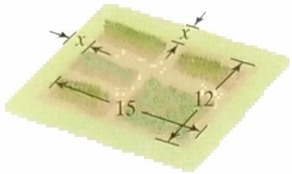
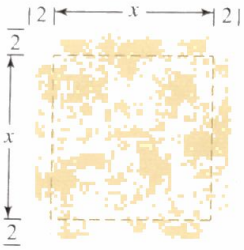
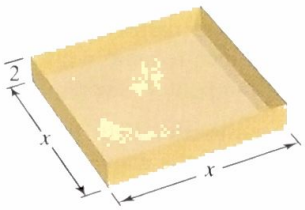
150. A vacant rectangular lot is being turned into a community vegetable garden measuring 15 meters by 12 meters. A path of uniform width is to surround the garden, as shown in the figure. If the area of the garden and path combined is 378 square meters, find the width of the path. 3 m



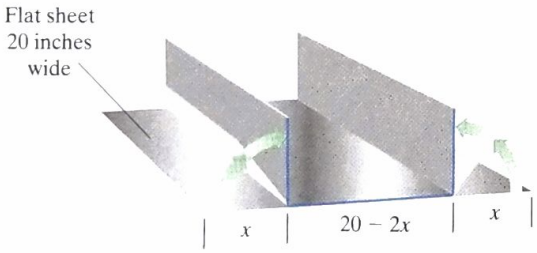
151. A machine produces open boxes using square sheets of metal. The figure illustrates that the machine cuts equal-sized squares measuring 2 inches on a side from the corners and then shapes the metal into an open box by turning up the sides. If each box must have a volume of 200 cubic inches, find the length and width of the open box. 10 in.



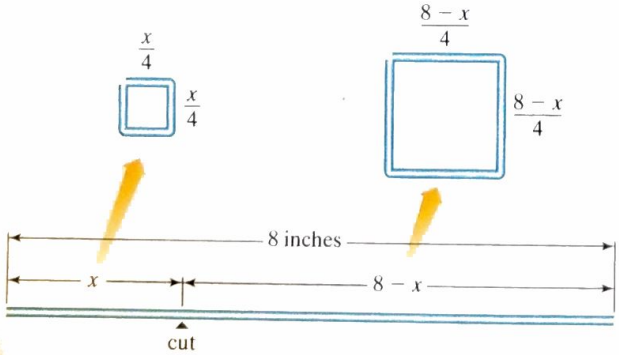


152. A machine produces open boxes using square sheets of metal. The machine cuts equal-sized squares measuring 3 inches on a side from the corners and then shapes the metal into an open box by turning up the sides. If each box must have a volume of 75 cubic inches, find the length and width of the open box. 5 in.

153. A rain gutter is made from sheets of aluminum that are 20 inches wide. As shown in the figure, the edges are turned up to form right angles. Determine the depth of the gutter that will allow a cross-sectional area of 13 square inches. Show that there are two different solutions to the problem. Round to the nearest tenth of an inch. 9.3 in. and 0.7 in.



154. A piece of wire is 8 inches long. The wire is cut into two pieces and then each piece is bent into a square. Find the length of each piece if the sum of the areas of these squares is to be 2 square inches. 4 in. and 4 in.



Explaining the Concepts 155–163. Answers will vary.

155. What is a quadratic equation?

156. Explain how to solve $x^2 + 6x + 8 = 0$ using factoring and the zero-product principle.

157. Explain how to solve $x^2 + 6x + 8 = 0$ by completing the square.

158. Explain how to solve $x^2 + 6x + 8 = 0$ using the quadratic formula.

159. How is the quadratic formula derived?

160. What is the discriminant and what information does it provide about a quadratic equation?

161. If you are given a quadratic equation, how do you determine which method to use to solve it?

162. Describe the relationship between the real solutions of $ax^2 + bx + c = 0$ and the graph of $y = ax^2 + bx + c$.

163. If a quadratic equation has imaginary solutions, how is this shown on the graph of $y = ax^2 + bx + c$?

Technology Exercises 164–165. Answers will vary.

164. Use a graphing utility and x-intercepts to verify any of the real solutions that you obtained for three of the quadratic equations in Exercises 65–74.

165. Use a graphing utility to graph $y = ax^2 + bx + c$ related to any five of the quadratic equations, $ax^2 + bx + c = 0$, in Exercises 75–82. How does each graph illustrate what you determined algebraically using the discriminant?

Critical Thinking Exercises

Make Sense? *In Exercises 166–169, determine whether each statement makes sense or does not make sense, and explain your reasoning.*

166. Because I want to solve $25x^2 - 169 = 0$ fairly quickly, I'll use the quadratic formula. does not make sense

167. I'm looking at a graph with one x-intercept, so it must be the graph of a linear equation. does not make sense

168. I obtained -17 for the discriminant, so there are two imaginary irrational solutions. does not make sense

169. When I use the square root property to determine the length of a right triangle's side, I don't even bother to list the negative square root. makes sense

In Exercises 170–173, determine whether each statement is true or false. If the statement is false, make the necessary change(s) to produce a true statement. Changes to false statements will vary.

170. The equation $(2x - 3)^2 = 25$ is equivalent to $2x - 3 = 5$.

171. Any quadratic equation that can be solved by completing the square can be solved by the quadratic formula. true

172. The quadratic formula is developed by applying factoring and the zero-product principle to the quadratic equation $ax^2 + bx + c = 0$. false

173. In using the quadratic formula to solve the quadratic equation $5x^2 = 2x - 7$, we have $a = 5$, $b = 2$, and $c = -7$. false

174. Write a quadratic equation in general form whose solution set is $\{-3, 5\}$. $x^2 - 2x - 15 = 0$

175. Solve for t: $s = -16t^2 + v_0t$. $t = \dfrac{v_0 \pm \sqrt{v_0^2 - 64s}}{32}$