

4. $\log_2 16 = 4$ $2^4 = 16$

7. $\log 1 = 0$

5. $\log_3 \left(\frac{1}{9}\right) = -2$ $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

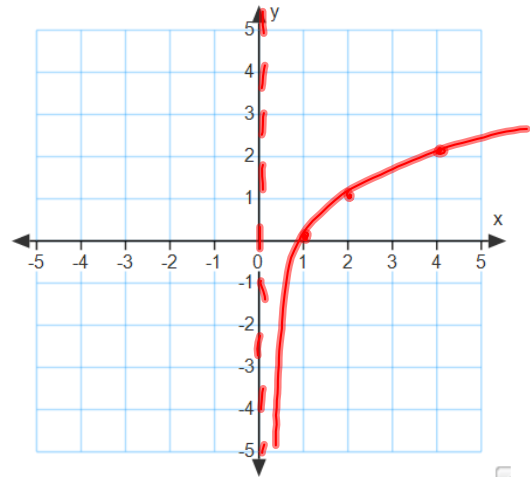
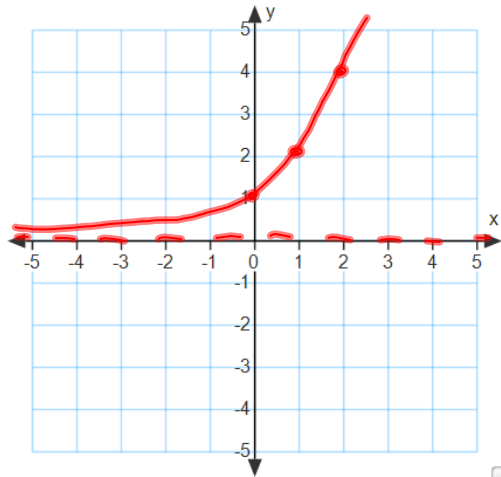
8. $\ln e = 1$

6. $\log 1000 = 3$

9. $\ln 1 = 0$

10. $y = 2^x$

11. $y = \log_2 x$

4.4?

49. $\ln x - 3 \left[\ln(x-5) + \ln(x+5) \right]$

$$= \ln x - 3 \ln \left[(x-5)(x+5) \right]$$

$$= \ln x - \ln (x^2 - 25)^3$$

$$= \ln \frac{x}{(x^2 - 25)^3}$$

4.5 Solving Exponential & Logarithmic Equations

$$3^{2x} = 3^5$$

$$2x = 5$$

$$x = \frac{5}{2}$$

$$\log_3 2x = \log_3 5$$

$$2x = 5$$

$$x = \frac{5}{2}$$

For any $a > 0, a \neq 1$,

$$a^x = a^y \leftrightarrow x = y$$

Similarly, for $M, N > 0, a > 0, a \neq 1$,

$$\log_a M = \log_a N \leftrightarrow M = N$$

$$2^x = 7$$

$$\ln 2^x = \ln 7$$

$$x \ln 2 = \ln 7$$

$$x = \frac{\ln 7}{\ln 2} \approx 2.8$$

$$e^{50t} = 300$$

$$\ln e^{50t} = \ln 300$$

$$50t = \ln 300$$

$$t = \frac{\ln 300}{50} \approx 0.114$$

$$\log x + \log(x + 3) = 1$$

$$\log_{10}(x(x+3)) = 1$$

$$10^1 = x(x+3)$$

$$10 = x^2 + 3x$$

$$0 = x^2 + 3x - 10$$

$$0 = (x+5)(x-2)$$

$$x = 2, \quad x = -5$$

$$\log_a b = c \Leftrightarrow a^c = b$$

★ When solving an equation with logs, always check your answers!

Domain of $\log_a x$ is $(0, \infty)$!

$$4. \quad 3^{7x} = 27$$

$$3^{7x} = 3^3$$

$$7x = 3$$

$$x = \frac{3}{7}$$

$$10. \quad 3^{x^2+4x} = \frac{1}{27}$$

$$3^{x^2+4x} = 3^{-3}$$

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

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

$$(x+3)(x+1) = 0$$

$$x = -1, -3$$

$$12. 28^x = 10^{-3x}$$

$$\log 28^x = \log 10^{-3x}$$

$$x \log 28 = -3x$$

$$x \log 28 + 3x = 0$$

$$x (\log 28 + 3) = 0$$

$$\boxed{x = 0}$$

$$20. 5^{x+2} = 4^{1-x}$$

$$\ln 5^{x+2} = \ln 4^{1-x}$$

$$(x+2) \ln 5 = (1-x) \ln 4$$

~~$$(x+2) 5 = (1-x) 4$$~~

$$x \ln 5 + 2 \ln 5 = \ln 4 - x \ln 4$$

$$x \ln 5 + x \ln 4 = \ln 4 - 2 \ln 5$$

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

$$x = \frac{\ln 4 - 2 \ln 5}{\ln 5 + \ln 4} = \frac{\ln \left(\frac{4}{25}\right)}{\ln 20} \approx -0.6$$

$$24. (e^x - 6e^{-x}) = (1) \cdot e^x$$

$$a^m a^n = a^{m+n}$$

$$e^x e^x - 6e^{-x} e^x = e^x$$

$$e^x e^x = e^{-x+x}$$

$$e^{2x} - 6 = e^x$$

$$= e^0 = 1$$

$$(e^x)^2 - e^x - 6 = 0$$

$$(a^m)^n = a^{mn}$$

$$\text{Let } u = e^x$$

$$u^2 - u - 6 = 0$$

$$(u-3)(u+2) = 0$$

$$u = 3 \quad u = -2$$

$$e^x = 3 \quad e^x = -2$$

$$\ln(e^x) = \ln 3 \quad \ln e^x = \ln -2$$

$$\boxed{x = \ln 3} \quad \cancel{x = \ln(-2)}$$

$$\approx 1.1$$

$$26. \left(\frac{5^x - 5^{-x}}{5^x + 5^{-x}} \right) = (8) \cdot (5^x + 5^{-x})$$

$$5^x - 5^{-x} = 8(5^x + 5^{-x})$$

$$1 \cdot 5^x - 5^{-x} = 8 \cdot 5^x + 8 \cdot 5^{-x}$$

$$0 = 8 \cdot 5^x - 1 \cdot 5^x + 8 \cdot 5^{-x} + 1 \cdot 5^{-x}$$

$$0 = [7(5^x) + 9(5^{-x})] \cdot 5^x$$

$$0 = 7 \cdot 5^{2x} + 9$$

$$-9 = 7 \cdot 5^{2x}$$

$$\frac{-9}{7} = 5^{2x}$$

$$\ln\left(\frac{-9}{7}\right) = \ln 5^{2x}$$

$$\ln\left(\frac{-9}{7}\right) = 2x \ln 5$$

$$\cancel{\frac{\ln\left(\frac{-9}{7}\right)}{2 \ln 5}} = x$$

no solution \cap

Homework:

4.5 # 1-25 odd