



## Practice Masters Level A

### 8.1 Laws of Exponents: Multiplying Monomials

For Exercises 1–8, identify the base and the exponent.

1.  $6^3$  \_\_\_\_\_      2.  $4^2$  \_\_\_\_\_      3.  $8^5$  \_\_\_\_\_      4.  $10^5$  \_\_\_\_\_  
 5.  $5^5$  \_\_\_\_\_      6.  $2^7$  \_\_\_\_\_      7.  $12^2$  \_\_\_\_\_      8.  $20^1$  \_\_\_\_\_

Evaluate.

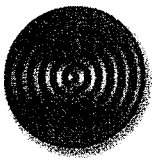
9.  $3^5$  \_\_\_\_\_      10.  $15^1$  \_\_\_\_\_      11.  $9^3$  \_\_\_\_\_      12.  $4^3$  \_\_\_\_\_  
 13.  $7^2$  \_\_\_\_\_      14.  $10^3$  \_\_\_\_\_      15.  $24^1$  \_\_\_\_\_      16.  $8^2$  \_\_\_\_\_

Simplify each product. Leave the product in exponent form.

17.  $5^2 \cdot 5^3$  \_\_\_\_\_      18.  $8^4 \cdot 8^7$  \_\_\_\_\_      19.  $9^3 \cdot 9^3$  \_\_\_\_\_      20.  $10^5 \cdot 10^2$  \_\_\_\_\_  
 21.  $7^4 \cdot 7^3$  \_\_\_\_\_      22.  $10^3 \cdot 10^9$  \_\_\_\_\_      23.  $2^5 \cdot 2^4$  \_\_\_\_\_      24.  $4^2 \cdot 4^6$  \_\_\_\_\_  
 25.  $6^3 \cdot 6^2$  \_\_\_\_\_      26.  $10^2 \cdot 10^2$  \_\_\_\_\_      27.  $3^3 \cdot 3^5$  \_\_\_\_\_      28.  $5^4 \cdot 5^4$  \_\_\_\_\_  
 29.  $10^5 \cdot 10^4$  \_\_\_\_\_      30.  $6^2 \cdot 6^7$  \_\_\_\_\_      31.  $7^2 \cdot 7^6$  \_\_\_\_\_      32.  $4^5 \cdot 4^5$  \_\_\_\_\_

Simplify each product.

33.  $(9x^2)(3x^3)$  \_\_\_\_\_      34.  $(5x^4)(2x^2y^5)$  \_\_\_\_\_  
 35.  $(3y^4)(4x^5y^5)$  \_\_\_\_\_      36.  $(7a^3)(-6a^6b^3)$  \_\_\_\_\_  
 37.  $(-5c^7)(2c^2d^3)$  \_\_\_\_\_      38.  $(9t^4)(4t^3v^8)$  \_\_\_\_\_  
 39.  $(-a^5)(4a^2)$  \_\_\_\_\_      40.  $(8x^7)(-3y^5z^6)$  \_\_\_\_\_  
 41.  $(7n^3)(-m^8n^6)$  \_\_\_\_\_      42.  $(6f^2)(5f^2g^6)$  \_\_\_\_\_  
 43.  $(-12r^3)(2r^4s^4)$  \_\_\_\_\_      44.  $(3a^3)(5b^2c^8)$  \_\_\_\_\_  
 45.  $(-x^4)(4y^5)$  \_\_\_\_\_      46.  $(9h^3)(-4h^2i^6)$  \_\_\_\_\_  
 47.  $(10w^2)(3u^6v^9)$  \_\_\_\_\_      48.  $(6b^2)(-4a^5b^4)$  \_\_\_\_\_  
 49.  $(-5s^2)(6s^5t^4)$  \_\_\_\_\_      50.  $(8p^9)(3n^7q^5)$  \_\_\_\_\_  
 51.  $(3d^4e^2)(5d^2e^3)$  \_\_\_\_\_      52.  $(2x^4y^2)(-7x^3y^5)$  \_\_\_\_\_  
 53.  $(7a^2c^5)(8b^6e^7)$  \_\_\_\_\_      54.  $(4r^2s^6)(-5r^5s^3)$  \_\_\_\_\_



## Practice Masters Level B

### 8.1 Laws of Exponents: Multiplying Monomials

For Exercises 1–4, identify the base and the exponent.

1.  $5^7$  \_\_\_\_\_ 2.  $6^6$  \_\_\_\_\_ 3.  $2^{12}$  \_\_\_\_\_ 4.  $7^4$  \_\_\_\_\_

Evaluate.

5.  $10^9$  \_\_\_\_\_ 6.  $4^7$  \_\_\_\_\_ 7.  $12^4$  \_\_\_\_\_ 8.  $9^5$  \_\_\_\_\_

Simplify each product. Leave the product in exponent form.

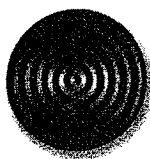
9.  $9^5 \cdot 9^9$  \_\_\_\_\_ 10.  $6^7 \cdot 6^7$  \_\_\_\_\_ 11.  $10^6 \cdot 10^{12}$  \_\_\_\_\_ 12.  $5^5 \cdot 5^{10}$  \_\_\_\_\_  
 13.  $4^7 \cdot 4^6$  \_\_\_\_\_ 14.  $8^5 \cdot 8^7$  \_\_\_\_\_ 15.  $10^{10} \cdot 10^{10}$  \_\_\_\_\_ 16.  $12^4 \cdot 12^5$  \_\_\_\_\_  
 17.  $2^7 \cdot 2^4$  \_\_\_\_\_ 18.  $3^8 \cdot 3^3$  \_\_\_\_\_ 19.  $10^x \cdot 10^y$  \_\_\_\_\_ 20.  $6^a \cdot 6^b$  \_\_\_\_\_

Simplify each product.

21.  $(-x^6)(7x^3)$  \_\_\_\_\_ 22.  $(9x^4)(-5x^6y^7)$  \_\_\_\_\_  
 23.  $(-10a^3b^5)(6a^4b^7)$  \_\_\_\_\_ 24.  $(14x^3y^5)(-4x^7z^9)$  \_\_\_\_\_  
 25.  $(5r^4s^3)(-7r^5s^9)$  \_\_\_\_\_ 26.  $(8a^4c^5)(9b^3c^8)$  \_\_\_\_\_  
 27.  $(-4w^4)(7w^6)(2x^8)$  \_\_\_\_\_ 28.  $(3a^2)(4b^5)(-4a^2b^2)$  \_\_\_\_\_  
 29.  $(-9x^2)(3x^4)(-3x^2)$  \_\_\_\_\_ 30.  $(4f^5)(-2e^3)(5e^4f^6)$  \_\_\_\_\_  
 31.  $(-2a^2)(-2b^4)(2b^3)$  \_\_\_\_\_ 32.  $(-3x^5)(-5y^4)(-4x^4y^6)$  \_\_\_\_\_  
 33.  $(-7f^3g^6)(4h^2)(-5g^3)$  \_\_\_\_\_ 34.  $(8b^2)(3b^4)(4a^5c^6)$  \_\_\_\_\_  
 35.  $(-3r^2)(-6t^8)(-4s^8)$  \_\_\_\_\_ 36.  $(2x^6)(5y^7)(9x^3z^5)$  \_\_\_\_\_  
 37.  $(2a^7)(12a^3)(-c^9)$  \_\_\_\_\_ 38.  $(5x^3z^2)(-8y^7)(4x^2y^2)$  \_\_\_\_\_

Use the formula  $V = lwh$  to find the volume of each rectangular prism.

39.  $l = 2x, w = 3y, h = 2z$  \_\_\_\_\_ 40.  $l = x, w = 5x, h = 4y$  \_\_\_\_\_  
 41.  $l = 4ab, w = 2ac, h = 2bc$  \_\_\_\_\_ 42.  $l = 6fgh, w = 2gh, h = 3fh$  \_\_\_\_\_  
 43.  $l = 3xyz, w = 3xy, h = 5xyz$  \_\_\_\_\_ 44.  $l = 7ab, w = 6b, h = 2bc$  \_\_\_\_\_



## Practice Masters Level C

### 8.1 Laws of Exponents: Multiplying Monomials

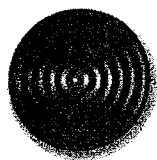
Simplify each product.

