

TOPIC: INTEGRALS OF EXPONENTIAL FUNCTIONS

Integrals of General Exponential Functions

◆ Recall: To find the *derivative* of a general exponential function b^x , multiply b^x by $\ln b$.

► To find the *integral* of a general exponential function b^x , _____ b^x by $\ln b$.

Recall	Rule for <i>Derivative</i> of b^x	New	Rule for <i>Integral</i> of b^x
$\frac{d}{dx}(b^x) = b^x \cdot \ln b$	$\frac{d}{dx}(7^x) = 7^x \cdot \ln 7$	$\int b^x dx = \text{_____} + C$ $b > 0$ $b \neq 1$	$\int 7^x dx =$

EXAMPLE

Evaluate the indefinite integral.

$$\int \left(3\left(\frac{1}{2}\right)^x + 8^x \right) dx$$

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PRACTICE

Evaluate the indefinite integrals.

Recall

$$\int b^x dx = \frac{b^x}{\ln b} + C$$

(A) $\int -(6)^x dx$

(B) $\int 3x^4 - (5)^x dx$

(C) $\int 2\left(\frac{1}{3}\right)^x dx$

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EXAMPLE

Evaluate the integrals using substitution.

(A) $\int 4^{7x} dx$

New

$$\int b^u du = \frac{b^u}{\ln b} + C$$

(B) $\int 5^{\cos \theta} \sin \theta d\theta$

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PRACTICE

Evaluate the definite integral.

$$\int_0^5 \frac{3^{\sqrt{x+4}}}{\sqrt{x+4}} dx$$

Recall

$$\int b^u du = \frac{b^u}{\ln b} + C$$

PRACTICE

Find the area under the graph of $f(x) = 3^{2x}$ between $x = 0$ and $x = 2$.

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Integrals of Natural Exponential Functions (e^x)

- ◆ Recall: $y = e^x$ is just a special case of $y = b^x$ where $b = e$.
- We can use the integral rule for general exponential functions to find the integral of e^x .

RULES OF INTEGRATION		
Name	Rule	Example
<i>General Exponential</i>	$\int b^x dx = \frac{b^x}{\ln b} + C$ $b > 0$ $b \neq 1$	$\int 7^x dx = \frac{7^x}{\ln 7} + C$
<i>Natural Exponential</i>	$\int e^x dx = \text{_____} + C = \text{_____} + C$	$\int 5e^x dx =$

EXAMPLE

Find the indefinite integral.

$$\int (3x^4 - \pi e^x + 2) dx$$

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PRACTICE

Evaluate the indefinite integrals.

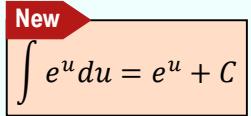
$$(A) \int (\sqrt{x} - e^x) dx$$

$$(B) \int \left(4e^x + \frac{1}{x^3}\right) dx$$

EXAMPLE

Evaluate the indefinite integral.

$$\int x^2 e^{x^3} dx$$

New 

$$\int e^u du = e^u + C$$

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PRACTICE

Evaluate the indefinite integrals.

(A) $\int \frac{e^{2\sqrt{x}}}{\sqrt{x}} dx$

(B) $\int e^{\sec \theta} \sec \theta \tan \theta d\theta$

Recall $\int e^u du = e^u + C$

EXAMPLE

Evaluate the integrals using substitution.

(A) $\int \frac{e^t + e^{4t}}{e^{2t}} dt$

(B) $\int 3e^{3x}(1 + e^{3x})^5 dx$

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PRACTICE

Find the definite integral.

$$\int_{-1}^1 x^2 e^{x^3} dx$$

PRACTICE

Find the area of $f(x) = 3 + e^{2x}$ from $x = 0$ to $x = 2$.