NCERT Solutions Class 12 Maths
Chapter 7: Integrals
Exercise 7.4

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Quick Summary: In NCERT Solutions Class 12 Maths Chapter 7 Exercise 7.4, students learn advanced integration techniques including integration by partial fractions and various substitution methods. This exercise covers complex rational functions and integrals involving square roots, which are frequently tested in CBSE board exams and competitive entrance tests.

Key Takeaways:

- Master partial fraction decomposition for rational functions like (3x^2)/(x^6+1) by breaking them into simpler fractions
- Apply trigonometric substitutions for integrals with forms (1)/(√a^2-x^2) and (1)/(√a^2+x^2)
- Use algebraic manipulation techniques to simplify complex expressions before integration
- Practice step-by-step solutions for high-scoring integration problems commonly appearing in CBSE Class 12 board exams

Complete Solutions

Question 1

QUESTION

Integrate: **(3x^2)/(x^6+1)**

SOLUTION

We are asked to integrate the function with respect to .

Step 1: Rewrite the integral

Notice that can be written as . This suggests a substitution. Let's rewrite the integral:

Step 2: Perform a u-substitution

Let . Then, the derivative of with respect to is:

This implies that . Now we can substitute and into the integral:

Step 3: Evaluate the integral

The integral of with respect to is a standard integral, which is the arctangent function:

Step 4: Substitute back for x

Now, substitute back in for :

Final Answer:

The integral of is .

ANSWER

\tan^-1(x^3)+C

Question 2

QUESTION

Integrate: **(1)/(√1+4x^2)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Rewrite the integral

We can rewrite the integral as:

Step 2: Apply a substitution

Let . Then, , which implies .

Substituting these into the integral, we get:

Step 3: Use the standard integral formula

We know that the integral of is . In our case, , so we have:

Step 4: Substitute back for x

Substituting back into the expression, we get:

where is the constant of integration.

Simplifying the expression under the square root:

Final Answer:

Therefore, the integral of is:

ANSWER

(1)/(2)\log\left|2x+√1+4x^2\right|+C

Question 3

QUESTION

Integrate: **(1)/(√(2-x)^2+1)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Rewrite the integral

The given integral is:

Step 2: Perform a u-substitution

Let . Then, , so . Substituting these into the integral, we get:

Step 3: Apply the standard integral formula

We know that . In our case, , so we have:

Step 4: Substitute back for x

Substitute back into the expression:

Simplifying the expression inside the square root:

So the integral becomes:

Step 5: Use logarithm properties

Since , we can rewrite the expression as:

Final Answer:

ANSWER

\log\left|(1)/(2-x+√x^2-4x+5)\right|+C

Question 4

QUESTION

Integrate: **(1)/(√9-25x^2)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Rewrite the integral

We can rewrite the integral as:

Step 2: Recognize the standard form

This integral resembles the standard form:

where is a constant and is a function of .

Step 3: Apply substitution

Let . Then, , which means .

Substituting these into the integral, we get:

Step 4: Integrate using the standard form

Now, we can directly apply the standard integral formula:

Step 5: Substitute back for

Substitute back into the expression:

Final Answer:

The integral of is .

ANSWER

(1)/(5)\sin^-1\left((5x)/(3)\right)+C

Question 5

QUESTION

Integrate: **(3x)/(1+2x^4)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Rewrite the integral

We can rewrite the integral as:

Step 2: Perform a u-substitution

Let . Then, , which implies . So, .

Substituting these into the integral, we get:

Step 3: Further simplification

We can rewrite the integral as:

Step 4: Perform another substitution

Let . Then, , which implies .

Substituting these into the integral, we get:

Step 5: Integrate

We know that .

So, we have:

Step 6: Substitute back

Substitute back into the equation:

Substitute back into the equation:

Final Answer:

ANSWER

(3)/(2√2)\tan^-1(√2\,x^2)+C

Question 6

QUESTION

Integrate: **(x^2)/(1-x^6)**

SOLUTION

We need to integrate the given function: .

Step 1: Rewrite the integral

We can rewrite the integral as:

Step 2: Use substitution

Let . Then, , which implies . Therefore, .

Substituting these into the integral, we get:

Step 3: Use partial fraction decomposition

We can express as a sum of partial fractions:

Multiplying both sides by , we get:

To find , let :

To find , let :

So,

Step 4: Integrate

Now we can rewrite the integral as:

Step 5: Substitute back

Substitute back into the expression:

Final Answer:

ANSWER

(1)/(6)\log\left|(1+x^3)/(1-x^3)\right|+C

Question 7

QUESTION

Integrate: **(x-1)/(√x^2-1)**

SOLUTION

We need to integrate the given function: .

Step 1: Split the integral

We can split the integral into two parts:

Step 2: Solve the first integral

Let . Use substitution: , so , and .