1.  $(-6a^3)(5a^2)(4a^4)$  \_\_\_\_\_
2.  $(2x^3)(5y^3)(-7x^4z^5)$  \_\_\_\_\_
3.  $(-4a^4b^3)(3a^5)(-2b^5)$  \_\_\_\_\_
4.  $(5c^4d^5)(-7c^3e^5)(-4d^5e^3)$  \_\_\_\_\_
5.  $(-a^5)(-b^7)(-2a^9b^5)$  \_\_\_\_\_
6.  $(-8r^4s^7)(-3r^2s^5)(-5r^6t^8)$  \_\_\_\_\_
7.  $(-2x^a)(2y^b)(-4x^c)$  \_\_\_\_\_
8.  $(4a^xb^x)(-3a^y)(7b^z)$  \_\_\_\_\_
9.  $(5r^a)(2r^a)(-10r^b)$  \_\_\_\_\_
10.  $(6c^fd^8)(8c^8)(-7d^3g)$  \_\_\_\_\_

For Exercises 11–14, find the value of  $x$ .

11.  $5^x \cdot 5^4 = 5^8$  \_\_\_\_\_
12.  $7^x \cdot 7^3 = 7^{12}$  \_\_\_\_\_
13.  $9^6 \cdot 9^x = 9^7$  \_\_\_\_\_
14.  $6^9 \cdot 6^x = 6^{18}$  \_\_\_\_\_

15. The width of a cube is represented by  $(a + b)^x$ . Find an expression for the volume of the cube. \_\_\_\_\_
16. The length of a rectangular prism is represented by  $3y$ , the width is represented by  $2x$  and the height is represented by  $4x$ . If the volume of the cube is 96 cubic units, find the possible values of  $x$  and  $y$ . \_\_\_\_\_
17. The volume of a rectangular prism is represented by  $70x^6y^3z^4$ . The length is represented by  $5xy$  and the width is represented by  $2x^3y^2$ . Find an expression for the height of the rectangular prism. \_\_\_\_\_
18. Millie had a bacteria culture that doubled in size every hour. She started with 2 milligrams of the culture at 8:00 A.M. How many milligrams will she have at 7:00 P.M.? \_\_\_\_\_
19. Find  $a$  such that  $(2x^2y^3)(4x^2y^a)(ax^4y^5) = -24x^4y^5$ . \_\_\_\_\_
20. Find  $x$  such that  $(5x^3)(4x^4) = 43,740$ . \_\_\_\_\_
21. Find  $a$  such that  $(x^{4a})(x^{3a})(x^7) = x^{24}$ . \_\_\_\_\_
22. Find  $a$  and  $b$  such that  $y^{a+b} = y^{10}$  and  $y^b = y^3$ . \_\_\_\_\_
23. Find  $m$  and  $n$  such that  $x^{m+n} = x^6$  and  $x^{m-n} = x^4$ . \_\_\_\_\_
24. Find a positive number that gets smaller when raised to a power. \_\_\_\_\_



## Practice Masters Level A

### 8.2 Laws of Exponents: Powers and Products

Simplify and find the value of each expression when possible.

1.  $(4^2)^3$  \_\_\_\_\_ 2.  $(5^3)^2$  \_\_\_\_\_ 3.  $(2^6)^3$  \_\_\_\_\_

4.  $(1^8)^{12}$  \_\_\_\_\_ 5.  $(y^1)^3$  \_\_\_\_\_ 6.  $(10^4)^2$  \_\_\_\_\_

7.  $(k^2)^2$  \_\_\_\_\_ 8.  $(0^6)^6$  \_\_\_\_\_ 9.  $(b^2)^4$  \_\_\_\_\_

10.  $(12^1)^2$  \_\_\_\_\_ 11.  $(9^1)^3$  \_\_\_\_\_ 12.  $(7^2)^2$  \_\_\_\_\_

Simplify each expression.

13.  $(z^4)^3$  \_\_\_\_\_ 14.  $(t^{12})^6$  \_\_\_\_\_ 15.  $(a^3)^2$  \_\_\_\_\_

16.  $(b^7)^1$  \_\_\_\_\_ 17.  $(w^3)^5$  \_\_\_\_\_ 18.  $(k^{13})^2$  \_\_\_\_\_

19.  $(xy)^4$  \_\_\_\_\_ 20.  $(j^4)^z$  \_\_\_\_\_ 21.  $(h^w)^5$  \_\_\_\_\_

22.  $(ab)^9$  \_\_\_\_\_ 23.  $(m^2n)^2$  \_\_\_\_\_ 24.  $(kp^5)^7$  \_\_\_\_\_

25.  $(c^2d^3)^4$  \_\_\_\_\_ 26.  $(s^{10}p)^2$  \_\_\_\_\_ 27.  $(h^2g^3)^1$  \_\_\_\_\_

28.  $(xy^9)^3$  \_\_\_\_\_ 29.  $(z^2y)^m$  \_\_\_\_\_ 30.  $(u^5v^5)^5$  \_\_\_\_\_

31.  $(m^p n^q)^2$  \_\_\_\_\_ 32.  $(g^p h^2)^7$  \_\_\_\_\_ 33.  $(x^2 y^3)^4$  \_\_\_\_\_

Verify the Power-of-a-Product Property by finding the value of each expression in two different ways.

34.  $(3 \cdot 5)^2$  \_\_\_\_\_ 35.  $(2 \cdot 1)^9$  \_\_\_\_\_ 36.  $(5 \cdot 3)^3$  \_\_\_\_\_

37.  $(8 \cdot 1)^3$  \_\_\_\_\_ 38.  $(3 \cdot 4)^4$  \_\_\_\_\_ 39.  $(10 \cdot 1)^2$  \_\_\_\_\_

40.  $(3 \cdot 2)^5$  \_\_\_\_\_ 41.  $(3 \cdot 3)^2$  \_\_\_\_\_ 42.  $(5 \cdot 2)^4$  \_\_\_\_\_

43.  $(2 \cdot 0)^7$  \_\_\_\_\_ 44.  $(6 \cdot 3)^1$  \_\_\_\_\_ 45.  $(9 \cdot 7)^2$  \_\_\_\_\_

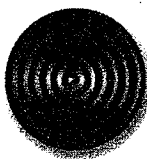
Evaluate each monomial for  $a = 3$ ,  $b = 5$ , and  $c = 2$ .

46.  $a^2b$  \_\_\_\_\_ 47.  $4c^3$  \_\_\_\_\_ 48.  $-8ac^2$  \_\_\_\_\_

49.  $b^2c^3$  \_\_\_\_\_ 50.  $a^cb$  \_\_\_\_\_ 51.  $(ac)^2$  \_\_\_\_\_

52.  $(a^2b)^a$  \_\_\_\_\_ 53.  $(abc)^2$  \_\_\_\_\_ 54.  $a^2c^4$  \_\_\_\_\_

55.  $(a^3c)^4$  \_\_\_\_\_ 56.  $(3ab)^3$  \_\_\_\_\_ 57.  $9c^2$  \_\_\_\_\_



## Practice Masters Level B

### 8.2 Laws of Exponents: Powers and Products

Simplify and find the value of each expression when possible.

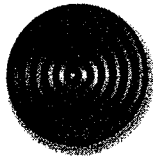
- |                     |                      |                       |
|---------------------|----------------------|-----------------------|
| 1. $-3^2$ _____     | 2. $(-r)^2$ _____    | 3. $(-1)^{501}$ _____ |
| 4. $(-g^2)^4$ _____ | 5. $-(3^2)$ _____    | 6. $(-7^1)^4$ _____   |
| 7. $-(w^2)^2$ _____ | 8. $(-8^2)^2$ _____  | 9. $-(-4^3)^2$ _____  |
| 10. $-10^2$ _____   | 11. $(-4^4)^3$ _____ | 12. $(-p^5)^3$ _____  |

Evaluate each monomial for  $a = -2$ ,  $b = 3$ , and  $c = -5$ .

