

6th Grade Math
Prime Factorization

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Notes:

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Factor Pairs = sets of factors

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Factor Pairs = sets of factors

for a particular number

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Example:

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48

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Example:

$$48 = 1 \cdot 48$$

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Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

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Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

$$= 3 \cdot 16$$

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Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

$$= 3 \cdot 16$$

$$= 4 \cdot 12$$

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Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

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Factor Pairs of 48

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Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

$$= 3 \cdot 16$$

$$= 4 \cdot 12$$

$$= 6 \cdot 8$$

Factor Pairs of 48

1·48, 2·24, 3·16, 4·12, and 6·8

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Notes:

Factor Pairs = sets of factors

for a particular number

Now Try for 36

Example:

$$48 = 1 \cdot 48$$

$$= 2 \cdot 24$$

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Factor Pairs of 48

1·48, 2·24, 3·16, 4·12, and 6·8

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1·48, 2·24, 3·16, 4·12, and 6·8

Now Try for 36

$$36 = 1 \cdot \underline{\quad}$$

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1·48, 2·24, 3·16, 4·12, and 6·8

Now Try for 36

$$36 = 1 \cdot \underline{\quad}$$

$$= 2 \cdot \underline{\quad}$$

$$= 3 \cdot \underline{\quad}$$

$$= 4 \cdot \underline{\quad}$$

$$= 6 \cdot \underline{\quad}$$

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Factor Pairs of 48

1-48, 2-24, 3-16, 4-12, and 6-8

Now Try for 36

$$36 = 1 \cdot \underline{\quad}$$

$$= 2 \cdot \underline{\quad}$$

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Factor Pairs of 36

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Factor Pairs of 48
1·48, 2·24, 3·16, 4·12, and 6·8

Now Try for 36
 $36 = 1 \cdot \underline{\quad}$
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Factor Pairs of 36
1·36, 2·18, 3·12, 4·9, 6·6

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Remember



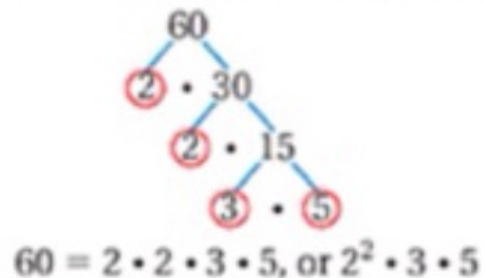
A prime number is a whole number greater than 1 with exactly two factors, 1 and itself. A *composite number* is a whole number greater than 1 with factors other than 1 and itself.

Key Idea

Prime Factorization

The **prime factorization** of a composite number is the number written as a product of its prime factors.

You can use factor pairs and a **factor tree** to help find the prime factorization of a number. The factor tree is complete when only prime factors appear in the product. A factor tree for 60 is shown.