Then, .

Integrating, we get .

Step 3: Solve the second integral

Let . This is a standard integral:

Step 4: Combine the results

Now, we combine the results of the two integrals:

where .

Final Answer:

ANSWER

√x^2-1-\log\left|x+√x^2-1\right|+C

Question 8

QUESTION

Integrate: **(x^2)/(√x^6+a^6)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Simplify the integral using substitution

Let . Then, , which implies . Therefore, .

Substituting these into the integral, we get:

Step 2: Apply the standard integral formula

We know that . Here, we have , so we can apply the same formula.

Step 3: Substitute back for

Since , we substitute back into the expression:

Final Answer:

The integral of is .

ANSWER

(1)/(3)\log\left|x^3+√x^6+a^6\right|+C

Question 9

QUESTION

Integrate: **(\sec^2 x)/(√\tan^2 x+4)**

SOLUTION

We need to evaluate the integral . This integral can be solved using substitution.

Step 1: Identify a suitable substitution

Let . Then, the derivative of with respect to is . This implies . This substitution simplifies the integral significantly.

Step 2: Substitute and rewrite the integral

Substituting and into the integral, we get:

Step 3: Recognize the standard integral form

The integral is a standard integral, and its result is , where is a constant.

Step 4: Apply the standard integral formula

In our case, , so . Applying the formula, we have:

Step 5: Substitute back for

Now, we substitute back into the result:

Final Answer:

Therefore, the integral is

ANSWER

\log\left|\tan x+√\tan^2 x+4\right|+C

Question 10

QUESTION

Integrate: **(1)/(√x^2+2x+2)**

SOLUTION

We need to integrate the given function: .

This integral can be solved by completing the square in the denominator and then using a standard integral formula.

Step 1: Complete the square in the denominator

We have . To complete the square, we need to express this in the form .

So, the integral becomes:

Step 2: Apply the standard integral formula

We know that .

In our case, we have . Let , then .

So the integral becomes:

Applying the formula, we get:

Step 3: Substitute back for x

Substitute back into the expression:

Simplify the expression under the square root:

So, the final answer is:

Final Answer:

ANSWER

\log\left|x+1+√x^2+2x+2\right|+C

Question 11

QUESTION

Integrate: **(1)/(9x^2+6x+5)**

SOLUTION

We need to integrate the function with respect to .

Step 1: Complete the square in the denominator

We want to rewrite the quadratic expression in the form of a perfect square plus a constant. Notice that looks like the first two terms of .

So, we can rewrite the denominator as:

Step 2: Rewrite the integral

Now we can rewrite the integral as:

Step 3: Use the standard integral formula

Recall the standard integral formula:

In our case, we have replaced by and . We also need to account for the chain rule.

Step 4: Apply u-substitution (optional, but clarifies the chain rule)

Let . Then, , so .

The integral becomes:

Step 5: Evaluate the integral

Using the standard integral formula:

Step 6: Substitute back for x

Substitute back into the expression:

Final Answer:

ANSWER

(1)/(6)\tan^-1\left((3x+1)/(2)\right)+C

Question 12

QUESTION

Integrate: **(1)/(√7-6x-x^2)**

SOLUTION

We need to evaluate the integral . This integral can be solved by completing the square in the denominator and then using a standard integral formula.

Step 1: Complete the square in the denominator

We have . Rearranging and completing the square:

To complete the square for , we need to add and subtract .

So,

Therefore,

Now the integral becomes:

Step 2: Use the standard integral formula

Recall the standard integral formula:

In our case, so , and , so .

Applying the formula, we get:

Final Answer:

The integral evaluates to:

ANSWER

\sin^-1\left((x+3)/(4)\right)+C

Question 13

QUESTION

Integrate: **(1)/(√(x-1)(x-2))**

SOLUTION

We need to integrate the function . This involves completing the square inside the square root.

Step 1: Simplify the expression inside the square root

First, expand the expression inside the square root:

So, the integral becomes:

Step 2: Complete the square

To complete the square for , we need to add and subtract :

Now the integral is:

Step 3: Apply the standard integral formula

We know that .

Here, we have in place of and in place of .

So, the integral becomes:

Step 4: Simplify the expression inside the square root

Therefore, the final answer is:

ANSWER

\log\left|x-(3)/(2)+√x^2-3x+2\right|+C

Question 14

QUESTION

Integrate: **(1)/(√8+3x-x^2)**

SOLUTION

We need to integrate the given expression: .

Step 1: Rewrite the quadratic expression inside the square root by completing the square.

We have . We can rewrite this as:

To complete the square, we need to add and subtract inside the parenthesis:

So, the integral becomes:

Step 2: Use the standard integral formula.

Recall the formula:

Here, , so , and is replaced by .

Applying the formula, we get:

Step 3: Simplify the expression.

