

The mathematics is the science of "Patterns". There are different patterns spread around us. Knowingly or unknowingly, we use these patterns. Patterns means a symmetry, a similarity or a relationship among pictures, designs and numbers. You can see a kites following a pattern. Similarly, a craft man makes pattern on the clothes, using a wooden block. The out line of a cloud, the cracks in a rock, the weaves on the sea-shores are some fractal pattern.

### ...FACTS



A craftsman dips the wooden block in different colours, to form different patterns. This art is known as block printing.



## Number Patterns

Patterns are very useful as sometimes without calculating, you can find solutions with their help.

**For Example :**  $1 + 2 + 3 + 4 + \dots + 10 = 55$   
 $11 + 12 + 13 + 14 + \dots + 20 = 155$   
 $\vdots$   
 $\vdots$   
 $\vdots$   
 $\vdots$   
 $91 + 92 + 93 + 94 + \dots + 100 = 955$



## Pattern in the Formation of 2-digit Numbers

$$1 \times 10 + 0 = 10$$

$$2 \times 10 + 0 = 20$$

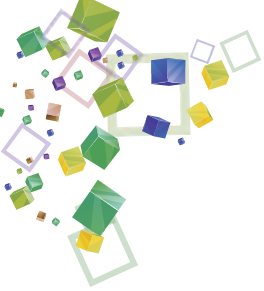
$$3 \times 10 + 0 = 30$$

$$1 \times 10 + 1 = 11$$

$$2 \times 10 + 1 = 21$$

$$3 \times 10 + 1 = 31$$





$$1 \times 10 + 2 = 12$$

$$2 \times 10 + 2 = 22$$

$$3 \times 10 + 2 = 32$$

$$1 \times 10 + 3 = 13$$

$$2 \times 10 + 3 = 23$$

$$3 \times 10 + 3 = 33$$

⋮

⋮

⋮

$$1 \times 10 + 89 = 99$$

$$2 \times 10 + 79 = 99$$

$$3 \times 10 + 69 = 99$$

In the similar pattern, 3-digit numbers, 4-digit numbers, 5-digit numbers etc., can be formed.



## Pattern Formation by Addition of Consecutive Numbers

Two Consecutive Numbers	Three Consecutive Numbers	Four Consecutive Numbers
$1 + 2 = 3$	$1 + 2 + 3 = 6$	$1 + 2 + 3 + 4 = 10$
$2 + 3 = 5$	$2 + 3 + 4 = 9$	$2 + 3 + 4 + 5 = 14$
$3 + 4 = 7$	$3 + 4 + 5 = 12$	$3 + 4 + 5 + 6 = 18$
$4 + 5 = 9$	$4 + 5 + 6 = 15$	$4 + 5 + 6 + 7 = 22$
	⋮	⋮
	$7 + 8 + 9 = 24$	$8 + 9 + 10 + 11 = 38$
	The sums are multiples of 3.	The sums are even numbers and increase in 4's.



## Pattern of Addition in Even Numbers

Study the pattern

$$2 + 4 = 6 \quad (2 \times 3)$$

$$2 + 4 + 6 = 12 \quad (2 \times 6)$$

$$2 + 4 + 6 + 8 = 20 \quad (2 \times 10)$$

$$2 + 4 + 6 + 8 + 10 = 30 \quad (2 \times 15)$$

$$2 + 4 + 6 + 8 + 10 + 12 = 42 \quad (2 \times 21)$$

and so on.





## Pattern of Addition in Odd Numbers

Study the pattern

$$\begin{array}{rclcl}
 1 + 3 & = & 4 & (2 \times 2) \\
 1 + 3 + 5 & = & 9 & (3 \times 3) \\
 1 + 3 + 5 + 7 & = & 16 & (4 \times 4) \\
 1 + 3 + 5 + 7 + 9 & = & 25 & (5 \times 5) \\
 1 + 3 + 5 + 7 + 9 + 11 & = & 36 & (6 \times 6)
 \end{array}$$

and so on.



## Pattern From Difference to Sum

Study the pattern

$$\begin{array}{rclcl}
 (2 \times 2) & - & (1 \times 1) & = & 2 + 1 \\
 (3 \times 3) & - & (2 \times 2) & = & 3 + 2 \\
 (4 \times 4) & - & (3 \times 3) & = & 4 + 3 \\
 (5 \times 5) & - & (4 \times 4) & = & 5 + 4 \\
 (6 \times 6) & - & (5 \times 5) & = & 6 + 5 \\
 \vdots & & & & \\
 (9 \times 9) & - & (8 \times 8) & = & 9 + 8
 \end{array}$$

This can be extended to more digits.

