cdot}2$.

(iii) In the formula for C above, $d \geq 1$.
What impact would changing d, so that $d < 1$, have on the charge for a repair?

You may use this page for extra work.
Label any extra work clearly with the question number and part.



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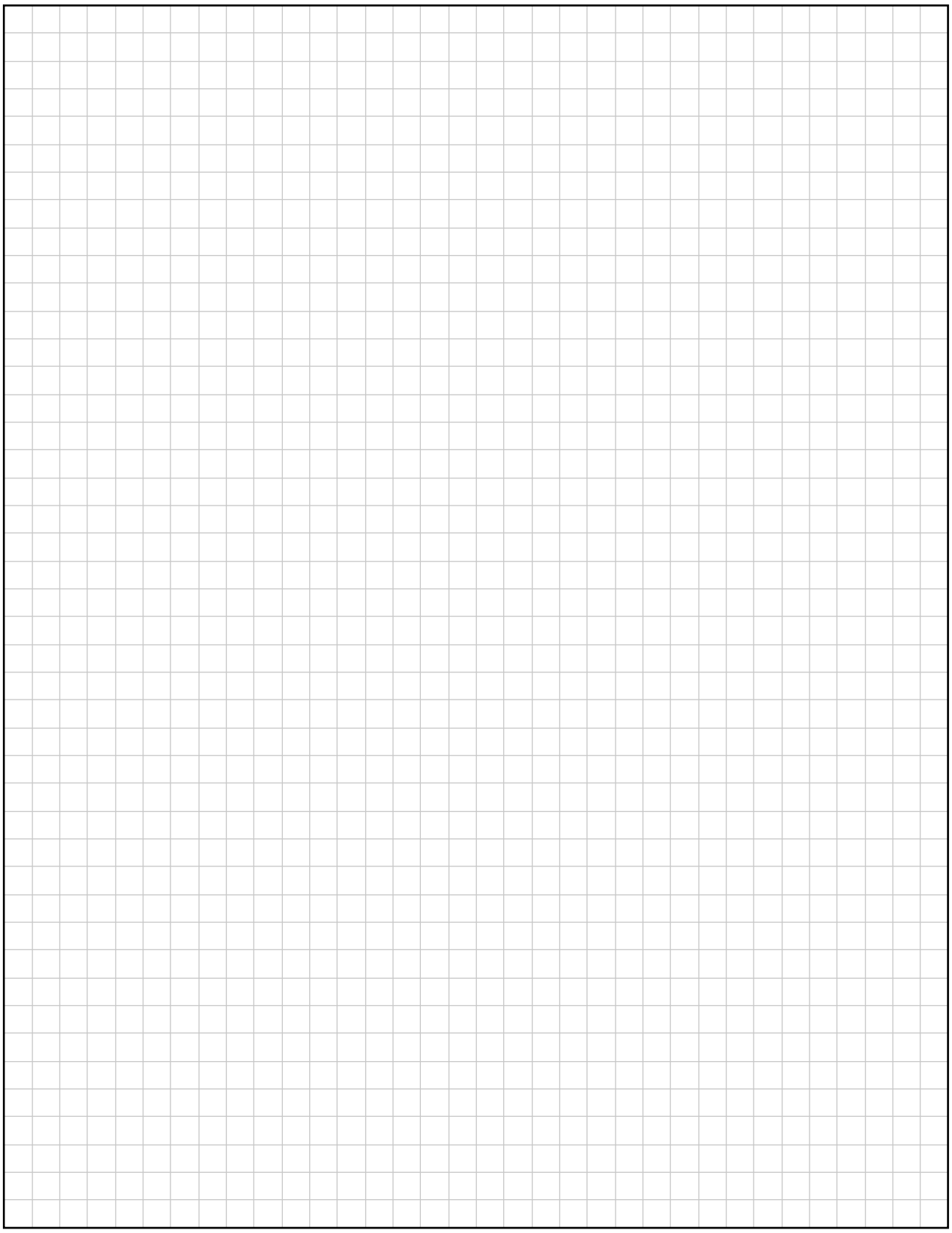

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Leaving Certificate – Ordinary Level

Mathematics Paper 1

Friday 6 June

Afternoon 2:00 - 4:30