NCERT Solutions Class 12 Maths
Chapter 7: Integrals
Exercise 7.6

Document Information:
Class: 12 | **Subject:** Mathematics | **Chapter:** 7 | **Exercise:** 7.6
Total Questions: 24 | **Academic Year:** 2025-26
Source: www.ncertbooks.net | **Generated:** February 21, 2026

Quick Summary: In NCERT Solutions Class 12 Maths Chapter 7 Exercise 7.6, students learn to integrate special functions using advanced integration techniques, particularly integration by parts. This exercise covers integrals involving products of algebraic and transcendental functions like $x \sin x$, $x^2 e^x$, and $x \log x$, which are essential for CBSE Board exams and competitive tests like JEE.

Key Takeaways:

- Master integration by parts formula: $\int u \, dv = uv - \int v \, du$ for products of functions
- Apply the ILATE rule (Inverse, Logarithmic, Algebraic, Trigonometric, Exponential) to choose u and dv correctly
- Solve integrals of the form $\int x \sin(ax) \, dx$ and $\int x^n e^x \, dx$ using systematic substitution
- Handle logarithmic integrals like $\int x \log x \, dx$ by treating $\log x$ as the first function

Complete Solutions

Question 1

QUESTION

Find the integral of x\sin x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Recall the integration by parts formula

The integration by parts formula is:

Step 2: Choose and

We choose and . The goal is to pick such that its derivative is simpler, and we can easily integrate .

Step 3: Find and

Differentiating , we get .

Integrating , we get .

Step 4: Apply the integration by parts formula

Substituting into the formula:

Step 5: Simplify

Step 6: Integrate the remaining term

We know that , where is the constant of integration.

Step 7: Write the final answer

Therefore,

Final Answer:

ANSWER

-x\cos x+\sin x+C

Question 2

QUESTION

Find the integral of x\sin 3x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Recall the integration by parts formula

The integration by parts formula is given by:

Step 2: Choose and

We choose and . This is because the derivative of is simpler than , which helps in simplifying the integral.

Step 3: Find and

If , then .

If , then we integrate to find :

Step 4: Apply the integration by parts formula

Now we substitute , , , and into the integration by parts formula:

Step 5: Simplify and integrate the remaining integral

The integral of is , so:

Step 6: Final simplification

Final Answer:

ANSWER

-(x)/(3)\cos 3x+(1)/(9)\sin 3x+C

Question 3

QUESTION

Find the integral of x^2 e^x.

SOLUTION

We need to find the integral of . This requires integration by parts, which states that .

Step 1: Choose and

Let and . The goal is to choose such that its derivative becomes simpler.

Step 2: Find and

Differentiating , we get . Integrating , we get .

Step 3: Apply integration by parts

Using the integration by parts formula, we have:

Step 4: Apply integration by parts again

Now we need to integrate . Let and . Then and . Applying integration by parts again:

Step 5: Substitute back into the original integral

Substituting this result back into the original equation:

Step 6: Simplify

We can factor out from the expression:

Final Answer:

ANSWER

e^x(x^2-2x+2)+C

Question 4

QUESTION

Find the integral of x\log x.

SOLUTION

This question requires us to find the indefinite integral of the function . We will use integration by parts to solve this problem.

Step 1: Recall the Integration by Parts Formula

Integration by parts states that:

where and are functions of .

Step 2: Choose and

We need to choose appropriate functions for and . A helpful guideline is "LIATE" (Logarithmic, Inverse trigonometric, Algebraic, Trigonometric, Exponential). In our case, we have a logarithmic function () and an algebraic function (). Logarithmic comes before algebraic, so we choose:

and

Step 3: Find and

Differentiate to find :

Integrate to find :

Step 4: Apply the Integration by Parts Formula

Substitute , , , and into the integration by parts formula:

Step 5: Simplify and Integrate

Simplify the integral:

Integrate the remaining term:

Step 6: Write the Final Answer

Substitute this back into the equation and add the constant of integration, :

Final Answer:

ANSWER

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

Question 5

QUESTION

Find the integral of x\log 2x.

