NCERT Solutions Class 12 Maths
Chapter 5: Continuity and Differentiability
Exercise 5.6

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Quick Summary: In NCERT Solutions Class 12 Maths Chapter 5 Exercise 5.6, students learn to find second order derivatives and apply the Mean Value Theorem and Rolle's Theorem. This exercise covers parametric differentiation, higher-order derivatives, and theorem applications which are essential for CBSE Class 12 board exams and competitive entrance tests.

Key Takeaways:

- Second order derivatives: For parametric functions, (d^2y)/(dx^2) = (d)/(dx)\left((dy)/(dx)\right) ÷ (dx)/(dt)
- Rolle's Theorem: If f(a) = f(b) and f is continuous on [a,b], then f'(c) = 0 for some c in (a,b)
- Mean Value Theorem: f'(c) = (f(b) - f(a))/(b - a) for some c in the interval (a,b)
- Parametric differentiation is crucial for finding derivatives when x and y are both functions of a parameter

Complete Solutions

Question 1

QUESTION

If x = 2at^2 and y = at^4, find (dy)/(dx) without eliminating the parameter.

SOLUTION

This question tests our understanding of finding derivatives of parametric functions. We are given and in terms of a parameter , and we need to find without eliminating .

Step 1: Find

We have . Differentiating with respect to , we get:

So, .

Step 2: Find

We have . Differentiating with respect to , we get:

So, .

Step 3: Find using the chain rule

We know that . Therefore:

Step 4: Simplify the expression

We can cancel out the common factors and (assuming and):

Final Answer: .

ANSWER

(dy)/(dx) = t^2.

Question 2

QUESTION

If x = a\cosθ and y = b\cosθ, find (dy)/(dx) without eliminating the parameter.

SOLUTION

We are given and as functions of and asked to find without eliminating . This involves using the chain rule.

Step 1: Find

Given , we differentiate with respect to :

Step 2: Find

Given , we differentiate with respect to :

Step 3: Apply the chain rule

We know that . This allows us to find the derivative of with respect to even though both are defined in terms of .

Step 4: Substitute the derivatives

Substituting the expressions we found in steps 1 and 2:

Step 5: Simplify

We can cancel out the terms and the negative signs:

Final Answer:

ANSWER

(dy)/(dx) = (b)/(a).

Question 3

QUESTION

If x = \sin t and y = \cos 2t, find (dy)/(dx) without eliminating the parameter.

SOLUTION

This question tests our understanding of derivatives of parametric functions. We need to find given and are functions of , without eliminating .

Step 1: Find

We are given . Differentiating with respect to , we get:

Step 2: Find

We are given . Differentiating with respect to , we get:

Here, we use the chain rule: the derivative of is , and the derivative of is .

Step 3: Apply the chain rule for parametric differentiation

We know that . This is a crucial formula for parametric differentiation.

Substituting the values we found in Steps 1 and 2:

Step 4: Simplify using trigonometric identities

We know that . Substituting this into our expression:

Simplifying by cancelling the terms:

Final Answer:

This method works because it utilizes the chain rule to relate the derivatives with respect to the parameter to the derivative of with respect to . A common mistake is forgetting to apply the chain rule correctly when differentiating .

ANSWER

(dy)/(dx) = -4\sin t.

Question 4

QUESTION

If x = 4t and y = (4)/(t), find (dy)/(dx) without eliminating the parameter.

SOLUTION

We are given and as functions of a parameter , and we need to find without eliminating .

Step 1: Find

We have . Differentiating with respect to , we get:

Step 2: Find

We have . Differentiating with respect to , we get:

Step 3: Use the chain rule to find

We know that . This is a direct application of the chain rule when both and are expressed in terms of a parameter .

Substituting the values we found in steps 1 and 2:

Step 4: Simplify the expression

Final Answer:

Conclusion: We found by first finding and and then using the chain rule to relate them. A common mistake is to forget to divide by .

ANSWER

(dy)/(dx) = -(1)/(t^2).

Question 5

QUESTION

If x = \cosθ - \cos 2θ and y = \sinθ - \sin 2θ, find (dy)/(dx) without eliminating the parameter.

SOLUTION

We are given parametric equations and , and we need to find without eliminating the parameter .

Step 1: Find

Differentiate with respect to :

Step 2: Find

Differentiate with respect to :

Step 3: Find using the chain rule

We know that .

Substitute the expressions we found for and :

Final Answer:

.

ANSWER

(dy)/(dx) = (\cosθ - 2\cos 2θ)/(2\sin 2θ - \sinθ).

Question 6

QUESTION

If x = a(θ - \sinθ) and y = a(1 + \cosθ), find (dy)/(dx) without eliminating the parameter.

SOLUTION

We need to find given and without eliminating the parameter .

Step 1: Differentiate with respect to

We have . Differentiating both sides with respect to , we get:

Step 2: Differentiate with respect to

We have . Differentiating both sides with respect to , we get:

Step 3: Find using the chain rule

We know that . Therefore,

Step 4: Simplify the expression using trigonometric identities

We can use the following identities:

Substituting these into the expression for , we get:

Final Answer:

ANSWER

(dy)/(dx) = -\cot\left((θ)/(2)\right).

