3-13. For each quadratic function below use the method of completing the square or averaging the x-intercepts to rewrite the equation in graphing form. Then, state the line of symmetry and give the vertex of each parabola. Try to use each method at least once. Homework Help ✎

a. $f(x) = x^2 + 6x + 15$

b. $y = x^2 - 4x + 9$

c. $f(x) = x^2 - 8x$

d. $y = x^2 + 7x - 2$

a) $f(x) = x^2 + 6x + 15$
$-6 \qquad\qquad +(-6)$

$f(x) - 6 = x^2 + 6x + 9$

$f(x) - 6 = (x+3)^2$
$\quad +6 \qquad\qquad +6$

$f(x) = (x+3)^2 + 6$

Vertex: $(-3, 6)$

Line of Symmetry: $X = -3$

$f(x) = x^2 - 8x$

$f(x) = x(x-8)$

X-int: $(0,0)$
$\qquad\quad (8,0)$

Line of Symmetry: $X = 4$

$f(x) = (4)^2 - 8(4)$

$= 16 - 32$

$= -16$

Vertex:
$(4, -16)$

$f(x) = (x-4)^2 - 16$

3-11.

Solve each equation. Think about Rewriting, Looking Inside, or Undoing. Homework Help ✎

a. $2(x-1)^2 + 7 = 39$

$-7 \quad -7$

$2\boxed{(x-1)}^2 = 32 \qquad x=5$

$\overset{4}{\frown}$

$x=-3$

c. $\frac{x}{2} + \frac{x}{3} = \frac{5x+2}{6}$

$\frac{3x}{6} + \frac{2x}{6} = \frac{5x+2}{6}$

$3x + 2x = 5x + 2$

$5x = 5x + 2$

$0 = 2$

b. $7(\sqrt{m+1} - 3) = 21$

$\overline{3 \quad 7} \qquad 7\overline{}$

$\sqrt{m+1} - 3 = 7 \quad \overset{3}{}$

$\sqrt{m+1} = 10 \; 6$

$m = 9 \; 35$

d. $-7 + \left(\frac{4x+2}{2}\right) = 8$

$\overset{\frown}{15}$

$\frac{4x+2}{2} = 15$

$4x+2 = 30$

$-2 \quad -2$

$4x = 28$

$x = \frac{28}{4}$

$x = 7$

3-18.

$$(x-h)^2 + (y-k)^2 = r^2 \qquad \text{Center: } (h,k)$$
$$\text{radius: } r$$

What are the center and radius of each circle? Rewrite the equations if necessary. Homework Help ✎

$$(x-(+3))^2 \qquad \sqrt{25}=5$$

a. $(y-7)^2 = 25 - (x-3)^2 \Rightarrow (x-3)^2 + (y-7)^2 = 25$

$$+(x-3)^2 \qquad + (x-3)^2$$

$$\text{Center: } (3,7) \quad R:5$$

b. $x^2 + y^2 + 10y = -9$

$$+25 \quad +25$$

$$x^2 + (y+5)^2 = 16 \qquad (0,-5)$$

c. $x^2 + y^2 + 18x - 8y + 47 = 0$

$$+50 \quad +50$$

$$x^2 + 18x + \underline{+81} + y^2 - 8y + \underline{16} = 50$$

$$(x+9)^2 + (y-4)^2 = 50$$

$$\text{center: } (-9,4)$$

$$R = \sqrt{50} = \sqrt{25 \cdot 2} = \sqrt{25} \cdot \sqrt{2} = \boxed{5\sqrt{2}}$$

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

$$R=4$$

$$(x-3)^2 + y^2 = 1$$

$$(3,0)$$

$$R=1$$
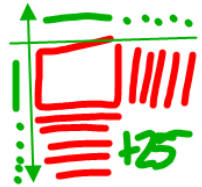
3-35.

