MATHS GAMES

APSMO

2025 MATHS GAMES

Important

The information contained in this file is ONLY for the use of registered participants of the 2025 APSMO Maths Games.

Organisation and Procedures

For full details, see the Members' Area

- Maths Games papers are to be conducted under test conditions.

DO	DO NOT
• Supervise students at all times. • Maintain silence. • Provide blank working paper. • Collect, mark and retain the papers.	• Print the papers prior to the scheduled 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.

- Papers should be scored by the PICO using the *Solutions and Answers* sheet provided.
- Original student answer sheets should be retained by the PICO until the end of the year.

Absent Students

- A student who is legitimately absent on the date of the Maths Games paper, may sit the paper on their return to school.
- If an absent student does not sit the paper on their return to school they should be marked as 'absent'.
- *Note: This policy differs from the Maths Olympiads Absent Student Policy which has additional requirements*.

APSMO

WEDNESDAY 30 JULY 2025

MATHS GAMES

MATHS GAMES JUNIOR

Suggested Time: ***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. What is the value of the following expression?

2025 – 225 – 252 – 522

3B. In my class there is one birthday in each of the months June, July, August and September.

Oliver's birthday is earlier than Amelia's.

Charlotte's birthday is 2 months after Jack's, but not in September.

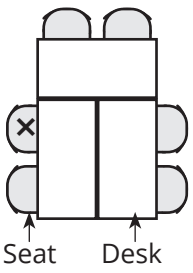
Who has a birthday in July?

3C. Consider the two fractions:

$\frac{306}{307}$ and $\frac{305}{306}$.

Which fraction has the larger value?

3D. Bhuva, Cate, Elise, Kristy, Ping, and Talia sit at a group of three desks, arranged as shown in the diagram.



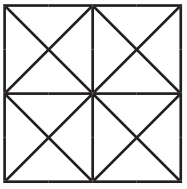
Cate sits at the same desk as Talia.

Talia and Elise face each other.

Bhuva doesn't sit at the same desk as Kristy, but her right elbow bumps Kristy's desk.

Who sits in the seat marked ×?

3E. How many triangles, of any size, can be drawn by tracing over the lines in this diagram?



APSMO

WEDNESDAY 30 JULY 2025

MATHS GAMES

JUNIOR

3A.

3B.

3C.

3D.

3E.

Student Name:

Fold here. Keep your answers hidden.

APSMO

WEDNESDAY 30 JULY 2025

MATHS GAMES JUNIOR

Solutions and Answers

3A: 1026	3B: Oliver	3C: $\frac{306}{307}$	3D: Cate	3E: 44

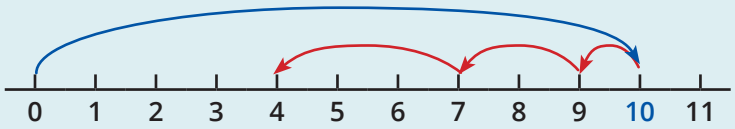
3A. What is the value of 2025 – 225 – 252 – 522?

Strategy 1: **Solve a Simpler Related Problem**

To work out the value of 2025 – 225 – 252 – 522, we can begin by considering what it means to perform three subtractions in a row.

If the question had been, for example, 10 – 1 – 2 – 3, we can visualise it as shown.

The result is the same as 10 – (1 + 2 + 3).



Since

2025 – 225 – 252 – 522

= 2025 – (225 + 252 + 522):

$$\begin{array}{r} 2\ 2\ 5 \\ 2\ 5\ 2 \\ +\ 5\ 2\ 2 \\ \hline 9\ 9\ 9 \end{array}$$

225 + 252 + 522 = 999.

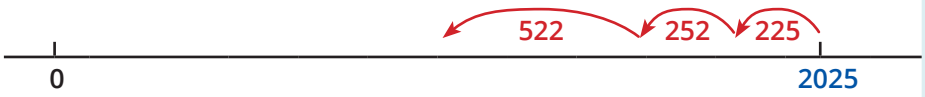
The value we want is given by the expression 2025 – 999.

It is relatively simple to work out that 2025 – 1000 = 1025.

If we subtracted 999 instead of 1000, the result would be reduced by a smaller amount.

Therefore:

2025 – 225 – 252 – 522



= 2025 – 999

= 2025 – 1000 + 1.

The value of 2025 – 1000 + 1 is 1025 + 1 = **1026**.

Strategy 2: **Use a Written Algorithm**

To find the value of 2025 – 225 – 252 – 522, we can perform the subtractions one a time.