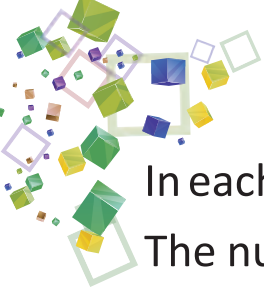
$$\begin{array}{rclcl}
 (10 \times 10) & - & (9 \times 9) & = & 10 + 9 \\
 (11 \times 11) & - & (10 \times 10) & = & 11 + 10 \\
 \vdots & & & & \\
 (99 \times 99) & - & (98 \times 98) & = & 99 + 98
 \end{array}$$



## Pattern in Multiplication

$\begin{array}{r} 15 \\ \times 15 \\ \hline 225 \end{array}$	$\begin{array}{r} 25 \\ \times 25 \\ \hline 625 \end{array}$	$\begin{array}{r} 35 \\ \times 35 \\ \hline 1225 \end{array}$	$\begin{array}{r} 115 \\ \times 115 \\ \hline 13225 \end{array}$	$\begin{array}{r} 125 \\ \times 125 \\ \hline 15625 \end{array}$	$\begin{array}{r} 135 \\ \times 135 \\ \hline 18225 \end{array}$
$\uparrow$	$\uparrow$	$\uparrow$	$\uparrow$	$\uparrow$	$\uparrow$
$1 \times 2$	$2 \times 3$	$3 \times 4$	$11 \times 12$	$12 \times 13$	$13 \times 14$





In each products, 25 is obtained on multiplying the 5 in the one's place.

The number to the left of 25 in the product can be obtained by multiplying the other digits with their successors.

**Study the following patterns :**

$$\begin{aligned}
 1 \times 1 &= 1 \\
 11 \times 11 &= 121 \\
 111 \times 111 &= 12321 \\
 1111 \times 1111 &= 1234321 \\
 11111 \times 11111 &= 123454321
 \end{aligned}$$

and so on

In the above multiplication, the digits read the same whether backward or forward. These numbers are called palindromic numbers.

- If the 2-digit number 11 is multiplied by itself, then the middle digit in the product is 2.
- If the 3-digit number 111 is multiplied by itself, then the middle digit in the product is 3.
- If the 4-digit number is multiplied by itself, then the middle digit in the product is 4 and so on.



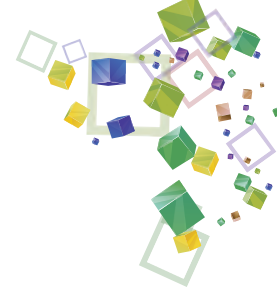
## Pattern in Division

Find the pattern in divisions as given below.

$$\begin{aligned}
 216 \div 4 &= 54 \\
 432 \div 8 &= 54 \\
 648 \div 12 &= 54
 \end{aligned}$$

You can see, in each case the division is multiplied by the quotient and got dividend.





# EXERCISE 14.1

## 1. Study the patterns and fill in the blanks.

$$(4 \times 4) - (3 \times 3) = 4 + 3 = 7$$

$$(6 \times 6) - (5 \times 5) = 6 + 5 = 11$$

a.  $(7 \times 7) - (6 \times 6) = \dots + \dots = \dots$

b.  $(8 \times 8) - (7 \times 7) = \dots + \dots = \dots$

c.  $(9 \times 9) - (8 \times 8) = \dots + \dots = \dots$

d.  $(10 \times 10) - (9 \times 9) = \dots + \dots =$

.....

## 2. For each of the given number sequences, find the rule to generate the sequence. Describe the rule in words and write down the next four terms with the help of this rule.

a. 1, 4, 7, 10, 13, 16, .....

b. 2, 6, 10, 14, 18, 22, .....

c. 8, 9, 11, 14, 18, 23, .....

d. 4, 8, 12, 16, 20, 24, .....

## 3. Carefully observe the patterns given below and write the number against each one.

$11 = 2$

$12 = 3$

Hint:  $11 = 1 + 1 = 2$

$38 = 11 = 2$

$86 = 14 = 5$

$12 = 1 + 2 = 3$  etc.

