



## SKILL 19: Exponents and Square Roots

Remember that in exponential notation, the **exponent** tells you how many times the base is used as a factor.

$$\begin{array}{c}
 \text{5 is the exponent.} \\
 \downarrow \\
 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^5 \\
 \uparrow \\
 \text{3 is the base.} \\
 \text{5 factors}
 \end{array}$$

$3^5$  is read as "3 to the fifth power."

Exponential form	Expanded form	Standard form
$3^5$	$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$	243
$(0.2)^3$	$0.2 \cdot 0.2 \cdot 0.2$	0.008
$\left(\frac{1}{5}\right)^2$	$\frac{1}{5} \cdot \frac{1}{5}$	$\frac{1}{25}$

### Example 1

Write  $(-7)^3$  in standard and expanded forms.

$$\begin{aligned}
 (-7)^3 &= (-7) \cdot (-7) \cdot (-7) \\
 &= 49 \cdot (-7) \\
 &= -343
 \end{aligned}$$

In expanded form,  $(-7)^3 = (-7) \cdot (-7) \cdot (-7)$ .

In standard form,  $(-7)^3 = -343$ .

#### Powers of Negative Numbers

Suppose the base is negative. If the exponent is an even number, the standard form is positive. If the exponent is an odd number, the standard form is negative.

$$\begin{aligned}
 (-2)^3 &= -8 & (-2)^4 &= 16 \\
 (-2)^5 &= -32 & (-2)^6 &= 64
 \end{aligned}$$

Finding the **square root** of a number is the inverse of squaring the number.

Squaring 5:  $5^2 = 25$  Square root of 25:  $\sqrt{25} = 5$ .

You can see numbers and their squares in the table at the right. You can also use a calculator.

$n$	$n^2$	$n$	$n^2$
1	1	11	121
2	4	12	144
3	9	13	169
4	16	14	196
5	25	15	225
6	36	16	256
7	49	17	289
8	64	18	324
9	81	19	361
10	100	20	400

### Example 2

Find the square root of 196.

From the table, you know  $14^2 = 196$ , so  $\sqrt{196} = 14$ .

### Guided Practice

1. Write  $(-3)^4$  in expanded and standard forms.

$-3$  is used as a factor \_\_\_\_\_ times.

Expanded form:  $(\underline{\quad}) \cdot (\underline{\quad}) \cdot (\underline{\quad}) \cdot (\underline{\quad})$ .

The exponent is an \_\_\_\_\_ number.  
(even/odd)

The standard form for  $(-3)^4$  is \_\_\_\_\_.

2. Find the square root of 324.

The number to the left of 324 in the table is \_\_\_\_\_.

$\sqrt{324} = \underline{\quad}$

### SKILL 19: Practice

Write using exponents.

- |  |   |
|--|---|
| 1. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ _____ | 2. $10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$ _____ |
| 3. $(-4) \cdot (-4) \cdot (-4)$ _____                | 4. $(-8) \cdot (-8) \cdot (-8) \cdot (-8)$ _____                    |
| 5. $9 \cdot 9$ _____                                 | 6. $(-1) \cdot (-1) \cdot (-1)$ _____                               |

Write in expanded form.

- |                  |                              |
|------------------|------------------------------|
| 7. $1.9^4$ _____ | 8. $(-0.6)^3$ _____          |
| 9. $20^5$ _____  | 10. $(-\frac{2}{3})^3$ _____ |
| 11. $2^6$ _____  | 12. $(-4)^4$ _____           |

Write in standard form.

- |                      |                    |                     |
|----------------------|--------------------|---------------------|
| 13. $4^3$ _____      | 14. $5^4$ _____    | 15. $10^2$ _____    |
| 16. $10^5$ _____     | 17. $(-2)^5$ _____ | 18. $(-3)^4$ _____  |
| 19. $20^3$ _____     | 20. $(-1)^4$ _____ | 21. $30^5$ _____    |
| 22. $(0.02)^3$ _____ | 23. $45^2$ _____   | 24. $(0.1)^4$ _____ |

Find each square root.

- |                        |                        |                        |
|------------------------|------------------------|------------------------|
| 25. $\sqrt{144}$ _____ | 26. $\sqrt{81}$ _____  | 27. $\sqrt{361}$ _____ |
| 28. $\sqrt{169}$ _____ | 29. $\sqrt{225}$ _____ | 30. $\sqrt{256}$ _____ |

Solve.

31. Suppose you toss a penny, a nickel, a dime, and a quarter at the same time and record the heads and tails. There are  $2^4$  ways the coins can land. Write this number in standard form. \_\_\_\_\_
32. Suppose you roll 3 dice of different colors and record what number you get for each color. There are  $6^3$  number combinations possible. Write this number in standard form. \_\_\_\_\_



33. What is  $(-2)^4$  in standard form?  
Skill 19
- |       |      |
|-------|------|
| A -8  | C 8  |
| B -16 | D 16 |

34. Solve:  $x + 2.5 = 1.5$ .  
Skill 18
- |      |     |
|------|-----|
| F -4 | H 4 |
| G -1 | J 3 |