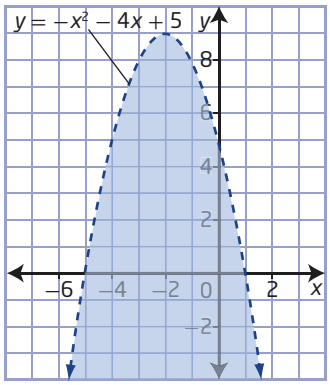
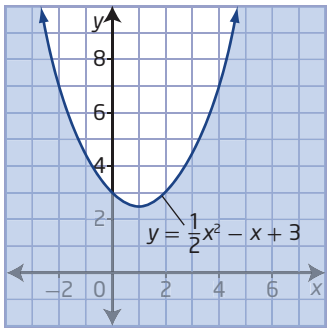
3. Write an inequality to describe each graph, given the function defining the boundary parabola.

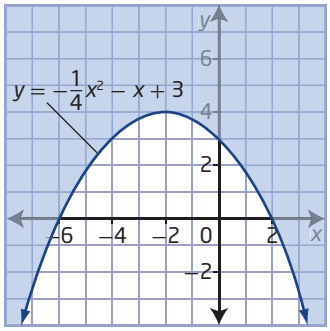
a)



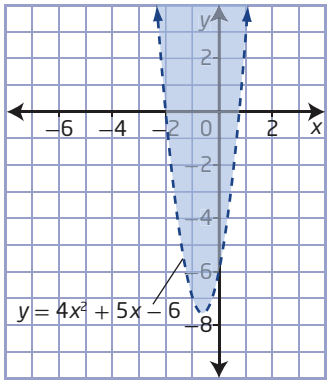
b)



c)



d)



4. Graph each quadratic inequality using transformations to sketch the boundary parabola.

a) $y \geq 2(x + 3)^2 + 4$

b) $y > -\frac{1}{2}(x - 4)^2 - 1$

c) $y < 3(x + 1)^2 + 5$

d) $y \leq \frac{1}{4}(x - 7)^2 - 2$

5. Graph each quadratic inequality using points and symmetry to sketch the boundary parabola.

a) $y < -2(x - 1)^2 - 5$

b) $y > (x + 6)^2 + 1$

c) $y \geq \frac{2}{3}(x - 8)^2$

d) $y \leq \frac{1}{2}(x + 7)^2 - 4$

6. Graph each quadratic inequality.

a) $y \leq x^2 + x - 6$

b) $y > x^2 - 5x + 4$

c) $y \geq x^2 - 6x - 16$

d) $y < x^2 + 8x + 16$

7. Graph each inequality using graphing technology.

a) $y < 3x^2 + 13x + 10$

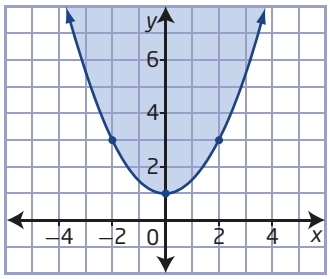
b) $y \geq -x^2 + 4x + 7$

c) $y \leq x^2 + 6$

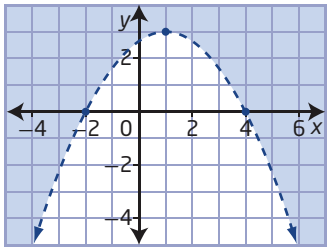
d) $y > -2x^2 + 5x - 8$

8. Write an inequality to describe each graph.

a)



b)



5. a) $\{x \mid -6 \le x \le 3, x \in \mathrm{R}\}$
b) $\{x \mid x \le -3 \text{ or } x \ge -1, x \in \mathrm{R}\}$
c) $\left\{x \mid \frac{3}{4} < x < 6, x \in \mathrm{R}\right\}$
d) $\{x \mid -8 \le x \le 2, x \in \mathrm{R}\}$

6. a) $\{x \mid -3 < x < 5, x \in \mathrm{R}\}$
b) $\{x \mid x < -12 \text{ or } x > -1, x \in \mathrm{R}\}$
c) $\{x \mid x \le 1 - \sqrt{6} \text{ or } x \ge 1 + \sqrt{6}, x \in \mathrm{R}\}$
d) $\left\{x \mid x \le -8 \text{ or } x \ge \frac{1}{2}, x \in \mathrm{R}\right\}$

7. a) $\{x \mid -8 \le x \le -6, x \in \mathrm{R}\}$
b) $\{x \mid x \le -4 \text{ or } x \ge 7, x \in \mathrm{R}\}$
c) There is no solution.
d) $\{x \mid x < -\frac{7}{2} \text{ or } x > \frac{9}{2}, x \in \mathrm{R}\}$

