MindChamps®
ENRICHMENT ACADEMY

PSLE Maths E-Guide

Heuristics: Pattern Identification

In this guide you will find:

- A breakdown of the Pattern Identification heuristic and when your child should apply it to his/her schoolwork and exams
- An overview of the 5 types of pattern sequences
- Worked examples for 2 of the pattern sequence types
- Sample questions that you can try out with your child, along with a detailed answer key to track your child's level of understanding

Generally speaking, heuristics are mental shortcuts that we use to solve problems and make conclusions quickly and efficiently. They help to shorten decision-making time and streamline our thought processes.

In the PSLE Maths paper, heuristics play a similar role – they are simple problem-solving strategies that your child can apply to reduce the time and effort needed to answer seemingly difficult questions. Common Maths heuristics include Model Drawing, Guess-and-Check and Working Backwards.

We cover all the important heuristic types in our PSLE Success Maths lessons, but in this guide, we will be focusing on Pattern Identification.

Pattern Identification

The Pattern Identification heuristic involves seeing the repeating elements in sequences and using this information to predict what should come next. It is a useful way of avoiding lengthy series of calculations and quickly arriving at the answer a question asks for.

WHEN SHOULD THIS HEURISTIC BE USED?

- When the question involves a set or series of data or diagrams
- When the question asks you to identify the next item in a set or series

While patterns come in all shapes and sizes, there are 5 main types of pattern sequences that your child may encounter in the PSLE.

Type 1 Patterns with equal interval

E.g. 2, 2 + 5, 2 + 5 + 5, 2 + 5 + 5 + 5, 2 + 5 + 5 + 5 + 5…

Type 2 Patterns with sum of consecutive numbers

E.g. 1, 1 + 2, 1 + 2 + 3, 1 + 2 + 3 + 4, 1 + 2 + 3 + 4 + 5…

Type 3 Patterns with sum of consecutive even numbers

E.g. 7, 7 + 2, 7 + 2 + 4, 7 + 2 + 4 + 6, 7 + 2 + 4 + 6 + 8…

Type 4 Patterns with square numbers

E.g. 1 × 1, 2 × 2, 3 × 3, 4 × 4, 5 × 5…

Type 5 Other variations of patterns

E.g. 3, 3 + 7, 3 + 7 + 2, 3 + 7 + 2 + 7, 3 + 7 + 2 + 7 + 2…

In the following pages, we will be elaborating on how to approach questions that feature Type 4 and 5 patterns.

Type 4: Patterns with Square Numbers

In this section, you and your child will be working with patterns that involve square numbers.

A square number is what you get when you multiply a whole number by itself. For example, the square of 1 is $1 \times 1 = 1$, whereas the square of 6 is $6 \times 6 = 36$.

Now, ask your child to try his/her hand at the worked example below. We have included both the recommended approach your child can take to solve such questions and the solutions for each question part.

WORKED EXAMPLE 1

The figures below are made up of rectangles. Study the pattern below and answer the following questions.

Figure 1 **Figure 2** **Figure 3**

i. How many rectangles are there in Figure 4?

ii. How many rectangles are there in Figure 10?

iii. Which figure has a total number of 225 rectangles?

Step 1

Count the number of rectangles that Figures 1 to 3 each contain.

Step 2

Record these numbers down in a table.

- If no table is provided, draw your own table
- Place the figure number in one column and the number of rectangles in another
- Let the figure number be n

Figure Number (n)	Number of Rectangles	Formula (n x n)
1	1	1 x 1
2	4	2 x 2
3	9	3 x 3
4	16	4 x 4

Step 3

Notice that each number in the second column (Number of Rectangles) is the square of the number in the first column (Figure Number).

- Use Figure 1 to **find** that relationship:

  Figure 1 → $1 \times 1 = \boxed{1}$

- Use Figure 2 to **confirm** the relationship:

  Figure 2 → $2 \times 2 = \boxed{4}$

Step 4

Make sure the formula works with the other figure.

Figure 3 → $3 \times 3 = \boxed{9}$

From this, you can conclude that for any figure number n, the number of rectangles in that figure will be $n \times n$, or its square.

