NCERT Solutions Class 12 Maths
Chapter 7: Integrals
Exercise 7.5

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Quick Summary: In NCERT Solutions Class 12 Maths Chapter 7 Exercise 7.5, students learn integration of rational functions using partial fractions and substitution methods. This exercise covers essential integration techniques for rational expressions like $\frac{x}{(x+1)(x-2)}$ and $\frac{1}{x^2-9}$, which are crucial for CBSE board exams and competitive entrance tests.

Key Takeaways:

- Master partial fraction decomposition for rational functions of the form $\frac{P(x)}{Q(x)}$ where degree of $P(x)$ < degree of $Q(x)$
- Apply standard integral formulas like $\int \frac{1}{x^2-a^2}\,dx = \frac{1}{2a} \ln\left|\frac{x-a}{x+a}\right| + C$
- Use substitution methods effectively when dealing with rational functions involving quadratic denominators
- Identify when to split rational functions into simpler fractions before integration for exam efficiency

Complete Solutions

Question 1

QUESTION

Integrate the rational function (x)/((x+1)(x+2)).

SOLUTION

We need to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 2: Solving for A and B

To find , let :

To find , let :

So, we have:

Step 3: Integration

Now, we integrate each term separately:

Using the fact that , we get:

Step 4: Simplify the result using logarithm rules

Using the logarithm property , we have:

Using the logarithm property , we get:

Final Answer:

ANSWER

\log\left|((x+2)^2)/(x+1)\right|+C

Question 2

QUESTION

Integrate the rational function (1)/(x^2-9).

SOLUTION

We are asked to integrate the rational function . This involves using partial fraction decomposition.

Step 1: Factor the denominator

We can factor the denominator as a difference of squares:

So, our integral becomes:

Step 2: Perform partial fraction decomposition

We want to express the integrand as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 3: Solve for A and B

We can solve for and by substituting suitable values of .

Let :

Let :

Step 4: Rewrite the integral

Now we can rewrite the integral as:

Step 5: Integrate

We know that . Therefore:

Step 6: Simplify using logarithm properties

Using the property , we get:

Final Answer:

ANSWER

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

Question 3

QUESTION

Integrate the rational function (3x-1)/((x-1)(x-2)(x-3)).

SOLUTION

We need to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 2: Solving for A, B, and C

Let :

, so

Let :

, so

Let :

, so

Step 3: Rewrite the integral

Now we can rewrite the integral as:

Step 4: Integrate each term

Step 5: Combine the results

Therefore, the integral is:

Final Answer:

ANSWER

\log|x-1|-5\log|x-2|+4\log|x-3|+C

Question 4

QUESTION

Integrate the rational function (x)/((x-1)(x-2)(x-3)).

SOLUTION

We need to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 2: Solving for A, B, and C

Let :

Let :

Let :

Step 3: Substitute A, B, and C back into the partial fraction decomposition

Step 4: Integrate each term

Final Answer:

ANSWER

(1)/(2)\log|x-1|-2\log|x-2|+(3)/(2)\log|x-3|+C

Question 5

QUESTION

Integrate the rational function (2x)/(x^2+3x+2).

SOLUTION

We need to integrate the rational function . This involves partial fraction decomposition.

Step 1: Factor the denominator

First, we factor the quadratic expression in the denominator:

Step 2: Perform partial fraction decomposition

We express the rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 3: Solve for A and B

To find A, let :

To find B, let :

Step 4: Rewrite the integral using partial fractions

Now we can rewrite the integral as:

Step 5: Integrate each term

Using the fact that , we have:

Final Answer:

ANSWER

4\log|x+2|-2\log|x+1|+C

Question 6

QUESTION

Integrate the rational function (1-x^2)/(x(1-2x)).

SOLUTION

We need to integrate the rational function . This requires us to perform polynomial long division first, as the degree of the numerator is not less than the degree of the denominator.

Step 1: Simplify the denominator

First, expand the denominator: . So the integral becomes .

Step 2: Perform polynomial long division

Divide by . We can rewrite the integrand as:

Multiplying the numerator and denominator of the second term by 2, we get:

Step 3: Partial fraction decomposition

Now we decompose the remaining fraction into partial fractions. Let Multiplying by gives: Comparing coefficients, we have:

So,

Step 4: Integrate

Now we integrate each term:

Final Answer:

ANSWER

(x)/(2)+\log|x|-(3)/(4)\log|1-2x|+C

Question 7

QUESTION

Integrate the rational function (x)/((x^2+1)(x-1)).

SOLUTION

We need to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 2: Solving for A, B, and C

Expanding the equation, we have:

Comparing coefficients, we get the following system of equations:

From , we have . From , we have . Substituting into , we get , so , and .

