CHAPTER 5

Vocabulary

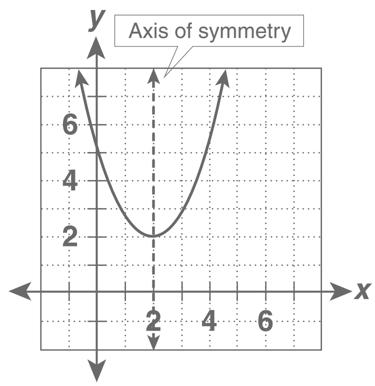
Know it! Note

The table contains important vocabulary terms from Chapter 5. As you work through the chapter, fill in the page number, definition, and a clarifying example.

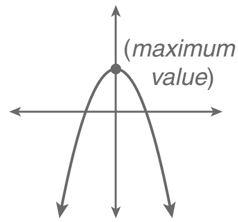
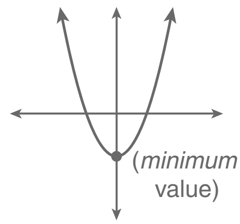
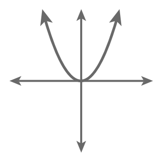
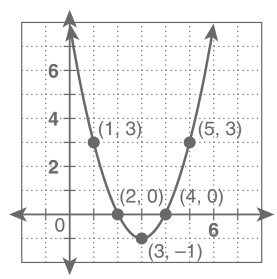
Term	Page	Definition	Clarifying Example
absolute value of a complex number			
axis of symmetry			
binomial			
complex conjugate			
complex number			
imaginary number			

Vocabulary

The table contains important vocabulary terms from Chapter 5. As you work through the chapter, fill in the page number, definition, and a clarifying example.

Term	Page	Definition	Clarifying Example
absolute value of a complex number	382	**The absolute value of $a + bi$ is the distance from the origin to the point (a, b) in the complex plane and is denoted $\lvert a + bi \rvert = \sqrt{a^2 + b^2}$.**	$\lvert 2 + 3i \rvert = \sqrt{2^2 + 3^2} = \sqrt{13}$
axis of symmetry	323	**A line that divides a plane figure or a graph into two congruent reflected halves.**	
binomial	336	**A polynomial with two terms.**	$x + y$ $2a^2 + 3$ $4m^3n^2 + 6mn^4$
complex conjugate	352	**The complex conjugate of any complex number $a + bi$, denoted $\overline{a + bi}$, is $a - bi$.**	$\overline{4 + 3i} = 4 - 3i.$ $\overline{4 - 3i} = 4 + 3i.$
complex number	351	**Any number that can be written as $a + bi$, where a and b are real numbers and $i = \sqrt{-1}$.**	$4 + 2i$ $5 + 0i = 5$ $0 - 7i = -7i$
imaginary number	350	**The square root of a negative number, written in the form bi, where b is a real number and i is the imaginary unit, $\sqrt{-1}$. Also called a pure imaginary number.**	$6i$

Term	Page	Definition	Clarifying Example
maximum value (of a function)			
minimum value (of a function)			
parabola			
quadratic function			
root of an equation			
standard form (of a quadratic equation)			
trinomial			
zero of a function			

Term	Page	Definition	Clarifying Example
maximum value (of a function)	326	The y-value of the highest point on the graph of the function.	
minimum value (of a function)	326	The y-value of the lowest point on the graph of the function.	
parabola	315	The shape of the graph of a quadratic function. Also, the set of points equidistant from a point F, called the focus, and a line d, called the directrix.	
quadratic function	315	A function that can be written in the form $f(x) = ax^2 + bx + c$, where a, b, and c are real numbers and $a \neq 0$, or in the form $f(x) = a(x - h)^2 + k$, where a, h, and k are real numbers and $a \neq 0$.	$f(x) = x^2 - 6x + 8$ 
root of an equation	334	Any value of the variable that makes the equation true.	$x^2 - 8x + 12 = 0$ $x = 2$ is a root of the equation.
standard form (of a quadratic equation)	324	$ax^2 + bx + c = 0$, where a, b, and c are real numbers and $a \neq 0$.	$2x^2 + 3x - 1 = 0$
trinomial	336	A polynomial with three terms.	$4x^2 + 3xy - 5y^2$
zero of a function	333	For the function f, any number x such that $f(x) = 0$.	$f(x) = x + 1$ $x = -1$ is a zero of the function.

