# Dividing Radicals

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A. Definitions

  1. **radical:** a mathematical symbol representing a root.

  2. **rationalize the denominator:** removing a radical from the denominator of a fraction.

B. Dividing Radicals (Monomial Denominators)

  1. Rationalize the denominator.

a) $\dfrac{\sqrt{2}}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}}$

$= \dfrac{\sqrt{6}}{\sqrt{9}}$

$= \boxed{\dfrac{\sqrt{6}}{3}}$

**To Solve**

a) To rationalize the denominator, we multiply top and bottom of the fraction by whatever the root is in the denominator.

b) Simplify the roots.

c) Simplify the fraction if possible.

b) $\dfrac{5\sqrt{2}}{\sqrt{8}} \times \dfrac{\sqrt{8}}{\sqrt{8}}$

$= \dfrac{5\sqrt{16}}{\sqrt{64}}$

$= \dfrac{20}{8} \begin{array}{l}\div 4 \\ \div 4\end{array}$

$= \boxed{\dfrac{5}{2}}$

c) $\dfrac{3}{2\sqrt{10}} \times \dfrac{\sqrt{10}}{\sqrt{10}}$

$= \dfrac{3\sqrt{10}}{2\sqrt{100}}$

$= \boxed{\dfrac{3\sqrt{10}}{20}}$

**d)** $\dfrac{\sqrt{24}}{\sqrt{72}}$   $\dfrac{\sqrt{4}\cdot\sqrt{6}}{\sqrt{36}\cdot\sqrt{2}}$     <span style="color:green">Simplify the roots first.</span>

$= \dfrac{2\sqrt{6}}{6\sqrt{2}}$  $\times\sqrt{2}$
$\phantom{= \dfrac{2\sqrt{6}}{6\sqrt{2}}}$ $\times\sqrt{2}$

$= \dfrac{2\sqrt{12}}{6\sqrt{4}} = \dfrac{2\sqrt{4}\cdot\sqrt{3}}{6\sqrt{4}}$

$= \dfrac{4\sqrt{3}}{12} \quad = \boxed{\dfrac{\sqrt{3}}{3}}$

**e)** $\dfrac{12\sqrt{54}}{-6\sqrt{12}} = \dfrac{12\sqrt{9}\cdot\sqrt{6}}{-6\sqrt{4}\cdot\sqrt{3}}$

$= \dfrac{36\sqrt{6}}{-12\sqrt{3}}\, \times\sqrt{3}$  $\times\sqrt{3}$

$= \dfrac{36\sqrt{18}}{-12\sqrt{9}} = \dfrac{36\sqrt{9}\cdot\sqrt{2}}{-12\sqrt{9}}$

$= \dfrac{108\sqrt{2}}{-36} = \dfrac{3\sqrt{2}}{-1} = \boxed{-3\sqrt{2}}$

**f)** $\dfrac{\sqrt{5}\,(4\sqrt{5}-2)}{\sqrt{5}}$   $\times\sqrt{5}$

$= \dfrac{4\sqrt{25} - 2\sqrt{5}}{\sqrt{25}}$

$= \dfrac{20 - 2\sqrt{5}}{5}$   complex fraction   $= \boxed{\dfrac{20-2\sqrt{5}}{5}}$

**g)** $\dfrac{9\sqrt{32} - 3\sqrt{24} + \sqrt{48}}{\sqrt{12}} = \dfrac{9\sqrt{16}\cdot\sqrt{2} - 3\sqrt{4}\cdot\sqrt{6} + \sqrt{16}\cdot\sqrt{3}}{\sqrt{4}\cdot\sqrt{3}}$

$= \dfrac{36\sqrt{2} - 6\sqrt{6} + 4\sqrt{3}}{2\sqrt{3}}$   $\times\sqrt{3}$

$= \dfrac{36\sqrt{6} - 6\sqrt{18} + 4\sqrt{9}}{2\sqrt{9}} = \dfrac{36\sqrt{6} - 6\sqrt{9}\cdot\sqrt{2} + 4\sqrt{9}}{2\sqrt{9}}$

$= \dfrac{36\sqrt{6} - 18\sqrt{2} + 12}{6} = 6\sqrt{6} - 3\sqrt{2} + 2 = \boxed{2 + 6\sqrt{6} - 3\sqrt{2}}$

