Chapter 1 Functions and Relations

Section 1.1 The Rectangular Coordinate System and Graphing Utilities

1. origin

2. quadrants

3. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

4. $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

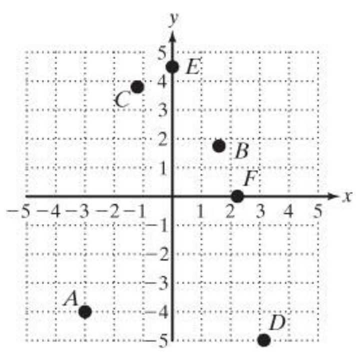
5. solution

6. 0

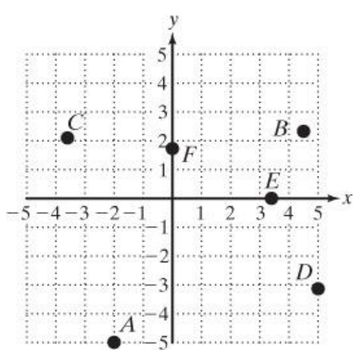
7. 0

8. 0; y

9.



10.



11. a. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$= \sqrt{[-4 - (-2)]^2 + (11 - 7)^2}$

$= \sqrt{(-2)^2 + (4)^2} = \sqrt{4 + 16}$

$= \sqrt{20} = 2\sqrt{5}$

b. $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$= \left(\frac{-4 + (-2)}{2}, \frac{11 + 7}{2}\right)$

$= \left(\frac{-6}{2}, \frac{18}{2}\right) = (-3, 9)$

12. a. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$= \sqrt{[3 - (-1)]^2 + [-7 - (-3)]^2}$

$= \sqrt{(4)^2 + (-4)^2}$

$= \sqrt{16 + 16} = \sqrt{32} = 4\sqrt{2}$

b. $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$= \left(\frac{3 + (-1)}{2}, \frac{-7 + (-3)}{2}\right)$

$= \left(\frac{2}{2}, \frac{-10}{2}\right) = (1, -5)$

13. a. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$= \sqrt{[2 - (-7)]^2 + [5 - (-4)]^2}$

$= \sqrt{(9)^2 + (9)^2}$

$= \sqrt{81 + 81} = \sqrt{162} = 9\sqrt{2}$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{2+(-7)}{2}, \frac{5+(-4)}{2}\right)$
$= \left(\frac{-5}{2}, \frac{1}{2}\right) = \left(-\frac{5}{2}, \frac{1}{2}\right)$

14. a. $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(-4-3)^2+(-1-6)^2}$
$= \sqrt{(-7)^2+(7)^2}$
$= \sqrt{49+49} = \sqrt{98} = 7\sqrt{2}$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{-4+3}{2}, \frac{-1+6}{2}\right)$
$= \left(\frac{-1}{2}, \frac{5}{2}\right) = \left(-\frac{1}{2}, \frac{5}{2}\right)$

15. a. $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(5.2-2.2)^2+[-6.4-(-2.4)]^2}$
$= \sqrt{(3)^2+(4)^2} = \sqrt{9+16} = \sqrt{25} = 5$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{5.2+2.2}{2}, \frac{-6.4+(-2.4)}{2}\right)$
$= \left(\frac{7.4}{2}, \frac{-8.8}{2}\right) = (3.7, -4.4)$

16. a. $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(31.1-37.1)^2+[-32.7-(-24.7)]^2}$
$= \sqrt{(-6)^2+(-8)^2}$
$= \sqrt{36+64} = \sqrt{100} = 10$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{31.1+37.1}{2}, \frac{-32.7+(-24.7)}{2}\right)$
$= \left(\frac{68.2}{2}, \frac{-57.4}{2}\right) = (34.1, -28.7)$

17. a. $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{\left(4\sqrt{5}-\sqrt{5}\right)^2+\left[-7\sqrt{2}-\left(-\sqrt{2}\right)\right]^2}$
$= \sqrt{\left(3\sqrt{5}\right)^2+\left(-6\sqrt{2}\right)^2}$
$= \sqrt{45+72} = \sqrt{117}$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{4\sqrt{5}+\sqrt{5}}{2}, \frac{-7\sqrt{2}+\left(-\sqrt{2}\right)}{2}\right)$
$= \left(\frac{5\sqrt{5}}{2}, \frac{-8\sqrt{2}}{2}\right) = \left(\frac{5\sqrt{5}}{2}, -4\sqrt{2}\right)$

18. a. $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{\left(2\sqrt{7}-\sqrt{7}\right)^2+\left[\sqrt{5}-\left(-3\sqrt{5}\right)\right]^2}$
$= \sqrt{\left(\sqrt{7}\right)^2+\left(4\sqrt{5}\right)^2}$
$= \sqrt{7+80} = \sqrt{87}$

b. $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
$= \left(\frac{2\sqrt{7}+\sqrt{7}}{2}, \frac{\sqrt{5}+\left(-3\sqrt{5}\right)}{2}\right)$
$= \left(\frac{3\sqrt{7}}{2}, \frac{-2\sqrt{5}}{2}\right) = \left(\frac{3\sqrt{7}}{2}, -\sqrt{5}\right)$

19. $d_1 = \sqrt{(3-1)^2+(1-3)^2}$
$= \sqrt{4+4} = 2\sqrt{2}$

$$d_2 = \sqrt{(0-3)^2 + (-2-1)^2}$$
$$= \sqrt{9+9} = 3\sqrt{2}$$
$$d_3 = \sqrt{(1-0)^2 + [3-(-2)]^2}$$
$$= \sqrt{1+25} = \sqrt{26}$$
$$d_1^2 + d_2^2 = d_3^2$$
$$(2\sqrt{2})^2 + (3\sqrt{2})^2 = (\sqrt{26})^2$$
$$8+18 = 26$$
$$26 = 26 \checkmark \text{ True}$$

