**Logarithmic Functions (7.4-7.5) Review** Name: Key

Advanced Algebra with Trig, Glawe P :

1) $\log y =$ $\log_{10} y$ 2) $\ln y =$ $\log_e y$

**Rewrite the equation in logarithmic form.**

3) $4^3 = 64$ 4) $16^{1/2} = 4$ 5) $3^{-4} = \frac{1}{81}$

$\log_4 64 = 3$ $\log_{16} 4 = \frac{1}{2}$ $\log_3\left(\frac{1}{81}\right) = -4$

**Rewrite the equation in exponential form.**

6) $\log_2 16 = 4$ 7) $\log_{100} 1 = 0$ 8) $\log_{\frac{1}{3}} 9 = -2$

$2^4 = 16$ $100^0 = 1$ $\left(\frac{1}{3}\right)^{-2} = 9$

**Evaluate the logarithm. No decimals.**

9) $\log_3 27 = \boxed{3}$ 10) $\log_5 5 = \boxed{1}$ 11) $\log_{36} 6 = \boxed{1/2}$ 12) $\log_{\frac{1}{4}} 256 = \boxed{-4}$

$\log_3 27 = x$

$3^x = 27 \quad x = 3$

$36^x = 6$

$\left(\frac{1}{4}\right)^x = 256$

**Simplify the following expressions.**

13) $2^{\log_2 -3x} = \boxed{-3x}$ 14) $e^{\ln 4} = \boxed{4}$ 15) $\log_3 3^{x^2} = \boxed{x^2}$ 16) $\log_7 49^{4x} =$

$e^{\log_e 4}$

$*\, b^{\log_b x} = x$ $*\, \log_b b^x = x$

$\log_7 (7^2)^{4x} =$

$\log_7 (7^{8x}) =$

$\boxed{8x}$

**Find the inverse of the given function.**

17) $y = \log\frac{5x}{4}$ 18) $y = 2\ln(x+6)$ 19) $y = e^{x-3}$ 20) $y = \log_2 x + 4$

17)

$x = \log_{10} \frac{5}{4}y$

$\log_{10} \frac{5}{4}y = x$

$\left(\frac{4}{5}\right)10^x = \frac{5}{4}y\left(\frac{4}{5}\right)$

$\boxed{y = \frac{4}{5}(10)^x}$

18)

$\frac{x}{2} = \frac{2\ln(y+6)}{2}$

$\ln(y+6) = \frac{x}{2}$

$\log_e (y+6) = \frac{x}{2}$

$e^{x/2} - 6 = y + 6 - 6$

$\boxed{y = e^{x/2} - 6}$

19)

$x = e^{y-3}$

$\log_e x = y - 3$

$+3 \quad +3$

$y = \log_e x + 3$

$\boxed{y = \ln x + 3}$

20)

$x = \log_2 y + 4$

$-4 \quad -4$

$\log_2 y = x - 4$

$\boxed{2^{x-4} = y}$

**Expand the logarithmic expression.**

21) $\log_7 \frac{4x^2}{y} =$ 22) $\ln\frac{2}{xy^3} = \ln 2 - \ln xy^3 =$

$\log_7 4x^2 - \log_7 y =$

$\log_7 4 + \log_7 x^2 - \log_7 y =$

$\boxed{\log_7 4 + 2\log_7 x - \log_7 y}$

$\ln 2 - (\ln x + \ln y^3) =$

$\ln 2 - \ln x - \ln y^3 =$

$\boxed{\ln 2 - \ln x - 3\ln y}$

**Condense the following logarithmic expressions.**

23) $2\log_4 y - 2\log_4 3 - 3\log_4 x$

$\log_4 y^2 - \log_4 3^2 - \log_4 x^3 =$

$\log_4 y^2 - \log_4 9 - \log_4 x^3 =$

$\log_4 \frac{y^2}{9} - \log_4 x^3 =$

$\boxed{\log_4 \frac{y^2}{9x^3}}$

*subtraction; so $x^3$ goes in denominator

OR:

$\log_4 y^2 - (\log_4 9 + \log_4 x^3)$

$= \log_4 y^2 - \log_4 9x^3$

$= \log_4 \frac{y^2}{9x^3}$

24) $4\ln 3 + \ln\frac{1}{3} - 5\ln x + \ln y$

$\ln 3^4 + \ln\frac{1}{3} - \ln x^5 + \ln y =$

$\ln 81 + \ln\frac{1}{3} - \ln x^5 + \ln y =$

$\ln 81\left(\frac{1}{3}\right) - \ln x^5 + \ln y =$

$\ln 27 - \ln x^5 + \ln y =$

$\ln\frac{27}{x^5} + \ln y = \boxed{\ln\frac{27y}{x^5}}$

*addition; so y goes in numerator

**Graph the logarithmic function. Fill in the table of values for $y = \log_b x$ and $y = \log_b(x-h) + k$. Then identify the domain, range and asymptote. Sketch the asymptote on the graph.** *Three of your four points should be integers (not decimals)*