2025 – 225 – 252 – 522 = **1026**.

$$\begin{array}{r} {}^{1}\not{2}\ {}^{1}0\ 2\ 5 \\ -\quad 2\ 2\ 5 \\ \hline 1\ 8\ 0\ 0 \end{array} \qquad \begin{array}{r} 1\ {}^{7}\not{8}\ {}^{9}\not{0}\ {}^{1}0 \\ -\quad 2\ 5\ 2 \\ \hline 1\ 5\ 4\ 8 \end{array} \qquad \begin{array}{r} 1\ 5\ 4\ 8 \\ -\quad 5\ 2\ 2 \\ \hline 1\ 0\ 2\ 6 \end{array}$$

Follow-Up: *What is the value of 2025 – (225 × 2) – (252 × 2) – (522 × 2)?* [27]

3B. Who has a birthday in July?

Strategy 1: **Eliminate All But One Possibility**

Oliver's birthday is earlier than Amelia's.

Oliver Amelia

Charlotte's birthday is two months after Jack's.

Since the students' birthdays are in consecutive months, one of Oliver's or Amelia's birthdays must be between Jack's birthday and Charlotte's.

Jack Oliver Charlotte Amelia

Oliver Jack Amelia Charlotte

We can now assign months to each of the two possible scenarios.

The students' birthdays are in June, July, August and September.

June	July	August	September
Jack	Oliver	Charlotte	Amelia

June	July	August	September
Oliver	Jack	Amelia	Charlotte

Charlotte's birthday is not in September.

This eliminates one possible scenario.

The student with a birthday in July must be **Oliver**.

June	July	August	September
Jack	Oliver	Charlotte	Amelia

June	July	August	~~September~~
Oliver	Jack	Amelia	~~Charlotte~~

Strategy 2: **Eliminate All But One Possibility (Alternative Approach)**

Charlotte's birthday is two months after Jack's, but not in September.

For this to be true, Jack and Charlotte's birthdays must be in June and August.

June	July	August	September
Jack		Charlotte	

Oliver's birthday is earlier than Amelia's.

June	July	August	September
Jack	Oliver	Charlotte	Amelia

The student with a birthday in July is **Oliver**.

June	July	August	September
Jack	Oliver	Charlotte	Amelia

Follow-Up: *One of the students has a twin sister, Rachel. Rachel is one month older than Oliver. Who is Rachel's twin ?* [Jack]

3C. Which fraction has the larger value: $\frac{306}{307}$ or $\frac{305}{306}$?

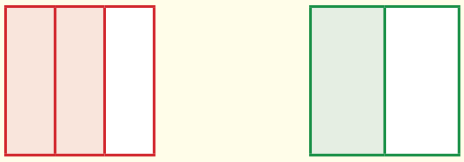
Strategy 1: **Solve a Simpler Related Problem, and Find a Pattern**

Suppose the fractions had smaller numbers.

For example, we could try the question:

Which fraction has the larger value: $\frac{2}{3}$, or $\frac{1}{2}$?

We can use diagrams to show the relative sizes of these fractions.

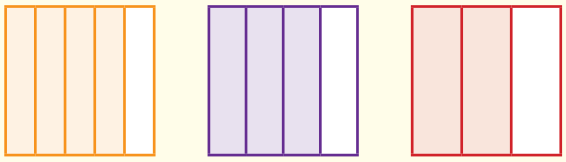


$\frac{2}{3}$ $\frac{1}{2}$

From the diagrams, we can see that $\frac{2}{3} > \frac{1}{2}$.

To check this idea, we can try the question with some more fractions.

Maintaining the pattern as for $\frac{306}{307}$ and $\frac{305}{306}$, where the numerator is one less than the denominator, and the numerator of one value is used as the denominator of the next:



$\frac{4}{5}$ $\frac{3}{4}$ $\frac{2}{3}$

These diagrams show that $\frac{4}{5} > \frac{3}{4} > \frac{2}{3}$.

The pattern we are seeing is that, when the numerator is one less than the denominator, the fraction with the larger denominator has the larger value.

Therefore, of the two fractions $\frac{306}{307}$ and $\frac{305}{306}$, $\frac{306}{307}$ has the larger value.