Yes

20. $d_1 = \sqrt{(3-1)^2 + (0-2)^2}$
$$= \sqrt{4+4} = 2\sqrt{2}$$
$$d_2 = \sqrt{(-3-3)^2 + (-2-0)^2}$$
$$= \sqrt{36+4} = 2\sqrt{10}$$
$$d_3 = \sqrt{[1-(-3)]^2 + [2-(-2)]^2}$$
$$= \sqrt{16+16} = 4\sqrt{2}$$
$$d_1^2 + d_3^2 = d_2^2$$
$$(2\sqrt{2})^2 + (4\sqrt{2})^2 = (2\sqrt{10})^2$$
$$8+32 = 40$$
$$40 = 40 \checkmark \text{ True}$$

Yes

21. $d_1 = \sqrt{[5-(-2)]^2 + (0-4)^2}$
$$= \sqrt{49+16} = \sqrt{65}$$
$$d_2 = \sqrt{(-5-5)^2 + (1-0)^2}$$
$$= \sqrt{100+1} = \sqrt{101}$$
$$d_3 = \sqrt{[-2-(-5)]^2 + (4-1)^2}$$
$$= \sqrt{9+9} = 3\sqrt{2}$$
$$d_1^2 + d_3^2 = d_2^2$$
$$(\sqrt{65})^2 + (3\sqrt{2})^2 = (\sqrt{101})^2$$
$$65+18 = 101$$
$$83 = 101 \text{ False}$$

No

22. $d_1 = \sqrt{(-6-3)^2 + (2-1)^2}$
$$= \sqrt{81+1} = \sqrt{82}$$
$$d_2 = \sqrt{(3-1)^2 + [1-(-2)]^2}$$
$$= \sqrt{4+9} = \sqrt{13}$$
$$d_3 = \sqrt{(-6-1)^2 + [2-(-2)]^2}$$
$$= \sqrt{49+16} = \sqrt{65}$$
$$d_2^2 + d_3^2 = d_1^2$$
$$(\sqrt{13})^2 + (\sqrt{65})^2 = (\sqrt{82})^2$$
$$13+65 = 82$$
$$78 = 82 \text{ False}$$

No

23. a. $x^2 + y = 1$
$$(-2)^2 + (-3) = 1$$
$$4-3 = 1$$
$$1 = 1 \checkmark$$

Yes

b. $x^2 + y = 1$
$$(4)^2 + (-17) = 1$$
$$16-17 = 1$$
$$-1 = 1 \text{ False}$$

No

c. $x^2 + y = 1$
$$\left(\frac{1}{2}\right)^2 + \left(\frac{3}{4}\right) = 1$$
$$\frac{1}{4} + \frac{3}{4} = 1$$
$$1 = 1 \checkmark$$

Yes

24. a. $|x-3| - y = 4$
$$|(1)-3| - (-2) = 4$$
$$2+2 = 4$$
$$4 = 4 \checkmark$$

Yes

b. $|x-3|-y=4$

$|(-2)-3|-(-3)=4$

$5+3=4$

$8=4$ False

No

c. $|x-3|-y=4$

$\left|\left(\frac{1}{10}\right)-3\right|-\left(-\frac{11}{10}\right)=4$

$10\left[\left|\left(\frac{1}{10}\right)-3\right|+\frac{11}{10}\right]=10[4]$

$|1-30|+11=40$

$29+11=40$

$40=40$ ✓

Yes

25. $x-3\neq 0$

$x\neq 3$

$\{x \mid x\neq 3\}$

26. $x+7\neq 0$

$x\neq -7$

$\{x \mid x\neq -7\}$

27. $x-10\geq 0$

$x\geq 10$

$\{x \mid x\geq 10\}$

28. $x+11\geq 0$

$x\geq -11$

$\{x \mid x\geq -11\}$

29. $1.5-x\geq 0$

$-x\geq -1.5$

$x\leq 1.5$

$\{x \mid x\leq 1.5\}$

30. $2.2-x\geq 0$

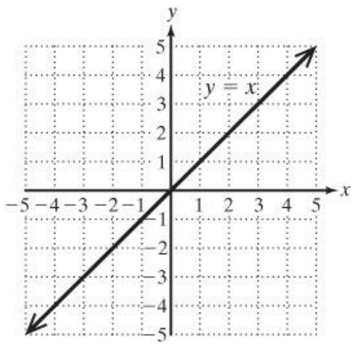
$-x\geq -2.2$

$x\leq 2.2$

$\{x \mid x\leq 2.2\}$

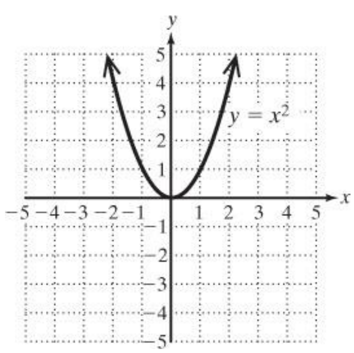
31. $y=x$

x	y	$y=x$	**Ordered pair**
–3	–3	$y=-3$	$(-3,-3)$
–2	–2	$y=-2$	$(-2,-2)$
–1	–1	$y=-1$	$(-1,-1)$
0	0	$y=0$	$(0,0)$
1	1	$y=1$	$(1,1)$
2	2	$y=2$	$(2,2)$
3	3	$y=3$	$(3,3)$



