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PART
1

Mathematics

Your NCERT companion · Learn · Practise · Play

CLASS
6

Revised for NCERT *Ganita Prakash* 2026-27

NEP 2020 · NCF-SE 2023 | Scan & Learn with the Schoolifi app

Preface

Dear students, teachers and parents,

This is the revised edition of **Schoolifi Maths, Class 6**. It follows the new NCERT textbook *Ganita Prakash* for Grade 6 and the NCF-SE 2023. The chapters are in the same order as the NCERT book, so what you learn at school and what you learn with Schoolifi go hand in hand.

We believe children learn maths best by **doing, talking and thinking**. So every chapter is full of activities. The language is simple, the steps are clear, and there are many pictures to help you understand *why* things work, not just *how*.

Every chapter ends with *The Last Words* and a *Mind Map* for quick revision, *Practice in Three Levels*, *Competency Practice* in the CBSE pattern, a *Chapter Test*, and *NCERT Help* with hints for the questions in your school book. Answers are at the end of each chapter, so that you try first on your own.

Look for the QR codes. Scan them to open the interactive chapter on the Schoolifi app and website, with animations, games and quizzes.

We hope this book makes every child say, "Maths is fun!" We welcome suggestions from teachers and parents.

With best wishes,
Team Schoolifi

Revised edition 2026-27 · Based on NCERT *Ganita Prakash* Grade 6
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SchooliFi
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Mathematics

Class 6 · Part 1



This book belongs to

Name .....

Class & Section .....

Roll No. .....

School .....

Revised edition 2026-27 · Based on NCERT *Ganita Prakash*

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In every chapter

Index and Learning Objectives · Activities · Worked examples · Exercises · The Last Words · Mind Map · Practice in Three Levels · Competency Practice · Chapter Test · NCERT Help · Answers · QR codes to the app

How to use this book

Every chapter has the same parts, so you always know where to look.

Let's Explore
Do it yourself. Use paper, pencil, seeds or buttons to discover an idea.

Math Talk
Discuss with a partner or your group. Say your thinking out loud.

Think & Explain
A question that makes you reason. Explain **why**, not just the answer.

Try This
Quick practice right after you learn something new.

Indian Knowledge
Stories of great Indian mathematicians and their ideas.

★ Key idea
The most important point. Learn it well.

Schoolie says · Word help
Tips and meanings of new words, in the side column.

Example
A solved question showing every step.

Exercise
Practice questions after each part of the chapter.

The Last Words · Mind Map
A short summary and a one-page map for revision.

Practice in Three Levels
Basic, Standard and Challenge questions.

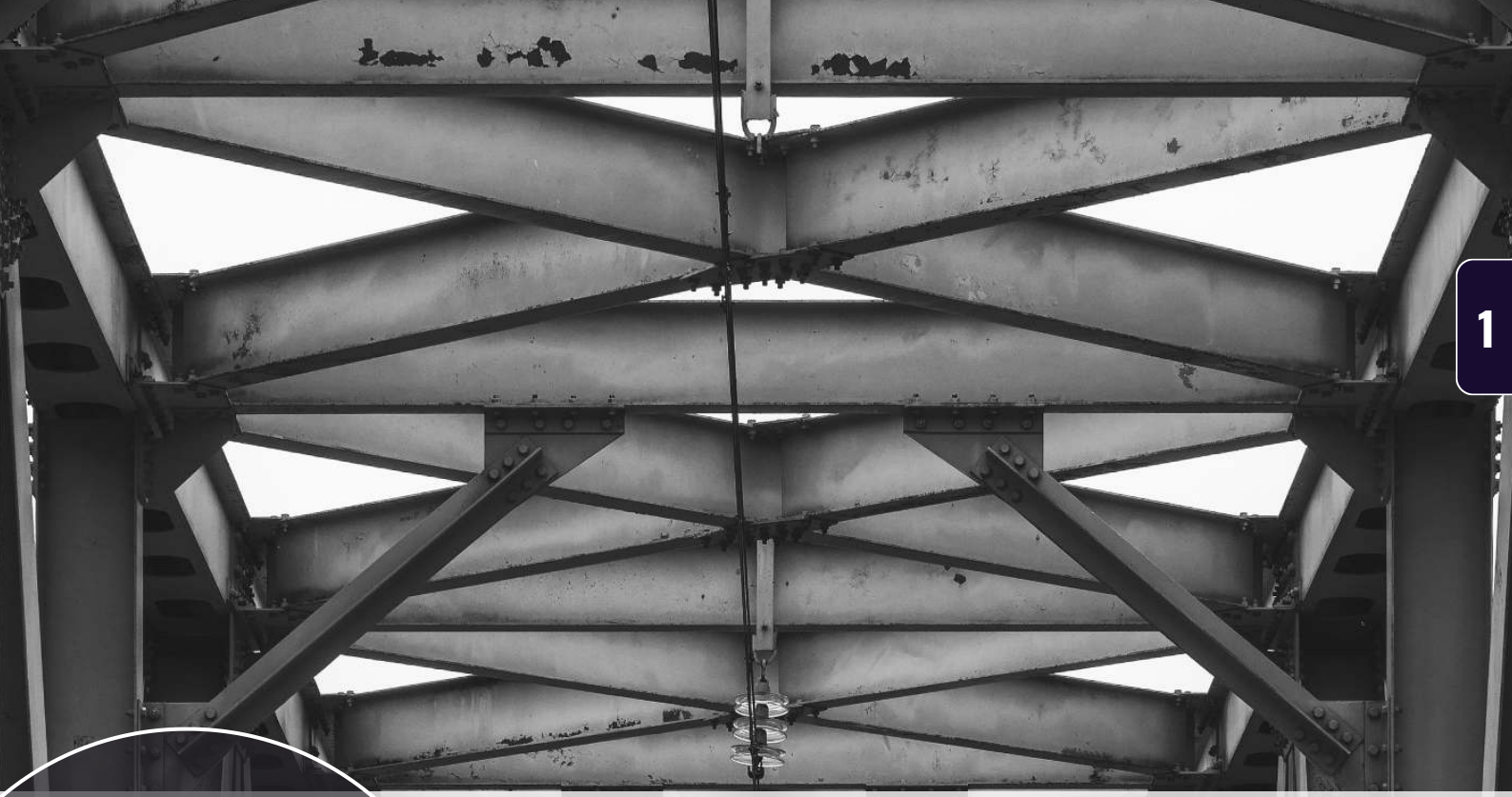
Competency Practice · Chapter Test
CBSE-style questions and a 25-mark test.

NCERT Help · QR codes
Hints for your NCERT book, and games in the app.

My notes
A lined page at the end of each chapter for your own notes.



"Hi, I am **Schoolie**! Try every activity, ask questions and have fun. Mistakes help us learn!"



