*** Answer The Following Questions In One Sentence.[1 Marks Each]** **[9]**

1. Represent the following numbers in the Roman system.
   1222

   Ans. : 1222 = 1000 + 100 + 100 + 10 + 10 + 1 + 1 = MCCXXII.

2. Represent the following numbers in the Roman system.
   2999

   Ans. : 2999 = 1000 + 1000 + 900 + 90 + 9 = 1000 + 1000 + (1000 – 100) + (100 – 10) + (10 – 1) = MMCMXCIX.

3. Represent the following numbers in the Roman system.
   302

   Ans. : 302 = 100 + 100 + 100 + 1 + 1 = CCCII.

4. Represent the following numbers in the Roman system.
   715

   Ans. : 15 = 500 + 100 + 100 + 10 + 5 = DCCXV.

5. Consider the extension of the Gumulgal number system beyond 6 in the same way of counting by 2s. Come up with ways of performing the different arithmetic operations (+, –, ×, ÷) for numbers occurring in this system, without using Hindu numerals. Use this to evaluate the following :
   (ukasar-ukasar-ukasar-ukasar-urapon) + (ukasar-ukasar- ukasar-urapon)

   Ans. : (ukasar-ukasar-ukasar-ukasar-urapon) + (ukasar-ukasar- ukasar-urapon)
   = (2 + 2 + 2 + 2 + 1) + (2 + 2 + 2 + 1)
   = 9 + 7 = 16

6. Consider the extension of the Gumulgal number system beyond 6 in the same way of counting by 2s. Come up with ways of performing the different arithmetic operations (+, –, ×, ÷) for numbers occurring in this system, without using Hindu numerals. Use this to evaluate the following :
   (ukasar-ukasar-ukasar-ukasar-urapon) – (ukasar-ukasar- ukasar)

   Ans. : (ukasar-ukasar-ukasar-ukasar-urapon) – (ukasar-ukasar- ukasar)
   = (2 + 2 + 2 + 2 + 1) – (2 + 2 + 2)
   = 9 – 6 = 3.

7. Consider the extension of the Gumulgal number system beyond 6 in the same way of counting by 2s. Come up with ways of performing the different arithmetic operations (+, –, ×, ÷) for numbers occurring in this system, without using Hindu numerals. Use this to evaluate the following :
   (ukasar-ukasar-ukasar-ukasar-urapon) × (ukasar-ukasar)

Ans. : (ukasar-ukasar-ukasar-ukasar-urapon) × (ukasar-ukasar)
= (2 + 2 + 2 + 2 + 1) × (2 + 2)
= 9 × 4 = 36.

8. Consider the extension of the Gumulgal number system beyond 6 in the same way of counting by 2s. Come up with ways of performing the different arithmetic operations (+, –, ×, ÷) for numbers occurring in this system, without using Hindu numerals. Use this to evaluate the following :
(ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar) ÷ (ukasar-ukasar)

Ans. : (ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar) ÷ (ukasar-ukasar)
= (2 + 2 + 2 + 2 + 2 + 2 + 2 + 2) ÷ (2 + 2)
= 16 ÷ 4 = 4.

9. Can there be a number whose representation in Egyptian numberals has one of the symbols occurring 10 or more times? Why not ?

Ans. : No, ten times any landmark number will give the next landmark number.

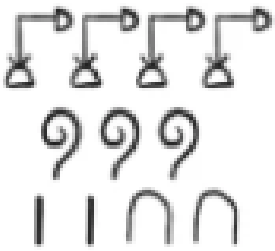
*** Questions With Calculation.[2 Marks Each]** **[4]**

10. What numbers do these numerals stand for?

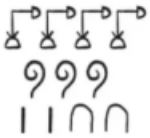
Ans. :

= (100 + 100) + (10 + 10 + 10 + 10 + 10 + 10 + 10) + (1 + 1 + 1) + (1 + 1 + 1)
= 200 + 70 + 6 = 276.