32. $y = x^2$

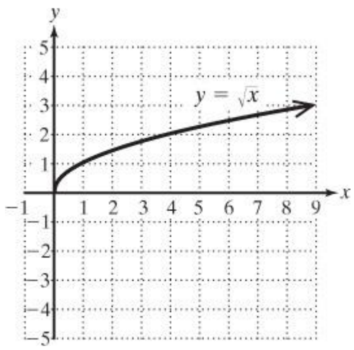
x	y	$y = x^2$	**Ordered**
–3	9	$y = (-3)^2 = 9$	$(-3, 9)$
–2	4	$y = (-2)^2 = 4$	$(-2, 4)$
–1	1	$y = (-1)^2 = 1$	$(-1, 1)$
0	0	$y = (0)^2 = 0$	$(0, 0)$
1	1	$y = (1)^2 = 1$	$(1, 1)$
2	4	$y = (2)^2 = 4$	$(2, 4)$
3	9	$y = (3)^2 = 9$	$(3, 9)$



33. $y = \sqrt{x}$

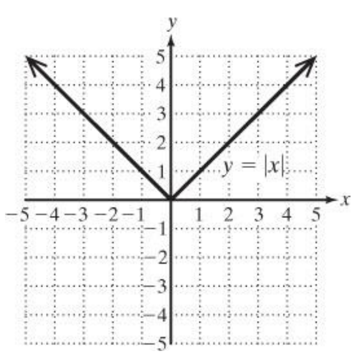
x	y	$y = \sqrt{x}$	**Ordered pair**
0	0	$y = \sqrt{0} = 0$	$(0, 0)$
1	1	$y = \sqrt{1} = 1$	$(1, 1)$

4	2	$y = \sqrt{4} = 2$	$(4, 2)$
9	3	$y = \sqrt{9} = 3$	$(9, 3)$



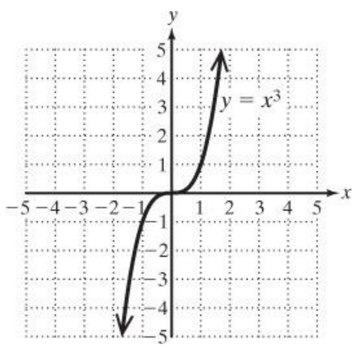
34. $y = |x|$

x	y	$y = \lvert x \rvert$	**Ordered pair**
−3	3	$y = \lvert -3 \rvert = 3$	$(-3, 3)$
−2	2	$y = \lvert -2 \rvert = 2$	$(-2, 2)$
−1	1	$y = \lvert -1 \rvert = 1$	$(-1, 1)$
0	0	$y = \lvert 0 \rvert = 0$	$(0, 0)$
1	1	$y = \lvert 1 \rvert = 1$	$(1, 1)$
2	2	$y = \lvert 2 \rvert = 2$	$(2, 2)$
3	3	$y = \lvert 3 \rvert = 3$	$(3, 3)$



35. $y = x^3$

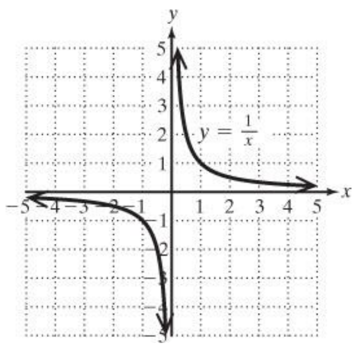
x	y	$y = x^3$	**Ordered pair**
-2	-8	$y = (-2)^3 = -8$	$(-2, -8)$
-1	-1	$y = (-1)^3 = -1$	$(-1, -1)$
0	0	$y = (0)^3 = 0$	$(0, 0)$
1	1	$y = (1)^3 = 1$	$(1, 1)$
2	8	$y = (2)^3 = 8$	$(2, 8)$



36. $y = \frac{1}{x}$

x	y	$y = \frac{1}{x}$	**Ordered pair**
-4	$-\frac{1}{4}$	$y = \frac{1}{(-4)} = -\frac{1}{4}$	$\left(-4, -\frac{1}{4}\right)$
-2	$-\frac{1}{2}$	$y = \frac{1}{(-2)} = -\frac{1}{2}$	$\left(-2, -\frac{1}{2}\right)$
-1	-1	$y = \frac{1}{(-1)} = -1$	$(-1, 1)$
$-\frac{1}{2}$	-2	$y = \frac{1}{\left(-\frac{1}{2}\right)} = -2$	$\left(-\frac{1}{2}, -2\right)$
$\frac{1}{2}$	2	$y = \frac{1}{\left(\frac{1}{2}\right)} = 2$	$\left(\frac{1}{2}, 2\right)$

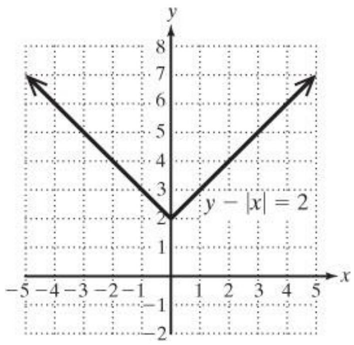
1	1	$y=\frac{1}{(1)}=1$	$(1,1)$
2	$\frac{1}{2}$	$y=\frac{1}{(2)}=\frac{1}{2}$	$\left(2,\frac{1}{2}\right)$
4	$\frac{1}{4}$	$y=\frac{1}{(4)}=\frac{1}{4}$	$\left(4,\frac{1}{4}\right)$



37. $y-|x|=2$

$y=|x|+2$

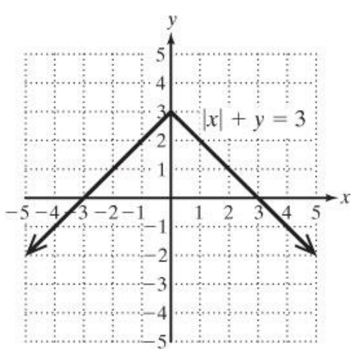
x	***y***	$\boldsymbol{y=|x|+2}$	**Ordered pair**
–3	5	$y=|-3|+2=5$	$(-3, 5)$
–2	4	$y=|-2|+2=4$	$(-2, 4)$
–1	3	$y=|-1|+2=3$	$(-1, 3)$
0	2	$y=|0|+2=2$	$(0, 2)$
1	3	$y=|1|+2=3$	$(1, 3)$
2	4	$y=|2|+2=4$	$(2, 4)$
3	5	$y=|3|+2=5$	$(3, 5)$



