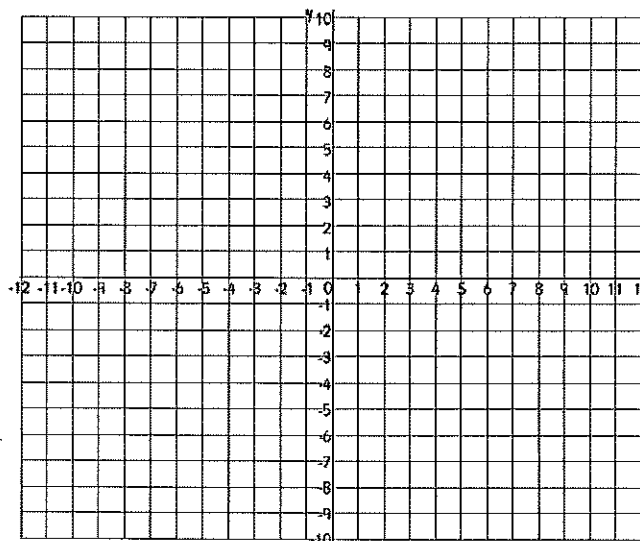
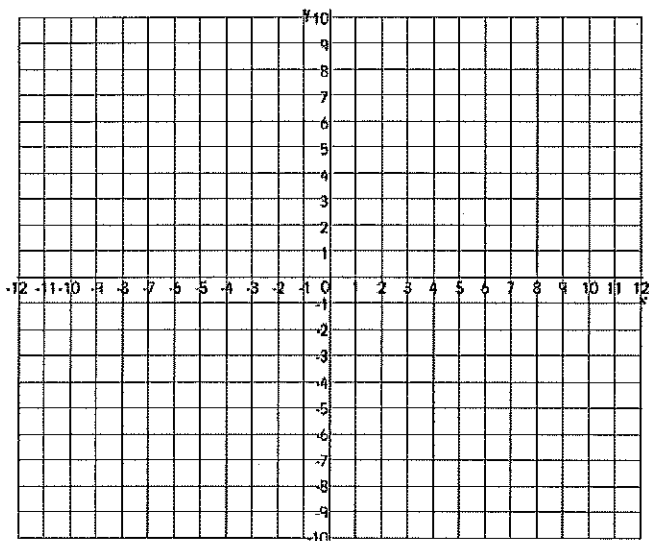


*Sketch the graph of each function. Then state the function's domain and range.*

1.  $y = 2(3)^x$

2.  $y = 0.5(4)^x$



*Determine whether each function represents exponential growth or decay.*

3.  $y = 2(4)^x$

4.  $y = 0.4\left(\frac{1}{3}\right)^x$

5.  $y = 3\left(\frac{5}{2}\right)^x$

Solve each equation. Check your solution.

6.  $3^{n-2} = 27$

7.  $2^{n+4} = 32^{-1}$

## P24: Solving Exponential Growth/Decay Problems

Target 4B. Model and evaluate applications involving exponential growth and decay

**Growth:**

$$y = a(1 + r)^x$$

**Decay:**

$$y = a(1 - r)^x$$

$a$  = initial amount before measuring growth/decay

$r$  = growth/decay rate (often a percent)

$x$  = number of time intervals that have passed

- 1) Given the equation  $y = 225(1.23)^x$ 
  - a) Does this equation represent growth or decay?
  - b) What is the rate of growth or decay?
  - c) What is the initial value?
  - d) Evaluate for  $x = 2$
- 2) Given the equation  $y = 154(1.06)^x$ 
  - a) Does this equation represent growth or decay?
  - b) What is the rate of growth or decay?
  - c) What is the initial value?
- 3) Given the equation  $y = 35(0.57)^x$ 
  - a) Does this equation represent growth or decay?
  - b) What is the rate of growth or decay?
  - c) What is the initial value?
  - d) Evaluate for  $x = 3$

For each word problem, write the exponential equation to model the situation. Then, solve the problem.

4) A zombie infection at Morton East High School grows by 15% per hour. The initial group of zombies was a group of 4 sophomores. How many zombies are there after 6 hours?

