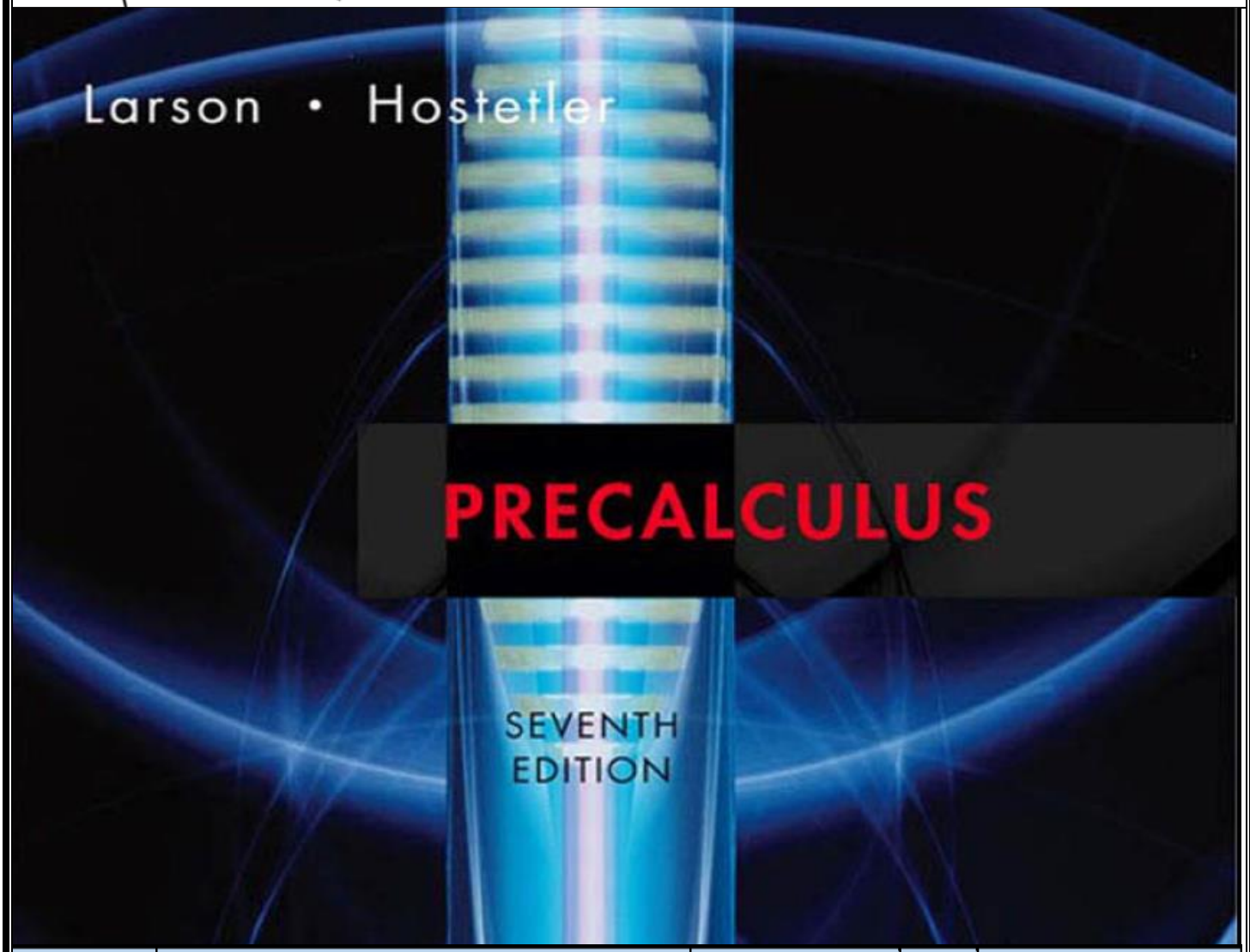


List of Topics	Lecture and Examples	Case Studies/Tutorials (Applications)	Contact Hours	Exercises to do by students as homework
Equations And Inequalities	Absolute Value and Distance (page: A4 in Appendix) Examples: 4	Pages: A8-A9 44, 48, 56	2	12, 28, 40, 42, 44, 108, 110, 112, 114
	Solving Equations • Equations and Solutions of Equations (pages: A46-A47 in Appendix) Examples:1, 2, 3 • Solving a Quadratic Equations A49, Examples: 4, 5, 6, 7,8, 9 • Equations Involving Radicals (Page: A54 in Appendix) Examples: 12 and 13 • Equations with Absolute Values (page: A55 in Appendix) Example 14	pages: A58:A59 22, 48, 162, 188, 192,	3	pages: A58:A59 8, 10, 28, 44, 54, 68, 80, 92,98, 132, 136, 138, 150, 160, 184, 185, 190, 194 and 204
	• Solving a Linear Inequality in One Variable (A62) Examples: 2 and 3 • Inequalities Involving Absolute Values (A64) Examples: 4, 5, 6	Pages: A66-A69 12,50, 84, 102, 109, 113,	2	Pages: A66-A69 4, 10, 18, 26, 38, 40, 42, 50, 60, 82, 86, 96, 104, 110, 114

Absolute Value and Distance

Definition of Absolute Value

If a is a real number, then the absolute value of a is

$$|a| = \begin{cases} a, & \text{if } a \geq 0 \\ -a, & \text{if } a < 0 \end{cases}$$

Example 4 Evaluating the Absolute Value of a Number

