

- **Rules of Logarithms**

1. $\log_a x = y \iff a^y = x$
2. $a^{\log_a M} = M$
3. $\log_a a = 1$
4. $\log_a 1 = 0$
5. $\log_a M^r = r \log_a M$
6. $\log_a(M \cdot N) = \log_a M + \log_a N$
7. $\log_a\left(\frac{M}{N}\right) = \log_a M - \log_a N$
8. $\log_a M = \frac{\log_b M}{\log_b a}$

- **Common Mistakes**

1. $\log_a(M - N) = \frac{\log_a M}{\log_a N}$
2. $\log_a(M + N) = \log_a(MN)$
3. $\frac{\log_b M}{\log_b a} = \frac{M}{a}$

- **Arrange from least to greatest:**

1. $e, \ln e, \frac{1}{2}$
2. $e^2, 1, \ln e^2$
3. $\ln \frac{1}{e}, e^{-1}, 1$
4. $4, \ln 4, e$

- **Simplify:**

1. $\log_{10} 10^{-3}$
2. $\log_3 27^{\frac{5}{3}}$
3. $\log_2 2\sqrt{8}$
4. $(\ln(e^2))^{-1}$
5. $2^{\log_2 3} \cdot 3^{\log_3 2}$
6. $* \log_2 3 \log_3 4 \log_4 8$
7. $* e^{\log_e 3 \cdot 27}$

- **Write as a sum or difference of logarithms without any exponents:**

1. $\ln(x^2 - y^2)$
2. $\log_2 \frac{3x^5}{y^8}$
3. $\log_a \sqrt[5]{\frac{2x}{x^2-1}}$
4. $\log_b \left(\sqrt[3]{\frac{1}{y^2}} \cdot \sqrt{\frac{x^2}{z}} \right)$

• **Combine into a single logarithm:**

1. $\log_2 4x + \log_2 x + 2 \log_2 x$
2. $\frac{1}{3}[\ln 2 + \ln y - \ln y^2 - 4 \ln y]$
3. $\frac{1}{3} \log_a x^2 + \log_a \sqrt{x + y^2} - \log_a(x^2 + y)$
4. $\frac{\ln x^3 + 1}{\ln 2} - \log_2(x^3 + 1)$ [Hint: Change of base.]

Sample Midterm	Sample Final			
9	A	B	C	D
13	A	B	C	D
16	A	B	C	D
23	A	B	C	D
29	A	B	C	D
40	A	B	C	D