

PRIME NUMBERS AND FACTORIZATION

PRIME NUMBERS

A positive whole number is a **prime number** if it has exactly two different factors. Numbers that have more than two factors are called **composite**. The number "one" is neither prime nor composite because it has only one factor.

Examples

Determine if each number is prime or composite.

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|----|--|----|--|
| a. | 2: factors are 1, 2 so prime | b. | 7: factors are 1, 7 so prime |
| c. | 9: factors are 1, 3, 9 so composite | d. | 17: factors are 1, 17 so prime |
| e. | 77: factors are 1, 7, 11, 77 composite | f. | 57: factors are 1, 3, 19, 57 composite |

Problems

Determine if each number is prime or composite.

- | | | | | | | | |
|----|----|-----|----|-----|----|-----|----|
| 1. | 5 | 2. | 11 | 3. | 17 | 4. | 54 |
| 5. | 27 | 6. | 29 | 7. | 99 | 8. | 19 |
| 9. | 51 | 10. | 91 | 11. | 1 | 12. | 97 |

PRIME FACTORIZATION

One of the most important properties of arithmetic is that, except for order, any whole number n ($n > 1$) can be factored into the product of primes and powers of primes in only one way. This factoring is called the **prime factorization**.

Examples

Factor each number into the product of primes. Write each answer using exponents.

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|----|---|----|--|
| a. | 12: $2 \cdot 6 = 2 \cdot 2 \cdot 3 = 2^2 \cdot 3$ | b. | 54: $9 \cdot 6 = 3 \cdot 3 \cdot 2 \cdot 3 = 2 \cdot 3^3$ |
| c. | 100: $10 \cdot 10 = 2 \cdot 5 \cdot 2 \cdot 5 = 2^2 \cdot 5^2$ | d. | 37: 37 is prime |
| e. | 364: $2 \cdot 182 = 2 \cdot 2 \cdot 91 = 2 \cdot 2 \cdot 7 \cdot 13 = 2^2 \cdot 7 \cdot 13$ | f. | 375: $3 \cdot 125 = 3 \cdot 5 \cdot 5 \cdot 5 = 3 \cdot 5^3$ |

Problems

Factor each number into the product of primes. Write each answer using exponents.

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|-----|-----|-----|-----|-----|------|-----|------|
| 13. | 50 | 14. | 27 | 15. | 39 | 16. | 80 |
| 17. | 36 | 18. | 144 | 19. | 64 | 20. | 23 |
| 21. | 129 | 22. | 51 | 23. | 1000 | 24. | 1001 |

Answers

- | | | | | | | | |
|-----|-----------------|-----|-----------------|-----|-----------------|-----|-----------------------|
| 1. | P | 2. | P | 3. | P | 4. | C |
| 5. | C | 6. | P | 7. | C | 8. | P |
| 9. | C | 10. | P | 11. | neither | 12. | P |
| 13. | $2 \cdot 5^2$ | 14. | 3^3 | 15. | $3 \cdot 13$ | 16. | $2^4 \cdot 5$ |
| 17. | $2^2 \cdot 3^2$ | 18. | $2^4 \cdot 3^2$ | 19. | 2^6 | 20. | 23 |
| 21. | $3 \cdot 43$ | 22. | $3 \cdot 17$ | 23. | $2^3 \cdot 5^3$ | 24. | $7 \cdot 11 \cdot 13$ |