- |                       |                      |                     |
|-----------------------|----------------------|---------------------|
| 13. $a^4$ _____       | 14. $(a^2c)^3$ _____ | 15. $a^2c^4$ _____  |
| 16. $-a^b$ _____      | 17. $(ac)^4$ _____   | 18. $a^2b^3$ _____  |
| 19. $-5c^5$ _____     | 20. $(bc)^2$ _____   | 21. $(abc)^3$ _____ |
| 22. $(2ca^2)^2$ _____ | 23. $(-a^3)^3$ _____ | 24. $(a^b)^5$ _____ |

Simplify each expression.

- |                                  |                                    |
|----------------------------------|------------------------------------|
| 25. $(-y^4x^3)^2$ _____          | 26. $(g^3)^6(g^2)^5$ _____         |
| 27. $(3c^2)^3(-4bc^2)^2$ _____   | 28. $(-6x^2y^5)^4(xy)^2$ _____     |
| 29. $(-13h^5p^8)^2$ _____        | 30. $(-5t^4v^9)^3$ _____           |
| 31. $(xy)(xy)^2(xy)^3$ _____     | 32. $(2m^5)^3(-3mn)^5$ _____       |
| 33. $(4cd^3)^3(-5c^2d)^2$ _____  | 34. $(12gh^2)(gh)^6$ _____         |
| 35. $(9a^2b)^2(-3ab)^5$ _____    | 36. $8(-5q^3)^3$ _____             |
| 37. $(-4a)^4(ab^2)^{11}$ _____   | 38. $(y^2)^3(x^6y^9)^4$ _____      |
| 39. $(3b^2)^2(-b)^5$ _____       | 40. $-15(ut^3)^8$ _____            |
| 41. $(4gh^2)^4(-hk^5)^7$ _____   | 42. $(-3n^2p^3)^5(np)^2$ _____     |
| 43. $(-1)^{794}a^8$ _____        | 44. $(-cd^3)^5(c^2d)^4$ _____      |
| 45. $(a^2bc^8)^2(-cd^3)^3$ _____ | 46. $(-3m^2n^6)^5(n^7p^3)^6$ _____ |
| 47. $(-a)^{200}(-b)^{201}$ _____ | 48. $(v^4w^8)^2(-w^3u^5)^2$ _____  |



# Practice Masters Level C

## 8.2 Laws of Exponents: Powers and Products

Simplify each expression.

1.  $\left(\frac{1}{2x^3y^4}\right)^5$  \_\_\_\_\_

2.  $\left(\frac{-3}{4a^3b^6c^2}\right)^3$  \_\_\_\_\_

3.  $\left(\frac{-1}{7m^5n^3p}\right)^4$  \_\_\_\_\_

4.  $\left(\frac{1}{4q^5w^{11}}\right)^5$  \_\_\_\_\_

5.  $\left(\frac{-1}{2u^2v^4}\right)^7$  \_\_\_\_\_

6.  $\left(\frac{-27a^7b^3d^{10}}{81}\right)^3$  \_\_\_\_\_

7.  $(-3u^3v^8w^2)^3 (u^7v^2w^3)^4 (u^3v^4w^5)^3$  \_\_\_\_\_

8.  $(-c)^{103} (b^{12}c^5d^{10})^4 (2b^2c^9d^{15})^2$  \_\_\_\_\_

9.  $(10x^8y^3z^{12})^3 (-x^{13}y^{22}z^4)^5$  \_\_\_\_\_

10.  $-(6m^2n^6p^8)^2 (-m^3np^5)^3 (-mn^2p^4)^5$  \_\_\_\_\_

Solve.

11. The height of a box is  $12c^2b^4$  and its width and length are given by  $3c^3b^2$  and  $2c^8b^4$ , respectively. What is the volume of the box?

\_\_\_\_\_

12. In Exercise 11, if  $b = 1$  and  $c = 1$ , and the measurements of the box are in centimeters, what is the volume of the box?

\_\_\_\_\_

13. The base of a right triangle is  $\left(\frac{4m^2n^4}{2m^3n^2}\right)^3$  meters and the height of the triangle is  $\left(\frac{-21m^5n^3}{7m^2n^8}\right)^4$ . What is the area of the triangle?

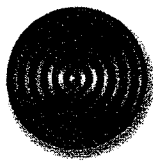
\_\_\_\_\_

14. Mrs. Stewart is planting a garden in her backyard. She wants the garden to have an area of  $12x^2y^8z^6$  square meters. If the length of the garden is  $4xy^5z^3$  meters, how wide is it?

\_\_\_\_\_

15. In Exercise 14, if mulch costs \$13.75 per  $6x^2y^8z^6$  square meters, how much will it cost for Mrs. Stewart to mulch her entire garden?

\_\_\_\_\_



# Practice Masters Level A

## 8.3 Laws of Exponents: Dividing Monomials

Find the value of each expression.

1.  $\frac{7^{11}}{7^9}$  \_\_\_\_\_ 2.  $\frac{12^4}{12^2}$  \_\_\_\_\_ 3.  $\frac{13^{14}}{13^{16}}$  \_\_\_\_\_

4.  $\frac{25^3}{25}$  \_\_\_\_\_ 5.  $\frac{10^6}{10^3}$  \_\_\_\_\_ 6.  $\frac{14^7}{14^8}$  \_\_\_\_\_

7.  $\frac{9^7}{9^3}$  \_\_\_\_\_ 8.  $\frac{2^{42}}{2^{48}}$  \_\_\_\_\_ 9.  $\frac{30^4}{30^6}$  \_\_\_\_\_

10.  $\frac{15^8}{15^6}$  \_\_\_\_\_ 11.  $\frac{50^5}{50^2}$  \_\_\_\_\_ 12.  $\frac{8^7}{8^4}$  \_\_\_\_\_

Use the Quotient-of-Powers to simplify each quotient. Assume that the conditions of the property are satisfied.

13.  $\frac{x^m}{x^n}$  \_\_\_\_\_ 14.  $\frac{c^8}{c^4}$  \_\_\_\_\_ 15.  $\frac{k^{p+1}}{k}$  \_\_\_\_\_

16.  $\frac{h^{13}}{h^d}$  \_\_\_\_\_ 17.  $\frac{b^{8u}}{b^{6u}}$  \_\_\_\_\_ 18.  $\frac{n^4}{n^{k+2}}$  \_\_\_\_\_

19.  $\frac{y^5}{y^q}$  \_\_\_\_\_ 20.  $\frac{(mn)^4}{(mn)^3}$  \_\_\_\_\_ 21.  $\frac{v^{u-4}}{v^{u-5}}$  \_\_\_\_\_

22.  $\frac{b^c}{b^d}$  \_\_\_\_\_ 23.  $\frac{g^5}{g^{h-1}}$  \_\_\_\_\_ 24.  $\frac{y^x}{y^{-x}}$  \_\_\_\_\_

25.  $\frac{f^4}{f^w}$  \_\_\_\_\_ 26.  $\frac{c^{3+d}}{c^d}$  \_\_\_\_\_ 27.  $\frac{n^{12}}{n^3}$  \_\_\_\_\_

Simplify each expression. Assume that the conditions of the Quotient-of-Powers Property are met.

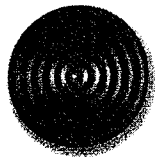
28.  $\frac{a^2b^4}{ab^2}$  \_\_\_\_\_ 29.  $\frac{6mn}{3m}$  \_\_\_\_\_ 30.  $\frac{h^5g^7}{2h^6g^9}$  \_\_\_\_\_

31.  $\frac{(xy)^c}{(xy)^d}$  \_\_\_\_\_ 32.  $\frac{u^3v^7}{u^2v^9}$  \_\_\_\_\_ 33.  $\frac{k^4h}{k^3g^2}$  \_\_\_\_\_

34.  $\frac{f^3p^7}{3fp^4}$  \_\_\_\_\_ 35.  $\frac{12m^8}{2m^4}$  \_\_\_\_\_ 36.  $\frac{169v}{13v}$  \_\_\_\_\_

37.  $\frac{5xy}{25x^2y}$  \_\_\_\_\_ 38.  $\frac{-8gh^7}{4gh}$  \_\_\_\_\_ 39.  $\frac{14f^3}{7d^2}$  \_\_\_\_\_

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## Practice Masters Level B

### 8.3 Laws of Exponents: Dividing Monomials

Simplify each expression. Assume that the conditions of the Quotient-of-Powers Property are met.