SOLUTION

This question requires us to find the indefinite integral of the function . We will use integration by parts to solve this.

Step 1: Recall the Integration by Parts Formula

Integration by parts states that:

We need to choose suitable functions for and .

Step 2: Choose and

Let and . This choice is guided by the fact that the derivative of is simpler than , and the integral of is straightforward.

Step 3: Find and

Differentiating with respect to , we get:

Integrating with respect to , we get:

Step 4: Apply the Integration by Parts Formula

Substituting , , , and into the integration by parts formula:

Step 5: Simplify the Integral

Step 6: Evaluate the Remaining Integral

So, we have:

Step 7: Final Answer

ANSWER

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

Question 6

QUESTION

Find the integral of x^2\log x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Recall the integration by parts formula

The integration by parts formula is:

Step 2: Choose and

We choose and . This is because the derivative of is simpler than itself, and we can easily integrate .

Step 3: Find and

If , then .

If , then .

Step 4: Apply the integration by parts formula

Simplifying:

Step 5: Evaluate the remaining integral

Step 6: Substitute back into the equation

Final Answer:

ANSWER

(x^3)/(3)\log x-(x^3)/(9)+C

Question 7

QUESTION

Find the integral of x\sin^-1x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Identify and

We will use integration by parts, which states: . Let's choose and . The choice of is guided by the fact that its derivative is simpler than itself.

Step 2: Find and

If , then .

If , then .

Step 3: Apply integration by parts formula

Step 4: Evaluate the remaining integral

Let . To solve this, we use the trigonometric substitution , so .

Then, .

Using the identity , we have:

Since , and . Therefore,

Step 5: Substitute back into the original integral

Final Answer:

ANSWER

(1)/(4)(2x^2-1)\sin^-1x+x√1-x^24+C

Question 8

QUESTION

Find the integral of x\tan^-1x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Identify the parts for integration by parts

Integration by parts formula is: . We need to choose and .

Let and . This choice is guided by the fact that the derivative of is simpler than itself, making the subsequent integration easier.

Step 2: Find and

If , then .

If , then .

Step 3: Apply the integration by parts formula

Step 4: Simplify the remaining integral

We can rewrite as .

So, .

Step 5: Substitute back into the main equation

Final Answer:

ANSWER

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

Question 9

QUESTION

Find the integral of x\cos^-1x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Identify and

We use the ILATE rule (Inverse, Logarithmic, Algebraic, Trigonometric, Exponential) to decide which function to take as . Here, is an inverse trigonometric function and is an algebraic function. So, we choose:

and

Step 2: Find and

Differentiate to find :

Integrate to find :

Step 3: Apply integration by parts formula

The integration by parts formula is:

Substituting the values we found:

Step 4: Evaluate the remaining integral

Let , then . Also, .

Using the identity :

Substituting back , we have and .

So,

Step 5: Substitute back into the original integral

Since ,

Final Answer:

ANSWER

(2x^2-1)\cos^-1x4-(x)/(4)√1-x^2+C

Question 10

QUESTION

Find the integral of (\sin^-1x)^2.

SOLUTION

We need to find the integral of . This requires integration by parts, possibly multiple times.

Step 1: Initial setup using integration by parts

Let . We'll use integration by parts, with and . Then and . The integration by parts formula is .

Applying this, we get:

Step 2: Second integration by parts

Now, let's focus on the integral . We'll use integration by parts again. Let and . Then . To find , we integrate :

. Let , so , and . Then .

So, .

Applying integration by parts:

Step 3: Substitute back into the original integral

Substitute this back into the expression for :

Final Answer:

ANSWER

x(\sin^-1x)^2+2√1-x^2\sin^-1x-2x+C

Question 11

QUESTION

Find the integral of x\cos^-1x√1-x^2.

SOLUTION

We need to find the integral of . This problem involves integration by parts and substitution.

Step 1: Substitution

Let . Then, . Differentiating with respect to , we get:

, which implies .

Also, .

Step 2: Rewrite the integral

Substituting these into the integral, we have:

Step 3: Integration by parts

Now we use integration by parts. Recall that . Let and . Then, and .

