

$x$        $y$   
+  
 $3$   
-  
 $\pi$

### 3.4 Solving Exponential & Logarithmic Functions

$$\log_3(1) \rightarrow 0$$

$$\log_3(3) \rightarrow 1$$

$$\log_3(9) = 2$$

$$3^x = 1$$

# Exponential Functions

$$1. e^{-x^2} = e^{-3x-4}$$

$$-x^2 = -3x-4$$

$$0 = x^2 - 3x - 4$$

$$(x-4)(x+1)$$

$$3. 2(3^{2t-5})^4 - 4 = 11$$

$$\frac{2}{2}(3^{2t-5})^4 = \frac{15}{2}$$

$$3^{2t-5} = 7.5$$

$$\log_3(7.5) = 2t-5$$

$$x=4, -1$$

$$2. \frac{3}{3}(2^x) = \frac{42}{3}$$

$$2^x = 14$$

$$\log_2 14 = x$$

$$x = 3.807$$

$$t = 3.417$$

$$\textcircled{4} \quad 5^{3x-7} = \frac{1}{625}$$

$$5^{3x-7} = 5^{-4}$$

$$3x-7 = -4$$

$$3x = 3$$

$$\boxed{x=1}$$

$$\textcircled{5} \quad 6^{x-2} = 9^{2x-5}$$

$$\log_6 6^{x-2} = \log_6 9^{2x-5}$$

$$x-2 = \log_6 9^{2x-5}$$

$$x-2 = (2x-5) \cdot \log_6 9$$

$$\boxed{x-2 = 2x \cdot \log_6 9 - 5 \cdot \log_6 9}$$

$$5 \cdot \log_6 9 - 2 = 2x \cdot \log_6 9 - x$$

$$5 \cdot \log_6 9 - 2 = x(2 \cdot \log_6 9 - 1)$$

$$\frac{5 \cdot \log_6 9 - 2}{2 \cdot \log_6 9 - 1} = x \quad \boxed{2.844}$$

$$\begin{aligned} \textcircled{6} \quad & 4^{2x+3} = 7^{x-5} \\ & \log_4 4^{2x+3} = \log_4 7^{x-5} \\ & 2x+3 = (x-5) \log_4 7 \\ & 2x+3 = x \cdot \log_4 7 - 5 \cdot \log_4 7 \\ & +5 \cdot \log_4 7 = x \cdot \log_4 7 - 2x \\ & +5 \cdot \log_4 7 = x(\log_4 7 - 2) \\ \frac{3+5 \cdot \log_4 7}{\log_4 7 - 2} &= x = -16.8 \end{aligned}$$

$$\begin{aligned} \textcircled{7} \quad & 9^x = 27 \\ & 3^{2x} = 3^3 \\ & 2x = 3 \\ & x = \frac{3}{2} \end{aligned}$$

# Logarithmic Functions

$$1.) \ln x = 2$$

$$\begin{aligned} e^2 &= x \\ x &= 7.389 \end{aligned}$$

$$2.) \log_3(5x - 1) = \log_3(x + 7)$$

$$\begin{aligned} 5x - 1 &= x + 7 \\ 4x &= 8 \\ x &= 2 \end{aligned}$$

## Log Functions (cont.)

$$3.) \log_6(3x + 14) - \log_6(5) = \log_6(2x)$$

$$\log_6\left(\frac{3x+14}{5}\right) = \log_6(2x)$$

$$\frac{3x+14}{5} = 2x$$

$$3x+14=10x$$

$$14=7x$$

$$x=2$$

## Log Functions (cont.)

$$4.) 5 + 2 \ln(x) = 4$$

$$\begin{aligned}2 \cdot \ln(x) &= -1 \\ \ln(x) &= -\frac{1}{2} \\ e^{-\frac{1}{2}} &= x \\ x &= \textcircled{e^{-\frac{1}{2}}} \end{aligned}$$

$$5.) 2 \log_5(3x) = 4$$

$$\begin{aligned}\log_5(3x) &= 2 \\ 5^2 &= 3x \\ 25 &= 3x \\ \textcircled{\frac{25}{3}} &= x\end{aligned}$$

# Practice Problems

- Pg 253 # 9 – 20

$$\textcircled{114} \quad 9000 = 4381 + 1883.1t$$

## Word Problems

$$\frac{4619}{1883.6} = 1883.6 \cdot t$$

$$\ln t = \frac{4619}{1883.6} \cdot 120 \\ t = 11.$$

- Read Example 10 on pg 251
- pg 254 # 109, 114

**109**

$$a) 350 = 500 - 0.5 e^{0.004x}$$

$$300 = e^{0.004x}$$

$$\ln 300 = 0.004x$$

$$x = 14.26$$

$$14.26 \cdot 350 = \$499,100$$

$$b) 300 = 500 - 0.5e^{0.004x}$$

$$400 = e^{0.004x}$$

$$\ln 400 = 0.004x$$

$$x = 14.98$$

$$14.98 \cdot 300 = \$449,400$$

# Homework

- Pg 254 # 25-65 odd, 75-101 odd