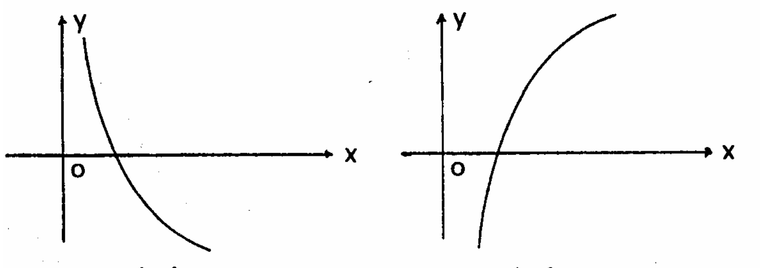
UNIT 4: The Logarithmic Function

Specific Objectives:

1. To Study the properties and graphs of the logarithmic functions to any base.
2. To solve simple equations involving logarithms.
3. To apply the reduction of the relation $y = kx^n$ to a linear relation.

	Detailed Content	Time Ratio	Notes on Teaching
4.1	**Properties and graphs of logarithmic functions $f(x) = \log_a x$ for $a > 0$, $a \neq 1$**	3	Students should have had plenty of practices in the use of common logarithms. For $f(x) = \log_a x$, consider the graphs  graph of $y = \log_a x$ when $0 < a < 1$ graph of $y = \log_a x$ when $a > 1$ (a) $\log_a x$ is defined for $a > 0$, $a \neq 1$ and $x > 0$ only. (b) when x increases $\log_a x$ will increase for $a > 1$ and decrease for $0 < a < 1$ (c) For a > 1, $\log_a x = \begin{cases} > 0 & \text{for all } x > 1 \\ = 0 & \text{for } x = 1 \\ < 0 & \text{for all } x < 1 \end{cases}$ (d) $\log_a a = 1$ Relations between exponential graphs and logarithmic graphs could be mentioned and discussed.

	Detailed Content	Time Ratio	Notes on Teaching
			Properties of logarithms (a) $\log_a(xy) = \log_a x + \log_a y$ (b) $\log_a(\frac{x}{y}) = \log_a x - \log_a y$ (c) $\log_a x^n = n\log_a x$ The proofs of the above could be provided however students are not expected to know the change of base. Natural logarithm should be discussed and Its importance mentioned.
4.2	**Solution of simple equations involving logarithms**	2	Checking of roots in this sub-unit is essential. Examples: (a) Solve $\log_{10}(x-2) + \log_{10}(x+1) = 1$ $(x-2)(x+1) = 10$ $x = 4 \text{ or } -3$ But $x = -3$ is rejected as $\log_{10}(x-2)$ or $\log_{10}(x+1)$ is undefined when $x = -3$. Equations of this kind should be mentioned. (b) Solve $3 \cdot 2^x = 5^{x-1}$ by taking logarithms.
4.3	**Reduction of the relation $y = kx^n$ to a linear relation.**	1	By taking logarithms on both sides of $y = kx^n$, students should obtain the relation $Y = nX + c$ where $X = \log_{10} x$, $Y = \log_{10} y$ and $c = \log_{10} k$ The equation $Y = nX + c$ represents a straight line on the X–Y coordinate system with slope n and Y–intercept c. Usually, the values of x and y are found experimentally. Thus, if pairs (x, y) of values of x and y are given, students can plot the graph of $\log_{10} y$ against $\log_{10} x$ from which they can read off the slope and Y–intercept to determine the values of n and k.
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