11. What numbers do these numerals stand for?



Ans. :



= (1000 + 1000 + 1000 + 1000) + (100 + 100 + 100) + (10 + 10) + (1 + 1)
= 4000 + 300 + 20 + 2
= 4322.

*** Questions With Calculation.[3 Marks Each]** **[30]**

12. One way of extending the number system in Method 2 is by using strings with more than one letter — for example, we could use 'aa' for 27. How can you extend this system to represent all the numbers? There are many ways of doing it!

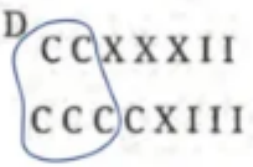
Ans. : One of the ways of extending the number system in Method 2 by using strings with more than one letter is :

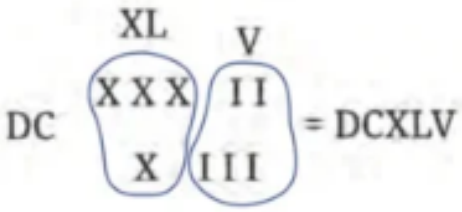
Single letter	Double letter combination	Triple letter combination
a = 1 b = 2 c = 3 .... z = 26	aa = 27 ab = 28 ac = 29 .... az = 52 ba = 53 bb = 54 bc = 55 .... zz = 702(26 x 26 + 26)	aaa = 703 aab = 704 aac = 705 and so on ...

13. Try adding the following numbers without converting them to Hindu numerals : CCXXXII + CCCCXIII

Ans. : Let us find the total number of Is, Xs, and Cs, and group them starting from the largest landmark number.
Apparently, it looks like the largest landmark number is C, but note that 5 Cs (100s)

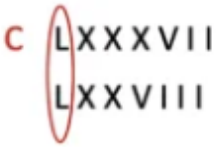
make a D (500). So the sum is

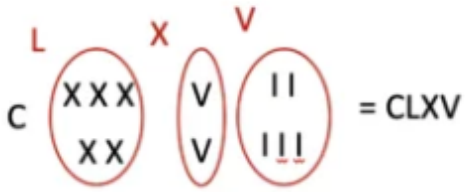




14. Try adding the following numbers without converting them to Hindu numerals : LXXXVII + LXXVIII

Ans. :





15. A group of indigenous people in a Pacific island use different sequences of number names to count different objects. Why do you think they do this?

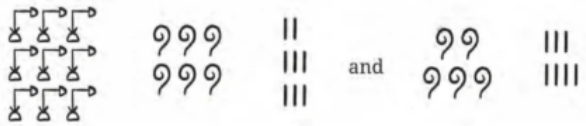
Ans. : They use different number sequences because :

(i) Different objects (like coconuts, fish) may have different social, cultural, or economic importance. So, using different number names helps emphasize the context and value of what is being counted.

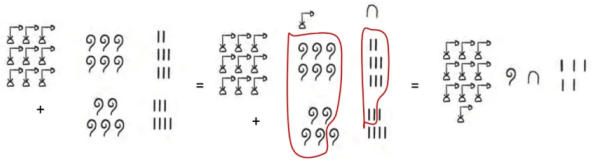
(ii) These counting systems are often passed down orally. Using object-specific counting sequences helps people remember quantities easily.

(iii) Not all cultures developed a general-purpose, abstract number system like Hindu-Arabic numerals. Instead, they built specific systems, like number names, to count different objects.

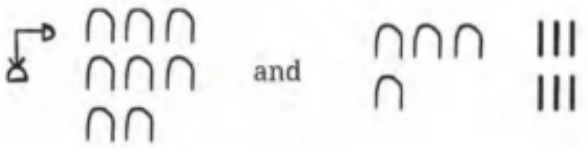
16. Add the following Egyptian numeral :



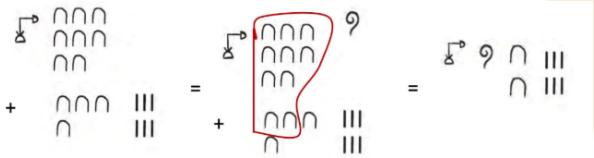
Ans. :