38. $|x|+y=3$

$y=3-|x|$

x	y	$y=3-\lvert x\rvert$	**Ordered pair**
–3	0	$y=3-\lvert-3\rvert=0$	$(-3, 0)$
–2	1	$y=3-\lvert-2\rvert=1$	$(-2, 1)$
–1	2	$y=3-\lvert-1\rvert=2$	$(-1, 2)$
0	3	$y=3-\lvert 0\rvert=3$	$(0, 3)$
1	2	$y=3-\lvert 1\rvert=2$	$(1, 2)$
2	1	$y=3-\lvert 2\rvert=1$	$(2, 1)$
3	0	$y=3-\lvert 3\rvert=0$	$(3, 0)$

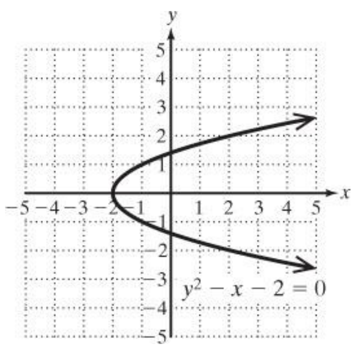


39. $y^2-x-2=0$

$y^2=x+2$

$y=\pm\sqrt{x+2}$

x	*y*	$y = \pm\sqrt{x+2}$	**Ordered pairs**
−2	1	$y = \pm\sqrt{(-2)+2} = 0$	$(-2, 0)$
−1	±1	$y = \pm\sqrt{(-1)+2} = \pm 1$	$(-1,1),(-1,-1)$
2	±2	$y = \pm\sqrt{(2)+2} = \pm 2$	$(2,2),(2,-2)$
7	±3	$y = \pm\sqrt{(7)+2} = \pm 3$	$(7,3),(7,-3)$

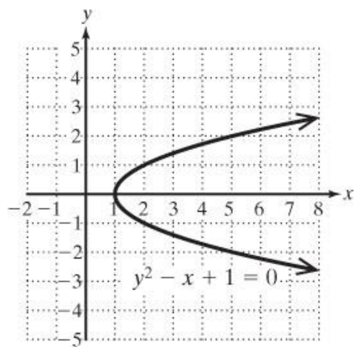


40. $y^2 - x + 1 = 0$

$y^2 = x - 1$

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

x	*y*	$y = \pm\sqrt{x-1}$	**Ordered pairs**
1	0	$y = \pm\sqrt{(1)-1} = 0$	$(1, 0)$
2	±1	$y = \pm\sqrt{(2)-1} = \pm 1$	$(2,1),(2,-1)$
5	±2	$y = \pm\sqrt{(5)-1} = \pm 2$	$(5,2),(5,-2)$
10	±3	$y = \pm\sqrt{(10)-1} = \pm 3$	$(10,3),(10,-3)$

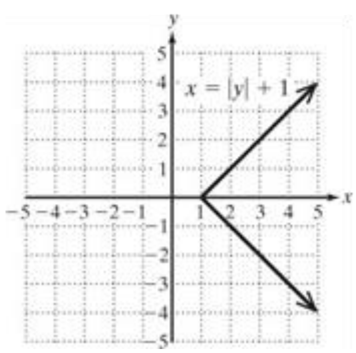


41. $x = |y| + 1$

$|y| = x - 1$

$y = \pm(x - 1)$

x	*y*	$y = \pm(x-1)$	**Ordered pairs**
1	0	$y = \pm[(1)-1] = 0$	$(1, 0)$
2	±1	$y = \pm[(2)-1] = \pm1$	$(2, 1), (2, -1)$
3	±2	$y = \pm[(3)-1] = \pm2$	$(3, 2), (3, -2)$
4	±3	$y = \pm[(4)-1] = \pm3$	$(4, 3), (4, -3)$
5	±4	$y = \pm[(5)-1] = \pm4$	$(5, 4), (5, -4)$



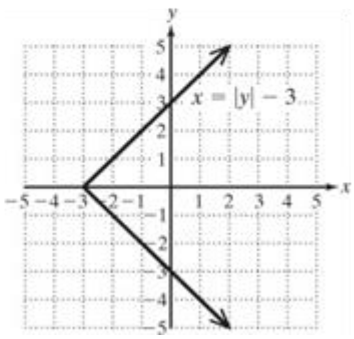
42. $x = |y| - 3$

$|y| = x + 3$

$y = \pm(x + 3)$

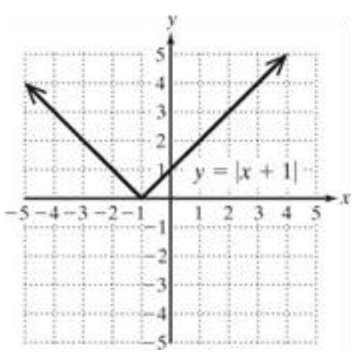
x	*y*	$y = \pm(x+3)$	**Ordered pairs**
–3	0	$y = \pm[(-3)+3] = 0$	$(-3, 0)$
–2	±1	$y = \pm[(-2)+3] = \pm1$	$(-2, 1), (-2, -1)$

−1	±2	$y=\pm\left[\left(-1\right)+3\right]=\pm2$	$\left(-1,2\right),\left(-1,-2\right)$
0	±3	$y=\pm\left[\left(0\right)+3\right]=\pm3$	$\left(0,3\right),\left(0,-3\right)$
1	±4	$y=\pm\left[\left(1\right)+3\right]=\pm4$	$\left(1,4\right),\left(1,-4\right)$
2	±5	$y=\pm\left[\left(2\right)+3\right]=\pm5$	$\left(2,5\right),\left(2,-5\right)$



