Name $\qquad$

Instructor $\qquad$ Section Number $\qquad$

## PREPARATION FOR COLLEGE MATH

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## MODULE 84 Workbook <br> Rational Exponents and Radicals

Middlesex Community College

## How to Complete This Module



To receive credit for problems, work must be shown. If the workbook is not completed satisfactorily, it will be returned to you for completion.

### 10.1 Radicals and Radical Functions

## objective

1 Finding Square Roots
(Click the in the multimedia textbook to see the video lecture)

- Study Objective 1, "Finding Square Roots," on pages 587 and 588 in the multimedia textbook.
- Write the definitions of the following terms.

Square root of a number -

Radical expression -

Radicand -

- Define, below, what is meant by Principal and Negative Square Roots found on page 587 in the multimedia textbook.

Principal square root -

Negative square root-

- Do Practice 1 on page 587 in the multimedia textbook, below.


## PRACtice

1 Simplify. Assume all variables represent positive numbers.
a. $\sqrt{49}=$
b. $\sqrt{\frac{0}{1}}=$
c. $\sqrt{\frac{16}{81}}=$
d. $\sqrt{0.64}=$
e. $\sqrt{z^{8}}=$
f. $\sqrt{16 b^{4}}=$
g. $-\sqrt{36}$
h. $\sqrt{-36}$

- Read the top of page 588.

Explain in your own words why the square root of a negative number is not a real number.

## obJECTIVE

## 2 Approximating Roots

(Click the in the multimedia textbook to see the video lecture)

- Watch the video for Objective 2 by clicking on the blue arrow to the right of "Objective 2 Approximating Roots" on page 588 in the multimedia textbook.
- Study Objective 2, "Approximating Roots," starting on page 588 in the multimedia textbook.

Explain in your own words the difference between a perfect square and an irrational number.

- Do Practice 2 on page 588 in the multimedia textbook, below.


## practice

2 Using your calculator, approximate the following to three decimal places. $\sqrt{45} \approx$

## objective

## 3 Finding Cube Roots

(Click the in the multimedia textbook to see the video lecture)

- Study Objective 3, "Finding Cube Roots," starting on the bottom of page 588 in the multimedia textbook.
- Write the explanation of a cube root found on the bottom of page 588 in the multimedia workbook.


## Cube Root -

- Do Practice Problem 3 on page 589 in the multimedia textbook, below.


## PRACTICE

3 Find the cube roots.
a. $\sqrt[3]{-1}$
d. $\sqrt[3]{x^{12}}=$
b. $\sqrt[3]{-27}=$
e. $\sqrt[3]{-8 x^{3}}=$
c. $\sqrt[3]{\frac{27}{64}}=$

## OBJECTIVE

## 4 Finding $\boldsymbol{n}^{\text {th }}$ Roots

(Click the in the multimedia textbook to see the video lecture)

- Study Objective 4, "Finding $n^{\text {th }}$ Roots," on pages 589 and 590 in the multimedia textbook. Pay close attention to the "Helpful Hint" in the yellow box.

In each of the following, write "yes" if the root is real and "no" if it is not.
a. $\sqrt{-16}=$ $\qquad$
d. $\sqrt{-9}=$
e. $\sqrt[4]{-16}=$ $\qquad$
b. $-\sqrt{16}=$ $\qquad$
c. $\sqrt[3]{-27}=$ $\qquad$ f. $\sqrt[6]{(-8)^{2}}=$ $\qquad$

- Do Practice 4 on page 590 in the multimedia textbook, below.


## PRACTICE

4 Simplify the following expressions.
a. $\sqrt[4]{10,000}=>$ d. $\sqrt[4]{-625}=$
b. $\sqrt[5]{-1}=$
e. $\sqrt[3]{27 x^{9}}=$
c. $-\sqrt{81}=$

## \section*{OBJECTIVE} <br> $5 \quad$ Finding $\sqrt[n]{a^{n}}$ Where $\boldsymbol{a}$ is a Real Number

(Click the in the multimedia textbook to see the video lecture)

- Watch the video for Objective 5 by clicking on the blue arrow to the right of "Objective 5 Finding $\sqrt[n]{a^{n}}$ Where $a$ is a Real Number" on page 590 in the multimedia textbook.
- Read Objective 5, "Finding $\sqrt[n]{a^{n}}$ Where $a$ is a Real Number," on page 590 in the multimedia textbook.
- Write the explanation for finding $\sqrt[n]{a^{n}}$ in the purple box on page 590 in the multimedia textbook.

Finding $\sqrt[n]{a^{n}}$

- Do Practice 5 on page 591 in space below.


