

## UNIT 5 WORKSHEET 9

### Exponential and Logarithmic Equations 1

Solve each of the following. (Round answers to 3 decimal places)

1)  $3^{2x-4} = 5$

$$\begin{aligned} \log_3 3^{2x-4} &= \log_3 5 \\ (2x-4) \log_3 &= \log_3 5 \\ 2x \log_3 3 - 4 \log_3 3 &= \log_3 5 \\ 2x \log_3 3 &= 4 \log_3 3 + \log_3 5 \\ x &= \frac{4 \log_3 3 + \log_3 5}{2 \log_3 3} \\ x &\approx 2.732 \end{aligned}$$

4)  $\left(1 + \frac{0.10}{12}\right)^{12t} = 2$

$$\begin{aligned} \log \left(1 + \frac{0.10}{12}\right)^{12t} &= \log 2 \\ 12t \log \left(1 + \frac{0.10}{12}\right) &= \log 2 \\ t &= \frac{\log 2}{12 \log \left(1 + \frac{0.10}{12}\right)} \\ t &\approx 6.960 \end{aligned}$$

7)  $2 - 6 \ln 3x = 10$

$$\begin{aligned} -6 \ln 3x &= 8 \\ \ln 3x &= -\frac{4}{3} \\ \text{Exp form} \quad e^{-4/3} &= 3x \\ x &= \frac{e^{-4/3}}{3} \\ x &\approx 0.088 \end{aligned}$$

2)  $3^{5x+6} = 4^x$

$$\begin{aligned} \log_3 3^{5x+6} &= \log_3 4^x \\ (5x+6) \log_3 3 &= x \log_3 4 \\ 5x \log_3 3 + 6 \log_3 3 &= x \log_3 4 \\ 5x \log_3 3 - x \log_3 4 &= -6 \log_3 3 \\ x (5 \log_3 3 - \log_3 4) &= -6 \log_3 3 \\ x &= \frac{-6 \log_3 3}{5 \log_3 3 - \log_3 4} \quad x \approx -1.605 \end{aligned}$$

5)  $\ln x + \ln(x-2) = 1$

$$\begin{aligned} \ln(x^2 - 2x) &= 1 \quad \text{Exp. Form} \\ e^1 &= x^2 - 2x \\ x^2 - 2x - e &= 0 \\ x &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-e)}}{2(1)} \\ x &= \frac{2 \pm \sqrt{4+4e}}{2} \quad \text{Does not work} \\ x &= \frac{2 + \sqrt{4+4e}}{2} \quad x \approx 2.928 \end{aligned}$$

3)  $5^{2x-4} = 3^{4x-5}$

$$\begin{aligned} (2x-4) \log_5 5 &= (4x-5) \log_3 3 \\ 2x \log_5 5 - 4 \log_5 5 &= 4x \log_3 3 - 5 \log_3 3 \\ 2x \log_5 5 - 4 \log_5 5 &= 4 \log_3 3 - 5 \log_3 3 \\ x (2 \log_5 5 - 4 \log_5 5) &= 4 \log_3 3 - 5 \log_3 3 \\ x &= \frac{4 \log_3 3 - 5 \log_3 3}{2 \log_5 5 - 4 \log_5 5} \\ x &= -0.804 \end{aligned}$$

6)  $e^{2x} = 7$

$$\begin{aligned} \ln e^{2x} &= \ln 7 \\ 2x \ln e &= \ln 7 \\ \ln e &= 1 \\ 2x &= \ln 7 \\ x &= \frac{\ln 7}{2} \\ x &\approx 0.973 \end{aligned}$$

8)  $\log_2 x + \log_2(x+2) = \log_2(x+6)$

$$\begin{aligned} \log_2(x^2 + 2x) &= \log_2(x+6) \\ \text{one-to-one property} \\ x^2 + 2x &= x+6 \\ x^2 + x - 6 &= 0 \\ (x+3)(x-2) &= 0 \\ x &= -3 \quad x = 2 \\ \log_2 2 + \log_2(2+2) &= \log_2(2+6) \\ 1 + 2 &= 3 \end{aligned}$$

9)  $e^{2x} + 3e^x - 10 = 0$

$$\begin{aligned} (e^x + 5)(e^x - 2) &= 0 \\ e^x + 5 = 0 \quad e^x - 2 = 0 \\ e^x &= -5 \quad e^x = 2 \\ \ln \text{ both sides} \\ \ln e^x &= \ln 2 \\ x \ln e &= \ln 2 \\ x &= \ln 2 \\ x &\approx 0.693 \end{aligned}$$