MATHS GAMES

APSMO

2025 MATHS GAMES

Important

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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*.

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WEDNESDAY 11 JUNE 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.

2A. In this subtraction, *XY*3*Z* and 41*P*8 represent 4-digit numbers.

What number does *XY*3*Z* represent?

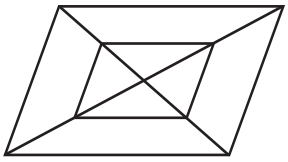
$$\begin{array}{r} X\ Y\ 3\ Z \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

2B. The 50th, 51st, 52nd and 53rd elements of a pattern are shown below.

What was the 2nd element of this pattern?

□△○	○□△	△○□	□△○
50th	51st	52nd	53rd

2C. How many triangles are possible by tracing on the lines of the given diagram?



2D. Numbers such as 45 and 14 have their digits in increasing order, because the ones digit is more than the tens digit.

The digits in 22 are not in increasing order.

How many whole numbers between 10 and 100 have their digits in increasing order?

2E. Dev receives $2.50 pocket money per week.

He can also earn:

- $2 per week if he packs his sister's lunch,
- $4 per week for vacuuming, and
- $5 per week for doing the laundry.

Over a four-week period, Dev received $39.

List the amounts that Dev could have earned for packing his sister's lunch.

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WEDNESDAY 11 JUNE 2025

MATHS GAMES

JUNIOR

2A.

2B.

2C.

2D.

2E.

Student Name:

Fold here. Keep your answers hidden.

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WEDNESDAY 11 JUNE 2025

MATHS GAMES

MATHS GAMES JUNIOR

Solutions and Answers

(Items in parentheses are not required)

2A: 6133	**2B:** □△○	**2C:** 16	**2D:** 36	**2E:** $2, $6, $8

2A. What number does *XY*3*Z* represent?

$$\begin{array}{r} X\ Y\ 3\ Z \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

***Strategy 1:* Work Backwards**

In the ones place, □ – 8 = 5.

This only works if □ = 13.

$$\begin{array}{r} X\ Y\ 3\ Z \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

For this to occur, ***Z*** must be **3**, and we will need to redistribute **10** from the tens place.

$$\begin{array}{r} X\ Y\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

In the tens place, either $2 - P = 2$, or $12 - P = 2$.

Since ***P*** is a single digit, it must be the case that ***P*** = **0**.

$$\begin{array}{r} X\ Y\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

There is no redistribution from the hundreds column.

$$\begin{array}{r} X\ Y\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ 0\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

In the hundreds place, □ – 1 = 0.

This only works if □ = 1.

There is no redistribution from the thousands column.

$$\begin{array}{r} X\ Y\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ 0\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

$$\begin{array}{r} X\ 1\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ 0\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

In the thousands place, □ – 4 = 2.

This only works if □ = 6.

$$\begin{array}{r} X\ 1\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ 0\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

$$\begin{array}{r} 6\ 1\ {}^{2}\not{3}\ {}^{1}3 \\ -\ 4\ 1\ 0\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

Let's check: **6133 – 4108 = 2025**.

*XY*3*Z* represents **6133**.

***Strategy 2:* Work Backwards (Alternative Approach)**

If ***XY*3*Z*** **– 41*P*8 = 2025**, then

41*P*8 + 2025 = *XY*3*Z*.

$$\begin{array}{r} X\ Y\ 3\ Z \\ -\ 4\ 1\ P\ 8 \\ \hline 2\ 0\ 2\ 5 \end{array}$$

$$\begin{array}{r} 4\ 1\ P\ 8 \\ +\ 2\ 0\ 2\ 5 \\ \hline X\ Y\ 3\ Z \end{array}$$

We can now complete the addition problem.

$$\begin{array}{r} {}^{1}\ \ \ \ \\ 4\ 1\ P\ 8 \\ +\ 2\ 0\ 2\ 5 \\ \hline 6\ 1\ 3\ 3 \end{array}$$

We note that there will be no redistribution from the tens place to the hundreds place.

The value ***XY*3*Z*** is the result of the sum.

*XY*3*Z* represents **6133**.

Follow-Up: *If AB5C – 45D6 = 999, what 4-digit number does AB5C represent ?* [5555]

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2B. What was the 2nd element of this pattern?

□△○	○□△	△○□	□△○
50th	51st	52nd	53rd

Strategy 1: **Build a Table, and Work Backwards**

When going from one element to the next in the pattern, the last symbol is moved to the front.

With **3** shapes in each element, the pattern repeats for every **3rd** element.

□△○ **50**th	○□△ **51**st	△○□ **52**nd
□△○ **53**rd	○□△ **54**th	△○□ **55**th

We can construct a table to visualise the pattern.

Since we know elements **50 - 55**, and we want to find element **2**, we will need to count down from **55**.

55	52	49	46	43	40	37	34	31	28	25	22	19	16	13	10	7	4
54	51	48	45	42	39	36	33	30	27	24	21	18	15	12	9	6	3
53	50	47	44	41	38	35	32	29	26	23	20	17	14	11	8	5	(2)

2 is in the same row as **50**, so the **2nd** element will have the same pattern as the **50th** element.