$142 = 7$

a.  $25 = \dots$       b.  $89 = \dots$       c.  $135 = \dots$

d.  $458 = \dots$       e.  $635 = \dots$

## 4. Study the following patterns and fill in the blanks.

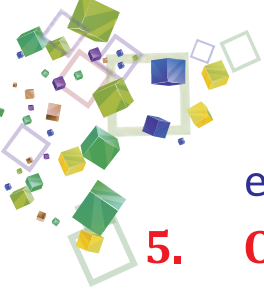
a.  $65 \times 65 = 4225$

b.  $105 \times 105 = 11025$

c.  $345 \times 345 = \dots$

d.  $505 \times 505 = \dots$





e.  $165 \times 165 = \dots\dots\dots$       f.  $195 \times 195 = \dots\dots\dots$

**5. Observe the following patterns and extend it for two more steps.**

a.	$1 \times 9 + 2 = 11$	b.	$111 \div 3 = 37$
	$12 \times 9 + 3 = 111$		$222 \div 6 = 37$
	$123 \times 9 + 4 = 1111$		$333 \div 9 = 37$
	$\dots\dots\dots = \dots\dots\dots$		$\dots\dots\dots = \dots\dots\dots$
	$\dots\dots\dots = \dots\dots\dots$		$\dots\dots\dots = \dots\dots\dots$



## Number Towers

Consider a few examples :

- Starting from the row of the bottom, you observe that:

$4 + 5 = 9, 5 + 7 = 12.$

In the second row :  $9 + 12 = 21.$

- The numbers have been arranged as a pyramid. You will observe that:

$6 + 7 = 13, 7 + 8 = 15$  and  $8 + 9 = 17.$

Similarly,

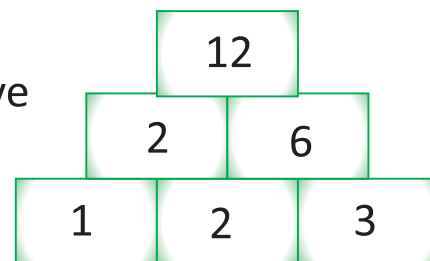
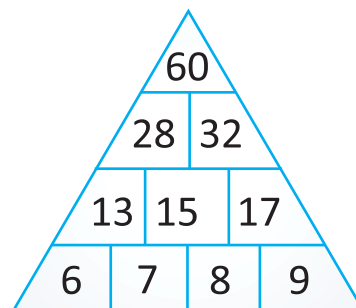
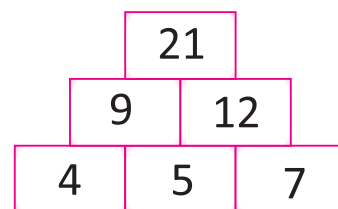
$13 + 15 = 28, 15 + 17 = 32.$

Finally,  $28 + 32 = 60.$

- Starting from the row of the bottom, you observe that:

$1 \times 2 = 2, 2 \times 3 = 6.$

Finally,  $2 \times 6 = 12.$



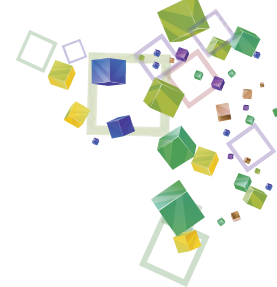
Multiply Multiply

### INFO ZONE



- In a Fibonacci sequence, from third term onwards, each term is obtained by adding the previous two terms, i.e. 0, 1, 1, 2, 3, 5, 8, 13, 21,...
- Once the pattern is identified, further terms can be easily written.





# Coding and Decoding

We can use some codes to send and receive some secret messages. In this coding, each letter is assigned a number.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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

Using this coding, we can write messages.

HAVE FUN is written as 8 1 22 5 6 21 14

MATHEMATICS is written as 13 1 20 8 5 13 1 20 9 3 19



# Tiling Patterns

Look around you at the floor and the walls.

These designs are made by tiles that fit into each other without any gaps or overlapping. These tiling patterns are called **tessalations**.

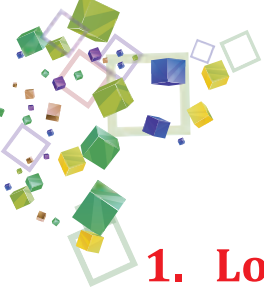


A floor design



A wall design

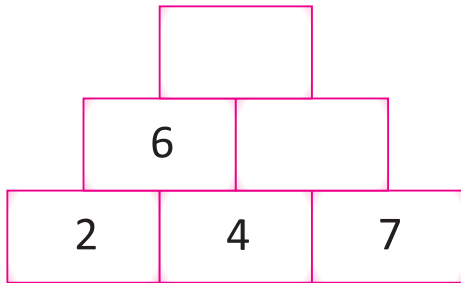




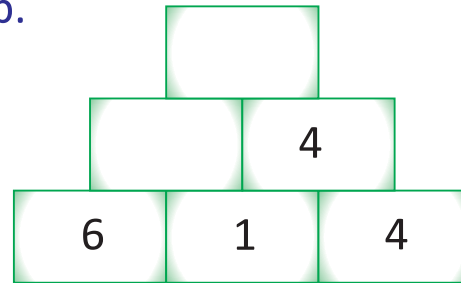
# EXERCISE 14.2

1. Look at the pattern and complete the number towers.

a.



b.