You decide to park your car in a parking garage that charges $3.00 for the first hour and $1.00 for each hour (or any part of an hour) after that. Homework Help ✎.

a. How much will it cost to park your car for 90 minutes? $3 + $1 = $4

b. How much will it cost to park your car for 118 minutes? 119 minutes? $4; $4

c. How much will it cost to park your car for 120 minutes? 121 minutes? $4; $5

d. Graph the cost in relation to the length of time your car is parked.
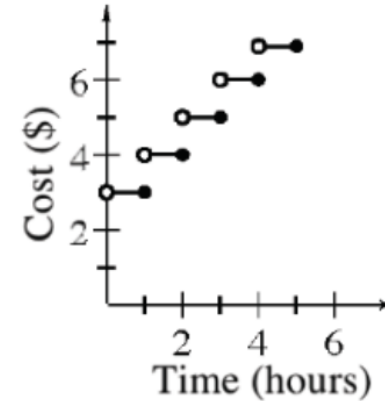
e. Is this function continuous? No.

f. Describe how the graph of this function will change if the parking garage raises their parking rate so that the first hour costs $5.00.

Graph will increase by $2 on y-axis
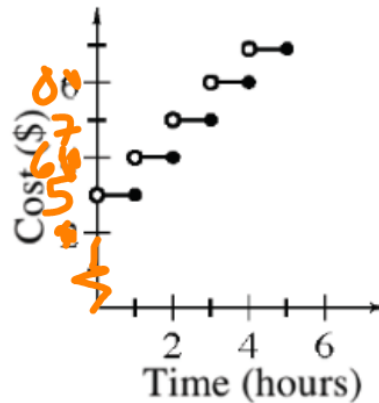
3-39.

Consider the graph of $f(x) = \frac{1}{2}(x-2)^3 + 1$ and $g(x) = 2x^2 - 6x - 3$ at right. Homework Help ✏.

a. Write an equation that you could solve using points A and B. What are the solutions to your equation? Substitute them into your equation to show that they work.

b. Are there any solutions to your equation in part (a) that do not appear on the graph? Explain.

~~No.~~ **Yes.** Desmos

c. Write an equation that you could use to solve for the x-coordinate of point C. Estimate the solution to your equation using the graph. Again, substitute your solution into your equation. How close was your estimate?

(.8, 0) ? (4, 5) (4, 5)

(0, -3)
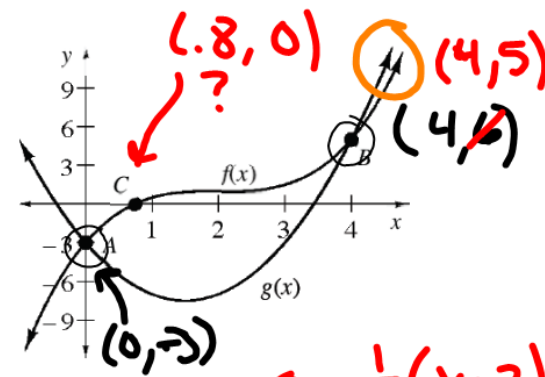
$0 = \frac{1}{2}(x-2)^3 + 1$

$$f(x) \overset{?}{=} g(x)$$

$$\frac{1}{2}(x-2)^3 + 1 = 2x^2 - 6x - 3$$

$$\frac{1}{2}(0-2)^3 + 1 \overset{?}{=} 2(0)^2 - 6(0) - 3$$

$$\frac{1}{2}(-2)^3 + 1 = 0 - 0 - 3$$

$$\frac{1}{2}(-8) + 1 = -3$$

$$-4 + 1 \overset{\checkmark}{=} -3$$

$$X = 0, \quad X = 4$$

$$\frac{1}{2}(4-2)^3 + 1 \overset{?}{=} 2(4)^2 - 6(4) - 3$$

$$\frac{1}{2}(2)^3 + 1 = 2(16) - 24 - 3$$

$$\frac{1}{2}(8) + 1 = 32 - 24 - 3$$

$$5 = 5$$

$$-1 = \frac{1}{2}(x-2)^3$$

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

$$\sqrt[3]{-2} = x - 2$$

$$2 + \sqrt[3]{-2} = X$$

3-44.

Consider the system of equations below. Homework Help ✏

$$3y - 4x = -19$$
$$y + 2x = 4$$

a. Solve this system algebraically.

b. Where do the graphs intersect?

c. Explain the relationship between parts (a) and (b).

