Section 1.2 – Squares and Square Roots

A FACTOR is a number that divides evenly into another number.

Ex: The factors of 6 are: 1, 2, 3, 6

The factors of 12 are: 1, 2, 3, 4, 6, 12.

Factors of Perfect Squares

If the factor Repeats, it's only Written once

The factors of **16** are: 1, 2, 4, 8, 16 (5 factors)

The factors of **49** are: 1, 7, 49 (3 factors)

A perfect square will always have an ODD number of factors.

Recall:

Since $4 \times 4 = 16$, **16 is the** SQUARE **of 4**, and **4 is the** Square Root **of 16.**

We use radical symbols ($\sqrt{}$) for square roots.

Ex: $\sqrt{25}$ means what number multiplies by itself to produce 25?

Answer:

$\sqrt{81} =$ 9×9

$\sqrt{36} =$ 6×6

$\sqrt{196} =$ 14×14

Lesson 1.2: Squares and Square Roots

1. Find.

a) $6^2 = 6 \times 6 = 36$ **b)** $11^2 = 11 \times 11$ 121 **c)** $5^2 = 5 \times 5 = 25$

2. Find a square root of each number.

a) 49 $49 = 7 \times 7$ **b)** 64 $= 8 \times 8$ **c)** $\sqrt{196} = 14$

$\sqrt{49} = 7$ $\sqrt{64} = 8$ Because $14 \times 14 = 196$

3. **a)** List the factors of each number in ascending order. Which numbers are squares? How do you know?

18 factors

180 = 1, 180; 2, 90; 3, 60; 4, 45; 5, 36; 6, 30; 9, 20; 10, 18; 12, 15; 15, 12

70 = 1, 70; 2, 35; 5, 14; 7, 10

1, 2, 5, 7, 10, 14, 35, 70

8 factors

144 = 1, 144; 2, 122; 3, 48; 4, 37; 6, 24; 8, 18; 9, 16; 12, 12

1, 2, 3, 4, 6, 8, 9, 12, 16, 18, 24, 37, 48, 122, 144

15 factors

i) 70 **ii)** 144 **iii)** 180

This number has an odd # of factors

b) Find a square root of each square number in part a.

$\sqrt{70}$: $\sqrt{64} = 8$, $9 = \sqrt{81}$ $= 8 \frac{70-64}{81-64} = 8\frac{6}{17} = 8.35$

$\sqrt{144} = 12$

$\sqrt{180}$: 169, 13; 196, 14 $= 13 \frac{180-169}{196-169} = 13\frac{11}{27} = 13.40$

4. The factors of each number are listed in ascending order. Which numbers are square numbers? Find a square root of each square number.

16 factors → not square

a) 216: 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 27, 36, 54, 72, 108, 216

b) 196: 1, 2, 4, 7, 14, 28, 49, 98, 196 9 factors → square → $\sqrt{196} = 14$

c) 441: 1, 3, 9, 21, 49, 147, 441 7 factors

Odd, so perfect square ⇒ $\sqrt{441} = 21$

5. Find a number whose square root is 24.

$\sqrt{?} = 24 \times 24$ $? = 576$

6. Find the square root of each number.

a) 12^2 **b)** 15^2 **c)** 37^2

$\sqrt{12^2} = \sqrt{144} = 12$ $\sqrt{15^2} = 15$ $\sqrt{37^2} = 37$

7. Find the square of each number.

a) $\sqrt{9}$ **b)** $\sqrt{121}$ **c)** $\sqrt{841}$

$\sqrt{9} \cdot \sqrt{9}$
$3 \cdot 3$
$= 9$

$\sqrt{121} \cdot \sqrt{121}$
$11 \cdot 11$
$= 121$

$\sqrt{841} \cdot \sqrt{841}$
$29 \cdot 29$
$= 841$

Try the following:

What is the square root of:

a) 36 FACTORS → 1, 36 2, 18 3, 13 4, 9 $\boxed{6, 6}$

b) 121 Factors → 1, 121 ; $\boxed{11, 11}$

c) 4^2 $4^2 = 4 \times 4 = 16 \rightarrow \sqrt{16} = 4$ so √ of a square is itself

d) 7^2 $7^2 \rightarrow \sqrt{7^2} = \boxed{7}$

e) $\sqrt{16}$ $\sqrt{16} = \sqrt{4} \times \sqrt{4} = 2 \times 2 = \boxed{4}$

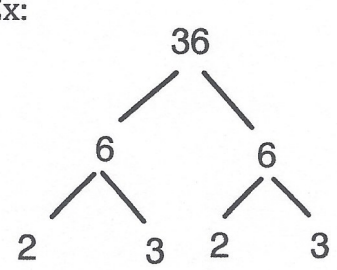
<u>Other methods for finding square roots:</u>

<u>Prime Factorization:</u>

Breaking a number into its prime factors.

We can use a factor tree:

Ex:

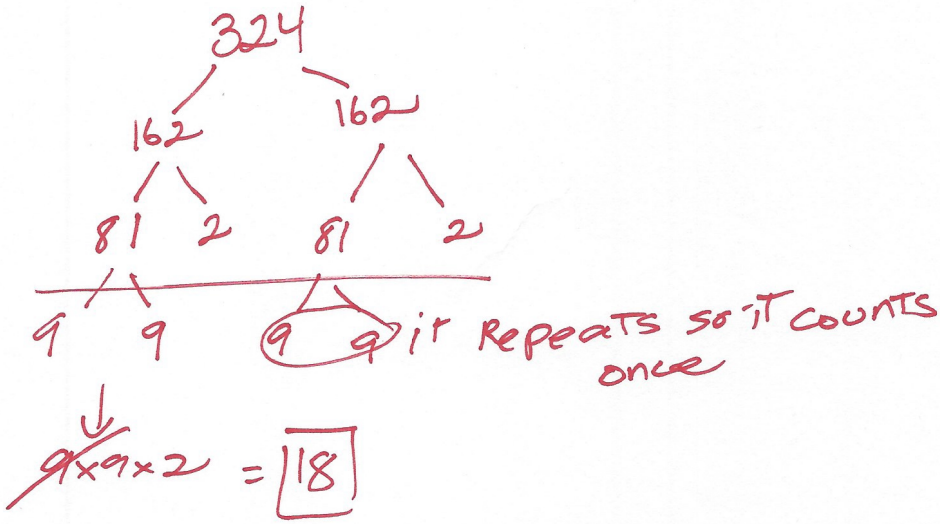


Since $2 \times 2 \times 3 \times 3 = 36$, we can group our pairs

$(2 \times 2) \times (3 \times 3) = 36$

$2 \times 3 = 6$, which is the square root.

Try: 324



Multiples of 100:

This method for finding square roots will work if the number is a multiple of 100, that is, it has an even number of zeroes, and starts with a perfect square.

Ex:

$\sqrt{2500}$

Break it down

Starts with 25 → $\sqrt{25} = 5$

So $\sqrt{25} \times \sqrt{100} = 5 \times 10 = 50$

$\sqrt{1\,440\,000}$

Starts with 144 = $\sqrt{144} = 12$

$\sqrt{144} \times \sqrt{1000} = \sqrt{144} \times \sqrt{100} \times \sqrt{100} = 12 \times 10 \times 10$
$= 1200$

Notice how it has double the zeroes

Example 1:

Find the square root of each, if possible:

a) $\sqrt{3600}$ • starts with perfect square • even # zeroes ✓

$\sqrt{36} \times \sqrt{100} = 6 \times 10 = 60$

b) $\sqrt{49000}$ • starts with perfect square. Not even amount of zeroes

So $\sqrt{49000}$ is not a whole number

c) $\sqrt{169000000}$

• starts with 169 → perfect square.

• 6 zeroes ✓

$\sqrt{169} \cdot \sqrt{100} \cdot \sqrt{100} \cdot \sqrt{100} = 13 \times 10 \times 10 \times 10 = 13000$