2024.S34

2024J003A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle Final Examination 2024

Mathematics

Higher Level

Friday 7 June Afternoon 1:30 - 3:30

270 marks

Examination Number

Date of Birth

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

Centre Stamp

Instructions

There are 13 questions on this examination paper. Answer **all** questions.

Questions do not necessarily carry equal marks. To help you manage your time during this examination, a maximum time for each question is suggested. If you remain within these times you should have about 10 minutes left to review your work.

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 may lose marks if your solutions do not include supporting work.

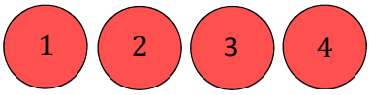
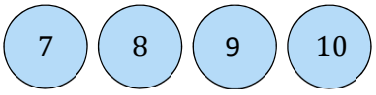
You may lose marks if you do not include the appropriate units of measurement, where relevant.

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:

Question 1 **(Suggested maximum time: 5 minutes)**

Bea has eight numbered counters.
There are four red counters numbered 1 to 4 and four blue counters numbered 7 to 10.

Red counters	Blue counters
	

Bea picks one red counter at random and one blue counter at random.

(a) Complete the table to show all 16 different pairs of counters Bea could pick.
One has already been done for you.

		Blue counters			
		7	**8**	**9**	**10**
Red counters	**1**				
	2		$(2, 8)$		
	3				
	4				

(b) Find the **probability** that one of the counters Bea picks is a 7.

(c) List the pairs of counters where **both** numbers are **prime**.

Question 2 **(Suggested maximum time: 15 minutes)**

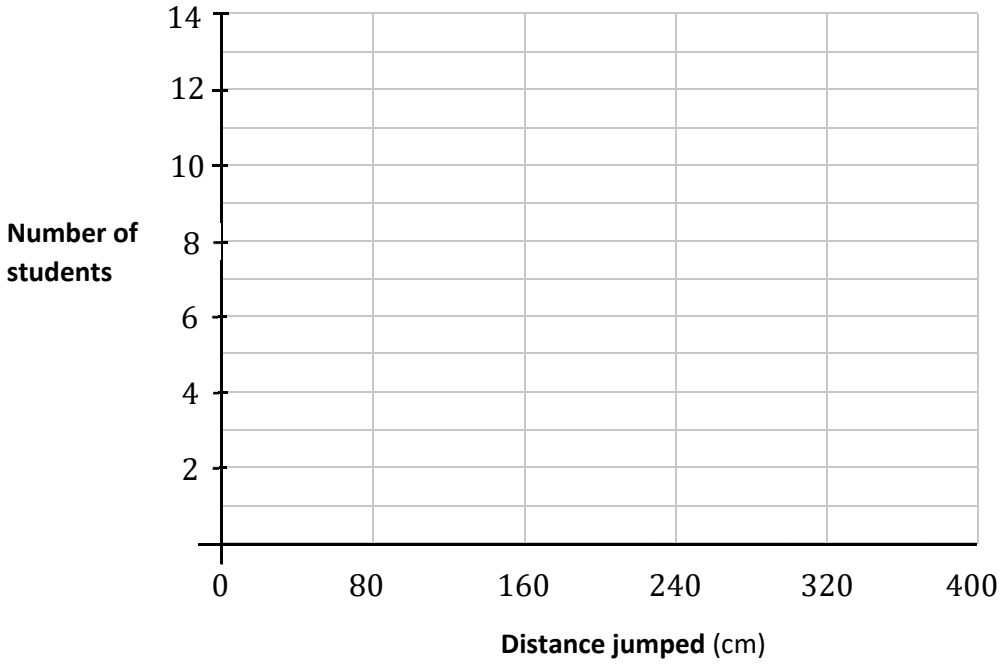
The table below shows the distances in centimetres jumped by a group of students during a school long jump competition.

Distance jumped (cm)	$0-80$	$80-160$	$160-240$	$240-320$	$320-400$
Number of students	0	2	7	12	3

[Note: $80-160$ means 80 cm or more, but less than 160 cm, etc.]

(a) Work out the number of students who jumped less than 240 cm.

(b) Draw a **histogram** to show the information in the table.
Use the axes and scales below.



(c) Work out the maximum number of students who could have jumped more than 200 cm.

(d) Use mid-interval values to estimate the mean distance jumped by the group of students.
Give your answer correct to the nearest centimetre.

(e) Estimate the median distance jumped, as accurately as you can.
Show your working out.

Estimate of median $=$

Question 3 **(Suggested maximum time: 10 minutes)**

Tomás works as a chef in a restaurant.

(a) The table below shows the hours he worked one weekend.
His basic pay is **€19 per hour.**

Day	Friday	Saturday	Sunday
Numbers of hours worked	7	8	6

(i) How much money in **total** did Tomás earn for working on Friday and Saturday?

