

# CHAPTER 5: NUMBER PLAY

## POSTER 1 – NUMBER PLAY BASICS

### 5.1 IS THIS A MULTIPLE OF?

#### 1. SUM OF CONSECUTIVE NUMBERS

Many natural numbers can be written as a sum of consecutive numbers in one or more ways.

Examples:

$$\begin{aligned} 7 &= 3 + 4 \\ 10 &= 1 + 2 + 3 + 4 \\ 12 &= 3 + 4 + 5 \\ 15 &= 7 + 8 = 4 + 5 + 6 \\ &= 1 + 2 + 3 + 4 + 5 \end{aligned}$$

#### Key Ideas

- All odd numbers can be written as a sum of two consecutive numbers.
- All even numbers can be written as a sum of one or more consecutive numbers.
- 0 can be written as a sum of consecutive numbers using negative numbers.

#### 2. FOUR CONSECUTIVE NUMBERS & SIGNS

Take 4 consecutive numbers (e.g., 3, 4, 5, 6). Place '+' and '-' between them. There are 8 possible expressions.

| Numbers | Sign Pattern<br>(+ for plus, - for minus) | Expression      | Result |
|---------|-------------------------------------------|-----------------|--------|
| 3 4 5 6 | + + +                                     | $3 + 4 + 5 + 6$ | 18     |
| 3 4 5 6 | + + -                                     | $3 + 4 + 5 - 6$ | 6      |
| 3 4 5 6 | + - +                                     | $3 + 4 - 5 + 6$ | 8      |
| 3 4 5 6 | + - -                                     | $3 + 4 - 5 - 6$ | -4     |
| 3 4 5 6 | - + +                                     | $3 - 4 + 5 + 6$ | 10     |
| 3 4 5 6 | - + -                                     | $3 - 4 + 5 - 6$ | -2     |
| 3 4 5 6 | - - +                                     | $3 - 4 - 5 + 6$ | 0      |
| 3 4 5 6 | - - -                                     | $3 - 4 - 5 - 6$ | -12    |

➔ No matter how the '+' and '-' signs are placed between 4 consecutive numbers, the result is always an even number.

#### 3. PARITY – WHY DO ALL 8 EXPRESSIONS HAVE THE SAME PARITY?

For any numbers  $a, b, c, d$  (not only consecutive), all expressions  $a \pm b \pm c \pm d$  have the same parity (all even or all odd).

##### (1) Sign Switching

Switching the sign of any term changes the value by an even number.

Example:

$$\begin{aligned} (a + b - c - d) - (a - b - c - d) \\ = 2b \text{ (even number)} \end{aligned}$$

➔ Numbers that differ by an even number have the same parity.

##### (2) Parity Rules

odd  $\pm$  odd = even  
even  $\pm$  even = even  
odd  $\pm$  even = odd

So,  $a \pm b$  has the same parity. Extending this, all  $a \pm b \pm c \pm d$  have the same parity.

##### (3) Integer (Token) Model

Using positive (+) and negative (-) tokens: equal numbers of + and - tokens cancel or form pairs, leaving an even result.



➔ Net result is always even.

#### 4. BREAKING EVEN – QUICK GUIDE

Identify which expressions are always even (for any integers).

##### Always Even

- ✓  $2a + 2b$
- ✓  $4m + 2n$
- ✓  $2u - 4v$
- ✓  $6m - 3n$
- ✓  $4k \times 3j$  (product of even and anything)
- ✓  $2 \times 2$  (i.e., 4)
- ✓  $\frac{2}{3} - \frac{2}{5}$  (sum of two even numbers)

##### Not Always Even

- ✗  $3g + 5h$
- ✗  $13k - 5k$
- ✗  $b^2$
- ✗  $x + 1$

#### 5. KEY DEFINITIONS

- **Parity:** Whether a number is even or odd.
- **Even Number:** Divisible by 2.
- **Odd Number:** Not divisible by 2.
- **Consecutive Numbers:** Numbers that follow one after another in natural order (e.g., 3, 4, 5, 6).

★ Big Idea: Patterns in numbers help us make general conclusions without checking every case. Reasoning makes mathematics powerful and beautiful!