Remember



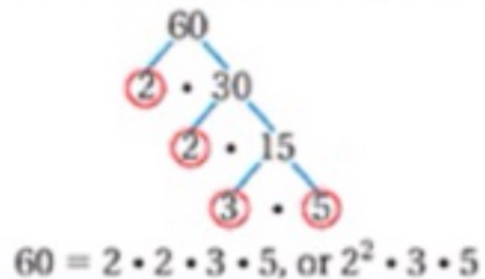
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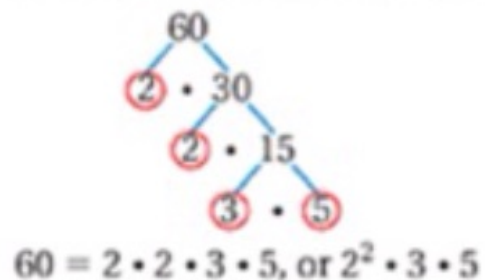
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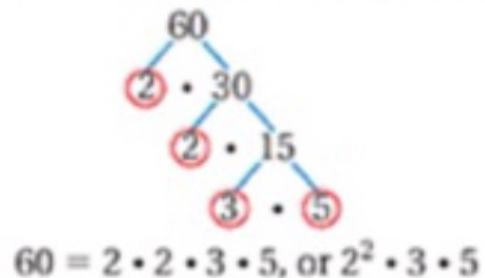
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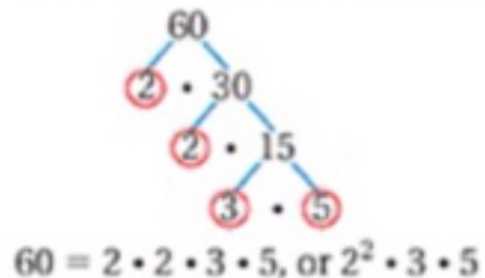
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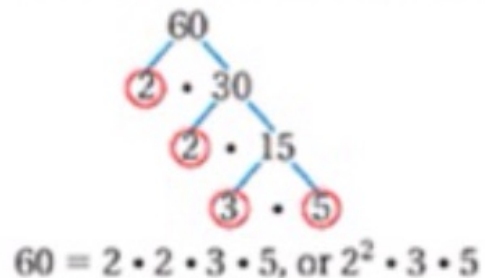
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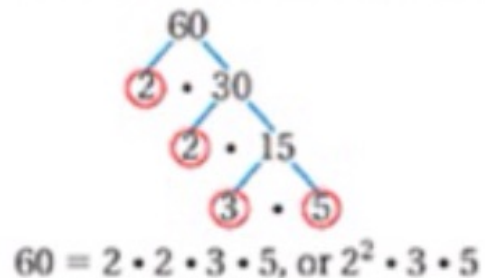
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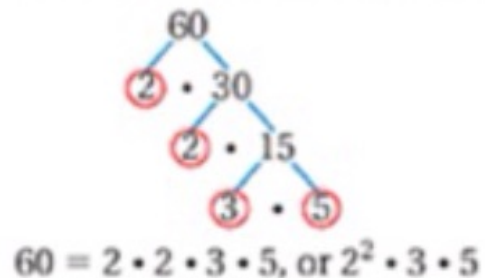
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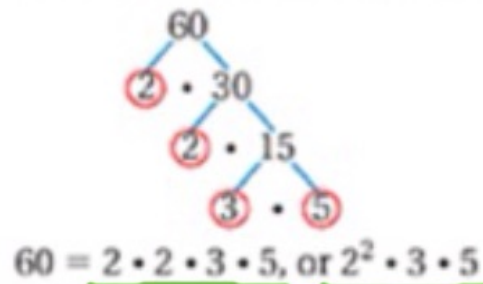
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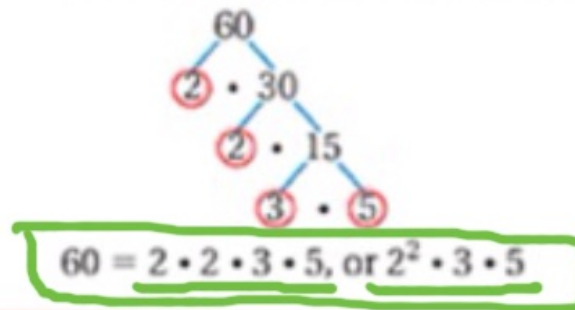
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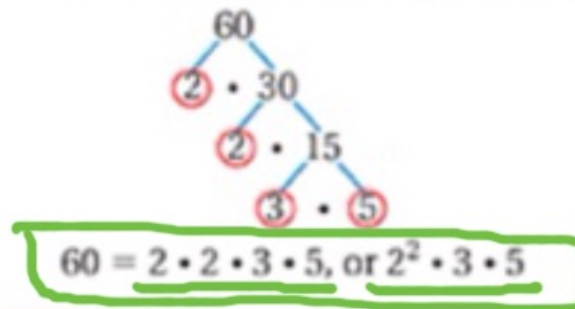
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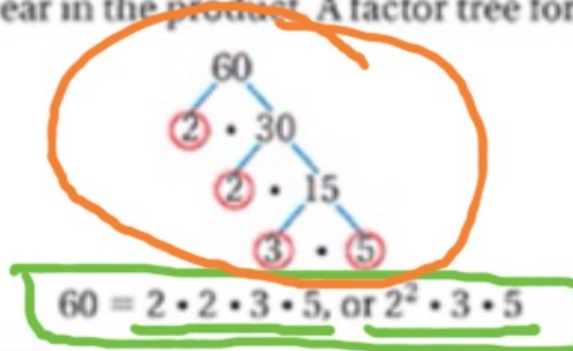
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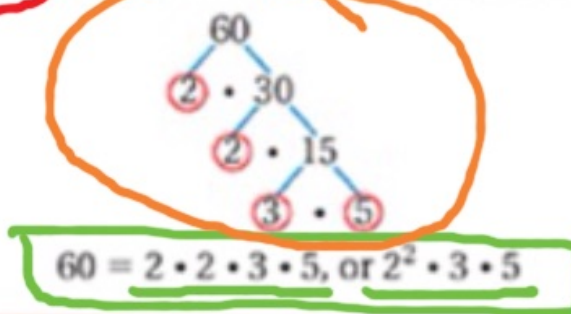
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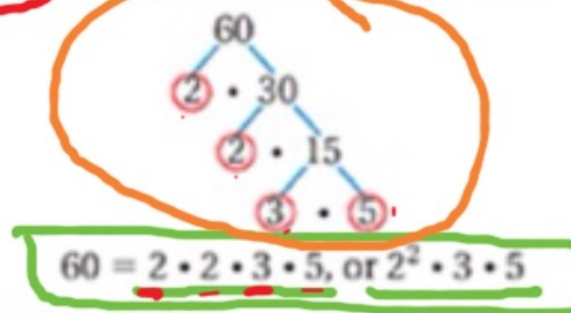
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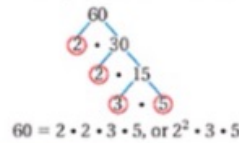
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EXAMPLE 2 Writing a Prime Factorization

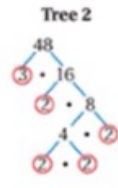
Write the prime factorization of 48.

Choose any factor pair of 48 to begin the factor tree.

Study Tip
 Notice that beginning with different factor pairs results in the same prime factorization. Every composite number has only one prime factorization.



Find a factor pair and draw "branches."
 Circle the prime factors as you find them.
 Find factors until each branch ends at a prime factor.



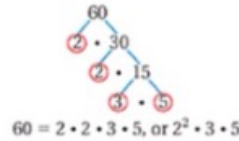
$48 = 2 \cdot 2 \cdot 3 \cdot 2 \cdot 2$

$48 = 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

The prime factorization of 48 is $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$, or $2^4 \cdot 3$.

Remember
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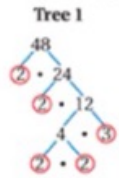


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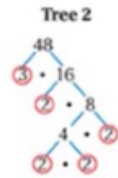
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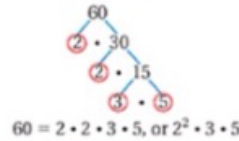
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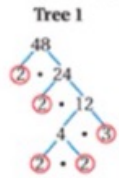


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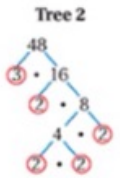
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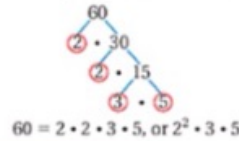
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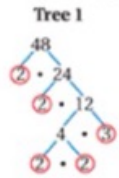