Final Answer:

ANSWER

\sin^-1\left((2x-3)/(√41)\right)+C

Question 15

QUESTION

Integrate: **(1)/(√(x-a)(x-b))**

SOLUTION

We are asked to integrate the function with respect to .

Step 1: Simplify the expression inside the square root

First, expand the expression inside the square root:

So, the integral becomes:

Step 2: Complete the square

To complete the square, we need to add and subtract inside the square root:

Step 3: Rewrite the integral

Now the integral becomes:

Step 4: Apply the standard integral formula

We use the formula:

Here, is replaced by and , so

Therefore, the integral is:

Step 5: Simplify the expression inside the logarithm

Notice that

So, the integral simplifies to:

Final Answer:

ANSWER

\log\left|x-(a+b)/(2)+√(x-a)(x-b)\right|+C

Question 16

QUESTION

Integrate: **(4x+1)/(√2x^2+x-3)**

SOLUTION

We are asked to integrate the function with respect to .

Step 1: Recognize the form of the integral

Notice that the numerator is the derivative of the expression inside the square root in the denominator, , up to a constant factor. Specifically, the derivative of is . This suggests a substitution.

Step 2: Perform the substitution

Let . Then, the derivative of with respect to is:

Therefore, .

Step 3: Rewrite the integral in terms of

Substituting and into the original integral, we get:

We can rewrite this as:

Step 4: Integrate with respect to

Using the power rule for integration, , we have:

Step 5: Substitute back for

Replace with to get the final answer in terms of :

Final Answer:

ANSWER

2√2x^2+x-3+C

Question 17

QUESTION

Integrate: **$(x+2)/(\sqrt{x^2-1})$**

SOLUTION

We need to integrate the given function: .

Step 1: Separate the integral into two parts

We can split the integral as follows:

Step 2: Solve the first integral

Let . We can use substitution. Let , then , so .

Thus, .

Integrating, we get .

Step 3: Solve the second integral

Let .

We know that . In our case, .

So, .

Step 4: Combine the results

Now, we add the two integrals:

, where .

Final Answer:

ANSWER

$\sqrt{x^2-1}+2\log\left|x+\sqrt{x^2-1}\right|+C$

Question 18

QUESTION

Integrate: **(5x-2)/(1+2x+3x^2)**

SOLUTION

We need to integrate the function . This integral can be solved by expressing the numerator in terms of the derivative of the denominator and then splitting the integral into two parts.

Step 1: Express the numerator in terms of the derivative of the denominator

Let , where and are constants.

Then, .

Comparing the coefficients of and the constant terms, we get:

and .

Solving for and :

So,

Step 2: Rewrite the integral

Step 3: Evaluate the first integral

Let . Since the numerator is the derivative of the denominator, we have:

Step 4: Evaluate the second integral

Let

Using the formula , we get:

Step 5: Combine the results

Final Answer:

ANSWER

(5)/(6)\log\left|3x^2+2x+1\right|-(11)/(3√2)\tan^-1\left((3x+1)/(√2)\right)+C

Question 19

QUESTION

Integrate: **(6x+7)/(√(x-5)(x-4))**

SOLUTION

We need to integrate the given function: .

Step 1: Simplify the expression inside the square root

First, expand the expression inside the square root:

So, the integral becomes:

Step 2: Express the numerator in terms of the derivative of the quadratic inside the square root

Let . The derivative of is .

So,

Comparing coefficients, we have:

Thus,

Step 3: Rewrite the integral

Step 4: Solve the first integral

Let , then . So,

Step 5: Solve the second integral

We have . Complete the square:

So,

Step 6: Combine the results

, where

Final Answer:

ANSWER

6√x^2-9x+20+34\log\left|x-(9)/(2)+√x^2-9x+20\right|+C

Question 20

QUESTION

Integrate: **(x+2)/(√4x-x^2)**

SOLUTION

We need to integrate the function .

Step 1: Rewrite the numerator

We want to express the numerator in terms of the derivative of the expression inside the square root in the denominator. The derivative of is . We can rewrite the numerator as follows:

, where and are constants.

Expanding, we get .

Comparing coefficients of , we have , so .

Comparing constant terms, we have , so , which gives , so .

Thus, .

Step 2: Rewrite the integral

Now we can rewrite the integral as:

Step 3: Evaluate the first integral

For the first integral, let , so . Then:

Step 4: Evaluate the second integral

For the second integral, we complete the square in the denominator:

.

So, .

Using the formula , we have:

.

Step 5: Combine the results

Combining the two integrals, we get:

, where .

Final Answer:

ANSWER

$-\sqrt{4x-x^2}+4\sin^{-1}\left(\frac{x-2}{2}\right)+C$

Question 21

QUESTION

Integrate: **$(x+2)/(\sqrt{x^2+2x+3})$**

SOLUTION

We are asked to integrate the function with respect to .