Solutions

i. How many rectangles are there in figure 4?
When n = 4, 4 x 4 = 16
Ans: $\boxed{16}$

ii. How many rectangles are there in figure 10?
When n = 10, 10 x 10 = 100
Ans: $\boxed{100}$

iii. Which figure has a total number of 225 rectangles?

$15 \times 15 = 225$ OR $\sqrt{225} = 15$
Therefore, n = 15
Ans: $\boxed{15}$

Type 5: Other Variations of Patterns

Sometimes, the pattern in a question will not conform to any of the other four types. This, however, is no cause for panic.

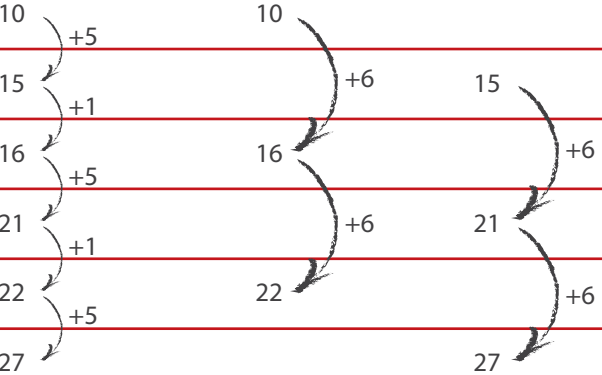
Using the Pattern Identification heuristic, your child will also be able to deduce what sort of pattern he/she is working with.

Now, ask your child to try his/her hand at the worked example below. We have included both the recommended approach your child can take to solve such questions and the solutions for each question part.

WORKED EXAMPLE 2

Study the pattern below and complete the table.

Row	Number	Odd Rows	Even Rows
Row 1	10	10	
Row 2	15		15
Row 3	16	16	
Row 4	21		21
Row 5	22	22	
Row 6	27		27
...	...		
Row 555	i)		
...	...		
Row 1024	ii)		



Step 1

Find the difference between two consecutive numbers. You will see that the number in each even row is 5 more than the number before it, while the number in each odd row (except row 1) is 1 more than the number before it.

Step 2

Notice that the interval for alternate rows is always the same (6).

Row 1 → 10 Row 2 → 15

Row 3 → 10 + 6 = 16 Row 4 → 15 + 6 = 21

Row 5 → 16 + 6 = 22 Row 6 → 21 + 6 = 27

Step 3

Deduce and confirm the relationship between each odd row and use the relationship to solve for the value of i).

If there is an **equal interval of (+6) between each odd row**, the relationship will be as follows:

Relationship: 1st Odd Row (Row 1) → $1 \times 6 + 4$ = 10

Confirmation: 2nd Odd Row (Row 3) → $2 \times 6 + 4$ = 16

Therefore Row 555 → $(555 + 1) \div 2$ = 278th Odd Row

278th Odd Row → $278 \times 6 + 4$ = 1672

Step 4

Deduce and confirm the relationship between each even row and use the relationship to solve for the value of ii).

If there is an **equal interval of (+6) between each even row**, the relationship will be as follows:

Relationship: 1st Even Row (Row 2) → $1 \times 6 + 9$ = 15

Confirmation: 2nd Even Row (Row 4) → $2 \times 6 + 9$ = 21

Therefore Row 1024 → $1024 \div 2$ = 512th Even Row

512th Even Row → $512 \times 6 + 9$ = 3081

Try It Yourself!

Now that your child has seen some examples of the Pattern Identification heuristic in action, he/she should be ready to try out some questions on his/her own. We have provided one practice question each for both Type 4 and Type 5 patterns.

The answer key is also included at the end of this guide for your reference, so you and your child will be able to review his/her responses together.

QUESTION 1
Type 4: Patterns with Square Numbers

The figures below are made up of squares.