CHAPTER
01

Maths

Patterns in Mathematics

CLASS 6





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Learning Objectives

- find a pattern and say its rule
- find the next terms of a sequence
- draw numbers as dot pictures
- show why a pattern works
- count the parts of shape patterns

Important Terms

Pattern
something that repeats or grows in the same way

Sequence
a list of numbers in an order, made by a rule

Term
each number in a sequence

Rule
the way to get the next term

Difference
how much a term goes up or down

Visualise
to see an idea as a picture

Learn it interactively!
Scan to open this chapter on the Schoolifi app and website: explore, play learning games and check your answers.
www.schoolifi.in/books/maths6/ch1



1.1 What is Mathematics?

? What comes next: Monday, Tuesday, Wednesday, ...? How did you know?

You knew because the days of the week always come in the same order. They **repeat**. Things that repeat or grow in the same way are called **patterns**.

Patterns are all around us:

- Day and night come again and again.
- The Moon looks a little different every night, and the same shapes come back every month.
- Tiles on a floor repeat in rows.
- Petals on a flower are arranged in a neat way.

★ Key idea

Mathematics is the study of patterns. In maths we find patterns, we describe them, and we try to understand **why** they happen.

Why do patterns matter?

Patterns help us **predict**, which means to say what will happen next.

- A farmer uses the pattern of the seasons to decide when to sow seeds.
- Scientists use the pattern of the Sun, Earth and Moon to say when the next eclipse will happen.
- A computer game works by following patterns written in code.

Math Talk

Look around your classroom. Find **three** patterns. Tell your partner what is repeating in each one. Is it a pattern of **numbers**, **shapes**, **colours** or **time**?

Try This

Draw the next two shapes: ● ■ ▲ ● ■ ▲ ● __ __



Schoolie says

Hi! I am Schoolie. I will give you tips in this column. Look for me on every page!

Word help

Predict = to say what will happen next, before it happens.

Open this chapter on the Schoolifi app



Schoolie says
A rule is like a recipe. If you know the recipe, you can make any term!

Word help
The three dots "…" mean **"and so on"**. The sequence keeps going.

Play the Sequence Builder game

1.2 Patterns in Numbers

? Count by 2s: 2, 4, 6, 8, … What is the next number?

The answer is 10, because we add 2 each time. The numbers 2, 4, 6, 8, 10, … make a **number sequence**.

★ **Key idea**
A **sequence** is a list of numbers made by a **rule**. Each number in the list is called a **term**.
In 2, 4, 6, 8, …, the 1st term is 2, the 2nd term is 4, and the rule is "add 2".

Ten famous number sequences

Read each row. Cover the last column with your hand. Can you find the rule yourself?

Name	First terms	Rule
All 1's	1, 1, 1, 1, 1, 1, …	Always 1
Counting numbers	1, 2, 3, 4, 5, 6, …	Add 1
Odd numbers	1, 3, 5, 7, 9, 11, …	Start at 1, add 2
Even numbers	2, 4, 6, 8, 10, 12, …	Start at 2, add 2
Triangular numbers	1, 3, 6, 10, 15, 21, …	Add 2, then 3, then 4, …
Square numbers	1, 4, 9, 16, 25, 36, …	1×1, 2×2, 3×3, …
Cube numbers	1, 8, 27, 64, 125, 216, …	1×1×1, 2×2×2, …
Virahanka numbers	1, 2, 3, 5, 8, 13, …	Add the two terms before
Powers of 2	1, 2, 4, 8, 16, 32, …	Multiply by 2
Powers of 3	1, 3, 9, 27, 81, 243, …	Multiply by 3

Let's Explore

1. Write the next **three** terms of each sequence in your notebook.
2. Which sequence grows the fastest? Which one does not grow at all?

How to find the rule of a sequence

Follow these steps:

1. Find the **difference** between each term and the term before it (later term − earlier term).
2. If all the differences are the **same**, the rule is "add" that number.
3. If the differences **change**, see if they follow their own pattern (like 2, 3, 4, 5).
4. If not, check if each term is the term before it **multiplied** by a number.
5. Test your rule on **every** term before you trust it.

Example 1

Find the next three terms: 2, 5, 8, 11, 14, …

Solution: The differences are 5 − 2 = 3, 8 − 5 = 3, 11 − 8 = 3 and 14 − 11 = 3. They are all the same, so the rule is **add 3**.

Next terms: 14 + 3 = **17**, 17 + 3 = **20**, 20 + 3 = **23**.



Each jump on the number line is 3

Example 2

Find the next two terms: 1, 3, 6, 10, 15, …

Solution: The differences are 2, 3, 4, 5. They go up by 1 each time. So the next differences are 6 and 7.

Next terms: 15 + 6 = **21**, 21 + 7 = **28**.

Example 3

Find the next two terms: 3, 6, 12, 24, …

Solution: The differences are 3, 6, 12. They are not the same, and they do not go up by 1. Now try multiplying: 3 × 2 = 6, 6 × 2 = 12, 12 × 2 = 24. The rule is **multiply by 2**.

Next terms: 24 × 2 = **48**, 48 × 2 = **96**.

Remember
Difference = later term − earlier term
Example: 8 − 5 = 3



Schoolie says
Write the differences in a small row under the terms. The pattern often hides there!

1

Answers
The answers to every Try This and Exercise are at the end of the chapter. Try first, then check!



Schoolie says
There can be more than one rule. That is not a mistake. It is maths being interesting!

Try This

1. Find the next three terms: 4, 9, 14, 19, ...
2. Find the next three terms: 1, 4, 16, 64, ...
3. Make your own sequence. Write its first five terms. Ask a friend to find your rule.

Think & Explain

Rani sees 1, 2, 4, ... and says the next terms are 8, 16, 32 (multiply by 2).

Ravi sees the same numbers and says the next terms are 7, 11, 16 (add 1, then 2, then 3, then 4, ...).

Who is right? What does this tell you about finding a rule from only three terms?

★ **Good habit**
Always **say your rule** along with your answer. Then everyone knows how you got it.

Patterns in daily life

Where?	Sequence	Rule
Dates of Mondays in a month	3, 10, 17, 24, 31	Add 7
Money saved, Rs 5 more each week	5, 10, 15, 20, ...	Add 5
A cell splits into 2 every hour	1, 2, 4, 8, 16, ...	Multiply by 2
Seats in rows of a hall	10, 12, 14, 16, ...	Add 2

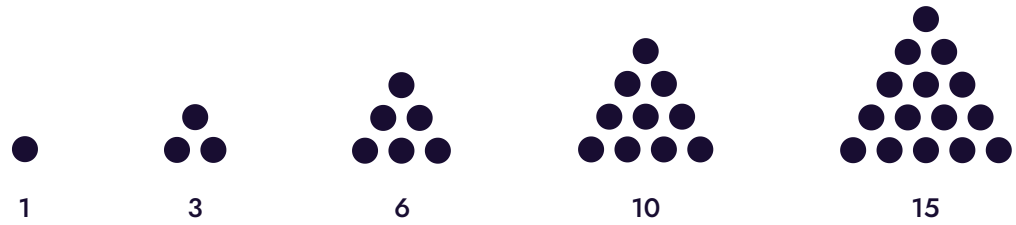
Math Talk

Think of one more number pattern from your home or school. Share it with the class.

1.3 Visualising Number Sequences

Visualising means making a picture in your mind or on paper. Many number sequences become easy to understand when we draw them with dots. The shape of the picture often gives the sequence its name.