1.  $\left(\frac{c}{d}\right)^5$  \_\_\_\_\_ 2.  $\left(\frac{g^2}{f^5}\right)^3$  \_\_\_\_\_ 3.  $\left(\frac{7y}{2x^3}\right)^2$  \_\_\_\_\_

4.  $\left(\frac{2a^4}{3b^7}\right)^4$  \_\_\_\_\_ 5.  $\left(\frac{14uv^2}{7u^3v^2}\right)^6$  \_\_\_\_\_ 6.  $\left(\frac{-gh^4}{g^3h}\right)^7$  \_\_\_\_\_

7.  $\left(\frac{9w^4}{q^6}\right)^2$  \_\_\_\_\_ 8.  $\left(\frac{5m^4}{n^7}\right)^{2p}$  \_\_\_\_\_ 9.  $\left(\frac{g^3f^6}{2f^3}\right)^4$  \_\_\_\_\_

10.  $\left(\frac{2t^3}{5v^2}\right)^3$  \_\_\_\_\_ 11.  $\left(\frac{7x^2y}{28x^5y^3}\right)^2$  \_\_\_\_\_ 12.  $\left(\frac{3z^2y}{xyz}\right)^{3v}$  \_\_\_\_\_

13.  $\left(\frac{-3uv^3}{9u^2v^5}\right)^3$  \_\_\_\_\_ 14.  $\left(\frac{(xy)^4}{x^3y^2}\right)^7$  \_\_\_\_\_ 15.  $\left(\frac{k^hp^5}{g^2}\right)^{2f}$  \_\_\_\_\_

Evaluate each quotient given  $a = 3$ ,  $b = -4$ , and  $c = 6$ .

16.  $\frac{b^5}{b^2}$  \_\_\_\_\_ 17.  $\frac{a^2bc^4}{ab^3c^5}$  \_\_\_\_\_ 18.  $\frac{b^4c}{b^5c^3}$  \_\_\_\_\_

19.  $\frac{b^ac^2}{ab^4c}$  \_\_\_\_\_ 20.  $\frac{2abc}{4a^2b}$  \_\_\_\_\_ 21.  $\frac{(abc)^4}{a^3b^5c^2}$  \_\_\_\_\_

22.  $\frac{c^{2a}b^2}{c^6b}$  \_\_\_\_\_ 23.  $\frac{c^2(2ab)^3}{c^3a^2}$  \_\_\_\_\_ 24.  $\left(\frac{ab}{c}\right)^3$  \_\_\_\_\_

Find each quotient. Assume that the conditions of the Quotient-of-Powers Property are met.

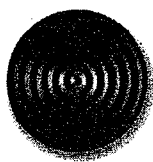
25.  $\frac{65b^4}{13b^2}$  \_\_\_\_\_ 26.  $\frac{-13xy^3}{169x^2y^8}$  \_\_\_\_\_ 27.  $\frac{-m^4n^7}{-3m^7n^5}$  \_\_\_\_\_

28.  $\frac{6a^5b^2c}{3a^4b^9c^3}$  \_\_\_\_\_ 29.  $\frac{-5z^{11}}{25yz^3}$  \_\_\_\_\_ 30.  $\frac{x^5yz^6}{x^2y^7z^2}$  \_\_\_\_\_

31.  $\frac{-5.04w^{12}(u^3v)^4}{0.56(w^5u)^{11}v^7}$  \_\_\_\_\_ 32.  $\frac{144m^3(np)^5q}{-4m(n^3p^2)^7q^2}$  \_\_\_\_\_

33.  $\frac{256(x^4y^3z^7)^2v^{11}}{-1024(xy^3z^2v^5)^2}$  \_\_\_\_\_ 34.  $\frac{535g^2h^7(f^7p)^4}{107(g^5hf^2)^5p^3}$  \_\_\_\_\_





## Practice Masters Level C

### 8.3 Laws of Exponents: Dividing Monomials

Find each quotient. Assume that the conditions of the Quotient-of-Powers Property are met.

$$1. \left( \frac{13u^2v(u^4v^2w^7)^3uw^6}{-26(uv^4)^3v^3(uw^2)^2} \right)^5 \quad \underline{\hspace{2cm}} \quad 2. \left( \frac{-3x^7y^4(x^2yz^5)^2}{2y(x^7z)^3(xy^4)^3} \right)^4 \quad \underline{\hspace{2cm}}$$

$$3. \left( \frac{-10mn(m^3n^5p)^2}{m^5n^3p(m^3p^7)^4} \right)^4 \quad \underline{\hspace{2cm}} \quad 4. \left( \frac{16q(q^4w^9v)^5}{4q^5w^{15}(qv^7)^2} \right)^5 \quad \underline{\hspace{2cm}}$$

$$5. \left( \frac{-19uvw(uvw)^4u^2}{38u^2v^4(u^2v^4)^3w^7} \right)^3 \quad \underline{\hspace{2cm}} \quad 6. \left( \frac{-3a^7b^3d^{10}}{9a(b^7d^3)^8a^5(b^2d)^4} \right)^2 \quad \underline{\hspace{2cm}}$$

$$7. \left( \frac{6a^3b(ab^3c^2)^4}{12a(a^5b^2c^7)^4} \right)^2 \cdot \left( \frac{28a^4(bc^5)^3ab^2c}{-56a(a^7bc^{12})^2b^7c^2} \right)^3 \quad \underline{\hspace{2cm}}$$

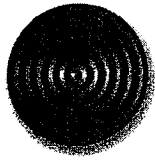
$$8. \left( \frac{17u^3v^5(u^2w^7)^3uw^9}{34uw^7(v^3w)^7u^5v} \right)^3 \cdot \left( \frac{81(u^7v)^2w^{12}(uw^2)^2}{-27u^3(uvw^8)^2uv^{12}} \right)^3 \quad \underline{\hspace{2cm}}$$

9. In a city with a population of approximately  $6.25 \times 10^5$  families, there are roughly  $2 \times 10^6$  cars. Simplify the expression  $\frac{2 \times 10^6}{6.25 \times 10^5}$  to find the average number of cars per family in the city. \_\_\_\_\_

10. The length of a side of a cube is  $\frac{24a^3(bc^2)^4}{12ab(b^3c^3)^3}$  centimeters. What is the volume of the cube? \_\_\_\_\_

11. In Exercise 10, what is the surface area of the cube? Recall that the surface area of a cube is found by calculating the area of one of the sides and multiplying by 6. \_\_\_\_\_

12. The diameter of a circle is  $\frac{2x^2(yz^5)^3}{x^7(y^2z^3)^2}$  meters. What is the area of the circle? Recall that the area of a circle is given by the formula  $A = \pi r^2$ , where  $r$  is the radius of the circle. \_\_\_\_\_



# Practice Masters Level A

## 8.4 Negative and Zero Exponents

Evaluate each expression.

1.  $4^{-2}$  \_\_\_\_\_ 2.  $(-3)^{-4}$  \_\_\_\_\_ 3.  $-2^3$  \_\_\_\_\_

4.  $\frac{7^{13}}{7^{15}}$  \_\_\_\_\_ 5.  $5^{-3}$  \_\_\_\_\_ 6.  $\frac{1^{15}}{1^{23}}$  \_\_\_\_\_

7.  $-(-2)^3$  \_\_\_\_\_ 8.  $\frac{10^8}{10^{12}}$  \_\_\_\_\_ 9.  $-8^2$  \_\_\_\_\_

10.  $\frac{15}{15^2}$  \_\_\_\_\_ 11.  $6^{-2}$  \_\_\_\_\_ 12.  $\frac{13^{-4}}{13^{-3}}$  \_\_\_\_\_

13.  $12^{7-7}$  \_\_\_\_\_ 14.  $\left(\frac{34^8}{34^3}\right)^0$  \_\_\_\_\_ 15.  $\frac{12^3}{12^1}$  \_\_\_\_\_

Write each of the following without negative or zero exponents.