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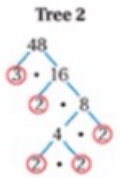
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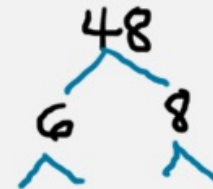
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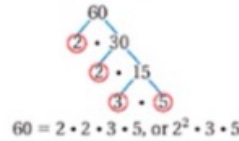
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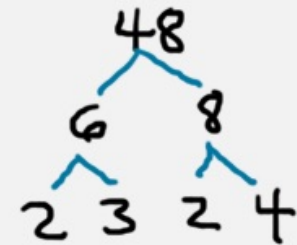
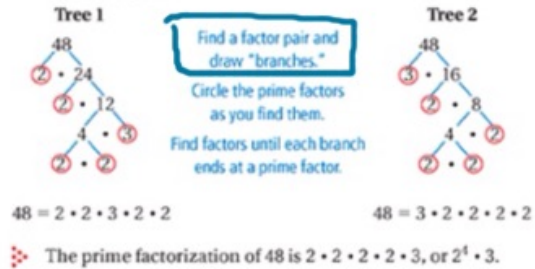


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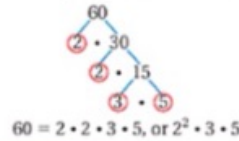
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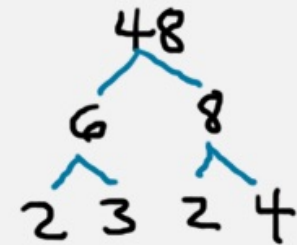
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Tree 1
 48 = 2 · 24 = 2 · 2 · 12 = 2 · 2 · 4 · 3 = 2 · 2 · 2 · 2 · 3
 48 = 2 · 2 · 3 · 2 · 2

Tree 2
 48 = 3 · 16 = 3 · 2 · 8 = 3 · 2 · 4 · 2 = 3 · 2 · 2 · 2 · 2
 48 = 3 · 2 · 2 · 2 · 2

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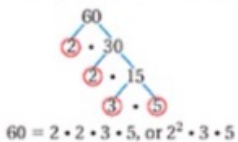
❖ The prime factorization of 48 is 2 · 2 · 2 · 2 · 3, or 2⁴ · 3.



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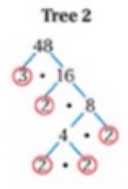
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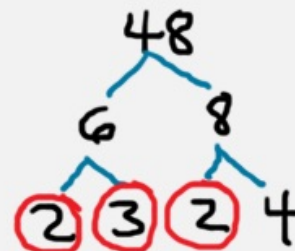
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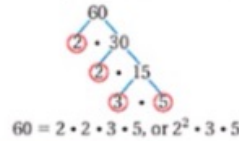
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 A **prime number** is a whole number greater than 1 with exactly two factors, 1 and itself. A **composite number** is a whole number greater than 1 with factors other than 1 and itself.

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EXAMPLE 2 Writing a Prime Factorization

Write the prime factorization of 48.

Choose any factor pair of 48 to begin the factor tree.

Study Tip
 Notice that beginning with different factor pairs results in the same prime factorization. Every composite number has only one prime factorization.

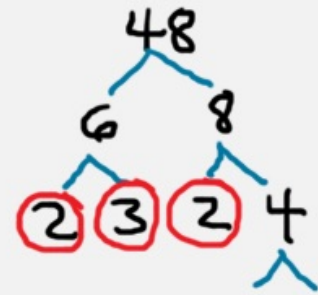
Tree 1
 48
 2 • 24
 2 • 12
 4 • 3
 2 • 2

Tree 2
 48
 3 • 16
 2 • 8
 4 • 2
 2 • 2

48 = 2 • 2 • 3 • 2 • 2 48 = 3 • 2 • 2 • 2 • 2

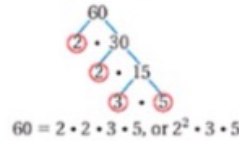
The prime factorization of 48 is 2 • 2 • 2 • 2 • 3, or 2⁴ • 3.

Find a factor pair and draw "branches."
 Circle the prime factors as you find them.
 Find factors until each branch ends at a prime factor.



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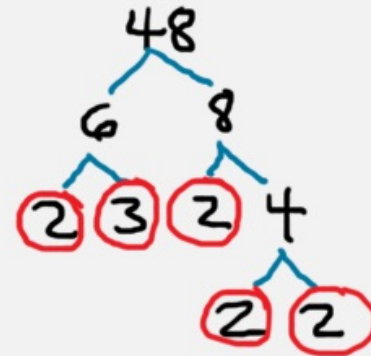
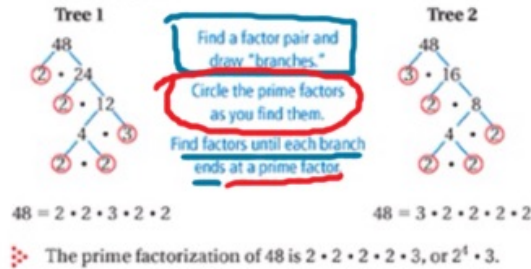


EXAMPLE 2 Writing a Prime Factorization

Write the prime factorization of 48.

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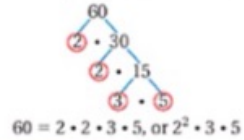
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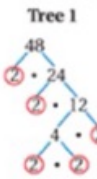


EXAMPLE 2 Writing a Prime Factorization

Write the prime factorization of 48.