2. Write the following words using the codes.

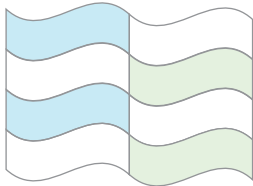
a. HAVE FUN .....

b. SAVE WATER .....

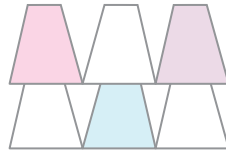
c. BEST OF LUCK .....

3. Tick (✓) the patterns that tessalate.

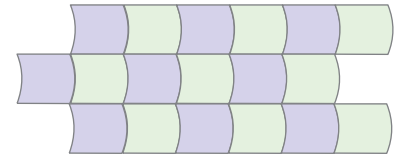
a.



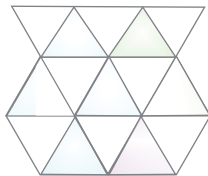
b.



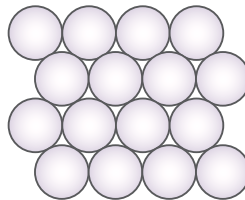
c.



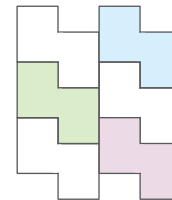
d.



e.



f.

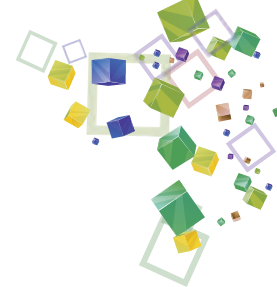


## POINTS TO REMEMBER

- ❖ Pattern means a symmetry, a similarity or a relation among pictures, designs and number.
- ❖ Outline of a cloud is an example of fractal pattern.
- ❖ There is also a pattern in multiplication and division.
- ❖ Number towers follow a pattern.
- ❖ Sending and receiving messages are easy with the help of coding.
- ❖ Secret codes can easily broke if we have clue or key.







# RECAP EXERCISE

## 1. Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

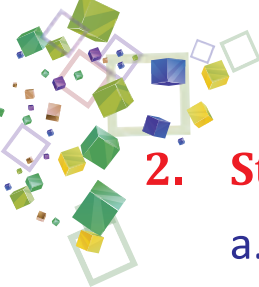
- a. Outline of a cloud is an example of.....
- |  |   |
|--|---|
| (i) Fractal pattern <input type="checkbox"/> | (ii) Tile pattern <input type="checkbox"/>  |
| (iii) Coding <input type="checkbox"/>        | (iv) Number towers <input type="checkbox"/> |

- b. The middle term in the pattern  $111 \times 111$  is.....
- |                                |                                 |                                  |                                 |
|--------------------------------|---------------------------------|----------------------------------|---------------------------------|
| (i) 4 <input type="checkbox"/> | (ii) 3 <input type="checkbox"/> | (iii) 2 <input type="checkbox"/> | (iv) 5 <input type="checkbox"/> |
|--------------------------------|---------------------------------|----------------------------------|---------------------------------|

- c. Look at the pattern.  $1 + 2 = 3; 2 + 3 = 5; 3 + 4 = 7$
- Which one is the next term?
- |                                 |                                  |                                  |                                  |
|---------------------------------|----------------------------------|----------------------------------|----------------------------------|
| (i) 12 <input type="checkbox"/> | (ii) 15 <input type="checkbox"/> | (iii) 9 <input type="checkbox"/> | (iv) 17 <input type="checkbox"/> |
|---------------------------------|----------------------------------|----------------------------------|----------------------------------|

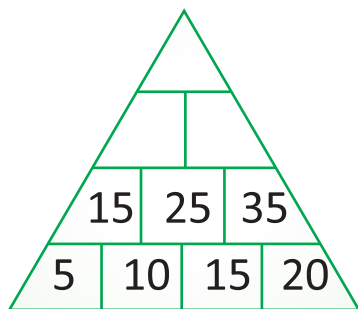
- d. Look at the coding.
- 8   1   22   5   6   21   14
- Which one is the decoding of the following?
- |                                       |  |
|---------------------------------------|--|
| (i) HAVE FUN <input type="checkbox"/> | (ii) GOOD <input type="checkbox"/>     |
| (iii) HELLO <input type="checkbox"/>  | (iv) SURPRISE <input type="checkbox"/> |

