

RAM Maths Circle

March 22, 2026

Nagpur

Introduction

In this session, participants explored number base systems, extending beyond the familiar decimal system. Through examples and pattern-based learning, they examined how numbers are represented in different bases and how place value varies accordingly. The session reinforced an understanding of the structure of number systems and their relevance in mathematics and computing.

Exploration:

The session was really engaging, with students actively trying to come up with their own logic behind the activity and diving deeper into the topic.

Activity: Number Base System Trick

Setup

Prepare the following 5 index cards before the session:

- **Card 1 (The "1" Card):** 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31
- **Card 2 (The "2" Card):** 2, 3, 6, 7, 10, 11, 14, 15, 18, 19, 22, 23, 26, 27, 30, 31
- **Card 3 (The "4" Card):** 4, 5, 6, 7, 12, 13, 14, 15, 20, 21, 22, 23, 28, 29, 30, 31
- **Card 4 (The "8" Card):** 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 28, 29, 30, 31
- **Card 5 (The "16" Card):** 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31

Mathematical Explanation

This activity is based on the binary (base-2) number system. The first numbers on each card—1, 2, 4, 8, and 16—represent powers of 2, which serve as place values in binary.

Each card contains numbers that include that specific place value in their binary form. When a participant selects the cards that contain their chosen number, they are indicating which binary place values are present (1) and which are absent (0).

By adding the first numbers of the selected cards, the original number can be reconstructed. This works because every number from 1 to 31 has a unique binary representation.

Problems:

Question: The postman's weights-

You are a postman with a traditional balance scale. You can only place weights on the **right** pan, and the package to be weighed is placed on the **left** pan. What is the minimum number of weights required to measure any integer mass from 1 kg to 15 kg? What are the exact masses of these weights?

Question:

How many 4-digit numbers in base 9 are perfect squares?

Question:

Convert the decimal number $\frac{7}{16}$ to base 6.

Question:

A two-digit number A in base 11 is one-third of the number formed by reversing its digits when considered in base 19. How many such numbers are possible?

Question:

Find the unknown base x for which the following multiplication is true:

$$(24)_x \times (13)_x = (345)_x$$

Question: The Martian age-

A Martian visits Earth and tells you, "I am 42 years old in Martian years!" You know that Martians count in base 5. Assuming Earthlings use the standard base 10 system, how old is the Martian in Earth years?

Question: The Alien Arithmetic Progression-

An alien civilization leaves behind a stone tablet with three numbers written in an unknown base x :

$$(15)_x \quad (24)_x \quad (33)_x$$

A robot analyzes the tablet and claims, “When converted to our standard base 10 system, these three numbers form an Arithmetic Progression (AP)!”

1. Is the robot’s claim true for any possible number base x ?
2. If not, what are the exact mathematical restrictions on x ? Explain your reasoning.

