MC Sir

Logarithm

1. Basic Maths (Revision of Class IX & X, Set Theory, Number Theory)

2. Exponential Form, Log Form, Fundamental Log Identity

3. Principal Properties of Logarithm, Base Changing Theorem

Logarithm

MC Sir

4. Logarithmic Equation,
   Common & Natural Logarithm

5. Characteristic and Mantissa

6. Modulus (Absolute Value Function)

7. Inequalities in Logarithm

Logarithm

MC Sir

No. of Questions				
2008	2009	2010	2011	2012
–	–	1	1	1

My Introduction

- At present I am Maths Faculty at ETOOS ACADEMY

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- Teaching Exp. 8 Yrs.

Rank Produced by Etoos

AIR-24

SURAJ SANJAY JOG

And Many Others

How to Study Maths For IIT-JEE

(i) Write and not read maths

How to Study Maths For IIT-JEE

(i) Write and not read maths

(ii) Try to apply using formulas /tricks given

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(iii) Practice Practice Practice

How to Make
Best use of the Course

Important points / formulas are highlighted

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Complete Assignment before moving to next lecture

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Basic Maths

Revision of Class VIII, IX, X

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- Remember Tables 1-19

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- Remember Tables 1-19
- Remember Squares 1-32

Basic Maths

Revision of Class VIII, IX, X

- Remember Tables 1-19
- Remember Squares 1-32
- Remember Cubes 1-12

Componendo & Dividendo

$$\frac{N-D}{N+D}$$

➡ To be applied both sides of the equation.

- $\left(a^{x}\right)^{y} = a^{xy}$

- $$\frac{a^x}{a^y} = a^{x-y}$$

- $a^x \cdot a^y = a^{x+y}$

- $x^a \cdot y^a = (xy)^a$

Additive Inverse,

Additive Inverse,

Additive Identity,

Additive Inverse,

Additive Identity,

Multiplicative Inverse,

Additive Inverse,

Additive Identity,

Multiplicative Inverse,

Multiplicative Identity

Set Theory

Classification of Sets

Roster or Tabular Form

Set- Builder Form

Quadratic Equation

Inequalities

Important Algebraic Formulas

- $a^2 - b^2 = (a - b)(a + b)$

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- $(a + b)^3 = a^3 + b^3 + 3a^2b + 3ab^2$

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- $(a - b)^3 = a^3 - b^3 + 3ab^2 - 3a^2b$

Important Algebraic Formulas

- $a^3+b^3+c^3 - 3abc = (a + b + c)\ (\Sigma a^2 - \Sigma ab)$

Number Theory

Number Theory

- Natural Number (N)

Number Theory

- Natural Number (N)
- Whole Number (W)

Prime,

Prime,

Composite,

Prime,

Composite,

Twin Prime,

Prime,

Composite,

Twin Prime,

Co- Prime

Integers (I)

Rational Numbers (Q)

Rational Numbers (Q)

- Converting Decimal to p/q form

Rational Numbers (Q)

- Example

$2.5 = ?$

$3.\overline{14} = ?$

Irrational Numbers

Real Numbers (R)

Complex Number (Z)

$\mathbb{N} \subset \mathbb{W} \subset \mathbb{I} \subset \mathbb{Q} \subset \mathbb{R} \subset \mathbb{Z}$

Exponential Form

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$$\left(N = a^{x}\right)$$

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- $a > 0 \quad \& \quad a \neq 1$

Exponential Form

$$\left(N = a^{x}\right)$$

- $a > 0 \quad \& \quad a \neq 1$
- a is called 'base' and
  x is called 'exponent'

Logarithmic form

$$\log_a N = x$$

Logarithmic form

$$\log_a N = x$$

Log_a N is defined when N > O, a > o, a $\neq$ 1

Logarithm Form

Logarithm Form

Find values :

Q. $\log_{81} 27 = ?$

Logarithm Form

Find values :

Q. $\log_2(\log_2 4) = ?$

Logarithm Form

Find values :

Q. $\log_{625} 125 = ?$

Logarithm Form

Find values :

Q. $\log_{1/3} 9\sqrt{3} = ?$

Fundamental Logarithm Identity

$$a^{\log_a N} = N$$

3 Important Deductions

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- $\log_N N = 1$

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- $\log_N N = 1$
- $\log_{\frac{1}{N}} N = -1$