$(3.1, -2.2)$

$$\begin{cases} 3y - 4x = -19 \\ y + 2x = 4 \\ -2x \quad -2x \\ y = 4 - 2x \end{cases}$$

$$3(4 - 2x) - 4x = -19$$
$$12 - 6x - 4x = -17$$
$$12 - 10x = -19$$
$$-10x = -31$$
$$\overline{-10} \qquad \overline{-10}$$
$$x = 3.1$$

$$y + 2(3.1) = 4$$
$$y + 6.2 = 4$$
$$y = -2.2$$

3-54.

$$-\sqrt[3]{8} = \sqrt[3]{-8} = -2 \cdot -2 \cdot -2$$

Determine if each of the functions below is even, odd, or neither. Homework Help ✎

Even $f(x) = f(-x)$

Odd $f(-x) = -f(x)$

a. $y = \sqrt[3]{x}$

$f(x) = \sqrt[3]{x}$

$\begin{cases} f(-x) = \sqrt[3]{-x} = -\sqrt[3]{x} \\ -f(x) = -\sqrt[3]{x} \end{cases}$

odd

b. $y = 9x^5 - x - 9$

$-f(x) = -(9x^5 - x - 9)$

$\quad = -9x^5 + x + 9$

$f(-x) = 9(-x)^5 - (-x) - 9$

$\quad = -9x^5 + x - 9$

Neither

c. $y = 4x^3 + 8x^7$

$-f(x) = -(4x^3 + 8x^7)$

$\updownarrow \quad = -4x^3 - 8x^7$

$f(-x) = 4(-x)^3 + 8(-x)^7$

$\quad = -4x^3 - 8x^7$

odd

3-65.

Jamilla is moving to a new city. She researches the rates charged by the local utility company for water. She finds the listing of rate explanations below. She expects that her family may use up to 1000 cubic feet of water each month.

Homework Help ✎

- $12.70 monthly service fee

- First 300 cubic feet of water used: $3.90 per 100 cubic feet, or fraction thereof

- After the first 300 cubic feet: $5.20 per 100 cubic feet, or fraction thereof

a. Sketch a graph of the cost of Jamilla's possible water usage in relationship to the cost during one month. Be sure to consider what the cost would be for partial units such as 220 or 675 cubic feet of water.

b. Is the graph for this situation a function? Why or why not?

c. What are the domain and range of your graph?

d. If the monthly service fee is decreased to $10.20, how would that change the graph?

3-77.

Given $f(x) = x^3 + 1$ and $g(x) = (x+1)^2$: _3-77 HW eTool_ (Desmos). Homework Help ✎

a. Sketch the graphs of the two functions.

b. Solve $f(x) = 9$.

c. Solve $g(x) = 0$.

d. Solve $f(x) = -7$.

e. Solve $g(x) = 12$.

f. For how many values of x does $f(x)$ equal $g(x)$? Explain.

g. Are each of the functions even, odd, or neither?

3-86.

Graph and completely describe $f(x) = 2^{(x-1)} - 4$.

3-96.

Sketch the graph of each of the following inequalities on a different set of axes. Homework Help ✎

a. $3x - 3 < y$

b. $3 > y$

c. $3x - 2y \leq 6$

d. $x^2 - y \leq 9$

3-109.

Consider the graph at right as you answer the following questions. [Homework Help](#) ✎

a. What is the equation of the parabola?

b. What is the equation of the line?

c. Use the graph to solve $x + 5 = \frac{1}{2}(x + 3)^2 - 2$. How can you verify that your solution(s) are correct?

d. Use the graph to solve the system below.
$$y = \frac{1}{2}(x + 3)^2 - 2$$
$$y = x + 5$$

e. Use the graph to solve the inequality $x + 5 < \frac{1}{2}(x + 3)^2 - 2$.

f. Use the graph to solve $\frac{1}{2}(x + 3)^2 - 2 = 0$.

g. How could you change the equation of the parabola so that the parabola and the lines do not intersect? Is there more than one way?
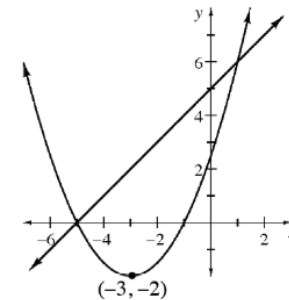
3-112.