## POSTER 2 – DIVISIBILITY MASTER CHART

### 5.2 CHECKING DIVISIBILITY QUICKLY

#### Divisibility Rules at a Glance

| Divisible by | Rule / Trick                                                           | Example                                             | Why it Works                                    |
|--------------|------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------|
| 2            | Last digit is even (0, 2, 4, 6, 8).                                    | 4826 ✓<br>1573 ✗                                    | Even numbers end with an even digit.            |
| 3            | Sum of digits is divisible by 3.                                       | 354 ( $3+5+4=12$ ) ✓<br>458 ( $4+5+8=17$ ) ✗        | Multiples of 3 have digit sum multiple of 3.    |
| 4            | Last two digits form a number divisible by 4.                          | 3168 (68 ✓)<br>5233 (33 ✗)                          | Based on place value ( $100 = 4 \times 25$ ).   |
| 5            | Last digit is 0 or 5.                                                  | 750 ✓<br>8425 ✓<br>731 ✗                            | Numbers ending in 0 or 5 are multiples of 5.    |
| 6            | Divisible by both 2 and 3.                                             | 132 (✓ and ✓)<br>245 (✗ or ✗)                       | $6 = 2 \times 3$                                |
| 8            | Last three digits form a number divisible by 8.                        | 12056 ( $056=56$ ) ✓<br>35124 (124 ✗)               | Based on place value ( $1000 = 8 \times 125$ ). |
| 9            | Sum of digits is divisible by 9.                                       | 729 ( $7+2+9=18$ ) ✓<br>456 ( $4+5+6=15$ ) ✗        | Multiples of 9 have digit sum multiple of 9.    |
| 10           | Last digit is 0.                                                       | 640 ✓<br>1230 ✓<br>987 ✗                            | All multiples of 10 end with 0.                 |
| 11           | Difference of the sums of alternating digits is 0 or a multiple of 11. | 5720 ( $5-7+2-0=0$ ) ✓<br>86134 ( $8-6+1-3+4=4$ ) ✗ | Based on alternating place values.              |
| 24           | Divisible by both 3 and 8.                                             | 1248 (✓ and ✓)<br>2504 (✓ and ✓)<br>3766 (✗ or ✗)   | $24 = 3 \times 8$                               |

#### Remainders and Divisibility

- If a number leaves remainder 0 when divided by  $n$ , it is divisible by  $n$ .
- If remainder  $\neq 0$ , it is not divisible by  $n$ .
- Divisibility helps us check quickly without doing full division.

##### Always / Sometimes / Never

When we study a statement about numbers:  
Always – True for all cases.  
Sometimes – True for some cases.  
Never – True for no cases.

Example: Statement: "The sum of two even numbers is odd."  
Answer: Never (because even + even = even)

##### Factors & Multiples

- **Factor of a number:** a number that divides it exactly.
- **Multiple of a number:** obtained by multiplying it by whole numbers.
- Every number has infinitely many multiples but limited factors.

Example: Factors of 12 = 1, 2, 3, 4, 6, 12  
Multiples of 12 = 12, 24, 36, 48, ...

##### Using LCM for Divisibility

If a number is divisible by two or more numbers, it is divisible by their LCM.  
Example: If a number is divisible by 4 and 6, it is divisible by LCM(4, 6) = 12.

- Many divisibility rules come from place value.
- Look at last digit(s) or digit sum to decide.
- Reasoning helps us understand WHY the rule works.

## POSTER 3 – DIGITAL ROOTS & DIGITS IN DISGUISE

### DIGITAL ROOTS

Digital Root of a number: Repeatedly add the digits until you get a single-digit number. (For 0, the digital root is 0.)

#### How to Find

1. Add all the digits.
2. If the sum has more than one digit, add its digits again.
3. Repeat until you get a single digit.

#### Examples

- $9875 \rightarrow 9+8+7+5=29 \rightarrow 2+9=11 \rightarrow 1+1=2$   
Digital root = 2
- $642 \rightarrow 6+4+2=12 \rightarrow 1+2=3$  Digital root = 3
- $1001 \rightarrow 1+0+0+1=2$  Digital root = 2

#### Key Properties

- Numbers with the same digital root leave the same remainder when divided by 9.
- Digital root is 0 if the number is a multiple of 9.
- It is 3 if the number is not a multiple of 9 but is a multiple of 3.

