APSMO

2025 OLYMPIADS

IMPORTANT

APSMO

2025 OLYMPIADS

MATHS OLYMPIAD

Organisation and Procedures

For full details, see the Members' Area

To ensure the integrity of the competition, the Olympiads must be administered under examination conditions.

DO	DO NOT
• Supervise students at all times • Seat students apart • Maintain silence • Provide blank working paper • Give time warnings when 3 minutes remain, and again when 1 minute remains • Collect, mark and retain the papers	• Print the Olympiad papers prior to the Olympiad Date • Read the questions aloud to the students • Interpret the questions for students • Permit any discussion or movement around the room • Permit the use of calculators or other electronic devices

- Olympiad papers are scored by the PICO using the *Solutions and Answers* sheet provided.
- Results should be submitted in the Members' Area within 7 days of the Olympiad.
- Original student answer sheets should be retained by the PICO until the end of the year.
- *Solutions and Answers sheets* are not to be handed out to students. They are a teaching resource for use in class ***after*** completion of the Olympiad paper.

Timing of the Olympiad

- The *Total Time Allowed* for the Olympiad is **30 minutes**.

Absent Student Policy

A student who is legitimately absent on the Olympiad date, may sit the Olympiad under examination conditions on their first day back at school (if that date is within 2 weeks of the original Olympiad date). If these conditions cannot be met, the student must be marked as absent on the submitted results.

The Absent Student Policy is available in the **Contest Administration** section of the Members' Area.

APSMO

2025: DIVISION J
WEDNESDAY 30 JULY 2025

OLYMPIAD

3

Total Time Allowed: ***30 Minutes***
Calculators NOT Permitted

Write your answers in the boxes on the back.

Keep your answers hidden by folding backwards on this line.

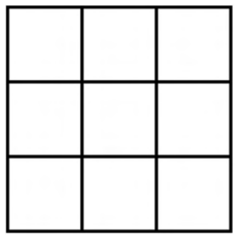
3A. There are three different prime factors of 429.

What is the sum of these prime factors?

3B. The largest square in this diagram is composed of nine 1×1 squares.

There are a total of 14 squares in the diagram.

How many squares, of any size, can be traced on the lines of a square composed of twenty-five 1×1 squares?



3C. Alice's friends are trying to guess her 3-digit number, which has no digit repeated and does not start with zero.

Bella guessed 538. Cindy guessed 275. Danny guessed 921. Eddy guessed 610.

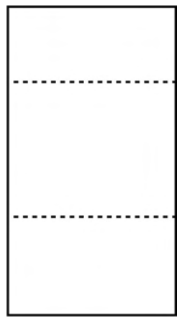
Alice said that two friends got exactly 1 digit correct while the other two got exactly 2 digits correct.

But Alice also said that none of the correct digits were in their correct place.
What is Alice's 3-digit number?

3D. A rectangle with perimeter 40 cm is divided into 3 smaller rectangles by adding two horizontal lines drawn parallel to the width of the larger rectangle.

The sum of the perimeters of the 3 smaller rectangles is 72 cm.

What is the area of the original rectangle in square centimetres?



3E. The letters in the word BAT can be arranged in 6 different ways.

The letters in the word BEE can be arranged in 3 different ways.

In how many different ways can the letters in the word COCOA be arranged?'

APSMO

MATHS OLYMPIAD

APSMO

2025: DIVISION J
WEDNESDAY 30 JULY 2025

OLYMPIAD

3

Student Name:

3A.

3B.

3C.

3D.

3E.

Fold Here. Keep your answers hidden.

APSMO MATHS OLYMPIAD

APSMO

2025: DIVISION J
WEDNESDAY 30 JULY 2025

OLYMPIAD 3

Solutions and Answers

For teacher use only. Not for Distribution.