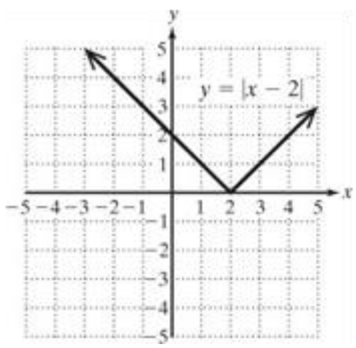
43. $y=\left|x+1\right|$

x	***y***	$y=\left|x+1\right|$	**Ordered pair**
−3	2	$y=\left|\left(-3\right)+1\right|=2$	$\left(-3,2\right)$
−2	1	$y=\left|\left(-2\right)+1\right|=1$	$\left(-2,1\right)$
−1	0	$y=\left|\left(-1\right)+1\right|=0$	$\left(-1,0\right)$
0	1	$y=\left|\left(0\right)+1\right|=1$	$\left(0,1\right)$
1	2	$y=\left|\left(1\right)+1\right|=2$	$\left(1,2\right)$
2	3	$y=\left|\left(2\right)+1\right|=3$	$\left(2,3\right)$
3	4	$y=\left|\left(3\right)+1\right|=4$	$\left(3,4\right)$



44. $y = |x - 2|$

x	y	$y = \|x - 2\|$	**Ordered** .
-2	4	$y = \|(-2) - 2\| = 4$	$(-2, 4)$
-1	3	$y = \|(-1) - 2\| = 3$	$(-1, 3)$
0	2	$y = \|(0) - 2\| = 2$	$(0, 2)$
1	1	$y = \|(1) - 2\| = 1$	$(1, 1)$
2	0	$y = \|(2) - 2\| = 0$	$(2, 0)$
3	1	$y = \|(3) - 2\| = 1$	$(3, 1)$
4	2	$y = \|(4) - 2\| = 2$	$(4, 2)$



45. x-intercepts: $(-1, 0), (9, 0)$

y-intercepts: $(0, -3), (0, 3)$

46. x-intercepts: $(-16, 0), (4, 0)$

y-intercepts: $(0, -8), (0, 8)$

47. x-intercept: $(-2, 0)$; y-intercept: none

48. x-intercept: none; y-intercept: $(0, 1)$

49. x-intercept: $(0, 0)$; y-intercept: $(0, 0)$

50. x-intercept: $(0, 0), (6, 0)$; y-intercept: $(0, 0)$

51. Substitute 0 for y: Substitute 0 for x:

$$-2x + 4y = 12 \qquad -2x + 4y = 12$$
$$-2x + 4(0) = 12 \qquad -2(0) + 4y = 12$$
$$-2x = 12 \qquad 4y = 12$$
$$x = -6 \qquad y = 3$$

x-intercept: $(-6, 0)$; y-intercept: $(0, 3)$

52. Substitute 0 for y: Substitute 0 for x:

$$-3x - 5y = 60 \qquad -3x - 5y = 60$$
$$-3x - 5(0) = 60 \qquad -3(0) - 5y = 60$$
$$-3x = 60 \qquad -5y = 60$$
$$x = -20 \qquad y = -12$$

x-intercept: $(-20, 0)$; y-intercept: $(0, -12)$

53. Substitute 0 for y: Substitute 0 for x:

$$x^2+y=9 \qquad x^2+y=9$$
$$x^2+(0)=9 \qquad (0)^2+y=9$$
$$x^2=9 \qquad y=9$$
$$x=\pm3$$

x-intercepts: $(-3,0),(3,0)$; y-intercept: $(0,9)$

54. Substitute 0 for y: Substitute 0 for x:

$$x^2=-y+16 \qquad x^2=-y+16$$
$$x^2=-(0)+16 \qquad (0)^2=-y+16$$
$$x^2=16 \qquad y=16$$
$$x=\pm4$$

x-intercepts: $(-4,0),(4,0)$; y-intercept: $(0,16)$

55. Substitute 0 for y:

$$y=|x-5|-2$$
$$(0)=|x-5|-2$$
$$|x-5|=2$$
$$x-5=-2 \quad \text{or} \quad x-5=2$$
$$x=3 \quad \text{or} \quad x=7$$

Substitute 0 for x:

$$y=|x-5|-2$$
$$y=|(0)-5|-2=3$$

x-intercepts: $(3,0),(7,0)$; y-intercept: $(0,3)$

56. Substitute 0 for y:

$$y=|x+4|-3$$
$$(0)=|x+4|-3$$
$$|x+4|=3$$
$$x+4=-3 \quad \text{or} \quad x+4=3$$
$$x=-7 \quad \text{or} \quad x=-1$$

Substitute 0 for x:

$$y=|x+4|-3$$
$$y=|(0)+4|-3=1$$

x-intercepts: $(-7,0),(-1,0)$; y-intercept: $(0,1)$

57. Substitute 0 for y: Substitute 0 for x:

$$x=y^2-1 \qquad x=y^2-1$$
$$x=(0)^2-1=-1 \qquad (0)=y^2-1$$
$$1=y^2$$
$$\pm1=y$$

x-intercept: $(-1,0)$; y-intercepts: $(0,-1),(0,1)$

58. Substitute 0 for y: Substitute 0 for x:

$$x=y^2-4 \qquad x=y^2-4$$
$$x=(0)^2-4 \qquad (0)=y^2-4$$
$$x=-4 \qquad 4=y^2$$
$$\pm2=y$$

x-intercept: $(-4,0)$; y-intercepts: $(0,-2),(0,2)$

59. Substitute 0 for y: Substitute 0 for x:

$$|x|=|y| \qquad |x|=|y|$$
$$|x|=|(0)| \qquad |(0)|=|y|$$
$$x=0 \qquad 0=y$$

x-intercept: $(0,0)$; y-intercepts: $(0,0)$

60. Substitute 0 for y: Substitute 0 for x:

$$x=|5y| \qquad x=|5y|$$
$$|x|=|5(0)| \qquad (0)=|5y|$$
$$|x|=0 \qquad 0=y$$
$$x=0$$