16.  $x^{-3}$  \_\_\_\_\_ 17.  $p^{-5}$  \_\_\_\_\_ 18.  $w^{t-t}$  \_\_\_\_\_

19.  $(mn)^0$  \_\_\_\_\_ 20.  $5w^{-2}$  \_\_\_\_\_ 21.  $13f^0$  \_\_\_\_\_

22.  $8b^{-12}$  \_\_\_\_\_ 23.  $12^0$  \_\_\_\_\_ 24.  $c^{-6}$  \_\_\_\_\_

25.  $\frac{y^{-5}}{2}$  \_\_\_\_\_ 26.  $5k^{-7}$  \_\_\_\_\_ 27.  $(5k)^{-7}$  \_\_\_\_\_

28.  $14cd^{-2}$  \_\_\_\_\_ 29.  $\frac{p^0}{q^0}$  \_\_\_\_\_ 30.  $d^5w^{-6}$  \_\_\_\_\_

31.  $a^{-4}b^0$  \_\_\_\_\_ 32.  $x^{-1}y^{-5}$  \_\_\_\_\_ 33.  $\frac{g^0}{h^{-9}}$  \_\_\_\_\_

Evaluate each expression for  $a = 4$ ,  $b = 2$ , and  $c = -3$ .

34.  $a^c$  \_\_\_\_\_ 35.  $\frac{c^b}{c^a}$  \_\_\_\_\_ 36.  $a^{-b}b^c$  \_\_\_\_\_

37.  $\frac{a^{-3}}{a^{-1}}$  \_\_\_\_\_ 38.  $b^{2c}b^4$  \_\_\_\_\_ 39.  $\frac{a^5}{a^{-c}}$  \_\_\_\_\_

40.  $\frac{(ab)^c}{a^{-4}}$  \_\_\_\_\_ 41.  $\frac{a^{-2}c^2}{b}$  \_\_\_\_\_ 42.  $(abc)^{-2}$  \_\_\_\_\_

43.  $ab^{-2}c^3$  \_\_\_\_\_ 44.  $b^{-3}a^2$  \_\_\_\_\_ 45.  $\frac{ab}{a^{-1}b^2c}$  \_\_\_\_\_

46.  $a^0b^c$  \_\_\_\_\_ 47.  $(a^cb^2)^0$  \_\_\_\_\_ 48.  $c^{-3}a^b$  \_\_\_\_\_



## Practice Masters Level B

### 8.4 Negative and Zero Exponents

Write each of the following without negative or zero exponents.

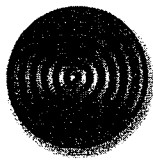
- |                                     |  |  |
|-------------------------------------|--|--|
| 1. $(u^{-8}v^2)^0$ _____            | 2. $-m^3n^{-4}$ _____                              | 3. $(-3b^2c)^{-3}$ _____                     |
| 4. $\frac{-9q^{-8}}{3w^{-3}}$ _____ | 5. $(2p^2q^{-7})^{-4}$ _____                       | 6. $\left(\frac{3t}{4s^5}\right)^{-1}$ _____ |
| 7. $\frac{10h^0}{2h^{-7}}$ _____    | 8. $(x^{-6}y^{-2})^{-2}$ _____                     | 9. $\frac{8^0}{(gh^2)^0}$ _____              |
| 10. $(-3v^{-5})^{-3}$ _____         | 11. $\left(\frac{2a^3}{3b^{-2}}\right)^{-3}$ _____ | 12. $w^{-4}w^5$ _____                        |
| 13. $\frac{3y^{-12}}{z^{-2}}$ _____ | 14. $(-2m^{-2})^{-3}$ _____                        | 15. $\frac{12p^{-11}}{4p^{-11}}$ _____       |

Evaluate each expression for  $x = -2$ ,  $y = 6$ , and  $z = -1$ .

- |                                    |                                      |  |
|------------------------------------|--------------------------------------|--|
| 16. $\frac{x^3y^{-2}}{z}$ _____    | 17. $y^3x^{-y}$ _____                | 18. $\frac{z^{13}y^x}{y}$ _____                |
| 19. $y^{-3}x^4z^2$ _____           | 20. $\frac{xyz}{x^{-1}z^{-5}}$ _____ | 21. $\left(\frac{y^3}{x^4z}\right)^{-3}$ _____ |
| 22. $\frac{x^3z^5}{y^{-2z}}$ _____ | 23. $(x^{-4}yz^2)^{-2}$ _____        | 24. $\frac{-3z^{-4}}{y^x}$ _____               |

Write each of the following without negative or zero exponents.

- |   |   |
|---|---|
| 25. $\frac{-3c^{-5}d^4f^{-1}}{-6d^{-5}d^{-4}f}$ _____           | 26. $(-13q^{-7}w^5)^{-2}$ _____                             |
| 27. $\frac{-x^{-9}x^8}{-25x^4x^{-4}}$ _____                     | 28. $\frac{21p^0b^{12}}{-42p^{-5}b^{12}}$ _____             |
| 29. $\left(\frac{9m^4n^7}{81m^{-1}n^3}\right)^0$ _____          | 30. $(8u^6v^2w^{-5})^{-1}$ _____                            |
| 31. $\frac{8a^2b^4c^{-3}}{a^{-3}b^4c^6}$ _____                  | 32. $\frac{12xy^{-5}z^8}{6x^{-1}y^5z^3}$ _____              |
| 33. $(-g^{-4}f^8h^{12})^{-3}$ _____                             | 34. $\frac{99a^{-10}b^2cd^{-5}}{-11a^{-9}bc^4d^{-5}}$ _____ |
| 35. $\left(\frac{r^{-4}s^{12}t^0}{4rs^{19}t^{-5}}\right)$ _____ | 36. $(-4p^5qw^{-10})^{-2}$ _____                            |



# Practice Masters Level C

## 8.4 Negative and Zero Exponents

Simplify and write each expression with positive exponents only.

1.  $\left(\frac{10x^{-6}z^2}{2x^3y^{-3}}\right)^3$  \_\_\_\_\_

2.  $\left(\frac{-3a^{-3}b^6c}{6a^5b^{-2}c^{-2}}\right)^2$  \_\_\_\_\_

3.  $\left(\frac{7a^{-12}b^2c^0}{7a^5b^3c}\right)^0$  \_\_\_\_\_

4.  $\left(\frac{15x^{19}y^{-5}z^{-5}}{15(x^{-2}y)^{-8}yz}\right)^6$  \_\_\_\_\_

5.  $\left(\frac{-u^{-5}vw^{12}}{2u^2v^{-8}w^{13}}\right)^{-1}$  \_\_\_\_\_

6.  $\left(\frac{4m^3n^{-8}(np)^{-1}}{-8mn(m^4np)^7}\right)^{-4}$  \_\_\_\_\_

7.  $\left(\frac{13f^{-4}g^9h^{-1}}{-13(fg)^{-2}h^5}\right)^3 \cdot \left(\frac{25f^2g^{-8}h^4}{5fg^{11}(fh^2)^{-6}}\right)^{-2}$  \_\_\_\_\_

8.  $\left(\frac{-3u^3v^{-8}w^2(u^{-1}w^3)^{-2}}{-9(uw^5)^4v^{-8}w}\right)^0 \cdot \left(\frac{9uvw^6(u^{-7})^2}{174u^{10}v^{12}w^{-4}}\right)^0$  \_\_\_\_\_

9.  $\left(\frac{12m^{-5}(n^5p)^{-4}q^7}{144(m^{-3}n^2)^{-2}pq^7}\right)^2 \cdot \left(\frac{5mn^6p^{-5}(n^3q^{10})^{-4}}{60m^{-3}n^7}\right)^{-2}$  \_\_\_\_\_

10.  $\left(\frac{-10xy^{13}(x^{-5}z^4)^2}{10x^7(x^{13}y)^5z^{-8}}\right)^{-1} \cdot \left(\frac{9x^{-4}y(x^6z^{-7})^{-1}}{27y^5(x^5yz^{-2})^{-8}}\right)^2$  \_\_\_\_\_

11. A circular swimming pool has a radius of  $\frac{2m^3n^{-4}p}{8(mm)^{-2}p^2}$  meters and a height of  $\frac{m^{-5}np^2}{27mn^{-2}p^{-1}}$  meters. What is the volume of the pool?