#### Aryabhata's Method (for Divisibility by 9)

Subtract 1 from the number and add the digits of the result. Repeat the process. If you get 0 (or a multiple of 9), the number is divisible by 9.

Example: 8736

$$8736 - 1 = 8735 \rightarrow 8+7+3+5 = 23$$

$$23 - 1 = 22 \rightarrow 2+2 = 4$$

4 is not 0 or a multiple of 9  $\rightarrow$  8736 is not divisible by 9.



### 5.3 DIGITS IN DISGUISE (CRYPTARITHMS)

A cryptarithm is a math puzzle where letters stand for digits (0–9). Each letter has a fixed digit. Different letters represent different digits.

#### General Rules

- Each letter = one digit (0–9).
- Different letters = different digits.
- Leading letter of a number  $\neq 0$ .
- Use logic, place value, and elimination.

#### Strategies to Solve

- ✓ Look for the leading letter (cannot be 0).
- ✓ Check the units column first.
- ✓ Find letters that produce a carry.
- ✓ Use uniqueness of digits to eliminate possibilities.

#### Addition Cryptarithm – Example

$$\begin{array}{r} \text{S E N D} \\ + \text{M O R E} \\ \hline \text{M O N E Y} \end{array}$$

Idea: Work column by column (from right to left).  
•  $Y = (D + E)$  unit digit  
• Find carry if  $D + E \geq 10$   
• Continue to thousands place.



#### Multiplication Cryptarithm – Example

$$\begin{array}{r} \text{T W O} \\ \times \text{T W O} \\ \hline \text{T W O} \\ \text{T W O} \\ \hline \text{T H R E E} \end{array}$$

Idea: Use place value and partial products carefully.



#### Practice Ideas

- ✓ Try simple puzzles first (2–3 letters).
- ✓ Use trial and error smartly.
- ✓ Cross out impossible options.
- ✓ Check your answer in the end.

#### Remember

Cryptarithms build logic, patience and number sense. Practice makes you a better problem solver!



Mathematics is full of patterns, rules and puzzles. Observe, reason and enjoy the beauty of numbers!



# NUMBER PLAY

## WORKSHEET-1

### Section A: MCQs (Part-1) ( $10 \times 1 = 10$ marks)

1. Which of the following numbers is divisible by both 4 and 6? (Conceptual)  
(a) 22                      (b) 36                      (c) 50                      (d) 70
2. The LCM of two co-prime numbers 7 and 11 is: (Application)  
(a) 7                      (b) 11                      (c) 77                      (d) 1
3. The number of prime numbers between 10 and 30 is: (Logical Reasoning)  
(a) 3                      (b) 4                      (c) 5                      (d) 6
4. If the sum of digits of a number is 18, the number is divisible by: (Conceptual)  
(a) 4                      (b) 6                      (c) 9                      (d) 11
5. What is the HCF of 36 and 48? (Application)  
(a) 6                      (b) 12                      (c) 18                      (d) 24
6. A number is divisible by 8 if: (Conceptual)  
(a) Its last digit is 8  
(b) Its last two digits are divisible by 8  
(c) Its last three digits form a number divisible by 8  
(d) The sum of its digits is divisible by 8
7. Which of these is NOT a factor of 60? (Logical Reasoning)  
(a) 12                      (b) 15                      (c) 16                      (d) 20
8. The smallest prime number that is also even is: (Conceptual)  
(a) 1                      (b) 2                      (c) 3                      (d) 4
9. If  $\text{LCM}(a, b) = 120$  and  $\text{HCF}(a, b) = 4$ , then  $a \times b$  is equal to: (Application)  
(a) 480                      (b) 124                      (c) 30                      (d) 116
10. A magic square is filled with the numbers 1 to 9 such that the sum of every row, column and diagonal is equal. The magic sum is: (Logical Reasoning)  
(a) 12                      (b) 15                      (c) 18                      (d) 21

**Section A: MCQs (Part-2) ( $10 \times 1 = 10$  marks)**

11. Which of the following numbers is divisible by 3?

- (a) 245      (b) 357      (c) 412      (d) 541

12. A number is divisible by 9 if:

- (a) Its last digit is 9      (b) The sum of its digits is divisible by 9  
(c) It is even      (d) It ends with 0