## practice

5 Simplify.
a. $\sqrt{(-4)^{2}}=$
e. $\sqrt[5]{(3 x-5)^{5}}=$
b. $\sqrt{x^{14}}=$
c. $\sqrt[4]{(x+7)^{4}}=$
f. $\sqrt{49 x^{2}}=$
g. $\sqrt{x^{2}+16 x+64}=$
d. $\sqrt[3]{(-7)^{3}}=$

## Graphing Calculator

The graphing calculator will be used for many of the concepts presented in this Module. It is necessary that you study the Graphing Calculator portions of this Workbook and complete all of the Graphing Calculator Practice Problems.

## Entering Radicals

- The square root can be obtained by pressing

Example: Find $\sqrt{30}$


- The cube root can be obtained by pressing

Example: Find $\sqrt[3]{30}$


- Radicals with an index greater than 3 can be obtained by entering the index and then pressing


## math 5



## Practice Problem 1:

Use your calculator to find each of the following. Round each answer to the nearest hundredth.
a. $\sqrt{32}=$
b. $\sqrt[3]{32}=$
c. $\sqrt[4]{32}=$
d. $\sqrt[6]{32}=$

## Vocabulary, Readiness \& Video Check

Use the choices below to fill in each blank. Not all choices will be used.
$\begin{array}{lllll}\text { is } & \text { cubes } & -\sqrt{a} & \text { radical sign } & \text { index } \\ \text { is not } & \text { squares } & \sqrt{-a} & \text { radicand } & \end{array}$

1. In the expression $\sqrt[n]{a}$, the $n$ is called the $\qquad$ , the $\sqrt{ }$ is called the $\qquad$ , and $a$ is called the $\qquad$ .
2. If $\sqrt{a}$ is the positive square root of $a, a \quad 0$, then___ is the negative square root of $a$.
3. The square root of a negative number $\qquad$ a real number.
4. Numbers such as $1,4,9$, and 25 are called perfect $\qquad$ whereas numbers such as $1,8,27$ and 125 are called perfect $\qquad$ .

Fill in your answers in the numbered spaces below.

1. $\qquad$
2. $\qquad$
3. $\qquad$
4. $\qquad$

Complete the Online homework in MML for Module 84 Section 10.1 HW.

Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Graphing Calculator Lesson
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).

Date assignments completed: $\qquad$ Move to the next section.


### 10.2 Rational Exponents

objective
1 Understanding the Meaning of $a^{1 / n}$
(Click the in the multimedia textbook to see the video lecture)

- Watch the video for Objective 1 by clicking on the blue arrow to the right of "Objective 1 Understanding the meaning of $a^{1 / n}$ " on page 596 in the multimedia textbook.
- Study Objective 1, "Understanding the meaning of $a^{1 / n}$," on page 596 in the multimedia textbook.
- Write the definition of $a^{1 / n}$, below.

Definition of $a^{1 / n}$

- Do Practice 1 on page 596 in the multimedia textbook, below.


## PRACTICE

1 Use radical notation to write the following. Simplify if possible.
a. $36^{1 / 2}=$
e. $-64^{1 / 2}=$
b. $1000^{1 / 3}=$
f. $\left(125 x^{9}\right)^{1 / 3}$
c. $x^{1 / 3}=$
g. $3 x^{1 / 4}$
d. $1^{1 / 4}=$
objective
2 Understanding the Meaning of $a^{m / n}$

- Study Objective 2, "Understanding the meaning of $a^{m / n}$," on pages 596 and 597 in the multimedia textbook.
- Write the definition of $a^{m / n}$, below.

Definition of $a^{m / n}$

## Helpful Hint

The denominator of a rational exponent is the index of the corresponding radical. For example, $x^{1 / 5}=\sqrt[5]{x}$ and $z^{2 / 3}=\sqrt[3]{z^{2}}$, or $z^{2 / 3}=(\sqrt[3]{z})^{2}$.

- Do Practice 2 on page 597 in the multimedia textbook, below.


## PRACtice

2 Use radical notation to write the following. Simplify if possible.
a. $16^{3 / 2}=$
d. $\left(\frac{1}{25}\right)^{3 / 2}$
b. $-1^{3 / 5}=$
e. $(3 x+2)^{5 / 9}=$

## objective

## 3 Understanding the Meaning of $a^{-m / n}$

(Click the in the multimedia textbook to see the video lecture)

- Study Objective 3, "Understanding the meaning of $a^{m / n}$," on the bottom of page 597 the multimedia textbook.
- Write the definitions of $a^{m / n}$, below.


## Definition of $a^{-m / n}$

## Helpful Hint

If an expression contains a negative rational exponent, such as $9^{-3 / 2}$, you may want to first write the expression with a positive exponent and then interpret the rational exponent. Notice that the sign of the base is not affected by the sign of its exponent. For example,

$$
9^{-3 / 2}=\frac{1}{9^{3 / 2}}=\frac{1}{(\sqrt{9})^{3}}=\frac{1}{27}
$$

Also,

$$
(-27)^{-1 / 3}=\frac{1}{(-27)^{1 / 3}}=-\frac{1}{3}
$$

- Do Practice 3 on the top of page 598 in the multimedia textbook, below.