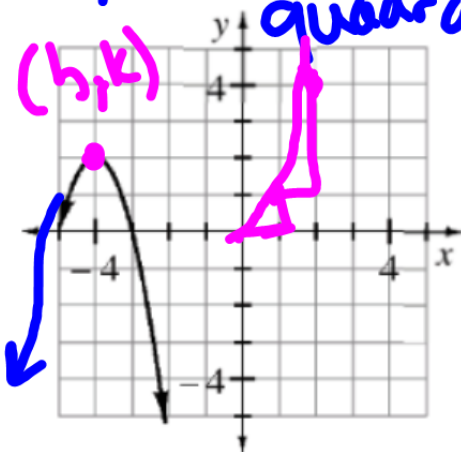On separate pairs of axes, sketch the graph of each equation or inequality below. Homework Help ✎

a. $y + 5 = (x - 2)^2$

b. $y \leq (x + 3)^3$

c. $y = 4 + \frac{1}{x-3}$

3-15. Write a possible equation for each graph. <u>Homework Help</u> ✏
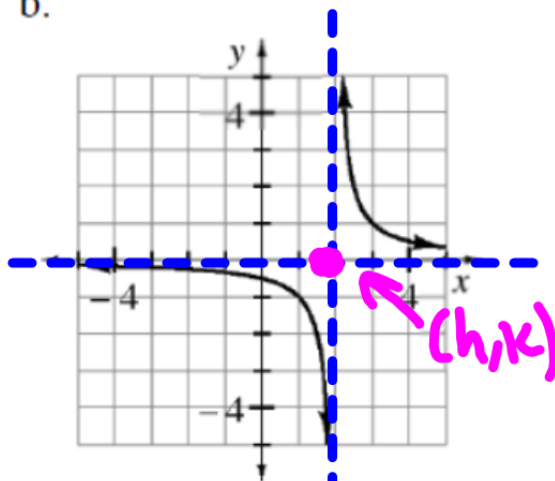
a. **Parabola, quadratic**

(h,k)

$y = a(x-h)^2 + k$

$(-4, 2)$
 h k

$y = -2(x+4)^2 + 2$

b. **Reciprocal**

(h,k)

$y = a\left(\frac{1}{x-h}\right) + k$

$(2, 0)$
 h k

$y = \frac{1}{x-2}$

c. **Cubic**

(h,k)

$y = a(x-h)^3 + k$

$(0, 3)$
 h k
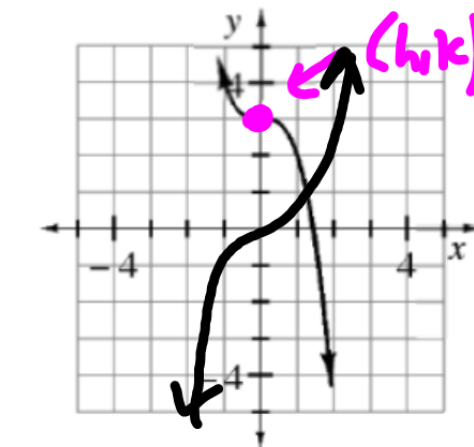
$y = -x^3 + 3$

3-32. Make a complete graph of a system of equations to solve $2|x-4|-3=\frac{2}{3}x-3$. Show your solutions clearly on your graph. 3-32 HW eTool (Desmos). Homework Help ✎.

$$y = 2|x-4|-3$$

$$y = \frac{2}{3}x - 3$$

$$y \overset{?}{=} y$$

(6, 1)

