

### Worksheet #13: Derivatives of Logarithmic Functions

#### Generalized Derivative Formulas:

$$\frac{d}{dx}[\ln(x)] = \frac{1}{x}$$

$$\frac{d}{dx}[\ln(u)] = \frac{1}{u} \frac{du}{dx}$$

$$\frac{d}{dx}[\log_b(u)] = \frac{1}{u \ln(b)} \frac{du}{dx}$$

Find  $\frac{dy}{dx}$  for the following:

1. a)  $y = \ln(6x^3 + 1)$       b)  $y = \log_5(\sin(2x) + \cot(x))$       c)  $y = \ln(\ln(x))$

2. Find  $\frac{dy}{dx}$  for the following: (Hint: Rewrite the functions first to make the differentiation easier.)

a)  $y = \ln((x+1)(2x-1))$       b)  $y = \ln(x^3 \sin^2 x)$       c)  $y = \ln\left(\frac{x \cos x}{(x-3)(5x+1)}\right)$

3. Find  $\frac{dy}{dx}$  by using logarithmic differentiation:

a)  $y = \frac{\sqrt[3]{(x^2 - 6)} \sqrt{\csc(x)}}{x^6 - 5x + 3}$

b)  $y = \frac{e^{\cos(x)} \sqrt{\sin(x)}}{\sqrt[3]{x^4 + 3x^3}}$

4. Find  $\frac{dy}{dx}$  by logarithmic differentiation for the following:

4.  $y = (\ln(x))^{\sin(x)}$

5.  $y = (\tan(x))^{x^2}$