Collegedunia NCERT Notes

NCERT Notes for Class 8 Mathematics Part 1 (2026-27 Syllabus)

Chapter 5: Number Play

These notes explain consecutive sums, parity, divisibility tests and digit puzzles. Each rule is supported by reasoning and worked examples.

Official scope. NCERT *Ganita Prakash*, Grade 8, Reprint 2026-27, Chapter 5 “Number Play” is the governing source.

Also see for this chapter:

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1 Playing with Consecutive Numbers

Consecutive integers differ by one. Their sums reveal patterns that algebra can explain for every possible starting number.

1.1 Writing numbers as consecutive sums

A natural number may have one or more consecutive-sum forms. For example, $15 = 7 + 8 = 4 + 5 + 6 = 1 + 2 + 3 + 4 + 5$.

- Two consecutive numbers have opposite parity.
- An odd number greater than one is the sum of two consecutive integers.
- Longer runs depend on factors of the target number.

Sum of a run

For (k) consecutive integers beginning at (n),

$$S = kn + \frac{k(k-1)}{2}.$$



Fast two-term form

For odd (N>1), use $(N-1)/2$ and $(N+1)/2$.

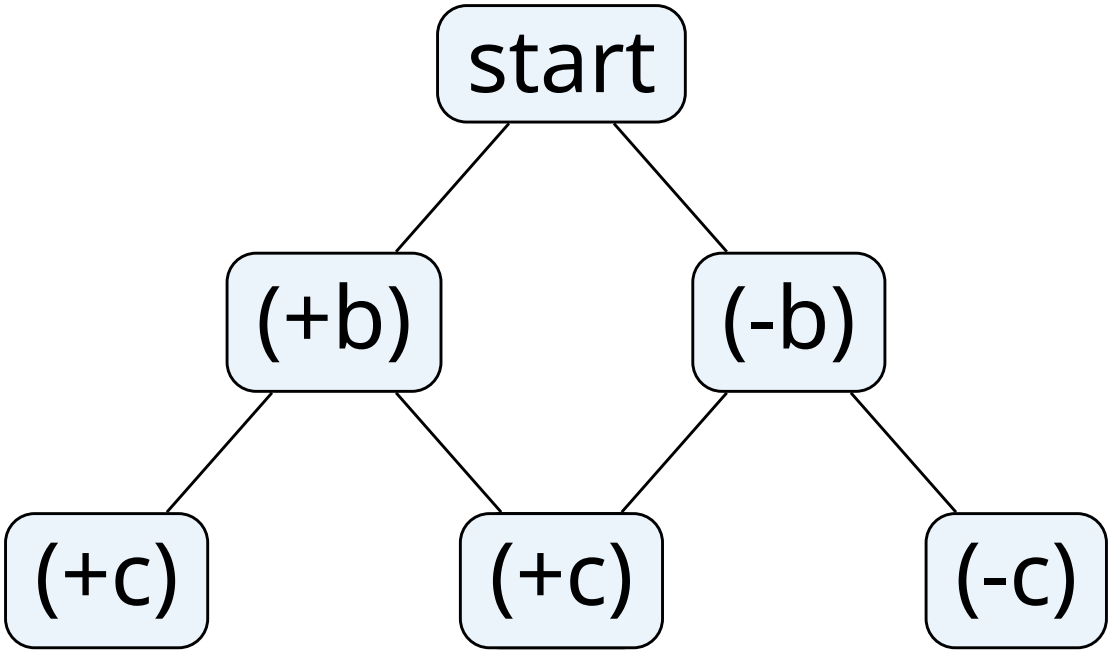
1.2 Four consecutive numbers and signs

Four numbers (n,n+1,n+2,n+3) give eight expressions when the three inner signs vary. All eight answers have the same parity.

General signed expression

$$n \pm (n+1) \pm (n+2) \pm (n+3).$$

Changing one sign changes the value by twice an integer. The parity therefore stays fixed.



Why the parity is fixed

Replacing (+x) by (-x) subtracts (2x). Adding or subtracting an even number never changes parity.

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1.3 Reasoning with variables

Variables turn many trials into one proof. Start with one expression, then compare it with a sign-switched version.

$$(a + b - c - d) - (a - b - c - d) = 2b.$$

The difference is even. Hence both expression values are either even or odd.

1. Write the two expressions inside brackets.
2. Subtract carefully and open the second bracket.
3. Pair equal terms and simplify.
4. Use the factor (2) to conclude parity.

Sign after a bracket

Every sign inside the second bracket changes during subtraction. Missing one change gives a false result.