CHAPTER 5

Chapter Review

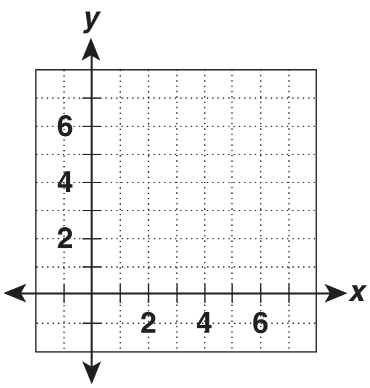
5-1 Using Transformations to Graph Quadratic Functions

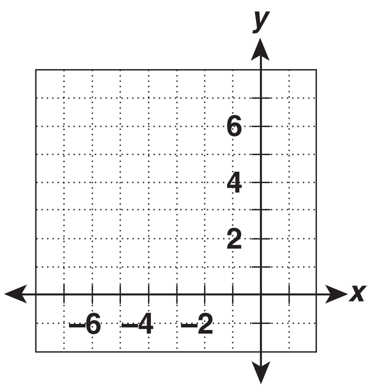
Using the graph of $f(x) = x^2$ as a guide, describe the transformations, and then graph each function.

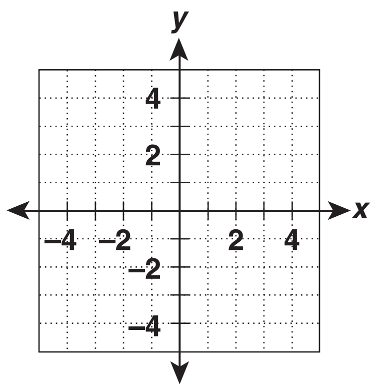
1. $g(x) = (x - 3)^2 + 2$

2. $g(x) = 3(x + 5)^2$

3. $g(x) = -\frac{1}{2}x^2 + 4$







Use the description to write each quadratic function in vertex form.

4. $f(x)^2$ is vertically stretched by a factor of 5 and translated 4 units right to create $g(x)$.

5. $f(x)^2$ is reflected across the x-axis, shifted 3 units right, and translated 2 units down to create $g(x)$.

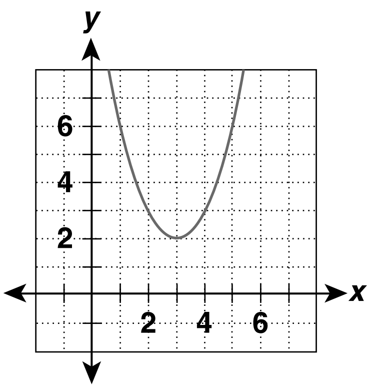
Chapter Review

5-1 Using Transformations to Graph Quadratic Functions

Using the graph of $f(x) = x^2$ as a guide, describe the transformations, and then graph each function.

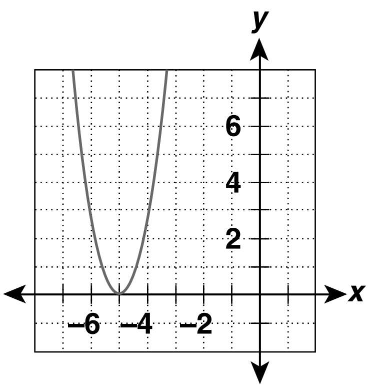
1. $g(x) = (x - 3)^2 + 2$

3 units right and 2 units up



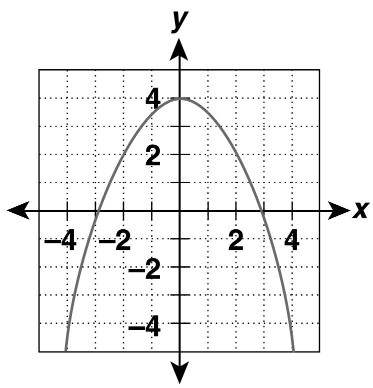
2. $g(x) = 3(x + 5)^2$

shifted 5 units left and stretched vertically by a factor of 3



3. $g(x) = -\frac{1}{2}x^2 + 4$

reflected across the x-axis, stretched vertically by a factor of $\frac{1}{2}$, and shifted up 4 units.



