Chapter Test

1. Given $f(x) = \dfrac{x+2}{x-2}$ and $g(x) = 2x + 5$, find:

   (a) $f \circ g$ and state its domain   (b) $(g \circ f)(-2)$

   (c) $(f \circ g)(-2)$

2. Determine whether the function is one-to-one.

   (a) $y = 4x^2 + 3$ (b) $y' = \sqrt{x+3} - 5$

3. Find the inverse of $f(x) = \dfrac{2}{3x-5}$ and check your answer. State the domain and range of f and f^{-1}.

4. If the point $(3, -5)$ is on the graph of a one-to-one function f, what point must be on the graph of f^{-1}?

In Problems 5–7, find the unknown value without using a calculator.

5. $3^x = 243$ 6. $\log_b 16 = 2$ 7. $\log_5 x = 4$

In Problems 8–11, use a calculator to evaluate each expression. Round your answer to three decimal places.

8. $e^3 + 2$ 9. $\log 20$

10. $\log_3 21$ 11. $\ln 133$

In Problems 12 and 13, use transformations to graph each function. Determine the domain, range, and any asymptotes.

12. $f(x) = 4^{x+1} - 2$ 13. $g(x) = 1 - \log_5(x - 2)$

In Problems 14–19, solve each equation.

14. $5^{x+2} = 125$ 15. $\log(x + 9) = 2$

16. $8 - 2e^{-x} = 4$ 17. $\log(x^2 + 3) = \log(x + 6)$

18. $7^{x+3} = e^x$ 19. $\log_2(x - 4) + \log_2(x + 4) = 3$

20. Write $\log_2\left(\dfrac{4x^3}{x^2 - 3x - 18}\right)$ as the sum and/or difference of logarithms. Express powers as factors.

21. A 50-mg sample of a radioactive substance decays to 34 mg after 30 days. How long will it take for there to be 2 mg remaining?

22. The average cost of college at 4-year private colleges was $19,710 in 2003–2004. This was a 6% increase from the previous year.

   (a) If the cost of college increases by 6% each year, what will be the average cost of college at 4-year private colleges in 2013–2014?

   (b) College savings plans allow individuals to put money aside now to help pay for college later. If one such plan offers a rate of 5% compounded continuously, how much would Angie have needed to put in a college savings plan in 2003 in order to pay for 1 year of the cost of college at a 4-year private college in 2013?

23. The decibel level, D, of sound is given by the equation $D = 10 \log\left(\dfrac{I}{I_0}\right)$, where I is the intensity of the sound and $I_0 = 10^{-12}$ watts per square meter.

   (a) If the shout of a single person measures 80 decibels, how loud will the sound be if two people shout at the same time? That is, how loud would the sound be if the intensity doubled?

   (b) The pain threshold for sound is 125 decibels. If the Athens Olympic Stadium 2004 (Olympiako Stadio Athinas 'Spyros Louis') can seat 74,400 people, how many people in the crowd need to shout at the same time in order for the resulting sound level to meet or exceed the pain threshold? (Ignore any possible sound dampening.)

24. The table shows the estimated number of U.S. cell phone subscribers (in millions), y, from 1985 to 2003. Use a graphing utility to make a scatter diagram of the data. Fit a logistic model to the data and use the model to predict the number of U.S. cell phone subscribers in 2007. Let $x =$ the number of years since 1985.

   SOURCE: Cellular Telecommunications & Internet Association

0	2	4	6	8	10	12	14	16	18
0.34	1.23	3.51	7.56	16.01	33.76	55.31	86.05	128.37	158.72

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1. (a) $f \circ g = \dfrac{2x + 7}{2x + 3}$, Domain: $\left\{ x \middle| x \neq -\dfrac{3}{2} \right\}$ (b) $(g \circ f)(-2) = 5$ (c) $(f \circ g)(-2) = -3$

2. (a) The function is not one-to-one. (b) The function is one-to-one.

3. $f^{-1}(x) = \dfrac{2 + 5x}{3x}$

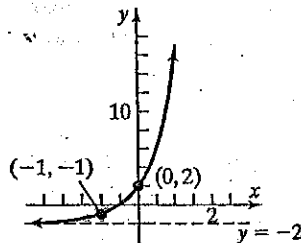|	Domain	Range
f	$x \neq \dfrac{5}{3}$	$y \neq 0$
f^{-1}	$x \neq 0$	$y \neq \dfrac{5}{3}$

4. The point $(-5, 3)$ must be on the graph of f^{-1}. 5. $x = 5$ 6. $b = 4$ 7. $x = 625$ 8. $e^3 + 2 \approx 22.086$ 9. $\log 20 \approx 1.301$

10. $\log_3 21 = \dfrac{\ln 21}{\ln 3} \approx 2.771$ 11. $\ln 133 \approx 4.890$

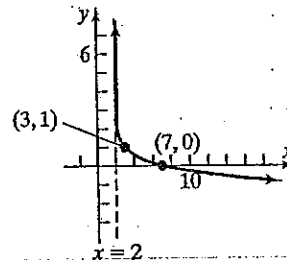12. Domain: $\{x | -\infty < x < \infty\}$
Range: $\{y | y > -2\}$
Asymptote: $y = -2$

13. Domain: $\{x | x > 2\}$
Range: $\{y | -\infty < y < \infty\}$
Asymptote: $x = 2$

14. $x = 1$ 15. $x = 91$ 16. $x = -\ln 2 \approx -0.693$ 17. $\dfrac{1 - \sqrt{13}}{2} \approx -1.303, \dfrac{1 + \sqrt{13}}{2} \approx 2.303$ 18. $x = \dfrac{3 \ln 7}{1 - \ln 7} \approx -6.172$

19. $x = 2\sqrt{6} \approx 4.899$ 20. $2 + 3 \log_2 x - \log_2 (x - 6) - \log_2 (x + 3)$ 21. About 250.39 days 22. (a) \$35,298 (b) \$21,409

23. (a) About 83 decibles (b) The pain threshold will be exceeded if 31,623 people shouted at the same time.

24. $y = \dfrac{213}{1 + 205.86 e^{-0.3564t}}$; 197 million U.S. cell phone subscribers