13. Which of the following is a prime number?

- (a) 27      (b) 39      (c) 41      (d) 51

14. The smallest composite number is:

- (a) 1      (b) 2      (c) 3      (d) 4

15. Which number is divisible by both 2 and 5?

- (a) 125      (b) 340      (c) 333      (d) 247

16. The sum of five consecutive integers is 145. What is the middle integer?

- (a) 27      (b) 28      (c) 29      (d) 30

17. Without performing division, which of the following numbers is divisible by 9?

- (a) 7,218      (b) 8,524      (c) 5,461      (d) 4,813

18. A number leaves a remainder of 4 when divided by 7. Which of the following numbers can be that number?

- (a) 61      (b) 60      (c) 59      (d) 58

19. The digital root of a number is 9. Which of the following numbers satisfies this condition?

- (a) 5,472      (b) 4,599      (c) 6,381      (d) 7,281

20. Using the divisibility rule of 11, which number is divisible by 11?

- (a) 4,356      (b) 6,149      (c) 7,832      (d) 8,514

## WORKSHEET-2

### SECTION B SHORT ANSWER (11×2=20 MARKS )

1. Write all factors of 48 and count them.

2. State the divisibility rule for 11 and check whether 71,753 is divisible by 11.

3. Find the HCF of 56 and 98 using prime factorisation.

4. Are 21 and 22 co-prime? Give a reason.

5. Write the first five multiples of 17.

6. A number leaves remainder 0 when divided by 2, 3 and 5. What is the smallest such number greater than 0?

7. Express 180 as a product of its prime factors.

8. Identify all twin prime pairs between 1 and 50.

9. A shop owner has 84 red pens and 126 blue pens. He wants to pack them into boxes such that each box has the same number of pens of the same colour and no pen is left over. What is the maximum number of pens each box can have?

10. Using divisibility rules only, without actual division, check whether 7,392 is divisible by 4.

11. What is the difference between a 'prime number' and a 'composite number'? Give one example of each.

**SECTION C SHORT ANSWER (6×3=18 MARKS )**

12. Find the LCM of 18, 24 and 36 using prime factorisation. Also verify:  $\text{LCM} \times \text{HCF} = \text{Product of two numbers}$ .

13. Two buses leave a bus stand at 6:00 AM. Bus A returns every 45 minutes and Bus B returns every 60 minutes. At what time will they both be at the bus stand together again?

14. List all prime numbers up to 50. How many prime numbers are there between 1 and 50?

15. A number  $N$  is such that:  $N$  is a 3-digit number,  $N$  is divisible by 9, the sum of its digits is 18, and it is also divisible by 6. Find at least two such values of  $N$ .

16. The length and breadth of a rectangular park are 90 m and 75 m respectively. What is the minimum length of rope needed to divide the park into square plots of equal size, leaving no area uncovered? (Find side of each square plot.)

17. Riya says, 'The product of two consecutive even numbers is always divisible by 8.' Is she correct? Verify with two examples and give a mathematical reason.

18. A school organises a sports day. There are 180 boys and 252 girls. The principal wants to form groups such that each group has equal numbers and consists of either all boys or all girls.

- (a) What is the maximum size of each group?
- (b) How many groups of boys and girls will be formed?
- (c) What mathematical concept did you use? Explain it briefly.

19. A digital clock shows time in hours (H) and minutes (M). The minute hand completes one round every 60 minutes. Arjun notices that the seconds hand, minute hand and hour hand of his clock align at 12:00:00.

- (a) After how many seconds will the seconds hand and minute hand align again?
- (b) After how many minutes will the minute hand and hour hand align for the first time after 12:00?
- (c) Explain how LCM and HCF are connected to such real-life periodic events.

20. Study the following patterns and answer the questions:

Pattern 1:  $1 + 3 = 4 = 2^2$ ,  $1 + 3 + 5 = 9 = 3^2$ ,  $1 + 3 + 5 + 7 = 16 = 4^2$

Pattern 2:  $6 = 1 + 2 + 3$ ,  $28 = 1 + 2 + 4 + 7 + 14$ ,  $496 = \text{sum of all its proper factors}$

- (a) Extend Pattern 1 to write the next two steps.
- (b) Numbers in Pattern 2 are called \_\_\_\_\_ numbers. Name two more such numbers.
- (c) Using Pattern 1, find the sum of first 10 odd numbers without adding them individually.
- (d) A number is called 'deficient' if the sum of its proper factors is less than the number. Give two examples.