Use the description to write each quadratic function in vertex form.

4. $f(x)^2$ is vertically stretched by a factor of 5 and translated 4 units right to create $g(x)$.

$g(x) = 5(x - 4)^2$

5. $f(x)^2$ is reflected across the x-axis, shifted 3 units right, and translated 2 units down to create $g(x)$.

$g(x) = -(x - 3)^2 - 2$

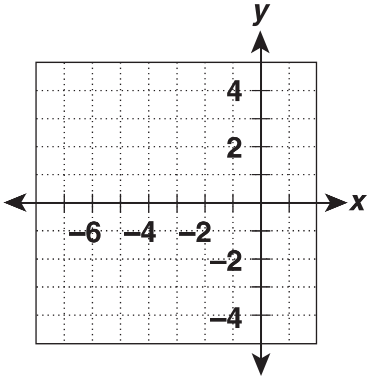
5-2 Properties of Quadratic Functions in Standard Form

For each function, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the *y*-intercept, and (e) graph the function.

6. $f(x) = x^2 + 8x + 12$ **7.** $g(x) = -x^2 - 2x + 8$ **8.** $h(x) = -x^2 + 3x$

a)	a)	a)
b)	b)	b)
c)	c)	c)
d)	d)	d)

e)



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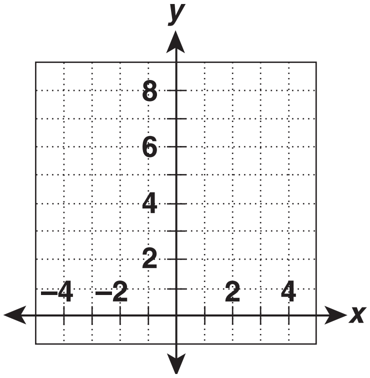

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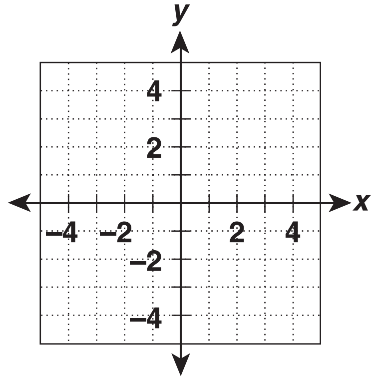


9. A baseball player hits a baseball whose height is modeled by the function $h(x) = -0.03x^2 + 2.4x + 2$ where x is the horizontal distance in feet that the ball travels. Find the maximum height of the ball to the nearest foot.

5-3 Solving Quadratic Equations by Graphing and Factoring

Find the roots of each equation by factoring.

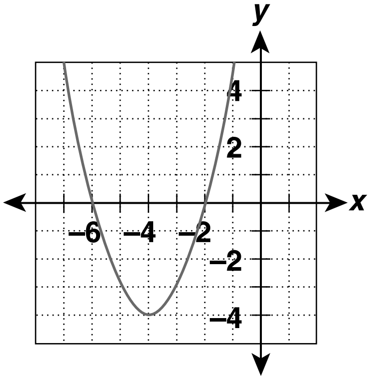
10. $x^2 + x = 20$ **11.** $x^2 - 36 = 0$ **12.** $7x^2 - 49x = 0$

5-2 Properties of Quadratic Functions in Standard Form

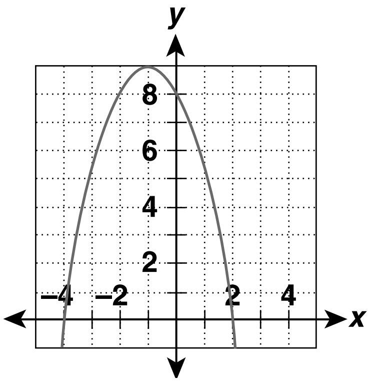
For each function, (a) determine whether the graph opens upward or downward, (b) find the axis of symmetry, (c) find the vertex, (d) find the *y*-intercept, and (e) graph the function.