*pay attention to scale*

x=2 ← vertical asymptotes (dotted lines)

25) Graph $y = \log_3(x-2) + 1$

parent function; right 2, up 1

| x | y |
|---|---|
| 1/3 | -1 |
| 1 | 0 |
| 3 | 1 |
| 9 | 2 |

+2, +1

| x | y |
|---|---|
| 7/3 | 0 |
| 3 | 1 |
| 5 | 2 |
| 11 | 3 |

parent function:

$y = \log_3 x$

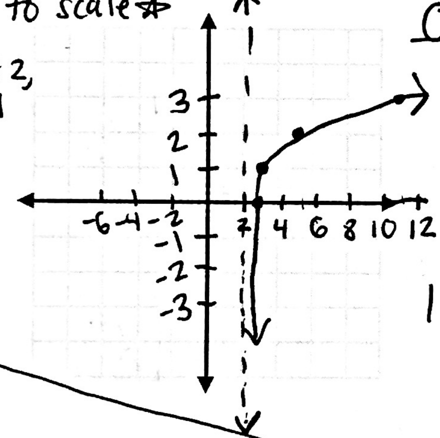
$\log_3 x = y$

$3^y = x$

$y = -1$:

$3^{-1} = x \quad \frac{1}{3} = x$

$(1/3, -1)$



OR:

without parent function:

$y = \log_3(x-2) + 1$

$y - 1 = \log_3(x-2)$

$\log_3(x-2) = y - 1$

$3^{y-1} = x - 2$

$+2 \quad +2$

$\boxed{x = 3^{y-1} + 2}$

$y = 1$:

$x = 3^{1-1} + 2$

$= 1 + 2 = 3$

$(1, 3)$

Domain: $(2, \infty)$

Range: $(-\infty, \infty)$

Asymptote: $x = 2$

26) Graph $y = \log_{1/2}(x+1) - 3$

left one, down three

x=-1

| x | y |
|---|---|
| 4 | -2 |
| 2 | -1 |
| 1 | 0 |
| 1/2 | 1 |

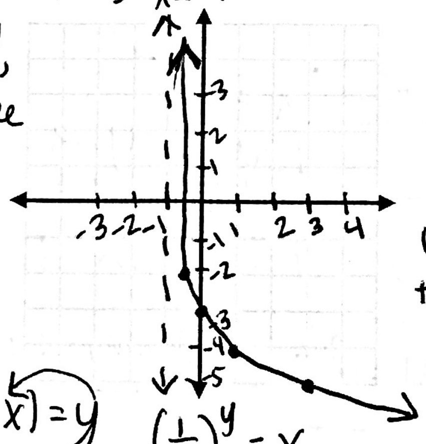
-1, -3

| x | y |
|---|---|
| 3 | -5 |
| 1 | -4 |
| 0 | -3 |
| -1/2 | -2 |

parent function:

$y = \log_{1/2}(x) \quad \log_{1/2}(x) = y$

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



OR:

w/o parent function:

$y = \log_{1/2}(x+1) - 3$

$+3 \quad +3$

$y + 3 = \log_{1/2}(x+1)$

$\log_{1/2}(x+1) = y + 3$

$\left(\frac{1}{2}\right)^{y+3} = x + 1$

$-1 \quad -1$

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

Domain: $(-1, \infty)$

Range: $(-\infty, \infty)$

Asymptote: $x = -1$

27) The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude $R$ is given by the function $R = 0.67\log(0.37E) + 1.46$ where $E$ is the energy (in kilowatt-hours) released by the earthquake. In 1999, an earthquake with the magnitude of 5.9 occurred in Athens, Greece. How much energy did that earthquake release?

$R = 0.67\log(0.37E) + 1.46$

$5.9 = 0.67\log(0.37E) + 1.46$

$-1.46 \quad -1.46$

$\frac{4.44}{0.67} = \frac{0.67\log(0.37E)}{0.67}$

$\log_{10}(0.37E) = \frac{4.44}{0.67}$

$\frac{10^{4.44/0.67}}{0.37} = \frac{0.37E}{0.37}$

$E = 11446268.99$

about 11,446,269 kilowatt-hours