Evaluate $\dfrac{|x|}{x}$ for (a) $x > 0$ and (b) $x < 0$.

47. $\dfrac{|x+2|}{x+2}, \quad x < -2$

Properties of Absolute Values

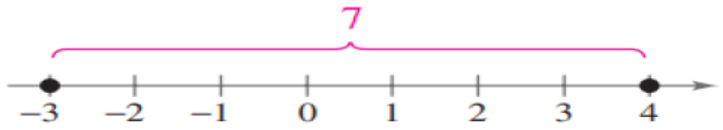
1. $|a| \geq 0$
2. $|-a| = |a|$
3. $|ab| = |a||b|$
4. $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}, \quad b \neq 0$

Absolute value can be used to define the distance between two points on the real number line.

Distance Between Two Points on the Real Number Line

Let a and b be real numbers. The **distance between a and b** is

$$d(a, b) = |b - a| = |a - b|.$$



In Exercises 39–48, evaluate the expression.

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44. $-3 - |-3|$

48. $\frac{|x-1|}{x-1}, \quad x > 1$

In Exercises 55–60, find the distance between a and b.

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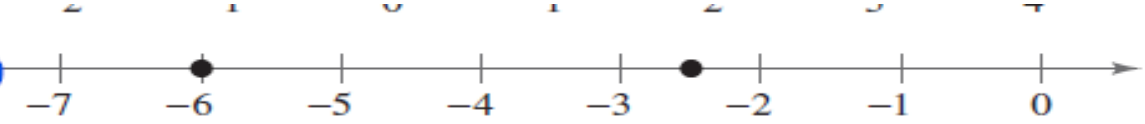
56. $a = -126, b = -75$

A.1 Exercises

In Exercises 11 and 12, approximate the numbers and place the correct symbol (< or >) between them.

12.



In Exercises 19–30, (a) give a verbal description of the subset of real numbers represented by the inequality or the interval, (b) sketch the subset on the real number line, and (c) state whether the interval is bounded or unbounded.

28. $0 < x \leq 6$

In Exercises 39–48, evaluate the expression.