x-intercept: $(0,0)$; y-intercepts: $(0,0)$

61. $$\frac{(x-3)^2}{4}+\frac{(y-4)^2}{9}=1$$
$$36\left[\frac{(x-3)^2}{4}+\frac{(y-4)^2}{9}\right]=36(1)$$
$$9(x-3)^2+4(y-4)^2=36$$
Substitute 0 for y:
$$9(x-3)^2+4(y-4)^2=36$$
$$9(x-3)^2+4[(0)-4]^2=36$$
$$9(x-3)^2+64=36$$
$$9(x-3)^2=-28$$
$$(x-3)^2=-\frac{28}{9}$$
$$x-3=\pm\sqrt{-\frac{28}{9}}$$
$$x=3\pm\sqrt{-\frac{28}{9}}$$
Not a real number.
Substitute 0 for x:
$$9(x-3)^2+4(y-4)^2=36$$
$$9[(0)-3]^2+4(y-4)^2=36$$
$$81+4(y-4)^2=36$$
$$4(y-4)^2=-45$$
$$(y-4)^2=-\frac{45}{4}$$
$$y-4=\pm\sqrt{-\frac{45}{4}}$$
$$y=4\pm\sqrt{-\frac{45}{4}}$$
Not a real number.
x-intercept: none; y-intercept: none

62. $$\frac{(x+6)^2}{16}+\frac{(y+3)^2}{4}=1$$
$$16\left[\frac{(x+6)^2}{16}+\frac{(y+3)^2}{4}\right]=16(1)$$
$$(x+6)^2+4(y+3)^2=16$$
Substitute 0 for y:
$$(x+6)^2+4(y+3)^2=16$$
$$(x+6)^2+4[(0)+3]^2=16$$
$$(x+6)^2+36=16$$
$$(x+6)^2=-20$$
$$x+6=\pm\sqrt{-20}$$
$$x=-6\pm\sqrt{-20}$$
Not a real number.
Substitute 0 for x:
$$(x+6)^2+4(y+3)^2=16$$
$$[(0)+6]^2+4(y+3)^2=16$$
$$36+4(y+3)^2=16$$
$$4(y+3)^2=-20$$
$$(y+3)^2=-5$$
$$y+3=\pm\sqrt{-5}$$
$$y=-3\pm\sqrt{-5}$$
Not a real number.
x-intercept: none; y-intercept: none

63. $$d_{AC}=\sqrt{[4-(-6)]^2+(8-10)^2}$$
$$=\sqrt{100+4}=\sqrt{104}=2\sqrt{26}$$
$$d_{BC}=\sqrt{(4-6)^2+(8-0)^2}$$
$$=\sqrt{4+64}=\sqrt{68}=2\sqrt{17}$$
Observation tower *B* is closer.

64. a. $$d=\sqrt{[1-(-2)]^2+(-3-3)^2}$$
$$=\sqrt{9+36}=\sqrt{45}$$
$$=3\sqrt{5}\text{ mi}\approx 6.7\text{ mi}$$

b. $M = \left(\frac{-2+1}{2}, \frac{3+(-3)}{2}\right)$
$= \left(\frac{-1}{2}, \frac{0}{2}\right) = \left(-\frac{1}{2}, 0\right)$

65. a. $d = \sqrt{(410-36)^2 + (53-315)^2}$
$= \sqrt{374^2 + (-262)^2}$
$= 456.64 \approx 457$ pixels

b. If both the player move directly towards each other at the same speed, then they will meet at the midpoint.

$\text{Midpoint} = \left(\frac{36+410}{2}, \frac{315+53}{2}\right)$
$= (223{,}184)$

c. The midpoint between A and B is $(224{,}184)$. If the A is 3 times faster than B, then A and B will meet at the midpoint of $(223{,}184)$ and B.

$\left(\frac{223+410}{2}, \frac{184+53}{2}\right) = (316.5{,}118.5)$
$\approx (317{,}119)$

Therefore, A and B meet at $(317{,}119)$

66. $d(A,B) = \sqrt{(80-460)^2 + (210-420)^2}$
$= 434.165 \approx 434$
$d(B,C) = \sqrt{(120-80)^2 + (60-210)^2}$
$= 10\sqrt{241} \approx 155$

The total distance between A to B to C is approximately 589 pixels.
At 120 pixels per second, the time required is only about 4.9 sec
Yes

67. $d(A,B) = \sqrt{(x-0)^2 + (0-0)^2}$
$= |x|$

$d(B,C) = \sqrt{\left(\frac{1}{2}x - x\right)^2 + \left(\frac{\sqrt{3}}{2}x - 0\right)^2}$
$= |x|$

$d(C,A) = \sqrt{\left(0 - \frac{1}{2}x\right)^2 + \left(0 - \frac{\sqrt{3}}{2}x\right)^2}$
$= |x|$

Therefore, the points A, B, and C make up the vertices of an equilateral triangle.

68. $d(A,B) = \sqrt{(x-0)^2 + (0-0)^2} = |x|$
$d(A,C) = \sqrt{(0-0)^2 + (x-0)^2} = |x|$

Therefore, the points A, B, and C make up the vertices of an isosceles triangle.

$d(B,C) = \sqrt{(0-x)^2 + (x-0)^2} = \sqrt{2}|x|$
$[d(B,C)]^2 = [d(A,B)]^2 + [d(A,C)]^2$
$(\sqrt{2}x)^2 = x^2 + x^2$, True

Therefore, the points A, B, and C make up the vertices of an isosceles right triangle.