The **2**nd element of the of this pattern was □△○.

Strategy 2: **Make an Organised List**

We can see that the pattern repeats every **3** elements. This means the **2**nd element is the same as the **2 + 3 = 5**th element in the pattern.

We can list all of the elements that are the same as the **2**nd element, until we reach an element that we know.

2, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47, 50

+3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3 +3

The **2**nd element in the pattern is the same as the **50**th, which is □△○.

Strategy 3: **Find a Pattern, and Work Backwards**

Since the pattern repeats for every **3**rd element, all elements that are a multiple of **3** will be the same.

□△○	○□△	△○□
50	51	52
53	54	55
56	57	58
59	60	

We know that **60 = 20 × 3**.

Since **60** is a multiple of **3**, and **3** is also a multiple of 3, we know that element **3** will look like element **60**.

Element 3 is ○□△.

Therefore, element 2 is □△○.

□△○	○□△	△○□
2	3	4
:	:	:
59	60	

Follow-Up: *What is the 1000th element in this pattern?* [The 999th is ○□△, so the 1000th would be △○□]

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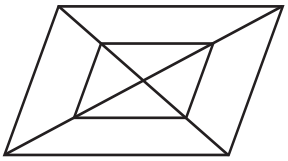
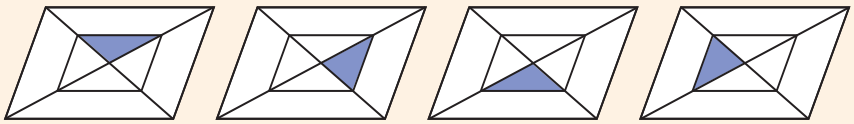
2C. How many triangles are possible by tracing on the lines of the given diagram?



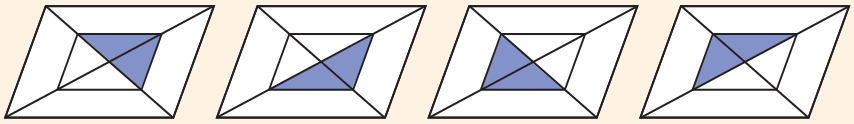
Strategy 1: **Make an Organised List**

There are **4** small triangles.

Each small triangle shares one side with two others.

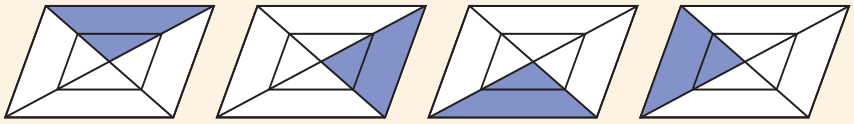


There are **4** ways to combine **2** small triangles to create a new triangle.

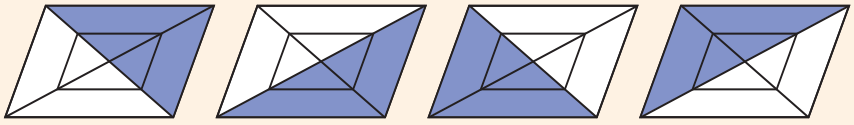


There are **4** large triangles.

Each large triangle shares one side with two others.



There are **4** ways to combine **2** large triangles to create a new triangle.

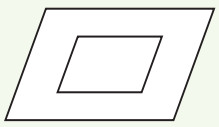


There are **16** triangles in this diagram.

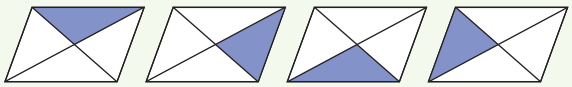
Strategy 2: **Solve a Simpler Related Problem**

We cannot create a triangle without at least one diagonal from the large parallelogram.

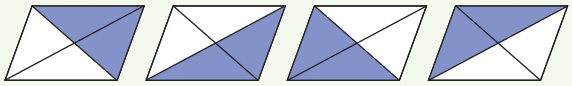
We can also see that a triangle cannot include one side from each parallelogram.



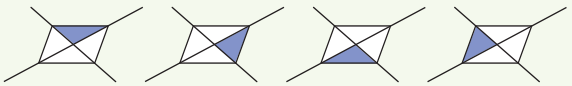
After removing the small parallelogram, we can see that there are **4** small triangles,



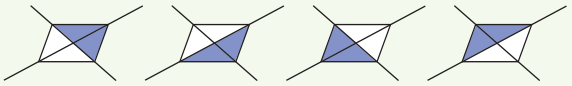
and **4** that can be created by combining **2** small triangles.



The same pattern of triangles can be created for the small parallelogram: **4** small triangles,



and **4** that can be created by combining **2** small triangles.



There are **16** triangles in this diagram.

Follow-Up: *This diagram is half of the original diagram:*  *. How many triangles are there in this diagram ?* [6]

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2D. How many whole numbers between 10 and 100 have their digits in increasing order?

Strategy 1: **Make an Organised List**

To determine how many whole numbers between **10** and **100** have their digits in increasing order, we can break this range of numbers into groups of **10** and find the amount in each of these groups.