Thus, , , and .

Step 3: Rewriting the Integral

Now we can rewrite the integral as:

Step 4: Evaluating the Integrals

The first integral is straightforward:

For the second integral, let , so :

The third integral is a standard form:

Step 5: Combining the Results

Adding the results together, we get:

Therefore, the integral of the given rational function is .

ANSWER

(1)/(2)\log|x-1|-(1)/(4)\log(x^2+1)+(1)/(2)\tan^-1x+C

Question 8

QUESTION

Integrate the rational function (x)/((x-1)^2(x+2)).

SOLUTION

We need to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Step 2: Solve for A, B, and C

Multiplying both sides by , we get:

Let's find the values of A, B, and C by substituting suitable values of x.

If , we have:

If , we have:

Now, let's substitute :

Substituting the values of B and C:

So, we have , , and .

Step 3: Integrate

Now we can rewrite the integral as:

Final Answer:

ANSWER

(2)/(9)\log\left|(x-1)/(x+2)\right|-(1)/(3(x-1))+C

Question 9

QUESTION

Integrate the rational function (3x+5)/(x^3-x^2-x+1).

SOLUTION

We need to integrate the rational function .

Step 1: Factorize the denominator

First, we factorize the denominator . Notice that we can factor by grouping:

So, we have .

Step 2: Partial fraction decomposition

We express the rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 3: Solve for A, B, and C

Let :

Let :

Now, let's expand and compare coefficients:

Comparing the coefficients of :

Step 4: Integrate

Now we have:

Final Answer:

ANSWER

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

Question 10

QUESTION

Integrate the rational function (2x-3)/((x^2-1)(2x+3)).

SOLUTION

We need to integrate the rational function . This problem involves partial fraction decomposition.

Step 1: Factor the denominator

First, we factor the denominator completely:

So, the rational function becomes:

Step 2: Perform partial fraction decomposition

We express the rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 3: Solve for A, B, and C

Let :

Let :

Let :

Step 4: Integrate

Now we have:

Final Answer:

ANSWER

(5)/(2)\log|x+1|-(1)/(10)\log|x-1|-(12)/(5)\log|2x+3|+C

Question 11

QUESTION

Integrate the rational function (5x)/((x+1)(x^2-4)).

SOLUTION

We need to integrate the rational function . This involves partial fraction decomposition.

Step 1: Factor the denominator

First, we factor the denominator completely:

So, the rational function becomes:

Step 2: Partial fraction decomposition

We express the rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 3: Solve for A, B, and C

Let :

Let :

Let :

Step 4: Integrate

Now we integrate the decomposed fractions:

Final Answer:

ANSWER

(5)/(3)\log|x+1|-(5)/(2)\log|x+2|+(5)/(6)\log|x-2|+C

Question 12

QUESTION

Integrate the rational function (x^3+x+1)/(x^2-1).

SOLUTION

We are asked to integrate the rational function . Since the degree of the numerator is greater than the degree of the denominator, we first perform long division.

Step 1: Perform Polynomial Long Division

Dividing by , we get:

Thus, .

Step 2: Decompose the Remainder into Partial Fractions

We need to decompose into partial fractions. Since , we can write:

Multiplying both sides by gives:

Step 3: Solve for A and B

Let :

Let :

So, .

Step 4: Integrate

Now we integrate:

Final Answer:

ANSWER

(x^2)/(2)+(1)/(2)\log|x+1|+(3)/(2)\log|x-1|+C

Question 13

QUESTION

Integrate the rational function (2)/((1-x)(1+x^2)).

SOLUTION

We are asked to integrate the rational function . This requires using partial fraction decomposition.

Step 1: Partial Fraction Decomposition

We express the given rational function as a sum of simpler fractions:

Multiplying both sides by , we get:

Step 2: Solving for A, B, and C

Let :

Now we have:

Rearranging:

Comparing coefficients:

Constant term:

term:

Step 3: Substitute A, B, and C back into the partial fraction decomposition

Step 4: Integrate each term

Let , then . So,

For , let , then . So,

And

Step 5: Combine the results

Final Answer:

ANSWER

-\log|x-1|+(1)/(2)\log(1+x^2)+\tan^-1x+C

Question 14

QUESTION

Integrate the rational function (3x-1)/((x+2)^2).

SOLUTION

We need to integrate the rational function . This requires us to decompose the rational function into simpler terms that are easier to integrate.

Step 1: Decompose the rational function using partial fractions

Since the denominator is , we can express the rational function as:

Multiplying both sides by gives:

Step 2: Solve for A and B

We can solve for and by substituting suitable values for . Let's set :

Now, let's compare the coefficients of on both sides:

So, we have and .

