

5.4 Exponential: Differentiation and Integration

- ★ Develop properties of the natural exponential function
- ★ Differentiate natural exponential functions
- ★ Integrate natural exponential functions

Definition of the Natural Exponential

$f(x) = \ln x$ the inverse is $f^{-1}(x) = e^x$

$$\ln e^x = x \qquad e^{\ln x} = x$$

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Ex 2

$$\ln(2x-3) = 5$$

$$e^{\ln(2x-3)} = e^5$$

$$2x-3 = e^5$$

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Properties

1. The domain if $f(x) = e^x$ is $(-\infty, \infty)$, and the range is $(0, \infty)$.
2. The function $f(x) = e^x$ is continuous, increasing, and one-to-one over its entire domain
3. The graph of $f(x) = e^x$ is concave upward on its entire domain.

$$4. \lim_{x \rightarrow -\infty} e^x = 0 \quad \lim_{x \rightarrow \infty} e^x = \infty$$



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Integrals

$$\textcircled{1} \int e^x dx = e^x + c \quad \textcircled{2} \int e^u du = e^u + c$$

$$\boxed{\text{Ex 1}} \int e^{3x+1} dx$$

$$\boxed{\text{Ex 2}} \int 5xe^{-x^2} dx$$

$$u = 3x + 1 \\ du = 3dx$$

$$\frac{1}{3} \int e^u du$$

$$\frac{1}{3} e^u + C$$

$$\frac{1}{3} e^{3x+1} + C$$

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$$\text{Ex 3)} \int \frac{e^{1/x}}{x^2} dx$$

$$u = \frac{1}{x}$$

$$du = -\frac{1}{x^2}$$

$$-\int e^u du$$

$$-e^{1/x} + C$$

$$\text{Ex 4)} \int \sin x e^{\cos x} dx$$

Pg 357

85-105
every other
odd

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