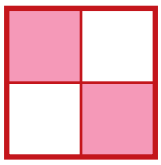


Figure 1

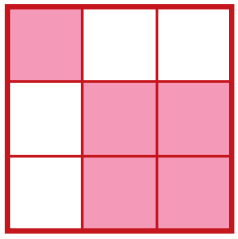


Figure 2

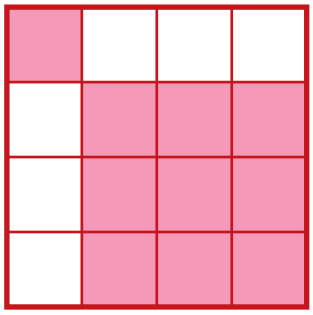


Figure 3

i. How many squares are there in Figure 4?
ii. How many squares are there in Figure 10?
iii. How many squares are there in Figure 30?
iv. Which figure has a total of 1156 squares?

SOLUTION

Figure number, n	Total number of squares	Pattern	Formula
1			
2			
3			
4			

i. How many squares are there in Figure 4? Ans:
ii. How many squares are there in Figure 10? Ans:
iii. How many squares are there in Figure 30? Ans:
iv. Which figure has a total of 1156 squares? Ans:

QUESTION 2

Type 5: Other Variations of Patterns

The figures below are made up of squares.

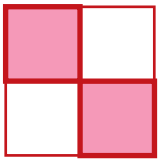


Figure 1

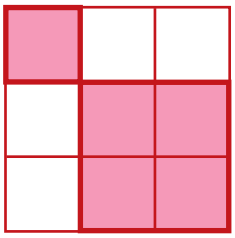


Figure 2

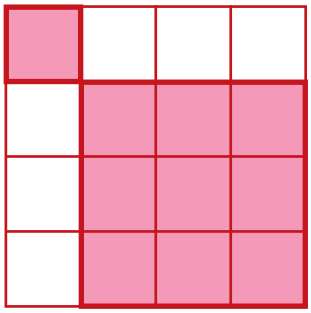


Figure 3

i. How many shaded squares are there in Figure 4?

ii. How many shaded squares are there in Figure 10?

iii. How many shaded squares are there in Figure 39?

iv. Which figure has 901 shaded squares?

SOLUTION

Figure number, n	Total number of shaded squares	Pattern	Formula
1			
2			
3			
4			

i. How many shaded squares are there in Figure 4? Ans:

ii. How many shaded squares are there in Figure 10? Ans:

iii. How many shaded squares are there in Figure 39? Ans:

iv. Which figure has 901 shaded squares? Ans:

Answer Key

QUESTION 1

Figure number, n	Total number of squares	Pattern	Formula (n+ 1) x (n+ 1)
1	4	2 x 2	(1+ 1) x (1+ 1)
2	9	3 x 3	(2+ 1) x (2+ 1)
3	16	4 x 4	(3+ 1) x (3+ 1)
4	25	5 x 5	(4+ 1) x (4+ 1)

i. How many squares are there in Figure 4?
$(4 + 1) \times (4 + 1) = 25$
Ans: 25

ii. How many squares are there in Figure 10?
$(10 + 1) \times (10 + 1) = 121$
Ans: 121

iii. How many squares are there in Figure 30?
$(30 + 1) \times (30 + 1) = 961$
Ans: 961

iv. Which figure has a total of 1156 squares?
$\sqrt{1156} = 34$
$34 - 1 = 33$
Ans: 33

QUESTION 2

Figure number, n	Total number of shaded squares	Pattern	Formula 1 + (n x n)
1	2	1 + 1	1 + (1 x 1)
2	5	1 + 4	1 + (2 x 2)
3	10	1 + 9	1 + (3 x 3)
4	17	1 + 16	1 + (4 x 4)

i. How many squares are there in Figure 4?
$1 + (4 \times 4) = 17$

Ans: 17

ii. How many squares are there in Figure 10?
$1 + (10 \times 10) = 101$

Ans: 101

iii. How many squares are there in Figure 30?
$1 + (39 \times 39) = 1522$

Ans: 1522

iv. Which figure has 901 shaded squares?

$$\begin{aligned} 1 + (n \times n) &= 901 \\ (n \times n) &= 901 - 1 \\ &= 900 \\ n &= \sqrt{900} \\ &= 30 \end{aligned}$$

Ans: 30