

S, D, B, M

Unit 3 Day 5 Notes: Solving Exponential Equations

check on calc Key

Solving Exponential Equations

- Get the exponential expression on one side of the equation, the constant on the other.
- Take the natural log (ln) OR log of both sides of the equation. (Both will result in the same final answer).
- Apply logarithmic properties.
- Solve!
- Do NOT use the calculator until the final step!!

Examples: Solve.

1. $4^x = 15$
 $\ln 4^x = \ln 15$
 $x \cdot \ln 4 = \ln 15$
 $x \approx 1.95$

2. $5^x = 134$
 $x \ln 5 = \ln 134$
 $x \approx 3.04$

3. $40e^{0.6x} = 240$
 $e^{0.6x} = 6$
 $\ln e^{0.6x} = \ln 6$
 $0.6x = \frac{\ln 6}{\ln e}$
 $x \approx 2.99$

4. $7e^{2x} = 63$
 $e^{2x} = 9$
 $\ln e^{2x} = \ln 9$
 $2x = \ln 9$
 $x \approx 1.1$

5. $5^{4x-7} = 13$
 $(4x-7) \ln 5 = \ln 13$
 $x = \frac{\ln 13}{\ln 5} + 7$
 $x \approx 2.15$

6. $6^{3x-4} = 2081$
 $(3x-4) \ln 6 = \ln 2081$
 $x \approx 2.76$

7. $5^x = 4^{x+1}$
 $x \ln 5 = (x+1) \ln 4$
 $x \ln 5 = x \ln 4 + \ln 4$
 $x(\ln 5 - \ln 4) = \ln 4$
 $x \approx 6.21$

8. $2^{3x+2} = 3^{x-2}$
 $(3x+2) \ln 2 = (x-2) \ln 3$
 $3x \ln 2 + 2 \ln 2 = x \ln 3 - 2 \ln 3$
 $-x \ln 3 + 3x \ln 2 = -2 \ln 3 - 2 \ln 2$
 $x(3 \ln 2 - \ln 3) = -2 \ln 3 - 2 \ln 2$
 $x \approx -2.95$

Classwork: Solve.

1. $2^x = 5$
 $\ln 2^x = \ln 5$
 $x \cdot \ln 2 = \ln 5$
 $x \approx 2.32$

3. $4^{3x} + 2 = 5$
 $4^{3x} = 3$
 $\ln 4^{3x} = \ln 3$
 $3x \cdot \ln 4 = \ln 3$
 $x \approx 0.26$

5. $1 = 2^{1+5x}$
 $\ln 1 = \ln 2^{1+5x}$
 $\ln 1 = (1+5x) \ln 2$
 $x = -\frac{1}{5} = -0.2$
 $n = \frac{1}{5}$

7. $2^{n+1} = 4^{1-2n}$
 $2^{n+1} = (2^2)^{1-2n}$
 $2^{n+1} = 2^{2-4n}$
 $n+1 = 2-4n$
 $1 = 2-5n$
 $-1 = -5n$
 $n = \frac{1}{5}$

2. $3^{5-x} = 100$
 $\ln 3^{5-x} = \ln 100$
 $(5-x) \ln 3 = \ln 100$
 $x \approx 0.81$

4. $e^{x+1} = 8$
 $\ln e^{x+1} = \ln 8$
 $x+1 = \ln 8$
 $x \approx 1.08$

6. $3e^{2x-1} = 12$
 $e^{2x-1} = 4$
 $\ln e^{2x-1} = \ln 4$
 $2x-1 = \ln 4$
 $x \approx 1.19$

8. $3^{2x-3} = 7^{3x+2}$
 $x \approx -1.97$

$$3^{2x-3} = 7^{3x+2}$$

$$(2x-3)\ln 3 = (3x+2)\ln 7$$

$$2x\ln 3 - 3\ln 3 = 3x\ln 7 + 2\ln 7$$

$$2x\ln 3 - 3x\ln 7 = (3\ln 3 + 2\ln 7)$$

$$x(2\ln 3 - 3\ln 7) = (3\ln 3 + 2\ln 7)$$

$$x \approx -1.97$$

#4:

$$\begin{aligned} 1) \quad 10^{-x} &= 2 \\ -x \cdot \log 10 &= \log 2 \\ \frac{-x \cdot \log 10}{\log 10} &= \frac{\log 2}{\log 10} \\ -x &= \frac{\log 2}{\log 10} \\ \frac{-x}{-1} &= \frac{\log 2}{-1} \end{aligned}$$

$$x \approx -0.3010$$

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

$$\begin{aligned} (2x-1) \log 3 &= \log 5 \\ \frac{(2x-1) \log 3}{\log 3} &= \frac{\log 5}{\log 3} \\ 2x-1 &= \frac{\log 5}{\log 3} \end{aligned}$$

$$x \approx 1.2325$$

$$3) \quad \frac{2e^{12x}}{2} = \frac{17}{2}$$

$$e^{12x} = 8.5$$

$$12x \cdot \ln e = \ln 8.5$$

$$\frac{12x}{12} = \frac{\ln 8.5}{12}$$

$$x \approx 0.1783$$

$$4) \quad \frac{4(1+10^{5x})}{4} = \frac{9}{4}$$

$$1+10^{5x} = 2.25$$

$$10^{5x} = 1.25$$

$$\frac{5x \cdot \log 10}{5 \log 10} = \frac{\log 1.25}{5 \log 10}$$

$$x \approx 0.0194$$

$$5) \quad 2^{3x} = 34$$

$$3x \cdot \log 2 = \log 34$$

$$x \approx 1.6958$$

$$6) \quad 3^{x/14} = 0.1$$

$$\frac{x}{14} \cdot \log 3 = \log 0.1$$

$$\frac{x \log 3}{14 \log 3} = \frac{\log 0.1}{\log 3}$$

$$x \approx -29.3426$$

$$7) \quad e^{3-5x} = 16$$

$$(3-5x) \ln e = \ln 16$$

$$x \approx 0.0455$$

$$8) \quad \left(\frac{1}{4}\right)^x = 75$$

$$x \log \frac{1}{4} = \log 75$$

$$x \approx -3.114$$

$$9) 10^{1-x} = 6^x$$

$$(1-x) \cdot \log 10 = x \log 6$$

$$(1-x) \cdot 1 = x \log 6$$

$$1-x = .7782x$$

$$\begin{array}{r} 1-x = .7782x \\ +x \quad \quad +x \\ \hline 1 = 1.7728x \end{array}$$

$$x \approx .5641$$

$$10) 7^{x/2} = 5^{1-x}$$

$$\frac{x}{2} \log 7 = (1-x) \log 5$$

$$\frac{x}{2} = (1-x) \cdot 0.8271$$

$$\frac{x}{2} = (.8271 - .8271x)$$

$$x = 1.6542 - 1.6542x$$

$$x \approx 1.6542$$