Chapter 1 – Operations with Radicals
1.1 Adding and Subtracting Radicals

*You should be able to demonstrate your understanding of these concepts without using a calculator.

1. Review from Math 10: Convert to a mixed radical in lowest terms.

a. $\sqrt{48}$	b. $\sqrt{96}$	c. $\sqrt[3]{54}$

2. Review from Math 10: Convert to an entire radical.

a. $6\sqrt{3}$	b. $-4\sqrt{5}$	c. $2\sqrt[3]{5}$

3. Simplify.

a. $3\sqrt{5}+\sqrt{5}-6\sqrt{5}$	b. $6\sqrt{7}-2\sqrt{3}-10\sqrt{3}+\sqrt{7}$	c. $-4\sqrt{10}+6\sqrt{7}+\sqrt{10}-14\sqrt{7}$

4. Simplify by first reducing each radical to lowest terms.

a. $\sqrt{150}-\sqrt{216}$	b. $3\sqrt{20}-\sqrt{45}+2\sqrt{72}$	c. $\sqrt{98}-\frac{1}{2}\sqrt{20}-\frac{1}{3}\sqrt{18}$

5. Determine the perimeter of a rectangle whose length is $\sqrt{27}+\sqrt{12}$ and whose width is $\sqrt{32}+\sqrt{18}$.

1.2 Multiplying Radicals

*You should be able to demonstrate you understanding of these concepts without using a calculator.

1. Multiply the following monomials. Simplify each answer.

a. $\left(5\sqrt{3}\right)\left(-4\sqrt{2}\right)$	b. $\left(\sqrt{32}\right)\left(\sqrt{6}\right)$	c. $\left(3\sqrt{x}\right)\left(-4\sqrt{x}\right)$

2. Write as a single radical in lowest terms.

a. $\left(3\sqrt{5}\right)^2$	b. $-\left(\sqrt{10}\right)^2$	c. $\left(-2\sqrt{8}\right)\left(3\sqrt{3}\right)\left(2\sqrt{2}\right)$

3. Expand each expression. Write the answers in lowest terms.

a. $2\sqrt{3}\left(\sqrt{6}-3\sqrt{12}\right)$	b. $\sqrt{8}\left(\sqrt{6}-2\sqrt{2}\right)$	c. $\sqrt{a}\left(\sqrt{a}+\sqrt{a}\right)$

4. Expand each expression. Write the answers in lowest terms.

a. $2\sqrt{5}\left(3\sqrt{5}-\sqrt{125}+\sqrt{3}\right)$	b. $\left(5+\sqrt{27}\right)\left(-1-\sqrt{12}\right)$	c. $\left(11\sqrt{2}+3\right)^2$

5. Can you state the conjugate of a monomial expression, such as $-2\sqrt{3}$? Explain your answer.

6. When stating the conjugate of a binomail expression, do you change the negative sign to a positive sign? For example, $-2+\sqrt{3}$ becomes $2+\sqrt{3}$?

7. State the conjugate of each binomial expression.

a. $\sqrt{5}+1$	b. $2-\sqrt{7}$	c. $\sqrt{18}+\sqrt{3}$

8. Multiply each binomial expression by its conjugate. Simplify the answers.

a. $\sqrt{5}+1$	b. $2-\sqrt{7}$	c. $\sqrt{18}+\sqrt{3}$

9. What do you notice happens when a binomial is multiplied by it's conjugate?

1.3 Dividing by Monomial Radical Expressions

*You should be able to demonstrate you understanding of these concepts without using a calculator.

1. Simplify each part (the rational and then the irrational) of the fraction, and then divide.

a. $\frac{8\sqrt{54}}{6\sqrt{8}}$	b. $\frac{\sqrt{96}}{2\sqrt{3}}$	c. $\frac{15\sqrt{30}}{12\sqrt{5}}$

2. Simplify.

a. $\frac{6\sqrt{150}}{\sqrt{24}}$	b. $\frac{-7\sqrt{24}}{\sqrt{162}}$	c. $\frac{a\sqrt{ab^3}}{b\sqrt{ab}}$

3. Divide each term in the numerator by the denominator. Write each answer in lowest terms.

a. $\frac{\sqrt{48}+\sqrt{96}-\sqrt{108}}{\sqrt{12}}$	b. $\frac{10\sqrt{20}-3\sqrt{125}}{2\sqrt{5}}$

4. Think and explain: What happens when a radical is multiplied by itself? WHY does this happen?

5. Simplify each fraction, with rationalized denominators.

a. $\frac{\sqrt{5}}{\sqrt{3}}$	b. $\frac{3}{4\sqrt{6}}$	c. $\frac{\sqrt{32}}{\sqrt{50}}$

6. Express each fraction with a rational denominator. Radicals must be in lowest terms.

a. $\frac{\sqrt{7}+\sqrt{3}}{\sqrt{3}}$	b. $\frac{\sqrt{6}+2\sqrt{3}}{-3\sqrt{2}}$	c. $\frac{10\sqrt{40}+8\sqrt{45}}{-2\sqrt{5}}$

1.4 Dividing by Binomial Denominators

*You should be able to demonstrate you understanding of these concepts without using a calculator.
*For this section, use your knowledge of conjugates from section 2.

1. Recall ….

A conjugate consists of _____ terms.

To create a "conjugate", you _____.

When you multiply an expression by its conjugate, you ALWAYS get _____ as a result.

2. Simplify by rationalizing the denominator (case 1: monomial numerators).

a. $\frac{\sqrt{10}}{\sqrt{10}+2}$	b. $\frac{\sqrt{5}}{\sqrt{10+\sqrt{5}}}$	c. $\frac{\sqrt{2}}{\sqrt{12}-\sqrt{8}}$

3. Simplify by rationalizing the denominator (case 2: binomial numerators).

a. $\frac{\sqrt{11}+3}{\sqrt{11}-3}$	b. $\frac{\sqrt{12}+\sqrt{2}}{\sqrt{12}-\sqrt{2}}$	c. $\frac{6-\sqrt{15}}{3+\sqrt{15}}$

4. Simplify by rationalizing the denominator.

a. $\frac{3\sqrt{6}-\sqrt{3}}{2\sqrt{3}+\sqrt{6}}$	b. $\frac{5}{2\sqrt{a}+5}$	c. Think: $\frac{*}{*-\sqrt{:)}}$