69. a. $l = \sqrt{[1-(-2)]^2 + (-3-0)^2}$
$= \sqrt{9+9} = \sqrt{18} = 3\sqrt{2}$ ft
$w = \sqrt{(3-1)^2 + (1-3)^2}$
$= \sqrt{4+4} = \sqrt{8} = 2\sqrt{2}$ ft

b. $P = 2l + 2w$
$= 2(3\sqrt{2}) + 2(2\sqrt{2})$
$= 2(5\sqrt{2}) = 10\sqrt{2}$ ft

$A = lw = (3\sqrt{2})(2\sqrt{2}) = 6(2) = 12 \text{ ft}^2$

70. a. $l = \sqrt{[5-(-1)]^2 + (-1-4)^2}$
$= \sqrt{36+25} = \sqrt{61}$ ft

$w=\sqrt{\left[-1-(-2)\right]^2+(4-3)^2}$
$=\sqrt{1+1}=\sqrt{2}$ ft

b. $P=2l+2w$
$=2\left(\sqrt{61}\right)+2\left(\sqrt{2}\right)$
$=2\left(\sqrt{61}+\sqrt{2}\right)$ ft

$A=lw=\left(\sqrt{61}\right)\left(\sqrt{2}\right)=\sqrt{122}$ ft^2

71. $C=\left(\frac{-2+4}{2},\frac{1+3}{2}\right)=\left(\frac{2}{2},\frac{4}{2}\right)=(1,2)$

$r=\frac{d}{2}=\frac{\sqrt{\left[4-(-2)\right]^2+(3-1)^2}}{2}$
$=\frac{\sqrt{36+4}}{2}=\frac{\sqrt{40}}{2}=\frac{2\sqrt{10}}{2}=\sqrt{10}$

Center: $(1,2)$; Radius: $\sqrt{10}$

72. $C=\left(\frac{-5+2}{2},\frac{3+(-1)}{2}\right)$
$=\left(\frac{-3}{2},\frac{2}{2}\right)$
$=\left(-\frac{3}{2},1\right)$

$r=\frac{d}{2}=\frac{\sqrt{\left[2-(-5)\right]^2+(-1-3)^2}}{2}$
$=\frac{\sqrt{49+16}}{2}=\frac{\sqrt{65}}{2}$

Center: $\left(-\frac{3}{2},1\right)$; Radius: $\frac{\sqrt{65}}{2}$

73. $M=\left(\frac{7+1}{2},\frac{6+(-2)}{2}\right)$
$=\left(\frac{8}{2},\frac{4}{2}\right)=(4,2)$

$h=\sqrt{(4-0)^2+(2-5)^2}$
$=\sqrt{16+9}$
$=\sqrt{25}=5$

$b=\sqrt{(7-1)^2+\left[6-(-2)\right]^2}$
$=\sqrt{36+64}=\sqrt{100}=10$

$\text{Area}=\frac{1}{2}bh=\frac{1}{2}(10)(5)=25\text{ m}^2$

74. $M=\left(\frac{(-7)+(-4)}{2},\frac{5+(-4)}{2}\right)$
$=\left(-\frac{11}{2},\frac{1}{2}\right)$

$h=\sqrt{\left[-1-\left(-\frac{11}{2}\right)\right]^2+\left(2-\frac{1}{2}\right)^2}$
$=\sqrt{\frac{81}{4}+\frac{9}{4}}$
$=\sqrt{\frac{90}{4}}=\frac{3\sqrt{10}}{2}$

$b=\sqrt{\left[-7-(-4)\right]^2+\left[5-(-4)\right]^2}$
$=\sqrt{9+81}=\sqrt{90}=3\sqrt{10}$

$\text{Area}=\frac{1}{2}\left(\frac{3\sqrt{10}}{2}\right)\left(3\sqrt{10}\right)=\frac{90}{4}=22.5\text{ m}^2$

75. $d_{AB}=\sqrt{(4-2)^2+(3-2)^2}$
$=\sqrt{4+1}=\sqrt{5}$

$d_{BC}=\sqrt{(8-4)^2+(5-3)^2}$
$=\sqrt{16+4}=\sqrt{20}=2\sqrt{5}$

$d_{AC}=\sqrt{(2-8)^2+(2-5)^2}$
$=\sqrt{36+9}=\sqrt{45}=3\sqrt{5}$

$d_{AB}+d_{BC}=d_{AC}$
$\sqrt{5}+2\sqrt{5}=3\sqrt{5}$
$3\sqrt{5}=3\sqrt{5}$ ✓ True

Collinear

76. $d_{AB}=\sqrt{(4-2)^2+(2-1.5)^2}=\sqrt{4+0.25}$
$=\sqrt{4.25}=\sqrt{0.25\cdot 17}=0.5\sqrt{17}$

$d_{BC}=\sqrt{(8-4)^2+(3-2)^2}$
$=\sqrt{16+1}=\sqrt{17}$

$$\begin{aligned} d_{AC} &= \sqrt{(2-8)^2 + (1.5-3)^2} \\ &= \sqrt{36+2.25} \\ &= \sqrt{38.25} = \sqrt{2.25\cdot 17} \\ &= 1.5\sqrt{17} \end{aligned}$$

$$d_{AB} + d_{BC} = d_{AC}$$
$$0.5\sqrt{17} + \sqrt{17} = 1.5\sqrt{17}$$
$$1.5\sqrt{17} = 1.5\sqrt{17} \checkmark \text{ True}$$

Collinear

77. $$\begin{aligned} d_{AB} &= \sqrt{[1-(-2)]^2 + (2-8)^2} \\ &= \sqrt{9+36} = \sqrt{45} = 3\sqrt{5} \\ d_{BC} &= \sqrt{(4-1)^2 + (-3-2)^2} \\ &= \sqrt{9+25} = \sqrt{34} \\ d_{AC} &= \sqrt{(-2-4)^2 + [8-(-3)]^2} \\ &= \sqrt{36+121} = \sqrt{157} \end{aligned}$$

$$d_{AB} + d_{BC} = d_{AC}$$
$$3\sqrt{5} + \sqrt{34} = \sqrt{157} \text{ False}$$

