Name: ___________________________________ Date: _____________

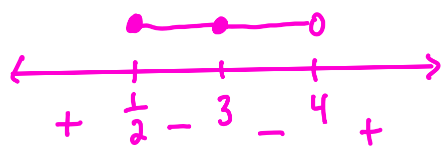
PCH Ms. Loughran

Do Now:

1. Solve and express solution set in interval notation:

$$\frac{(x-3)(2x^2-7x+3)}{(x-4)} \le 0$$

$$\frac{(x-3)^2(2x-1)}{x-4} \le 0$$



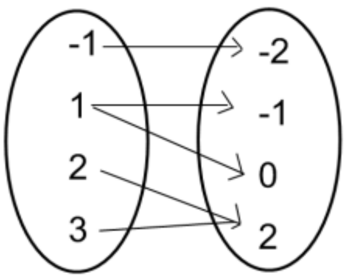
$\left[\frac{1}{2}, 4\right)$

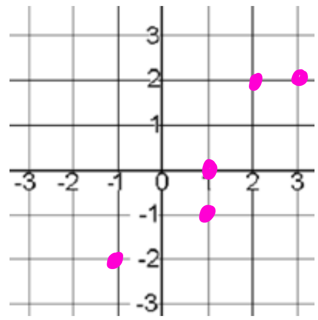
Name:

<u>Practice</u>: Relations & Functions

Use the given form of each relation to complete the other forms. Then determine if the relation is a function.

1] Rewrite the relation given in the mapping diagram as a scatterplot.



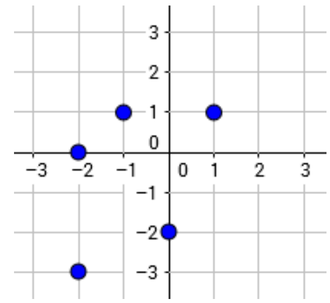


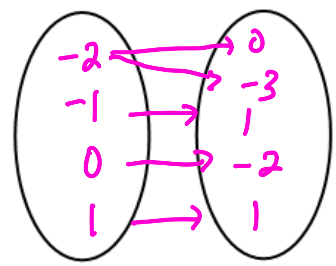
Is the relation also a function?

No, b/c it fails the vertical line test

No, bc there is repetition in the domain

2] Rewrite the relation given in the scatter plot as a mapping diagram.



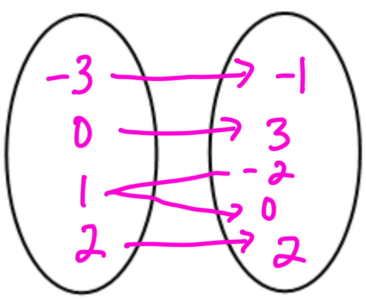


Is the relation also a function?

No for same reasons as 1

3] Rewrite the relation given in the table as a mapping diagram.

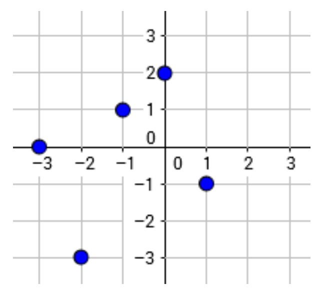
x	y
1	-2
-3	-1
1	0
2	2
0	3



Is the relation also a function?

No for same reasons as 1 and 2

4] Rewrite the relation given in the scatter plot as a **<u>set</u>** of ordered pairs (NOT a table).



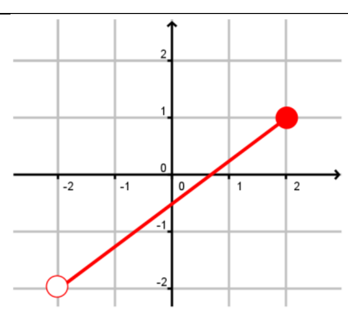
{(0,2), (-1,1), (1,-1), (-3,0), (-2,-3)}

Is the relation also a function?

Yes

Identify the domain and range, then determine if each graph shows a function or a relation only.