8. a) $\{x \mid 2 < x < 8, x \in \mathrm{R}\}$
Example: Use graphing because it is a simple graph to draw.
b) $\left\{x \mid x \le -\frac{3}{4} \text{ or } x \ge \frac{5}{3}, x \in \mathrm{R}\right\}$
Example: Use sign analysis because it is easy to factor.
c) $\{x \mid 1 - \sqrt{13} \le x \le 1 + \sqrt{13}, x \in \mathrm{R}\}$
Example: Use test points and the zeros.
d) $\{x \mid x \ne 3, x \in \mathrm{R}\}$
Example: Use case analysis because it is easy to factor and solve for the inequalities.

9. a) $\left\{x \mid \frac{13 - \sqrt{145}}{2} \le x \le \frac{13 + \sqrt{145}}{2}, x \in \mathrm{R}\right\}$
b) $\{x \mid x < -12 \text{ or } x > 2, x \in \mathrm{R}\}$
c) $\left\{x \mid x < \frac{5}{2} \text{ or } x > 4, x \in \mathrm{R}\right\}$
d) $\left\{x \mid x \le -\frac{8}{3} \text{ or } x \ge \frac{7}{2}, x \in \mathrm{R}\right\}$

10. a) Ice equal to or thicker than $\frac{5\sqrt{30}}{3}$ cm, or about 9.13 cm, will support the weight of a vehicle.
b) $9h^2 \ge 1500$
c) Ice equal to or thicker than $\frac{10\sqrt{15}}{3}$ cm, or about 12.91 cm, will support the weight of a vehicle.
d) Example: The relationship between ice strength and thickness is not linear.

11. a) $\pi x^2 \le 630\,000$, where x represents the radius, in metres.
b) $0 \le x \le \sqrt{\frac{630\,000}{\pi}}$ **c)** $0 \text{ m} \le x \le 447.81 \text{ m}$

12. a) 2 years or more
b) One of the solutions is negative, which does not make sense in this problem. Time cannot be negative.
c) $-t^2 + 14 \le 5$; $t \ge 3$; 3 years or more

13. $\frac{x^2}{2} + x \ge 4$; the shorter leg should be greater than or equal to 2 cm.

14. a) $a > 0$; $b^2 - 4ac \le 0$ **b)** $a < 0$; $b^2 - 4ac = 0$
c) $a \ne 0$; $b^2 - 4ac > 0$

15. Examples:
a) $x^2 - 5x - 14 \le 0$ **b)** $x^2 - 11x + 10 > 0$
c) $3x^2 - 23x + 30 \le 0$ **d)** $20x^2 + 19x + 3 > 0$
e) $x^2 + 6x + 2 \ge 0$ **f)** $x^2 + 1 > 0$
g) $x^2 + 1 < 0$

16. $\{x \mid x \le -\sqrt{6} \text{ or } -\sqrt{2} \le x \le \sqrt{2} \text{ or } x \ge \sqrt{6}, x \in \mathrm{R}\}$

17. a) It is the solution because it is the set of values for which the parabola lies above the line.
b) $-x^2 + 13x - 12 \ge 0$
c) $\{x \mid 1 \le x \le 12, x \in \mathrm{R}\}$
d) They are the same solutions. The inequality was just rearranged in part c).

18. They all require this step because you need the related function to work with.

19. Answers may vary.

20. a) The solution is incorrect. He switched the inequality sign when he added 2 to both sides in the first step.
b) $\{x \mid -3 \le x \le -2, x \in \mathrm{R}\}$

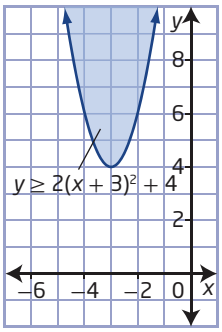
9.3 Quadratic Inequalities in Two Variables, pages 496 to 500

1. a) (2, 6), (−1, 3)
b) (2, −2), (0, −6), (−2, −15)
c) None
d) (−4, 2), (1, 3.5), (3, 2.5)

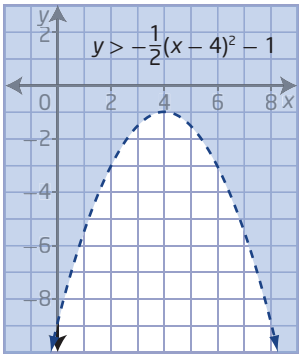
2. a) (0, 1), (1, 0), (3, 6), (−2, 15)
b) (−2, −3), (0, −8)
c) (2, 9)
d) (−2, 2), (−3, −2)