Not collinear

78. $$\begin{aligned} d_{AB} &= \sqrt{[0-(-1)]^2 + (3-5)^2} \\ &= \sqrt{1+4} = \sqrt{5} \\ d_{BC} &= \sqrt{(5-0)^2 + (-13-3)^2} \\ &= \sqrt{25+256} = \sqrt{281} \\ d_{AC} &= \sqrt{(-1-5)^2 + [5-(-13)]^2} \\ &= \sqrt{36+324} = \sqrt{360} = 6\sqrt{10} \end{aligned}$$

$$d_{AB} + d_{BC} = d_{AC}$$
$$\sqrt{5} + \sqrt{281} = 6\sqrt{10} \text{ False}$$

Not collinear

79. The points (x_1, y_1) and (x_2, y_2) define the endpoints of the hypotenuse d of a right triangle. The lengths of the legs of the triangle are $|x_2 - x_1|$ and $|y_2 - y_1|$. Applying the Pythagorean theorem produces $d^2 = |x_2 - x_1|^2 + |y_2 - y_1|^2$, or equivalently $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ for $d \geq 0$.

80. The midpoint formula results in an ordered pair. The *x*-coordinate of the midpoint is the average of the *x*-coordinates of the endpoints. The *y*-coordinate of the midpoint is the average of the *y*-coordinates of the endpoints.

81. To find the *x*-intercept(s), substitute 0 for *y* and solve for *x*. To find the *y*-intercept(s), substitute 0 for *x* and solve for *y*.

82. The graph of the equation represents the set of all solutions to the equation graphed in a rectangular coordinate system.

83. $$\begin{aligned} d &= \sqrt{(4-5)^2 + [6-(-3)]^2 + (-1-2)^2} \\ &= \sqrt{1+81+9} = \sqrt{91} \end{aligned}$$

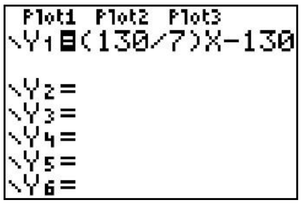
84. $$\begin{aligned} d &= \sqrt{(2-6)^2 + [3-(-4)]^2 + [1-(-1)]^2} \\ &= \sqrt{16+49+4} = \sqrt{69} \end{aligned}$$

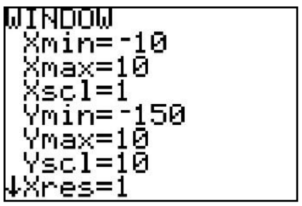
85. $$\begin{aligned} d &= \sqrt{(0-3)^2 + (-5-7)^2 + [1-(-2)]^2} \\ &= \sqrt{9+144+9} = \sqrt{162} = 9\sqrt{2} \end{aligned}$$

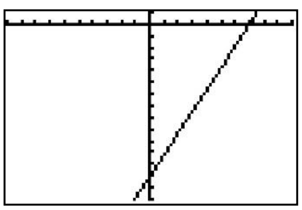
86. $$\begin{aligned} d &= \sqrt{(2-9)^2 + [0-(-5)]^2 + [1-(-3)]^2} \\ &= \sqrt{49+25+16} = \sqrt{90} = 3\sqrt{10} \end{aligned}$$

87. The viewing window is part of the Cartesian plane shown in the display screen of a calculator. The boundaries of the window are often denoted by [Xmin, Xmax, Xscl] by [Ymin, Ymax, Yscl].

88.
$$780x - 42y = 5460$$
$$42y = 780x - 5460$$
$$y = \frac{780x - 5460}{42}$$
$$y = \frac{130}{7}x - 130$$

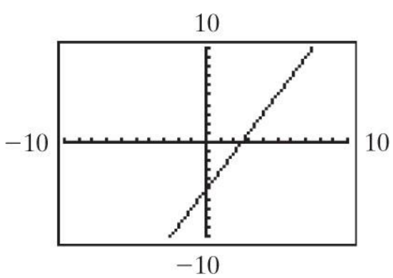




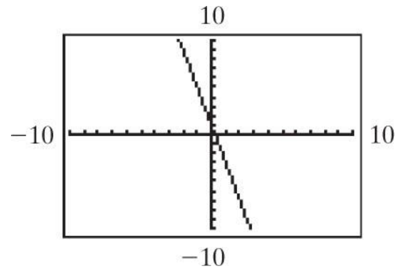


Window d

89.



90.



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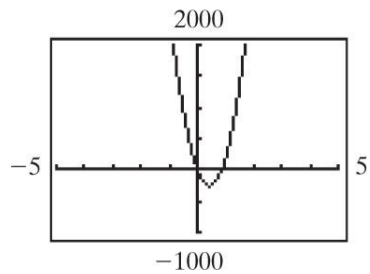
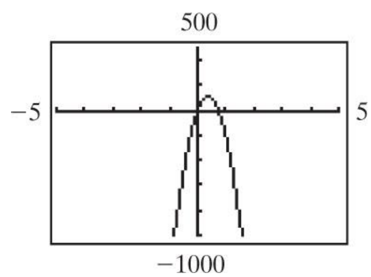
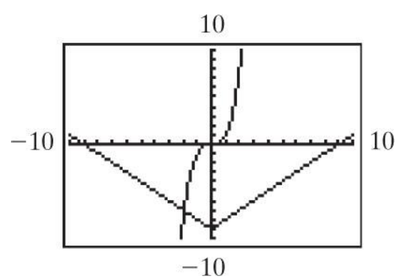


92.



93.



94.