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4.1 Estimating Roots

The concept of square root and cube root was developed earlier and will now be extended to roots including the n^{th} root using the notation:

 $\sqrt[n]{x}$, where *n* is the index and *x* is the radicand

It should be emphasized that when there is no numerical index stated, the value of the index is 2. For example, $\sqrt{36}$ indicates a square root with an index of 2.



Since $3\bigcirc 9$, 3 is the square root of 9. So we write $3 = \sqrt[3]{9}$.

Since $3^{3} = 27$, 3 is the cube root of 27. So we write $3 = \sqrt[9]{27}$.

Since 3^{4} = 81, 3 is the fourth root of 81. So we write $3 = 3^{4}\overline{81}$.

How could you write 5 as a square root? $5 = \sqrt{25}$

A cube root? 5 = 3125

A fourth root? 5 = (625)

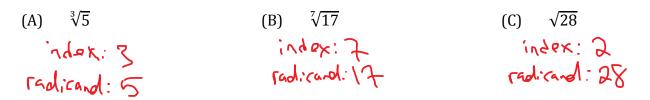
There is a relationship between the power and the index or the root. What is it?

Example 1:

If
$$\left(\frac{2}{3}\right)^4 = \frac{16}{81}$$
, what would be the index be for $\sqrt[x]{\frac{16}{81}} = \frac{2}{3}$
 $\chi = 4$

Example 2:

Identify the index and the radicand for each of the following:



Estimating Roots Using Calculators

In Grade 9, you used upper and lower benchmarks to approximate square roots of nonperfect square rational numbers. This strategy can be adapted to approximate the *n*th root of rational numbers.

For example, to approximate $\sqrt[3]{10}$, students should identify the closest perfect cubes $\sqrt[3]{8} = 2$ and $\sqrt[3]{27} = 3$.

Since 10 is closer to 8, the value of $\sqrt[3]{10}$ would be closer to 2.

Students can select numbers close to 2 and check with a calculator:

$$2.1^{5} = 9.261$$

$$2.2^{3} = 10.648$$

$$(2.19)^{3} = 10.548$$

$$(2.19)^{3} = 10.077$$

$$(2.15)^{3} = 9.93$$

$$2.155)^{3} = 10.007$$

Example 3:

Determine the approximate root of the following:

Determine the approximate root of the following:
(A)
$$\sqrt{20}$$
 $\sqrt{16} = 4$, $\sqrt{25} = 5$ $(4.48)^{3} = 30.07$
 $(4.4)^{3} = 19.36$ $(4.47.5)^{2} = 30.02$
 $(4.5)^{2} = 30.25$ $\sqrt{30} \sim 4.475$
 $(4.47)^{3} = 19.58$
 $(4.47)^{3} = 19.58$
(B) $\sqrt[3]{16}$ $\sqrt{38} = 2$ $\sqrt[3]{27} = 3$
 $(2.5)^{3} = 15.635$ $\sqrt{16} \sim 2.52$
 $(2.6)^{5} = (7.576)$ $\sqrt{16} \sim 2.52$
 $(2.5)^{3} = 15.81$
 $(2.5)^{3} = 15.81$
 $(2.5)^{3} = 16.003$
(c) $\sqrt[3]{50}$ $\sqrt[3]{27} = 3$ $\sqrt[3]{50} = 3.485$

Textbook Questions: page 206 #2 (identify the index and the radicand), 3, 5 flow Could

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