HINT: Find the area of the circle and multiply by the height. \_\_\_\_\_

12. In Exercise 11, if  $m = 7$ ,  $n = 1$  and  $p = 5$ , what is the volume of the pool to the nearest tenth? \_\_\_\_\_

13. Explain why it would not make sense to define  $x^0 = 0$ , for any nonzero number  $x$ , and why it does make sense to define  $x^0 = 1$ .

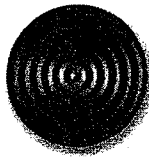
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\_\_\_\_\_

\_\_\_\_\_

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## Practice Masters Level A

### 8.5 Scientific Notation

Write each number in scientific notation.

1. 500,000  
\_\_\_\_\_

2. 40,000,000  
\_\_\_\_\_

3. 100,000,000,000,000  
\_\_\_\_\_

4. 235,000,000  
\_\_\_\_\_

5. 170,000,000,000  
\_\_\_\_\_

6. 0.0000006  
\_\_\_\_\_

7. 0.000077  
\_\_\_\_\_

8. 0.00000000001  
\_\_\_\_\_

9. 30,000,000  
\_\_\_\_\_

10. 0.00000085  
\_\_\_\_\_

11. 0.00978  
\_\_\_\_\_

12. 0.0412  
\_\_\_\_\_

Write each number in decimal notation.

13.  $9 \times 10^9$   
\_\_\_\_\_

14.  $6 \times 10^4$   
\_\_\_\_\_

15.  $1.8 \times 10^5$   
\_\_\_\_\_

16.  $2.071 \times 10^7$   
\_\_\_\_\_

17.  $2 \times 10^{-8}$   
\_\_\_\_\_

18.  $4.9 \times 10^6$   
\_\_\_\_\_

19.  $3.001 \times 10^8$   
\_\_\_\_\_

20.  $4 \times 10^{-1}$   
\_\_\_\_\_

21.  $2.74 \times 10^2$   
\_\_\_\_\_

22.  $8.6 \times 10^{-3}$   
\_\_\_\_\_

23.  $2.07 \times 10^9$   
\_\_\_\_\_

24.  $3 \times 10^{-3}$   
\_\_\_\_\_

Perform the following computations. Write your answers in scientific notation.

25.  $(4 \times 10^8)(2 \times 10^3)$   
\_\_\_\_\_

26.  $(3 \times 10^2)(3 \times 10^5)$   
\_\_\_\_\_

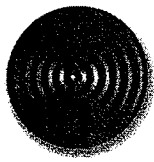
27.  $(5 \times 10^3)(2 \times 10^6)$   
\_\_\_\_\_

28.  $(7 \times 10^5)(4 \times 10^9)$   
\_\_\_\_\_

29.  $(5.6 \times 10^4) - (2.1 \times 10^4)$   
\_\_\_\_\_

30.  $(7.8 \times 10^{14}) + (3.7 \times 10^{14})$   
\_\_\_\_\_

31. Assume the answer to Exercise 30 represents the distance, in miles, between two stars. For your science class, you are to write a report about these two stars. Explain the benefits of using scientific notation in your report. \_\_\_\_\_  
\_\_\_\_\_



## Practice Masters Level B

### 8.5 Scientific Notation

Write each number in scientific notation.

1. 8,000,000,000,000

\_\_\_\_\_

2. 22

\_\_\_\_\_

3. 38,500,000,000

\_\_\_\_\_

4. 40,080,000

\_\_\_\_\_

5. 950

\_\_\_\_\_

6. 2.7

\_\_\_\_\_

7. 0.000304

\_\_\_\_\_

8. 0.0000006819

\_\_\_\_\_

9. 512,000,000,000,000,000

\_\_\_\_\_

10. 70

\_\_\_\_\_

11. 0.000010

\_\_\_\_\_

12. 0.000000000000037

\_\_\_\_\_

Write each number in decimal notation.

13.  $2 \times 10^{15}$

\_\_\_\_\_

14.  $8 \times 10^4$

\_\_\_\_\_

15.  $7.6 \times 10^{10}$

\_\_\_\_\_

16.  $8.075 \times 10^{16}$

\_\_\_\_\_

17.  $3.2 \times 10^{-4}$

\_\_\_\_\_

18.  $9.0 \times 10^{-6}$

\_\_\_\_\_

19.  $3.001 \times 10^{-8}$

\_\_\_\_\_

20.  $4.50 \times 10^{-4}$

\_\_\_\_\_

21.  $7.19 \times 10^5$

\_\_\_\_\_

22.  $1.06 \times 10^{-8}$

\_\_\_\_\_

23.  $4.3 \times 10^9$

\_\_\_\_\_

24.  $2 \times 10^{-1}$

\_\_\_\_\_

Solve for  $x$ . Write your answers in scientific notation.

25.  $\frac{x}{2 \times 10^3} = (3 \times 10^4)$

\_\_\_\_\_

26.  $\frac{x}{4 \times 10^5} = (6 \times 10^8)$

\_\_\_\_\_

27.  $\frac{x}{5 \times 10^9} = (8 \times 10^{12})$

\_\_\_\_\_

28.  $(4 \times 10^7) + x = (7 \times 10^7)$

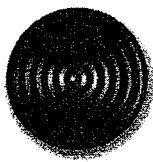
\_\_\_\_\_

29.  $(4 \times 10^5) + x = (8 \times 10^9)$

\_\_\_\_\_

30.  $(6 \times 10^8) - x = (8 \times 10^8)$

\_\_\_\_\_



## Practice Masters Level C

### 8.5 Scientific Notation

Solve for  $x$ . Write your answers in scientific notation.

$$1. \frac{x}{1 \times 10^{15}} = (6 \times 10^{12})$$

\_\_\_\_\_

$$2. \frac{x}{5 \times 10^{16}} = (8 \times 10^{20})$$

\_\_\_\_\_

$$3. \frac{x}{2.4 \times 10^{10}} = (5 \times 10^{10})$$

\_\_\_\_\_

$$4. \frac{x}{3.08 \times 10^{11}} = (2.1 \times 10^{30})$$

\_\_\_\_\_

$$5. \frac{x}{7.5 \times 10^{33}} = (8 \times 10^{31})$$

\_\_\_\_\_

$$6. \frac{x}{8.6 \times 10^8} = (4.5 \times 10^{15})$$

\_\_\_\_\_

$$7. (2 \times 10^8)x = (6 \times 10^8)$$

\_\_\_\_\_

$$8. (3.8 \times 10^{12})x = (1.9 \times 10^{21})$$

\_\_\_\_\_

$$9. (7.5 \times 10^{10})x = (1.5 \times 10^6)$$

\_\_\_\_\_

$$10. (2.4 \times 10^{-8})x = (8.1 \times 10^{-6})$$

\_\_\_\_\_

$$11. (5 \times 10^{-9})x = (1 \times 10^4)$$

\_\_\_\_\_

$$12. (1 \times 10^{14})x = (4 \times 10^{12})$$

\_\_\_\_\_

$$13. (3 \times 10^{15}) + x = (8 \times 10^{15})$$

\_\_\_\_\_

$$14. (8 \times 10^9) + x = (3 \times 10^{10})$$

\_\_\_\_\_

$$15. (4.5 \times 10^8) + x = (1 \times 10^{11})$$

\_\_\_\_\_

$$16. (1.2 \times 10^6) + x = (4 \times 10^8)$$

\_\_\_\_\_

$$17. (8 \times 10^4) + x = (3.7 \times 10^7)$$

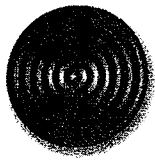
\_\_\_\_\_

$$18. (2 \times 10^{-2}) + x = (7 \times 10^3)$$

\_\_\_\_\_

19. An astrologer, specializing in black holes, concentrates his attention in one particular area of space for his research. To determine the distance,  $d$ , that a constellation is from Earth in this region, he uses the formula  $d - (1 \times 10^{21}) = c$ . If  $c$  equals  $4.5 \times 10^{19}$  miles, what is  $d$ ? \_\_\_\_\_