17. Add the following Egyptian numeral :

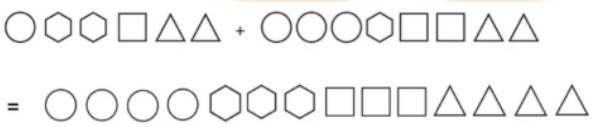


Ans. :



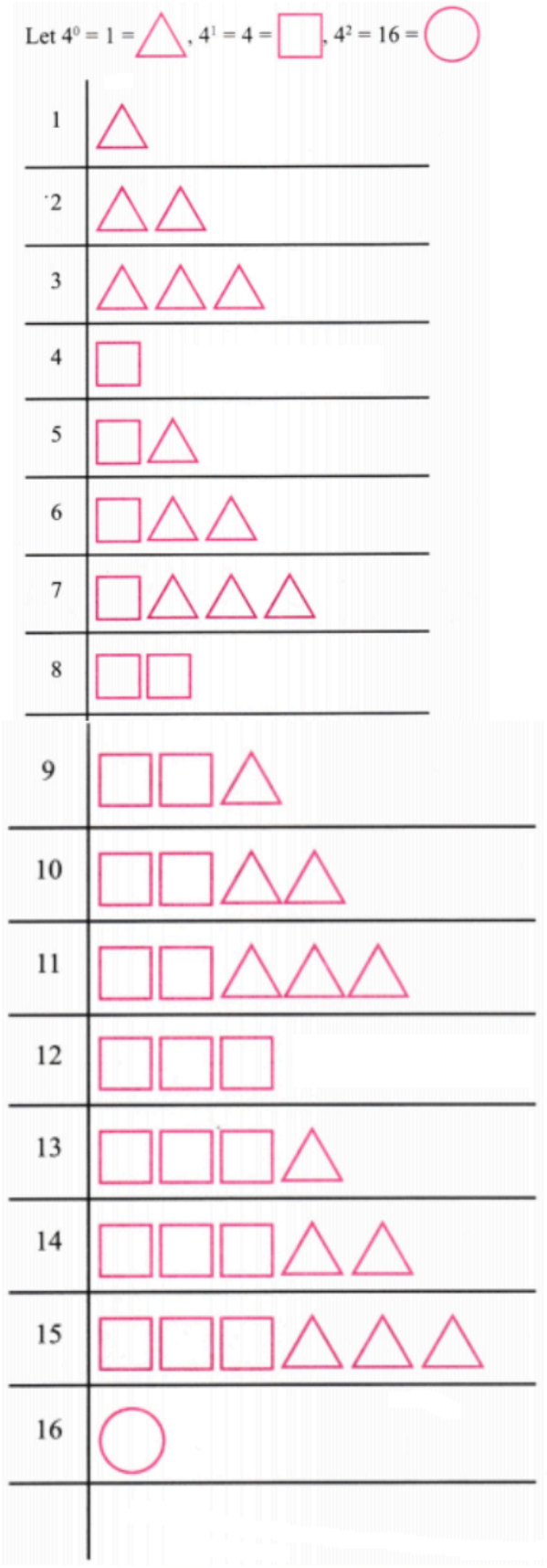
18. Add the following numeral that are in the base-5 system that we created :

Ans. :



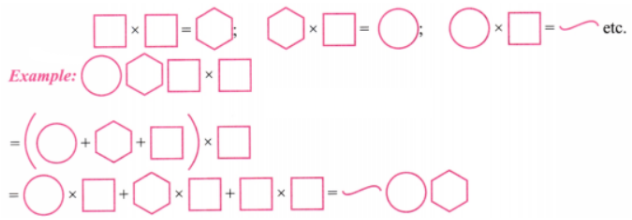
19. Create your own number system of base 4, and represent numbers from 1 to 16.