40. $|0|$

42. $|4 - 1|$

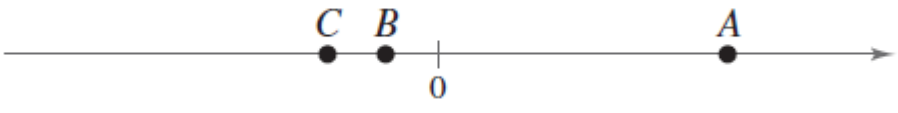
True or False? **In Exercises 107 and 108, determine whether the statement is true or false. Justify your answer.**

108. Because $\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c}$, then $\frac{c}{a+b} = \frac{c}{a} + \frac{c}{b}$.

110. ***Think About It*** Is there a difference between saying that a real number is positive and saying that a real number is nonnegative? Explain.

112. ***Writing*** Describe the differences among the sets of natural numbers, whole numbers, integers, rational numbers, and irrational numbers.

In Exercises 113 and 114, use the real numbers *A*, *B*, and *C* shown on the number line. Determine the sign of each expression.



114. (a) $-C$

(b) $A - C$

A.5 Solving Equations

An **equation** in x is a statement that two algebraic expressions are equal.

$$3x - 5 = 7,\ x^2 - x - 6 = 0, \text{ and } \sqrt{2x} = 4$$

Linear Equations in One Variable

Definition of a Linear Equation

A **linear equation in one variable** x is an equation that can be written in the standard form

$$ax + b = 0$$

where a and b are real numbers with $a \neq 0$.

Example 1 Solving a Linear Equation

a. $3x - 6 = 0$

b. $5x + 4 = 3x - 8$

Now try Exercise **13.** $7 - 2x = 25$

Example 2 **An Equation Involving Fractional Expressions**

Solve $\frac{x}{3} + \frac{3x}{4} = 2.$

Example 3 **An Equation with an Extraneous Solution**

Solve $\frac{1}{x-2} = \frac{3}{x+2} - \frac{6x}{x^2-4}.$

Now try Exercise **37.** $\frac{x}{x+4} + \frac{4}{x+4} + 2 = 0$

CHAPTER- (0)- Equations and Inequalities MAT 122

Quadratic Equations

A **quadratic equation** in x is an equation that can be written in the general form

$$ax^2 + bx + c = 0$$

second-degree polynomial equation in x.

Solving a Quadratic Equation

Factoring: If $ab = 0$, then $a = 0$ or $b = 0$.

Example 4 Solving a Quadratic Equation by Factoring

a. $2x^2 + 9x + 7 = 3$

b. $6x^2 - 3x = 0$

Now try Exercise **57.** $x^2 - 2x - 8 = 0$

Square Root Principle: If $u^2 = c$, where $c > 0$, then $u = \pm\sqrt{c}$.

Example 5 Extracting Square Roots

Solve each equation by extracting square roots.

a. $4x^2 = 12$

b. $(x - 3)^2 = 7$

Completing the Square: If $x^2 + bx = c$, then

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = c + \left(\frac{b}{2}\right)^2$$

Add $\left(\frac{b}{2}\right)^2$ to each side.

$$\left(x + \frac{b}{2}\right)^2 = c + \frac{b^2}{4}.$$

Example 6 **Completing the Square: Leading Coefficient Is 1**

Solve $x^2 + 2x - 6 = 0$ by completing the square.

Now try Exercise ..... $x^2 + 12x + 25 = 0$

Example 7 **Completing the Square: Leading Coefficient Is Not 1**

$3x^2 - 4x - 5 = 0$

Now try Exercise **91.** $2x^2 + 5x - 8 = 0$

CHAPTER- (0)- Equations and Inequalities

Quadratic Formula: If $ax^2 + bx + c = 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Example 8 **The Quadratic Formula: Two Distinct Solutions**

Use the Quadratic Formula to solve $x^2 + 3x = 9$.

Now try Exercise **101.** $x^2 + 8x - 4 = 0$

Example 9 **The Quadratic Formula: One Solution**

Use the Quadratic Formula to solve $8x^2 - 24x + 18 = 0$.