## PRACTICE

3 Write each expression with a positive exponent; then simplify.
a. $9^{-3 / 2}=$
b. $(-64)^{-2 / 3}=$

## objective

## 4 Using Rules for Exponents to Simplify Expressions

- Watch the video for Objective 4 by clicking on the blue arrow to the right of "Objective 4 Using Rules for Exponents to Simplify Expressions" on page 598 in the multimedia textbook.
- In the box below, write the Summary of Exponent Rules listed in the purple box on page 598 in the multimedia textbook.


## Summary of Exponent Rules

If $m$ and $n$ are rational numbers, and $a, b$, and $c$ are numbers for which the expressions below exist, then:

Product rule for exponents:

Power rule for exponents:

Power rules for products and quotients:

Quotient rule for exponents:

Zero exponent:

Negative exponent:

- Study EXAMPLE 4 and EXAMPLE 5 on pages 598 and 599 in the multimedia textbook.
- Do Practice 4 and 5 on page 599 in the multimedia textbook, below.

| practice <br> 4 Use properties of exponents to simplify. | PRACtICE 5 Multiply. |
| :---: | :---: |
| a. $y^{2 / 3} \cdot y^{8 / 3}=$ | a. $x^{3 / 5}\left(x^{1 / 3}-x^{2}\right)=$ |
| b. $x^{3 / 5} \cdot x^{1 / 4}=$ |  |
| c. $\frac{9^{2 / 7}}{9^{9 / 7}}=$ |  |
| d. $b^{4 / 9} \cdot b^{-2 / 9}=$ | b. $\left(x^{1 / 2}+6\right)\left(x^{1 / 2}-2\right)=$ |
| e. $\frac{\left(3 x^{1 / 4} y^{-2 / 3}\right)^{4}}{x^{4} y}=$ |  |

## objective

5 Using Rational Exponents to Simplify Radical Expressions (Click the in the multimedia textbook to see the video lecture)

- Watch the video for Objective 5 by clicking on
- Study Objective 5, "Using Rational Exponents to Simplify Radical Expressions," on page 600 in the multimedia textbook.
- Do Practice 7 and 8 on page 600 in the multimedia textbook, below.

| PRActice <br> 7 <br> Assume variables represent positive <br> numbers. | PRActice <br> $8 \quad$ Use rational exponents to write <br> each of the following as a single radical. |
| :--- | :--- |
| a. $\sqrt[9]{x^{3}}=$ | a. $\sqrt[3]{x} \cdot \sqrt[4]{x}=$ |
| b. $\sqrt[4]{36}=$ |  |
| c. $\sqrt[8]{a^{4} b^{2}}=$ | b. $\frac{\sqrt[3]{y}}{\sqrt[5]{y}}=$ |

## Graphing Calculator

## Rational Exponents on your graphing calculator.

Now that you have been introduced to rational exponents, we can use them to evaluate radical expressions.

We can use the $\Delta$ key to write exponents, including rational exponents.
When working with rational exponents, we need to be sure to use parentheses correctly.
For example, if we want to evaluate $8^{\frac{2}{3}}$, we need to enter:


Screen:


Important note: If we do not use the parentheses to indicate that the fraction $2 / 3$ is the exponent, we will obtain a wrong answer because, according to the order of operations, the calculator will do $8^{2}$ first and then divide it by 3 as shown by the following screen:


Example: Find $45^{2 / 3}$ using a rational exponent on your calculator.


Example: Find $\sqrt[3]{30}$ using a rational exponent on your calculator.


Example: Find $\sqrt[5]{30^{2}}$


## Practice Problem 1:

Use your calculator to find each of the following. Round each answer to the nearest hundredth.
a. $12^{4 / 3}=$
b. $30^{2 / 5}=$
c. $\sqrt[3]{36}=$
d. $\sqrt[3]{36^{2}}=$

Complete the Vocabulary, Readiness \& Video Check Exercises on p. 600 in your multimedia textbook. Copy the answers in the spaces provided.

## Vocabulary, Readiness \& Video Check

Answer each true or false.

1. $9^{-1 / 2}$ is a positive number. $\qquad$
2. $9^{-1 / 2}$ is a whole number. $\qquad$
3. $\frac{1}{a^{-m / n}}=a^{m / n}$ (where $a^{m / n}$ is a nonzero real number). $\qquad$
Fill in the blank with the correct choice
4. To simplify $x^{2 / 3} \times x^{1 / 5}$, $\qquad$ the exponents.
a. add b. subtract
c. multiply
d. divide
5. To simplify $\left(x^{2 / 3}\right)^{1 / 5}$, $\qquad$ the exponents.
a. add
b. subtract
c. multiply
d. divide
6. To simplify $\frac{x^{2 / 3}}{x^{1 / 5}}$, $\qquad$ the exponents.
a. add
b. subtract
c. multiply
d. divide

Fill in your answers in the numbered spaces below.