(ii) Tomás is paid 50% extra for working on Sunday.
How much did he earn for working on Sunday?

(b) Tomás's gross income was €1900 last month.
He pays tax at a rate of 20%.
His monthly Tax Credit is €312·50.
Work out Tomás's **net income** for the month.

(c) Tomás puts €2500 into a special savings account.
This account offers interest at a rate of $3{\cdot}2\%$ per year for 2 years, compounded annually.
Tomás does not put any money in or take any money out of the account over the 2 years.

(i) How much **interest** will Tomás earn in the first year?

(ii) Work out the **total amount** in the account after the 2 years.

Question 4 **(Suggested maximum time: 10 minutes)**

Ciara is making an orange drink.
The orange drink is made by mixing concentrate and water.
The ratio of concentrate to water is $1 : 4$.

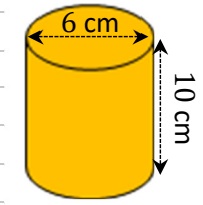
(a) Ciara makes 15 litres of the orange drink.
Work out how many **litres of concentrate** Ciara uses to make the drink.

(b) Ciara sells glasses of the orange drink for **€0·20 each.**
Each glass contains 250 ml of the drink.

She sells 10 litres altogether.
The total cost was €$5{\cdot}50$.

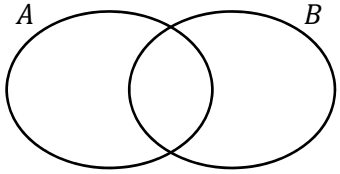
Work out her **profit** as a **percentage** of the total cost.
Give your answer correct to 1 decimal place.

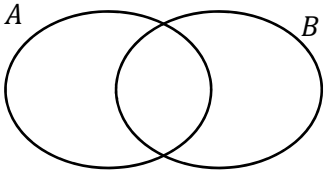
(c) Each glass is approximately the shape of a cylinder with **diameter** 6 cm and **height** 10 cm.
Find the volume of a glass correct to the nearest cm^3.



Question 5 **(Suggested maximum time: 5 minutes)**

(a) A and B are two sets.
Complete the tables below by shading in each of the given sets in the diagram.

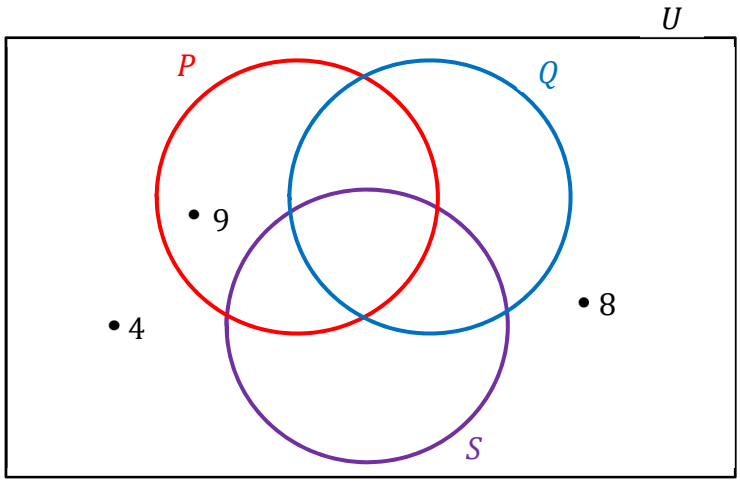
Set	$A \cap B$
Venn diagram	

Set	$A \backslash B$
Venn diagram	

(b) The sets U, P, Q, and S are as follows:

$$U = \{\text{Natural numbers from 1 to 10}\}$$
$$P = \{3,\ 5,\ 6,\ 9\}$$
$$Q = \{3,\ 5,\ 10\}$$
$$S = \{\text{factors of 10}\}$$

Complete the Venn diagram below by writing each element of the set U in the correct region of the Venn diagram.



(i) List the element(s) of the set $P \cap Q \cap S$.

$P \cap Q \cap S =$

(ii) List the elements of the set $P \backslash Q$.