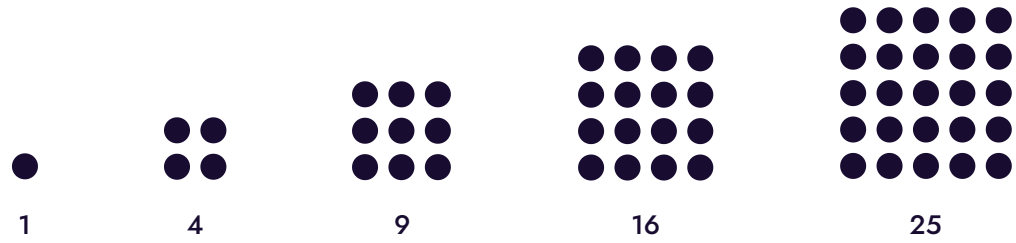
Triangular numbers: 1, 3, 6, 10, 15, ...



Each new picture gets one more row at the bottom. The dots make a **triangle**.

1 + 2 + 3 + 4 + 5 = 15

Square numbers: 1, 4, 9, 16, 25, ...



The dots make a **square**: the number of rows is the same as the number of columns.

4 rows × 4 columns = 16 dots

> ★ **Key idea**
> Triangular number: add 1 + 2 + 3 + ... | Square number: a number multiplied by itself

Make it!
Use buttons, seeds or bindis to build each dot picture on your desk.



Schoolie says
Count the dots row by row: 1, then 2, then 3 ... That is the triangle rule!

Grow dot pictures on screen

Word help

Hexagon = a shape with 6 sides. Honeycombs made by bees have hexagons.



Schoolie says

Rings of a hexagon: 6, 12, 18, 24 … Each ring adds 6 more!

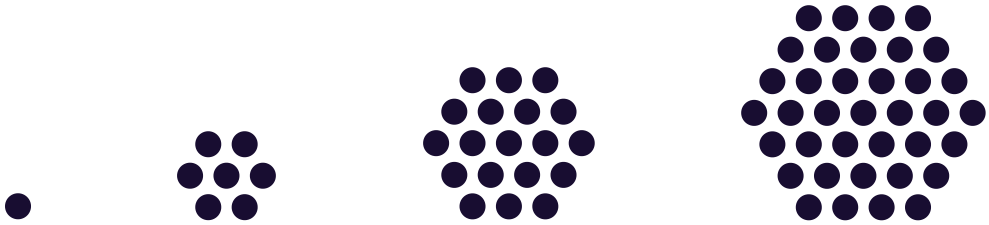
Cube numbers: 1, 8, 27, 64, …



1 8 27 64

Stack small cubes to make a bigger cube. A cube that is 3 long, 3 wide and 3 tall has 3 × 3 × 3 = **27** small cubes.

Hexagonal numbers: 1, 7, 19, 37, …



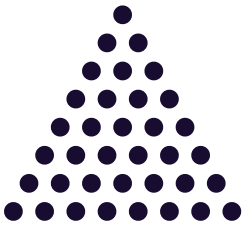
1 7 19 37

A **hexagon** is a shape with 6 sides. Start with 1 dot. Put a ring of 6 dots around it. Then a ring of 12 dots, then 18 dots. Each ring has **6 more** dots than the ring before.

1, 1 + 6 = 7, 7 + 12 = 19, 19 + 18 = 37

One number, two shapes

36 is special. It is a triangular number **and** a square number!



Triangle: 1 + 2 + … + 8 = 36

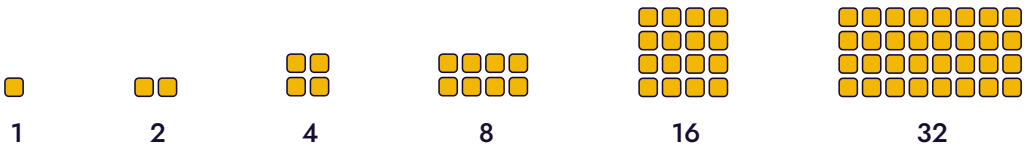


Square: 6 × 6 = 36

Powers of 2: 1, 2, 4, 8, 16, 32, ...

Start with 1 and keep **doubling**. Each picture is two copies of the picture before it.

Power	1st	2nd	3rd	4th	5th	6th	7th	8th
Value	1	2	4	8	16	32	64	128



Let's Explore

1. Draw the next hexagonal number. How many dots does it have?
2. Find all numbers up to 50 that are both triangular and square.
3. Draw powers of 3 (1, 3, 9, 27). How is each picture made from the one before?

Exercise 1.1

1. Write the next three terms. Also write the rule in words.
   a. 5, 10, 15, 20, ...
   b. 3, 6, 12, 24, ...
   c. 1, 3, 6, 10, 15, ...
   d. 100, 90, 81, 73, 66, ...
   e. 3, 5, 8, 13, ...
   f. 1, 8, 27, 64, ...
2. Draw dot pictures for the first five odd numbers (1, 3, 5, 7, 9). What shape do you see?
3. Is 100 a square number? Is it a triangular number? Explain.
4. Which number does not belong here: 1, 4, 9, 15, 16, 25? Why?
5. Find the 5th and the 6th hexagonal numbers. (Hint: the rings have 24 and 30 dots.)

Did you know?
If you double 1 just 10 times, you get 1024!



Schoolie says
Write your answers in your notebook. Then check them at the end of the chapter.



Schoolie says

An odd number of tiles can always bend into an L with two equal arms. Try it with 7 tiles!

Watch the L-shapes grow

1.4 Relations among Number Sequences

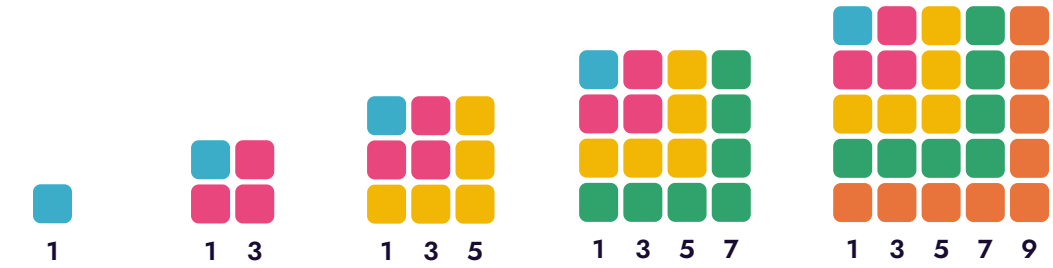
? What do you get when you add odd numbers: 1 + 3? 1 + 3 + 5? 1 + 3 + 5 + 7?

Sequences are often connected to each other. Pictures help us see **why**.

Adding odd numbers gives square numbers

1 = 1 1 + 3 = 4 1 + 3 + 5 = 9 1 + 3 + 5 + 7 = 16

All the answers are square numbers! Look at the picture. Each odd number makes an **L-shape**. The L fits around the square before it and makes a bigger square.



★ **Key idea**

Add the first **n** odd numbers and you get **n × n**.

Example: first 5 odd numbers: 1 + 3 + 5 + 7 + 9 = 5 × 5 = 25.