Ans. :



20. Give a simple rule to multiply a given number by 5 in the base-5 system that we created.

Ans. : Rule: The Product of a landmark number with another landmark number gives a landmark number.



21. Form a base-2 place value system using 'ukasar' and 'urapon' as the digits. Compare this system with that of the Gumulgal's.

Ans. : Let $2^0 = 1 = A, 2^1 = 2 = B, 2^2 = 4 = C, 2^4 = 16 = D, \ldots$

Base 2-system	Gumulgal system
1:A	ur
2 : B	uk
3 : BA	uk - ur
4 : C	uk - uk
5 : CA	uk - uk - ur
6 : CB	uk-uk-uk
7 : CBA	uk-uk-uk-ur
8 : D	uk-uk-uk-uk

Both have the same base 2, but the base 2 system has many landmark numbers, whereas the Gumulgal system has only two landmark numbers.

*** Questions With Calculation.[5 Marks Each]** **[10]**

22. What could be the difficulties with using a number system that counts only in groups of a single particular size? How would you represent a number like 1345 in a system that counts only by 5s?

Ans. : The difficulties with using a number system that counts only in groups of a single particular size are :

(i) Numbers that are not multiples of 5 cannot be directly represented and need a way to handle the remainder after grouping in 5 s .

(ii) Representing large numbers might need a large number of symbols or steps, which is time-consuming and inefficient.

(iii) Operations like addition, subtraction, or especially division and multiplication become more complex with fixed-size groupings.

$1345 \div 5 = 269$ remainder 2.

So :

$1345 = 5 \times 269$

In a system that only counts in 5s, you would show:

269 groups of 5 with 0 leftover.

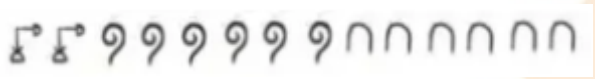
23. Represent the following numbers in the Egyptian system : 10458, 1023, 2660, 784,

1111, 70707.

Ans. : (i) 10458 = 10000 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 =

(ii) 1023 = 1000 + 10 + 10 + 1 + 1 + 1 =

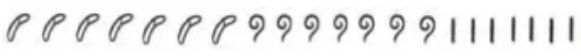
(iii) 2660 = 1000 + 1000 + 100 + 100 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 10 =



(iv) 784 = 100 + 100 + 100 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 =

(v) 1111 = 1000 + 100 + 10 + 1 =

(vi) 70707 = 10000 + 10000 + 10000 + 10000 + 10000 + 10000 + 10000 + 100 + 100 + 100 + 100 + 100 + 100 + 100 + 1 + 1 + 1 + 1 + 1 + 1 + 1 =



*** Questions With Calculation.[4 Marks Each]** **[20]**

24. Suppose you are using the number system that uses sticks to represent numbers, as in Method 1. Without using either the number names or the numerals of the Hindu number system, give a method for adding, subtracting, multiplying and dividing two numbers or two collections of sticks.

Ans. : 1. Addition : (i) Take two groups of sticks (say group A and B).
(ii) Put both groups together in a single pile.
(iii) The resulting pile shows the total quantity.
2. Subtraction : (i) Start with the group having more sticks.
(ii) Remove from it the number of sticks in the smaller group by physically taking that many sticks away.
(iii) The remaining sticks in the pile show the difference.
3. Multiplication : (i) Take one group of sticks (say, representing one set).
(ii) Repeat this group the number of times as indicated by the second group (e.g., 4 times).
(iii) Put all repeated groups together in one pile. The final collection shows the

product.

4. Division : (i) Start with a pile of sticks (the total quantity).

(ii) Distribute the sticks one by one into equal-sized groups (e.g., for equal sharing).

(iii) The number of sticks in each group is the quotient, and any leftover sticks are the remainder.

25. How will you multiply two numbers given in Roman numerals, without converting them to Hindu numerals? Try to find the product of the following pairs of landmark numbers : V × L, L × D, V × D, VII × IX.

Ans. : Multiplying two numbers given in Roman numerals without converting them to Hindu-Arabic numerals can be done using methods such as repeated addition or doubling and halving techniques.