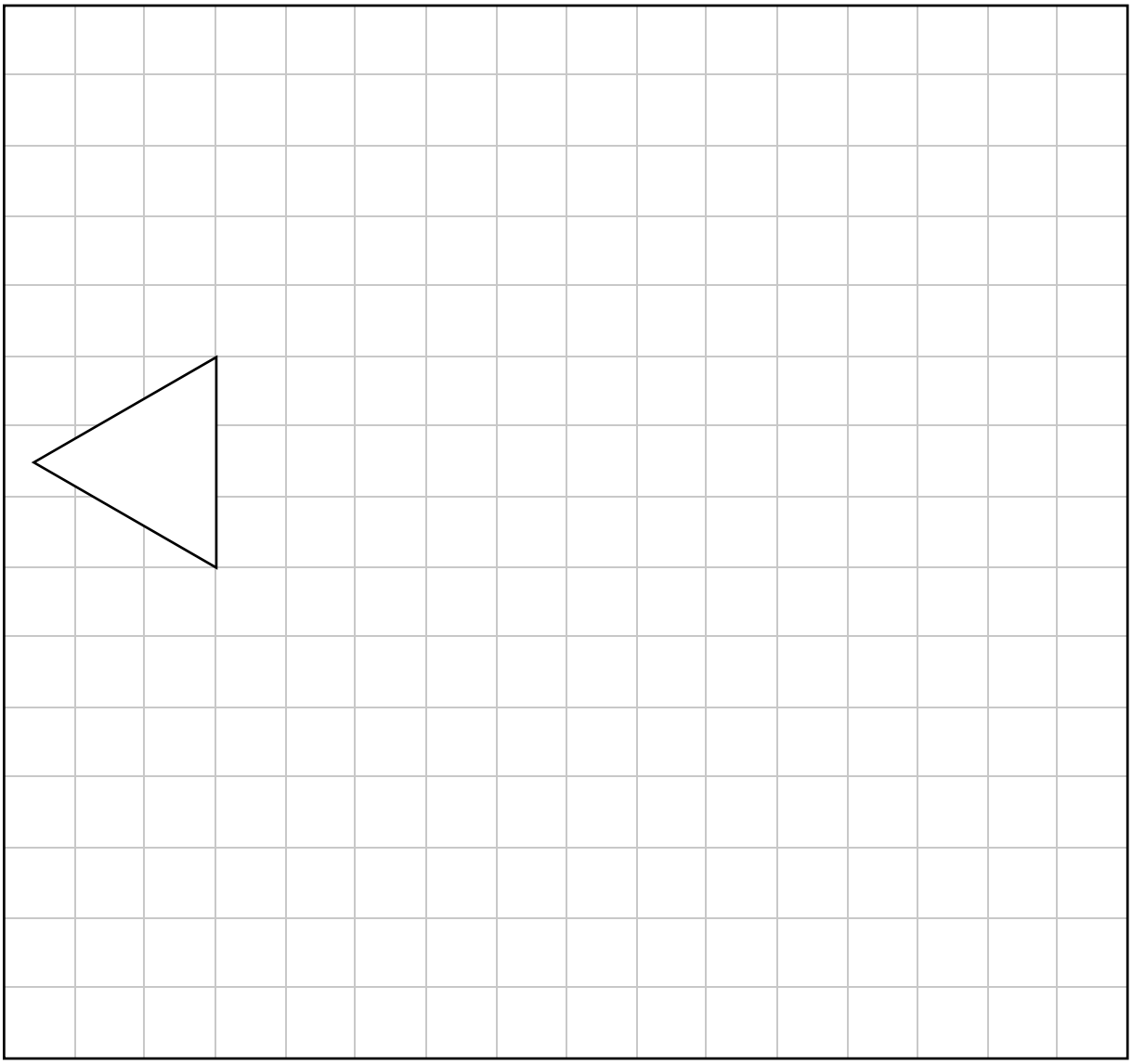
$P \backslash Q =$

Question 6 **(Suggested maximum time: 5 minutes)**

A chocolate bar in the shape of a prism is shown below.

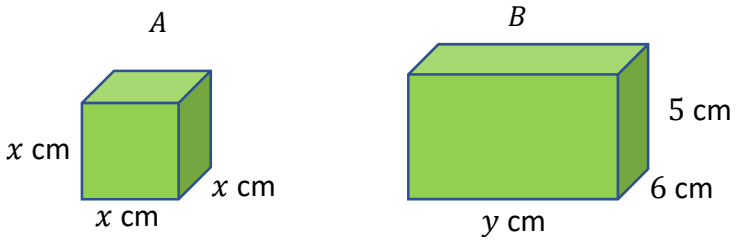
The front and back faces are each in the shape of equilateral triangles, with sides of length 3 cm.
The other three faces are each in the shape of rectangles that are 9 cm in length, as shown above.

Complete an accurate net of the prism below, by drawing in the four missing faces.
One of the triangular faces has already been drawn.
Each small square in the grid has sides of length 1 cm.



Question 7 **(Suggested maximum time: 10 minutes)**

Two rectangular solids, a cube A and a cuboid B, are shown in the diagram below (not to scale).
The edges of cube A have length x cm, where $x \in \mathbb{R}$.
Cuboid B has dimensions 5 cm, 6 cm, and y cm, where $y \in \mathbb{R}$.



(a) The **volume** of A is 216 cm^3.
Find the value of x.