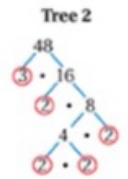
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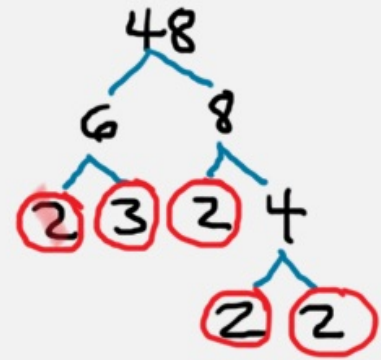
$48 = 2 \cdot 2 \cdot 3 \cdot 2 \cdot 2$

Find a factor pair and draw "branches."
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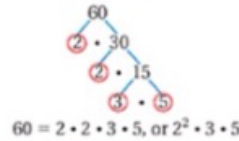
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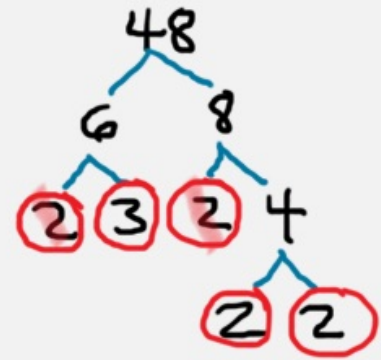
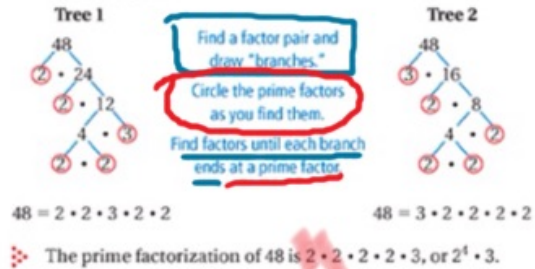


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Write the prime factorization of 48.

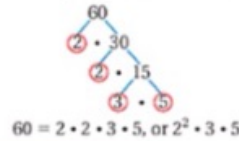
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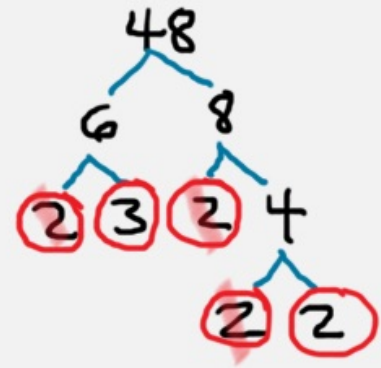
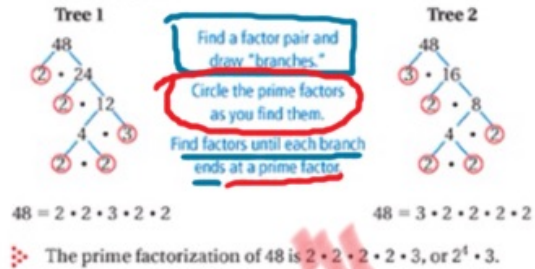


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Write the prime factorization of 48.

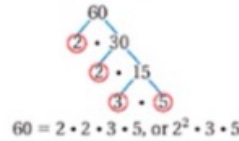
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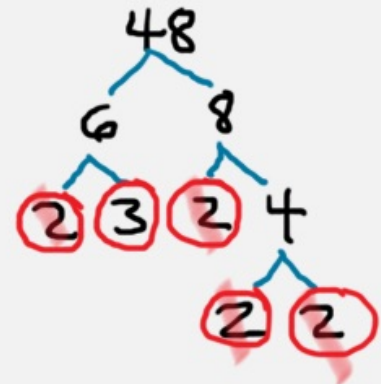
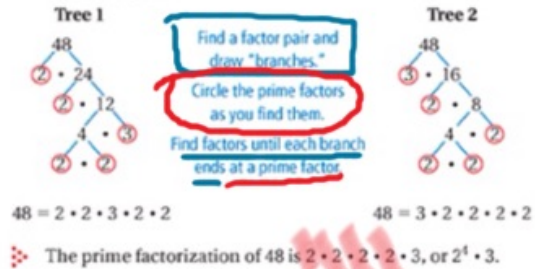


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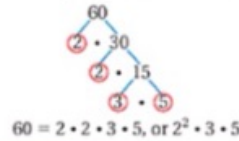
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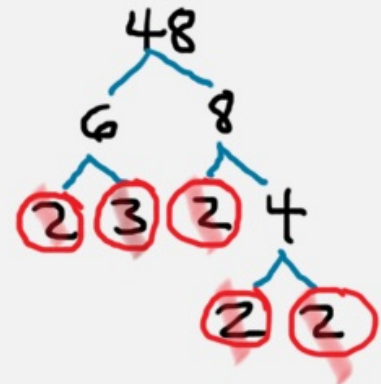
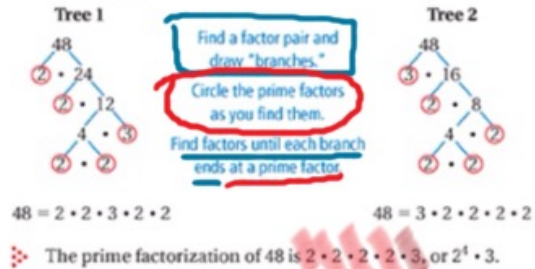


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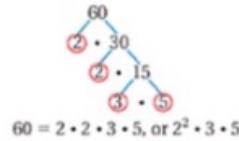
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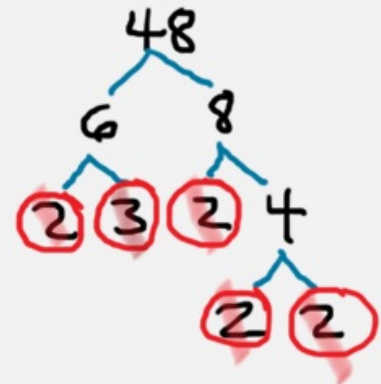
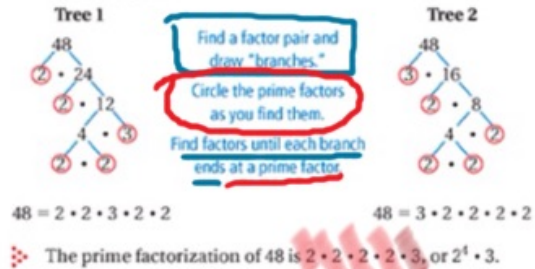


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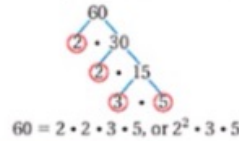