So, .

Step 4: Substitute back

Therefore, .

Now we substitute back . Then and .

So, the integral becomes:

.

Final Answer:

The integral of is .

ANSWER

-√1-x^2\cos^-1x+x+C

Question 12

QUESTION

Find the integral of x\sec^2 x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Recall the integration by parts formula

The integration by parts formula is:

Step 2: Choose and

We choose and . This is because the derivative of is simpler, and we know the integral of .

Step 3: Find and

If , then .

If , then .

Step 4: Apply the integration by parts formula

Step 5: Evaluate the remaining integral

We know that , where is a constant of integration.

Therefore,

Simplifying, we get:

Final Answer:

ANSWER

x\tan x+\log|\cos x|+C

Question 13

QUESTION

Find the integral of \tan^-1x.

SOLUTION

We need to find the integral of the inverse tangent function, . This requires integration by parts.

Step 1: Set up integration by parts

Recall the integration by parts formula: . We choose and . This implies and .

Step 2: Apply the integration by parts formula

Using the formula, we have:

Step 3: Evaluate the remaining integral

Now we need to evaluate . We can use a substitution. Let . Then , so . Thus,

Note that we can drop the absolute value signs since is always positive.

Step 4: Combine the results

Substituting this back into our integration by parts equation, we get:

Final Answer:

The integral of is .

ANSWER

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

Question 14

QUESTION

Find the integral of x(\log x)^2.

SOLUTION

We need to find the integral of . This requires integration by parts, possibly multiple times.

Step 1: Identify the parts for integration by parts

We will use integration by parts, which states: . Let's choose and .

Step 2: Calculate and

If , then .

If , then .

Step 3: Apply integration by parts

Step 4: Integrate using integration by parts again

Let and . Then and .

Step 5: Substitute back into the original integral

Final Answer:

ANSWER

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

Question 15

QUESTION

Find the integral of (x^2+1)\log x.

SOLUTION

We need to find the integral of . This requires integration by parts.

Step 1: Identify the parts for integration by parts

We will use integration by parts, which states: . Let's choose and . This is a good choice because differentiating simplifies the expression.

Step 2: Calculate and

If , then .

If , then we integrate to find :

Step 3: Apply integration by parts formula

Now we plug , , , and into the integration by parts formula:

Step 4: Simplify the integral

Simplify the integral on the right side:

Step 5: Evaluate the remaining integral

Now we integrate the simplified expression:

Step 6: Combine the results

Substitute this back into the integration by parts equation:

Final Answer:

ANSWER

\left((x^3)/(3)+x\right)\log x-(x^3)/(9)-x+C

Question 16

QUESTION

Find the integral of e^x(\sin x+\cos x).

SOLUTION

We are asked to find the integral of the function . This problem utilizes the concept of integration by parts and recognizing specific patterns in integrals.

Step 1: Recognize the pattern

Notice that the integral has the form . The derivative of is . This suggests we can directly apply a known integration rule.

Step 2: Apply the integration rule

The integral of the form is equal to , where is the constant of integration.

Step 3: Identify and

In our case, and . Therefore, we have:

Step 4: Apply the formula

Using the formula , we get:

Final Answer:

The integral of is .

Conclusion:

The key to solving this integral is recognizing the pattern , which allows for a direct application of the integration rule. Without recognizing this pattern, one might attempt integration by parts, which would lead to a more complex solution but ultimately the same result.

ANSWER

e^x\sin x+C

Question 17

QUESTION

Find the integral of (x e^x)/((1+x)^2).

SOLUTION

We need to find the integral of the function . This problem requires us to manipulate the integrand to a form that is easily integrable.

Step 1: Rewrite the numerator

We can rewrite the numerator as . This allows us to split the fraction:

Step 2: Split the integral

Now, split the integral into two parts:

Step 3: Focus on the first integral

Let's focus on the first integral, . We will try to manipulate it so that when we subtract the second integral, we can simplify the expression.