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- $\log_N N = 1$
- $\log_{\frac{1}{N}} N = -1$
- $\log_a 1 = 0$

Examples

Examples

Find values :

Q. $\log_{\tan 20^\circ} \tan 70^\circ = ?$

Find values :

Q. $\log_{2-\sqrt{3}}(2+\sqrt{3}) = ?$

Find values :

Q. $\log_{10}(0.\overline{9}) = ?$

Find values :

Q. $\log_5 \sqrt{5.\sqrt{5.\sqrt{5.\sqrt{5....\infty}}}} = ?$

(Integer Type)

Q. The value of :

$$6+\log_{\frac{3}{2}}\left(\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}\sqrt{4-\frac{1}{3\sqrt{2}}\sqrt{}}}}\right) \text{ is}$$

[JEE 2012, 4]

Solve :

Q. $7^{\log_7 x} + 2x + 9 = 0$

Solve :

Q. $\log(\tan 5)\log(\tan 9)\log(\tan 13).....\log(\tan 61)=?$

Antilog/Power form

Antilog/Power form

Q $\text{antilog}_8\left(\frac{2}{3}\right) = ?$

Antilog/Power form

Q $\text{antilog}_{\frac{1}{100}}\left(-\frac{1}{2}\right) = ?$

Note

It must be noted that whenever the number and the base are on the same side of unity then logarithm of that number to that base is (+ve), however if the number and the base are located on different side of unity them logarithm of that number to that base is (-ve)

Examples

Q. $\log_{\sqrt{7}} 49 = ?$

Q. $\log_{10} \sqrt[3]{10} = ?$

Q. $\log_{\frac{1}{2}}\left(\frac{1}{8}\right) = ?$

Q. $\log_2\left(\frac{1}{32}\right) = ?$

Q. $\log_{10}(0.001) = ?$

Principal Properties of Log.

- $\log_a mn = \log_a m + \log_a n$

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Principal Properties of Log.

- $\log_a mn = \log_a m + \log_a n$
- $\log_a \frac{m}{n} = \log_a m - \log_a n$
- $\log_a m^x = x \log_a m$
- $\log_{n^y} m = \frac{1}{y} \log_n m$

Note

$\log_2 x^2 = 4$ *and* $2\log_2 x = 4$ will not have the same solution.

Example

Q. Let $y = \sqrt{\log_2 3.\log_2 12.\log_2 48.\log_2 192 + 16} - \log_2 12.\log_2 48 + 10.$

Base Change Theorem

$$\log_b a = \frac{\log_c a}{\log_c b}$$

Base Change Theorem

$$\log_b a = \frac{\log_c a}{\log_c b}$$

$$a^{\log_b x} = x^{\log_b a}$$

Examples

Q. If $(\log_2 3)(\log_3 4)(\log_4 5)....(\log_n (n+1))=10$, find n

Q. $7^{\log_3 5} + 3^{\log_5 7} - 5^{\log_3 7} - 7^{\log_5 3} = ?$

Q. Prove that $\log_2 7$ is irrational

Q. If $\log_a x = b$ for permissible values of a and x then which of the following may be correct :

(A) If a rational and b rational then x can be rational.

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(A) If a rational and b rational then x can be rational.

(B) If a irrational and b rational then x can be rational.

(C) If a rational and b irrational then x can be rational.

(D) If a and b are two irrational numbers then x can be rational.

Number of solutions of $\log_4(x-1) = \log_2(x-3)$ is

(a) 3

(b) 1

(c) 2

(d) 0

[JEE 2001, (Screening)]

