AB Calculus
4.4 Derivatives of Exponential
and Logarithms

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(a^x) = a^x \cdot \ln a$$

$$\frac{d}{dx}(\ln x) = \frac{1}{x}, \qquad x > 0$$

$$\frac{d}{dx}(\ln|x|) = \frac{1}{x}, \qquad x \neq 0$$

$$\frac{d}{dx}(\log_a x) = \frac{1}{x \cdot \ln a}, \qquad x > 0$$

Examples:

1. Find y' if:

   a. $y = e^{2x}$

   b. $y = x^2e^x - xe^x$

   c. $y = 9^{-x}$

   d. $y = (\ln x)^2$

   e. $y = \frac{1}{\log_2 x}$

f. $y = \log_3(1 + x\ln 3)$

g. $y = x^{1+\sqrt{2}}$

2. Find $\frac{dy}{dx}$ if $y = e^{(x+x^2)}$

3. At what point on the graph of the function $y = 2^t - 3$ does the tangent line have slope 21?

4. Find the derivative of the following:

   a. $y = x^{\sqrt{2}}$

   b. $y = (2 + \sin 3x)^{\pi}$

4. Find y' of $y = x^x$

5. Find $\frac{dy}{dx}$ of $y = x^{\sin(2x)}$

1. The spread of a flu in a certain school is modeled by

$$P(t) = \frac{100}{1+e^{3-t}}$$

where $P(t)$ is the total number of students infected t days after the flu was first noticed. Many of them may already be well again at time t.

   a. Estimate the initial number of students infected by the flu.
   b. How fast is the flu spreading after 3 days?
   c. When will the flu spread at its maximum rate? What is this rate?