Example 4

Find 1 + 3 + 5 + … + 19 (the first 10 odd numbers).

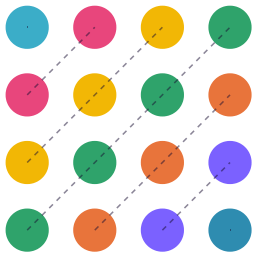
Solution: We are adding 10 odd numbers. So the answer is 10 × 10 = **100**. We did not have to add them one by one!

Think & Explain

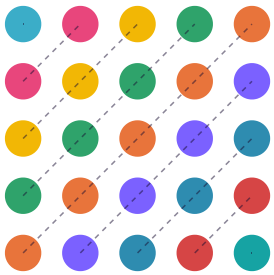
What is the sum of the first 100 odd numbers? Explain to a friend using the L-shape picture.

Up and down

Count up from 1 and then back down to 1: 1 + 2 + 3 + 4 + 3 + 2 + 1. The answer is 16 = 4 × 4. Look at the slanting lines of dots in the square below. They have 1, 2, 3, 4, 3, 2, 1 dots.



1 + 2 + 3 + 4 + 3 + 2 + 1 = 16



1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1 = 25

★ **Key idea**

1 + 2 + ... + n + ... + 2 + 1 = **n × n**.

Example: 1 + 2 + ... + 100 + ... + 2 + 1 = 100 × 100 = 10000.

Two triangles make a square

Add two triangular numbers that are next to each other:

1 + 3 = 4 3 + 6 = 9 6 + 10 = 16 10 + 15 = 25

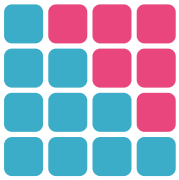
We get square numbers again! In the pictures, the blue dots make one triangle and the pink dots make the smaller triangle before it.



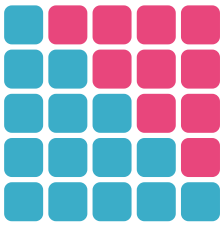
3 + 1 = 4



6 + 3 = 9



10 + 6 = 16



15 + 10 = 25

Remember

Triangular numbers: 1, 3, 6, 10, 15, 21, 28, ...



Schoolie says

Count the blue dots, then the pink dots. Add them. Is it a square?



Schoolie says

The colours show the 6 slices. Count one colour, then multiply by 6. Do not forget the middle dot!

Adding powers of 2

Add the powers of 2, and then add 1 more:

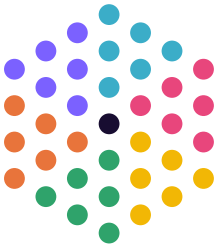
1 + 1 = 2 1 + 2 + 1 = 4 1 + 2 + 4 + 1 = 8 1 + 2 + 4 + 8 + 1 = 16

The answer is always the **next** power of 2. So, without adding everything:

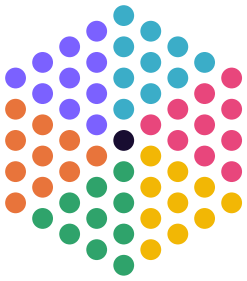
1 + 2 + 4 + 8 + 16 + 32 = 64 − 1 = 63

Hexagons are made of triangles

Cut a hexagonal dot picture into 6 equal slices around the middle dot. Each slice is a triangular number of dots. In the first picture each slice has 6 dots, so there are 6 × 6 + 1 = **37** dots.



37 = 6 × 6 + 1



61 = 6 × 10 + 1

★ **Key idea**

Hexagonal number = 6 × (a triangular number) + 1

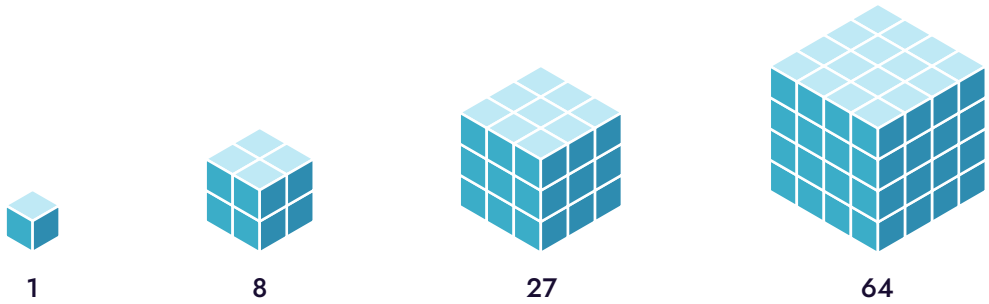
Let's Explore

1. Find 1 + 2 + 4 + 8 + 16 + 32 + 64 using the rule above.
2. Add 1 + 2 + 3, then 1 + 2 + 3 + 4, and so on. Which sequence do you get?
3. Take the triangular numbers 1, 3, 6, 10. Multiply each by 6 and add 1. What do you get?

Adding hexagonal numbers gives cubes

1 = 1 1 + 7 = 8 1 + 7 + 19 = 27 1 + 7 + 19 + 37 = 64

These are the cube numbers! Look at a cube from one corner. Its outline looks like a hexagon. Each hexagonal layer covers the smaller cube and makes the next bigger cube.



Indian Knowledge

Long ago, Indian poets made rhythms with **short** sounds (1 beat) and **long** sounds (2 beats). They asked: how many different rhythms can be made with 1 beat, 2 beats, 3 beats, and so on? The answers are 1, 2, 3, 5, 8, 13, 21, ... Each number is the **sum of the two numbers before it**.

The scholar **Virahanka** wrote this rule more than 1200 years ago (between 600 and 800 CE). Later, Indian scholars **Gopala** and **Hemachandra** also wrote about it. In Europe, **Fibonacci** wrote about these numbers in 1202. That is why many books call them Fibonacci numbers. We call them **Virahanka numbers**.

Example 5

How many rhythms of 4 beats can a drummer play using short (S = 1 beat) and long (L = 2 beats) sounds?

Solution: SSSS, SSL, SLS, LSS, LL. There are **5** rhythms. And 5 is the 4th Virahanka number!



Schoolie says

Clap it! Short = one quick clap. Long = clap and hold. Try all the 5-beat rhythms.

Play the Rhythm Maker



Schoolie says

Stuck? Draw a small picture first. Pictures make hard sums easy.

Remember

First n odd numbers add up to n × n.

Exercise 1.2

1. Find 1 + 3 + 5 + ... + 29 without adding all the numbers. (First count how many odd numbers there are.)
2. Find 1 + 2 + 3 + ... + 19 + 20 + 19 + ... + 3 + 2 + 1.
3. Which odd number should be added to 64 to get the next square number?
4. Find 1 + 2 + 4 + 8 + 16 + 32 + 64.
5. The 6th triangular number is 21. Use it to find the 7th hexagonal number. (Look at page 12.)
6. Add the 5th and the 6th triangular numbers. What kind of number do you get?
7. Shreya says, "The sum of the first 8 odd numbers is 72." Is she right? Explain.
8. Write the next Virahanka number after 1, 2, 3, 5, 8, 13, 21, 34.

