



Finding and Approximating Square Roots

Goal: Find and approximate square roots of numbers.

Vocabulary

Perfect square: A number that is the square of an integer

Square root: A square root of a number n is a number m which, when multiplied by itself, equals n

Radical expression: An expression that involves a radical sign

Square Roots

Words A square root of a number n is a number m which, when multiplied by itself, equals n .

Numbers The square roots of 25 are 5 and -5 because $5^2 = 25$ and $(-5)^2 = 25$.

Algebra If $m^2 = n$, then m is a square root of n .

EXAMPLE 1 Finding Square Roots

a. You know that $8^2 = 64$ and $(-8)^2 = 64$. Therefore, the square roots of 64 are 8 and -8 .

b. You know that $6^2 = 36$ and $(-6)^2 = 36$. Therefore, the square roots of 36 are 6 and -6 .

EXAMPLE 2 Evaluating Square Roots

a. $\sqrt{25} = \boxed{5}$ because $\boxed{5}^2 = 25$ and $\boxed{5} > 0$.

b. $-\sqrt{49} = \boxed{-7}$ because $\boxed{-7}^2 = 49$ and $\boxed{-7} < 0$.

Guided Practice Find the square root.

1. $\sqrt{9}$	2. $\sqrt{1}$	3. $-\sqrt{64}$	4. $-\sqrt{100}$
---------------	---------------	-----------------	------------------

EXAMPLE 3 Approximate a Square Root

Between which two consecutive integers does $\sqrt{200}$ lie?

Make a list of numbers that are perfect squares:

... **100**, $\boxed{121}$, $\boxed{144}$, $\boxed{169}$, $\boxed{196}$, $\boxed{225}$, ... Note that 200 is between $\boxed{196}$

and $\boxed{225}$. This statement can be expressed by the compound inequality

$$\boxed{196} < 200 < \boxed{225}$$

$$\boxed{196} < 200 < \boxed{225}$$
 Identify perfect squares closest to 200.

$$\sqrt{\boxed{196}} < \sqrt{200} < \sqrt{\boxed{225}}$$
 Take positive square root of each number.

$$\boxed{14} < \sqrt{200} < \boxed{15}$$
 Evaluate square root of each perfect square.

Answer: The number $\sqrt{200}$ lies between $\boxed{14}$ and $\boxed{15}$.

EXAMPLE 4 Multiple Choice Practice

What is the value of $\sqrt{70}$ rounded to the nearest whole number?

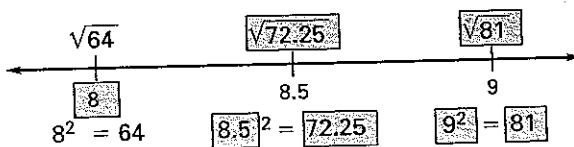
- (A) 7 (B) 8 (C) 9 (D) 10

Solution

You can use a number line to approximate $\sqrt{70}$ to the nearest whole number. Because $\sqrt{70}$ is between 8 and 9, you need to decide whether

$\sqrt{70}$ is closer to 8 or 9. Find 8.5^2 .

You can calculate that $8.5^2 = 72.25$ and $(\sqrt{70})^2 = 70$.



As shown on the number line, $\sqrt{70}$ is between $\sqrt{64}$ and $\sqrt{72.25}$,

so it has a value between 8 and 8.5. Therefore, to the nearest whole number, $\sqrt{70} \approx 8$.

Answer: The correct answer is **B**. (A) (B) (C) (D)

EXAMPLE 5 Using a Calculator

Evaluate the square root. Round to the nearest tenth, if necessary.

- a. $\sqrt{361}$ b. $-\sqrt{30.25}$ c. $\sqrt{12}$ d. $-\sqrt{1528}$

Solution

Keystrokes	Display	Answer
a. $2^{\text{nd}} [\sqrt{\quad}] 361 [=]$	19	19
b. $[(-)] 2^{\text{nd}} [\sqrt{\quad}] 30.25 [=]$	-5.5	-5.5
c. $2^{\text{nd}} [\sqrt{\quad}] 12 [=]$	3.4641016	3.5
d. $[(-)] 2^{\text{nd}} [\sqrt{\quad}] 1528 [=]$	-39.089641	-39.1

Guided Practice Approximate to the nearest whole number.

5. $\sqrt{19}$	6. $\sqrt{40}$	7. $\sqrt{75}$	8. $\sqrt{138}$
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Use a calculator to evaluate. Round to the nearest tenth.

9. $\sqrt{248}$	10. $\sqrt{10}$	11. $-\sqrt{25.25}$	12. $-\sqrt{3965}$
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

EXAMPLE 6 Using a Square Root in Real Life

Science The equation $t = \sqrt{\frac{h}{16}}$ gives the time in seconds that it takes an object to fall h feet. An eagle flying at a height of 100 feet drops a fish. How long will it take the fish to reach the ground?

Solution

$$t = \sqrt{\frac{h}{16}}$$

Write equation for falling object.

$$= \sqrt{\frac{100}{16}}$$

Substitute for h .

$$= \sqrt{6.25}$$

Divide.

$$= 2.5$$

Find square root.

ANSWER It will take for the fish to reach the ground.

Homework