Strategy 2: **Solve a Simpler Related Problem (Alternative Approach)**

We can rewrite $\frac{306}{307}$ as follows:

$$\frac{306}{307} = \frac{307 - 1}{307}$$

$$= \frac{307}{307} - \frac{1}{307}$$

$$= 1 - \frac{1}{307}.$$

Likewise, we can rewrite $\frac{305}{306}$ as:

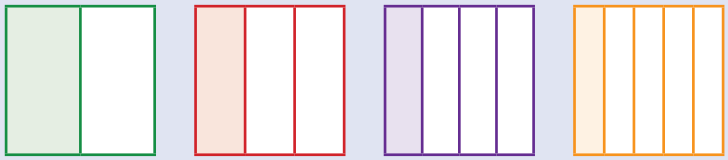
$$\frac{305}{306} = \frac{306 - 1}{306}$$

$$= \frac{306}{306} - \frac{1}{306}$$

$$= 1 - \frac{1}{306}.$$

To work out which fraction has the larger value, we can consider how much has been removed from the whole (**1**).

Since, in each case, we are removing a unit fraction, the quantity being removed can be represented diagrammatically:



$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ ...

As the denominator increases, the size of the fraction decreases.

Comparing $\frac{1}{306}$ and $\frac{1}{307}$, the removal of $\frac{1}{307}$ reduces the value by a lesser amount.

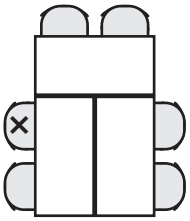
$\frac{306}{307}$ is greater than $\frac{305}{306}$.

Follow-Up: *What is the difference between 306/307 and 305/306 ?* [1/(306 × 307) = 1/93942]

3D. Cate sits at the same desk as Talia. Talia and Elise face each other.

Bhuva doesn't sit at the same desk as Kristy, but her right elbow bumps Kristy's desk.

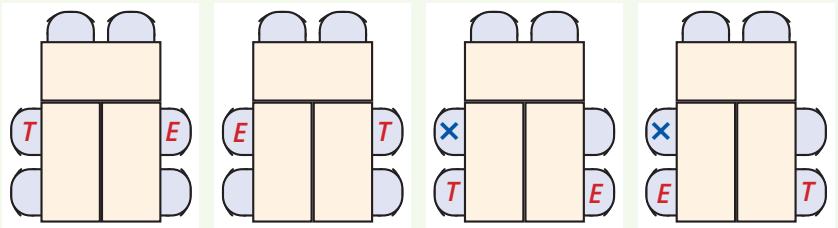
Who sits in the seat marked ✕?



Strategy 1: **Eliminate All But One Possibility**

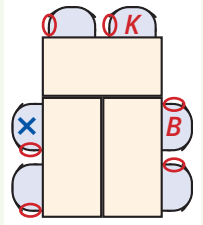
Talia and Elise face each other.

This can occur in **4** different ways.

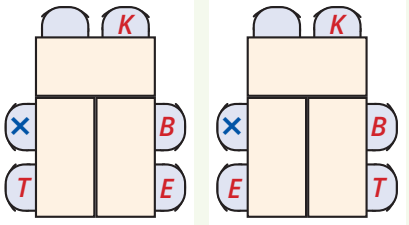


Bhuva doesn't sit with Kristy, but her right elbow bumps the books on Kristy's desk.

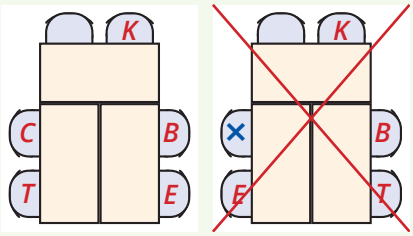
By marking the right side of each chair, we see that there is only one way that this can occur.



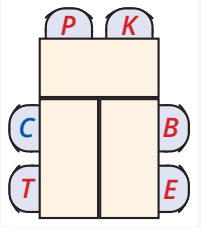
There are now just two ways that we can arrange Talia and Elise.



Cate sits at the same desk as Talia.



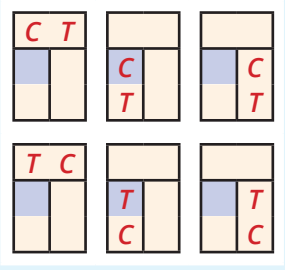
Cate sits in the seat marked ✕.



Strategy 2: **Eliminate All But One Possibility (Alternative Approach)**

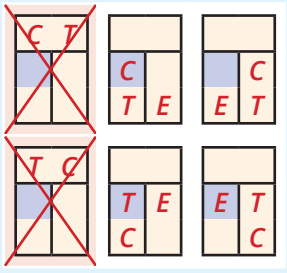
Cate sits at the same desk as Talia.