Step 4: Integration by parts

Consider the first integral . We can rewrite it and apply integration by parts. Let and . Then, and .

Using integration by parts formula, , we get:

Step 5: Substitute back into the original expression

Now, substitute this back into our original expression:

Step 6: Simplify

Notice that the integral terms cancel each other out:

Final Answer:

ANSWER

(e^x)/(1+x)+C

Question 18

QUESTION

Find the integral of e^x\left((1+\sin x)/(1+\cos x)\right).

SOLUTION

We need to find the integral of .

Step 1: Simplify the expression inside the integral

We can use trigonometric identities to simplify the expression . Recall the following identities:

Therefore,

Substituting these into the expression, we get:

Step 2: Rewrite the integral

Now, the integral becomes:

Step 3: Recognize the form of the integral

Notice that the integral is in the form , where . The derivative of is:

The integral of this form is given by:

Step 4: Apply the formula

In our case, , so the integral is:

Final Answer:

ANSWER

e^x\tan(x)/(2)+C

Question 19

QUESTION

Find the integral of e^x\left((1)/(x)-(1)/(x^2)\right).

SOLUTION

We are asked to find the integral of the function .

Step 1: Recognize the form of the integral

The given integral is of the form , where . We need to verify that is indeed the derivative of .

Step 2: Verify the derivative

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

Thus, we have the integral in the form .

Step 3: Apply the standard integral formula

The integral of the form is equal to , where is the constant of integration. This is a standard result derived from integration by parts.

Step 4: Apply the formula to the given integral

In our case, , so the integral becomes:

Step 5: Simplify the result

The integral simplifies to:

Final Answer:

ANSWER

(e^x)/(x)+C

Question 20

QUESTION

Find the integral of ((x-3)e^x)/((x-1)^3).

SOLUTION

We need to find the integral of . This problem requires us to manipulate the integrand to a form that is easily integrable, often involving integration by parts or recognizing a derivative pattern.

Step 1: Rewrite the numerator

We can rewrite the numerator as . This allows us to split the fraction:

Step 2: Manipulate the first term

We want to express the integrand in the form so that the integral is simply . To do this, we rewrite the first term:

Now, we need to find the derivative of . The derivative is:

Step 3: Rewrite the integral

Now we can rewrite the original integral as:

Since we have the form , where and , the integral is simply .

Step 4: Write the final answer

Therefore, the integral is:

ANSWER

(e^x)/((x-1)^2)+C

Question 21

QUESTION

Find the integral of e^2x\sin x.

SOLUTION

We need to find the integral of . This requires integration by parts, which may need to be applied twice.

Step 1: Apply integration by parts once

Let . We will use integration by parts: .

Let and . Then and .

So, .

Step 2: Apply integration by parts again

Now we need to integrate . Again, we use integration by parts.

Let and . Then and .

So, .

Step 3: Substitute back into the original integral

Substituting this back into our expression for , we get:

Step 4: Solve for I

Now, we solve for :

Final Answer:

The integral of is .

ANSWER

e^2x5(2\sin x-\cos x)+C

Question 22

QUESTION

Find the integral of \sin^-1\left((2x)/(1+x^2)\right).

SOLUTION

We are asked to find the integral of the inverse trigonometric function .

Step 1: Simplify the integrand using a trigonometric substitution

Let's substitute . Then, and .

Now, we have:

So,

Step 2: Rewrite the integral with the substitution

Our integral becomes:

Step 3: Integrate by parts

We will use integration by parts, where .

Let and . Then, and .

So, we have:

Step 4: Evaluate the remaining integral

We know that .

Therefore:

Step 5: Substitute back to the original variable

Since , we have .

Also, .

Substituting back, we get:

Final Answer:

ANSWER

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

Question 23

QUESTION

\displaystyle \int x^2 e^x^3\,dx equals

SOLUTION

We are asked to evaluate the indefinite integral . This question tests our knowledge of integration by substitution.

Step 1: Identify a suitable substitution

Notice that the derivative of is , which is a multiple of , a term present in the integrand. This suggests the substitution .