5]

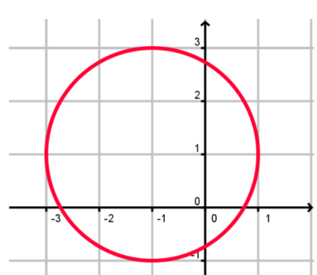


Domain: (-2, 2]

Range: (-2, 1]

Function? Yes

6]

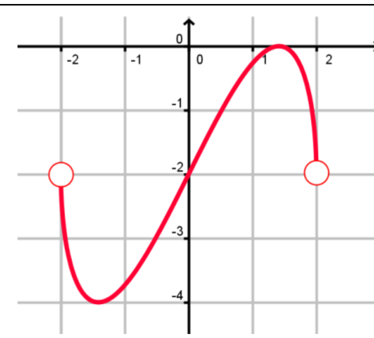


Domain: [-3, 1]

Range: [-1, 3]

Function? No

7]



Domain: (-2, 2)

Range: [-4, 0]

Function? Yes

Identify the domain and range, then evaluate each function for the given value of x.

8] $f = \{(10,7), (-2,4), (5,3), (4,10)\}$

Domain: $\{-2, 4, 5, 10\}$

Range: $\{3, 4, 7, 10\}$

$f(10) =$ 7

9]

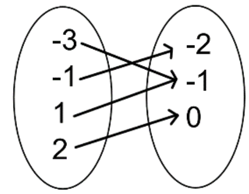
x	y
-3	3
-1	1
0	0
1	1

Domain: $\{-3, -1, 0, 1\}$

Range: $\{0, 1, 3\}$

$f(-1) =$ 1

10]

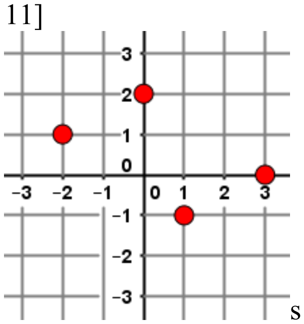


Domain: $\{-3, -1, 1, 2\}$

Range: $\{-2, -1, 0\}$

$f(-3) =$ -1

11]



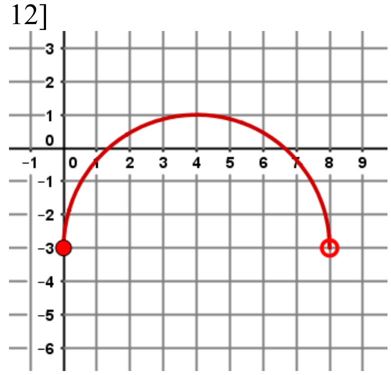
s

Domain: $\{-2, 0, 1, 3\}$

Range: $\{-1, 0, 1, 2\}$

$f(3) =$ 0

12]



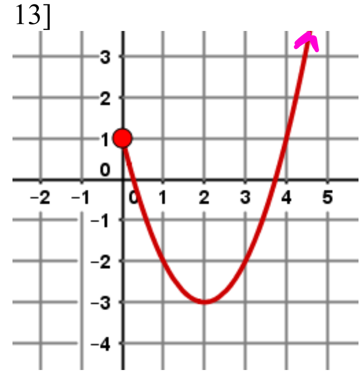
Domain: $[0, 8)$

Range: $[-3, 1]$

$f(0) =$ -3

$f(8) =$ not defined

13]



Domain: $[0, \infty)$

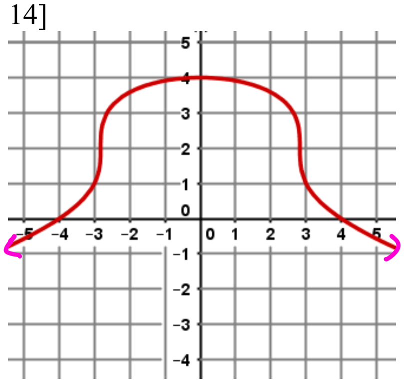
$\{x \mid x \geq 0\}$

Range: $[-3, \infty)$

$\{y \mid y \geq -3\}$

$f(4) =$ 1

14]