Assignment:    Dividing Radicals Assignment #3, 4, 5, 9, 10

# Assignment

1. Simplify.

a) $\dfrac{\sqrt{50}}{\sqrt{5}}$

b) $\dfrac{\sqrt{35}}{\sqrt{7}}$

c) $\dfrac{\sqrt{39}}{\sqrt{3}}$

d) $\dfrac{\sqrt{28}}{\sqrt{7}}$

e) $\dfrac{8\sqrt{42}}{2\sqrt{6}}$

f) $\dfrac{25\sqrt{88}}{5\sqrt{8}}$

g) $\dfrac{12\sqrt{51}}{-6\sqrt{17}}$

h) $\dfrac{4\sqrt{50}}{8\sqrt{10}}$

2. Simplify.

a) $\dfrac{\sqrt{270}}{\sqrt{10}}$

b) $\dfrac{\sqrt{90}}{\sqrt{5}}$

c) $\dfrac{\sqrt{96}}{4\sqrt{3}}$

d) $\dfrac{3\sqrt{200}}{2\sqrt{5}}$

3. Simplify.

a) $\dfrac{2\sqrt{150}}{\sqrt{8}}$

b) $\dfrac{4\sqrt{90}}{\sqrt{72}}$

c) $\dfrac{3\sqrt{240}}{\sqrt{108}}$

d) $\dfrac{18\sqrt{24}}{\sqrt{162}}$

**4.** Simplify.

a) $\dfrac{\sqrt{35} - \sqrt{21}}{\sqrt{7}}$

b) $\dfrac{9\sqrt{20} - 3\sqrt{10}}{3\sqrt{2}}$

c) $\dfrac{8\sqrt{42} + 12\sqrt{75}}{4\sqrt{3}}$

d) $\dfrac{8\sqrt{20} + 10\sqrt{125}}{2\sqrt{5}}$

e) $\dfrac{\sqrt{75} + \sqrt{48} - \sqrt{27}}{\sqrt{3}}$

f) $\dfrac{\sqrt{90} + 2\sqrt{40} - \sqrt{160}}{\sqrt{5}}$

**5.** Simplify by rationalizing the denominator.

a) $\dfrac{1}{\sqrt{2}}$

b) $\dfrac{6}{\sqrt{6}}$

c) $\dfrac{\sqrt{5}}{\sqrt{3}}$

d) $\dfrac{\sqrt{3}}{-\sqrt{2}}$

e) $\dfrac{\sqrt{10}}{\sqrt{7}}$

f) $\dfrac{\sqrt{12}}{\sqrt{5}}$

g) $\dfrac{2}{5\sqrt{6}}$

h) $\dfrac{\sqrt{32}}{\sqrt{18}}$

i) $\dfrac{5}{\sqrt{50}}$

j) $\dfrac{14}{\sqrt{98}}$

k) $\dfrac{-2}{\sqrt{88}}$

l) $\dfrac{3\sqrt{500}}{-\sqrt{27}}$

9. Simplify and express in lowest terms.

a) $\dfrac{10\sqrt{18} - 5\sqrt{24}}{\sqrt{5}}$

b) $\dfrac{15\sqrt{18} - 3\sqrt{242}}{-3\sqrt{8}}$

10. Simplify

a) $\dfrac{6\sqrt{18} + 5\sqrt{20} - 3\sqrt{72} - 6\sqrt{125}}{\sqrt{5}}$

b) $\dfrac{7\sqrt{50} + 8\sqrt{48} - 12\sqrt{75} - 8\sqrt{18}}{2\sqrt{6}}$

## Answer Key

1. a) $\sqrt{10}$   b) $\sqrt{5}$   c) $\sqrt{13}$   d) 2   e) $4\sqrt{7}$   f) $5\sqrt{11}$   g) $-2\sqrt{3}$   h) $\frac{1}{2}\sqrt{5}$

2. a) $3\sqrt{3}$   b) $3\sqrt{2}$   c) $\sqrt{2}$   d) $3\sqrt{10}$

3. a) $5\sqrt{3}$   b) $2\sqrt{5}$   c) $2\sqrt{5}$   d) $4\sqrt{3}$

4. a) $\sqrt{5}-\sqrt{3}$   b) $3\sqrt{10}-\sqrt{5}$   c) $2\sqrt{14}+15$   d) 33   e) 6   f) $3\sqrt{2}$

5. a) $\frac{1}{2}\sqrt{2}$   b) $\sqrt{6}$   c) $\frac{1}{3}\sqrt{15}$   d) $-\frac{1}{2}\sqrt{6}$   e) $\frac{1}{7}\sqrt{70}$   f) $\frac{2}{3}\sqrt{15}$   g) $\frac{1}{15}\sqrt{6}$
   h) $\frac{4}{3}$   i) $\frac{1}{2}\sqrt{2}$   j) $\sqrt{2}$   k) $-\frac{1}{22}\sqrt{22}$   l) $-\frac{10}{3}\sqrt{15}$

6. a) $\frac{3}{10}\sqrt{30}$   b) $\sqrt{5}$   c) $\frac{9}{2}\sqrt{6}$   d) $\frac{1}{3}\sqrt{15}$

7. a) $\dfrac{\sqrt{14}-2}{2}$   b) $\dfrac{3+2\sqrt{6}}{6}$   c) $\dfrac{\sqrt{30}+2\sqrt{3}}{6}$

8. a) $6\sqrt{2}-8$   probably Jaclyn's method   b) 40 and 20 do not divide exactly by 7

9. a) $6\sqrt{10}-2\sqrt{30}$   b) $-2$

10. a) $-20$   b) $\dfrac{11\sqrt{3}-42\sqrt{2}}{6}$

11. a) $\sqrt{3}-\sqrt{2}$ meters   b) 15.3 metres

12. a) $\dfrac{72-4\sqrt{6}}{3}$ meters   b) 20.73 metres

13. D          14. D          15. C

16. | 0 | . | 3 | 1 |
    
17. | 6 | . | - | |
    
18. | 1 | 0 | . | |