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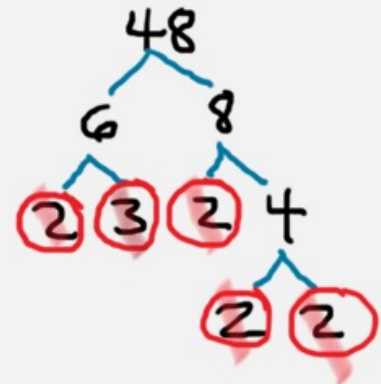
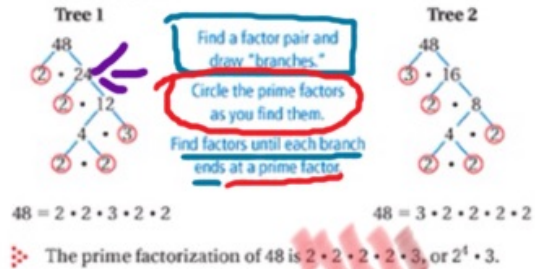
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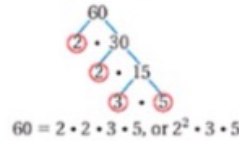
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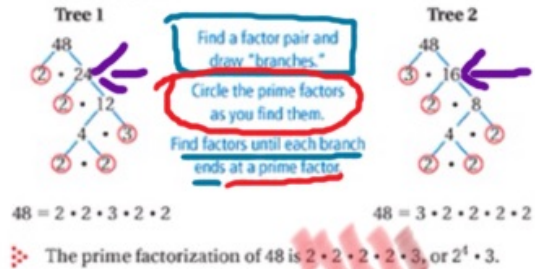


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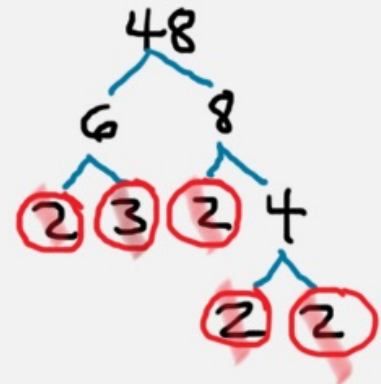
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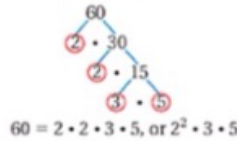


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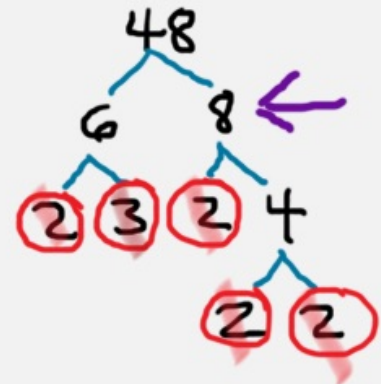
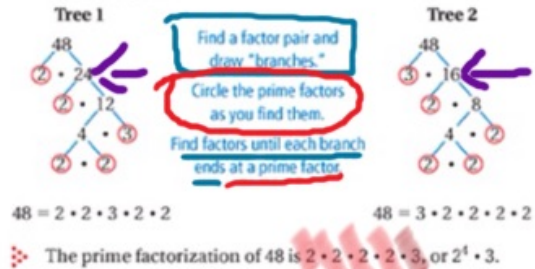


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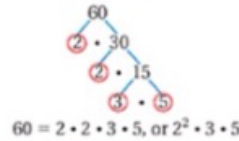
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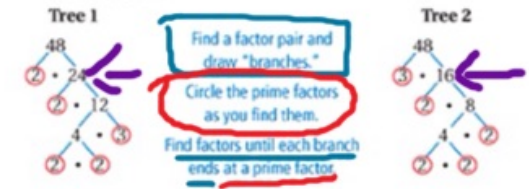


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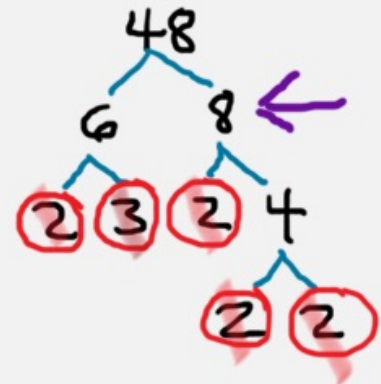
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3
Using a Prime Factorization

What is the greatest perfect square that is a factor of 1575?

Because 1575 has many factors, it is not efficient to list all of its factors and check for perfect squares. Use the prime factorization of 1575 to find any perfect squares that are factors.

```

graph TD
    1575 --- 25
    1575 --- 63
    25 --- 5_1((5))
    25 --- 5_2((5))
    63 --- 7((7))
    63 --- 9
    9 --- 3_1((3))
    9 --- 3_2((3))
            
```

$1575 = 3 \cdot 3 \cdot 5 \cdot 5 \cdot 7$

The prime factorization shows that 1575 has three factors other than 1 that are perfect squares.

$3 \cdot 3 = 9$
 $5 \cdot 5 = 25$
 $(3 \cdot 5) \cdot (3 \cdot 5) = 15 \cdot 15 = 225$

❖ So, the greatest perfect square that is a factor of 1575 is 225.

On Your Own

Write the prime factorization of the number.

5. 20
6. 88
7. 90
8. 462

9. What is the greatest perfect square that is a factor of 396? Explain.

Perfect Square

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    1575 --> 25
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    25 --> 5
    25 --> 5
    63 --> 7
    63 --> 9
    9 --> 3
    9 --> 3
    style 5 stroke:#f00,stroke-width:2px
    style 5 stroke:#f00,stroke-width:2px
    style 7 stroke:#f00,stroke-width:2px
    style 3 stroke:#f00,stroke-width:2px
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1575 = 3 · 3 · 5 · 5 · 7

The prime factorization shows that 1575 has three factors other than 1 ~~that are perfect squares.~~ **2 are perfect squares.**

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      style 5_1 stroke:#f96,stroke-width:2px
      style 5_2 stroke:#f96,stroke-width:2px
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or

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     /  \
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   / \  / \
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   \ /  \ / \
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9. What is the greatest perfect square that is a factor of 396? Explain.