(3, −1)
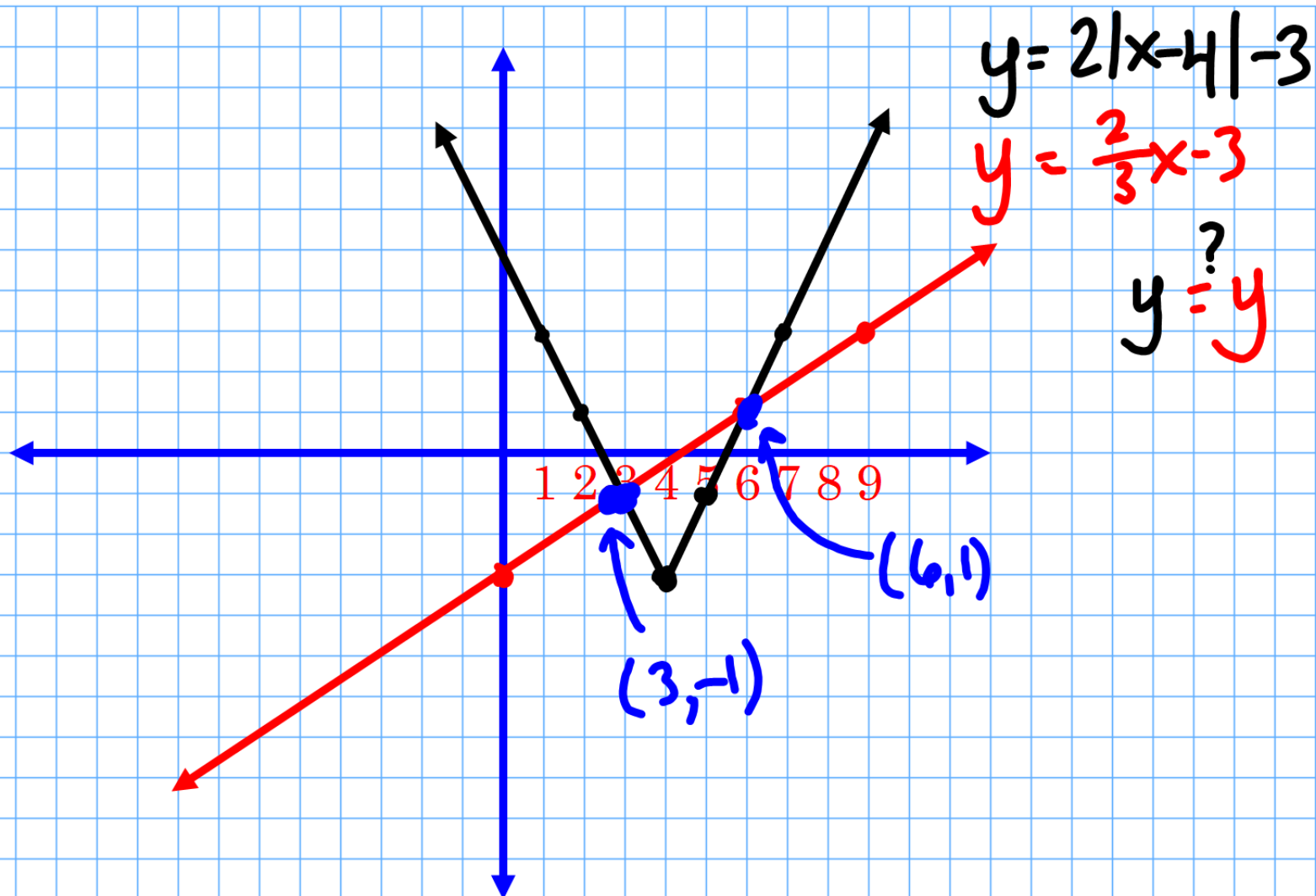
3-34. If $g(x) = x^2 - 5$, determine:

a. $g(\frac{1}{2})$

b. $g(h+1)$

$g(\frac{1}{2}) = (\frac{1}{2})^2 - 5$

$g(\frac{1}{2}) = \frac{1}{4} - 5$

$g(\frac{1}{2}) = -4.75$

$g(h+1) = (h+1)^2 - 5$

$g(h+1) = h^2 + 2h + 1 - 5$

$g(h+1) = h^2 + 2h - 4$

3-40. Solve the following equations. Be sure to check your solutions.

extraneous?

a. $\sqrt{2x-1} - x = -8$

$\underline{+x \quad +x}$

$(\sqrt{2x-1})^2 = (x-8)^2$

$2x - 1 = x^2 - 16x + 64$

$\underline{-2x + 1 \qquad -2x + 1}$

$0 = x^2 - 18x + 65$

b. $\sqrt{2x-1} - x = 0$

$\underline{+x \quad +x}$

$\sqrt{?} - x = 0$

$\sqrt{2x-1} = x$

$2x - 1 = x^2$

$0 = x^2 - 2x + 1$

$\sqrt{0} = \sqrt{(x-1)^2}$

$0 = |x-1|$

$1 = x$

Check:

$\sqrt{2(1)-1} - 1 \overset{?}{=} 0$

$\sqrt{1} - 1 = 0$

$1 - 1 = 0$ ✓

$\cancel{65x^2}$

$-13x \quad -5x$

$-18x$

$0 = (x-13)(x-5)$

$13 = x \quad \leftarrow \quad 0 = x - 13$

$5 = x \quad \leftarrow \quad 0 = x - 5$

$y = \sqrt{2x-1} - x$

$y = -8$

3-49. Solve each of the following systems algebraically. What do the solutions tell you about the graph of each system? Visualizing the graphs may help with your description. Homework Help ✎.

a. $y = 3x - 5$
   $y = -2x - 15$

b. $y - 7 = -2x$
   $4x + 2y = 14$

c. $y = 2(x + 3)^2 - 5$
   $y = 14x + 17$

d. $y = 3(x - 2)^2 + 3$
   $y = 6x - 12$

$14x + 17 = 2(x+3)^2 - 5$

$\qquad = 2(x^2 + 6x + 9) - 5$

$\qquad = 2x^2 + 12x + 18 - 5$

$14x + 17 = 2x^2 + 12x + 13$
$-14x - 17 \qquad -14x - 17$

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

$0 = (2x - 4)(x + 1)$

$x = -1 \qquad x = 2$

$y = 14(-1) + 17$

$y = +3$

$y = 14(2) + 17$

$y = 45$
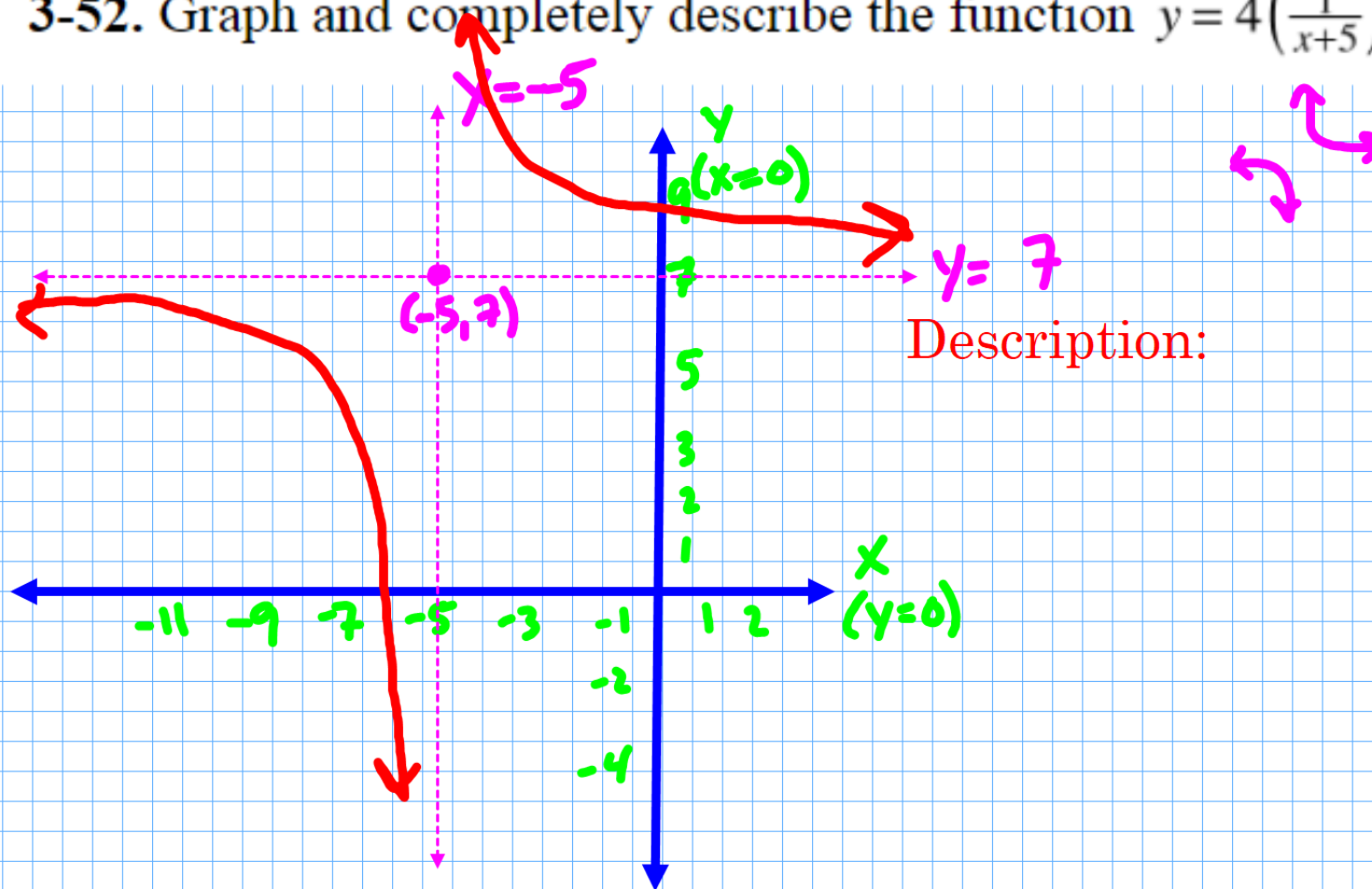
$(-1, +3)$
$(2, 45)$

$\dfrac{6x - 12}{3} = \dfrac{3(x-2)^2 + 3}{3}$

$3x - 4 = (x-2)^2 + 1$

3-52. Graph and completely describe the function $y = 4\left(\frac{1}{x+5}\right) + 7$.

x = -5

y = 7

(-5, 7)

Description:

Y

g(x=0)

7

5

3

2

1

X (y=0)

-11 -9 -7 -5 -3 -1 1 2

-2

-4