20. To determine the difference between an infrared wavelength and an ultraviolet wavelength, a physicist subtracted  $5.2 \times 10^{-8}$  meters from  $1 \times 10^{-6}$  meters. What was the result? \_\_\_\_\_



# Practice Masters Level A

## 8.6 Exponential Functions

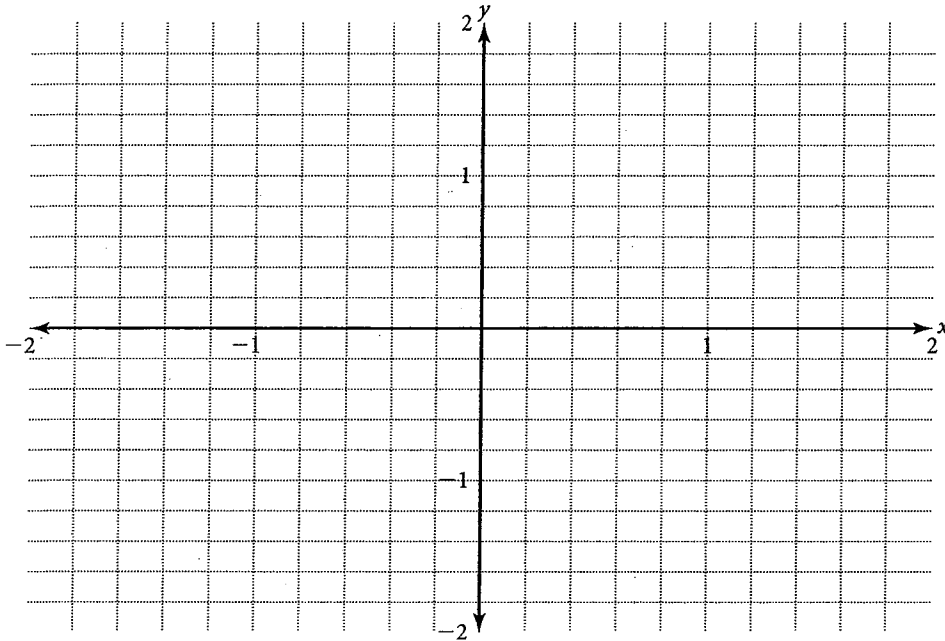
Graph each of the following on the same coordinate axes.

1.  $y = \left(\frac{1}{9}\right)^x$

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

3.  $y = 3^x$

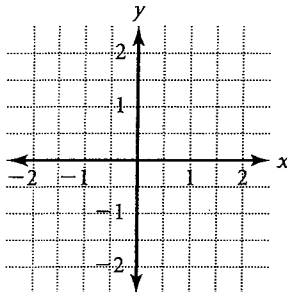
4.  $y = 9^x$



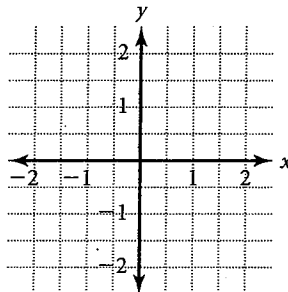
5. At what point do all the graphs from Exercise 1–4 intersect? \_\_\_\_\_
6. The graphs of all exponential functions having a base  $> 1$  rises towards the \_\_\_\_\_ and a base  $< 1$  rises towards the \_\_\_\_\_.

Graph each of the following.

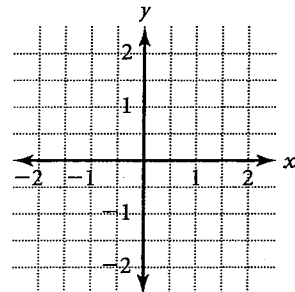
7.  $y = 5^x$



8.  $y = 1.3^x$

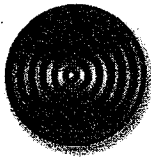


9.  $y = 2.1^x$



10. A telephone tree starts with the president of a club. The president phones two members. These members phone two other members. Each of those members phone two other members, and so on, until everyone is called. Write an equation, using  $x$  and  $y$ , for this situation. \_\_\_\_\_





# Practice Masters Level B

## 8.6 Exponential Functions

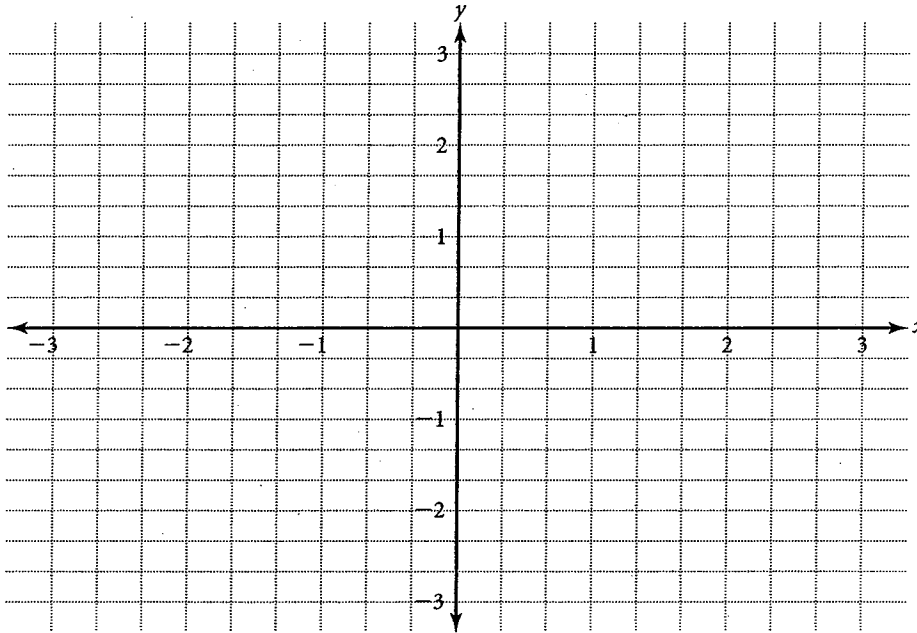
Graph each of the following on the same coordinate axes.

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

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

3.  $y = 4^x$

4.  $y = -4^x$



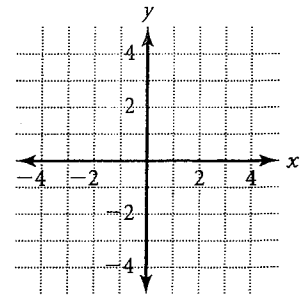
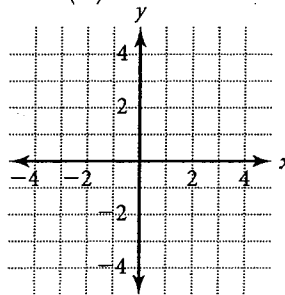
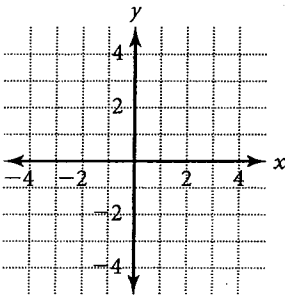
- 5. Each graph crosses the  $y$ -axis at  $x =$  ? \_\_\_\_\_
- 6. Which quadrants do the graphs of all positive exponential functions lie in? \_\_\_\_\_
- 7. Which quadrants do the graphs of all negative exponential functions lie in? \_\_\_\_\_
- 8. The graph of  $y = 4^x$  is the image of ? \_\_\_\_\_ reflected over the  $x$ -axis. \_\_\_\_\_

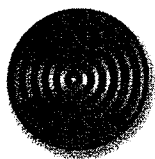
Graph each of the following.

9.  $y = 0.5^x$

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

11.  $y = 1.75^x$





# Practice Masters Level C

## 8.6 Exponential Functions

Graph each of the following on the same coordinate axes.

