

**NO CALCULATOR!**

Write the exponential equation in logarithmic form:

- 1)  $4^3 = 64$   
 A)  $\log_4 3 = 64$   
 B)  $\log_3 4 = 64$   
 C)  $\log_4 64 = 3$   
 D)  $\log_3 64 = 4$

- 2)  $e^0 = 1$   
 A)  $\log 0 = 1$   
 B)  $\ln 0 = 1$   
 C)  $\log e = 0$   
 D)  $\ln 1 = 0$

Evaluate:

- 3)  $\log 1000$   
 A) 10  
 B) 3  
 C) 2  
 D) 1

- 4)  $\log_4 \left( \frac{1}{4} \right)$   
 A) -1  
 B) 1  
 C) -2  
 D) 0

Rewrite the expression:

- 5)  $\log_4 9$   
 A)  $\frac{\ln 4}{\ln 9}$   
 B)  $\frac{\log 9}{\log 4}$   
 C)  $\frac{\log_4 9}{\log_4 4}$   
 D)  $\ln \left( \frac{9}{4} \right)$

- 6)  $\log_2 \left( \frac{1}{12} \right)$   
 A)  $\log_2 12 - 1$   
 B)  $\log_2 (-12)$   
 C)  $\frac{\ln 2}{\ln 12}$   
 D)  $-\log_2 12$

- 7)  $\ln(3xy^2)$   
 A)  $\ln 3 + \ln x + \ln(2y)$   
 B)  $\log 3 + \log x + \log y^2$   
 C)  $\ln 3 + \ln x + 2 \ln y$   
 D)  $2 \ln 3xy$

- 8)  $-2 \log x - 5 \log(x+6)$   
 A)  $\log(-2x) - \log(x+6)^5$   
 B)  $\log \frac{1}{x^2(x+6)^5}$   
 C)  $-\log \frac{x^2}{(x+6)^5}$   
 D)  $\log(x^2(x+6)^5)$

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Condense the expression so it is a single number:

$$9) \log_4 64 = 3$$

$$10) \log_2 \left( \frac{1}{8} \right) = -3$$

$$11) \log_3 \left( \frac{1}{9} \right) = -2$$

$$12) \log_6 1 = 0$$

$$13) 3\log_2 4 + \log_2 8$$

$$3(2) + 3 = 9$$

$$14) \log_4 16 + 4\log_4 2$$

$$2 + 4\left(\frac{1}{2}\right) = 4$$

$$15) \log 1000^2$$

$$= 2 \log_{10} 1000 \\ = 2(3) = 6$$

$$16) 8^{\log_8 x} = x$$

$$17) \log_3 243^2$$

$$= 2(5) = 10$$

$$18) \ln e^{-2} = -2$$

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NOW you can use a calculator ☺

Solve the equation- round all answers to three decimal places, and check for extraneous solutions:

19)  $12 = 10^{x+5} - 7$

$$10^{x+5} = 19$$

$$\log_{10} 19 = x+5$$

$$x \approx \log_{10} 19 - 5$$

$$\boxed{x \approx -3.721}$$

20)  $5 - \ln x = 7$

$$\ln x = -2$$

$$x = e^{-2} \approx \boxed{0.135}$$

21)  $\log_2 4x = \log_2(x+15)$

$$4x = x+15$$

$$3x = 15$$

$$\boxed{x = 5}$$

22)  $\frac{4}{1+2.5e^{-4x}} = 3.3$

$$\frac{4}{3.3} = 1 + 2.5e^{-4x}$$

$$e^{-4x} = \frac{\frac{4}{3.3} - 1}{2.5} = \frac{14}{165}$$

$$-4x = \ln \frac{14}{165}$$

$$\boxed{x \approx 0.617}$$

23)  $\log_6(x+12) - \log_6 x = \log_6(x+5)$

$$\log_6 \left( \frac{x+12}{x} \right) = \log_6(x+5)$$

$$\frac{x+12}{x} = x+5$$

$$x+12 = x^2+5x$$

$$0 = x^2+4x-12$$

$$0 = (x+6)(x-2)$$

$$\boxed{x = -6} \quad \boxed{x = 2}$$

can't have log of  $< 0$

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Word Problems!