Step 1: Split the integral

We can rewrite the numerator as . This allows us to split the integral into two parts:

Step 2: Evaluate the first integral

Let . Then, , so . The first integral becomes:

Step 3: Evaluate the second integral

We complete the square in the denominator: . Thus, the second integral becomes:

Using the formula , we get:

Step 4: Combine the results

Adding the two integrals, we get:

where .

Final Answer:

ANSWER

$\sqrt{x^2+2x+3}+\log\left|x+1+\sqrt{x^2+2x+3}\right|+C$

Question 22

QUESTION

Integrate: **(x+3)/(x^2-2x-5)**

SOLUTION

We need to integrate the given function . This integral can be solved by expressing the numerator in terms of the derivative of the denominator.

Step 1: Express the numerator in terms of the derivative of the denominator

Let . The derivative of the denominator is . So we have:

Comparing coefficients of and the constant terms, we get:

Therefore,

Step 2: Rewrite the integral

Now we can rewrite the integral as:

Step 3: Evaluate the first integral

For the first integral, let , then . So,

Step 4: Evaluate the second integral

For the second integral, we complete the square in the denominator:

So,

Using the formula , we get:

Step 5: Combine the results

Adding the two integrals, we get:

Final Answer:

ANSWER

(1)/(2)\log\left|x^2-2x-5\right|+(2)/(√6)\log\left|x-1-√6x-1+√6\right|+C

Question 23

QUESTION

Integrate: **(5x+3)/(√x^2+4x+10)**

SOLUTION

We need to integrate the function .

Step 1: Separate the numerator to create the derivative of the expression inside the square root.

Let , where is the derivative of .

Expanding, we get . Comparing coefficients, we have:

So, .

Step 2: Rewrite the integral.

Step 3: Solve the first integral.

Let , then .

Step 4: Solve the second integral.

Using the formula , we get:

Step 5: Combine the results.

Final Answer:

ANSWER

5√x^2+4x+10-7\log\left|x+2+√x^2+4x+10\right|+C

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Key Formulas

Important Formulas for Exercise 7.4

Formula / Concept	Description
Integrals of Some Particular Functions	
$\int \frac{1}{x^2 - a^2} \,dx = \frac{1}{2a} \log\left\|\frac{x-a}{x+a}\right\| + C$	Integration of a rational function where the denominator is a difference of two squares.
$\int \frac{1}{a^2 - x^2} \,dx = \frac{1}{2a} \log\left\|\frac{a+x}{a-x}\right\| + C$	Integration of a rational function, a variation of the difference of two squares.
$\int \frac{1}{x^2 + a^2} \,dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + C$	Integration of a rational function where the denominator is a sum of two squares.
$\int \frac{1}{\sqrt{x^2 - a^2}} \,dx = \log\left\|x + \sqrt{x^2 - a^2}\right\| + C$	Integration of a function with a square root in the denominator.
$\int \frac{1}{\sqrt{a^2 - x^2}} \,dx = \sin^{-1}\left(\frac{x}{a}\right) + C$	This integral results in the inverse sine function.
$\int \frac{1}{\sqrt{x^2 + a^2}} \,dx = \log\left\|x + \sqrt{x^2 + a^2}\right\| + C$	Integration of a function with a square root in the denominator.
Methods for Solving Integrals in Ex 7.4	
Completing the Square For $ax^2 + bx + c$, we write: $a\left[\left(x + \frac{b}{2a}\right)^2 - \left(\frac{b^2 - 4ac}{4a^2}\right)\right]$	A technique to convert a quadratic expression into the sum or difference of two squares, to match the standard integral forms.
For integrals of the form: $\int \frac{px+q}{ax^2+bx+c} \,dx$ or $\int \frac{px+q}{\sqrt{ax^2+bx+c}} \,dx$	Express the numerator as $px+q = A \frac{d}{dx}(ax^2+bx+c) + B$. Find constants A and B, then split the integral into two simpler integrals that can be solved using standard forms.
Related Integration Concepts	
Integration by Partial Fractions	A method to decompose a complex rational function into a sum of simpler fractions that are easier to integrate. The form of decomposition depends on the factors of the denominator (linear, repeated, quadratic, etc.).

Formula / Concept	Description
Integration by Parts \int u \, dv = uv - \int v \, du	A technique for integrating the product of two functions. The choice of 'u' (the function to differentiate) and 'dv' (the function to integrate) is often guided by the ILATE rule (Inverse, Logarithmic, Algebraic, Trigonometric, Exponential).
Fundamental Theorem of Calculus If F'(x) = f(x), then \int_a^b f(x) \,dx = F(b) - F(a)	This theorem connects differentiation and integration. The second part states that the definite integral of a function can be found by evaluating its antiderivative at the limits of integration.

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