Step 3: Rewrite the integral

Now we can rewrite the integral as:

Step 4: Integrate each term separately

Step 5: Combine the results

where is the constant of integration.

Final Answer:

ANSWER

3\log|x+2|+(7)/(x+2)+C

Question 15

QUESTION

Integrate the rational function (1)/(x^4-1).

SOLUTION

We are asked to integrate the rational function . This requires partial fraction decomposition.

Step 1: Factor the denominator

We can factor the denominator as a difference of squares:

Step 2: Perform partial fraction decomposition

We express the rational function as a sum of simpler fractions:

Multiplying both sides by gives:

Step 3: Solve for A, B, C, and D

Let :

Let :

Let :

Comparing coefficients of :

Step 4: Rewrite the integral

Now we can rewrite the integral as:

Step 5: Integrate each term

Step 6: Simplify

Final Answer:

ANSWER

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

Question 16

QUESTION

Integrate the rational function (1)/(x(x^n+1)).

Hint: multiply numerator and denominator by x^n-1 and put x^n=t.

SOLUTION

We are asked to integrate the rational function . The hint suggests multiplying the numerator and denominator by and substituting .

Step 1: Multiply numerator and denominator by

Multiply both the numerator and denominator of the integrand by :

Step 2: Substitute

Let . Then, differentiating both sides with respect to , we get:

Substituting these into the integral, we have:

Step 3: Partial fraction decomposition

We can decompose the fraction using partial fractions:

If , then , so .

If , then , so and .

Therefore, .

Step 4: Integrate

Step 5: Substitute back

Therefore, the integral of is .

ANSWER

(1)/(n)\log\left|(x^n)/(x^n+1)\right|+C

Question 17

QUESTION

Integrate (\cos x)/((1-\sin x)(2-\sin x)).

Hint: Put \sin x=t.

SOLUTION

This question requires us to integrate a trigonometric function. The given hint suggests a substitution to simplify the integral.

Step 1: Substitution

Let . Then, differentiating both sides with respect to , we get:

Step 2: Rewrite the integral

Substituting and into the original integral, we have:

Step 3: Partial Fraction Decomposition

We decompose the fraction into partial fractions. Let:

Multiplying both sides by , we get:

To find , let :

To find , let :

Thus, we have:

Step 4: Integrate

Now, we integrate the decomposed fractions:

Step 5: Substitute back

Substitute back into the expression:

Final Answer:

ANSWER

\log\left|(2-\sin x)/(1-\sin x)\right|+C

Question 18

QUESTION

Integrate the rational function ((x^2+1)(x^2+2))/((x^2+3)(x^2+4)).

SOLUTION

This question requires us to integrate a rational function. The key is to simplify the integrand using algebraic manipulation and partial fractions before applying standard integration formulas.

Step 1: Simplify the integrand

We can rewrite the integrand as follows:

Now, perform long division (or add and subtract terms) to get:

Step 2: Partial fraction decomposition

Decompose the fractional part into partial fractions:

Multiplying both sides by , we get:

Comparing coefficients, we have:

and . Solving this system of equations gives and .

So,

Step 3: Integrate

Now, we can rewrite the original integral as:

Using the formula , we get:

Final Answer:

ANSWER

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

Question 19

QUESTION

Integrate the rational function (2x)/((x^2+1)(x^2+3)).

SOLUTION

We are asked to integrate the rational function . This problem involves integration using partial fractions, with a substitution to simplify the process.

Step 1: Substitution

Let . Then, , which implies . This substitution simplifies the integral.

Step 2: Rewrite the integral

Using the substitution, the integral becomes:

Step 3: Partial fraction decomposition

We decompose the rational function into partial fractions:

Multiplying both sides by , we get:

Step 4: Solve for A and B

To find , let :

To find , let :

Step 5: Rewrite the integral with partial fractions

Now we have:

Step 6: Integrate

Integrating each term, we get:

Step 7: Simplify using logarithm properties

Using the property , we have:

Step 8: Substitute back for

Substituting back into the expression, we get:

Since and are always positive, we can drop the absolute value signs.

Final Answer:

ANSWER

(1)/(2)\log\left((x^2+1)/(x^2+3)\right)+C

Question 20

QUESTION

Integrate the rational function (1)/(x(x^4-1)).

SOLUTION

We need to integrate the rational function . This requires partial fraction decomposition and knowledge of logarithmic integrals.

Step 1: Manipulate the integrand

Multiply and divide by to get:

Step 2: Substitute

Let . Then, , so . Substituting, we get:

Step 3: Partial fraction decomposition

We can write as . Multiplying by , we get:

If , then , so .

If , then , so .

Thus, .