2 Parity and Algebra

Parity tells whether an integer is even or odd. It often answers a question without full calculation.

2.1 Parity rules for operations

The parity rules follow from writing an even number as (2m) and an odd number as (2m+1).

Operation	Input types	Result
Addition	same parity	even
Addition	different parity	odd
Multiplication	at least one even	even
Multiplication	both odd	odd

Algebraic forms

$$2m + 2n = 2(m + n), \qquad (2m + 1) + (2n + 1) = 2(m + n + 1).$$

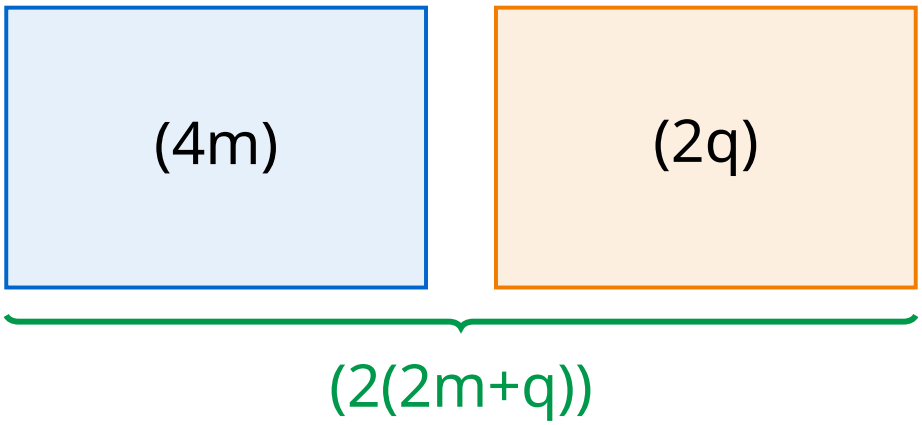
Same gives even

For addition or subtraction, same parity gives even. Different parity gives odd.

2.2 Expressions that are always even

An expression is always even if a factor 2 can be taken from every term. For example, $4m + 2q = 2(2m + q)$.

- (2a+2b) is always even.
- (4m+2n) is always even.
- $13k - 5k = 8k$ is always even.
- $x^2 + 2$ is not always even.



Factor before testing

Take out the greatest common factor. A visible factor (2) settles an always-even claim.

2.3 Examples and counterexamples

One example cannot prove an always claim. One counterexample can disprove it.

Testing $x^2 + 2$

If $x = 6$, the value is 38, which is even. If $x = 3$, the value is 11, which is odd. Therefore the expression is not always even.

Use a small even input and a small odd input first. Then explain the general parity from $x = 2m$ or $x = 2m + 1$.

A single trial is not a proof

Several successful substitutions still do not prove an identity. Use algebra for an always claim.

3 Remainders and Multiples

Remainders sort integers into useful groups. This makes questions about multiples much easier.

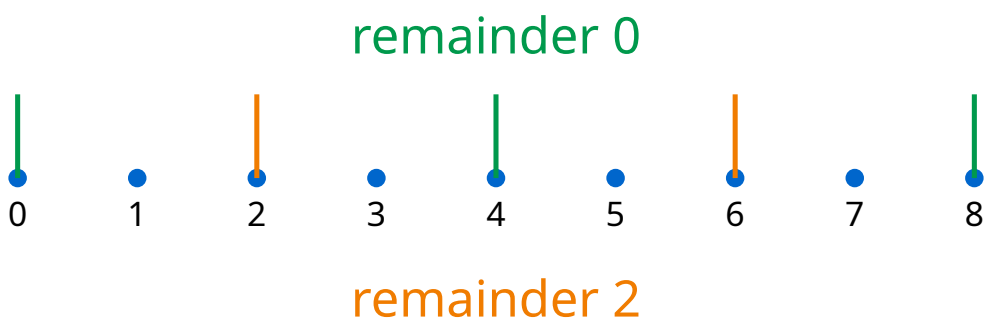
3.1 Even numbers modulo four

Every even number leaves remainder (0) or (2) when divided by (4). Write these forms as (4m) and (4m+2).

Adding even-number types

$$4m + 4n = 4(m + n), \qquad (4m + 2) + (4n + 2) = 4(m + n + 1).$$

Different types give (4(m+n)+2), which is not divisible by (4).