1. $\qquad$ 2. $\qquad$
2. $\qquad$ 4. $\qquad$
3. $\qquad$ 6. $\qquad$

Complete the Online homework in MML for Module 84 Section 10.2 HW.

Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).
Date assignments completed: $\qquad$ Move to the next section.


### 10.3 Simplifying Radical Expressions

objective
1 Using the Product Rule
(Click the in the multimedia textbook to see the video lecture)

- Study Objective 1, "Using the Product Rule," on page 603 in the multimedia textbook.
- Write the Product Rule for Radicals, below.

Product Rule for Radicals

- Do Practice 1 on the bottom of page 603 in the multimedia textbook, below.
practice
1 Multiply.
a. $\sqrt{5} \cdot \sqrt{7}=$
b. $\sqrt{13} \cdot \sqrt{z}=$
c. $\sqrt[4]{125} \cdot \sqrt[4]{5}=$
d. $\sqrt[3]{5 y} \cdot \sqrt[3]{3 x^{2}}=$
e. $\sqrt{\frac{5}{m}} \cdot \sqrt{\frac{t}{2}}=$
objective
2 Using the Quotient Rule
(Click the in the multimedia textbook to see the video lecture)
- Study Objective 2, "Using the Quotient Rule," on page 604 up to Practice 2 in the multimedia textbook.
- Write the Quotient Rule for Radicals, below.

Quotient Rule for Radicals

- Do Practice 2 on the bottom of page 604 in the multimedia textbook below.

PRACTICE
2 Use the quotient rule to simplify.
a. $\sqrt{\frac{36}{49}}=$
c. $\sqrt[3]{\frac{125}{8}}=$
b. $\sqrt{\frac{z}{16}}=$
d. $\sqrt[4]{\frac{5}{81 x^{8}}}=$
obJECTIVE

## 3 Simplifying Radicals

- Study Objective 3, "Simplifying Radicals," on page 605 in the multimedia textbook.
- Write out the perfect squares up to $12^{2}$ below.

| $1^{2}=$ | $7^{2}=$ |
| :--- | :--- |
| $2^{2}=$ | $8^{2}=$ |
| $3^{2}=$ | $9^{2}=$ |
| $4^{2}=$ | $10^{2}=$ |
| $5^{2}=$ | $11^{2}=$ |
| $6^{2}=$ | $12^{2}=$ |


| Write out the perfect cubes up to $5^{3}$, <br> below. | Write out the perfect fourth powers <br> up to $4^{4}$, below. |
| :--- | :--- |
| $1^{3}=$ | $1^{4}=$ |
| $2^{3}=$ | $2^{4}=$ |
| $3^{3}=$ | $3^{4}=$ |
| $4^{3}=$ | $4^{4}=$ |
| $5^{3}=$ |  |

- Do Practice 3 on page 605 in the multimedia textbook, below.


## Helpful Hint

Don't forget that, for example, $5 \sqrt{2}$ means $5 \cdot \sqrt{2}$.

## PRACTICE

3 Simplify the following.

| a. $\sqrt{98}=$ | c. $\sqrt{35}=$ |
| :--- | :--- |

b. $\sqrt[3]{54}=$
d. $\sqrt[4]{243}=$

- Watch the video for EXAMPLE 4
- Do Practice 4 on page 606 in the multimedia textbook, below.

PRACTICE
4 Use the product rule to simplify.
a. $\sqrt{36 z^{7}}=$
b. $\sqrt[3]{32 p^{4} q^{7}}=$
c. $\sqrt[4]{16 x^{15}}=$

- Watch the videos for EXAMPLE 5 .
- Do Practice 5 on page 607 in the multimedia textbook, in the boxes given at the top of the next page.


## practice

5 Use the quotient rule to divide and simplify.
a. $\frac{\sqrt{80}}{\sqrt{5}}=$
c. $\frac{5 \sqrt[3]{40 x^{5} y^{7}}}{\sqrt[3]{5 y}}=$
b. $\frac{\sqrt{98 z}}{3 \sqrt{2}}=$
d. $\frac{3 \sqrt[5]{64 x^{9} y^{8}}}{\sqrt[5]{x^{-1} y^{2}}}=$

OBJECTIVE
4 Using the Distance and Midpoint Formulas
(Click the in the multimedia textbook to see the video lecture)

- Study Objective 4, "Using the Distance and Midpoint Formulas," on pages 607 and 608 up through EXAMPLE 6 in the multimedia textbook.
- Write the distance formula, below.

