1. Are the following relations functions?

(a) $\{(1, 2), (1, 3), (2, 3)\}$

No. (1, 2) and (1, 3) pair 1 with 2 and 3.

(b) $\{(x, y) | y = 2x^2\}$

Yes. Every x value is paired with exactly one y value.

2. Are the following functions one-to-one?

(a) $\{(1, 2), (2, 3), (4, 4)\}$

Yes. Every y value is paired with exactly one x value.

(b) $\{(x, y) | y = x^2 + 1\}$

No. When $y = 2$, $x = 1$ and $x = -1$.

3. Find the inverse function.

$$f(x) = 2x - 9$$

$$y = 2x - 9$$
$$x = 2y - 9$$
$$x + 0 = 2y - 9$$
$$\underline{+9} \qquad \underline{+9}$$
$$x + 9 = 2y + 0$$
$$\frac{x+9}{2} = \frac{2y}{2}$$
$$f^{-1}(x) = \frac{x+9}{2}$$

4. Find the inverse function.

$$f(x) = \frac{3}{x+2}$$

$$y = \frac{3}{x+2}$$
$$x = \frac{3}{y+2}$$
$$x(y+2) = \frac{3}{y+2} \bullet (y+2)$$
$$xy + 2x = 3$$
$$\underline{-2x} \quad \underline{-2x}$$
$$xy \qquad = 3 - 2x$$
$$\frac{xy}{x} = \frac{3-2x}{x}$$
$$f^{-1}(x) = \frac{3-2x}{x}$$

5. Find the ending balance in a savings account if the initial principal, \$12,000, was invested at a rate of 6%, compounded monthly, for 10 years.

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

$P = 12{,}000;\ \ r = 0.06;\ \ n = 12;\ \ t = 10$

$$A = 12000\left(1+\frac{.06}{12}\right)^{12\bullet 10}$$

$$A = 12000(1+0.005)^{12\bullet 10}$$

$$A = 12000(1.005)^{120}$$

$$A \approx \$21{,}832.76$$

6. Find the ending balance in a savings account if the initial principal, \$12,000, was invested at a rate of 6%, compounded continuously, for 10 years.

$$A = Pe^{rt}$$

$P = 12{,}000;\ \ r = 0.06;\ \ t = 10$

$$A = 12000e^{0.06\bullet 10}$$

$$A = 12000e^{0.6}$$

$$A \approx \$21865.43$$

7. Solve.

$$25^{4x} = 5$$

$$(5^2)^{4x} = 5$$

$$5^{8x} = 5^1$$

$$8x = 1$$

$$\frac{8x}{8} = \frac{1}{8}$$

$$x = \frac{1}{8}$$

8. Solve.

$$16^{x+1} = 8$$

$$(2^4)^{x+1} = 2^3$$

$$2^{4(x+1)} = 2^3$$

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

$$4x + 4 = 3$$

$$\underline{-4}\quad \underline{-4}$$

$$4x + 0 = -1$$

$$\frac{4x}{4} = \frac{-1}{4}$$

$$x = -\frac{1}{4}$$

9. Solve.

$$9^{x+2} = 3^{x-1}$$
$$\left(3^2\right)^{x+2} = 3^{x-1}$$
$$3^{2(x+2)} = 3^{x-1}$$
$$3^{2x+4} = 3^{x-1}$$
$$2x + 4 = x - 1$$
$$\underline{-x} \quad \underline{-x}$$
$$x + 4 = 0 - 1$$
$$\underline{-4} \quad \underline{-4}$$
$$x + 0 = -4 - 1$$
$$x = -5$$

10. Solve.

$$\frac{1}{4^x} = 8^{2x+1}$$
$$\frac{1}{\left(2^2\right)^x} = \left(2^3\right)^{2x+1}$$
$$\frac{1}{2^{2x}} = 2^{3(2x+1)}$$
$$2^{-2x} = 2^{6x+3}$$
$$-2x = 6x + 3$$
$$\underline{-6x} \quad \underline{-6x}$$
$$-8x = 0 + 3$$
$$\frac{-8x}{-8} = \frac{3}{-8}$$
$$x = -\frac{3}{8}$$

