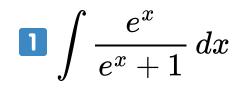
# What methods can be used to differentiate and integrate exponential functions with bases other than *e*?

# **Quick Check**

Without integrating, state the integration formula/ steps that you would take to integrate each of the following.



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

#### Exponential functions to Base a

If a is a positive real number ( $a \neq 1$ ) and x is any real number, then the exponential function to the base a is denoted  $a^x$  and is defined by

 $a^x = e^{(\ln a) \cdot x}$ 

If a = 1, then  $= 1^x$  is a constant function.

Some familiar properties:

1. 
$$a^0 = 1$$
  
2.  $a^x a^y = a^{x+y}$ 

3. 
$$\frac{a^x}{a^y} = a^{x-y}$$
  
4.  $(a^x)^y = a^{xy}$ 

# **Evaluating Logarithms**

$$a^x = y \iff \log_a y = x$$



**2**  $\log_2 32$ 

 $3 \log_{10} .1$ 

 $\log_{16} 4$ 

#### Logarithm function to Base a

If a is a positive real number ( $a \neq 1$ ) and x is any real number, then the logarithmic function to the base a is denoted  $\log_a x$  and is defined by

$$\log_a x = rac{1}{\ln a} \ln x$$

Some familiar properties:

1. 
$$\log_a 1 = 0$$
3.  $\log_a x^n = n \log_a x$ 2.  $\log_a xy = \log_a x + \log_a y$ 4.  $\log_a \frac{x}{y} = \log_a x - \log_a y$ 

## **Quick Review**

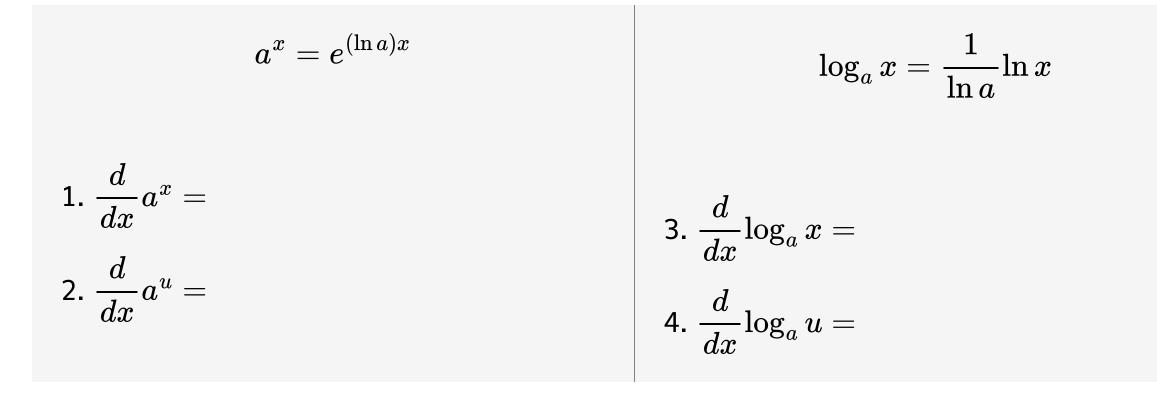
 $3^x = \frac{1}{81}$ 

**2**  $\log_2 x = -4$ 

 $\boxed{3} \log_2{(x-1)} = 5$ 

#### **Derivatives of Exponential and Logarithmic Fuctions**

Let a be a real number ( $a \neq 1$ ) and u be a differentiable function of x.



### Practice

Differentiate each function.

Example	Practice
1. $y=2^x$	l $f(x)=4^x$
2. $y=2^{x^2+3x}$	2 $g(t)=t^22^t$
3. $y=\log_{10}\cos x$	${f 3}\;f(x)=\log_2{x^2\over x-x}$
4. $y=x^{2/x}$	$\mathcal{L} = \mathcal{L} = \mathcal{L}$

 $\mathbf{2}$ -1 $4 f(x) = (\ln x)^{\cos x}$ 

**!** careful!

$$5 y = e^e$$

$$b y = e^x$$

7  $y = x^e$ 8  $y = x^x$ 

# Integrating Exponential Functions to another base

$$a^x = e^{(\ln a)x}$$
 $\downarrow$ 
 $\int a^x \, dx =$ 

Example:

$$\int 2^x dx =$$

primethinker.com

#### Practice

 $\Box \int 5^{-x} dx$ **2**  $\int (3-x)7^{(3-x)^2} dx$  $3\int 2^{\sin x} \cdot \cos x \, dx$  $\int_{1}^{e} 6^{x} - 2^{x} dx$