Perfect Square

$n^2 = n \cdot n$

$$\begin{array}{r} 4 \\ 25 \\ \times 9 \\ \hline 225 \end{array}$$

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3 Using a Prime Factorization

What is the greatest perfect square that is a factor of 1575?

Because 1575 has many factors, it is not efficient to list all of its factors and check for perfect squares. Use the prime factorization of 1575 to find any perfect squares that are factors.

1575 = 3 · 3 · 5 · 5 · 7

The prime factorization shows that 1575 has three factors other than 1 ~~that are perfect squares~~. **2 are perfect squares.**

3 · 3 = 9 5 · 5 = 25 → (3 · 5) · (3 · 5) = 15 · 15 = 225

❖ So, the greatest perfect square that is a factor of 1575 is 225.

On Your Own

Write the prime factorization of the number.

5. 20 6. 88 7. 90 8. 462

9. What is the greatest perfect square that is a factor of 396? Explain.

Perfect Square

$n^2 = n \cdot n$

4
25
or
x 9

225

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Practice and Problem Solving

Use divisibility rules to determine whether the number is divisible by 2, 3, 5, 6, 9, and 10. Use a calculator to check your answer.


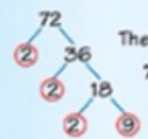
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16. 16 17. 25 18. 30 19. 26
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  The prime factorization of $72 = 2 \cdot 2 \cdot 2 \cdot 9 = 2^3 \cdot 9$.

24. **ERROR ANALYSIS** Describe and correct the error in writing the prime factorization.

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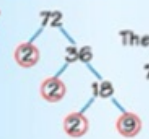
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$4 \overline{)1044}$

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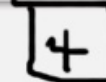
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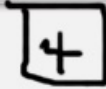
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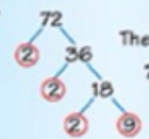
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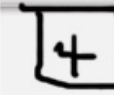
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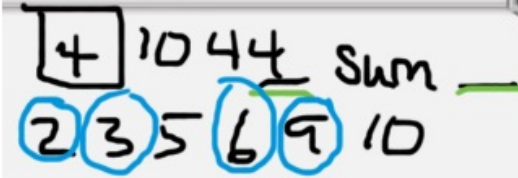
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 A hand-drawn diagram on a whiteboard background. At the top, a box contains the number 4. To its right is the number 1044 with a horizontal line underneath it. Further right is the word "Sum" followed by a horizontal line. Below these elements, the numbers 2, 3, 5, 6, 9, and 10 are written. The numbers 2, 3, 6, and 9 are each circled in blue.

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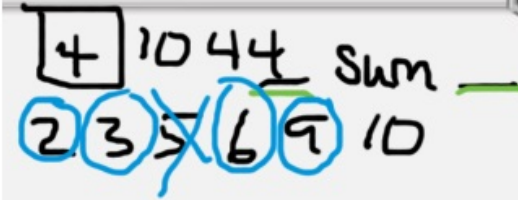
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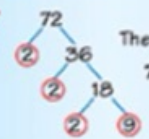
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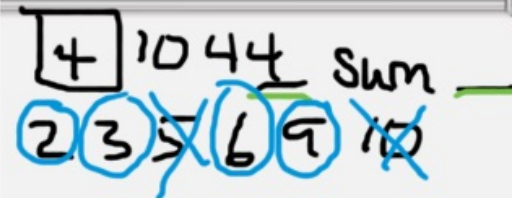
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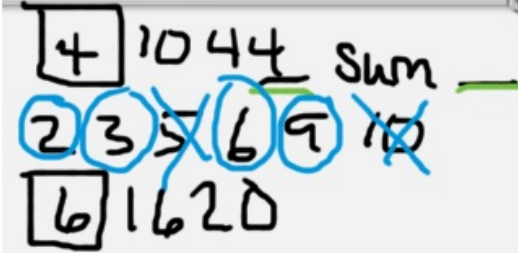
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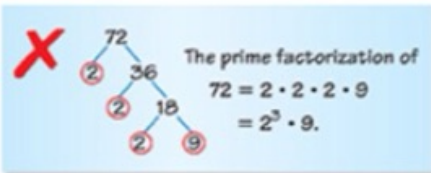
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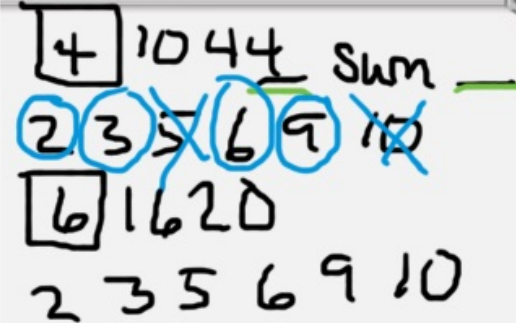
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$\boxed{4} \mid 1044$ Sum \rightarrow
 $\textcircled{2} \textcircled{3} \textcircled{6} \textcircled{9}$ ~~5~~ ~~10~~
 $\boxed{6} \mid 1620$
 2 3 5 6 9 10

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6 1620

2 3 5 6 9 10

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 $2 \quad 3 \quad 5 \quad 6 \quad 9 \quad 10$
 $6 \mid 1620$
 $2 \quad 3 \quad 5 \quad 6 \quad 9 \quad 10$
 $8 \mid 15 = 1 \cdot 15$
 $3 \cdot 5$



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$\boxed{10}$ 34

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 2 3 5 6 9 10

$\boxed{8}$ 15 = 1 · 15
 3 · 5

$\boxed{10}$ 34 = 1 ·

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72
 2 36
 2 18
 2 9

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 2 3 5 6 9 10

6 | 1620
 2 3 5 6 9 10

8 | 15 = 1 · 15
 3 · 5

10 | 34 = 1 · 34
 = 2

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$\boxed{6}$ 1620
 2 3 5 6 9 10

$\boxed{8}$ $15 = 1 \cdot 15$
 $3 \cdot 5$

$\boxed{10}$ $34 = 1 \cdot 34$
 $= 2 \cdot 17$

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4 1044 Sum —

~~2~~ ~~3~~ ~~5~~ ~~6~~ ~~9~~ ~~10~~

6 1620

2 3 5 6 9 10

8 15 = 1 · 15
 3 · 5

10 34 = 1 · 34
 = 2 · 17

12 45 =

Practice and Problem Solving

Use divisibility rules to determine whether the number is divisible by 2, 3, 5, 6, 9, and 10. Use a calculator to check your answer.