Distance Formula

- Do Practice 6 on page 608 in the multimedia textbook, given in the box at the top of the next page.

PRACTICE
6 Find the distance between $(-3,7)$ and $(-2,3)$. Give an exact distance and a three-decimal-place approximation.

Note: Write the exact distance answer as a simplified radical.

Exact distance $=$

Approximate distance $=$

- Continue studying Objective 4 until the end of page 608 in the multimedia textbook.
- Write the midpoint formula, below.


## Midpoint Formula

- Do Practice 7 on page 608 in the multimedia textbook, below.
practice
7 Find the midpoint of the line segment that joins points $P(5,-2)$ and $Q(8,-6)$.

Complete the Vocabulary, Readiness \& Video Check Exercises on p. 609 in your multimedia textbook. Copy the answers in the spaces provided.

## Vocabulary, Readiness \& Video Check

Use the choices below to fill in each blank. Some choices may be used more than once.
distance midpoint point

1. The $\qquad$ of a line segment is a $\qquad$ exactly halfway between the two endpoints of the line segment.
2. The $\qquad$ between two points is a distance, measured in units.
3. The formula is $d=\sqrt{\left(x_{2}-x_{1}\right)^{2}+\left(y_{2}-y_{1}\right)^{2}}$.
4. The ___ formula is $\left(\frac{x_{1}+x_{2}}{2}, \frac{y_{1}+y_{2}}{2}\right)$.

Fill in your answers in the numbered spaces below.

1. $\qquad$ 2. $\qquad$
2. $\qquad$

Complete the Online homework in MML for Module $\mathbf{8 4}$ Section 10.3 HW.


Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).
Date assignments completed: $\qquad$ Move to the next section.


### 10.4 Adding, Subtracting, and Multiplying Radical Expressions

objective
1 Adding or Subtracting Radical Expressions
(Click the in the multimedia textbook to see the video lecture)

- Study Objective 1, "Adding or Subtraction Radical Expressions," on page 611 up through EXAMPLE 2 on the top of page 613 in the multimedia textbook.
- Explain what "like radicals" are, below.


## Like Radicals

Give an example of two terms that are "like radicals."

Give an example of two terms that are not "like radicals."

- Do Practice 1 and 2 below and on the next page making sure to:
- Simplify each radical, if possible.
- Combine radicals that are like after you have simplified them.

| PRACTICE <br> 1 | Add or subtract as indicated. |  |
| :--- | :--- | :--- |
| a. $3 \sqrt{17}+5 \sqrt{17}$ | b. $7 \sqrt[3]{5 z}-12 \sqrt[3]{5 z}$ | c. $3 \sqrt{2}+5 \sqrt[3]{2}$ |
|  |  |  |

## practice

2 Add or subtract.
a. $\sqrt{24}+3 \sqrt{54}=$
d. $\sqrt{40}+\sqrt[3]{40}=$
b. $\sqrt[3]{24}-4 \sqrt[3]{81}+\sqrt[3]{3}=$
e. $\sqrt[3]{81 x^{4}}+\sqrt[3]{3 x^{4}}$
c. $\sqrt{75 x}-3 \sqrt{27 x}+\sqrt{12 x}=$

- Study EXAMPLE 3 on page 613 in the multimedia textbook.
- Do Practice 3 on the bottom of page 613 in the multimedia textbook. Be sure to find a common denominator before combining terms.


## Practice

3 Add or subtract as indicated.
a. $\frac{\sqrt{28}}{3}-\frac{\sqrt{7}}{4}$
b. $\sqrt[3]{\frac{6 y}{64}}+3 \sqrt[3]{6 y}$

## 2 Multiplying Radical Expressions

- Watch the video for Objective 2 by clicking on the blue arrow to the right of "Objective 2 Multiplying Radical Expressions" on the top of page 614 in the multimedia textbook in MyMathLab.
- Study EXAMPLE 4 on page 614 in the multimedia textbook.
- Do Practice 4 on the bottom of page 614 in the multimedia textbook. Be sure to use the distributive property and product rule for radicals.

| Practice <br> 4 Multiply. |  |
| :--- | :--- |
| a. $\sqrt{5}(2+\sqrt{15})=$ |  |
| b. $(\sqrt{2}-\sqrt{5})(\sqrt{6}+2)=$ |  |
| e. $(3 \sqrt{z}-4)(2 \sqrt{z}+3)=$ | d. $(\sqrt{6}-3)^{2}=$ |
|  |  |

Complete the Vocabulary, Readiness \& Video Check Exercises on p. 255 in your multimedia textbook. Copy the answers in the spaces provided on the next page

## Vocabulary, Readiness \& Video Check

Complete the table with "Like" or "Unlike."
1.

