# 1 Exponentials

| | **General Base** $a > 0$ | **Special Case: Base** $e = 2.71828\cdots$ |
|---|---|---|
| **Laws:** | $a^b a^c = a^{b+c}$ | $e^b e^c = e^{b+c}$ |
| | $\dfrac{a^b}{a^c} = a^{b-c}$ | $\dfrac{e^b}{e^c} = e^{b-c}$ |
| | $(a^b)^c = a^{bc}$ | $(e^b)^c = e^{bc}$ |
| **Derivative:** | $\dfrac{d}{dx}[a^x] = a^x \ln(a)$ | $\dfrac{d}{dx}[e^x] = e^x$ |

# 2 Logarithms

**Definiton:** $\log_a(b)$ is the power to which $a$ is raised to give $b$.

**Definiton:** $\ln(b) = \log_e(b)$, the power to which $e$ is raised to give $b$.

| | **General Base** $a > 0$ | **Special Case: Base** $e = 2.71828\cdots$ |
|---|---|---|
| **Laws:** | $\log_a(bc) = \log_a(b) + \log_a(c)$ | $\ln(bc) = \ln(b) + \ln(c)$ |
| | $\log_a\left(\dfrac{b}{c}\right) = \log_a(b) - \log_a(c)$ | $\ln\left(\dfrac{b}{c}\right) = \ln(b) - \ln(c)$ |
| | $\log_a(b^c) = c\log_a(b)$ | $\ln(b^c) = c\ln(b)$ |
| **Change of Base:** | $\log_b(c) = \dfrac{\log_a(c)}{\log_a(b)}$ | $\log_b(c) = \dfrac{\ln(c)}{\ln(b)}$ |
| **Derivative:** | $\dfrac{d}{dx}[\log_a(x)] = \dfrac{1}{x\ln(a)}$ | $\dfrac{d}{dx}[\ln(x)] = \dfrac{1}{x}$ |

# 3 Inverse Properties

| **General Base** $a > 0$ | **Special Case: Base** $e = 2.71828\cdots$ |
|---|---|
| $a^{\log_a(x)} = x$ | $e^{\ln(x)} = x$ |
| $\log_a(a^x) = x$ | $\ln(e^x) = x$ |