

Enhanced Features

JEE Focus Points

$f(x) = a \sin x + b \cos x$
 $= \sqrt{a^2 + b^2} \sin(x + \alpha), \tan \alpha = \frac{b}{a}$
 $= \sqrt{a^2 + b^2} \cos(x - \beta), \tan \beta = \frac{a}{b}$

Proof $f(x) = a \sin x + b \cos x$
 $= \sqrt{a^2 + b^2} \left(\frac{a}{\sqrt{a^2 + b^2}} \sin x + \frac{b}{\sqrt{a^2 + b^2}} \cos x \right)$
[divide and multiply by $\sqrt{a^2 + b^2}$]
 $= \sqrt{a^2 + b^2} (\sin x \cos \alpha + \cos x \sin \alpha)$
[$\because \cos \alpha = \frac{a}{\sqrt{a^2 + b^2}}, \sin \alpha = \frac{b}{\sqrt{a^2 + b^2}}$]
 $= \sqrt{a^2 + b^2} \sin(x + \alpha), \text{ where } \tan \alpha = \frac{b}{a}$

or $f(x) = \sqrt{a^2 + b^2} (\sin x \sin \beta + \cos x \cos \beta)$
 $= \sqrt{a^2 + b^2} \cos(x - \beta), \text{ where } \tan \beta = \frac{a}{b}$
[$\because \sin \beta = \frac{a}{\sqrt{a^2 + b^2}}, \cos \beta = \frac{b}{\sqrt{a^2 + b^2}}$]

$-\sqrt{a^2 + b^2} \leq a \sin x + b \cos x \leq \sqrt{a^2 + b^2}$

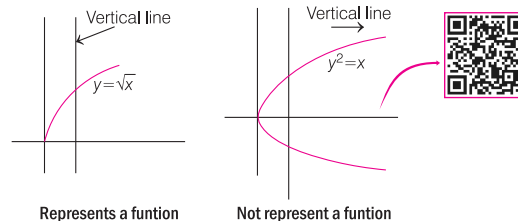


A collection of Key Points/Results prime from JEE Preparation point of View. These are further elaborated with support videos.

Seggregated most valuable Pointers for JEE preparation

JEE SPIKE

Vertical line test for f to be a function If graph of a function is cut a line parallel to Y-axis at more than one point, then it does not form a function.



JEE SCANNER

Example Similar to PYQ Asked in JEE Main 2023

If $f(x) = \frac{9^x}{9^x + 3}$, then the value of

$$f\left(\frac{1}{1996}\right) + f\left(\frac{2}{1996}\right) + f\left(\frac{3}{1996}\right) + \dots + f\left(\frac{1995}{1996}\right) \text{ is}$$

- (a) 997.5 (b) 979.5 (c) 597.9 (d) 959.7

Sol. (a) We have, $f(x) = \frac{9^x}{9^x + 3}$

$$\therefore f(1-x) = \frac{9^{1-x}}{9^{1-x} + 3} = \frac{3}{3 + 9^x}$$

Skill Builder

If $f(x) = \frac{4^x}{4^x + 2}$, then the value of $f\left(\frac{1}{20}\right) + f\left(\frac{2}{20}\right)$

+ $f\left(\frac{3}{20}\right) + \dots + f\left(\frac{19}{20}\right)$ is equal to

- (a) 10.5 (b) 10
(c) 9 (d) 9.5



For more practice See Q.5 of Milestone Practice 2.1.

Unmatched Concept elevation tool helpful in syncing recent JEE Main & Advanced PYQs with theory and provide additional practice through Skill Builders.

Contents

1. Essential Tools of Mathematics

1-23

- Intervals
- Linear Inequalities
- Polynomial Inequality
- Rational Inequality
- Modulus Inequality
- Inequality Involving GIF and Fractional Part Function
- Trigonometric Inequality
- Logarithmic Inequality

Practice Milestones

- Practice Milestone - JEE Main Pattern

2. Functions

24-142

Milestone 1 - Introduction

- Definition of Function
- Representation of Function
- Algebra of Function
- Value of Function
- Number of Functions
- Domain, Codomain and Range of Function

Milestone 2 - Types of Functions I

- Algebraic Function
- Non-algebraic Function (Transcendental Function)
- Piecewise Function

Milestone 3 - Types of Functions II

- One-one (Injective) Function/Monomorphic
- Many-one Function
- Onto or Surjective Function
- Into Function
- One-one Onto/Bijjective Function

Milestone 4 - Types of Functions III (Some Special Types of Functions)

- Even and Odd Function
- Periodic Function
- Composite Function
- Inverse of a Function
- Equal or Identical Function
- Bounded Function
- Implicit and Explicit Function
- Homogeneous Function

Milestone 5 - Some Special Points

- Functional Rule
- Functional Equation
- Miscellaneous Problems of Function

Practice Milestones

- Practice Milestone 1 - JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems

3. Limits

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Milestone 1 - Limits

- Definition of Limits
- Indeterminate Forms
- Algebra of Limits
- Evaluation of Limits
- Direct Substitution Method

Milestone 2 - Limits of Algebraic Functions

- Factorisation Method

- Standard Formula
- Rationalisation Method
- Method of Substitution

Milestone 3 - Limits of Transcendental Function

- Trigonometric Limits
- Logarithmic Limits
- Exponential Limits

Milestone 4 - Some Special Limits

- Limits Using Expansion
- Evaluation of Limits of the form 0^0 and ∞^0
- Limits of the Form 1^∞
- Limit Using Special Type of Function

Milestone 5 - Use of Standard Theorem

- Use of Standard Theorems/Results

- L'Hospital Rule
- Newton Leibnitz's Theorem
- One Sided Limits
- Geometrical Limits

Practice Milestones

- Practice Milestone 1- JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems

4. Continuity and Differentiability

242-359

Milestone 1 - Introduction - Continuity

- Continuity of Function

Milestone 2 - Types of Discontinuity

- Discontinuity
- Types of Discontinuity
- Points of Discontinuity

Milestone 3 - Theorems of Continuity

Milestone 4 - Continuity Involving Special Functions

- Continuity of Functions Involving GIF [•]
- Continuity of Functions Involving Fractional Part Function

- Continuity of Functions Involving Signum Function
- Continuity of Composite Functions

Milestone 5 - Differentiability

- Differentiability of Function

Milestone 6 - Differentiability Over an Interval

- Algebra of Differentiability

Milestone 7 - Functional Equation

Practice Milestones

- Practice Milestone 1- JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems

5. Differentiation

360-449

Milestone 1 - Derivative and Its Geometrical Meaning

- Meaning of Derivatives
- Geometrical Meaning of Derivatives
- Derivative of $f(x)$ by First Principle
- Some Standard Formulae
- Rules for Differentiation

Milestone 2 - Differentiation of Implicit Functions

- Chain Rule
- Differentiation of Implicit Function

Milestone 3 - Differentiation of Inverse Function

- Derivatives of Invertible Function
- Geometrical Interpretation
- Derivatives Involving Inverse Trigonometric Function (ITF)

Milestone 4 - Logarithmic Differentiation

Milestone 5 - Differentiation of Parametric Function

- Parametric Differentiation
- Differentiation of One Function with respect to Other Function

Milestone 6 - Higher Order Derivatives

Milestone 7 - Special Points

- Differentiation of a Function in the form of Determinant
- Sum of Special Series Obtained by Differentiation

Practice Milestones

- Practice Milestone 1- JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems



6. Application of Derivatives - I (Derivatives as a Rate Measure, Tangent & Normal, Theorems)

450-530

Milestone 1 - Derivative as a Rate Measure, Velocity and Acceleration

- Derivative as a Rate Measure
- Velocity and Acceleration

Milestone 2 - Differential and Approximation

- Differential and Approximation
- Geometrical Meaning of Δx , Δy , dx and dy
- Errors

Milestone 3 - Tangent and Normal

- Slope of Tangent
- Slope of Normal
- Equation of Tangent
- Equation of Normal

Milestone 4 - Angle of Intersection Between Curves

- Angle of Intersection Between Two Curves
- Length of Tangent, Sub-tangent, Normal and Sub-normal
- Shortest Distance Between Two Curves

Milestone 5 - Rolle's Theorem, Lagrange's Mean Value Theorem

- Rolle's Theorem and Its Geometrical Interpretation
- Lagrange's Mean Value Theorem and Its Geometrical Interpretation

Practice Milestones

- Practice Milestone 1- JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems

7. Application of Derivatives-II (Monotonicity and Maxima-Minima)

531-658

Milestone 1 - Monotonicity and Its Critical Points

- Monotonicity at a Point
- Monotonicity in an Interval
- Application of Derivatives in Monotonicity
- Critical Points

Milestone 2 - Application of Monotonicity

- Establishing Inequalities
- Comparison of Constants
- Greatest and Least Value of a Function
- Solution of Equations
- Jensen Inequality

Milestone 3 - Introduction of Maxima and Minima

- Local (Relative) Maxima and Minima

- Maxima and Minima Using Derivatives
- Concept of Global Maximum/Minimum Values
- Maxima and Minima of Discontinuous Functions

Milestone 4 - Application of Maxima and Minima

- Application of Maxima and Minima
- Convexity/Concavity and Point of Inflection
- Relation of Concavity with the Derivative
- Nature of Roots of Cubic Polynomials
- Graphical Representation of Roots of Cubic Polynomials

Practice Milestones

- Practice Milestone 1- JEE Main Pattern
- Practice Milestone 2 - JEE Advanced Pattern
- Practice Milestone 3 - Challenging Problems