There are **6** ways that this can occur.



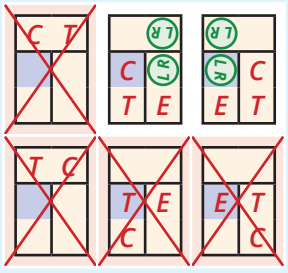
Talia and Elise face each other.

This eliminates two options.



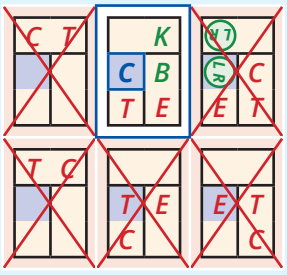
Bhuva doesn't share a desk with Kristy.

Kristy's desk is next to Bhuva's right elbow.



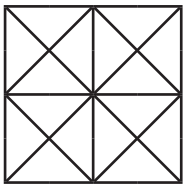
There is only one configuration that fits the conditions.

✕ marks **Cate**'s seat.



Follow-Up: *Who sits at the same desk as Ping?* [Kristy]

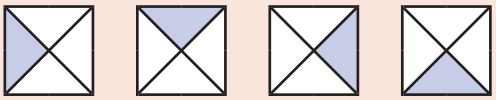
3E. How many triangles, of any size, can be drawn by tracing over the lines in this diagram?



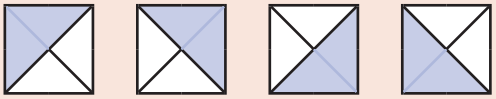
Strategy: **Solve a Simpler Related Problem**

We can begin by looking at the triangles that are present in each of the four smaller squares.

There are 4 small triangles. We shall say that each small triangle has an area of **1** square unit.



By combining pairs of small triangles, we can find 4 triangles that each have an area of **2** square units.



Since there are **4** small squares, and each small square contains the 4 + 4 = 8 triangles as identified here, we have found **4** × 8 = 32 triangles so far.

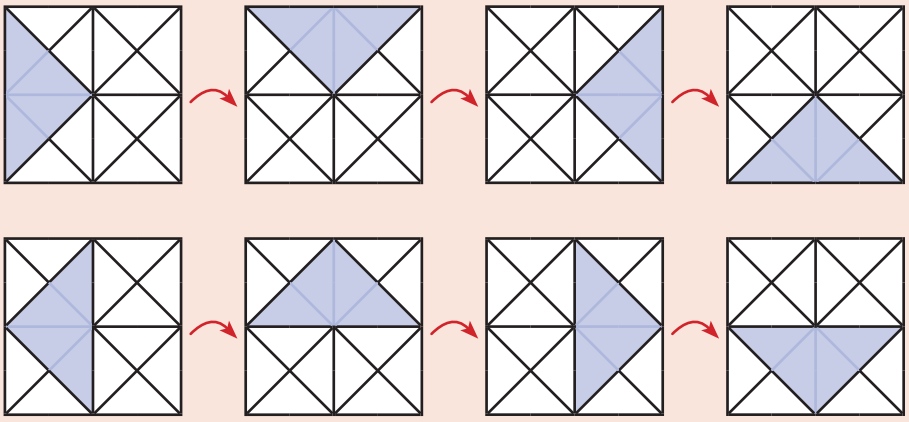
We also notice that the diagram has rotational symmetry.

Each subsequent triangle is identified to the previous one, rotated by **90°**.

After re-forming the original diagram, we can combine pairs of **2** square unit triangles, to make triangles with an area of **4** square units.

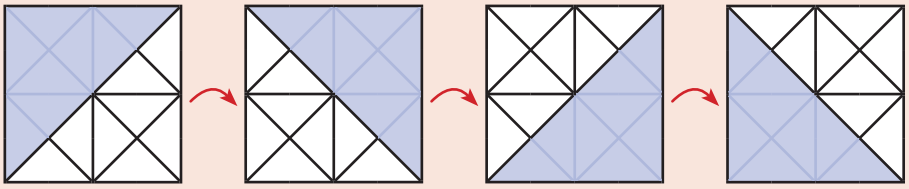
In each case, we are combining two triangles that share a short edge.

This adds another 8 triangles.



We can then combine pairs of **4** square unit triangles, to make triangles with an area of **8** square units.

This adds another 4 triangles.



There are **32 + 8 + 4 = 44** triangles in this diagram.

Follow-Up: *How many rectangles, of any size, can be drawn by tracing over lines in the original diagram?* [18]