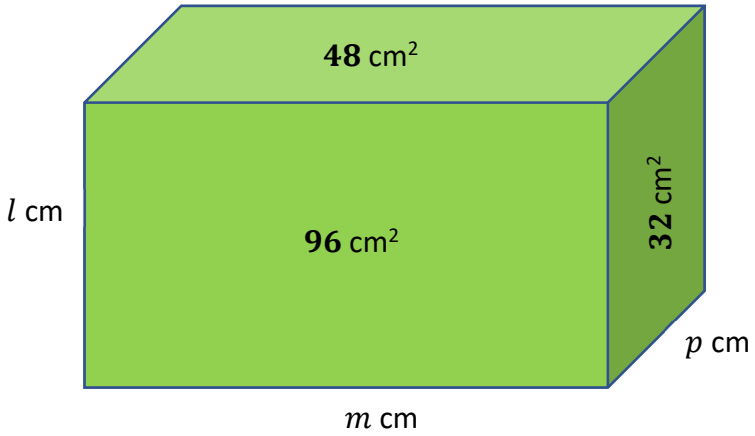
(b) **(i)** Show that the **surface area** of B is $(22y + 60)$ cm^2.

(ii) The **surface area** of B is 269 cm^2.
Work out the value of y.

This question continues on the next page

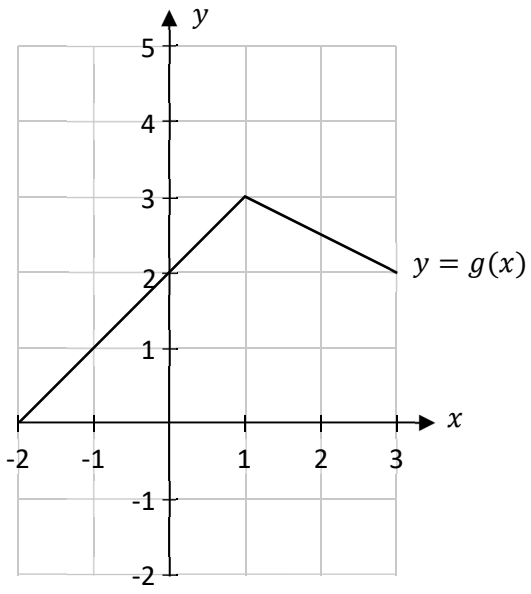
(c) The area of three faces of a different cuboid are shown on the diagram below (not to scale). The dimensions of this cuboid are l cm by m cm by p cm, where l, m and p are all **whole numbers.**

Work out the **volume** of the cuboid.
Give your answer in cm^3.



Question 8 **(Suggested maximum time: 5 minutes)**

The graph below shows the function $g(x)$ for $-2 \leq x \leq 3, x \in \mathbb{R}$.
Use this graph to answer the following questions.



(a) Write down the value $g(3)$.

$$g(3) = \boxed{}$$

(b) Write down the value of x for which $g(x) = 1$.

$$x = \boxed{}$$

(c) **Draw** the graph of the function

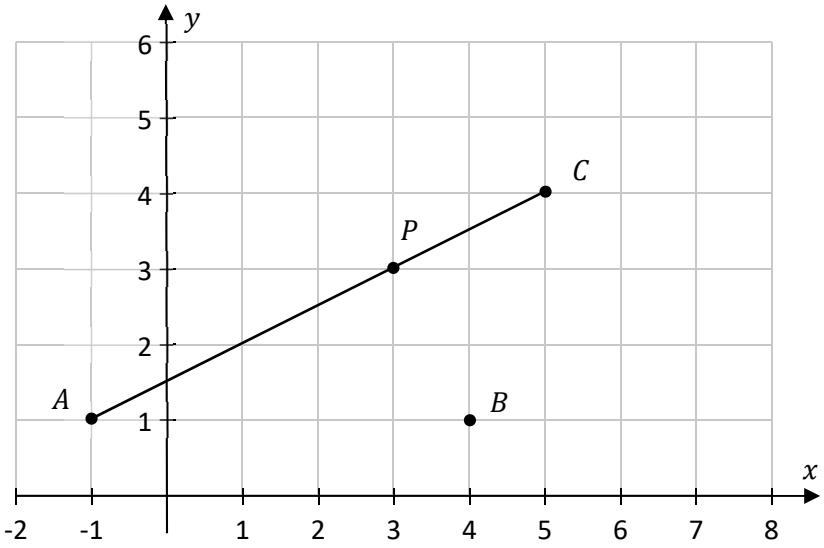
$$y = g(x) - 2$$

on the diagram above, for $-2 \leq x \leq 3, x \in \mathbb{R}$.

Calculations, if needed:

Question 9 **(Suggested maximum time: 10 minutes)**

The co-ordinate diagram below shows a line segment $[AC]$ and the points $B(4, 1)$ and $P(3, 3)$.



(a) Write down the co-ordinates of the point A and the point C.

