# Prime Numbers and Prime Factorization on the ISEE

**All Levels**

LESSON GOAL: Be able to provide the prime factorization of any number given on the ISEE.

***ISEE Question:*** How many distinct prime factors does 150 have?

***Solution:*** Pay attention to the phrasing of the question. The most important words are "*distinct*" (different from each other) and "*prime*."

***Prime numbers*** are those that have exactly two factors (they are divisible by only two numbers): themselves and 1. For example, 7 is a prime number because it is only divisible by 7 and by 1.

> ***NOTE*** that the number 1 doesn't fit into the above definition (it has only one factor), and so it is NOT a prime number! That is a very common trap on the ISEE.

So, the ***list of prime numbers*** starts with 2 (the only even prime), then 3, 5, 7, 11, 13, 17, 19, 23, and so on …

STEP 1: We're going to use the ***line method***. Write the number and draw a vertical line next to it.


STEP 2: On the other side of the line, write the smallest prime number that can divide 150. (That is 2.)

STEP 3: Write the quotient below the 150 (it is 75) and next to it, the smallest prime number that divides that.

| | |
|---|---|
| 150 | 2 |
| 75 | 3 |
| 25 | 5 |
| 5 | 5 |
| 1 | |

Repeat STEPS 2 and 3 until you reach the number 1 (GAME OVER!).

On the right side of the line you have the ***prime factorization***: $150 = 2 \times 3 \times 5 \times 5$

But, of course, we are looking for distinct prime factors, so the answer is "3 distinct prime factors: 2, 3 and 5."

NOTE that 150 has many other factors that AREN'T prime: 6, 10, 15, 25, 50, 75, and 150. Those can be found by using the ***factor tree method*** (see the lesson on "Factoring Numbers on the ISEE").