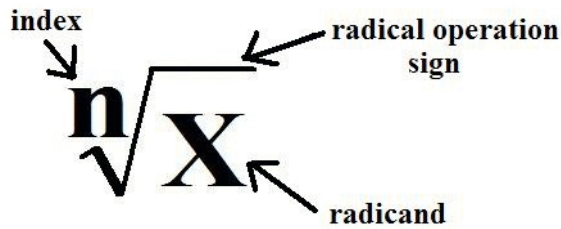


Objective # 43 **Square Roots and Operations with Radicals**

Material: Teacher Notes

Homework: worksheet

Parts of a Radical:



Square Root: is a radical operation (*index* = 2) performed on a number to get a value, such that the value when squared will give the original number back.

Cube Root: is a radical operation (*index* = 3) performed on a number to get a value, such that the value when cubed will give the original number back.

Example: Perform the following operations:

a) $\sqrt{36} = 6$ b) $\sqrt{64} = 8$ c) $\sqrt{169} = 13$ d) $\sqrt[3]{8} = 2$ e) $\sqrt[3]{27} = 3$

Simplest Form of a Square Root: A square root is in its simplest form when the radicand does NOT contain a factor which is a perfect square.

Perfect Squares: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, etc.

Example: Simplify each of the following:

a) $\sqrt{50}$ is not in its simplest form because 50 has a factor of 25 which is a perfect square
 $\sqrt{50} = (\sqrt{25})(\sqrt{2}) = (5)(\sqrt{2}) = 5\sqrt{2}$

b) $\sqrt{8} = (\sqrt{4})(\sqrt{2}) = (2)(\sqrt{2}) = 2\sqrt{2}$

c) $\sqrt{48} = (\sqrt{16})(\sqrt{3}) = (4)(\sqrt{3}) = 4\sqrt{3}$

d) $\sqrt{80} = (\sqrt{16})(\sqrt{5}) = (4)(\sqrt{5}) = 4\sqrt{5}$

e) $\sqrt{288} = (\sqrt{4})(\sqrt{72}) = (\sqrt{4})(\sqrt{9})(\sqrt{8}) = (\sqrt{4})(\sqrt{9})(\sqrt{4})(\sqrt{2})$
 $= (2)(3)(2)(\sqrt{2}) = 12\sqrt{2}$

f) $\sqrt{288} = (\sqrt{144})(\sqrt{2}) = (12)(\sqrt{2}) = 12\sqrt{2}$

g) $7\sqrt{175} = (7)(\sqrt{25})(\sqrt{7}) = (7)(5)(\sqrt{7}) = 35\sqrt{7}$

NOW DO EXERCISE 1 ON THE WORKSHEET!

Multiplying and Dividing Square Roots: If two square roots are being multiplied or divided, then write a single square root and move the multiplication or division inside that square root.

Example: Perform the following operations and simplify all radicals:

a) $(\sqrt{2})(\sqrt{3}) = \sqrt{(2)(3)} = \sqrt{6}$ b) $\frac{\sqrt{24}}{\sqrt{8}} = \sqrt{\frac{24}{8}} = \sqrt{3}$

c) $(3\sqrt{5})(4\sqrt{10}) = (3)(4)(\sqrt{(5)(10)}) = 12\sqrt{50} = (12)(\sqrt{25})(\sqrt{2}) = (12)(5)(\sqrt{2})$
 $= 60\sqrt{2}$

d) $\frac{32\sqrt{54}}{2\sqrt{3}} = \left(\frac{32}{2}\right)\left(\sqrt{\frac{54}{3}}\right) = 16\sqrt{18} = (16)(\sqrt{9})(\sqrt{2}) = (16)(3)(\sqrt{2}) = 48\sqrt{2}$

NOW DO EXERCISE 2 ON THE WORKSHEET!

Like Square Roots: Like Square Roots are square roots that have the same number inside the radical sign.