Picture puzzle

Draw a 5 × 5 square of dots. Use two colours to show that it is made of two triangular numbers, 15 and 10.

1.5 Patterns in Shapes

? Can shapes make a pattern too? Look at the shapes below. What changes each time?

Regular polygons

A **polygon** is a closed shape made of straight lines. It is **regular** when all its sides are equal and all its angles are equal. Each shape below has one more side than the shape before it.



Triangle | Square | Pentagon | Hexagon | Heptagon | Octagon

Complete graphs

Put some dots in a circle. Join **every** dot to **every other** dot with a straight line.



2 dots | 3 dots | 4 dots | 5 dots | 6 dots

Stacked squares and stacked triangles

Arrange small squares into bigger squares, and small triangles into bigger triangles.



1 × 1 | 2 × 2 | 3 × 3 | 4 × 4 | 1 row | 2 rows | 3 rows | 4 rows

Word help

Polygon = a closed shape with straight sides.
Regular = all sides and angles equal.



Schoolie says

Use a ruler and a sharp pencil. Neat drawings help you count correctly.

Draw shapes on screen

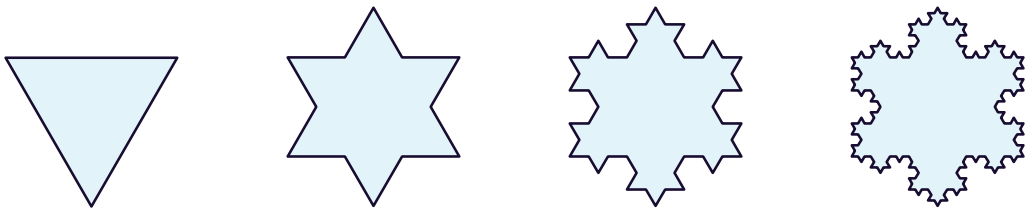
Did you know?
The Koch snowflake is a **fractal**. If you zoom into a small part, it looks like the whole shape!

Grow the snowflake

Koch snowflake

This is a beautiful shape pattern. Follow these steps:

1. Start with a triangle with equal sides.
2. Divide every side into 3 equal parts.
3. On the middle part, draw a small triangle pointing outwards. Remove the base of the small triangle.
4. Repeat steps 2 and 3 on every new side.



Step 1 Step 2 Step 3 Step 4

The shape gets more and more "spiky", like a snowflake. Each side changes into **4** smaller sides.

★ **Key idea**
A shape pattern grows by a rule, just like a number pattern.

Math Talk
Choose one shape pattern from pages 15 and 16. Tell your partner in your own words how to draw the **next** shape.

Try This
Draw the next shape in the regular polygon pattern. How many sides does it have? What is it called?

1.6 Relations to Number Sequences

? If you count the parts of each shape, will you get a number pattern?

Yes! Count something in each shape pattern and a number sequence appears.

Shape pattern	What we count	Number sequence
Regular polygons	Sides (or corners)	3, 4, 5, 6, 7, … (counting numbers from 3)
Complete graphs	Lines	1, 3, 6, 10, 15, … (triangular numbers)
Stacked squares	Small squares	1, 4, 9, 16, … (square numbers)
Stacked triangles	Small triangles	1, 4, 9, 16, … (square numbers)
Koch snowflake	Sides	3, 12, 48, 192, … (multiply by 4)

Why do complete graphs give triangular numbers?

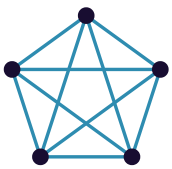
Take 5 dots. The 1st dot joins to 4 other dots. The 2nd dot joins to 3 new dots. The 3rd dot joins to 2 new dots. The 4th dot joins to 1 new dot.

Lines = 4 + 3 + 2 + 1 = 10, a triangular number

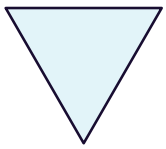
Why does the Koch snowflake multiply by 4?

In every step, each side changes into 4 smaller sides.

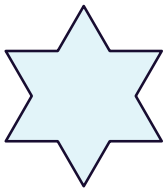
3, 3 × 4 = 12, 12 × 4 = 48, 48 × 4 = 192



5 dots: 4 + 3 + 2 + 1 = 10 lines



3 sides



12 sides



Schoolie says

When you count lines, do not count the same line twice!

Remember

Triangular numbers: 1, 3, 6, 10, 15, 21, 28, …



Schoolie says
A rule like "3 × n + 1" helps you find the 100th term without drawing 100 squares!

Remember
A side that is shared is counted only **once**.

Build with virtual matchsticks

Matchstick patterns

Make squares in a row with matchsticks:



1 square: 4 sticks | 2 squares: 7 sticks | 3 squares: 10 sticks | 4 squares: 13 sticks

The first square needs **4** sticks. Every new square shares one side with the square before it. So each new square needs only **3** more sticks.

4, 7, 10, 13, ... (add 3)

Squares (n)	1	2	3	4	5	10
Sticks	4	7	10	13	16	31

★ **Key idea**
Sticks for **n** squares in a row = **3 × n + 1**
For 10 squares: 3 × 10 + 1 = **31** sticks.

Example 6

How many sticks are needed for 25 squares in a row?
Solution: 3 × 25 + 1 = 75 + 1 = **76** sticks. We did not need to make 25 squares!

Try This

1. Make triangles in a row with matchsticks. Count the sticks for 1, 2, 3 and 4 triangles. What is the rule?
2. How many lines does a complete graph with 6 dots have? Count them in the picture on page 15.

Exercise 1.3

1. A regular polygon has 10 sides. What is it called? How many corners does it have?
2. How many lines are there in a complete graph with 7 dots? With 8 dots?
3. The Koch snowflake has 3, 12, 48 and 192 sides in its first four steps. How many sides does it have in step 5?
4. How many small squares are there in the 7th stacked-square picture?
5. Look at the matchstick squares in a row.
   a. How many sticks are needed for 12 squares?
   b. Sonu has 61 sticks. How many squares in a row can he make using all of them?
6. A stacked-triangle picture has 6 rows. How many small triangles are there? Explain how you know without counting.
7. Draw your own shape pattern. Count something in it and write the number sequence.

Math Lab Activity: Patterns around me

Work in groups of four.

1. Find **two** number patterns and **two** shape patterns at school or at home. (Ideas: house numbers, steps, floor tiles, a jali, a rangoli, a calendar.)
2. Draw or photograph each pattern and write its rule.
3. For one pattern, guess the 10th term. Check it if you can.
4. Share your patterns with your class on a chart or in the Schoolifi app.

Brain Teaser

1. At a party, 8 friends each shake hands with every other friend once. How many handshakes are there? (Hint: which shape pattern is this?)
2. Aarav climbs stairs taking 1 or 2 steps at a time. In how many ways can he climb 6 steps? (Hint: try 1, 2 and 3 steps first.)



Schoolie says

Brain teasers are like games. It is fine to take your time!

Share your Math Lab work



Schoolie says

Be honest! "Not yet" only means you will get there soon. Go back to that page and try again.