6. $f(x) = x^2 + 8x + 12$	**7.** $g(x) = -x^2 - 2x + 8$	**8.** $h(x) = -x^2 + 3x$
a) up	a) down	a) down
b) $x = -4$	b) $x = -1$	b) $x = \frac{3}{2}$
c) $(-4, -4)$	c) $(-1, 9)$	c) $\left(\frac{3}{2}, \frac{9}{4}\right)$
d) 12	d) 8	d) 0

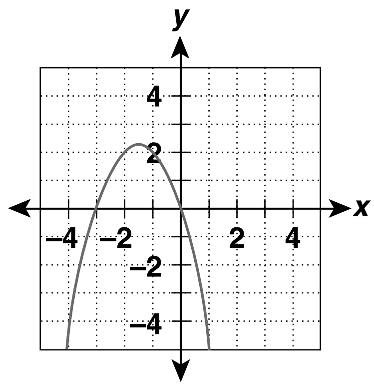
e)



e)



e)



9. A baseball player hits a baseball whose height is modeled by the function $h(x) = -0.03x^2 + 2.4x + 2$ where x is the horizontal distance in feet that the ball travels. Find the maximum height of the ball to the nearest foot.

50 feet

5-3 Solving Quadratic Equations by Graphing and Factoring

Find the roots of each equation by factoring.

10. $x^2 + x = 20$

4, −5

11. $x^2 - 36 = 0$

6, −6

12. $7x^2 - 49x = 0$

0, 7

5-4 Completing the Square

Solve each equation by completing the square.

13. $x^2 + 2x = 63$

14. $x^2 - 10x = -14$

15. $x^2 = -12x + 9$

Write each function in vertex form, and identify its vertex.

16. $f(x) = x^2 + 8x + 14$

17. $g(x) = x^2 - 12x + 108$

18. $h(x) = -4x^2 + 24x - 39$

5-5 Complex Numbers and Roots

Solve each equation.

19. $6x^2 + 150 = 0$

20. $x^2 + 8x = -18$

21. $x^2 = x - 19$

5-6 The Quadratic Formula

Find the zeros of each function by using the Quadratic Formula.

22. $f(x) = 2x^2 + 8x + 24$

23. $g(x) = 3x^2 + 6x + 8$

24. $h(x) = -x^2 + 4x + 77$

Find the type and number of solutions for each equation.

25. $x^2 + 81 = 18x$

26. $x^2 + 9x = 36$

27. $x^2 - 100 = 0$

5-4 Completing the Square

Solve each equation by completing the square.

13. $x^2 + 2x = 63$

9, 7

14. $x^2 - 10x = -14$

$.5 \pm \sqrt{11}$

15. $x^2 = -12x + 9$

$-6 \pm 3\sqrt{5}$

Write each function in vertex form, and identify its vertex.

16. $f(x) = x^2 + 8x + 14$

$f(x) = (x + 4)^2 - 2$; $(-4, -2)$

17. $g(x) = x^2 - 12x + 108$

$g(x) = (x - 6)^2 + 72$; $(6, 72)$

18. $h(x) = -4x^2 + 24x - 39$

$f(x) = -4(x - 3)^2 - 3$; $(3, -3)$

5-5 Complex Numbers and Roots

Solve each equation.

19. $6x^2 + 150 = 0$

$\pm 5i$

20. $x^2 + 8x = -18$

$-4 \pm i\sqrt{2}$

21. $x^2 = x - 19$

$\dfrac{1 + 5i\sqrt{3}}{2}$

5-6 The Quadratic Formula

Find the zeros of each function by using the Quadratic Formula.

22. $f(x) = 2x^2 + 8x + 24$

2, −6

23. $g(x) = 3x^2 + 6x + 8$

$\dfrac{-3 \pm i\sqrt{15}}{3}$

24. $h(x) = -x^2 + 4x + 77$

7, 11

Find the type and number of solutions for each equation.