Step 2: Perform the substitution

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

Rearranging, we have:

Or:

Step 3: Rewrite the integral in terms of

Substituting and into the original integral, we get:

Step 4: Evaluate the integral with respect to

The integral of with respect to is simply . Therefore:

, where is the constant of integration.

Step 5: Substitute back to express the result in terms of

Since , we substitute back to get the final answer in terms of :

Final Answer:

Therefore, the correct option is .

The other options are incorrect because they result from either incorrect substitution or incorrect integration.

ANSWER

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Question 24

QUESTION

\displaystyle \int e^x\sec x(1+\tan x)\,dx equals

SOLUTION

We are asked to evaluate the indefinite integral and choose the correct option.

Step 1: Simplify the integrand

First, distribute inside the parenthesis:

So, the integral becomes:

Step 2: Recognize the form of the integral

Notice that this integral is in the form , where and .

Recall that the derivative of is . That is, .

Step 3: Apply the integration rule

The integral of the form is equal to .

Therefore, .

Step 4: State the final answer

The integral equals .

Therefore, the correct option is .

Why other options are incorrect:

is incorrect because the derivative of is not .

is incorrect because the derivative of is not .

is incorrect because the derivative of is not .

ANSWER

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Key Formulas

Important Formulas for Exercise 7.6

Formula / Concept	Description
Integration by Parts	A method used to find the integral of a product of two functions.
$\int u \cdot v \,dx = u \int v \,dx - \int \left(\frac{du}{dx} \int v \,dx \right) dx$	This is the primary formula for integration by parts, where u is the first function and v is the second function.
ILATE / LIATE Rule	A rule of thumb to determine which function to choose as the first function (u). The order of preference is: Inverse trigonometric, Logarithmic, Algebraic, Trigonometric, Exponential.
$\int e^x [f(x) + f'(x)] \,dx = e^x f(x) + C$	A special and useful form of integration by parts.
Fundamental Theorem of Calculus	This theorem connects the concepts of differentiation and integration.
If f is continuous on [a, b] and F is an antiderivative of f, then $\int_a^b f(x) \,dx = F(b) - F(a)$	This is the second part of the Fundamental Theorem of Calculus, used to evaluate definite integrals.
Standard Integration Formulas	These are prerequisite formulas often used within the integration by parts method.
$\int x^n \,dx = x^n+1n+1 + C, \quad n \neq -1$	Power rule for integration.
$\int \frac{1}{x} \,dx = \ln\vert x\vert + C$	Integral of the reciprocal function.
$\int e^x \,dx = e^x + C$	Integral of the natural exponential function.
$\int a^x \,dx = \frac{a^x}{\ln a} + C$	Integral of an exponential function with base a.
$\int \sin x \,dx = -\cos x + C$	Integral of the sine function.
$\int \cos x \,dx = \sin x + C$	Integral of the cosine function.
$\int \sec^2 x \,dx = \tan x + C$	Integral of secant squared.

Formula / Concept	Description
\int \csc^2 x \,dx = -\cot x + C	Integral of cosecant squared.
\int \sec x \tan x \,dx = \sec x + C	Integral of secant times tangent.
\int \csc x \cot x \,dx = -\csc x + C	Integral of cosecant times cotangent.
\int (1)/(√a^2 - x^2) \,dx = \sin^-1\left((x)/(a)\right) + C	Integral leading to the inverse sine function.
\int (1)/(a^2 + x^2) \,dx = (1)/(a) \tan^-1\left((x)/(a)\right) + C	Integral leading to the inverse tangent function.
\int (1)/(x√x^2 - a^2) \,dx = (1)/(a) \sec^-1\left((x)/(a)\right) + C	Integral leading to the inverse secant function.

More Exercises

Visit all exercises from Chapter 7:

Exercise 7.1 →

Exercise 7.2 →

Exercise 7.3 →

Exercise 7.4 →

Exercise 7.5 →

Exercise 7.6 ✓ →

Exercise 7.7 →

Exercise 7.8 →

Exercise 7.9 →

Exercise 7.10 →

Exercise 7. Miscellaneous →

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