3. a) $y < -x^2 - 4x + 5$ **b)** $y \le \frac{1}{2}x^2 - x + 3$
c) $y \ge -\frac{1}{4}x^2 - x + 3$ **d)** $y > 4x^2 + 5x - 6$

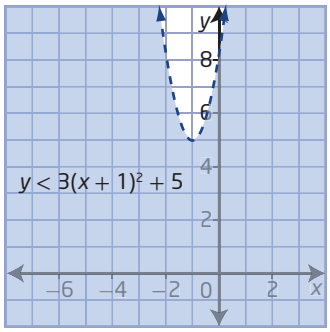
4. a)



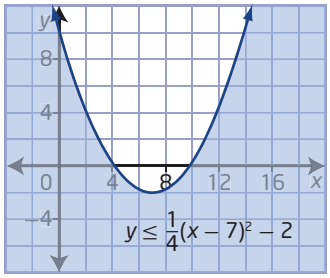
b)



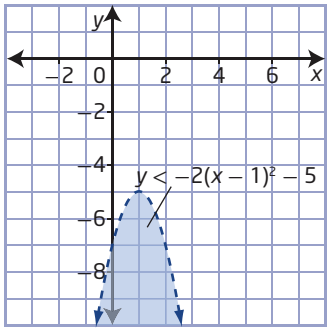
c)



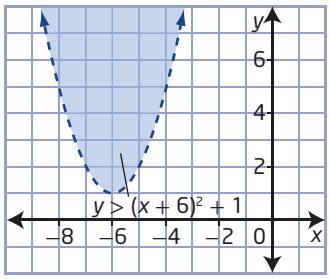
d)



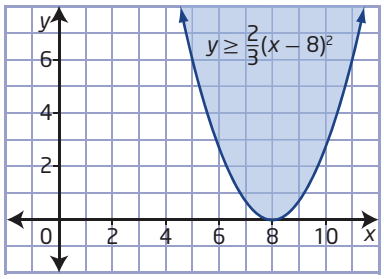
5. a)



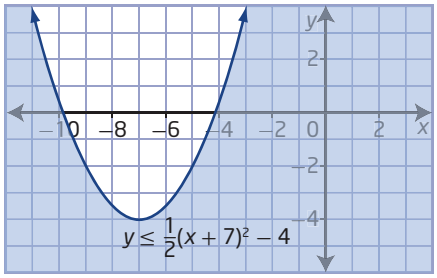
b)



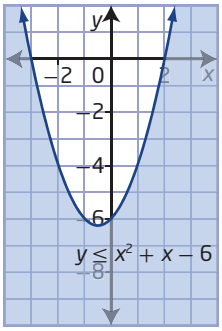
c)



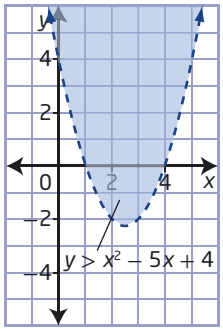
d)



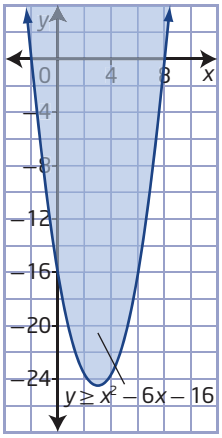
6. a)



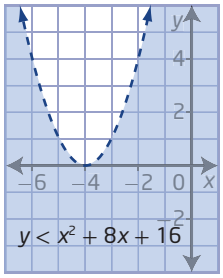
b)



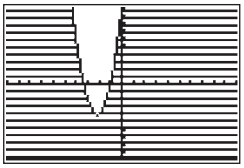
c)



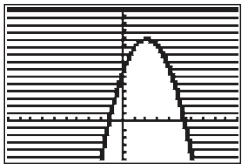
d)



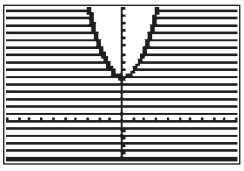
7. a) $y < 3x^2 + 13x + 10$



b) $y \geq -x^2 + 4x + 7$



c) $y \leq x^2 + 6$



d) $y > -2x^2 + 5x - 8$

8. a) $y \geq \frac{1}{2}x^2 + 1$

b) $y > -\frac{1}{3}(x - 1)^2 + 3$