3-74. What are the boundary points for each of the following inequalities? Draw the boundaries on a number line and shade the solution regions. Homework Help
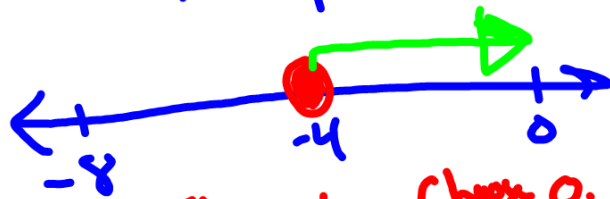
✎

a. $3x + 2 \geq x - 6$

b. $2x^2 - 5x < 12$

$3x + 2 = x - 6$

$-x + (-2) \quad -x \quad -2$

$2x = -8$

$x = -4$

Choose -8

$3(-8) + 2 \geq -8 - 6$

$-22 \geq -14$

✗

Choose 0.

$3(0) + 2 \geq 0 - 6$?

$2 \geq -4$

✓

$2x^2 - 5x = 12$

$2x^2 - 5x - 12 = 0$

$-8 \cdot 3 = -24 \quad -8 + 3 = -5$

$-4 \quad \begin{array}{c|c|c} & -8x & -12 \\ \hline x & 2x^2 & 3x \end{array}$

$2x + 3$

$(x - 4)(2x + 3) = 0$

$x = 4 \qquad x = \frac{-3}{2}$

$-2 \qquad -\frac{3}{2} \quad 0 \qquad 4 \qquad 5$

$2(-2)^2 - 5(-2) < 12$? $2(0)^2 - 5(0) < 12$? $2(5)^2 - 5(5) < 0$?

$2(4) - 5(-2) < 12$?   True   ↓ false

$8 + 10 \leq 12$

No!

3-81. Make a complete graph of the four inequalities below on the same set of axes. Homework Help ✏

$y = \frac{1}{2}x - \frac{3}{2}$

i. $2y \geq x - 3$

ii. $x - 2y \geq -7$ $y = \frac{1}{2}x + \frac{7}{2}$

iii. $y \leq -2x + 6$

iv. $-9 \leq 2x + y$

$y = -2x + 6$ $y = -2x - 9$

a) What type of polygon is formed by the solution of this set of inequalities? Write a convincing argument to justify your answer.