Now try Exercise 105. **105.** $9x^2 + 24x + 16 = 0$

Equations Involving Radicals

Example 12 **Solving Equations Involving Radicals**

a. $\sqrt{2x + 7} - x = 2$ Original equation

b. $\sqrt{2x - 5} - \sqrt{x - 3} = 1$

Example 14 **Solving an Equation Involving Absolute Value**

Solve $|x^2 - 3x| = -4x + 6$.

181. $|x| = x^2 + x - 3$

A.5 Exercises

In Exercises 1–10, determine whether the equation is an identity or a conditional equation.

8. $x^2 + 2(3x - 2) = x^2 + 6x - 4$

10. $\frac{5}{x} + \frac{3}{x} = 24$

In Exercises 27–48, solve the equation and check your solution. (If not possible, explain why.)

28. $8(x + 2) - 3(2x + 1) = 2(x + 5)$

44. $\frac{6}{x} - \frac{2}{x + 3} = \frac{3(x + 5)}{x^2 + 3x}$

In Exercises 49–54, write the quadratic equation in general form.

54. $x(x + 2) = 5x^2 + 1$

In Exercises 55–68, solve the quadratic equation by factoring.

68. $(x + a)^2 - b^2 = 0$, a and b are real numbers

In Exercises 69–82, solve the equation by extracting square roots.

80. $(4x + 7)^2 = 44$

In Exercises 83–92, solve the quadratic equation by completing the square.

92. $4x^2 - 4x - 99 = 0$

In Exercises 93–116, use the Quadratic Formula to solve the equation.

98 $x^2 - 10x + 22 = 0$

In Exercises 125–134, solve the equation using any convenient method.

132. $a^2x^2 - b^2 = 0$, a and b are real numbers

In Exercises 135–152, find all solutions of the equation. Check your solutions in the original equation.

136 $20x^3 - 125x = 0$

138. $x^6 - 64 = 0$

150. $36t^4 + 29t^2 - 7 = 0$

In Exercises 153–184, find all solutions of the equation. Check your solutions in the original equation.

160 $x + \sqrt{31 - 9x} = 5$

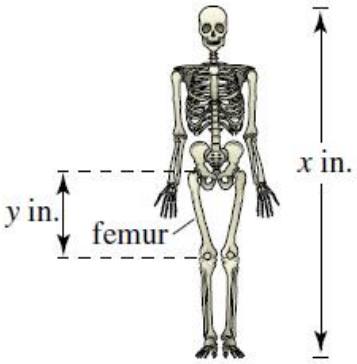
184 $|x - 10| = x^2 - 10x$

185. ***Anthropology*** The relationship between the length of an adult's femur (thigh bone) and the height of the adult can be approximated by the linear equations

$y = 0.432x - 10.44$ Female

$y = 0.449x - 12.15$ Male

where y is the length of the femur in inches and x is the height of the adult in inches (see figure).



(a) An anthropologist discovers a femur belonging to an adult human female. The bone is 16 inches long. Estimate the height of the female.

(b) From the foot bones of an adult human male, an anthropologist estimates that the person's height was 69 inches. A few feet away from the site where the foot bones were discovered, the anthropologist discovers a male adult femur that is 19 inches long. Is it likely that both the foot bones and the thigh bone came from the same person?

(c) Complete the table to determine if there is a height of an adult for which an anthropologist would not be able to determine whether the femur belonged to a male or a female.

Height, x	Female femur length, y	Male femur length, y
60		
70		
80		
90		
100		
110		

190. ***Geometry*** The hypotenuse of an isosceles right triangle is 5 centimeters long. How long are its sides?

194. ***Airline Passengers*** An airline offers daily flights between Chicago and Denver. The total monthly cost C (in millions of dollars) of these flights is $C = \sqrt{0.2x + 1}$ where x is the number of passengers (in thousands). The total cost of the flights for June is 2.5 million dollars. How many passengers flew in June?

