NCERT Solutions Class 12 Maths
Chapter 5: Continuity and Differentiability
Exercise 5.7

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Quick Summary: In NCERT Solutions Class 12 Maths Chapter 5 Exercise 5.7, students learn to find second-order derivatives of various functions including polynomial, trigonometric, and logarithmic functions. This exercise focuses on applying differentiation rules systematically to compute (d^2y)/(dx^2) for complex functions, building essential skills for CBSE board exams and competitive tests.

Key Takeaways:

- Master the power rule for second derivatives: (d^2)/(dx^2)(x^n) = n(n-1)x^n-2
- Apply product rule for functions like y = x \cos x where second derivative requires careful application of differentiation rules
- Understand logarithmic differentiation: (d^2)/(dx^2)(\log x) = -(1)/(x^2)
- Practice systematic step-by-step approach to find higher-order derivatives essential for continuity and differentiability problems

Complete Solutions

Question 1

QUESTION

Find the second order derivative of the function y = x^2 + 3x + 2.

SOLUTION

We are asked to find the second-order derivative of the function . This means we need to differentiate the function twice with respect to .

Step 1: Find the first derivative

We differentiate with respect to to find the first derivative, denoted as .

Using the power rule of differentiation, , and the fact that the derivative of a constant is 0, we have:

Step 2: Find the second derivative

Now, we differentiate the first derivative, , with respect to to find the second derivative, denoted as .

Final Answer:

The second-order derivative of the function is:

ANSWER

(d^2y)/(dx^2) = 2

Question 2

QUESTION

Find the second order derivative of the function y = x^20.

SOLUTION

We are asked to find the second derivative of the function . This means we need to differentiate the function twice with respect to .

Step 1: Find the first derivative

We will use the power rule for differentiation, which states that if , then .

Applying the power rule to , we get:

Step 2: Find the second derivative

Now, we need to differentiate with respect to again. We will apply the power rule once more.

Since 20 is a constant, we can write:

Applying the power rule to , we get:

Therefore, the second derivative is:

Final Answer:

ANSWER

(d^2y)/(dx^2) = 380x^18

Question 3

QUESTION

Find the second order derivative of the function y = x· \cos x.

SOLUTION

We are asked to find the second derivative of the function . This requires us to differentiate the function twice with respect to .

Step 1: Find the first derivative

We need to use the product rule, which states that if , then . In our case, and .

So, and .

Applying the product rule:

Step 2: Find the second derivative

Now we need to differentiate with respect to .

We differentiate each term separately. For , we again use the product rule with and . Then and .

So, the derivative of is .

The derivative of is .

Therefore,

Final Answer:

ANSWER

(d^2y)/(dx^2) = -x\cos x - 2\sin x

Question 4

QUESTION

Find the second order derivative of the function y = \log x.

SOLUTION

We are asked to find the second derivative of the function . This means we need to differentiate the function twice with respect to .

Step 1: Find the first derivative

The first derivative of with respect to is given by:

We know that the derivative of is . Therefore,

Step 2: Find the second derivative

Now, we need to differentiate with respect to again to find the second derivative.

We can rewrite as . So,

Using the power rule for differentiation, , we get:

Therefore,

Final Answer:

The second derivative of is .

ANSWER

(d^2y)/(dx^2) = -(1)/(x^2)

Question 5

QUESTION

Find the second order derivative of the function y = x^3\log x.

SOLUTION

We are asked to find the second derivative of the function .

Step 1: Find the first derivative

We need to differentiate with respect to . We will use the product rule, which states that . Here, and .

So, and .

Applying the product rule:

Thus, .

Step 2: Find the second derivative

Now we need to differentiate with respect to .

We can rewrite this as . We already know the derivative of from Step 1.

So, .

.

.

Therefore, .

Step 3: Simplify the second derivative

We can factor out an from the expression:

Final Answer:

ANSWER

(d^2y)/(dx^2) = x(5 + 6\log x)

Question 6

QUESTION

Find the second order derivative of the function y = e^x\sin 5x.

SOLUTION

We are asked to find the second derivative of the function . This requires us to differentiate the function twice with respect to .

Step 1: Find the first derivative,

We will use the product rule: , where and .

and

Therefore,

Step 2: Find the second derivative,

We need to differentiate with respect to . Again, we use the product rule, where and .

and

Therefore,

Final Answer:

ANSWER

(d^2y)/(dx^2) = 2e^x(5\cos 5x - 12\sin 5x)

Question 7

QUESTION

Find the second order derivative of the function y = e^6x\cos 3x.

SOLUTION

We need to find the second derivative of the function . This involves applying the product rule twice.

