# Prime Factorization with Exponents

| Name: _____ | Date: _____ | Score: _____ / 24 |
|---|---|---|

## Quick Review

The **prime factorization** of a whole number writes it as a product of *prime numbers* only — numbers like $2, 3, 5, 7, 11$ that have no factors besides $1$ and themselves. A **factor tree** helps: keep breaking a number into two factors until every branch ends in a prime. When the same prime shows up more than once, gather the copies into an **exponent**, so $2 \times 2 \times 2 = 2^3$. Every whole number greater than $1$ has exactly *one* prime factorization, so this is like a number's fingerprint. It also makes finding the GCF and LCM much easier.

◇ **Example:** Write the prime factorization of $72$ using exponents.

⇒ Build a factor tree. Start by splitting $72 = 8 \times 9$. Now break each branch: $8 = 2 \times 2 \times 2$ and $9 = 3 \times 3$. Every branch now ends in a prime, so $72 = 2 \times 2 \times 2 \times 3 \times 3$. Finally, collect the repeats into exponents — there are three $2$s and two $3$s — which gives $2^3 \times 3^2$. (Quick check: $8 \times 9 = 72$.)

**Answer:** $72 = 2^3 \times 3^2$

## PRACTICE

*Write the prime factorization of each number using exponents.*

**1.** $12$ _____

**2.** $18$ _____

**3.** $20$ _____

**4.** $24$ _____

**5.** $27$ _____

**6.** $30$ _____

**7.** $36$ _____

**8.** $40$ _____

**9.** $45$ _____

**10.** $48$ _____

**11.** $50$ _____

**12.** $60$ _____

**13.** $64$ _____

**14.** $75$ _____

**15.** $80$ _____

**16.** $90$ _____

**17.** $100$ _____

**18.** $120$ _____

**19.** $144$ _____

**20.** $200$ _____

### Word Problems

**21.** A music teacher has $84$ stickers to share. Write the prime factorization of $84$ using exponents. _____

**22.** A number's prime factorization is $2^3 \times 3$. What is the number? _____

**23.** Two gears have $2^2 \times 3$ and $2 \times 3^2$ teeth. Using prime factorizations, find the least common multiple of their tooth counts. _____

**24.** Nina says the prime factorization of $30$ is $1 \times 2 \times 3 \times 5$. What mistake did she make? _____

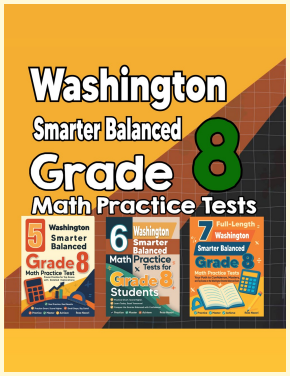
# Answer Keys

1. $2^2 \times 3$
2. $2 \times 3^2$
3. $2^2 \times 5$
4. $2^3 \times 3$
5. $3^3$
6. $2 \times 3 \times 5$
7. $2^2 \times 3^2$
8. $2^3 \times 5$
9. $3^2 \times 5$
10. $2^4 \times 3$
11. $2 \times 5^2$
12. $2^2 \times 3 \times 5$
13. $2^6$
14. $3 \times 5^2$
15. $2^4 \times 5$
16. $2 \times 3^2 \times 5$
17. $2^2 \times 5^2$
18. $2^3 \times 3 \times 5$
19. $2^4 \times 3^2$
20. $2^3 \times 5^2$
21. $84 = 2^2 \times 3 \times 7$
22. $24$
23. $36$
24. $1$ is not prime; $30 = 2 \times 3 \times 5$

## Step-by-Step Explanations

1. $12 = 4 \times 3 = 2 \times 2 \times 3$, which is $2^2 \times 3$.
2. $18 = 2 \times 9 = 2 \times 3 \times 3 = 2 \times 3^2$.
3. $20 = 4 \times 5 = 2 \times 2 \times 5 = 2^2 \times 5$.
4. $24 = 8 \times 3 = 2 \times 2 \times 2 \times 3 = 2^3 \times 3$.
5. $27 = 3 \times 9 = 3 \times 3 \times 3 = 3^3$.
6. $30 = 2 \times 15 = 2 \times 3 \times 5$; each prime appears once.
7. $36 = 4 \times 9 = 2 \times 2 \times 3 \times 3 = 2^2 \times 3^2$.
8. $40 = 8 \times 5 = 2 \times 2 \times 2 \times 5 = 2^3 \times 5$.
9. $45 = 9 \times 5 = 3 \times 3 \times 5 = 3^2 \times 5$.
10. $48 = 16 \times 3 = 2 \times 2 \times 2 \times 2 \times 3 = 2^4 \times 3$.
11. $50 = 2 \times 25 = 2 \times 5 \times 5 = 2 \times 5^2$.
12. $60 = 4 \times 15 = 2 \times 2 \times 3 \times 5 = 2^2 \times 3 \times 5$.
13. $64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$.
14. $75 = 3 \times 25 = 3 \times 5 \times 5 = 3 \times 5^2$.
15. $80 = 16 \times 5 = 2^4 \times 5$.
16. $90 = 2 \times 45 = 2 \times 3 \times 3 \times 5 = 2 \times 3^2 \times 5$.
17. $100 = 4 \times 25 = 2 \times 2 \times 5 \times 5 = 2^2 \times 5^2$.
18. $120 = 8 \times 15 = 2^3 \times 3 \times 5$.
19. $144 = 16 \times 9 = 2^4 \times 3^2$.
20. $200 = 8 \times 25 = 2^3 \times 5^2$.
21. $84 = 4 \times 21 = 2 \times 2 \times 3 \times 7$. Collecting the two 2s gives $2^2 \times 3 \times 7$.
22. $2^3 = 8$ and then $8 \times 3 = 24$, so the number is $24$.
23. Take the highest power of each prime that appears: $2^2$ and $3^2$. The LCM is $2^2 \times 3^2 = 4 \times 9 = 36$.
24. The number $1$ is not a prime number, so it should never appear in a prime factorization. The correct answer is just $2 \times 3 \times 5$.

## Want Even More Practice? Check Out Our Other Washington SBAC Test Books!




### Washington SBAC Grade 8 Math Preparation Bundle

18 full-length practice tests across three books (5 + 6 + 7)

No repeated questions—maximum practice value!

**18 Tests!**
**3 Books**
**One Bundle**

**Important:** All our test books contain **unique, completely different tests** from each other! Each book offers fresh practice questions—no repeats!

### 5 Practice Tests

- ✓ 5 complete practice tests with detailed explanations
- ✓ Perfect foundation for SBAC test preparation
- ✓ Builds confidence and test-taking skills
- ✓ High-quality questions aligned with state standards

**Start your practice journey!**

### 6 Practice Tests

- ✓ 6 complete practice tests with detailed explanations
- ✓ **Unique tests**—different from the 5 tests book
- ✓ Perfect for more practice after mastering 5 tests
- ✓ Builds even more confidence and test-taking skills
- ✓ Same high-quality questions aligned with standards

**Take your practice to the next level!**

### 7 Practice Tests

- ✓ 7 complete practice tests for maximum preparation
- ✓ **Unique tests**—different from 5 and 6 tests books
- ✓ The most comprehensive practice for Grade 8
- ✓ Ideal for students aiming for top scores
- ✓ Extensive practice builds mastery and confidence

**Go all the way with comprehensive practice!**