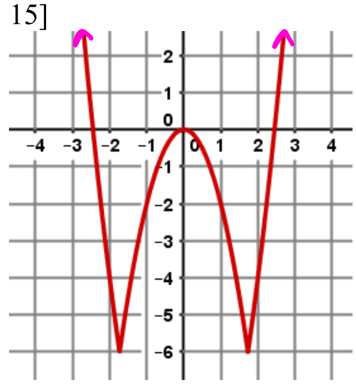
Domain: $(-\infty, \infty)$

$\{x \mid x \in \mathbb{R}\}$

Range: $(-\infty, 4]$

$f(-3) =$ 1

15]

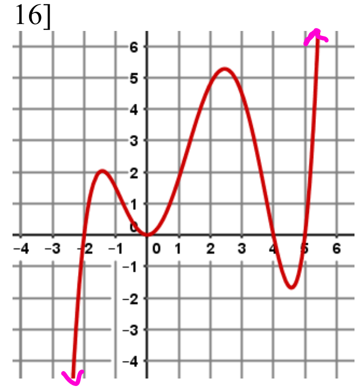


Domain: $(-\infty, \infty)$

Range: $[-6, \infty)$

$f(2) =$ -4

16]



Domain: $(-\infty, \infty)$

Range: $(-\infty, \infty)$

$f(-2) =$ 0

17. If $f(x) = \sqrt{x+4}$, find

(a) $f(-1)$ $= \sqrt{-1+4}$ $= \sqrt{3}$

(b) $f(a)$ $= \sqrt{a+4}$

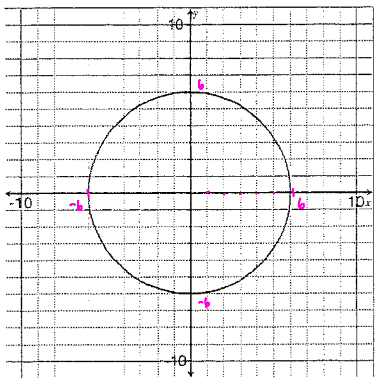
(c) $f(x+h)$ $= \sqrt{x+h+4}$

(d) $f($☺$)$ $= \sqrt{}$☺ $+4$

More Practice

For exercises 1-6. decide whether each graph is the graph of a function. Then determine domain and range.

1.

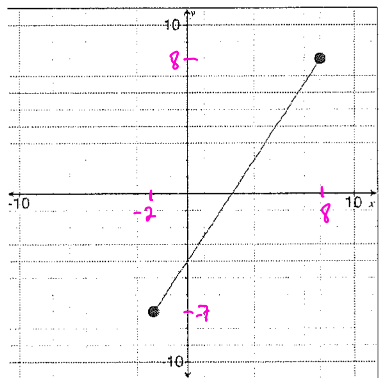


(a) Is it a function? No

(b) Domain: [-6, 6]

(c) Range: [-6, 6]

2.

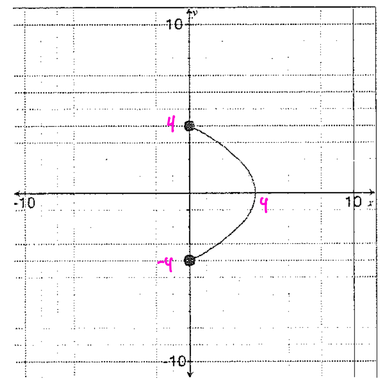


(a) Is it a function? Yes

(b) Domain: [-2, 8]

(c) Range: [-7, 8]

3.

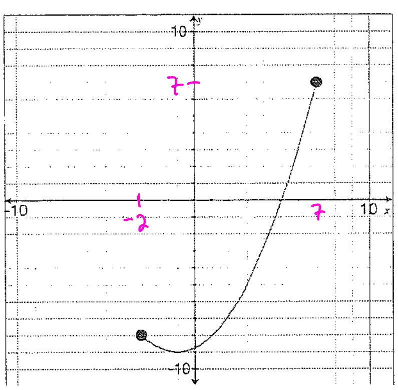


(a) Is it a function? No

(b) Domain: [0, 4]

(c) Range: [-4, 4]

4.

