

## 8.6 Part 3 Solving Exponential Equations

## Solving Equations With a Calculator

If we cannot rewrite each side to have a common base, we must use a logarithm and a calculator.

Example 1: Solve  $4^x = 11$ .

$$\begin{aligned} \log 4^x &= \log 11 \\ x \log 4 &= \log 11 \\ \frac{x \log 4}{\log 4} &= \frac{\log 11}{\log 4} \\ x &= \frac{\log 11}{\log 4} \approx 1.7297 \end{aligned}$$

$$x \approx 1.730$$

Example 2: Solve  $15^x = 7$ .

$$\begin{aligned} \log 15^x &= \log 7 \\ x \log 15 &= \log 7 \\ \frac{x \log 15}{\log 15} &= \frac{\log 7}{\log 15} \\ x &= \frac{\log 7}{\log 15} \approx 0.7185 \end{aligned}$$

$$x \approx 0.719$$

Example 3: Solve  $0.5^x - 7 = -6.8$ .

$$+7 \quad +7.0$$

$$0.5^x = 0.2$$

$$\log 0.5^x = \log 0.2$$

$$\frac{x \log 0.5}{\log 0.5} = \frac{\log 0.2}{\log 0.5}$$

$$x = \frac{\log 0.2}{\log 0.5} \approx 2.3219$$

$$x \approx 2.322$$

Example 4: Solve  $\left(\frac{2}{3}\right)^x + 4 = 16$ .

$$-4 \quad -4$$

$$\left(\frac{2}{3}\right)^x = 12$$

$$\log\left(\frac{2}{3}\right)^x = \log 12$$

$$\frac{x \log \frac{2}{3}}{\log \frac{2}{3}} = \frac{\log 12}{\log \frac{2}{3}}$$

$$x = \frac{\log 12}{\log \frac{2}{3}} \approx -6.1285$$

$$x \approx -6.129$$

Example 5: Solve  $4^{-x} + 2 = 11$ .

$$-2 \quad -2$$

$$4^{-x} = 9$$

$$\log 4^{-x} = \log 9$$

$$\frac{-x \log 4}{-\log 4} = \frac{\log 9}{-\log 4}$$

$$x = \frac{\log 9}{-\log 4} \approx 1.5849 \approx \boxed{-1.585}$$

Example 6: Solve  $1 - \left(\frac{2}{3}\right)^x = -6$ .

$$\frac{-\left(\frac{2}{3}\right)^x}{-1} = \frac{-7}{-1}$$

$$\left(\frac{2}{3}\right)^x = 7$$

$$\log \left(\frac{2}{3}\right)^x = \log 7$$

$$\frac{x \log \left(\frac{2}{3}\right)}{\log \left(\frac{2}{3}\right)} = \frac{\log 7}{\log \left(\frac{2}{3}\right)}$$

$$x = \frac{\log 7}{\log \left(\frac{2}{3}\right)} = -4.7992$$

$$\boxed{x \approx -4.799}$$

Example 7: Solve  $6^{-4x} + 3 = 16$ .  
 $-3 \quad -3$

$$6^{-4x} = 13$$

$$\log 6^{-4x} = \log 13$$

$$\frac{-4x \log 6}{-4 \log 6} = \frac{\log 13}{-4 \log 6}$$

$$x = \frac{\log 13}{(-4 \log 6)} \approx -0.3578$$

$$x \approx -0.358$$

Example 8: Solve  $7^{2x} - 26 = 51$ .  
 $+26 \quad +26$

$$7^{2x} = 77$$

$$\log 7^{2x} = \log 77$$

$$\frac{2x \log 7}{2 \log 7} = \frac{\log 77}{2 \log 7}$$

$$x = \frac{\log 77}{2 \log 7} \approx 1.1161$$

$$x \approx 1.116$$