204. Solve $3(x + 4)^2 + (x + 4) - 2 = 0$ in two ways.

(a) Let $u = x + 4$, and solve the resulting equation for u. Then solve the u-solution for x.

(b) Expand and collect like terms in the equation, and solve the resulting equation for x.

(c) Which method is easier? Explain.

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In Exercises 11–26, solve the equation and check your solution.

22. $\frac{x}{5} - \frac{x}{2} = 3 + \frac{3x}{10}$

In Exercises 27–48, solve the equation and check your solution. (If not possible, explain why.)

48. $(2x + 1)^2 = 4(x^2 + x + 1)$

In Exercises 153–184, find all solutions of the equation. Check your solutions in the original equation.

162. $\sqrt{x+5} = \sqrt{x-5}$

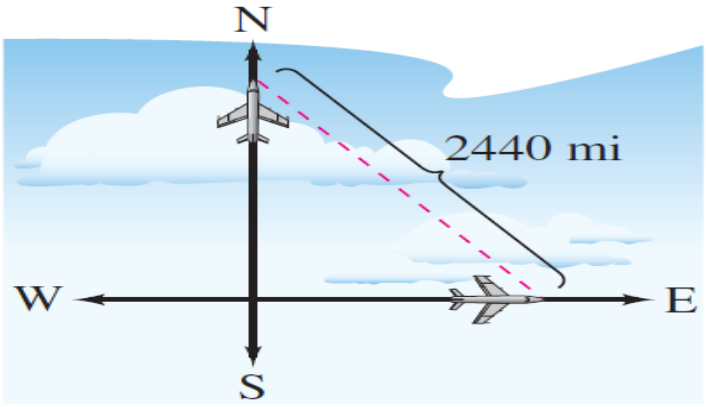
188. ***Floor Space*** The floor of a one-story building is 14 feet longer than it is wide. The building has 1632 square feet of floor space.

(a) Draw a diagram that gives a visual representation of the floor space. Represent the width as w and show the length in terms of w.

(b) Write a quadratic equation in terms of w.

(c) Find the length and width of the floor of the building.

192. ***Flying Speed*** Two planes leave simultaneously from Chicago's O'Hare Airport, one flying due north and the other due east (see figure). The northbound plane is flying 50 miles per hour faster than the eastbound plane. After 3 hours, the planes are 2440 miles apart. Find the speed of each plane.



CHAPTER- (0)- Equations and Inequalities

Solving a Linear Inequality in One Variable

Example 2 Solving Linear Inequalities

Solve each inequality.

a. $5x - 7 > 3x + 9$

b. $1 - \frac{3x}{2} \geq x - 4$

25. $2x + 7 < 3 + 4x$

Example 3 Solving a Double Inequality

$-3 \leq 6x - 1 < 3$

37. $1 < 2x + 3 < 9$

Inequalities Involving Absolute Values

1. The solutions of $|x| < a$ are all values of x that lie between $-a$ and a.

   $|x| < a$ if and only if $-a < x < a$. Double inequality

2. The solutions of $|x| > a$ are all values of x that are less than $-a$ or greater than a.

   $|x| > a$ if and only if $x < -a$ or $x > a$. Compound inequality

Example 4 Solving an Absolute Value Inequality

Solve each inequality.

a. $|x - 5| < 2$ **b.** $|x + 3| \geq 7$

A.6 Exercises

In Exercises 1–6, (a) write an inequality that represents the interval and (b) state whether the interval is bounded or unbounded.

4. $[-5, \infty)$

In Exercises 7–12, match the inequality with its graph. [The graphs are labeled (a), (b), (c), (d), (e), and (f).]

10. $0 \leq x \leq \frac{9}{2}$

In Exercises 13–18, determine whether each value of x is a solution of the inequality.

Inequality	*Values*
18. $\lvert 2x - 3 \rvert < 15$	(a) $x = -6$ (b) $x = 0$ (c) $x = 12$ (d) $x = 7$

In Exercises 19–44, solve the inequality and sketch the solution on the real number line. (Some inequalities have no solutions.)