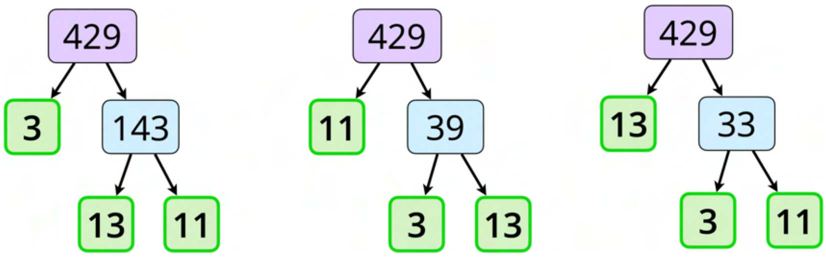
3A: 27	**3B:** 55	**3C:** 152	**3D:** 96	**3E:** 30

3A. The question is:

There are three different prime factors of 429. What is the sum of these prime factors?

Strategy: *Draw a diagram.*

Find the factors of 429 using factor trees and identify the 3 prime numbers.



The sum of these 3 prime factors is 3 + 11 + 13 = **27**

Strategy: *Prime factorisation using the division method.*

To find the 3 different prime factors of 429, we can use the prime factorisation division method.
The first step is to divide 429 by the smallest prime number that divides the number evenly.

3	429
	143

429 is not divisible by 2. The smallest prime number that does divide 429 evenly is **3**.
Now we divide the quotient (143) by the smallest prime number by which it can be divided evenly.

3	429
11	143
	13

143 is not divisible by 2, 3, 5 or 7.
The smallest prime number that does divide 143 evenly is **11**.
143 ÷ 11 = 13
13 is not divisible by 2, 3, 5, 7 or 11.

3	429
11	143
13	13
	1

Therefore, the smallest prime number that can divide 13 evenly is **13**.
13 ÷ 13 = 1
Now we have 1 as the quotient.
We have completed the prime factorisation of 429.
The sum of these 3 prime factors is 3 + 11 + 13 = **27**

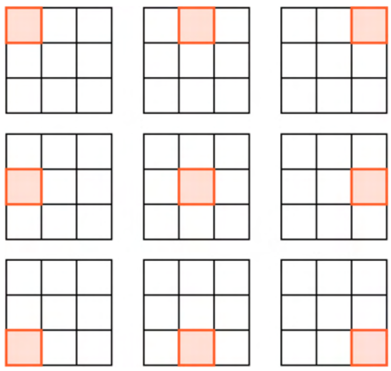
3B. The question is:

How many squares, of any size, can be traced on the lines of a square composed of twenty-five 1×1 squares?

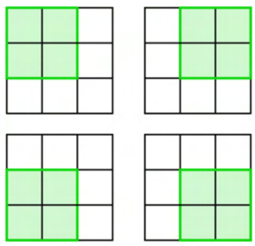
Strategy: *Build a table and look for a pattern.*

Start with the diagram of nine 1×1 squares.

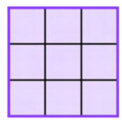
Count the number of squares that have a side length of **1**. There are 9.



Next, count the number of squares that have a side length of **2**. There are 4.



Next, count the squares that have a side length of 3. There is one square.



Organise the data collected into a table and look for a pattern.
Each of these numbers is a perfect square.

Size of Square	Number of Squares	
1×1	9	→ 3^2
2×2	4	→ 2^2
3×3	1	→ 1^2
Total	**14**	

We can extend this pattern to find the total number of squares when the size of the square is 25 1×1 squares.

Size of Square	Number of Squares	
1×1	25	→ 5^2
2×2	16	→ 4^2
3×3	9	→ 3^2
4×4	4	→ 2^2
5×5	1	→ 1^2
Total	**55**	

There are **55** squares that can be traced on the lines of a square composed of 25 1×1 squares.