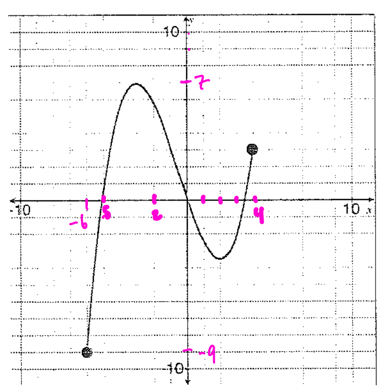


(a) Is it a function? Yes

(b) Domain: [-2, 7]

(c) Range: [-9, 7]

5.

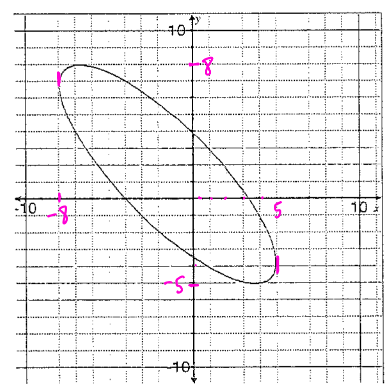


(a) Is it a function? Yes

(b) Domain: [-6, 4]

(c) Range: [-9, 7]

6.



(a) Is it a function? No

(b) Domain: [-8, 5]

(c) Range: [-5, 8]

For exercises 7-9, use each table to determine whether the relation is a function. Then determine the domain and range.

7.

x	2	4	6	8	10
y	1	3	5	7	9

(a) Is it a function? Yes

(b) Domain: $\{2, 4, 6, 8, 10\}$

(c) Range: $\{1, 3, 5, 7, 9\}$

8.

x	2	2	4	4	6
y	-5	0	5	10	15

(a) Is it a function? No

(b) Domain: $\{2, 4, 6\}$

(c) Range: $\{-5, 0, 5, 10, 15\}$

9.

x	1	2	3	4	5
y	-5	-5	5	5	15

(a) Is it a function? Yes

(b) Domain: $\{1, 2, 3, 4, 5\}$

(c) Range: $\{-5, 5, 15\}$

10. If $f(x) = x^2 - 2x + 1$, find

(a) $f(2) = 2^2 - 2(2) + 1 = 1$

(b) $f(\sqrt{5}) = (\sqrt{5})^2 - 2\sqrt{5} + 1 = 6 - 2\sqrt{5}$

(c) $f(-1+\sqrt{2}) = (-1+\sqrt{2})^2 - 2(-1+\sqrt{2}) + 1 = 1 - 2\sqrt{2} + 2 + 2 - 2\sqrt{2} + 1 = 6 - 4\sqrt{2}$

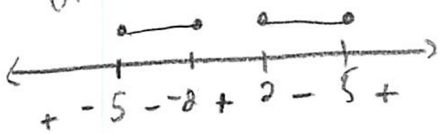
(d) $f(2w+1) = (2w+1)^2 - 2(2w+1) + 1 = 4w^2 + \cancel{4w} + 1 - \cancel{4w} - 2 + 1 = 4w^2$