For **10 - 19**, numbers greater than **11** have their digits in increasing order.

There are **8** numbers with their digits in increasing order.

10	11
12	13
14	15
16	17
18	19

For **20 - 29**, the **7** numbers greater than **22** have their digits in increasing order.

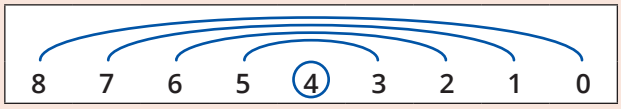
20	21
22	23
24	25
26	27
28	29

For **30 - 39**, the **6** numbers greater than **33** have their digits in increasing order.

30	31
32	33
34	35
36	37
38	39

Every time we increase the tens digit by **1**, the amount of numbers with digits in increasing order decreases by **1**.

From **10** to **99** inclusive, there are **8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 + 0** numbers with digits in increasing order.



8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 + 0 = 4 × 8 + 4 = 36.

100 does not have digits in increasing order.

There are **36** whole numbers between **10** and **100** with digits in increasing order.

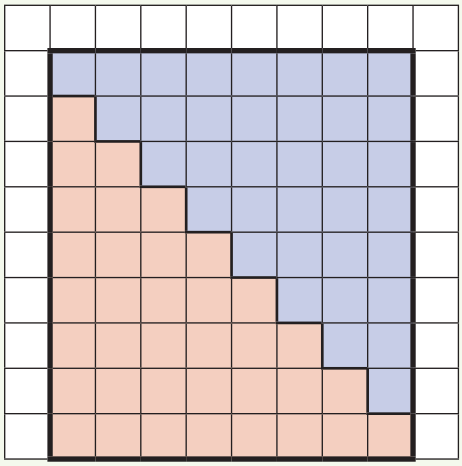
Range	Numbers in increasing order	Count
40 - 49	45 - 49	5
50 - 59	56 - 59	4
60 - 69	67 - 69	3
70 - 79	78 - 79	2
80 - 89	89	1
90 - 99		0

Strategy 2: **Build a Table**

We can also use a hundred grid to identify these numbers.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Doubling the shaded area creates a rectangle that measures **9** units high by **8** units wide.



Since there are **9 × 8 = 72** numbers in this rectangle, there are **72 ÷ 2 = 36** whole numbers between **10** and **100** with digits in increasing order.

Follow-Up: *How many whole numbers between 10 and 100 have their digits in decreasing order?* [45]

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2E. List the amounts that Dev could have earned for packing his sister's lunch.

Strategy 1: **Make an Organised List**

Over the four week period, Dev received **\$2.50 × 4 = \$10** without doing any chores.

So, the total amount he earned over the four-week period from chores alone is **\$39 – \$10 = \$29**.

Let's see if it is possible for Dev to have earned **\$0** over the period for packing his sister's lunch.

This would mean that he earned **\$29** from **\$4** (vacuuming) and **\$5** (laundry) payments.

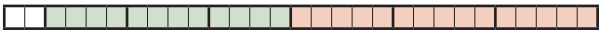
Since **\$29** is odd, Dev would have done laundry an odd number of times: either once, or three times.

Suppose Dev did laundry once.

He could have done vacuuming at most 4 times.

Since 4 × \$4 + 1 × \$5 < **\$29**, Dev could not have earned **\$29** in this instance.

Suppose Dev did laundry three times.



Since 3 × \$5 = \$15, and **\$29** – \$15 = **\$14** is not divisible by \$4, Dev could not have earned **\$29** in this instance.

Dev could not have earned **\$0** for packing his sister's lunch.

If Dev earned **\$2** for packing lunch, the remaining **\$29 – \$2 = \$27** would be from vacuuming and laundry.

Again, **\$27** is odd, so Dev would need to do laundry an odd number of times.

Dev could have earned 1 × \$2 = \$2 for packing lunch:
1 × \$2 + 3 × \$4 + 3 × \$5 = **\$29**.

We can continue checking amounts in an organised way.

Dev could not earn 2 × \$2 = \$4 for packing lunch, and **\$29** – \$4 = **\$25** from vacuuming and laundry.

Dev could have earned 3 × \$2 = \$6 for packing lunch:
3 × \$2 + 2 × \$4 + 3 × \$5 = **\$29**.

Dev could have earned 4 × \$2 = \$8 for packing lunch:
4 × \$2 + 4 × \$4 + 1 × \$5 = **\$29**.

Dev could have earned **\$2**, **\$6** or **\$8** for packing his sister's lunch.

Strategy 2: **Build a Table**

We can also use a table to keep track of reasoning that is similar to that used in ***Strategy 1***.

Dev could have earned **\$2**, **\$6** or **\$8** for packing his sister's lunch.

Lunch (\$2)	0 × \$2	1 × \$2	2 × \$2	3 × \$2	4 × \$2
Vacuum (\$4)		3 × \$4		2 × \$4	4 × \$4
Laundry (\$5)		3 × \$5		3 × \$5	1 × \$5
Total (\$)		\$29		\$29	\$29

Follow-Up: *Over another 4-week period, Dev received \$38. How much could he have earned from doing laundry?* [\$10 or \$20]

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