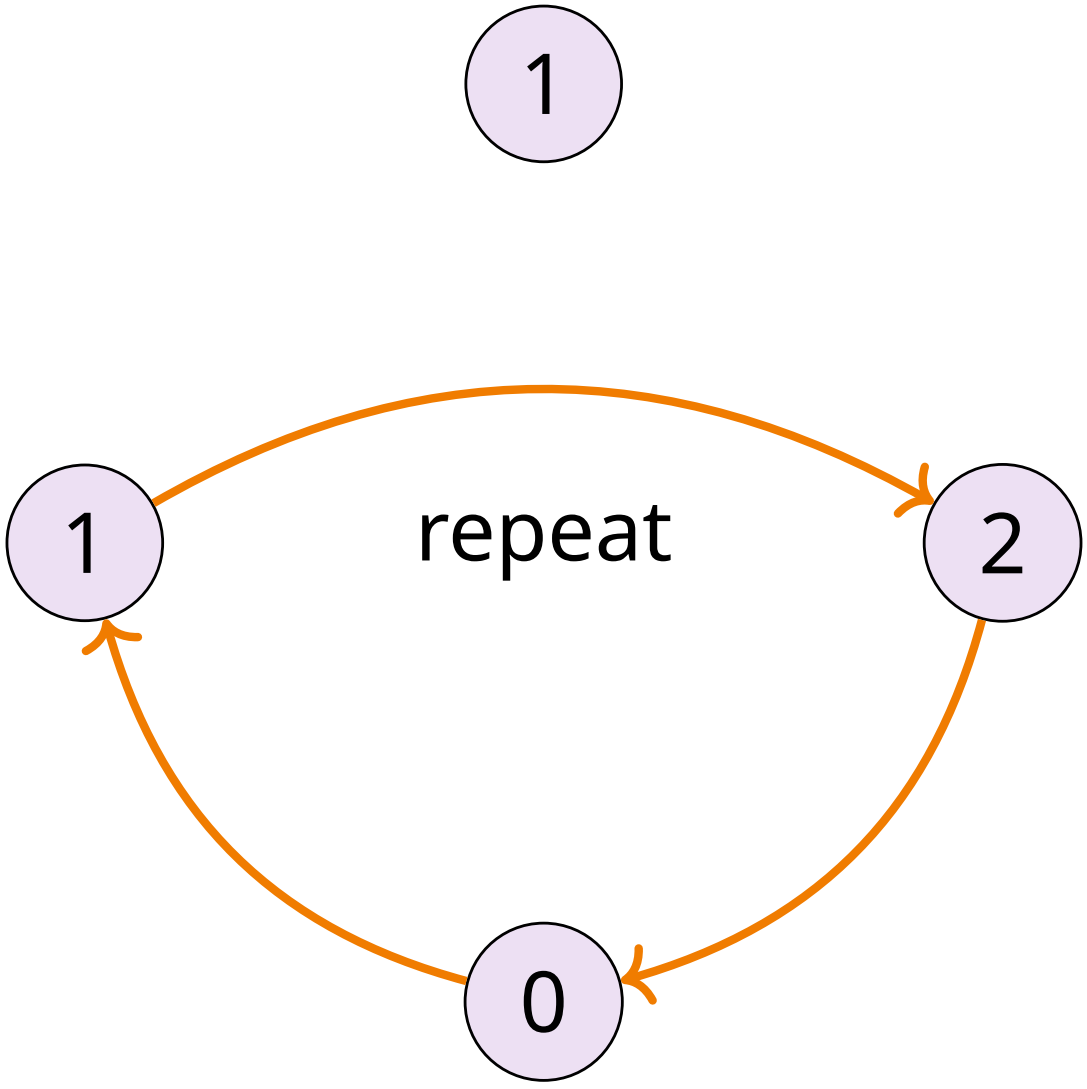
Pairing objects

Rows of four chairs model remainder classes. An even total either fills all rows or leaves two chairs.

3.2 Remainder cycles

Powers often repeat their remainders. The cycle can replace a very large computation.

- List the first few powers.
- Reduce each value by the divisor.
- Mark the repeating block.
- Use the exponent's position in the cycle.



Record only remainders

Large powers are unnecessary. Reduce after every multiplication to keep numbers small.

3.3 Consecutive-sum conditions

The run formula $S = kn + k(k-1)/2$ helps decide whether a target has a representation of length k.

1. Set the formula equal to the target.
2. Solve for (n).
3. Check that (n) is an integer.
4. Check any required positivity condition.

Example: three terms for 36

Set $3n + 3 = 36$. This gives $n = 11$, so $36 = 11 + 12 + 13$.

4 Checking Divisibility Quickly

Divisibility tests read information from digits. Each test comes from place value and remainders.

4.1 Tests for 2, 5 and 10

Only the units digit decides divisibility by (2), (5) and (10).