Homework 10-02

2. $100 - 29x^2 \le -x^4$

$x^4 - 29x^2 + 100 \le 0$

$(x^2 - 25)(x^2 - 4) \le 0$



SB $\{x \mid -5 \le x \le -2 \lor 2 \le x \le 5\}$

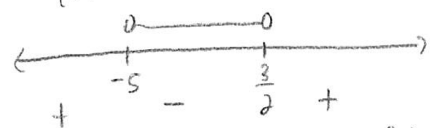
IN: $[-5, -2] \cup [2, 5]$

3. $15 - 2x^2 > 7x$

$-2x^2 - 7x + 15 > 0$

$2x^2 + 7x - 15 < 0$

$(2x - 3)(x + 5) < 0$

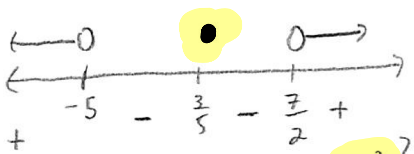


SB: $\{x \mid -5 < x < 3/2\}$ IN: $(-5, \frac{3}{2})$

$(5x-3)^2$

4. $\dfrac{25x^2 - 30x + 9}{2x^2 + 3x - 35} \ge 0$

$(2x - 7)(x + 5)$



SB: $\{x \mid x < -5 \lor x > \frac{7}{2} \lor x = \frac{3}{5}\}$

IN: $(-\infty, -5) \cup \{\frac{3}{5}\} \cup (\frac{7}{2}, \infty)$

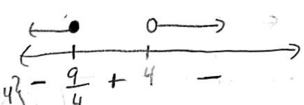
5. $\dfrac{x+3}{4-x} \le 3$

$\dfrac{x+3}{4-x} - 3 \le 0$

$-12 + 3x$

$\dfrac{x+3-3(4-x)}{4-x} \le 0$

$\dfrac{4x-9}{4-x} \le 0$



b) $\{x \mid x \le \frac{9}{4} \lor x > 4\}$

c) $(-\infty, \frac{9}{4}] \cup (4, \infty)$

34. $x^2 + 5x + 6 > 0 \quad \Leftrightarrow \quad (x+3)(x+2) > 0$. The expression on the left of the inequality changes sign where $x = -3$ and $x = -2$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -3)$	$(-3, -2)$	$(-2, \infty)$
Sign of $x+3$	$-$	$+$	$+$
Sign of $x+2$	$-$	$-$	$+$
Sign of $(x+3)(x+2)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x < -3 \text{ or } -2 < x\}$. Interval: $(-\infty, -3) \cup (-2, \infty)$.

Graph: -3 -2

35. $2x^2 + x \geq 1 \quad \Leftrightarrow \quad 2x^2 + x - 1 \geq 0 \quad \Leftrightarrow \quad (x+1)(2x-1) \geq 0$. The expression on the left of the inequality changes sign where $x = -1$ and where $x = \frac{1}{2}$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -1)$	$(-1, \frac{1}{2})$	$(\frac{1}{2}, \infty)$
Sign of $x+1$	$-$	$+$	$+$
Sign of $2x-1$	$-$	$-$	$+$
Sign of $(x+1)(2x-1)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x \leq -1 \text{ or } \frac{1}{2} \leq x\}$. Interval: $(-\infty, -1] \cup [\frac{1}{2}, \infty)$.

Graph: -1 $\frac{1}{2}$

+ − +

36. $x^2 < x + 2 \quad \Leftrightarrow \quad x^2 - x - 2 < 0 \quad \Leftrightarrow \quad (x+1)(x-2) < 0$. The expression on the left of the inequality changes sign when $x = -1$ and $x = 2$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -1)$	$(-1, 2)$	$(2, \infty)$
Sign of $x+1$	$-$	$+$	$+$
Sign of $x-2$	$-$	$-$	$+$
Sign of $(x+1)(x-2)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -1 < x < 2\}$. Interval: $(-1, 2)$.

Graph: -1 2

37. $3x^2 - 3x < 2x^2 + 4 \quad \Leftrightarrow \quad x^2 - 3x - 4 < 0 \quad \Leftrightarrow \quad (x+1)(x-4) < 0$. The expression on the left of the inequality changes sign where $x = -1$ and where $x = 4$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -1)$	$(-1, 4)$	$(4, \infty)$
Sign of $x+1$	$-$	$+$	$+$
Sign of $x-4$	$-$	$-$	$+$
Sign of $(x+1)(x-4)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -1 < x < 4\}$. Interval: $(-1, 4)$.

Graph: -1 4

38. $5x^2 + 3x \geq 3x^2 + 2 \quad \Leftrightarrow \quad 2x^2 + 3x - 2 \geq 0 \quad \Leftrightarrow \quad (2x-1)(x+2) \geq 0$. The expression on the left of the inequality changes sign when $x = \frac{1}{2}$ and $x = -2$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -2)$	$(-2, \frac{1}{2})$	$(\frac{1}{2}, \infty)$
Sign of $2x-1$	$-$	$-$	$+$
Sign of $x+2$	$-$	$+$	$+$
Sign of $(2x-1)(x+2)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x \leq -2 \text{ or } \frac{1}{2} \leq x\}$. Interval: $(-\infty, -2] \cup [\frac{1}{2}, \infty)$.

