

# Exponents and Order of Operations

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

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 24

## Q Quick Review

An **exponent** is a shortcut for repeated multiplication. In  $4^3$ , the 4 is the **base** and the 3 is the **exponent**, so  $4^3 = 4 \times 4 \times 4 = 64$ . When an expression has several operations, follow the **order of operations**: first do anything inside **parentheses**, then **exponents**, then **multiplication and division** from left to right, and finally **addition and subtraction** from left to right. Working in this order every time keeps your answer correct and consistent.

◇ **Example:** Evaluate  $2 + 3 \times 5^2$ .

⇒ Let's take it one careful step at a time. There are no parentheses, so we start with the exponent:  $5^2 = 25$ . Now the expression reads  $2 + 3 \times 25$ . Next comes multiplication:  $3 \times 25 = 75$ . Finally we add:  $2 + 75 = 77$ . The trick is to resist adding the  $2 + 3$  first — multiplication and exponents always come before addition.

**Answer:** 77

## PRACTICE

Evaluate each expression. Follow the order of operations.

- |                       |       |                              |       |
|-----------------------|-------|------------------------------|-------|
| 1. $3^2$              | _____ | 11. $4^2 + 5$                | _____ |
| 2. $2^4$              | _____ | 12. $30 - 2^3$               | _____ |
| 3. $5^3$              | _____ | 13. $(6 - 2)^2$              | _____ |
| 4. $10^2$             | _____ | 14. $12 + 8 \div 4$          | _____ |
| 5. $1^6$              | _____ | 15. $3 \times (2 + 4)^2$     | _____ |
| 6. $6 + 2 \times 3$   | _____ | 16. $50 - 3 \times 4^2$      | _____ |
| 7. $20 - 4 \times 3$  | _____ | 17. $100 \div (5 + 5) + 6$   | _____ |
| 8. $(4 + 5) \times 2$ | _____ | 18. $2^3 + 4 \times 5$       | _____ |
| 9. $18 \div 3 + 7$    | _____ | 19. $(8 + 2) \times (9 - 4)$ | _____ |
| 10. $2 \times 3^2$    | _____ | 20. $7 + 2 \times (3^2 - 1)$ | _____ |

## ◆ Word Problems

21. A square garden has sides of 9 feet. Its area is the side length squared. What is the area of the garden? \_\_\_\_\_
22. Maria buys 3 packs of markers with 8 markers each, then gives away 5 markers. Write and evaluate  $3 \times 8 - 5$  to find how many she has left. \_\_\_\_\_
23. A theater has 6 rows with 4 seats each on the left and the same on the right. Evaluate  $2 \times (6 \times 4)$  to find the total number of seats. \_\_\_\_\_
24. A bacteria sample doubles each hour. After 4 hours it has multiplied by  $2^4$ . If it started with 5 cells, evaluate  $5 \times 2^4$  to find how many cells there are. \_\_\_\_\_



## Answer Keys

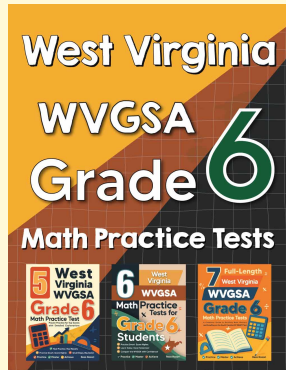
- |                                     |   |
|-------------------------------------|---|
| 1. <input type="text" value="9"/>   | 13. <input type="text" value="16"/>             |
| 2. <input type="text" value="16"/>  | 14. <input type="text" value="14"/>             |
| 3. <input type="text" value="125"/> | 15. <input type="text" value="108"/>            |
| 4. <input type="text" value="100"/> | 16. <input type="text" value="2"/>              |
| 5. <input type="text" value="1"/>   | 17. <input type="text" value="16"/>             |
| 6. <input type="text" value="12"/>  | 18. <input type="text" value="28"/>             |
| 7. <input type="text" value="8"/>   | 19. <input type="text" value="50"/>             |
| 8. <input type="text" value="18"/>  | 20. <input type="text" value="23"/>             |
| 9. <input type="text" value="13"/>  | 21. <input type="text" value="81 square feet"/> |
| 10. <input type="text" value="18"/> | 22. <input type="text" value="19 markers"/>     |
| 11. <input type="text" value="21"/> | 23. <input type="text" value="48 seats"/>       |
| 12. <input type="text" value="22"/> | 24. <input type="text" value="80 cells"/>       |

### Step-by-Step Explanations

- |   |   |
|---|---|
| <p>1. <math>3^2</math> means <math>3 \times 3</math>, which equals 9.</p> <p>2. <math>2^4 = 2 \times 2 \times 2 \times 2 = 16</math>.</p> <p>3. <math>5^3 = 5 \times 5 \times 5 = 125</math>.</p> <p>4. <math>10^2 = 10 \times 10 = 100</math>.</p> <p>5. One multiplied by itself any number of times is still 1.</p> <p>6. Multiply first: <math>2 \times 3 = 6</math>, then add <math>6 + 6 = 12</math>.</p> <p>7. Multiplication before subtraction: <math>4 \times 3 = 12</math>, then <math>20 - 12 = 8</math>.</p> <p>8. Parentheses first: <math>4 + 5 = 9</math>, then <math>9 \times 2 = 18</math>.</p> <p>9. Divide first: <math>18 \div 3 = 6</math>, then add <math>6 + 7 = 13</math>.</p> <p>10. Exponent first: <math>3^2 = 9</math>, then <math>2 \times 9 = 18</math>.</p> <p>11. <math>4^2 = 16</math>, then <math>16 + 5 = 21</math>.</p> <p>12. <math>2^3 = 8</math>, then <math>30 - 8 = 22</math>.</p> <p>13. Parentheses first: <math>6 - 2 = 4</math>, then <math>4^2 = 16</math>.</p> <p>14. Divide before adding: <math>8 \div 4 = 2</math>, then <math>12 + 2 = 14</math>.</p> | <p>15. Parentheses: <math>2 + 4 = 6</math>. Exponent: <math>6^2 = 36</math>. Multiply: <math>3 \times 36 = 108</math>.</p> <p>16. Exponent: <math>4^2 = 16</math>. Multiply: <math>3 \times 16 = 48</math>. Subtract: <math>50 - 48 = 2</math>.</p> <p>17. Parentheses: <math>5 + 5 = 10</math>. Divide: <math>100 \div 10 = 10</math>. Add: <math>10 + 6 = 16</math>.</p> <p>18. <math>2^3 = 8</math> and <math>4 \times 5 = 20</math>, so <math>8 + 20 = 28</math>.</p> <p>19. Each set of parentheses first: 10 and 5, then <math>10 \times 5 = 50</math>.</p> <p>20. Exponent inside: <math>3^2 = 9</math>, then <math>9 - 1 = 8</math>. Multiply: <math>2 \times 8 = 16</math>. Add: <math>7 + 16 = 23</math>.</p> <p>21. Area of a square is side squared: <math>9^2 = 9 \times 9 = 81</math>. So the garden covers 81 square feet.</p> <p>22. Multiply before subtracting: <math>3 \times 8 = 24</math>, then <math>24 - 5 = 19</math>. Maria keeps 19 markers.</p> <p>23. Inside the parentheses first: <math>6 \times 4 = 24</math>. Then <math>2 \times 24 = 48</math>, so there are 48 seats in all.</p> <p>24. Exponent first: <math>2^4 = 16</math>. Then <math>5 \times 16 = 80</math>, so the sample has 80 cells after 4 hours.</p> |
|---|---|



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