Divisor	Units-digit test
2	The last digit is (0,2,4,6) or (8).
5	The last digit is (0) or (5).
10	The last digit is (0).

Place-value reason

For $N = 10q + r$, the tens part $10q$ is divisible by $2, 5$ and 10. Only r remains to test.

Last digit family

Two, five and ten look only at the end.

4.2 Tests for 3 and 9

Add the digits. The original number and its digit sum leave the same remainder on division by (3) or (9).

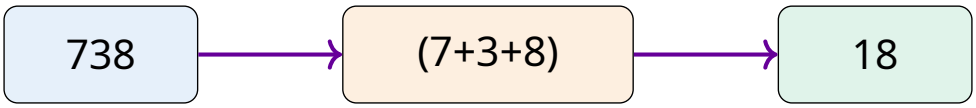
Why digit sums work

Since $10 \equiv 1 \pmod 9$,

$$100a + 10b + c \equiv a + b + c \pmod 9.$$

The same reasoning works modulo (3).

For (738), the digit sum is (18). Hence (738) is divisible by both (3) and (9).



Do not test the wrong sum

Use every digit exactly once. Recheck zeros and repeated digits.

4.3 The divisibility test for 11

Take the difference between the sums of alternating digits. A multiple of (11), including zero, means the number is divisible by (11).

Alternating-sum rule

For digits (a,b,c,d), test

$$(a + c) - (b + d).$$

For (2728), ((2+2)-(7+8)=-11). Therefore (2728) is divisible by (11).

Mark alternate places

Underline every second digit. Add the underlined digits and the remaining digits separately.

5 Building and Explaining Divisibility Tests

A divisibility test is not magic. Place value explains why the shortcut keeps the correct remainder.

5.1 Divisibility by 4 and 8

For division by (4), only the last two digits matter because (100) is divisible by (4). For division by (8), only the last three digits matter because (1000) is divisible by (8).

- (7316) is divisible by (4) because (16) is divisible by (4).
- 15432 is divisible by 8 because $432 = 8 \times 54$.
- Leading zeros in the ending block are allowed.



Error checks in codes

Remainder rules help computers detect some typing errors in identification numbers and stored data.

5.2 Combining tests

A number is divisible by a product of coprime factors when it is divisible by each factor.

Target	Factor tests	Condition
6	2 and 3	even last digit and digit sum multiple of 3
12	3 and 4	digit sum multiple of 3 and last two digits multiple of 4
18	2 and 9	even last digit and digit sum multiple of 9

Coprime matters

Tests for (2) and (6) do not prove divisibility by (12). Their least common multiple is only (6).

5.3 Finding a missing digit

Digit tests can turn a puzzle into a short equation. Suppose (47x2) is divisible by (9).

$$4 + 7 + x + 2 = 13 + x.$$

The next multiple of 9 is 18, so $x = 5$.

1. Write the relevant digit expression.
2. List nearby multiples of the divisor.
3. Keep only digit values from (0) to (9).
4. Verify in the original number.

A letter-digit has limits

A digit variable can only be $0, 1, \ldots, 9$. A leading digit cannot be zero.

6 Digits in Disguise

A numeral is a place-value expression. Writing this expression exposes hidden relationships between digits.

6.1 Two-digit and three-digit forms

If a and b are digits, the two-digit numeral $\overline{ab}$ equals $10a + b$. It is not the product ab.

Place-value notation

$$\overline{ab} = 10a + b, \qquad \overline{abc} = 100a + 10b + c.$$

hundreds	tens	ones
(a)	(b)	(c)

Place means multiplier

Hundreds, tens, ones means multiply by (100,10,1).

6.2 Reversing digits

The reverse of $\overline{ab}$ is $\overline{ba}$. Their difference always has a factor 9.

Reversal difference

$$(10a + b) - (10b + a) = 9(a - b).$$

Therefore, the difference between a two-digit number and its reverse is divisible by (9). Its sign depends on which digit is larger.

> **Reverse safely**
>
> Write both place-value forms before subtracting. This prevents treating the digit string as a product.

6.3 Digit puzzles as equations

Translate each sentence into an equation. Keep the digit restrictions visible throughout the solution.

Example puzzle

A two-digit number has digit sum 11. It is 27 more than its reverse. Then $a + b = 11$ and $9(a - b) = 27$. Thus $a - b = 3$, giving $a = 7, b = 4$. The number is 74.

Check the result: $7 + 4 = 11$ and $74 - 47 = 27$.