APSMO

2025: DIVISION J

WEDNESDAY 30 JULY 2025

OLYMPIAD 3

3B. The question is:

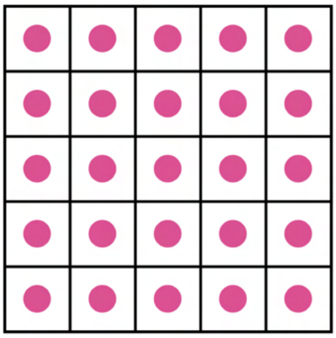
How many squares, of any size, can be traced on the lines of a square composed of twenty-five 1×1 squares?

Strategy: *Count in an organised way.*

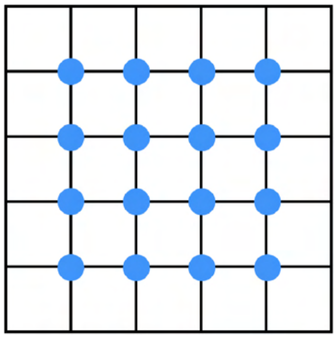
We can count all of the squares systematically, by size, beginning with **1×1** squares, then **2×2** squares, **3×3** squares. and so on.

In the following diagrams, each dot represents the **centre** of a specific square that measures $n \times n$.

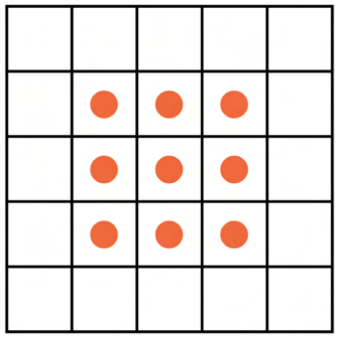
There are **$5 \times 5 = 25$** 1×1 squares.



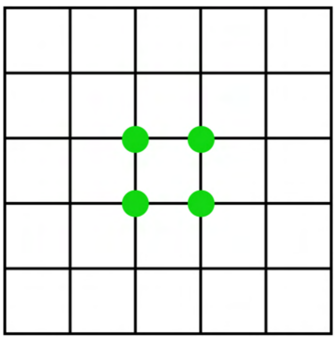
There are **$4 \times 4 = 16$** 2×2 squares.



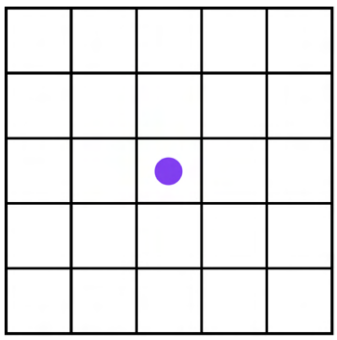
There are **$3 \times 3 = 9$** 3×3 squares.



There are **$2 \times 2 = 4$** 4×4 squares.



There is **$1 \times 1 = 1$** 5×5 square.



In total, there are $25 + 16 + 9 + 4 + 1 =$ **55 squares** that can be traced along the lines in this diagram.

3C. The question is:

Alice's friends are trying to guess her 3-digit number, which has no digit repeated and does not start with zero.

Bella guessed 538. Cindy guessed 275. Danny guessed 921. Eddy guessed 610.

Alice said that two friends got exactly 1 digit correct while the other two got exactly 2 digits correct.

But Alice also said that none of the correct digits were in their correct place. What is Alice's 3-digit number?

Strategy: *Build a table and reason logically.*

To find Alice's 3-digit number, we can build a table and record each guess that her friends made.
Each of her friends have guessed at least one of the digits in her number.

Bella	5	3	8
Cindy	2	7	5
Danny	9	2	1
Eddy	6	1	0

Highlight the digits that appear in multiple guesses and eliminate the digits that were only guessed by one person, as each correct digit was guessed by 2 people.

Bella	5	3	8
Cindy	2	7	5
Danny	9	2	1
Eddy	6	1	0

Alice's 3 digits are **5**, **2** and **1**.
Alice has said that **none** of the correct digits were in the correct place.

Therefore as **5** cannot be the first or third digit, it must be the **second** digit.
2 cannot be the first or second digit, it must be the **third** digit.
Finally, **1** cannot be the second or third digit, it is the **first** digit.