11. The population of aphids on a rose plant is given by the following formula:

$$P = 80e^{0.17t}$$

where t is time (in weeks) since the plant was inspected. Find the aphid population at 2 weeks.

$$P = 80e^{0.17t}$$
$$P = 80e^{0.17 \cdot 2}$$
$$P = 80e^{0.34}$$
$$P \approx 113 \text{ aphids}$$

(We choose the next whole number greater than the approximation calculation as aphids are living things.)

12. What amount should be invested at 4% compounded continuously in order to have an accumulated savings of $50,000 in 18 years?

$$A = Pe^{rt}$$
$$A = 50000; \quad r = 0.04; \quad t = 18$$
$$50000 = Pe^{0.04 \cdot 18}$$
$$50000 = Pe^{0.72}$$
$$\frac{50000}{e^{0.72}} = \frac{Pe^{0.72}}{e^{0.72}}$$
$$\frac{50000}{e^{0.72}} = P$$
$$P \approx \$24,337.61$$

13. Write the exponential equations in logarithmic form

(a) $3^4 = 81$

$\log_3(81) = 4$

(b) $12^0 = 1$

$\log_{12}(1) = 0$

14. Write the following logarithmic equations in exponential form

(a) $\log_5(125) = 3$

$5^3 = 125$

(b) $\ln(5) = x$

$e^x = 5$

15. Evaluate

(a) $\log_5(625)$

$\log_5(625) = x$

$5^x = 625$

$5^x = 5^4$

$x = 4$

$\log_5(625) = 4$

(b) $\ln e$

$\ln e = x$
$e^x = e$
$e^x = e^1$
$x = 1$
$\ln e = 1$

16. Use a calculator to evaluate the following. Round your answers to the nearest hundredth (x.xx)

(a) $\log(4.5)$

$\log(4.5) \approx 0.65$

(b) $\ln(4.5)$

$\ln(4.5) \approx 1.50$

17. Use the properties of logarithms to rewrite the expression as logarithms of single variables or numbers. Simplify if possible.

$$\log_m\left(\frac{5^2}{m}\right)$$

$= \log_m(5^2) - \log_m(m)$

$= 2\log_m(5) - 1$

18. Use the properties of logarithms to rewrite the expression as a single logarithm.

$$\frac{1}{2}\log_m(5) + 3\log_m(x)$$

$= \log_m(5^{\frac{1}{2}}) + \log_m(x^3)$

$= \log_m(\sqrt{5}) + \log_m(x^3)$

$= \log_m(x^3\sqrt{5})$

19. Solve (to nearest hundredth x.xx)

(a) $5^x = 10$

$\log 5^x = \log 10$

$x \bullet \log 5 = \log 10$

$\dfrac{x\log 5}{\log 5} = \dfrac{\log 10}{\log 5}$

$x = \dfrac{\log 10}{\log 5}$

$x \approx 1.43$

(b) $e^x = 10$

$\ln e^x = \ln 10$

$x \bullet \ln e = \ln 10$

$x \bullet 1 = \ln 10$

$x = \ln 10$

$x \approx 2.30$

20. Solve

$$\log_3(x) + \log_3(x-2) = \log_3(15)$$

$\log_3(x)(x-2) = \log_3(15)$

$\log_3(x^2 - 2x) = \log_3(15)$

$x^2 - 2x = 15$

$x^2 - 2x + 0 = 15$

$\underline{-15}\quad\underline{-15}$

$x^2 - 2x - 15 = 0$

$(x+3)(x-5) = 0$

$x + 3 = 0$ or $x - 5 = 0$

$\underline{-3}\quad\underline{-3}\qquad\qquad\underline{+5}\quad\underline{+5}$

$x + 0 = -3$ or $x + 0 = 5$

$x = -3$ or $x = 5$

–3 is not an allowable value (it's a negative argument)

Solution set: {5}