Take the 2-minute quiz

The Last Words

- Mathematics is the study of patterns and the reasons behind them.
- A **sequence** is a list of numbers made by a rule. Each number is a **term**.
- To find a rule, look at the **differences** between the terms. If that does not work, try multiplying.
- Triangular numbers: 1, 3, 6, 10, … Square numbers: 1, 4, 9, 16, … Cube numbers: 1, 8, 27, 64, … Hexagonal numbers: 1, 7, 19, 37, … Virahanka numbers: 1, 2, 3, 5, 8, …
- Dot pictures help us see why a pattern works.
- The first n odd numbers add up to n × n.
- 1 + 2 + … + n + … + 2 + 1 = n × n.
- Two triangular numbers next to each other add up to a square number.
- 1 + 2 + 4 + … (powers of 2) = the next power of 2, minus 1.
- Hexagonal number = 6 × (a triangular number) + 1. Adding hexagonal numbers gives cube numbers.
- Each Virahanka number is the sum of the two before it. Virahanka wrote about them long before Fibonacci.
- When we count the parts of shape patterns, we get number sequences.

Self-check: how sure am I?

Put a tick (✓) in one box for each line.

I can …	Yes	Almost	Not yet
find the next terms and say the rule			
draw triangular, square and hexagonal numbers			
use a picture to explain why a pattern works			
find the number pattern in a shape pattern			

Mind Map

Number sequences

- Counting 1, 2, 3, 4 …
- Odd 1, 3, 5 … · Even 2, 4, 6 …
- Triangular 1, 3, 6, 10 …
- Square 1, 4, 9, 16 …
- Cube 1, 8, 27, 64 …
- Virahanka 1, 2, 3, 5, 8 …
- Powers of 2 and 3

Finding the rule

- Find the differences
- Same difference: “add”
- Changing differences: look for their pattern
- Else try “multiply by”
- Test the rule on every term
- Always say your rule

CHAPTER 1

Patterns in Mathematics

Maths is the search for patterns and the reasons behind them.

Pictures of numbers

- Triangle: add one more row
- Square: rows = columns
- Cube: n × n × n small cubes
- Hexagon: rings of 6, 12, 18 …
- 36 is triangle and square

Relations

- First n odd numbers = n × n
- 1 + 2 + … + n + … + 2 + 1 = n × n
- Two triangles side by side = square
- 1 + 2 + 4 + … = next power of 2 − 1
- Hexagonal = 6 × triangular + 1
- Hexagonal numbers add up to cubes

Shape sequences give number sequences

- Polygons: sides 3, 4, 5 … · Complete graphs: lines 1, 3, 6, 10 …
- Stacked squares and triangles: 1, 4, 9, 16 …
- Koch snowflake: 3, 12, 48 … (× 4) · Matchsticks: 3 × n + 1

How to use

Read the mind map before a test. Can you explain every line to a friend? Cover one box and say what is in it.



Schoolie says

Make your own mind map in your notebook. Use colours!

Level badges
Level 1 = remember
Level 2 = apply
Level 3 = think deeper



Schoolie says
Tick each level you finish. Level 3 is for brave thinkers!

More practice in the app

Practice in Three Levels

Start with Level 1. Move up when you get most answers right. Answers are at the end of the chapter.

Level 1 · Basic — Warm up: do you remember the main ideas?

1. Write the next two terms: 6, 12, 18, 24, _____, _____
2. Write the next two terms: 50, 45, 40, 35, _____, _____
3. Is 21 a triangular number? Show it as a sum 1 + 2 + 3 + ...
4. Write the 7th square number.
5. Find 2 × 2 × 2 × 2 × 2. Which sequence is this number in?
6. How many sides does a hexagon have? How many corners?
7. Which of these are odd numbers: 27, 34, 41, 50?
8. True or false: 64 is both a square number and a cube number.

Level 2 · Standard — Use the rules and pictures from the chapter.

9. Find 1 + 3 + 5 + ... + 39 without adding all the numbers.
10. Find the 9th triangular number and the 9th square number.
11. Write the next two terms of 2, 5, 10, 17, 26, ... and say the rule. (Hint: look at the square numbers.)
12. How many lines are there in a complete graph with 9 dots?
13. Sonu has 100 matchsticks. How many squares in a row can he make using all of them?
14. How many rhythms of 7 beats can be made with short (1 beat) and long (2 beats) sounds?
15. Find 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128.

Level 3 · Challenge Think deeper. Explain your answer with a picture or reasons.

16. Find two triangular numbers next to each other that add up to 81.
17. Riya says the 10th hexagonal number is 271. Is she right? Use hexagonal number = 6 × (triangular number) + 1.
18. Look at the pattern 1, 1 + 2 + 1, 1 + 2 + 3 + 2 + 1, … What is the 15th term?
19. Triangles in a row need 2 × n + 1 matchsticks. How many triangles can you make with 51 sticks?
20. In which step does the Koch snowflake first have more than 1000 sides?
21. 36 is both a triangular and a square number. Find a bigger number that is both. (Hint: try 35 × 35, and add 1 + 2 + 3 + … + 49.)

Think & Explain

Make up one Level 3 question of your own about patterns. Swap with a friend and solve each other's question.

Rough work



Schoolie says

Stuck on Level 3? Draw it, make a table, or try smaller numbers first.

Exam tip
For Assertion and Reason:
1. Is A true?
2. Is R true?
3. Does R explain A?



Schoolie says
Read every option before you choose.

Competency Practice

A. Choose the correct answer.

1. The next term of 2, 6, 18, 54, ... is
   (a) 108 (b) 162 (c) 72 (d) 216
2. Which of these is a triangular number?
   (a) 20 (b) 24 (c) 28 (d) 32
3. 1 + 3 + 5 + 7 + 9 + 11 + 13 =
   (a) 36 (b) 42 (c) 49 (d) 64
4. The Virahanka number after 8 and 13 is
   (a) 18 (b) 20 (c) 21 (d) 26
5. A complete graph with 6 dots has how many lines?
   (a) 6 (b) 12 (c) 15 (d) 21
6. How many matchsticks make 5 squares in a row?
   (a) 15 (b) 16 (c) 20 (d) 21

B. Assertion and Reason

Read the Assertion (A) and the Reason (R). Then choose:
(a) A and R are both true, and R explains A. (b) A and R are both true, but R does not explain A.
(c) A is true, but R is false. (d) A is false, but R is true.

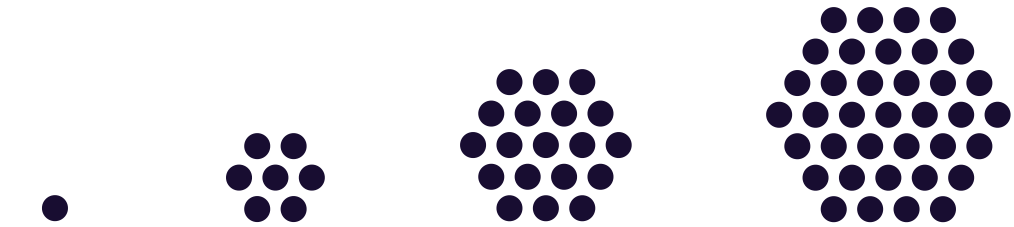
1. **A:** 1 + 3 + 5 + ... + 15 = 64.
   R: The first n odd numbers add up to n × n, and here there are 8 odd numbers.
2. **A:** The 5th hexagonal number is 61.
   R: A hexagonal number is 6 times a triangular number, plus 1, and 6 × 10 + 1 = 61.
3. **A:** 36 is both a square number and a triangular number.
   R: Every square number is also a triangular number.