4. 1044 5. 1485 6. 1620 7. 1709

List the factor pairs of the number.

8. 15 9. 22 10. 34 11. 39
 12. 45 13. 54 14. 59 15. 61

Write the prime factorization of the number.

16. 16 17. 25 18. 30 19. 26
 20. 84 21. 54 22. 65 23. 77

X

72

36

18

9

The prime factorization of
 $72 = 2 \cdot 2 \cdot 2 \cdot 9$
 $= 2^3 \cdot 9.$

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[8] $15 = 1 \cdot 15$
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[10] $34 = 1 \cdot 34$
 $= 2 \cdot 17$

[12] $45 = 1 \cdot$

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Practice and Problem Solving

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- 4. 1044
- 5. 1485
- 6. 1620
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Created with Doceri



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The prime factorization of 72 = 2 · 2 · 2 · 9 = 2³ · 9.

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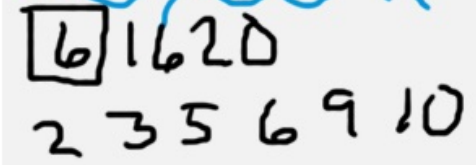
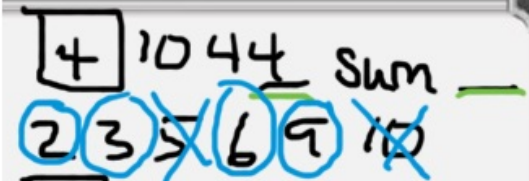
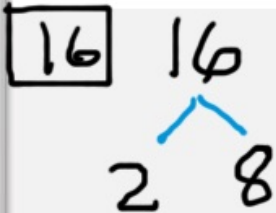
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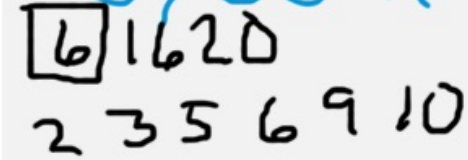
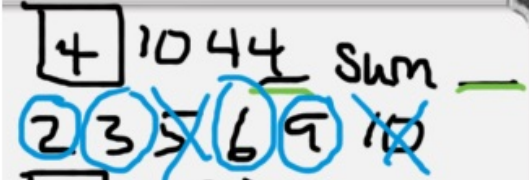
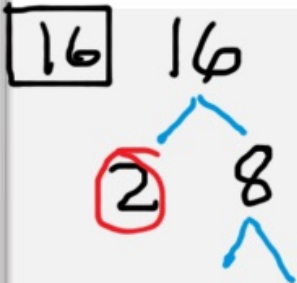
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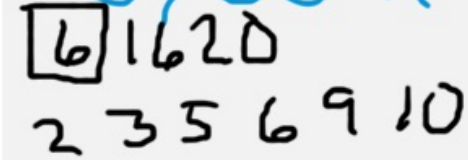
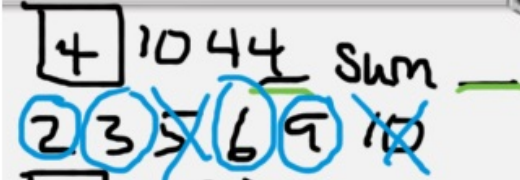
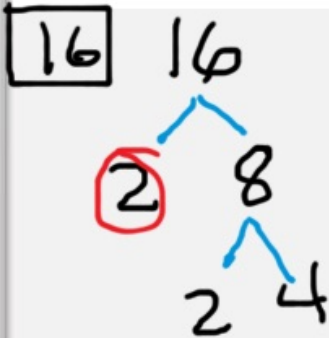
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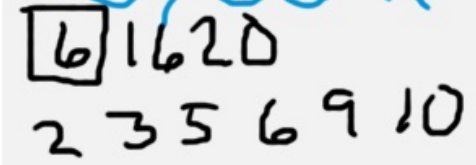
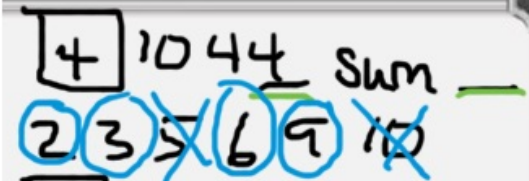
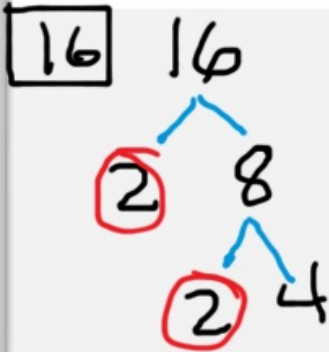
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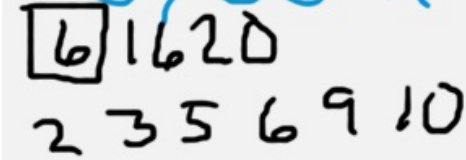
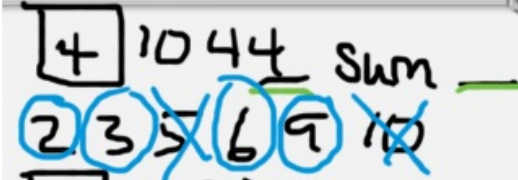
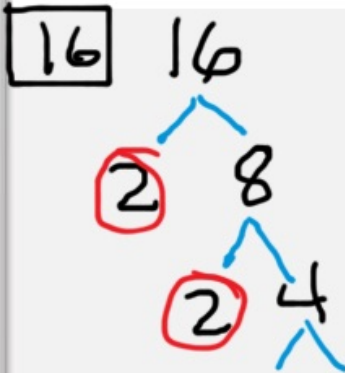
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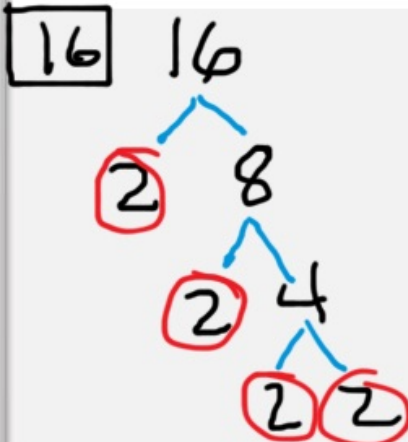
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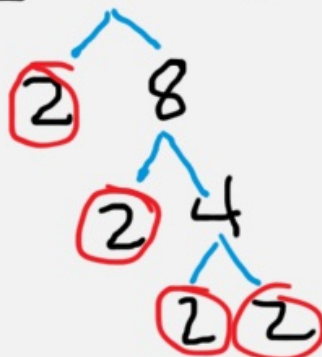
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16 $16 = 2 \cdot 2 \cdot 2 \cdot 2$ **18** 30