For example, to compute V × L, we add V (five) a total of L (fifty) times.

(i) V × L = L + L + L + L + L = 50 + 50 + 50 + 50 + 50 = 100 + 100 + 50 = CCL.

(ii) L × D = D + D + D + ... 50 times = 500 + 500 + 500 + ... 50 times = 25,000

(iii) V × D = D + D + D + D + D = 500 + 500 + 500 + 500 + 500 = 1000 + 1000 + 500 = MMD.

(iv) VII × IX = VII + VII + VII + VII + VII + VII + VII + VII + VII = 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 = 63 = 50 + 10 + 3 = LXIII.

26. Identify the features of the Hindu number system that make it efficient when compared to the Roman number system.

Ans. : The Hindu number system is much more efficient than the Roman number system because :

(i) Large numbers are written compactly (e.g., 1,000,000), unlike Roman numerals, which become long and clumsy.

(ii) It uses place value, where a digit's position (units, tens, hundreds) affects its value. Roman numerals lack this.

(iii) It includes zero, both as a number and a placeholder. Roman numerals have no symbol for zero.

(iv) It uses just 10 digits (0–9) to write any number, while Roman numerals need many symbols.

(v) Arithmetic operations are easy using standard rules. Roman operations are complex and often require conversion.

27. Represent the following numbers in the Mesopotamian system :

(i) 63

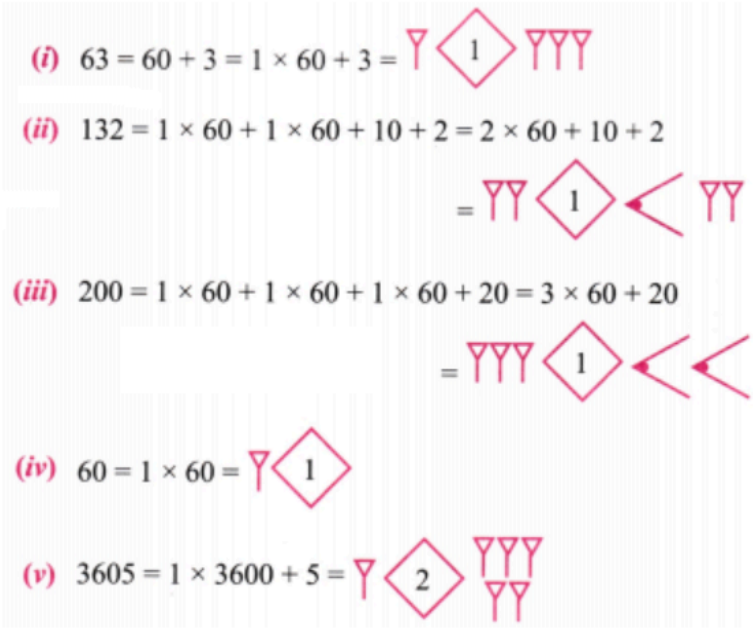
(ii) 132

(iii) 200

(iv) 60

(v) 3605

Ans. :



28. The ancient Indians likely used base 10 for the Hindu number system because humans have 10 fingers, and so we can use our fingers to count. But what if we had only 8 fingers? How would we be writing numbers then? What would the Hindu numerals look like if we were using base 8 instead? Base 5? Try writing the base-10 Hindu numeral 25 as base-8 and base-5 Hindu numerals, respectively. Can you write it in base-2?

Ans. : For base 8, the numerals would have been: 0, 1, 2, 3, 4, 5, 6, 7
For base 5, the numerals would have been: 0, 1, 2, 3, 4

8	25
	3 – 1

$25_{10} = 31_8$

25 can be written as 31 in base 8.

5	25
	5 – 0

$25_{10} = 50_5$

25 can be written as 50 in base 5.

2	25
2	12 – 1
2	6 – 0
2	3 – 0
	1 – 1

$25_{10} = 11001_2$

25 can be written as 1101 in base 2 .

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