**Case Study Based Questions ( $4 \times 2 = 8$  marks)**

21. The school garden is rectangular, measuring 126 m in length and 84 m in breadth. The gardener wants to plant trees at equal intervals along the boundary of the garden (at corners too), using the least number of trees possible. He also wants to divide the garden into square plots of maximum possible size for different flowers

- (i) What is the maximum side length of each square plot? Show working.
- (ii) How many square plots will the garden be divided into? Justify.
- (iii) At what intervals should trees be planted along the boundary?
- (iv) How many trees are needed in total to go around the boundary at those intervals?

22. Three lighthouses on a coast flash their lights at regular intervals. The table below shows their flashing schedule:

| Lighthouse   | Colour of Flash | Flashing Interval |
|--------------|-----------------|-------------------|
| Lighthouse A | Red             | 12 seconds        |
| Lighthouse B | Green           | 18 seconds        |
| Lighthouse C | Blue            | 24 seconds        |

- (i) All three lighthouses flash together at 8:00:00 PM. After how many seconds will they flash together again?
- (ii) Find the LCM of 12, 18 and 24 using prime factorisation. Show all steps.
- (iii) How many times will Lighthouse A and Lighthouse B flash together (not C) in the first 3 minutes after 8:00:00 PM?
- (iv) A sailor can only see lights flashing simultaneously from at least two lighthouses. How many such simultaneous flashes (of any two or all three) will he observe in the first 5 minutes?

**Self Assessment:**

I understood all concepts:

☐ Yes

☐ No

I need more practice:

☐ Yes

☐ No

Name of Concepts having doubts/Not Cleared: \_\_\_\_\_

**Parent's Assessment:**

My ward understood the all the concepts

☐ Yes

☐ No

He/She need more practice

☐ Yes

☐ No

Name of Concepts having doubts/Not Cleared: \_\_\_\_\_

**Signature of Parent:**

**Teacher's Assessment:**

|  |
|--|
|  |
|--|

### Answers of Worksheet-1:

|     |    |    |    |    |    |    |    |    |    |    |
|-----|----|----|----|----|----|----|----|----|----|----|
| Q   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| Ans | b  | c  | c  | c  | b  | c  | c  | b  | a  | b  |
| Q   | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Ans | b  | b  | c  | d  | b  | c  | a  | b  | a  | d  |

### Answers of Worksheet:

|     |                                                                    |                                                                         |                                                          |                                                                              |                |
|-----|--------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------|----------------|
| Q   | 1                                                                  | 2                                                                       | 3                                                        | 4                                                                            | 5              |
| Ans | 1,2,3,4,6,8,12,16,24,48<br>total 10 factors                        | yes                                                                     | 14                                                       | YES                                                                          | 17,34,51,68,85 |
| Q   | 6                                                                  | 7                                                                       | 8                                                        | 9                                                                            | 10             |
| Ans | LCM=30                                                             | $2^2 \times 32 \times 5$                                                | (3,5),<br>(5,7),<br>(11,13)                              | 42                                                                           | YES            |
| Q   | 11                                                                 | 12                                                                      | 13                                                       | 14                                                                           | 15             |
| Ans | prime exactly<br>two factor<br>coprime: more<br>than two factor.   | HCF =6<br>LCM=72                                                        | LCM=180<br>minutes<br>9:00 am                            | 15                                                                           | 990,<br>882    |
| Q   | 16                                                                 | 17                                                                      | 18                                                       | 19                                                                           | 20             |
| Ans | 30 plots                                                           | Riya is correct                                                         | 36<br>students<br>Boys =5<br>groups<br>Girls=7<br>groups | a)every 60 sec.<br>b)first alignment<br>1:05:27 am<br>c) HCF and LCM explain | A) $5^2, 6^2$  |
| Q   | 21                                                                 | 22                                                                      |                                                          |                                                                              |                |
| Ans | A)42M<br>b) 6plots<br>c)42 m<br>d) preimeter<br>=420 m<br>trees=10 | LCM=72 Sec.<br>Lcm =72<br>iii) 36 sec.<br>in 3 min. =180 sec.<br>iv) 16 |                                                          |                                                                              |                |