| Terms | Like or Unlike Radical Terms? |
| :--- | :--- |
| $\sqrt{7}, \sqrt[3]{7}$ |  |
| $\sqrt[3]{x^{2} y}, \sqrt[3]{y x^{2}}$ |  |
| $\sqrt[3]{a b c}, \sqrt[3]{c b a}$ |  |
| $2 x \sqrt{5}, 2 x \sqrt{10}$ |  |

Simplify. Assume that all variables represent positive real numbers.
5. $2 \sqrt{3}+4 \sqrt{3}=$ $\qquad$
6. $5 \sqrt{7}+3 \sqrt{7}=$ $\qquad$ 7. $8 \sqrt{x}-\sqrt{x}=$ $\qquad$
8. $3 \sqrt{y}-\sqrt{y}=$ $\qquad$
9. $7 \sqrt[3]{x}+\sqrt[3]{x}=$ $\qquad$
10. $8 \sqrt[3]{z}+\sqrt[3]{z}=$ $\qquad$ Fill
in your answers in the numbered spaces below.

1. $\qquad$
2. $\qquad$
3. $\qquad$
4. $\qquad$
5. $\qquad$
6. $\qquad$
7. $\qquad$
8. $\qquad$
9. $\qquad$
10. $\qquad$

Complete the Online homework in MML for Module 84 Section 10.4 HW.
Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).
Date assignments completed: $\qquad$ Move to the next section.


### 10.5 Rationalizing Denominators and Numerators of Rational Expressions

(Note: Rationalization of Numerators will not be included.)

## objective

1 Rationalizing Denominators of Radical Expressions

- Watch the video for Objective 1 by clicking on the blue arrow to the right of "Objective 1 Rationalizing Denominators of Radical Expressions" on page 617 in the multimedia textbook.
- In your own words, describe what it means to rationalize a denominator in a rational expression, below.
- Study EXAMPLES $\mathbf{1 - 3}$ on pages 617 and 618 in the multimedia textbook.
- Do Practice 1,2 , and 3 on page 618 in the multimedia textbook making sure to:
- Note that any fractional radicand can be written as two separate radicals.
- For example: $\sqrt{\frac{3 x}{2}}=\frac{\sqrt{3 x}}{\sqrt{2}}$
- Note that you may find it easier to simplify the numerator and denominator first before rationalizing the denominator.



## OBJECTIVE

2 Rationalizing Denominators Having Two Terms
(Click the in the multimedia textbook to see the video lecture)

- Study Objective 2, "Rationalizing Denominators Having Two Terms," on page 619 up to EXAMPLE 4 in the multimedia textbook.
- Answer the following questions about conjugates, below.

What is a conjugate?

Why are conjugates important?

What is the conjugate of $\sqrt{5}-2$ ?

- Multiply $\sqrt{5}-2$ by its conjugate. Show your work below.
- Study EXAMPLE 4 on pages 619 and 620 in the multimedia textbook.
- EXAMPLE 4 a is rewritten below. Provide a reason for each step.

EXAMPLE 4 a: Rationalize the denominator for: $\frac{2}{3 \sqrt{2}+4}$
STEPS REASONS
1.

$$
\frac{2}{3 \sqrt{2}+4}=\frac{2(3 \sqrt{2}-4)}{(3 \sqrt{2}+4)(3 \sqrt{2}-4)}
$$

2. 

$$
=\frac{2(3 \sqrt{2}-4)}{(3 \sqrt{2})^{2}-4^{2}}
$$

3. 

$$
=\frac{2(3 \sqrt{2}-4)}{18-16}
$$

4. 

$$
=\frac{2(3 \sqrt{2}-4)}{2}, \text { or } 3 \sqrt{2}-4
$$

4. 
5. 
6. 
7. 

教

- Do Practice 4 on page 620 in the multimedia textbook, below.


## PrActice

4 Rationalize the denominator. Show your work.
4a. $\frac{5}{3 \sqrt{5}+2}$

4b. $\frac{\sqrt{2}+5}{\sqrt{3}-\sqrt{5}}$

4c. $\frac{3 \sqrt{x}}{2 \sqrt{x}+\sqrt{y}}$

Complete the Vocabulary, Readiness \& Video Check Exercises on p. 621 in your multimedia textbook. Copy the answers in the spaces provided below.

## Vocabulary, Readiness \& Video Check

Use the choices below to fill in each blank. Not all choices will be used.

| rationalizing the numerator | conjugate | $\frac{\sqrt{3}}{\sqrt{3}}$ |
| :--- | :--- | :--- |
| rationalizing the denominator | $\frac{5}{5}$ |  |

1. The $\qquad$ of $a+b$ is $a-b$.
2. The process of writing an equivalent expression, but without a radical in the denominator, is called
3. The process of writing an equivalent expression, but without a radical in the numerator, is called $\qquad$ .
4. To rationalize the denominator of $\frac{5}{\sqrt{3}}$, we multiply by

Fill in your answers in the numbered spaces below.