b. What are the vertices of the polygon? If your graph is very accurately drawn, you will be able to determine the points from the graph. If it is not, you will need to solve the systems (pairs) of equations that represent the corners of your graphs.
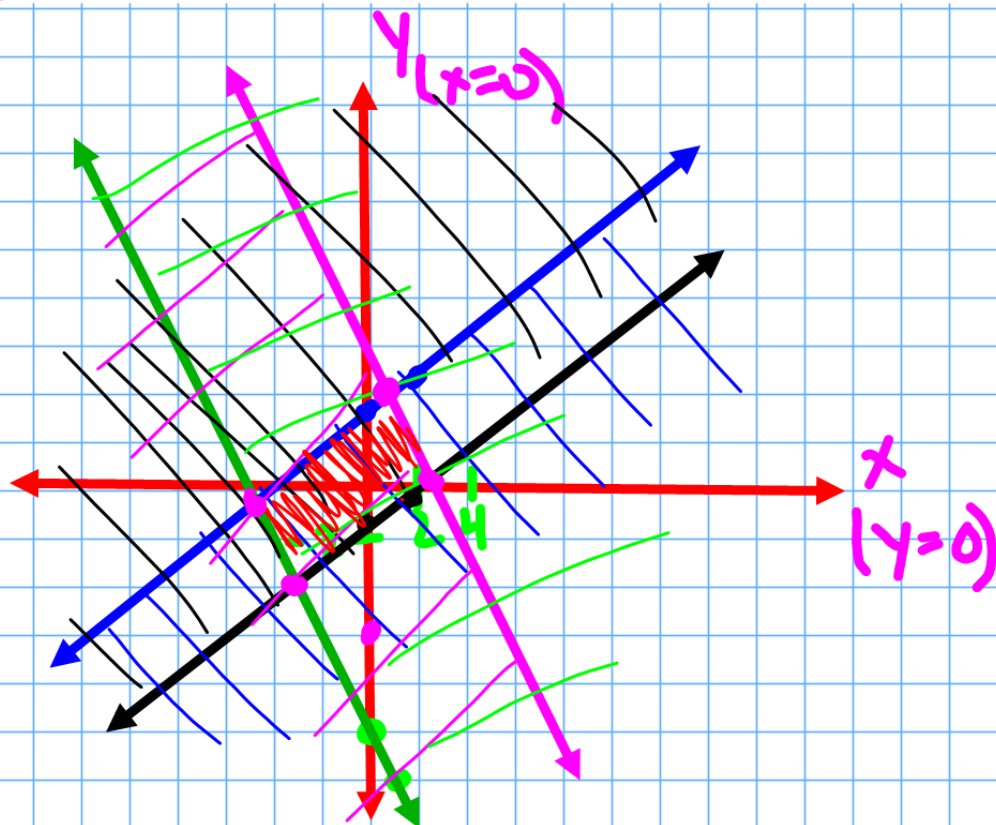
$(1,4)$ $(3,0)$

$(-3,-3)$ $(-5,-1)$

3-83. Solve the following systems algebraically. What does each solution reveal about the graph of the equations in the system? Homework Help ✎

a. $x + 2y = 17$
   $x - y = 2$

b. $4x + 5y = 11$
   $(\cdot 2)(2x + 6y) = (16)(\cdot 2)$

c. $4x - 3y = -10$
   $x = \frac{1}{4}y - 1$

d. $2x + y = -2x + 5$
   $3x + 2y = 2x + 3y$

b)

$4x + 5y = 11$
$-4x - 12y = -32$
───────────
$-7y = -21$
$y = 3$

$2x + 6(3) = 16$ $(-1, 3)$
$2x + 18 = 16$
$x = -1$

$y = -2x - 2x + 5$
$y = -4x + 5$

$4x + y - 5 = 0$
$+ x - y = 0$
───────────
$5x - 5 = 0$
$5x = 5$
$x = 1$
$y = 1$

3-97. Complete the square to rewrite $y = x^2 - 5x + 7$ in graphing form and state the vertex.

Help ✎

$$y = x^2 - 5x + 7$$
$$-.75 \qquad\qquad -.75$$

$$y - .75 = x^2 - 5x + 6.25$$

$$y - .75 = (x - 2.5)^2$$

$$y = (x - 2.5)^2 + .75$$

Vertex: $(2.5, .75)$

	$-2.5x$	$+6.25$
x	x^2	$-2.5x$

$x - 2.5$

(2.5, 0.75)