Number puzzles and coding

Digit constraints are small search problems. They introduce the same ideas used in constraint-based computer programs.

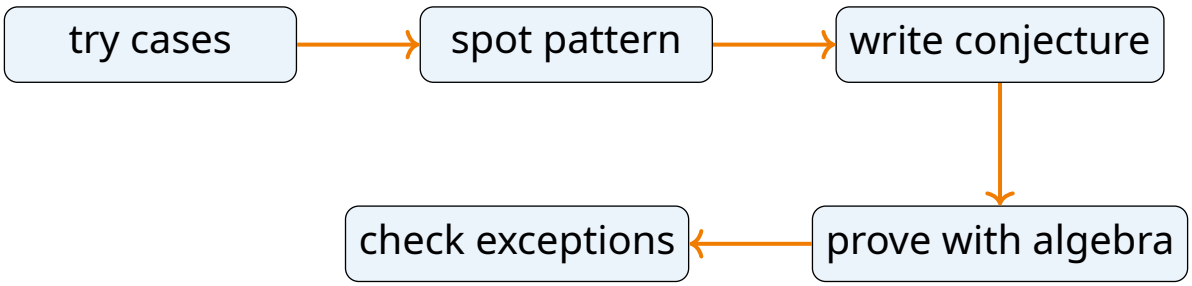
7 Strategy, Practice and Revision

Good number play combines observation, examples, algebra and a final check. Each method has a clear role.

7.1 A reliable problem-solving plan

Use this sequence for unfamiliar pattern questions.

1. Try small cases and record results neatly.
2. State a conjecture in precise words.
3. Introduce variables for a general case.
4. Simplify and justify each step.
5. Test edge cases, including zero or negative integers when allowed.



Mathematical investigation

Scientists and data analysts follow a similar cycle: observe, conjecture, test, explain and revise.

7.2 Common mistakes and how to avoid them

Most errors in this chapter come from notation or an unchecked assumption.

- **Consecutive means step one:** $4, 6, 8$ are consecutive even numbers, not consecutive integers.
- **A numeral is not a product:** $\overline{ab} = 10a + b$, not $a \times b$.
- **Always claims need proof:** trials only suggest a result.
- **Check digit limits:** use digits from 0 to 9.
- **Use the correct divisibility block:** two digits for 4, three for 8.

Keep claim and evidence together

After a calculation, write the rule it supports. A bare answer does not explain why the pattern continues.

7.3 Previous-year style question trends

School assessments usually mix short rules with explanation-based pattern questions.

Question type	Typical skill	Best response
One mark	apply a divisibility test	show the decisive digit or sum
Two marks	find a missing digit	write condition and valid digit
Three marks	prove a parity claim	use (2m) and (2m+1)
Case study	analyse a pattern	table, conjecture and algebraic reason

Match detail to marks

A proof question needs a general variable argument. Do not submit only two or three examples.

8 Formula Sheet and Quick Recall

This section gathers the core results for fast revision. Read the reason behind each rule before memorising it.

8.1 Core formulas

Consecutive integers

$$n + (n+1) + \cdots + (n+k-1) = kn + \frac{k(k-1)}{2}.$$

Digit forms

$$\overline{ab} = 10a + b, \quad \overline{abc} = 100a + 10b + c, \quad \overline{ab} - \overline{ba} = 9(a-b).$$

Parity forms

$$\text{even} = 2m, \qquad \text{odd} = 2m + 1.$$

Quick recall line

Parity uses twos, digit sums use threes and nines, alternating sums use eleven.

8.2 Divisibility summary

Divisor	Test
2	last digit is even
3	digit sum is divisible by 3
4	last two digits form a multiple of 4
5	last digit is 0 or 5
8	last three digits form a multiple of 8
9	digit sum is divisible by 9
10	last digit is 0
11	alternating digit-sum difference is a multiple of 11

Final self-check

State the rule, apply it to the correct digits, and write the conclusion. This three-part answer is both short and complete.

8.3 Rapid practice set

Try these without a calculator, then explain the reason.

1. Write (45) as a sum of two consecutive integers.
2. Decide whether (7a+5a) is always even.
3. Find the digit (x) if (36x4) is divisible by (9).
4. Test (57244) for divisibility by (4) and (8).
5. Prove that a two-digit number minus its reverse is divisible by (9).
6. Find a counterexample to the claim that $x^2 + 2$ is always even.

Answers

$45 = 22 + 23$. The expression $12a$ is even. For $36x4$, $x = 5$. The number is divisible by 4, but not by 8. The reversal proof gives $9(a - b)$. For the last item, $x = 1$ gives 3.

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