

Prime Factorization 2

To find all of the prime numbers less than 100 we can use the *sieve of Eratosthenes*.

2	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Cross out every even number starting at 4.

Cross out every third number starting at 6.

(You don't have to check every fourth number. Why?)

Cross out every fifth number starting at 10.

(You don't have to check every sixth number. Why?)

Cross out every seventh number starting at 14.

(You don't have to check every eighth number. Why?)

(You don't have to check every ninth number. Why?)

(You don't have to check every tenth number. Why?)

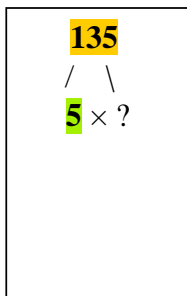
The explanation why you don't have to check numbers bigger than 10 is beyond this text.

The numbers that are not crossed out are primes.

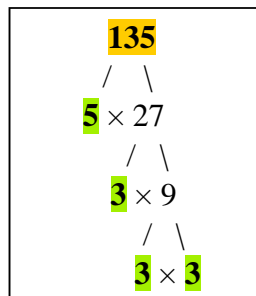
Now you should only have left all the primes between 0 and 100:

2, 3, 5, 7, _____

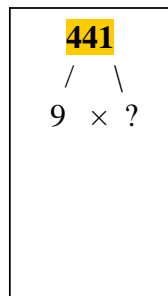
Use the divisibility tests for 2, 3, 4, 5, 6, 9, or 10 in factoring.



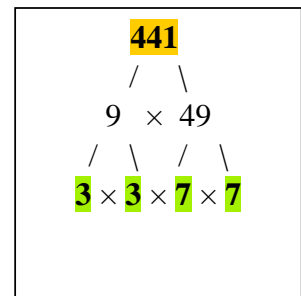
$$\begin{array}{r} 27 \\ 5 \overline{) 135} \\ \underline{-10} \\ 35 \\ \underline{-35} \\ 0 \end{array}$$



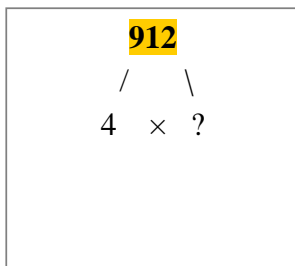
We start out by noticing that 135 is **divisible by 5**. Long division tells us that $135 = 5 \times 27$. Eventually we get $135 = 3 \times 3 \times 3 \times 5$.



$$\begin{array}{r} 49 \\ 9 \overline{) 441} \\ \underline{-36} \\ 81 \\ \underline{-81} \\ 0 \end{array}$$

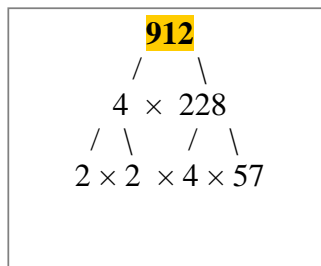


Adding the digits of 441, we get 9, so it is **divisible by 9**. We divide to get $441 = 9 \times 49$. Eventually, we get $441 = 3 \times 3 \times 7 \times 7$.

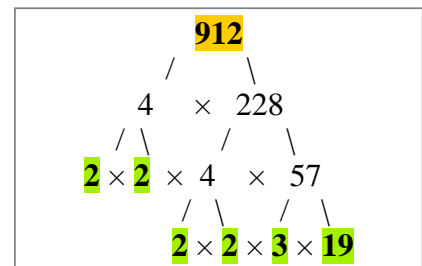


$$\begin{array}{r} 228 \\ 4 \overline{) 912} \\ \underline{-8} \\ 11 \\ \underline{-8} \\ 32 \\ \underline{-32} \\ 0 \end{array}$$

The last two digits of 912 are "12" so it is **divisible by 4**.



228 is also **divisible by 4** (because its last digits are "28").



Lastly, 57 is factored to 3×19 . So, 912 factored is $2 \times 2 \times 2 \times 2 \times 3 \times 19$.

1. Factor these numbers till the factors are prime numbers. Use a notebook for the long division.

<div>a. 124</div> <div><div>/ \</div><div>2 × <u> </u></div><div>/ \</div></div>	<div>b. 260</div> <div><div>/ \</div><div>10 × <u> </u></div><div>/ \ / \</div></div>	<div>c. 96</div> <div><div>/ \</div><div>3 × <u> </u></div><div>/ \</div></div>
<div>d. 90</div>	<div>e. 165</div>	<div>f. 95</div>
<div>g. 80</div>	<div>h. 240</div>	<div>i. 272</div>
<div>j. 76</div>	<div>k. 126</div>	<div>l. 104</div>

2. Factor the following numbers to prime factors.

a. 196	b. 380	c. 336
d. 306	e. 116	f. 720
g. 675	h. 990	i. 945

Puzzle Corner

Find all primes between 0 and 200. Use the sieve of Eratosthenes again (you need to make a grid in your notebook).

This time you need to cross out every 2nd number starting at 4, every 3rd number starting at 6, every 5th number starting at 10, every 7th number starting at 14, every 11th number starting at 22, and every 13th number starting at 26.