$A =$ (,) $C =$ (,)

(b) **(i)** D is a point (not shown).
D is the image of the point B under **central symmetry** in the point P.

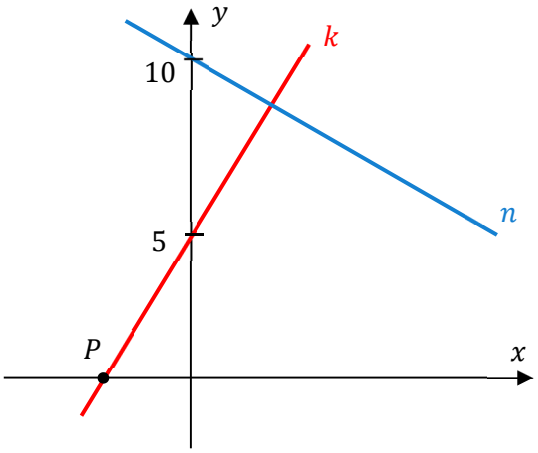
Plot and label the point D on the diagram above and **join** the points A, B, C and D to form the quadrilateral $ABCD$.

(ii) Kate says the quadrilateral $ABCD$ is **not** a parallelogram.

Find $|AB|$ and $|CD|$ and use these values to explain why Kate is correct.

Question 10 **(Suggested maximum time: 5 minutes)**

The equation of the line k is $y = 2x + 5$.
The line k intersects the y-axis at the point $(0, 5)$ and the x-axis at the point P.



(a) Find the co-ordinates of the point P.

$$\mathrm{P} = \boxed{(\qquad , \qquad)}$$

(b) The line n is **perpendicular** to the line k, and goes through the point $(0, 10)$.
Find the equation of the line n.
Give your answer in the form $ax + by + c = 0$, where $a, b, c \in \mathbb{Z}$.

Question 11 **(Suggested maximum time: 10 minutes)**

(a) Work out the value of $12 - 3k^2$ when $k = -2$.

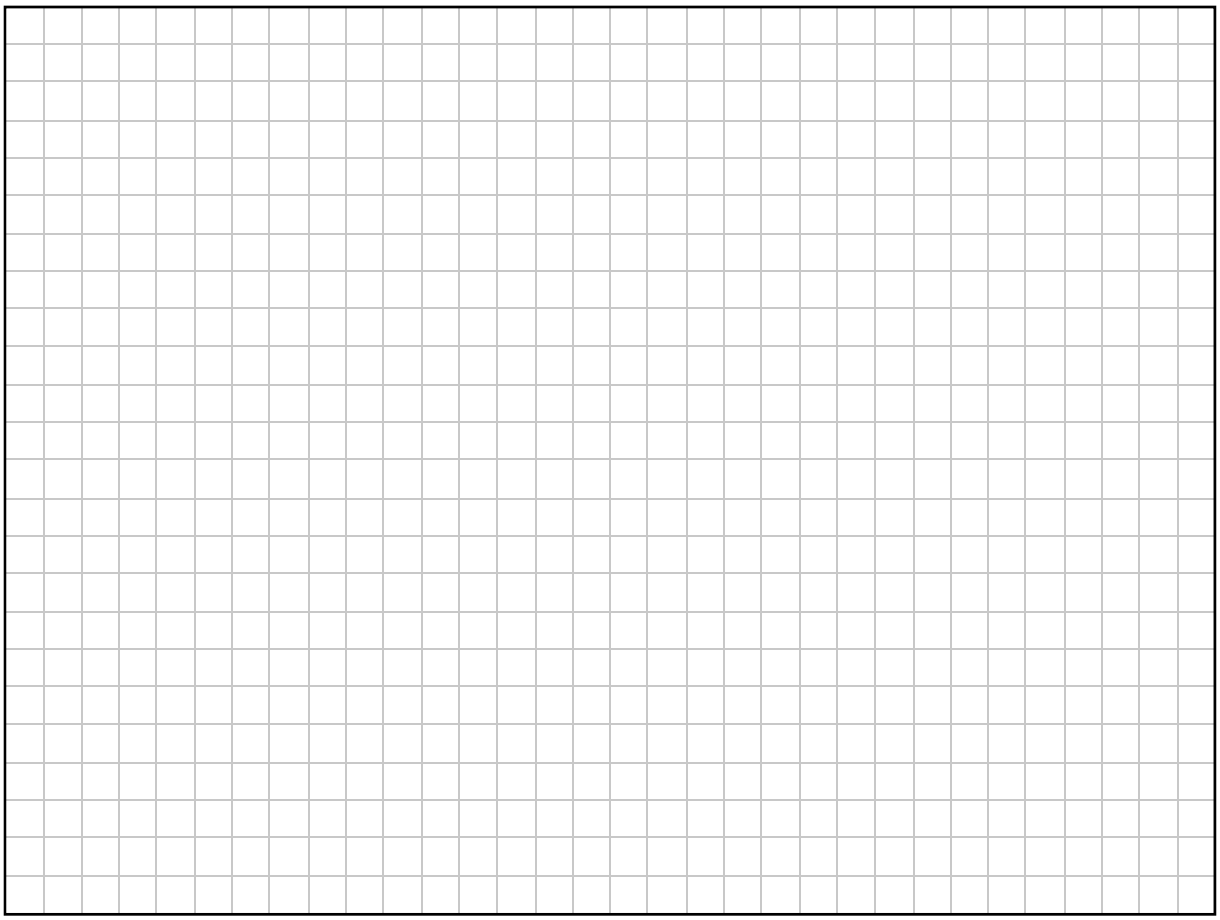
(b) Factorise fully $pm + 3p - m - 3$.