C. Short answer questions

1. What is the 10th triangular number? Show how you found it.
2. Find the next two terms of 2, 6, 12, 20, 30, ... Write the rule.
3. Write 25 as a sum of odd numbers, starting from 1.

D. Case-based question: Diya's rangoli

For Diwali, Diya makes rangoli designs with dots. Her first design has 1 dot. For every new design, she adds a ring of dots shaped like a hexagon around the old design.



Design 1 Design 2 Design 3 Design 4

1. How many dots are there in Design 3?
2. How many dots does she add to make Design 5? How many dots does Design 5 have?
3. Diya counts all the dots in her first four designs together. How many dots are there? What do you notice?
4. Diya has colour for only 100 dots. What is the biggest design she can make? Which design number is it?

Draw Design 5 here.



Schoolie says

Read the story two times. Then draw it. Real-life questions become easy!

Make Diya's rangoli on screen



Schoolie says

Be creative with your Pattern Book. Use colours!

E. Think like a mathematician

1. Pooja says, “Every number in 1, 4, 7, 10, 13, … leaves remainder 1 when divided by 3.” Check her claim for five terms. Explain why it is always true.
2. Draw the powers-of-2 picture that comes after 16. How many squares does it have? How is it made from the picture for 16?
3. Explain with a picture why two triangular numbers next to each other always make a square number.

Project: My Pattern Book

Make a small “Pattern Book” with 4 pages. On each page, draw one pattern from nature or your home (flower petals, a pineapple, a honeycomb, a staircase, a calendar). Write the number sequence it shows and its rule. Share a photo of your book in the Schoolifi app to earn a **Pattern Star** badge!

My notes

Chapter Test

Time: **40 minutes** Maximum marks: **25** Name: _____

Answer all questions. Show your working. Marks are given in brackets.

Section A · Choose the correct answer. (1 × 5 = 5)

1. The next term of 4, 8, 16, 32, … is

   (a) 48 (b) 64 (c) 36 (d) 40

2. Which of these is a square number?

   (a) 50 (b) 64 (c) 72 (d) 90

3. The sum of the first 6 odd numbers is

   (a) 30 (b) 36 (c) 42 (d) 49

4. How many corners does an octagon have?

   (a) 6 (b) 7 (c) 8 (d) 10

5. 1, 2, 3, 5, 8, … are called

   (a) powers of 2 (b) Virahanka numbers (c) triangular numbers (d) odd numbers

Section B · Short answers (2 × 4 = 8)

6. Write the next three terms of 7, 11, 15, 19, … and write the rule.

7. Draw the 4th triangular number as a dot picture and write its value.

8. Find 1 + 2 + 3 + … + 12 + … + 3 + 2 + 1.

9. How many lines are there in a complete graph with 7 dots? Show your working.

Test tips

Read each question twice. Do the ones you know first. Check your answers at the end.



Schoolie says

You can do it! Take a deep breath before you start.

Marks guide
22–25 Excellent
17–21 Very good
12–16 Good, revise once
Below 12 Read the chapter again, then retry

Take this test online

Section C · Explain your answer (3 × 3 = 9)

10. Use L-shapes to show why 1 + 3 + 5 + 7 + 9 = 25. Draw the picture.
11. Find 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128. Explain the shortcut you used.
12. Find the 5th hexagonal number using the rule "6 × triangular number + 1". Check your answer by counting the rings: 1 + 6 + 12 + …

Section D · Case-based question (1 × 3 = 3)

Aman builds a staircase with square tiles. Step 1 has 1 tile, step 2 has 2 tiles, step 3 has 3 tiles, and so on, with the steps standing side by side.



1 steps 2 steps 3 steps 4 steps

13. How many tiles does a staircase with 5 steps need?
14. How many tiles does a staircase with 10 steps need?
15. Aman puts a 5-step staircase and a 4-step staircase together to make a square. How many tiles are in the square?

Rough work

My score: _____ / 25 Signature of parent or teacher: _____

NCERT Help

Hints for the **"Figure it Out"** questions in your NCERT book *Ganita Prakash*, Chapter 1. **Try each question yourself first.** Use a hint only when you are stuck.

Section 1.1 · Figure it Out

Q1–2. Think about your day: shopping and change, cooking with measures, cricket scores, the calendar, mobile phones, weather reports, bridges and buildings. Say how numbers or patterns help in each.

Section 1.2 · Figure it Out

Q1–2. Use the table on page 4 of this book: it gives the rule for each sequence in simple words. To find the next three terms, use the steps on page 5. Check your answers on page 31.

Section 1.3 · Figure it Out

Q1. Triangle: add one more row at the bottom. Square: add one row and one column. Cube: add one more layer on three sides.

Q2. Look at the shapes the dots make on pages 7 and 8 of this book: triangles, squares and cubes.

Q3. 36 dots make a triangle with 8 rows (1 + 2 + … + 8) and a square with 6 rows of 6. See page 8.

Q4. These are hexagonal numbers. The next ring has 24 dots, so the next number is 37 + 24 = 61.

Q5. Powers of 2: each picture is two copies of the one before (page 9). Powers of 3: use three copies.

Important
These are hints written by Schoolifi to help you think. Your NCERT book has the questions.



Schoolie says
Hints are like a torch. They show the path, but you still have to walk!



Schoolie says

Compare your answer with the hint. Did you think of it in a different way? That is great too!

Section 1.4 · Figure it Out

Q1. Colour the dots of a square along slanting lines, as on page 11 of this book.

Q2. The picture is a 100 × 100 square, so the total is 10000.

Q3. Adding the All 1's up gives 1, 2, 3, 4 ... (counting numbers). Adding them up and down gives 1, 3, 5, 7 ... (odd numbers).

Q4. You get triangular numbers. Draw them as a staircase of dots.

Q5. You get square numbers. Two triangles side by side make a square (page 11).

Q6. You get 1, 3, 7, 15, 31 ... Adding 1 gives 2, 4, 8, 16, 32: powers of 2. Each new power of 2 is one more than all the earlier ones added up.

Q7. You get hexagonal numbers: 7, 19, 37, 61 ... Cut a hexagon into 6 triangle slices around the middle dot (page 12).

Q8. You get cube numbers: 1, 8, 27, 64 ... Each hexagon is one layer of a cube seen from a corner (page 13).

Q9. Your own patterns. Try adding even numbers, or adding square numbers, and look for a rule.

Section 1.5 · Figure it Out

Q1–2. Polygons: add one side. Complete graphs: add one dot and join it to every other dot. Stacked squares: add a row and a column. Stacked triangles: add one row. Koch snowflake: change every side into 4 smaller sides.

Section 1.6 · Figure it Out

Q1. Sides: 3, 4, 5, 6 ... Corners: the same numbers, because every side ends at a corner and every corner joins two sides.