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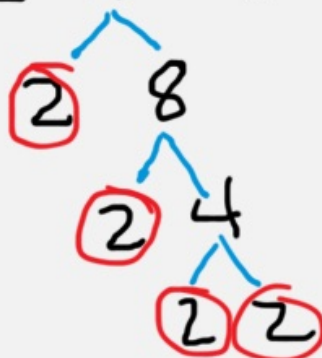
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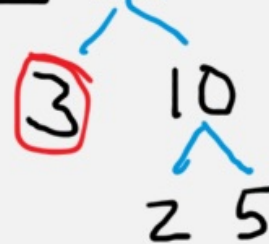
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18 30



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 = 5 ·
 = 9 ·

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Practice and Problem Solving

Use divisibility rules to determine whether the number is divisible by 2, 3, 5, 6, 9, and 10. Use a calculator to check your answer.

- | | | | |
|---------|---------|---------|---------|
| 4. 1044 | 5. 1485 | 6. 1620 | 7. 1709 |
|---------|---------|---------|---------|

List the factor pairs of the number.

- | | | | |
|--------|--------|--------|--------|
| 8. 15 | 9. 22 | 10. 34 | 11. 39 |
| 12. 45 | 13. 54 | 14. 59 | 15. 61 |

Write the prime factorization of the number.

- | | | | |
|--------|--------|--------|--------|
| 16. 16 | 17. 25 | 18. 30 | 19. 26 |
| 20. 84 | 21. 54 | 22. 65 | 23. 77 |

X

The prime factorization of 72 = 2 · 2 · 2 · 9 = 2³ · 9.

24. **ERROR ANALYSIS** Describe and correct the error in writing the prime factorization.

16 $16 = 2 \cdot 2 \cdot 2 \cdot 2$

18 $30 = 3 \cdot 2 \cdot 5$

4 1044 Sum —

2 3 5 6 9 10

6 1620

2 3 5 6 9 10

8 $15 = 1 \cdot 15$
 $3 \cdot 5$

10 $34 = 1 \cdot 34$

12 $45 = 1 \cdot 45$
 $3 \cdot 15$
 $5 \cdot 9$
 $9 = 3 \cdot 3$

$= 3 \cdot 3 \cdot 5$
 $= 3^2 \cdot 5$

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Practice and Problem Solving

Use divisibility rules to determine whether the number is divisible by 2, 3, 5, 6, 9, and 10. Use a calculator to check your answer.

- | | | | |
|---------|---------|---------|---------|
| 4. 1044 | 5. 1485 | 6. 1620 | 7. 1709 |
|---------|---------|---------|---------|

List the factor pairs of the number.

- | | | | |
|--------|--------|--------|--------|
| 8. 15 | 9. 22 | 10. 34 | 11. 39 |
| 12. 45 | 13. 54 | 14. 59 | 15. 61 |

Write the prime factorization of the number.

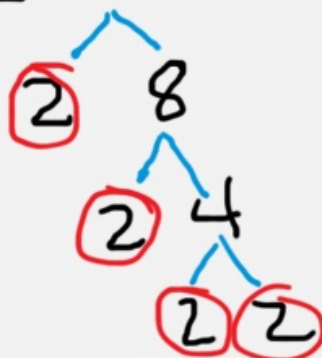
- | | | | |
|--------|--------|--------|--------|
| 16. 16 | 17. 25 | 18. 30 | 19. 26 |
| 20. 84 | 21. 54 | 22. 65 | 23. 77 |

X

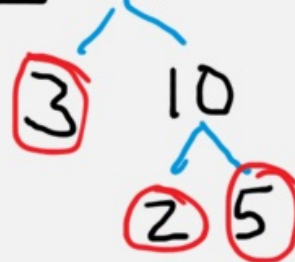
The prime factorization of 72 = $2 \cdot 2 \cdot 2 \cdot 2 \cdot 9$
 = $2^4 \cdot 9$.

24. **ERROR ANALYSIS** Describe and correct the error in writing the prime factorization.

16 $16 = 2 \cdot 2 \cdot 2 \cdot 2$



18 $30 = 2 \cdot 3 \cdot 5$



4 1044 Sum —
~~2~~ ~~3~~ ~~5~~ ~~6~~ ~~9~~ ~~10~~

6 1620
 2 3 5 6 9 10

8 $15 = 1 \cdot 15$
 $3 \cdot 5$

10 $34 = 1 \cdot 34$

12 $45 = 1 \cdot 45$
 sum 9 = $2 \cdot 17$

= $3 \cdot 15$
 = $5 \cdot 9$

= $3 \cdot 3 \cdot 3$

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