Step 4: Integrate

Step 5: Substitute back

Final Answer:

ANSWER

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

Question 21

QUESTION

Integrate (1)/(e^x-1).

Hint: Put e^x=t.

SOLUTION

We need to integrate the function with respect to .

Step 1: Substitution

As suggested by the hint, let's substitute . Then, differentiating both sides with respect to , we get:

, which implies .

Step 2: Rewrite the integral

Substituting and into the integral, we get:

Step 3: Partial Fraction Decomposition

We can decompose the fraction into partial fractions. We want to find constants and such that:

Multiplying both sides by , we get:

If , then , so .

If , then , so .

Thus, .

Step 4: Integrate the Partial Fractions

Now we can rewrite the integral as:

Step 5: Substitute back

Substitute back into the expression:

Final Answer:

ANSWER

\log\left((e^x-1)/(e^x)\right)+C

Question 22

QUESTION

Choose the correct answer:

\displaystyle \int (x\,dx)/((x-1)(x-2)) equals

(A) \log\left|((x-1)^2)/(x-2)\right|+C

(B) \log\left|((x-2)^2)/(x-1)\right|+C

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

(D) \log|(x-1)(x-2)|+C

SOLUTION

We need to evaluate the integral and choose the correct option.

Step 1: Partial Fraction Decomposition

We decompose the integrand into partial fractions. Let Multiplying both sides by , we get

Step 2: Solving for A and B

To find , let : To find , let : So, we have

Step 3: Integrating

Now we integrate:

Step 4: Simplifying the Result

Using logarithm properties:

Final Answer:

The correct answer is (B)

Option A is incorrect because the powers are inverted. Option C is incorrect as it squares the entire fraction, not just the numerator. Option D is incorrect because it adds the logarithms instead of having the correct squared term.

ANSWER

B

Question 23

QUESTION

Choose the correct answer:

\displaystyle \int (dx)/(x(x^2+1)) equals

(A) \log|x|-(1)/(2)\log(x^2+1)+C

(B) \log|x|+(1)/(2)\log(x^2+1)+C

(C) -\log|x|+(1)/(2)\log(x^2+1)+C

(D) (1)/(2)\log|x|+\log(x^2+1)+C

SOLUTION

We need to evaluate the integral and choose the correct answer from the given options. This problem tests our ability to use partial fraction decomposition to solve integrals.

Step 1: Partial Fraction Decomposition

We decompose the integrand into partial fractions:

Multiplying both sides by , we get:

Step 2: Solve for A, B, and C

Comparing coefficients, we have:

, ,

Since and , we get .

Thus, , , and .

Step 3: Rewrite the integral

Now we can rewrite the integral as:

Step 4: Evaluate the integrals

The first integral is straightforward:

For the second integral, we use substitution. Let , then , so .

Step 5: Combine the results

Combining the two integrals, we get:

, where .

Therefore, the correct answer is (A) .

> **ANSWER**
>
> A

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Key Formulas

Important Formulas for Exercise 7.5

Formula / Concept	Description
Rational Function	A function of the form $(P(x))/(Q(x))$, where P(x) and Q(x) are polynomials and $Q(x) \neq 0$.
Proper Rational Function	A rational function where the degree of the numerator is less than the degree of the denominator.
Improper Rational Function	A rational function where the degree of the numerator is greater than or equal to the degree of the denominator. It can be reduced to a proper rational function by long division.
Partial Fraction Decomposition	The process of expressing a complex rational function as a sum of simpler fractions, which makes integration easier.
Forms of Partial Fractions	
$(px+q)/((x-a)(x-b))$	$(A)/(x-a) + (B)/(x-b)$, where $a \neq b$.
$(px+q)/((x-a)^2)$	$(A)/(x-a) + (B)/((x-a)^2)$
$(px^2+qx+r)/((x-a)(x-b)(x-c))$	$(A)/(x-a) + (B)/(x-b) + (C)/(x-c)$
$(px^2+qx+r)/((x-a)^2(x-b))$	$(A)/(x-a) + (B)/((x-a)^2) + (C)/(x-b)$
	$(A)/(x-a) + (Bx+C)/(x^2+bx+c)$, where x^2+bx+c cannot be factorized further.

Formula / Concept	Description
(px^2+qx+r)/((x-a)(x^2+bx+c))	
Fundamental Theorem of Calculus	
First Fundamental Theorem	If f is a continuous function on [a, b] and A(x) is the area function, then A'(x) = f(x) for all x \in [a, b]. It connects differentiation and integration as inverse operations.
Second Fundamental Theorem	If f is a continuous function on [a, b] and F is an antiderivative of f, then \int_a^b f(x) dx = F(b) - F(a). This theorem provides a method to evaluate definite integrals.

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