(c) Graph each of the following inequalities on the number line given.

Inequality	Number line
$\boldsymbol{x < 2}$, where $\boldsymbol{x} \in \mathbb{Z}$	-4 -3 -2 -1 0 1 2 3 4
$\boldsymbol{x \leq 3}$, where $\boldsymbol{x} \in \mathbb{N}$	-4 -3 -2 -1 0 1 2 3 4
$\boldsymbol{-2 < x \leq 4}$, where $\boldsymbol{x} \in \mathbb{R}$	-4 -3 -2 -1 0 1 2 3 4

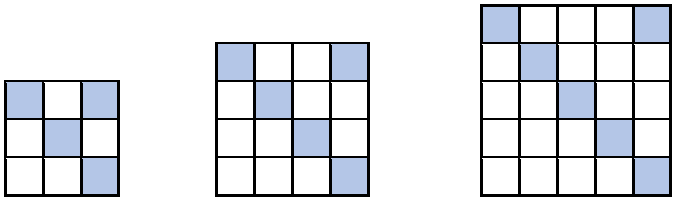
(d) Write the following expression as a single fraction in its simplest form:

$$\frac{5x-2}{3}+\frac{2}{5x+2}$$



Question 12 **(Suggested maximum time: 10 minutes)**

The first 3 patterns in a sequence are shown below.
Each pattern consists of white squares and shaded squares.



Pattern 1 Pattern 2 Pattern 3

(a) Draw Pattern 4 in the sequence.

(b) Complete the table to show the number of **shaded squares** and the **total** number of squares in the sequence. Give your answer in the last row in terms of n, where $n \in \mathbb{N}$.

Pattern	Number of shaded squares	Total number of squares
1	4	9
2		
3		
4		
5		
$\boldsymbol{n}$		$\boldsymbol{(n+2)^2}$

(c) In pattern $\boldsymbol{k}$, the **difference** between the **total number of squares** and the **number of shaded** squares is $\mathbf{271}$.

(i) Show that this means that:

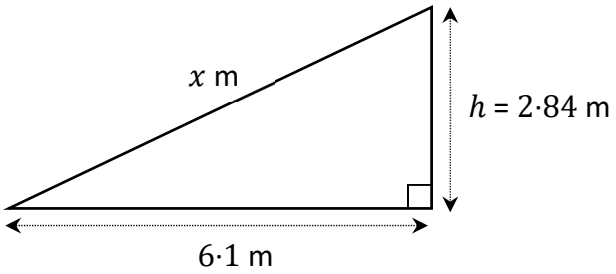
$$k^2 + 3k + 1 = 271$$

(ii) Solve the equation $\boldsymbol{k^2 + 3k + 1 = 271}$ to work out the value of $\boldsymbol{k}$.

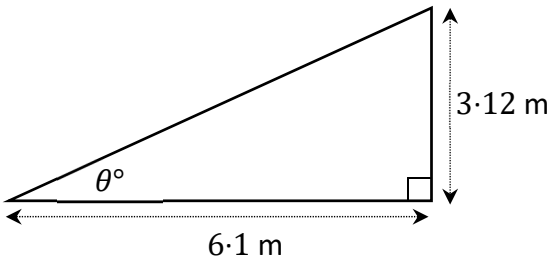
Question 13 **(Suggested maximum time: 10 minutes)**

Michael is designing the roof of a house.
The width of the roof is $6{\cdot}1$ m.
The roof will be in the shape of a right angled triangle of height h, where $h \in \mathbb{R}$.
Michael can choose different values for h.