- e. Which one is the next term of the following pattern?
- $3 \times 37, 037 = 1, 11, 111; 6 \times 37, 037 = 2, 22, 222; 9 \times 37, 037 = \dots\dots\dots$
- |   |  |
|---|--|
| (i) 4, 44, 444 <input type="checkbox"/>   | (ii) 3, 33, 333 <input type="checkbox"/> |
| (iii) 5, 55, 555 <input type="checkbox"/> | (iv) 6, 66, 666 <input type="checkbox"/> |

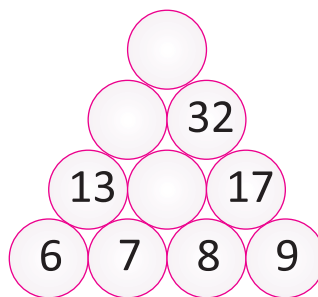


**2. Study the patterns and fill in the missing numbers.**

a.

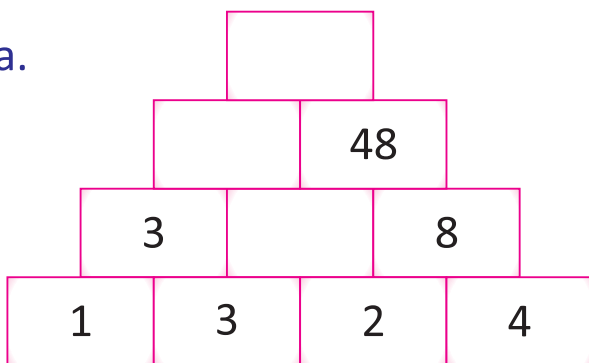


b.

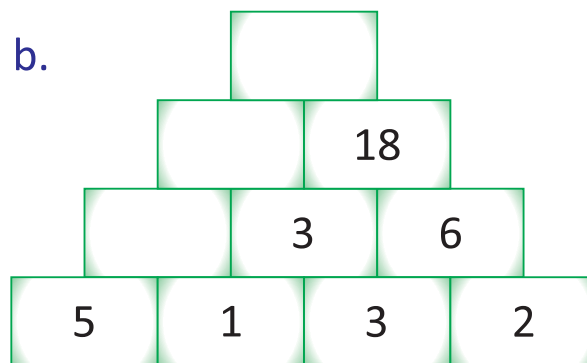


**3. Study the patterns and fill in the missing numbers.**

a.



b.



**4. Study the following patterns and fill in the blanks.**

$65 \times 65 = 4225$ ;       $105 \times 105 = 11025$

a.  $75 \times 75 = \dots\dots\dots$       b.  $95 \times 95 = \dots\dots\dots$

c.  $135 \times 135 = \dots\dots\dots$       d.  $175 \times 175 = \dots\dots\dots$

**5. Write the next 3 terms in each of the following.**

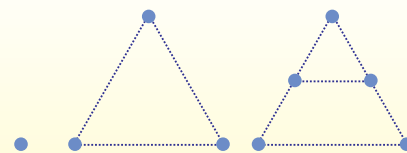
a. 95, 90, 85, 80, 75,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,

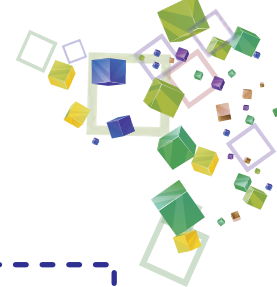
b. 37, 47, 57, 67, 77,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,

c. 111, 222, 333, 444,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,  $\dots\dots\dots$ ,



Numbers like 1, 3, 6, which can be arranged as points in the shape of a triangle, are called triangular numbers. Write the next two numbers.





# Lab Activity

**Objective :** To create and appreciate patterns.

**Materials :** Chart papers, carved wooden blocks, poster colours etc.

**Presentation :**

- ❖ Make a group of 6 to 8 students.
- ❖ The group must have a wooden block and some poster colours.
- ❖ First, one student will take the block and put some colour on it.
- ❖ He will then place the block on the paper and press for making a pattern of his choice.
- ❖ Another student of the group will then take the block.
- ❖ He may change the colour if he wants to and then use the block to make a different pattern.
- ❖ Then the next student of the group will take the block and create another pattern by using different colours or different positions of the block.
- ❖ Each member must take part and create his own pattern.

