Section 8.1
Finding Roots

Be CAREFUL on the turns!!!

What is the maximum speed at which a racing cyclist can turn a corner without tipping over?

The answer, in miles per hour, is given by an algebraic expression that involves finding a square root.

In this section, we develop the basics of radical expressions, and then apply them in various applications, including cycling.

First Steps:

- ☐ **Take comprehensive notes** from your instructor's lecture and insert your notes into this section of the *Learning Guide*. Be sure to write down all examples, definitions, and other key concepts. Additional learning resources include the *Lecture Series on DVD*, the *PowerPoints*, and Section 8.1 of your textbook which begins on page 566.
- ☐ Complete the ***Concept and Vocabulary Check*** on page 571 of the textbook.

Guided Practice:

- ☐ Review each of the following ***Solved Problems*** and complete each ***Pencil Problem***.

Objective #1: Find square roots.

✔ *Solved Problem #1*	*Pencil Problem #1*
1a. Evaluate: $\sqrt{81}$ $\sqrt{81} = 9$ The principal square root of 81 is 9.	**1a.** Evaluate: $\sqrt{36}$
1b. Evaluate: $\sqrt{\frac{1}{25}}$ $\sqrt{\frac{1}{25}} = \frac{1}{5}$ because $\left(\frac{1}{5}\right)^2 = \frac{1}{25}$.	**1b.** Evaluate: $\sqrt{\frac{1}{9}}$
1c. Evaluate: $\sqrt{36+64}$ $\sqrt{36+64} = \sqrt{100} = 10$	**1c.** Evaluate: $\sqrt{33-8}$

1d. Evaluate: $\sqrt{36}+\sqrt{64}$

$\sqrt{36}+\sqrt{64}=6+8$
$=14$

1d. Evaluate: $\sqrt{144}+\sqrt{25}$

Objective #2: Evaluate models containing square roots.

✔ *Solved Problem #2*

2. The amount of evaporation, in inches per day, from the surface of a large body of water can be modeled by the formula $E=\frac{w}{20\sqrt{a}}$ where a is the area of the water, in square miles, w is the average wind speed of the air over the water, in miles per hour, and E is the surface evaporation, in inches per day.
Determine the evaporation from the surface of a lake whose area is 4 square miles on a day when the wind speed is 20 miles per hour.

$E=\frac{w}{20\sqrt{a}}$

$E=\frac{20}{20\sqrt{4}}=\frac{1}{2}$

The surface evaporation is $\frac{1}{2}$ of an inch on this day.

✎ *Pencil Problem #2*

2. Racing cyclists use the formula $v=4\sqrt{r}$ to determine the maximum velocity, v, in miles per hour, to turn a corner with radius r, in feet, without tipping over. What is the maximum velocity that a cyclist should travel around a corner of radius 9 feet without tipping over?

Objective #3: Use a calculator to find decimal approximations for irrational square roots.

✔ *Solved Problem #3*

3. The mathematical model $P=2.2\sqrt{t}+45$ describes the percentage of bachelor's degrees, P, awarded to women in U.S. colleges t years after 1975.
Use the formula to find the percentage, to the nearest percent, of degrees awarded to women in 1995.

1995 is 20 years after 1975. Therefore, substitute 20 for t into the formula.

$P=2.2\sqrt{t}+45$

$P=2.2\sqrt{20}+45\approx 55$

According to the model, about 55% of degrees were awarded to women in 1995.

✎ *Pencil Problem #3*

3. Use a calculator to approximate the expression. Round to three decimal places.

$$\frac{-5+\sqrt{321}}{6}$$

Objective #4: Find higher roots.

✔ *Solved Problem #4*	*Pencil Problem #4*
4a. Find the cube root: $\sqrt[3]{1}$ $\sqrt[3]{1} = 1$ because $1^3 = 1$.	**4a.** Find the cube root: $\sqrt[3]{64}$
4b. Find the cube root: $\sqrt[3]{-27}$ $\sqrt[3]{-27} = -3$ because $(-3)^3 = -27$.	**4b.** Find the cube root: $\sqrt[3]{-1000}$
4c. Find the cube root: $\sqrt[3]{\frac{1}{125}}$ $\sqrt[3]{\frac{1}{125}} = \frac{1}{5}$ because $\left(\frac{1}{5}\right)^3 = \frac{1}{125}$.	**4c.** Find the cube root: $-\sqrt[3]{\frac{1}{8}}$
4d. Find the indicated root: $\sqrt[4]{81}$ $\sqrt[4]{81} = 3$ because $3^4 = 81$.	**4d.** Find the indicated root: $\sqrt[4]{16}$
4e. Find the indicated root: $\sqrt[4]{-81}$ $\sqrt[4]{-81}$ is not a real number because the index, 4, is even and the radicand, -81, is negative.	**4e.** Find the indicated root: $\sqrt[4]{-16}$

4f. Find the indicated root: $-\sqrt[4]{81}$ $-\sqrt[4]{81} = -3$ because $\sqrt[4]{81} = 3$.	**4f.** Find the indicated root: $-\sqrt[4]{256}$
4g. Find the indicated root: $\sqrt[5]{-\frac{1}{32}}$ $\sqrt[5]{-\frac{1}{32}} = -\frac{1}{2}$ because $\left(-\frac{1}{2}\right)^5 = -\frac{1}{32}$.	**4g.** Find the indicated root: $\sqrt[5]{-1}$

Answers for Pencil Problems *(Textbook Exercise references in parentheses)*:

1a. 6 *(8.1 #1)* **1b.** $\frac{1}{3}$ *(8.1 #7)* **1c.** 5 *(8.1 #17)* **1d.** 17 *(8.1 #23)*

2. 12 miles per hour *(8.1 #85)*

3. 2.153 *(8.1 #41)*

4a. 4 *(8.1 #47)* **4b.** −10 *(8.1 # 55)* **4c.** $-\frac{1}{2}$ *(8.1 # 51)* **4d.** 2 *(8.1 #59)*

4e. not a real number *(8.1 #63)* **4f.** −4 *(8.1 #69)* **4g.** −1 *(8.1 #65)*

Homework:

- ☐ **Review the Section 8.1 summary** on page 613 of the textbook.
- ☐ **Insert your homework** into this section of the *Learning Guide*. Show all work neatly and check your answers. Strive to work through difficulties when possible, making note of any exercises where you need additional help. Remember, even if your instructor assigns homework through *MyMathLab*, you should still write out your work.