Bella	5	3	8
Cindy	2	7	5
Danny	9	2	1
Eddy	6	1	0
	1	5	2

Alice's 3 digit number is **152**.

3C. The question is:

What is Alice's 3-digit number?

Strategy: *Build a table and use a process of elimination.*

None of the guesses has digits in the correct place.

This eliminates 5, 2, 9 and 6 as the first digit.

3, 7, 2, 1 can be eliminated as the second digit.

8, 5, 1 and 0 can be eliminated as the third digit.

Build a table and list the remaining possible digits for each place.

4 can be eliminated as it was not included in any guesses.

1	0	2
3	~~4~~	3
~~4~~	5	~~4~~
7	6	6
8	8	7
	9	9

0, **3**, **6**, **7**, **8** and **9** can be eliminated as they were only guessed by one of Alice's friends and each correct digit was guessed by 2 people.

1	~~0~~	2
~~3~~	~~4~~	~~3~~
~~4~~	5	~~4~~
~~7~~	~~6~~	~~6~~
~~8~~	~~8~~	~~7~~
	~~9~~	~~9~~

Through a process of elimination, Alice's 3-digit mystery number must be **152.**

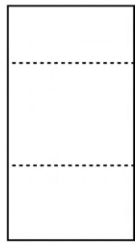
1	~~0~~	**2**
~~3~~	~~4~~	~~3~~
~~4~~	**5**	~~4~~
~~7~~	~~6~~	~~6~~
~~8~~	~~8~~	~~7~~
	~~9~~	~~9~~

3D. The question is:

A rectangle with perimeter 40 cm is divided into 3 smaller rectangles by adding two horizontal lines drawn parallel to the width of the larger rectangle.

The sum of the perimeters of the 3 smaller rectangles is 72 cm.

What is the area of the original rectangle in square centimetres?

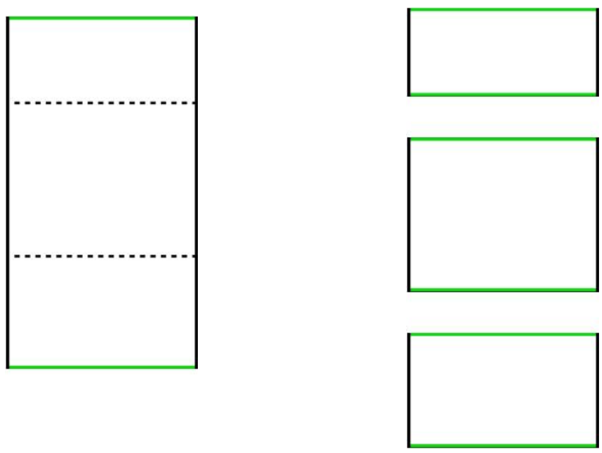


Strategy: *Build a table and reason logically.*

Separate the 3 smaller rectangles.

This separation has not changed the sum of the heights of the smaller rectangles.

However, when combining the perimeters of the 3 smaller rectangles the width is now counted 6 times (an extra 4 times).



The question states that the sum of the perimeters of the 3 smaller rectangles is 72 cm, which is 32 cm more than the perimeter of the original rectangle.

Dividing the increase by 4 determines the width of the smaller rectangles. $32 \div 4 =$ **8 cm**.

The perimeter of the original rectangle is 40 cm.

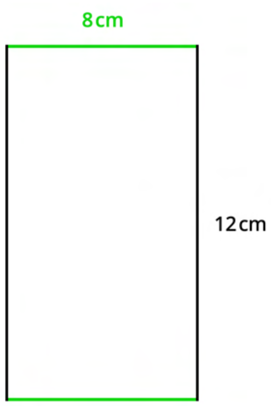
The length of the original rectangle

$= 40\text{ cm} - (2 \times \mathbf{8\text{ cm}}) \div 2$

$= 24\text{ cm} \div 2$

= 12 cm

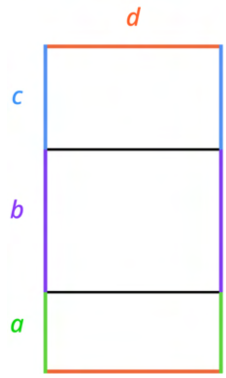
The area of the original rectangle is $8\text{ cm} \times 12\text{ cm} =$ **96 cm^2**