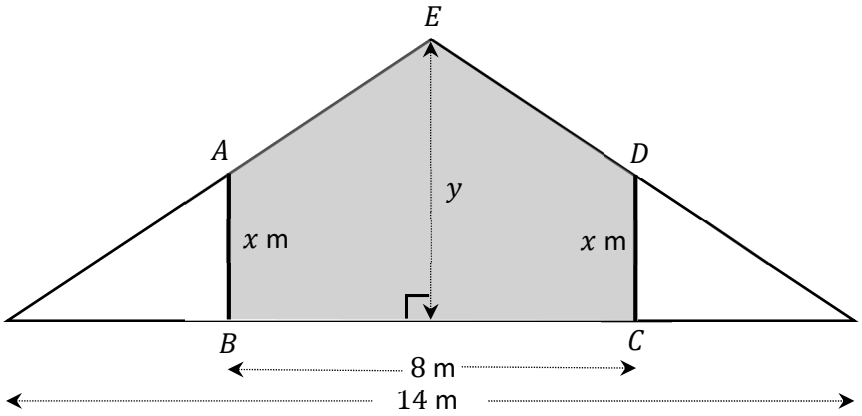
(a) The diagram below shows one possible design for the roof (not to scale).
Calculate the slant height (x m) of the roof in this diagram, correct to 2 decimal places.



(b) The diagram below shows a different design for this part of the roof (not to scale).
Use trigonometry to work out the size of the angle marked θ in the diagram.
Give your answer in degrees, correct to the nearest degree.



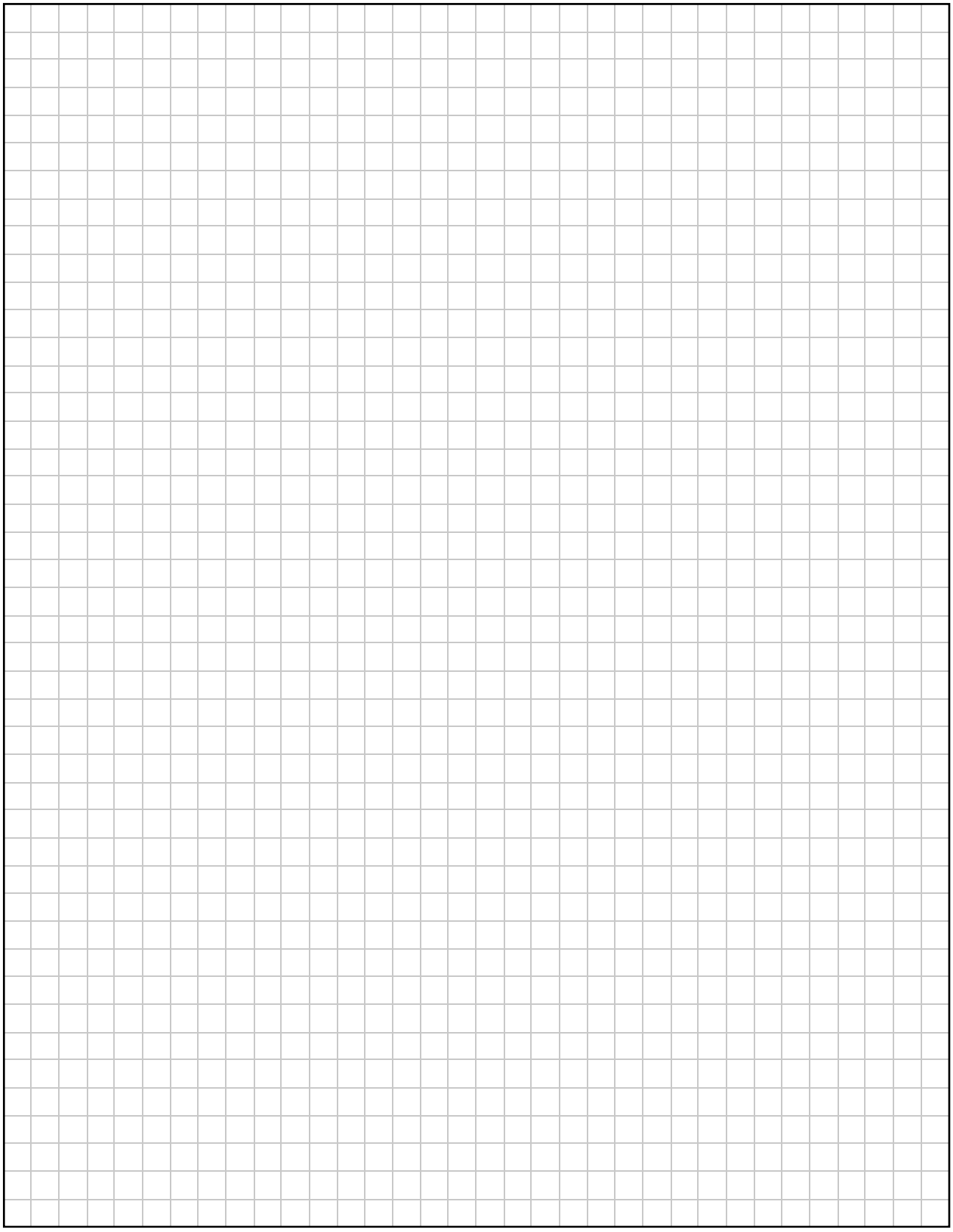
A different part of the roof is in the shape of an isosceles triangle, with base 14 m. In this part of the roof Michael makes an attic room, by putting in the two vertical side walls $[AB]$ and $[DC]$ shown in the diagram below (not to scale). The distance from B to C is 8 m.
The total height of the roof is y metres, and $|AB| = |DC| = x$ metres, where $x, y \in \mathbb{R}$.