1. $\qquad$
2. $\qquad$
3. $\qquad$
4. $\qquad$

Complete the Online homework in MML for Module 84 Section 10.5 HW.

Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).
Date assignments completed: $\qquad$ Move to the next section.


### 10.6 Radical Equations and Problem Solving

objective
1 Solving Equations that Contain Radical Expressions

- Read Objective 1, "Solving Equations that Contain Radical Expressions," on page 624. Take notes as you read and answer the following questions below.

State the Power Rule

Why are algebraic solutions to a radical equation called proposed solutions?

What is meant by extraneous solutions to an equation?

Notes:

- Study Example 1 and watch the accompanying video on page 624.
- Do Practice 1 on the next page. Be sure to show your work.

PRACTICE
1 Solve: $\sqrt{3 x-5}=7$.

- Study Example 2 on page 625.
- Do Practice 2 below. Be sure to show your work.
practice
2 Solve: $\sqrt{16 x-3}-4 x=0$.
- In the box below, write down the steps used to solve radical equations found on the top of page 626 in the multimedia textbook, below and on the next page.

Solving a Radical Equation:
STEP 1:

STEP 2:

STEP 3:

STEP 4:

- Watch the video for EXAMPLE 3 on page 626 in the multimedia textbook.
- Do Practice 3 on page 626 in the multimedia textbook, below.


## PRACtICE

3 Solve the following equation by showing the steps required to solve a radical equation. Don't forget to check all proposed solutions (STEP 4). Show your work.

$$
\text { Solve: } \sqrt[3]{x-2}+1=3
$$

- Watch the video for EXAMPLE 4 on page 626 in the multimedia textbook.
- Study Example 4.


## D Helpful Hint

In Example 4, notice that $(x-2)^{2}=x^{2}-4 x+4$. Make sure binomials are squared correctly.

- On the next page, do Practice 4 given on the bottom of page 626 in the multimedia textbook.


## PRACTICE

4 Solve the following equation by showing the steps required to solve a radical equation. Don't forget to check all proposed solutions (STEP 4). Show your work.

$$
\text { Solve: } \sqrt{16+x}=x-4
$$

- Study EXAMPLE 5 on page 627 in the multimedia textbook.

In your own words, what makes this problem different from those you have solved so far?

Use the FOIL method to multiply the following.

$$
\begin{array}{l|l}
(7-\sqrt{3 x})(7-\sqrt{3 x}) & (\sqrt{5 x}+2)(\sqrt{5 x}+2)
\end{array}
$$

- Do Practice 5 on page 627 in the multimedia textbook, below.

PRACtice
5 Solve and check. Show your work.

$$
\sqrt{8 x+1}+\sqrt{3 x}=2
$$

Check

## Graphing Calculator

## Solving Radical Equations using the graphing calculator

Note: Please refer to the Module 80 Workbook, pages 19 - 20, to review how to solve equations using the Intersect feature of your graphing calculator.

Example: Use the graphing calculator to solve the radical equation $\sqrt{x}+3=8$.
We must first enter each side of the equation as $Y_{1}$ and $Y_{2}$ - in the $Y$ - editor.
Important note: When entering $\sqrt{x}+3$ in $Y_{1}$, make sure that 3 is not under the square root symbol. Keystrokes: $\square$ 2nd $x^{2} \times, \mathrm{T}, \mathrm{\theta}, \mathrm{n}$ $\square$ $+3$. Using the $) \rightarrow$ keys after entering $x$ tells the calculator that only the $x$ is part of the radical.


Next, we need to choose a good viewing window where the graphs of both equations and where they intersect can be seen. In this case, the second equation represents a horizontal line through the value 8, so the Standard window (ZOOM 6) can be a good one to start with.

Then, press
to see the graphs of both equations and, in particular, to look at the intersection (or lack thereof) of both.


In this case, we cannot see the intersection in the Standard window. Notice that the intersection happens at values of x that are greater than the $x=10$ which limits the standard window, so we need to modify the window settings to see the graph further to the right. We may also want to change the limits for the variable $y$, to avoid the point of intersection showing too close to the edge of the screen and making finding its coordinates a bit easier.

For example,


Now, we can use the 2nd TRACE , 5: intersect option to find the point of intersection.


Since the original equation contains the variable $x$, we find the value $x=25$ as a potential solution. To check that it is indeed a solution, we must replace that value in the equation and verify that it makes it true:


Now, we can say that $x=25$ is the solution to the equation.

## Practice Problem 1:

Use the Intersect feature of your graphing calculator to find the solution to the equation $\sqrt{2 x+8}=5$.