Q2. Lines: 1, 3, 6, 10 ... (triangular numbers). See page 17.

Q3. Little squares: 1, 4, 9, 16 ... (square numbers), because each picture is n rows of n.

Q4. Little triangles per row: 1, 3, 5, 7 ... (odd numbers). They add up to square numbers.

Q5. Sides: 3, 12, 48, 192 ... Multiply by 4 each time.

Answers

1.1 Try This

● ■ (the pattern circle, square, triangle repeats)

1.2 Let's Explore (next three terms)

All 1's: 1, 1, 1 · Counting: 7, 8, 9 · Odd: 13, 15, 17 · Even: 14, 16, 18 · Triangular: 28, 36, 45 · Square: 49, 64, 81 · Cube: 343, 512, 729 · Virahanka: 21, 34, 55 · Powers of 2: 64, 128, 256 · Powers of 3: 729, 2187, 6561. Powers of 3 grow the fastest. All 1's do not grow at all.

Try This (page 6)

1. 24, 29, 34 (add 5)
2. 256, 1024, 4096 (multiply by 4)
3. Answers will vary.

Think & Explain: Both can be right. Three terms are not enough to be sure of the rule, so we must always say which rule we are using.

Let's Explore (page 9)

1. 61 dots (the ring has 24 dots).
2. 1 and 36.
3. Each picture is three copies of the one before: 1, 3, 9, 27, ...

Exercise 1.1

1. (a) 25, 30, 35: add 5 (b) 48, 96, 192: multiply by 2 (c) 21, 28, 36: add 2, then 3, then 4, ... (d) 60, 55, 51: subtract 10, then 9, then 8, ... (e) 21, 34, 55: add the two terms before (f) 125, 216, 343: cube numbers
2. L-shapes with equal arms.
3. Yes, $100 = 10 \times 10$ is a square number. It is not a triangular number: $1 + 2 + \ldots + 13 = 91$ and $1 + 2 + \ldots + 14 = 105$, so 100 is skipped.
4. 15. All the others are square numbers.
5. 61 and 91.

Think & Explain (page 10)

$100 \times 100 = 10000$.

Let's Explore (page 12)

1. $128 - 1 = 127$
2. The triangular numbers: 3, 6, 10, 15, ...
3. 7, 19, 37, 61: the hexagonal numbers after 1.



Schoolie says

Got one wrong? Great! Find the step where your thinking changed. That is how we learn.



Schoolie says
Check each answer carefully. Mark the ones you got wrong and try them again tomorrow.

Exercise 1.2

1. There are 15 odd numbers, so the sum is 15 × 15 = 225.
2. 20 × 20 = 400.
3. 17, because 64 + 17 = 81.
4. 128 − 1 = 127.
5. 6 × 21 + 1 = 127.
6. 15 + 21 = 36, a square number.
7. No. The first 8 odd numbers add up to 8 × 8 = 64. (72 is the sum of the first 8 even numbers.)
8. 55 (21 + 34).

Picture puzzle: colour the dots on and below one slanting line in one colour (15 dots) and the rest in another colour (10 dots).

Try This (page 16)

A nonagon: 9 sides.

Try This (page 18)

1. 3, 5, 7, 9 sticks. The rule is 2 × n + 1.
2. 15 lines.

Exercise 1.3

1. A decagon; 10 corners.
2. 7 dots: 21 lines. 8 dots: 28 lines.
3. 192 × 4 = 768.
4. 7 × 7 = 49.
5. (a) 3 × 12 + 1 = 37 sticks (b) 3 × n + 1 = 61, so 3 × n = 60 and n = **20** squares.
6. 36. Each new row adds the next odd number of triangles: 1 + 3 + 5 + 7 + 9 + 11 = 36 = 6 × 6.
7. Answers will vary.

Brain Teaser

1. 28 handshakes (like a complete graph with 8 dots: 7 + 6 + 5 + 4 + 3 + 2 + 1).
2. 13 ways (Virahanka numbers: 1, 2, 3, 5, 8, 13).

Competency Practice

A. 1. (b) 162 2. (c) 28 3. (c) 49 4. (c) 21 5. (c) 15 6. (b) 16

B. 1. (a) 2. (a) 3. (c). R is false: for example, 4 is a square number but not a triangular number.

C. 1. 1 + 2 + … + 10 = 55. 2. 42, 56. The differences are 4, 6, 8, 10, so the next differences are 12 and 14. 3. 25 = 1 + 3 + 5 + 7 + 9.

D. 1. 19 dots. 2. She adds 24 dots. Design 5 has 61 dots. 3. 1 + 7 + 19 + 37 = 64. It is a cube number (4 × 4 × 4). 4. Design 6, with 91 dots (Design 7 would need 127).

E. 1. The terms start at 1 and go up by 3. So each term is 1 more than a multiple of 3. 2. 32 squares. It is two copies of the picture for 16, side by side. 3. Draw a square of dots and cut it along a slanting line, keeping that line in one part (see page 11).

Practice in Three Levels

Level 1. 1. 30, 36 2. 30, 25 3. Yes: 1 + 2 + 3 + 4 + 5 + 6 = 21 4. 49 5. 32; powers of 2 6. 6 sides, 6 corners 7. 27 and 41 8. True: 8 × 8 = 64 and 4 × 4 × 4 = 64

Level 2. 9. 20 odd numbers, so 20 × 20 = 400 10. 45 and 81 11. 37, 50. Each term is a square number plus 1 12. 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 36 13. 3 × n + 1 = 100, so n = 33 squares 14. 21 rhythms (1, 2, 3, 5, 8, 13, 21) 15. 256 − 1 = 255

Level 3. 16. 36 + 45 = 81 17. Yes: the 9th triangular number is 45, and 6 × 45 + 1 = 271 18. 15 × 15 = 225 19. 2 × n + 1 = 51, so n = 25 triangles 20. Step 6 (3, 12, 48, 192, 768, 3072) 21. 1225: 35 × 35 = 1225 and 1 + 2 + … + 49 = 1225

Chapter Test

A. 1. (b) 64 2. (b) 64 3. (b) 36 4. (c) 8 5. (b) Virahanka numbers

B. 6. 23, 27, 31; add 4 7. Rows of 1, 2, 3 and 4 dots; 10 8. 12 × 12 = 144 9. 6 + 5 + 4 + 3 + 2 + 1 = 21 lines

C. 10. Draw a 5 × 5 square made of L-shapes of 1, 3, 5, 7 and 9 tiles. 11. 255. Adding 1 gives 256, the next power of 2, so the sum is 256 − 1. 12. 6 × 10 + 1 = 61; rings: 1 + 6 + 12 + 18 + 24 = 61

D. 13. 1 + 2 + 3 + 4 + 5 = 15 tiles 14. 55 tiles 15. 15 + 10 = 25 tiles (a 5 × 5 square)

Marking: give full marks for a correct answer with working. Give part marks for correct working with a small slip.

Next chapter
Lines and Angles: points, lines, rays and angles, and how to measure them.



See all answers online



Schoolie says

Write new words, tricky questions or your own patterns here.

My notes

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