25. $x^2 + 81 = 18x$

1 distinct real solution

26. $x^2 + 9x = 36$

2 distinct real solutions

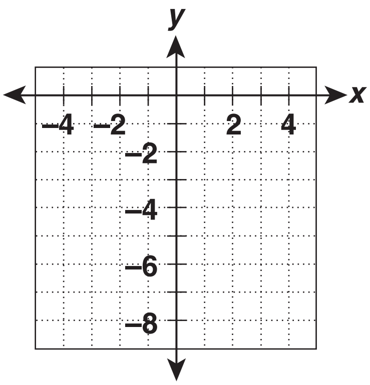
27. $x^2 - 100 = 0$

2 distinct real solutions

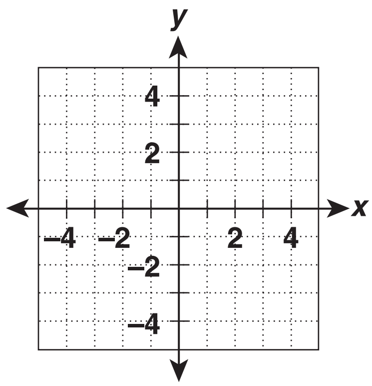
5-7 Solving Quadratic Inequalities

Graph each inequality.

28. $y > x^2 - 2x - 8$



29. $y \geq -x^2 - 3x$



Solve each inequality by using tables or graphs.

30. $x^2 - 10x + 20 < 4$

31. $2x^2 - 4x - 27 \geq 3$

Solve each inequality by algebra.

32. $x^2 + 5x > 0$

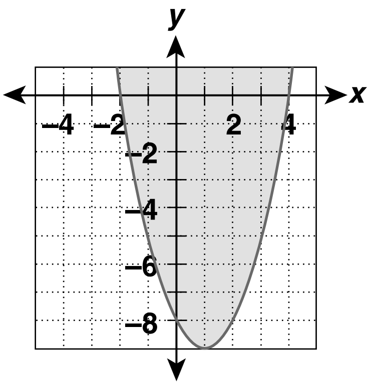
33. $x^2 - 4x - 27 \leq -6$

34. The height of an object thrown upwards off of a cliff is modeled by the function $h(x) = -16t^2 + 25t + 40$, where t is the time. For what range of time will the object have a height of at least 40 feet?

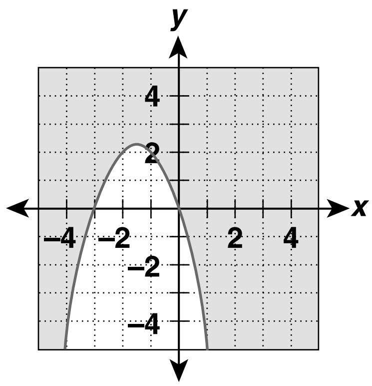
5-7 Solving Quadratic Inequalities

Graph each inequality.

28. $y > x^2 - 2x - 8$



29. $y \geq -x^2 - 3x$



Solve each inequality by using tables or graphs.

30. $x^2 - 10x + 20 < 4$

$2 < x < 8$

31. $2x^2 - 4x - 27 \geq 3$

$x \leq -3$ or $x \geq 5$

Solve each inequality by algebra.

32. $x^2 + 5x > 0$

$x > 0$ or $x < -5$

33. $x^2 - 4x - 27 \leq -6$

$-3 \leq x \leq 7$

34. The height of an object thrown upwards off of a cliff is modeled by the function $h(x) = -16t^2 + 25t + 40$, where t is the time. For what range of time will the object have a height of at least 40 feet?

between 0 and 1.6 seconds

5-8 Curve Fitting with Quadratic Models

Determine whether each data set could represent a quadratic function. Explain.

35.

x	0	1	2	3	4
y	-4	-5	-4	-1	4

36.

x	1	3	5	7	9
y	-3	1	5	9	13

Write a quadratic function that fits each set of points.

37. (0, -6), (1, 0), and (2, 8)

38. (0, 3), (2, –5), and (4, –21)

For Exercises 43–45, use the table of the number of normal temperature highs for Anchorage, Alaska.

DAY #	DATE	TEMPERATURE
31	Jan 31	22
120	April 30	47
212	July 31	64
304	October 31	37

39. Use the data to find a quadratic regression equation to model the normal temperature high given the day.

40. Use your model to predict the normal temperature high on June 1 (day 181).

41. Use your model to predict the normal temperature high on November 24 (day 328).

5-8 Curve Fitting with Quadratic Models

Determine whether each data set could represent a quadratic function. Explain.

35.

x	0	1	2	3	4
y	-4	-5	-4	-1	4

Yes; quadratic function: For some of the *y*-values there are two *x*-values.