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

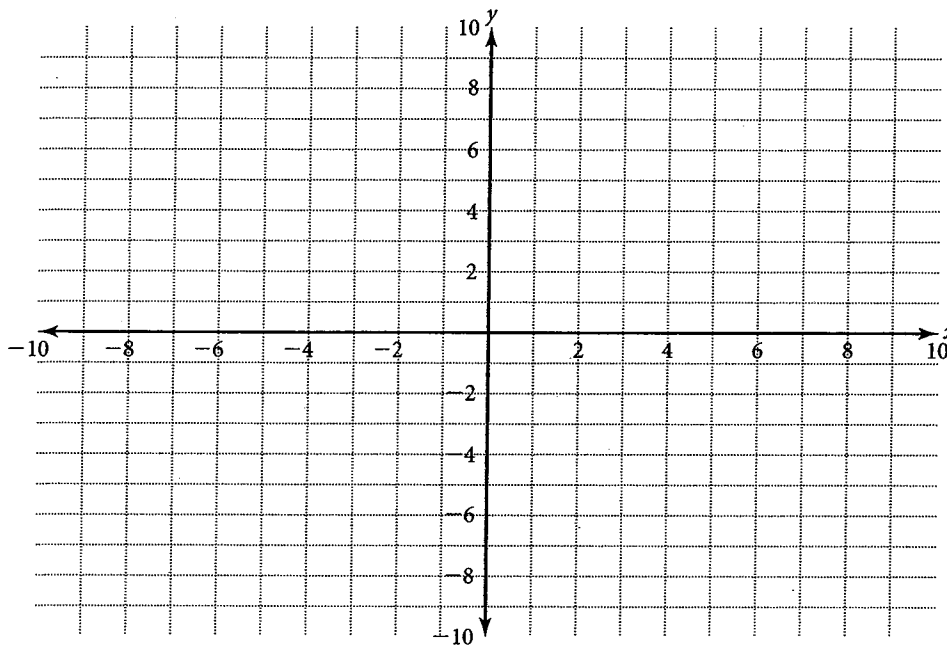
2.  $y = \left(\frac{1}{2}\right)^x$

3.  $y = 2^x$

4.  $y = -2^x$

5.  $y = 2^{x+4}$

6.  $y = 2^{x-4}$



7. Multiplying the function rule of an exponential function by  $-1$  reflects its graph across the         $y$ -axis.

8. Suppose a function is in the form of  $y = b^x$ . Its image is  $y = b^{-x}$ . Describe the transformation.

9. How does adding or subtracting a number to the exponent affect the graph?

10. In 1995 the population of a small city in the United States was about 123,000 and was growing at a rate of  $33\frac{1}{3}\%$  per year. At this rate, estimate the population in 2000.

11. If the population growth rate of the city in Exercise 10 changed to 8.5% in 2001, estimate the population in 2005.



## Practice Masters Level A

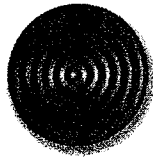
### 8.7 Applications of Exponential Functions

Use the following information for Exercises 1–8. Carbon-14 is used to determine the age of artifacts. It has a half-life of 5700 years. This means that in 0 years,  $\left(\frac{1}{2}\right)^0$ , or 100%, of the original amount of carbon-14 remains in the artifact. In 5700 years,  $\left(\frac{1}{2}\right)^1$ , or 50%, of the original amount of carbon-14 remains.

1. Suppose that 40% of the original carbon remains in a piece of pottery.  
Between which two ages should you base an estimate of its age? \_\_\_\_\_
2. Estimate the age of the pottery in Exercise 1. \_\_\_\_\_
3. Suppose that 75% of the original carbon remains in a piece of pottery.  
Between which two ages should you base an estimate of its age? \_\_\_\_\_
4. Estimate the age of the pottery in Exercise 3. \_\_\_\_\_
5. Suppose that  $\frac{1}{5}$  of the original carbon remains in a piece of pottery.  
Between which two ages should you base an estimate of its age? \_\_\_\_\_
6. Estimate the age of the pottery in Exercise 5. \_\_\_\_\_
7. Suppose that 2% of the original carbon remains in a piece of pottery.  
Between which two ages should you base an estimate of its age? \_\_\_\_\_
8. Estimate the age of the pottery in Exercise 7. \_\_\_\_\_

Use the general growth formula,  $P = A(1 + r)^t$ , for Exercises 9–11.

9. In 3 years you want to have \$2000 in your savings account to buy a new computer. The current interest rate for a savings account is 4% compounded annually. How much do you need to deposit in a savings account now in order to have enough to buy the computer in 3 years? \_\_\_\_\_
10. The value of a condominium has increased in value 3% per year for 5 years. If the condominium is worth \$128,500 now, what was its value 5 years ago? Round your answer to the nearest hundred dollars. \_\_\_\_\_
11. What will the condominium, in Exercise 10, be worth in 3 more years, if the annual percent increase remains the same? Round your answer to the nearest hundred dollars. \_\_\_\_\_



## Practice Masters Level B

### 8.7 Applications of Exponential Functions

Use the following information for Exercises 1–5.

A substance has a half-life of 72 hours.

1. Estimate the percent of the original substance remaining after one week? \_\_\_\_\_
2. Approximately what fraction of the original substance remains after 2 days? \_\_\_\_\_
3. To the nearest tenth of a percent, estimate how much of the original substance remains after 30 days? \_\_\_\_\_
4. In about how many days will the substance have about 10% of its original amount remaining? \_\_\_\_\_
5. In about how many days will the substance have about 70% of its original amount remaining? \_\_\_\_\_

Use the general growth formula  $P = A(1 + r)^t$  for Exercises 6–9.

6. In 2 years you want to have \$2500 in your savings account to buy a new computer. The current interest rate for a savings account is 3.5% compounded annually. How much do you need to deposit in a savings account now in order to have enough to buy the computer in 2 years? \_\_\_\_\_
7. Suppose in Exercise 6 the savings account interest rate is 4%, rather than 3.5%. Will the initial deposit amount be more than or less than the amount calculated in Exercise 6? How much more or less? \_\_\_\_\_
8. A house has increased in value 4.5% per year since it was purchased 4 years ago. The house is now worth \$149,800. What was the original purchase price? Round your answer to the nearest hundred dollars. \_\_\_\_\_
9. If the house increases in value by the same percentage each year, what will be its value in 5 years? Round your answer to the nearest hundred dollars. \_\_\_\_\_

Use this information for Exercises 10–12.

The value of a car decreased from \$38,500 to \$28,875 in one year.

10. What is the percent decrease in value? \_\_\_\_\_
11. If the value of the car is decreasing exponentially, what will be its value in 4 years, to the nearest dollar? \_\_\_\_\_
12. What is the age of the car when its value is about 10% of its original value? \_\_\_\_\_



## Practice Masters Level C

### 8.7 Applications of Exponential Functions

Use the following information to answer Exercises 1–3.

When a substance was 40 years old, it had about 6.25% of its original amount remaining. When it was only 30 years old, it had about 12.5% of its original amount remaining.

1. What is the half-life of the substance? \_\_\_\_\_
2. In approximately how many years will the substance contain about 20% of its original substance? \_\_\_\_\_
3. To the nearest tenth of a percent, about how much of its original substance will remain after 100 years? \_\_\_\_\_

Use this information for Exercises 4–8.

Suppose you deposited \$10,000 into an account on January 1, 2000.

4. If you deposited all the money into an account earning 2.5% annual interest, how much money will be in the account after 5 years? \_\_\_\_\_
5. If you deposited all the money into an account earning 5% annual interest, how much money will be in the account after 5 years? \_\_\_\_\_
6. Suppose you deposited part of the money at 2.5% annual interest and the rest at 5% annual interest. After 5 years, you had a total of \$12,400.63. How much did you deposit in the 5% account? \_\_\_\_\_
7. In what year can you expect to have at least \$20,000 if you deposit the entire amount in the 2.5% account? \_\_\_\_\_
8. In what year can you expect to have at least \$20,000 if you deposit the entire amount in the 5% account? \_\_\_\_\_

**Solve.**

9. Tom is investing \$3,500 in an account earning 4% annual interest. In another state, his cousin Marla will invest a certain amount earning 12% annual interest. How much should Marla invest if she wants to have the same amount in her account as Tom has in his, after 3 years? \_\_\_\_\_
10. Hal invested some money in an account that earned 10.5% annual interest over 6 years. At the end of 6 years, he had \$40,049.43 in his account. How much was his original investment? \_\_\_\_\_