Trichotomy

True / False

Q. $\log_3 5 > \log_{17} 25$

For A Non Negative Number

$$\sqrt[n]{a} = a^{1/n}$$

For A Non Negative Number

$$\sqrt[n]{a} = a^{1/n}$$

‘a’ & N $\geq$ 2, n $\in$ N

Logrithmic Equations

Q. $Solve\ for\ 'x'\quad 2\log_2 \frac{x-7}{x-1} + \log_2 \frac{x-1}{x+1} = 1$

Logrithmic Equations

Q. *Solve for 'x'* $\log_5\left(5^{1/x}+125\right)-\log_5(6)=1+\frac{1}{2x}$

Logrithmic Equations

Q. *Solve for 'x'* $\log_5\left(\sqrt[x]{5}+125\right)-\log_5(6)=1+\frac{1}{2x}$

Examples

Q. **Solve for 'x'**

$$5^{1+(\log_4 x)} + 5^{(\log_{1/4} x)-1} = \frac{26}{5}$$

Taking Log. Both Sides

Q. **Solve for x** $3^{\log_3^2 x} + x^{\log_3 x} = 162$

Taking Log. Both Sides

Q. **Solve for x** $(x+1)^{\log_{10}(x+1)} = 100(x+1)$

Taking Log. Both Sides

Q. Let (x_0, y_0) the solution of the following equations

$$(2x)^{ln2} = (3y)^{ln3}$$

$$3^{ln}x = 2^{lny}.$$

Then x_0 is

(A) $\frac{1}{6}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) 6

[JEE 2011,3]

Common and Natural Logarithm

Characteristic & Mantissa

- Standard form of a positive number

Examples on Characteristic & Mantissa

Using log 2 = 0.3010 and log 3 = 0.4771, and log 7 = 0.8451

Q. Find the number of digits

(A) 6^{50} (B) 5^{25}

Examples on Characteristic & Mantissa

Using log 2 = 0.3010 and log 3 = 0.4771, and log 7 = 0.8451

Q. Find the number of zeros after decimal before a significant figure start in

(A) $\left(\frac{9}{8}\right)^{-100}$ (B) 3^{-50}

Examples on Characteristic & Mantissa

Let $\log_3 N = \alpha_1 + \beta_1$; $\log_5 N = \alpha_2 + \beta_2$; $\log_7 N = \alpha_3 + \beta_3$
where $\alpha_1, \alpha_2, \alpha_3$ are integers and $\beta_1, \beta_2, \beta_3 \in [0,1)$

Q. Find the number of integral and $\alpha_1 = 4$ and $\alpha_2 = 2$

Q. Find the largest integral value of N if $\alpha_1 = 5$, $\alpha_2 = 3$ and $\alpha_3 = 2$

Q. Find the difference of largest and smallest integral values of N if

$\alpha_1 = 5$, $\alpha_2 = 3$ and $\alpha_3 = 2$

Modulus
(Absolute Value Function)

Examples on Modulus

Solve for *x*

Solve for x

Q. $|x| = 2$

Solve for x

Q. $|x-1|=4$

Solve for *x*

Q. $|x-1|+|x-3|=5$

Solve for *x*

Q. $|x| - |x - 2| = 2$

Solve for *x*

Q. $|x+1|+|x+2|=2$

Solve for *x*

Q. $|3x - 2| + x = 11$

Solve for x

Q. $|x-2|^{10x^2-1} = |x-2|^{3x}$

More Examples on Modulus

Q. Least value of x satisfying

$$\left|\,|x-3|+2\,|x+1|\,\right| = 4$$

Q. If the sum of all solutions of the equation

$$\left(x^{\log_{10} 3}\right) - \left(3^{\log_{10} x}\right) - 2 = 0 \text{ is } \left(a^{\log_b c}\right)$$

where *b* and *c* are relatively prime and a, b, c $\in$ N.

Find the value of (a + b + c)

Q. **Solve for 'x'**

$$\log_4\left(x^2-1\right)-\log_4(x-1)^2=\log_4\sqrt{(4-x)^2}$$

Q. **Solve for 'x'**

$$2\log_8(2x)+\log_8\left(x^2+1-2x\right)=\frac{4}{3}$$

Q. **Solve for 'x'**

$$\frac{3}{2}\log_4 (x+2)^2 + 3 = \log_4 (4-x)^3 + \log_4 (6+x)^3 .$$

Q. **Solve for 'x'**

$$|x-3|^{3x^2-10x+3}=1$$

Q. **Solve for 'x'**

$$2\log_3(x-2)+\log_3(x-4)^2=0$$

Q. **Solve for 'x'**

$$|x-1|^{\log_3 x^2 - 2\log_x 9} = (x-1)^7$$

Q. **Solve for 'x'**

$$x^{(3/4)(\log_2 x)^2+\log_2 x-(5/4)} = \sqrt{2}$$

Log. Inequalities

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- For $a > 1$ the inequality $0 < x < y$ & $\log_a x < \log_a y$ are equivalent