(c) **(i)** Use similar triangles to show that $x = \frac{3y}{7}$.

(ii) The area of the shaded region $ABCDE$ in the diagram is 12 m^2.
Using your answer from **part (c)(i)**, or otherwise, work out the value of y.

Page for extra work.
Label any extra work clearly with the question number and part.



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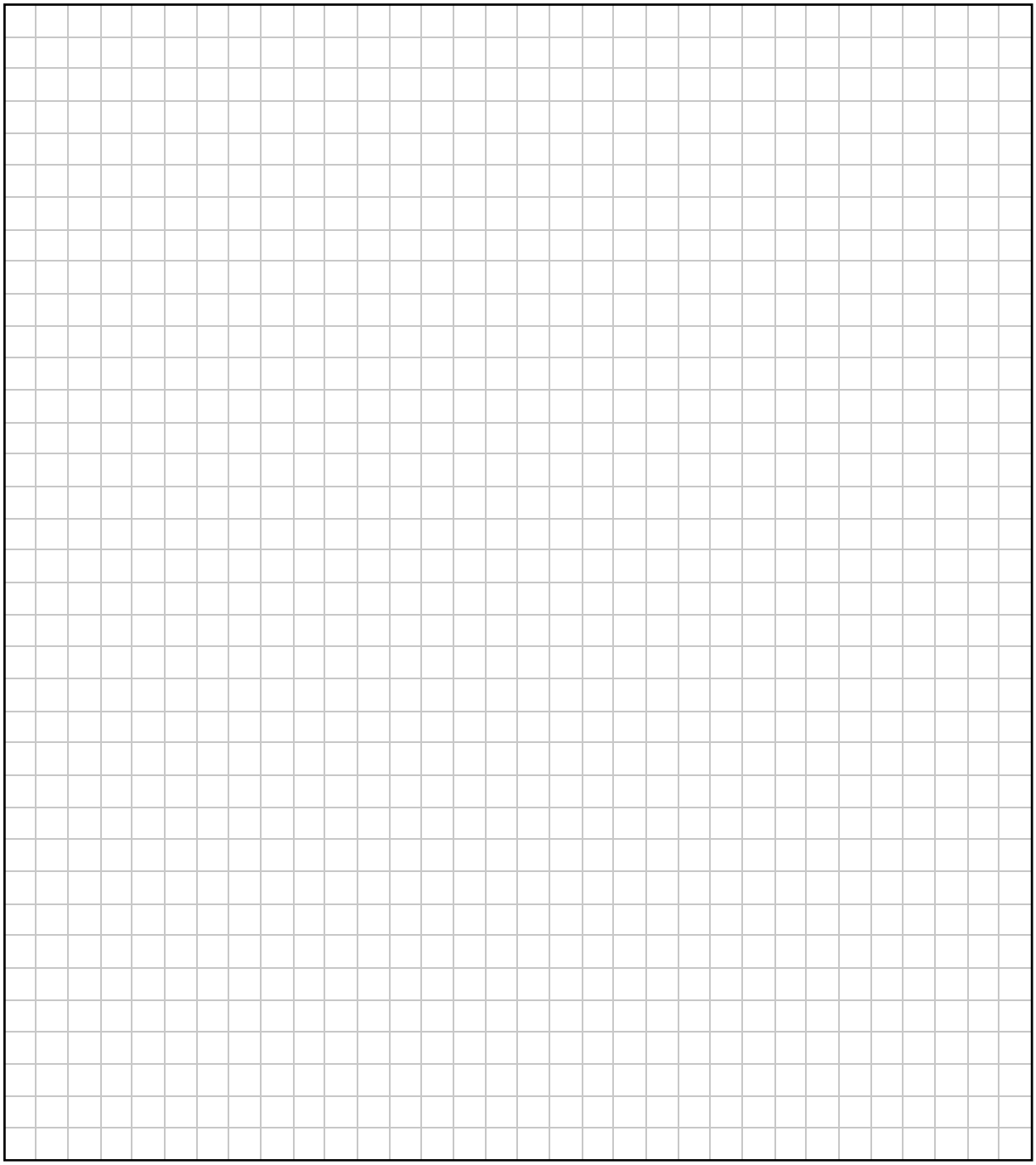

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Junior Cycle Final Examination – Higher Level

Mathematics

Friday 7 June

Afternoon 1:30 - 3:30