38. $-8 \le -(3x + 5) < 13$

40. $0 \le \frac{x + 3}{2} < 5$

42. $-1 < 2 - \frac{x}{3} < 1$

50. $|x - 7| < -5$

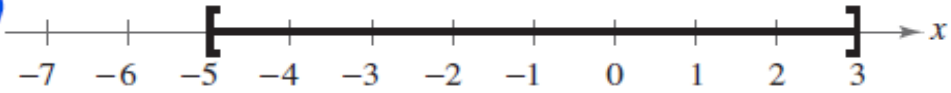
26. $3x + 1 \ge 2 + x$

60 $3|4 - 5x| \le 9$

82. ***Think About It*** The graph of $|x - 2| > 5$ can be described as all real numbers more than five units from 2. Give a similar description of $|x - 8| > 4$.

In Exercises 83–90, use absolute value notation to define the interval (or pair of intervals) on the real number line.

86.



96. ***Cost, Revenue, and Profit*** The revenue for selling x units of a product is $R = 24.55x$. The cost of producing x units is

$$C = 15.4x + 150{,}000.$$

To obtain a profit, the revenue must be greater than the cost. For what values of x will this product return a profit?

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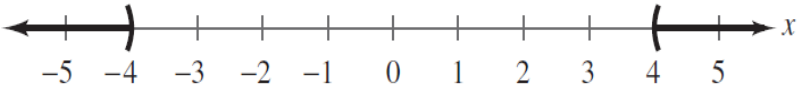
In Exercises 7–12, match the inequality with its graph. [The graphs are labeled (a), (b), (c), (d), (e), and (f).]

12. $|x| > 4$

(a)

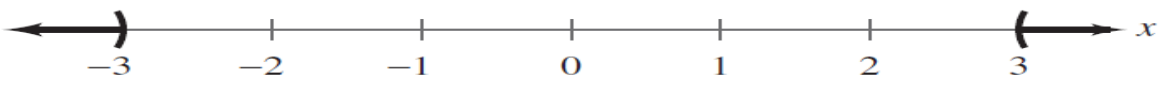


In Exercises 45–60, solve the inequality and sketch the solution on the real number line. (Some inequalities have no solution.)

50. $|x - 7| < -5$

In Exercises 83–90, use absolute value notation to define the interval (or pair of intervals) on the real number line.

84.



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102. ***Egg Production*** The number of eggs E (in billions) produced in the United States from 1990 to 2002 can be modeled by

$$E = 1.64t + 67.2, \quad 0 \le t \le 12$$

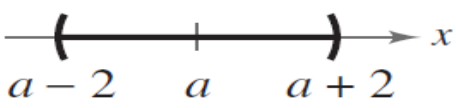
where t represents the year, with $t = 0$ corresponding to 1990. (Source: U.S. Department of Agriculture)

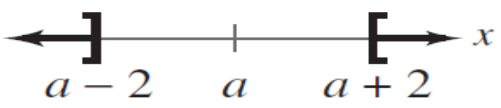
(a) According to this model, when was the annual egg production 70 billion, but no more than 80 billion?

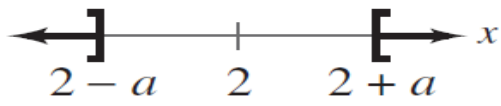
(b) According to this model, when will the annual egg production exceed 95 billion?

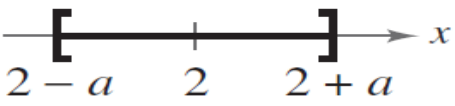
109. ***Meteorology*** An electronic device is to be operated in an environment with relative humidity h in the interval defined by $|h - 50| \leq 30$. What are the minimum and maximum relative humidities for the operation of this device?

113. Identify the graph of the inequality $|x - a| \geq 2$.

(a) 

(b) 

(c) 

(d) 

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