MATHEMATICS
WORKSHEET_260426
CHAPTER 03 THE STORY OF NUMBERS (Ganita Prakashan)
(ANSWERS)

SUBJECT: MATHEMATICS **MAX. MARKS : 40**
CLASS : VIII **DURATION : 1½ hr**

General Instructions:
(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A
Questions 1 to 10 carry 1 mark each.

1. The oldest known tally stick, the Ishango bone, has a series of notches believed to represent which of the following?
(a) The number of days in a year (b) A lunar calendar
(c) The number of hunting trips (d) The total number of items in a collection
Ans. (b) A lunar calendar
The **Ishango bone** (and the similar **Lebombo bone**) are widely believed by archaeologists and historians to represent a **lunar calendar** due to the groupings of notches that correspond to phases of the moon.

2. Which of the following numbers would be the most difficult to perform subtraction on using the Roman number system?
(a) V – I (b) L – X (c) M – I (d) D - C
Ans. (c) M – I
Subtraction is the most difficult operation in the Roman system, particularly when dealing with large numbers, as it lacks a consistent base and a symbol for zero. Subtracting a small number (I = 1) from the largest number (M = 1000) requires complex conversion or an abacus. D - C (500 - 100) and L - X (50 - 10) are simpler conversions.

3. The number system of the Gumulgal people, who counted in twos, would likely have a landmark number of 8, which could be represented as:
(a) four groups of two (b) three groups of two and a one
(c) eight ones (d) a special symbol for eight
Ans. (a) four groups of two
The Gumulgal people counted in **twos** (a base-2 system). To represent 8, they would group it as 2 × 4, meaning **four groups of two**.

4. A number system that relies on repeating symbols to add up to a value is called a(n):
(a) subtractive system (b) positional system (c) additive system (d) base-n system
Ans. (c) additive system
An additive system (like the Egyptian or early Roman system) is one where the value of a number is the sum of the values of its symbols, often involving repetition (e.g., 10 + 10 + 1 for 21).

5. The number 10101 in a binary (base-2) system is equivalent to what number in the decimal system?
(a) 10 (b) 12 (c) 21 (d) 16
Ans. (c) 21
To convert binary to decimal: $(1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) = 16 + 0 + 4 + 0 + 1 = 21$.

6. The Roman numeral for the number 900 is CM. This is an example of which principle?
(a) an additive principle. (b) a subtractive principle.
(c) a place value system. (d) a decimal system.
Ans. (b) a subtractive principle.
The Roman numeral **CM** represents 1000 – 100 = 900. When a smaller value (C = 100) precedes a larger value (M = 1000), the smaller value is **subtracted** from the larger one.

7. In the number 8,629, the value of the digit 6 is determined by its position. This is an example of which concept?
(a) a base-n system (b) a positional number system
(c) a tally system (d) a landmark number
Ans. (b) a positional number system
In 8629, the value of the '6' is 600 because of its **position** (the hundreds place). This is the defining feature of a **positional number system** (or **place value system**).

8. A group of archaeologists discover an ancient bone with 35 notches carved into it. This is an example of which counting method?
(a) a tally system (b) a base-10 system
(c) one-to-one mapping (d) both (a) and (c)
Ans. (d) both (a) and (c)
A bone with 35 notches is a **tally system** (a method of keeping count). By associating each notch with one item, it is also demonstrating **one-to-one mapping**.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. **Assertion (A):** The Roman numeral XLV is 45.
Reason (R): The Roman number system uses both the additive and subtractive principles.
Ans. (b) Both A and R are true, but R is not the correct explanation of A.
The assertion is true: XLV = (50 − 10) + 5 = 45. The reason is true: the system uses both principles. However, the reason only supports *how* the number is written, not *why* the total is 45, so R is not the *correct explanation* of A.

10. **Assertion (A):** The Hindu number system is a positional number system.
Reason (R): The Hindu number system uses a base of 10.
Ans. (b) Both A and R are true, but R is not the correct explanation of A.
The assertion is true: The **Hindu number system is a positional system**. The reason is true: **It uses a base of 10** (decimal). While the base of 10 makes it a decimal system, the feature that makes it a *positional* system is the use of **place value**, which is a separate concept from the base itself.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. An ancient Egyptian uses a system where a single symbol represents a value. He has 8 symbols for 100, and 12 symbols for 1. What is the total number he has? Show your working.
Ans. The Egyptian has 8 symbols for 100, which is 8 x 100 = 800. He also has 12 symbols for 1, which is 12 x 1 = 12. The total number he has is 800 + 12 = 812.

12. What is the Roman numeral for the year 1995? Show your working.
Ans. To find the Roman numeral for 1995, we break it down:

1000 = M, 900 = CM, 90 = XC, 5 = V
So, the Roman numeral is **MCMXCV**.