Examples: **Like Square Roots:** $\sqrt{3}, 4\sqrt{3}, -2\sqrt{3}$
 NOT Like Square Roots: $\sqrt{3}, 4\sqrt{5}, -2\sqrt{7}$

Adding and Subtracting Square Roots: ONLY like square roots can be added or subtracted ... carry the common square root and add or subtract the coefficients (Numbers in front of the square root)

Example: Perform the following operations and simplify all radicals:

a) $3\sqrt{5} - 7\sqrt{5} + 8\sqrt{5} = 4\sqrt{5}$

b) $\sqrt{50} + \sqrt{18}$ **NOTE:** These are not like square roots and can't be added but they can be simplified

$(\sqrt{25})(\sqrt{2}) + (\sqrt{9})(\sqrt{2}) = 5\sqrt{2} + 3\sqrt{2}$ **Once they are simplified we notice that they are now like square roots and can now be added**
 $= 8\sqrt{2}$

c) $3\sqrt{28} - \sqrt{63} = (3)(\sqrt{4})(\sqrt{7}) - (\sqrt{9})(\sqrt{7})$ $(\sqrt{2} + \sqrt{3})(\sqrt{3} + \sqrt{2})$
 $= (3)(2)(\sqrt{7}) - (3)(\sqrt{7})$ d) $\sqrt{6} - \sqrt{4} + \sqrt{9} + \sqrt{6}$
 $= 6\sqrt{7} - 3\sqrt{7} = 3\sqrt{7}$ $2\sqrt{6} - 2 + 3 = 2\sqrt{6} + 1$

NOW DO EXERCISE 3 and 4 ON THE WORKSHEET!

Square Roots and Operations with Radicals

Worksheet

1. Express each of the following radicals in their simplest form:

a) $\sqrt{12}$

b) $\sqrt{20}$

c) $\sqrt{18}$

d) $\sqrt{27}$

e) $\sqrt{98}$

f) $\sqrt{72}$

g) $\sqrt{125}$

h) $\sqrt{396}$

i) $\sqrt{363}$

j) $2\sqrt{44}$

k) $7\sqrt{128}$

l) $4\sqrt{300}$

2. Perform the following operations and simplify all radicals:

a) $(\sqrt{2})(\sqrt{5})$

b) $(3\sqrt{2})(\sqrt{6})$

c) $(\sqrt{8})(\sqrt{6})$

d) $\frac{\sqrt{72}}{\sqrt{6}}$

e) $\frac{\sqrt{50}}{\sqrt{5}}$

f) $\frac{27\sqrt{490}}{9\sqrt{5}}$

g) $(\sqrt{8})\left(\sqrt{\frac{1}{2}}\right)$

h) $(2\sqrt{15})(3\sqrt{30})$

i) $(6\sqrt{2})(6\sqrt{18})$

j) $\left(\sqrt{\frac{2}{5}}\right)\left(\sqrt{\frac{9}{2}}\right)\left(\sqrt{\frac{10}{3}}\right)$

k) $\frac{\sqrt{7}}{\sqrt{63}}$

l) $\frac{24\sqrt{56}}{6\sqrt{7}}$

3. Perform the following operations and simplify all radicals:

a) $3\sqrt{5} + 4\sqrt{5}$

b) $2\sqrt{7} + 7\sqrt{2}$

c) $14\sqrt{8} - 5\sqrt{8}$

d) $2\sqrt{11} + 7\sqrt{11} - 4\sqrt{11}$

e) $7\sqrt{6} + 4\sqrt{3} - 3\sqrt{6} + 2\sqrt{2}$

f) $\sqrt{8} + \sqrt{18}$

g) $\sqrt{75} - \sqrt{20}$

h) $\sqrt{27} + \sqrt{48} - 2\sqrt{3}$

I) $-5\sqrt{44} + 2\sqrt{99}$

g) $3\sqrt{72} + 2\sqrt{75} - 3\sqrt{27} + \sqrt{108}$

h) $\sqrt{250} - \sqrt{135} - \sqrt{40} + \sqrt{735}$

4. Perform the following operations and simplify all radicals:

a) $(\sqrt{5} + \sqrt{3})(\sqrt{5} - \sqrt{3})$

b) $(\sqrt{6} + \sqrt{2})^2$

c) $(2\sqrt{5} + \sqrt{2})(\sqrt{3} + \sqrt{6})$

d) $(\sqrt{2} + \sqrt{6})(\sqrt{10} - \sqrt{3})$

e) $(\sqrt{8} - \sqrt{6})^2$