What is the point of intersection? $x=$

$$
y=
$$

What is the solution to the equation? Remember, you must check your result from the point of intersection to see if it is, indeed, a solution to the equation.

## Practice Problem 2:

Use the Intersect feature of your graphing calculator to find the solution to the equation $\sqrt{2 x+5}=x+1$.

What is the point of intersection? $x=$

$$
y=
$$

What is the solution to the equation? Remember, you must check your result from the point of intersection to see if it is, indeed, a solution to the equation.

## Practice Problem 3:

Use the Intersect feature of your graphing calculator to find the solution to the equation $4-\sqrt{x}=5$.

What is the point of intersection? $\mathrm{x}=$

$$
y=
$$

What is the solution to the equation? Remember, you must check your result from the point of intersection to see if it is, indeed, a solution to the equation.
objective
2 Using the Pythagorean Theorem

- Read Objective 2, "Using the Pythagorean Theorem," starting on the bottom of page 627 and continuing through EXAMPLE 7 on page 629 in the multimedia textbook.
- Write the Pythagorean Theorem including a diagram of a right triangle with labels for the legs and hypotenuse, below.
Pythagorean Theorem
- Do Practice 6 on page 628 in the multimedia textbook, below.
radicals. Simplify your answer.
- Do Practice 7 on page 629 in the multimedia textbook, below.

PRACTICE
7 Keith Robinson bought two Siamese fighting fish, but when he got home, he found he only had one rectangular tank that was 12 in . long, 7 in . wide and 5 in . deep. Since the fish must be kept separated, he needed to insert a plastic divider in the diagonal of the tank. He already has a piece that is 5 in . in one dimension, but how long must it be to fit corner to corner in the tank?

Label and use the diagram to the right to help you solve the problem. One of the labels will be the unknown you are trying to find.


Complete the Vocabulary, Readiness \& Video Check Exercises on p. 629 in your multimedia textbook. Copy the answers in the spaces provided on the following page.

## Vocabulary, Readiness \& Video Check

Use the choices below to fill in each blank. Not all choices will be used.

| hypotenuse | right | $x^{2}+25$ | $16-8 \sqrt{7 x}+7 x$ |
| :--- | :--- | :--- | :--- |
| extraneous solution | legs | $x^{2}-10 x+25$ | $16+7 x$ |

1. A proposed solution that is not a solution of the original equation is called $a(n)$
2. The Pythagorean theorem states that $a^{2}+b^{2}=c^{2}$ where $a$ and $b$ are the lengths of the $\qquad$ of $a(n)$
$\qquad$ triangle and $c$ is the length of the $\qquad$ -.
3. The square of $x-5$, or $(x-5)^{2}=$ $\qquad$
4. The square of $4-\sqrt{7 x}$, or $(4-\sqrt{7 x})^{2}=$ $\qquad$ .
5. $\qquad$
6. $\qquad$ 4. $\qquad$

Complete the Online homework in MML for Module 84 Section 10.6 HW.
Before moving on to the next section, check to make sure you have done ALL the assignments in this section. Put an $X$ in the box next to those that you have completed. Go back to those assignments which are incomplete.
$\square$ Student Module Workbook
$\square$ Graphing Calculator Lesson
$\square$ Vocabulary, Readiness \& Video Check
$\square$ Online homework in MyMathLab (with a grade of $80 \%$ or higher).

## Next take the Review Quiz for Module 84 in MyMathLab:

- click on the Module 84 button
- click on the Take the Review Quiz button
- choose the Module 84 Review Quiz.

This quiz can be taken outside of the classroom.
No password is needed.

## GRAPHING CALCULATOR TOOLS

## In Modules 70 and above you will be required to know how to use the TI-84 graphing calculator. This includes: TI-83, TI-83 Plus, TI-84 Plus, TI-84 Silver, etc.

For resources on how to use the graphing calculator, click on the Graphing Calculator Tools button in the left navigation pane in your Prep for College Math Course.


The Graphing Calculator Reference Card is a 6-page summary of how to use the calculator and some of its important functions.

- You may view this online or print it out.
- You may find this a handy reference tool, especially if you have worked with a graphing calculator before.
The Graphing Calculator Tutorial is set of interactive lessons to help you learn to use your graphing calculator.
- Modules requiring Graphing Calculator exercises will direct you to the appropriate topic.
- Click on the folder to open the various lessons.

- As you go through the lessons, you will be clicking a simulation of the calculator.
- Be sure to use YOUR calculator to perform the steps, making sure that you understand the process.
- DON'T JUST CLICK THE BUTTONS ON THE SCREEN! Follow along with your own calculator
- You are responsible for knowing the material the graphing calculator lessons
- You are responsible for the required graphing calculator problems in the module workbooks
- These skills are required for the modules 70 and above and for future courses.

