

**Directions: No Calculators Allowed.** Evaluate the following **without** a calculator.

1.  $\log_9 27$

2.  $\log_6 36$

3.  $\log_5 5^4$

4.  $\ln 1$

5.  $\log_4 64$

6.  $\log_8 4$

7.  $\log_9 \left(\frac{1}{3}\right)$

8.  $\ln e^{\sqrt{5}}$

9.  $\log_{\frac{1}{9}} 27$

10.  $\log 100$

11.  $\log_{\frac{1}{2}} 16$

12.  $\log_{36} 6$

**Directions:** Use properties of exponents to help solve the following equations.

13.  $3^{x-1} = 9^{2x+5}$

14.  $\left(\frac{1}{4}\right)^{x+2} = (16)^{4x+1}$

15.  $4^{2x-3} = 2^x$

16.  $36^{2x-1} = \left(\frac{1}{6}\right)^{x-3}$

17.  $4(2)^{x-1} + 7 = 15$

18.  $e^{2x-1} = e^{x^2}$

19.  $(8)^{3x-2} = (16)^{5x+4}$

20.  $25^{2x-5} = 125^{4x}$