13. In a fictional number system with a base of 8, what would be the first three landmark numbers?
Ans. In a base-8 system, the landmark numbers are powers of 8, starting with 8^0. The first three landmark numbers would be:
8^0 = **1**
8^1 = **8**
8^2 = **64**

14. Convert the binary number 1101 to its decimal equivalent.
Ans. To convert 1101 from binary to decimal, we use its place value:
The first digit 1 is in the 2^3 (or 8) place. Value = 1 x 8 = 8.
The second digit 1 is in the 2^2 (or 4) place. Value = 1 x 4 = 4.
The third digit 0 is in the 2^1 (or 2) place. Value = 0 x 2 = 0.
The fourth digit 1 is in the 2^0 (or 1) place. Value = 1 x 1 = 1.
The sum is 8 + 4 + 0 + 1 = 13.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Explain how the Hindu number system's use of zero allows for the unambiguous writing of all numbers. Use the numbers 3, 30, and 300 as examples.
Ans. The Hindu number system's use of zero allows for the unambiguous writing of all numbers by acting as a placeholder. Without it, numbers could be misinterpreted. For example:
- 3 represents three.
- If we did not have a zero, the number 30 could not be distinguished from 3. The zero holds the place of the ones column, signifying there are no ones, and moving the digit 3 into the tens column, giving it a value of thirty.
- Similarly, 300 has zeros in the ones and tens columns, clearly placing the digit 3 in the hundreds column, giving it the value of three hundred.

16. The Roman numeral system is not as efficient for complex calculations as the Hindu number system. Explain why this is so, using the subtraction of LXXX from C as an example.
Ans. The Roman numeral system is inefficient for complex calculations because it lacks a consistent base and a symbol for zero, making it difficult to use a place value system for multiplication and division.
For example, to subtract LXXX from C, you would have to convert the numbers: C = 100 and LXXX = 80.
100 – 80 = 20. You then convert 20 back to Roman numerals, XX. This requires conversion to another system, which shows its inefficiency.

17. A Mesopotamian scribe uses two vertical wedges to represent 2, and four horizontal wedges to represent 40. How would the scribe represent the number 164? Explain the process of grouping.
Ans. To represent 164 in the Mesopotamian system, which has a base of 60, the scribe would group it as follows: 164 = (2 x 60) + 44.
So, we would use two symbols for 60.
The remaining 44 would be represented by four symbols for 10 and four symbols for 1.

SECTION – D

Questions 18 carry 5 marks each.

18. Design a number system with a base of 5. Create a set of symbols for the numbers 1, 5, and 25. Then, use these symbols to represent the number 142. Explain how this process demonstrates the efficiency of a base-n system.

Ans. **Base:** The base of the system is 5.
Symbols:
1 = A,   5 = B,   25 = C
Representation of 142:
The largest landmark number less than 142 is 25.
142 = 5 * 25 + 17.
The next largest landmark is 5.
17 = 3 x 5 + 2.
So, 142 = (5 x 25) + (3 x 5) + (2 x 1)
Using the symbols, this would be **CCCCCBBAA**.
Efficiency: This system demonstrates the efficiency of a base-n system by using a limited set of symbols to represent a large number. A tally system would require 142 individual marks, which is highly inefficient. The base-5 system uses a compact, structured representation.

SECTION – E (Case Study Based Question)

Question 19 to 20 carry 4 mark

19. Case Study-1: The Abacus Master

Rohan's grandfather, a retired accountant, shows him an old abacus. He tells Rohan, "This was my calculator before you had a phone." He explains that the abacus is a form of a place value system. On the board, the first line from the right represents ones (10^0), the next line represents tens (10^1), and so on. A single bead on a line has a value of one times the line's value, while a special bead, a "five-bead," has a value of 5 times the line's value. He challenges Rohan to represent numbers on the abacus. Rohan realizes how this simple tool made complex calculations possible for people who did not have calculators.

(i) On this abacus, what is the value of a bead on the fifth line from the right? (1)
(ii) How would you represent the number 39 on this abacus, using the beads described? (1)
(iii) If there is one five-bead on the thousands line, what is its value? (1)
(iv) How would you represent the number 17 on this abacus? (1)
Ans. (i) The fifth line from the right would be the ten thousands line (10^4), so the value of a bead on that line is 10,000.
(ii) To represent 39, you would place three beads on the tens line and one five-bead and four regular beads on the ones line.
(iii) The value of a five-bead on the thousands line would be 5 x 1000 = 5000.
(iv) To represent 17, you would place one bead on the tens line and one five-bead and two regular beads on the ones line.

20. Case Study-2: The Hindu Numerals

A historian, Dr. Priya, is researching the spread of the Hindu numeral system. She finds that the system, with its ten digits, including zero, was so powerful that it enabled a new way of doing mathematics. Unlike the Roman system, it was perfect for performing multiplication and division. She discovers that the word "algorithm" is named after the Persian mathematician Al-Khwarizmi, who wrote a book explaining the system. This system's efficiency ultimately led to it becoming the global standard for mathematics and science, a testament to its elegance and power.

(i) What is the base of the Hindu number system? (1)
(ii) What is a key arithmetic operation that the Hindu numeral system made easy, but was difficult in the Roman system? (1)
(iii) Convert the number 4,321 to the Roman number system. (1)
(iv) The word "algorithm" is named after which mathematician? (1)

Ans. (i) The base of the Hindu number system is 10.
(ii) The Hindu numeral system made multiplication and division easy, which were difficult in the Roman system.
(iii) To convert 4,321 to the Roman number system, we break it down:
4000 = MMMM
300 = CCC
20 = XX
1 = I
The final number is MMMMCCCXXI.
(iv) The word "algorithm" is named after the Persian mathematician Al-Khwarizmi.