36.

x	1	3	5	7	9
y	-3	1	5	9	13

Not a quadratic function: There are different *y*-values for each *x*-value.

Write a quadratic function that fits each set of points.

37. (0, -6), (1, 0), and (2, 8)

$y = x^2 + 5x - 6$

38. (0, 3), (2, –5), and (4, –21)

$y = -x^2 - 2x + 3$

For Exercises 43–45, use the table of the number of normal temperature highs for Anchorage, Alaska.

DAY #	DATE	TEMPERATURE
31	Jan 31	22
120	April 30	47
212	July 31	64
304	October 31	37

39. Use the data to find a quadratic regression equation to model the normal temperature high given the day.

$y = -0.0016x^2 + 0.5989x + 3.1718$

40. Use your model to predict the normal temperature high on June 1 (day 181).

about 59°

41. Use your model to predict the normal temperature high on November 24 (day 328).

about 27°

5-9 Operations with Complex Numbers

Find each absolute value.

42. $|-8i|$

43. $|2 - 5i|$

44. $|4 + i|$

Perform each indicated operation, and write the result in the form *a* + *bi*.

45. $(4 + 2i) - (5 - 3i)$

46. $(-7 - 2i) + (6 + 5i)$

47. $-2i(8 - 2i)$

48. $(7 + 3i)(4 - 8i)$

49. $(3 + 9i)(3 - 9i)$

50. $-6i^{18}$

51. $\frac{9 + 5i}{i}$

52. $\frac{2 + i}{7 - 4i}$

5-9 Operations with Complex Numbers

Find each absolute value.

42. $|-8i|$

8

43. $|2 - 5i|$

13

44. $|4 + i|$

$\sqrt{17}$

Perform each indicated operation, and write the result in the form *a* + *bi*.

45. $(4 + 2i) - (5 - 3i)$

$-1 + 5i$

46. $(-7 - 2i) + (6 + 5i)$

$-1 + 3i$

47. $-2i(8 - 2i)$

$-4 - 16i$

48. $(7 + 3i)(4 - 8i)$

$52 - 44i$

49. $(3 + 9i)(3 - 9i)$

90

50. $-6i^{18}$

6

51. $\frac{9 + 5i}{i}$

$5 - 9i$

52. $\frac{2 + i}{7 - 4i}$

$\frac{2 + 3i}{11}$

CHAPTER 5

Big Ideas

Answer these questions to summarize the important concepts from Chapter 5 in your own words.

1. Explain how to convert a quadratic equation in vertex form to standard form.

2. Explain how to convert a quadratic equation in standard form to vertex form.

3. Explain how the quadratic formula relates to the process of completing the square.

4. What is the relationship between the roots of a quadratic equation and the graph of the quadratic equation?

For more review of Chapter 5:

- Complete the Chapter 5 Study Guide and Review on pages 366–369 of your textbook.
- Complete the Ready to Go On quizzes on pages 329 and 365 of your textbook.

Big Ideas

Answer these questions to summarize the important concepts from Chapter 5 in your own words.

1. Explain how to convert a quadratic equation in vertex form to standard form.

Answers will vary. Possible answer: A quadratic equation in vertex form, $y = a(x - h)^2 + k$, can be converted to standard form by expanding the binomial $(x - h)^2$ and then distributing the a, and adding k.

2. Explain how to convert a quadratic equation in standard form to vertex form.

Answers will vary. Possible answer: A quadratic equation in standard form $ax^2 + bx + c$, can be converted to vertex form by completing the square.

3. Explain how the quadratic formula relates to the process of completing the square.

Answers will vary. Possible answer: If you complete the square of the general quadratic equation $ax^2 + bx + c = 0$, you can derive the quadratic formula $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

4. What is the relationship between the roots of a quadratic equation and the graph of the quadratic equation?

Answers will vary. Possible answer: The roots of a quadratic equation are the x-intercepts of the graph. Two distinct real roots indicates that the graph will have two distinct x-intercepts, 1 real root implies 1 x-intercept, and 0 real roots implies no x-intercepts.

For more review of Chapter 5:

- Complete the Chapter 5 Study Guide and Review on pages 366–369 of your textbook.
- Complete the Ready to Go On quizzes on pages 329 and 365 of your textbook.