3D. **Strategy:** *Reason algebraically.*

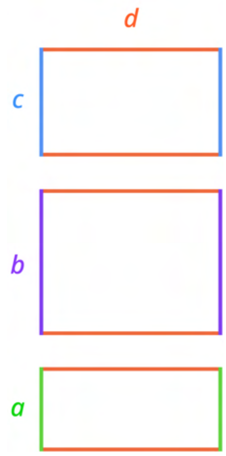
Let a, b, c and d represent the heights and width of the 3 rectangles.

We are given the perimeter of the original rectangle:



$$2a+2b+2c+2d=40\text{ cm}$$
$$a+b+c+d=\mathbf{20\text{ cm}}$$

We are given the sum of the perimeters of the 3 smaller rectangles:



$$2a+2d+2b+2d+2c+2d=72\text{ cm}$$
$$a+d+b+d+c+d=36\text{ cm}$$
$$a+b+c+d+2d=36\text{ cm}$$

Earlier we found that $a+b+c+d=$ **20 cm**, so:

$$\mathbf{20\text{ cm}}+2d=36\text{ cm}$$
$$2d=16\text{ cm}$$
$$d=8\text{ cm}$$

Substituting $d=8\text{ cm}$ into $a+b+c+d=20\text{ cm}$ leads to

$$a+b+c=12\text{ cm}$$

Area of the original rectangle = $12\text{ cm}\times 8\text{ cm}$

= $\mathbf{96\text{ cm}^2}$

3E. The question is:

How many different ways can the letters in the word COCOA be arranged?'

Strategy: *Write an organised list.*

There are 3 letters in the word COCOA. Make a list to show all possible arrangements starting with each A, C and O.

Arrangements starting with **A.**

A can be followed by **C**:

ACCOO
ACOCO
ACOOC

A can be followed by **O**:

AOCCO
AOCOC
AOOCC

There are 6 arrangements starting with **A.**

Arrangements starting with **C.**

C can be followed by **A**:

CACOO
CAOCO
CAOOC

C can be followed by **C**:

CCAOO
CCOAO
CCOOA

C can be followed by **O**;

COACO
COAOC
COCAO
COCOA
COOAC
COOCA

There are 12 arrangements starting with **C.**

Arrangements starting with **O.**

O can be followed by **A**:

OACCO
OACOC
OAOCC

O can be followed by **C**:

OCACO
OCAOC
OCCAO
OCCOA
OCOAC
OCOCA

O can be followed by **O**:

OOACC
OOCAC
OOCCA

There are 12 arrangements starting with **O.**

Altogether, there are 6 + 12 + 12 = **30** different ways to arrange the letters COCOA.

Strategy: *Use the fundamental counting principle and eliminate duplicates.*

The word BAT can be rearranged in 3 × 2 × 1 = 6 unique ways as each letter only appears once. BEE, another 3 letter word, can only be arranged in 3 unique ways as E appears twice.

COCOA has 5 letters.

Begin by considering each letter as unique. There are 5 × 4 × 3 × 2 × 1 = **120** ways to rearrange the letters. However, each **C** is interchangeable. For example,

C_1 O C_2 O A

C_2 O C_1 O A

This means we have overcounted the number of possible arrangements by a factor of 2.

120 ÷ 2 = **60**.

C is not the only repeated letter. **O** appears twice in the word COCOA. Each **O** is interchangeable. For example,

C O_1 C O_2 A

C O_2 C O_1 A

This means we have once again overcounted the number of possible arrangements by a factor of 2.

60 ÷ 2 = **30**.

Altogether there are **30** ways to rearrange the letters in the word COCOA.