5) Ryan is saving for his college tuition. He has \$2,550 in a savings account that pays 6.25% annual interest. How much money does he have at the end of two years?

- 6) Cars depreciate in value over time. A used car was purchased for \$12,329 this year. Each year the car's value decreases 8.5%. How much is the car worth after five years?
- 7) Jeremiah owns a side business detailing cars. His first year he made \$10,500 and each of the following years his profit increased 9%. How much money did he make in three years?
- 8) There are 128 teams entered in a basketball tournament. Half of the teams are eliminated each round. How many teams are left after 4 rounds?
- 9) Bacteria in a dirty glass triple every hour. If there are 25 bacteria to start, what is the bacteria count after 1 day?
- 10) The population of a city of 750,000 people is devastated by an unknown virus that kills 20% of the population per day. How many people are left after a week?
- 11) There are 1,750,235 acres of forest in northwestern Idaho. One-half percent of the forest is destroyed by pollution every year. How many acres are left after 65 years?
- 12) A new Ipod is estimated to lose 25% of its value every six months after purchase. How much is the value of an Ipod that costs \$299 after someone has owned it for 2 years?
- 13) A recent college graduate accepts a job at Google Inc. The job has a salary of \$47,000 and is guaranteed an annual pay increase of 3%. What is the person's salary at the beginning of their 10<sup>th</sup> year of work?

P25

Date \_\_\_\_\_

**Rewrite each equation in exponential form.**

1)  $\log_{13} 169 = 2$

2)  $\log_{17} 289 = 2$

3)  $\log_9 \frac{1}{81} = -2$

4)  $\log_{36} 6 = \frac{1}{2}$

**Rewrite each equation in logarithmic form.**

5)  $6^3 = 216$

6)  $361^{\frac{1}{2}} = 19$

7)  $16^{-\frac{1}{4}} = \frac{1}{2}$

8)  $6^2 = 36$

**Evaluate each expression.**

9)  $\log_6 \frac{1}{36}$

10)  $\log_4 16$

11)  $\log_2 \frac{1}{64}$

12)  $\log_2 32$

## Answers to P25

1)  $13^2 = 169$

2)  $17^2 = 289$

3)  $9^{-2} = \frac{1}{81}$

4)  $36^{\frac{1}{2}} = 6$

5)  $\log_6 216 = 3$

6)  $\log_{361} 19 = \frac{1}{2}$

7)  $\log_{16} \frac{1}{2} = -\frac{1}{4}$

8)  $\log_6 36 = 2$

9)  $-2$

10)  $2$

11)  $-6$

12)  $5$

**P26: Logarithm Practice Problems***Write each equation in logarithmic form.*

1.  $5^3 = 125$

2.  $7^0 = 1$

3.  $3^4 = 81$

4.  $3^{-4} = \frac{1}{81}$

5.  $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$

6.  $7776^{\frac{1}{5}} = 6$

*Write each equation in exponential form.*

7.  $\log_6 216 = 3$

8.  $\log_2 64 = 6$

9.  $\log_3 \frac{1}{81} = -4$

10.  $\log_{10} 0.00001 = -5$

11.  $\log_{25} 5 = \frac{1}{2}$

12.  $\log_{32} 8 = \frac{3}{5}$

*Evaluate each expression.*

13.  $\log_3 81$

14.  $\log_{10} 0.0001$

15.  $\log_2 \frac{1}{16}$

16.  $\log_{\frac{1}{3}} 27$

17.  $\log_9 1$

18.  $\log_8 4$

19.  $\log_7 \frac{1}{49}$

20.  $\log_6 6^4$

21.  $\log_3 \frac{1}{3}$

22.  $\log_4 \frac{1}{256}$

23.  $\log_9 9^{n+1}$

24.  $2^{\log_2 32}$

*Solve each equation.*

25.  $\log_{10} n = -3$

26.  $\log_4 x = \frac{3}{2}$

27.  $\log_4(2a + 8) = 2$

28.  $\log_8(3x + 7) = \log_8(7x + 4)$

29.  $\log_7(3x - 1) = \log_7(2x + 3)$

**Advanced Algebra – Expand/Condense Logs**  
**P27**

**Name:** \_\_\_\_\_

- Expand the expression:

1.  $\log_{10} 7x^5$

2.  $\log_4 \frac{x^2}{9}$

3.  $\log_{10}(3y^5z^3)$

- Condense the expression:

4.  $5\log_2 x - \log_2 3$

5.  $\log_{10} 8 + 4\log_{10} y$

6.  $7\log_{10} x - 2\log_{10} y$

- Solve the equation:

7.  $\log_2 5 + 4\log_2 m = \log_2 405$

8.  $\log_3 42 - \log_3 n = \log_3 7$

10.4. Advanced Algebra  
P28: Common Logarithms

DATE: \_\_\_\_\_

Target 4E. Solve exponential and logarithmic equations.



**Common Logarithms:** base 10 logarithms (common logarithms are usually written without the subscript 10;  $y = \log_{10} x$  is written as  $y = \log x$ )

Sometimes an application of logarithms requires that you use the inverse of logarithms, or exponentiation. Here is an example:

Solve  $\log x = \frac{1}{4}$  for  $x$ .

**Solve Logarithmic Equations Using Exponentiation**

Solve each equation and round to four decimals if necessary.

1.  $\log_4 r = 3$

2.  $\log z = -2$

3.  $\log_3(4x - 5) = 5$

4.  $\log_2 y = \frac{1}{2}$



Solving Exponential Equations Using Logarithms

Solve each equation and round to four decimals if necessary.

5.  $3^x = 11$

6.  $11^x = 25.4$

7.  $4^{5n} = 30$

8.  $3.1^{a-3} = 9.42$

9.  $3^{n+2} = 14.5$

10.  $4^{3c} = 10$

11.  $6^{x+2} = 18$

12.  $7^{3x-1} = 21$

10.5. Advanced Algebra  
P29: Base  $e$  and Natural Logarithms

DATE: \_\_\_\_\_

Target 4E. Solve exponential and logarithmic equations.

$e$ , the natural base: the irrational number 2.71828...

Evaluate Natural Base Expressions

Use a calculator to evaluate each expression to four decimal places.

1.  $e^2$                       2.  $e^{-1.5}$                       3.  $e^{-8}$                       4.  $e^{0.5}$

$\ln$ , the natural logarithm:  $\log_e x = \ln x$

Evaluate Natural Logarithmic Expressions

Use a calculator to evaluate each expression to four decimal places.

5.  $\ln 4$                       6.  $\ln 0.05$                       7.  $\ln 3$                       8.  $\ln \frac{1}{4}$

Inverse Property of Base  $e$  and Natural Logarithms

Evaluate each expression.

9.  $e^{\ln 7}$                       10.  $\ln e^{4x+3}$                       11.  $e^{\ln 21}$                       12.  $\ln e^{\frac{1}{5}}$

Solve Base  $e$  Equations

Solve each equation.

13.  $5e^{-x} - 7 = 2$                       14.  $3e^{-2x} + 4 = 10$

$$15. 2e^x - 5 = 1$$

$$16. 3 + e^{-2x} = 8$$

**Solve Natural Log Equations**

Solve each equation.

$$17. \ln 5x = 4$$

$$18. \ln(x - 1) = -2$$

$$19. \ln 3x = 0.5$$

$$20. \ln(2x - 3) = 2.5$$

*Solve each of the following.*

1. If \$500 was invested at 4% compounded annually for 10 years, how much money would there be after 10 years?
2. What principal will amount to \$2000 if invested at 4% interest compounded semi-annually for 5 years?
3. What principal will amount to \$1750 if invested at 3% interest compounded quarterly for 5 years?
4. A thousand dollars is left in a credit union drawing 7% compounded monthly. What is the balance at the end of 10 years?
5. An 8.5% account earns continuous interest. If \$2500 is deposited for 5 years, what is the total accumulated?

**Challenge Problem**

6. You lend your friend \$100 at 10% continuous interest. If you are repaid *2 months later*, how much will your friend have to pay you?