Step 1: Find the first derivative,

Using the product rule, , where and :

Therefore,

Step 2: Find the second derivative,

Now, we differentiate again using the product rule. Let and .

Applying the product rule:

Step 3: Simplify the expression

Final Answer:

ANSWER

(d^2y)/(dx^2) = 9e^6x(3\cos 3x - 4\sin 3x)

Question 8

QUESTION

Find the second order derivative of the function y = \tan^-1x.

SOLUTION

We are asked to find the second derivative of the function . This requires us to differentiate the function twice with respect to .

Step 1: Find the first derivative,

We know that the derivative of with respect to is . Therefore:

Step 2: Find the second derivative,

Now, we need to differentiate with respect to again. We can rewrite this as . Using the chain rule:

Applying the power rule and chain rule, we get:

The derivative of with respect to is . So:

Final Answer:

The second derivative of is:

ANSWER

(d^2y)/(dx^2) = -(2x)/((1 + x^2)^2)

Question 9

QUESTION

Find the second order derivative of the function y = \log(\log x).

SOLUTION

We need to find the second derivative of the function . This requires us to differentiate the function twice with respect to .

Step 1: Find the first derivative,

Using the chain rule, we have:

Step 2: Find the second derivative,

Now we differentiate with respect to . We can rewrite this as .

Using the chain rule again:

Step 3: Differentiate using the product rule

Step 4: Substitute back into the expression for

Final Answer:

Therefore, the second derivative is:

ANSWER

(d^2y)/(dx^2) = -(1 + \log x)/((x\log x)^2)

Question 10

QUESTION

Find the second order derivative of the function y = \sin(\log x).

SOLUTION

We are asked to find the second derivative of the function .

Step 1: Find the first derivative

We will use the chain rule. Let . Then .

So, .

We have and .

Therefore, .

Step 2: Find the second derivative

We need to differentiate with respect to . We will use the quotient rule:

If , then .

Here, and .

First, we find . Let . Then .

So, .

Next, we find .

Now, we apply the quotient rule:

.

Therefore, .

Final Answer:

ANSWER

(d^2y)/(dx^2) = -(\sin(\log x) + \cos(\log x))/(x^2)

Question 12

QUESTION

If y = \cos^-1x, find (d^2y)/(dx^2) in terms of y alone.

SOLUTION

This question asks us to find the second derivative of with respect to , but the final answer must be expressed in terms of only. This requires us to use the chain rule and trigonometric identities.

Step 1: Find the first derivative

Given , we can write .

Differentiating both sides with respect to , we get:

Therefore, .

Step 2: Find the second derivative

Now, we differentiate with respect to .

Using the chain rule:

We know that .

So,

Step 3: Substitute

We know that , so we substitute this into the equation:

Final Answer:

ANSWER

(d^2y)/(dx^2) = -\cot y\,\cosec^2 y

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🔢 Key Formulas

Important Formulas for Exercise 5.7

Formula / Concept	Description
Rolle's Theorem	If a function f(x) is continuous on the closed interval [a, b], differentiable on the open interval (a, b), and f(a) = f(b), then there exists at least one number c in the open interval (a, b) such that f'(c) = 0.
Conditions for Rolle's Theorem	A function f(x) must satisfy three conditions for Rolle's Theorem to be applicable: 1. f is continuous on the closed interval [a, b]. 2. f is differentiable on the open interval (a, b). 3. f(a) = f(b).
Geometrical Interpretation of Rolle's Theorem	Geometrically, Rolle's Theorem means that if a continuous and differentiable curve has the same height at two points, there must be at least one point between them where the tangent to the curve is horizontal (parallel to the x-axis).
Mean Value Theorem (MVT)	If a function f(x) is continuous on the closed interval [a, b] and differentiable on the open interval (a, b), then there exists at least one number c in (a, b) such that: f'(c) = (f(b) - f(a))/(b - a)
Conditions for Mean Value Theorem	A function f(x) must satisfy two conditions for the Mean Value Theorem to apply: 1. f is continuous on the closed interval [a, b]. 2. f is differentiable on the open interval (a, b).
Geometrical Interpretation of Mean Value Theorem	The theorem states that for a smooth curve, there is at least one point between two endpoints where the tangent to the curve is parallel to the secant line connecting the endpoints. The value (f(b) - f(a))/(b - a) is the slope of the secant line.
Relationship between Theorems	Rolle's Theorem is a special case of the Mean Value Theorem. If the condition f(a) = f(b) is added to the Mean Value Theorem, the slope of the secant line becomes zero, which leads to f'(c) = 0.

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Exercise 5.7 ✓ →

Miscellaneous Exercise on Chapter 5 →

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