$\qquad$
$\qquad$ Per $\qquad$
Solve each logarithmic equation. Don't forget to check domain and eliminate extraneous solutions! Express irrational solutions in exact form and as decimals rounded to $\mathbf{3}$ decimal places.

1. $\log _{4} x=2$
2. $\log (x+6)=1$
3. $\log _{3}(3 x-1)=2$
4. $\log _{x}\left(\frac{1}{8}\right)=3$
5. $5 \ln x-3=-1$
6. $\frac{1}{4} \ln (x+7)=1$
7. $\log _{4}(x+2)=\log _{4} 8$
8. $\frac{1}{2} \log _{3} x=2 \log _{3} 2$
9. $2 \log _{3}(x+4)-\log _{3} 9=2$
10. $\log x+\log (x+15)=2$
11. $\log (2 x+1)=1+\log (x-2)$
12. $\log _{8}(x+6)=1-\log _{8}(x+4)$
13. $\ln (x+2)+\ln (x-5)=\ln (x+11)$
14. $\log _{a}(x-1)-\log _{a}(x+6)=\log _{a}(x-2)-\log _{a}(x+3)$

Solve each exponential equation. Express irrational solutions in exact form and as decimals rounded to 3 decimal places.
15. $e^{-2 x}=\frac{1}{3}$
16. $10^{x-9}=15$
17. $e^{2 x+5}=8$
18. $5 e^{0.2 x}=7$
19. $4 e^{x+1}=5$
20. $8(10)^{2 x-7}=3$
21. $2^{x}=10$
22. $8^{-x}=1.2$
23. $5\left(2^{3 x}\right)=8$
24. $e^{2 x-3}=7^{x}$
25. $10^{x+5}=3^{3 x-2}$
26. $2^{4 x+1}=5^{2-x}$
27. $3^{1-2 x}=4^{x}$
$\qquad$ Date $\qquad$ Per $\qquad$

## Solve each problem.

28. The pH of a chemical solution is given by the formula

$$
\mathrm{pH}=-\log \left[\mathrm{H}^{+}\right]
$$

where $\left[\mathrm{H}^{+}\right]$is the concentration of hydrogen ions in moles/liter. Values of pH range from 0 (acidic) to 14 (basic or alkaline).
a) What is the pH of a solution for which $\left[\mathrm{H}^{+}\right]$is 0.1 moles/liter?
b) What is the pH of a solution for which $\left[\mathrm{H}^{+}\right]$is 0.01 moles/liter?
c) What is the pH of a solution for which $\left[\mathrm{H}^{+}\right]$is 0.001 moles/liter?
d) What happens to the pH as the hydrogen ion concentration decreases?
e) Determine the hydrogen ion concentration of an orange $(\mathrm{pH}=3.5)$.
f) Determine the hydrogen ion concentration of human blood $(\mathrm{pH}=7.4)$.
29. The normal healing of wounds can be modeled by the formula $A(n)=A_{0} e^{-0.35 n}$, where $A_{0}$ is the original area of a wound, and $A$ is the area of the wound $n$ days after an injury. Suppose that a wound initially had an area of 100 square millimeters.
a) What will the area of the wound be after 3 days?
b) How long will it take for the area of the wound to be half its original area?
30. A model for the number $N$ of people in a college community who have heard a certain rumor is $N=P\left(1-e^{-0.15 d}\right)$, where $P$ is the total population and $d$ is the number of days that have elapsed since the rumor began. In a community of 1000 students, how many days will elapse before 450 students have heard the rumor?