- 24) You deposit \$7550 in an account that pays 7.25% interest, compounded continuously. How long will it take the money to triple?

$$22650 = 7550 e^{.0725 t}$$

$$3 = e^{.0725 t}$$

$$t = \frac{\ln(3)}{.0725} \approx 15.153 \text{ years}$$

- 25) The speed of the wind,  $S$ , in miles per hour, near the center of a tornado and the distance,  $d$ , in miles, the tornado travels are related by the model

$$S = 93 \log d + 65$$

A large tornado struck portions of Kansas with wind speed at the center of about 283 miles per hour. Approximate the distance traveled by this tornado.

$$283 = 93 \log d + 65$$

$$\frac{218}{93} = \log d$$

$$d = 10^{\frac{218}{93}} \approx 220.844 \text{ miles}$$

- 26) A species of bat is in danger of becoming extinct. Five years ago, the total population of the species was 2000. Two years ago, the total population of the species was 1400. What was the total population of the species one year ago?

$$5 \rightarrow 2000$$

$$2 \rightarrow 1400$$

$$1 \rightarrow ?$$

$$1400 = 2000 e^{k(3)}$$

$$k = \frac{\ln(\frac{7}{10})}{3} \approx -.11889$$

$$x = 2000 e^{4(-.11889)}$$

$$\approx 1243 \text{ bats}$$

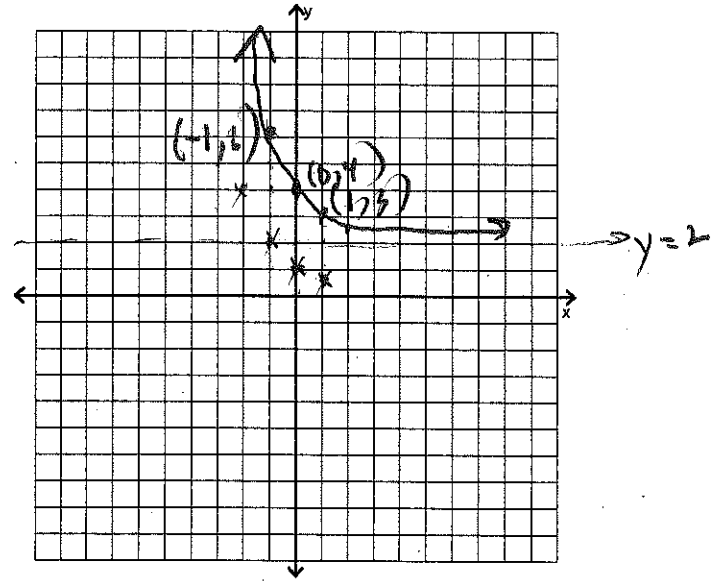
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Graphing!

27) Sketch graphs of the following exponentials and logarithms based on the parent function and transformations:

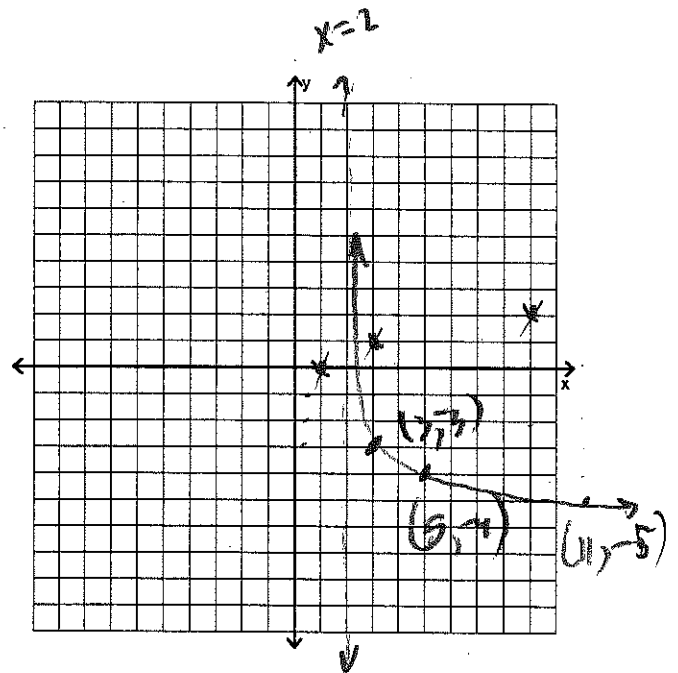
a)  $y = \left(\frac{1}{2}\right)^{x-1} + 2$

$y = \left(\frac{1}{2}\right)^x$



b)  $y = -\log_3(x-2) - 3$

$y = \log_3 x$



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c)  $y = -(4)^x + 5$

$y = 4^x$