Question 7

QUESTION

If x = (\sin^3 t)/(√\cos 2t) and y = (\cos^3 t)/(√\cos 2t), find (dy)/(dx) without eliminating the parameter.

SOLUTION

This question tests our understanding of parametric differentiation. We need to find when both and are given as functions of a parameter .

Step 1: Find

Given , we differentiate with respect to using the quotient rule:

Step 2: Find

Given , we differentiate with respect to using the quotient rule:

Step 3: Find

Using , we have:

Using the identities and , we get:

ANSWER

(dy)/(dx) = -\cot 3t.

Question 8

QUESTION

If x = a\left(\cos t + \log\tan(t)/(2)\right) and y = a\sin t, find (dy)/(dx) without eliminating the parameter.

SOLUTION

We are given parametric equations and in terms of and asked to find without eliminating the parameter .

Step 1: Find

We have . Differentiating with respect to , we get:

Using the identity , we have:

Step 2: Find

We have . Differentiating with respect to , we get:

Step 3: Find

Using the chain rule, we have:

Final Answer:

ANSWER

(dy)/(dx) = \tan t.

Question 9

QUESTION

If x = a\secθ and y = b\tanθ, find (dy)/(dx) without eliminating the parameter.

SOLUTION

This question tests our understanding of parametric differentiation. We need to find when both and are given in terms of a parameter, , without eliminating .

Step 1: Differentiate with respect to

We have . Differentiating both sides with respect to , we get:

We know that the derivative of is . Therefore:

Step 2: Differentiate with respect to

We have . Differentiating both sides with respect to , we get:

We know that the derivative of is . Therefore:

Step 3: Find using the chain rule

We know that . Substituting the values we found in steps 1 and 2:

Step 4: Simplify the expression

We can simplify the expression by canceling out a factor of :

Now, we can rewrite as and as :

The terms cancel out:

Since , we have:

Final Answer:

ANSWER

(dy)/(dx) = (b)/(a)\cosecθ.

Question 10

QUESTION

If x = a(\cosθ + θ\sinθ) and y = a(\sinθ - θ\cosθ), find (dy)/(dx) without eliminating the parameter.

SOLUTION

We are given and as functions of and asked to find without eliminating the parameter . This requires using the chain rule.

Step 1: Find

Given , we differentiate with respect to :

Simplifying, we get:

Step 2: Find

Given , we differentiate with respect to :

Simplifying, we get:

Step 3: Find using the chain rule

We know that . Therefore:

Step 4: Simplify the expression

The terms cancel out, leaving:

Since , we have:

Final Answer:

ANSWER

(dy)/(dx) = \tanθ.

Question 11

QUESTION

If x = √a^\sin^-1 t and y = √a^\cos^-1 t, show that (dy)/(dx) = -(y)/(x).

SOLUTION

This question tests our understanding of derivatives of inverse trigonometric functions and implicit differentiation. We need to show that given and , the derivative .

Step 1: Simplify the given equations

We have and . Let's square both equations:

and

Step 2: Multiply the squared equations

Multiplying and , we get:

Step 3: Use the identity

We know that . Substituting this into the equation, we get:

Step 4: Differentiate both sides with respect to x

Differentiating with respect to , we use the product rule and chain rule:

Note that is a constant, so its derivative is 0.

Step 5: Solve for

Rearrange the equation to solve for :

Final Answer:

Therefore, we have shown that .

ANSWER

(dy)/(dx) = -(y)/(x).

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Key Formulas

Important Formulas for Exercise 5.6

Formula / Concept	Description
Second Order Derivative	The second derivative, or the second order derivative, of a function f is the derivative of the derivative of f. It represents the rate at which the first derivative is changing.
Notations for Second Order Derivative	If y = f(x), the second order derivative can be denoted by f''(x), y'', (d^2y)/(dx^2), or D^2y.
Parametric Differentiation (First Order)	If x = f(t) and y = g(t), then the first derivative of y with respect to x is given by the chain rule: (dy)/(dx) = (dy)/(dt)(dx)/(dt), provided (dx)/(dt) ≠ 0.
Parametric Differentiation (Second Order)	To find the second order derivative of a parametric function, we differentiate the first derivative with respect to x: (d^2y)/(dx^2) = (d)/(dx)\left((dy)/(dx)\right) = (d)/(dt)\left((dy)/(dx)\right) (dx)/(dt).
Rolle's Theorem	If a function f 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 (a, b) such that f'(c) = 0.
Geometrical Interpretation of Rolle's Theorem	If a continuous curve has the same y-value at two different points and a unique tangent at every point in between, then there must be at least one point where the tangent is parallel to the x-axis.
Lagrange's Mean Value Theorem (MVT)	If a function f 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).
Geometrical Interpretation of Mean Value Theorem	For a continuous and differentiable curve between two points, there is at least one point on the curve where the slope of the tangent line is equal to the slope of the secant line connecting the two endpoints.

More Exercises

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Miscellaneous Exercise on Chapter 5 →

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