Log. Inequalities

- For $a > 1$ the inequality $0 < x < y$ & $\log_a x < \log_a y$ are equivalent
- For $0 < a < 1$ the inequality $0 < x < y$ & $\log_a x > \log_a y$ are equivalent

Assignment

Prilepko (Page No.92-93)

Examples

Solve the following equations :

Q. $\log_{x-1} 3 = 2$

Solve the following equations :

Q. $\log_4\left(2\log_3\left(1+\log_2\left(1+3\log_3 x\right)\right)\right)=\frac{1}{2}$

Solve the following equations :

Q. $\log_3\left(1+\log_3\left(2^x-7\right)\right)=1$

Solve the following equations :

Q. $\log_3\left(3^x - 8\right) = 2 - x$

Solve the following equations :

Q. $\dfrac{\log_2\left(9-2^x\right)}{3-x}=1$

Solve the following equations :

Q. $\log_{5-x}\left(x^2-2x+65\right)=2$

Solve the following equations :

Q. $\log_3\left(\log_9 x+\frac{1}{2}+9^x\right)=2x$

Solve the following equations :

Q. $\log_3(x+1)+\log_3(x+3)=1$

Solve the following equations :

Q. $\log_7\left(2^x-1\right)+\log_7\left(2^x-7\right)=1$

Solve the following equations :

Q. $\log 5 + \log(x+10) - 1 = \log(21x - 20) - \log(2x - 1)$

Solve the following equations :

Q. $1-\log 5=\frac{1}{3}\left(\log\frac{1}{2}+\log x+\frac{1}{3}\log 5\right)$

Solve the following equations :

Q. $$\log x - \frac{1}{2}\log\left(x - \frac{1}{2}\right) = \log\left(x + \frac{1}{2}\right) - \frac{1}{2}\log\left(x + \frac{1}{8}\right)$$

Solve the following equations :

Q. $9^{\log_3(1-2x)} = 5x^2 - 5$

Solve the following equations :

Q. $x^{1+\log x} = 10x$

Solve the following equations :

Q. $x^{2\log x} = 10x^2$

Solve the following equations :

Q. $x^{\frac{\log x+5}{3}} = 10^{5+\log x}$

Solve the following equations :

Q. $x^{\log_3 x} = 9$

Solve the following equations :

Q. $\left(\sqrt{x}\right)^{\log_5 x - 1} = 5$

Solve the following equations :

Q. $x^{\log x+1} = 10^6$

Solve the following equations :

Q. $x^{\frac{\log x+7}{4}} = 10^{\log x+1}$

Solve the following equations :

Q. $x^{\log_{\sqrt{x}}(x-2)} = 9$

Solve the following equations :

Q. $$\left(\frac{\log x}{2}\right)^{\log^2 x+\log x^2-2} = \log\sqrt{x}$$

Solve the following equations :

Q. $3\sqrt{\log_2 x} - \log_2 8x + 1 = 0$

Solve the following equations :

Q. $\log^2 x - 3\log x = \log(x^2) - 4$

Solve the following equations :

Q. $\log_{1/3} x - 3\sqrt{\log_{1/3} x} + 2 = 0$

Solve the following equations :

Q. $2\left(\log_x \sqrt{5}\right)^2 - 3\log_x \sqrt{5} + 1 = 0$

Solve the following equations :

Q. $\log_2^2 x + 2\log_2 \sqrt{x} - 2 = 0$

Solve the following equations :

Q. $\left(a^{\log_b x}\right)^2 - 5x^{\log_b a} + 6 = 0$

Solve the following equations :

Q. $\log^2(100x) + \log^2(10x) = 14 + \log\left(\frac{1}{x}\right)$

Solve the following equations :

Q. $\log_4(x+3) - \log_4(x-1) = 2 - \log_4 8$

Solve the following equations :

Q. $2\log_4(4-x) = 4-\log_2(-2-x)$

Solve Sheet

To Attain IIT-Level