Graph: -2 $\frac{1}{2}$

39. $x^2 > 3(x+6) \quad \Leftrightarrow \quad x^2 - 3x - 18 > 0 \quad \Leftrightarrow \quad (x+3)(x-6) > 0$. The expression on the left of the inequality changes sign where $x = 6$ and where $x = -3$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -3)$	$(-3, 6)$	$(6, \infty)$
Sign of $x+3$	$-$	$+$	$+$
Sign of $x-6$	$-$	$-$	$+$
Sign of $(x+3)(x-6)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x < -3 \text{ or } 6 < x\}$. Interval: $(-\infty, -3) \cup (6, \infty)$.

Graph: -3 6

40. $x^2 + 2x > 3 \quad \Leftrightarrow \quad x^2 + 2x - 3 > 0 \quad \Leftrightarrow \quad (x+3)(x-1) > 0$. The expression on the left of the inequality changes sign when $x = -3$ and $x = 1$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -3)$	$(-3, 1)$	$(1, \infty)$
Sign of $x+3$	$-$	$+$	$+$
Sign of $x-1$	$-$	$-$	$+$
Sign of $(x+3)(x-1)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x < -3 \text{ or } 1 < x\}$. Interval: $(-\infty, -3) \cup (1, \infty)$.

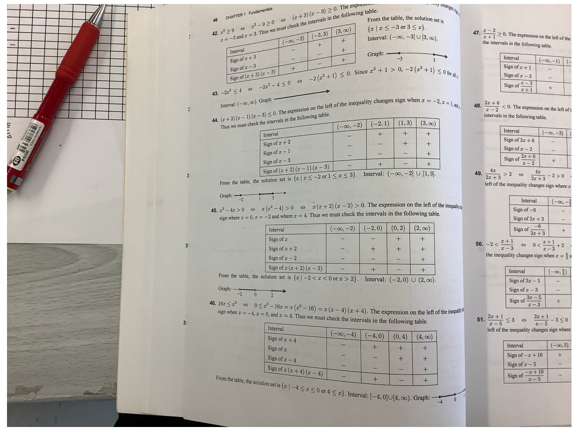
Graph: -3 1

41. $x^2 < 4 \quad \Leftrightarrow \quad x^2 - 4 < 0 \quad \Leftrightarrow \quad (x+2)(x-2) < 0$. The expression on the left of the inequality changes sign where $x = -2$ and where $x = 2$. Thus we must check the intervals in the following table.

Interval	$(-\infty, -2)$	$(-2, 2)$	$(2, \infty)$
Sign of $x+2$	$-$	$+$	$+$
Sign of $x-2$	$-$	$-$	$+$
Sign of $(x+2)(x-2)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -2 < x < 2\}$. Interval: $(-2, 2)$.

Graph: -2 2



46 CHAPTER 1 Fundamentals

42. $x^2 \geq 9 \Leftrightarrow x^2 - 9 \geq 0 \Leftrightarrow (x+3)(x-3) \geq 0$. The expression ... $x = -3$ and $x = 3$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-3)$	$(-3,3)$	$(3,\infty)$
Sign of $x+3$	$-$	$+$	$+$
Sign of $x-3$	$-$	$-$	$+$
Sign of $(x+3)(x-3)$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x \leq -3 \text{ or } 3 \leq x\}$. Interval: $(-\infty,-3] \cup [3,\infty)$.

Graph: -3 3

43. $-2x^2 \leq 4 \Leftrightarrow -2x^2 - 4 \leq 0 \Leftrightarrow -2(x^2+1) \leq 0$. Since $x^2+1>0$, $-2(x^2+1) \leq 0$ for all x. Interval: $(-\infty,\infty)$. Graph:

44. $(x+2)(x-1)(x-3) \leq 0$. The expression on the left of the inequality changes sign when $x=-2$, $x=1$, and $x=3$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,1)$	$(1,3)$	$(3,\infty)$
Sign of $x+2$	$-$	$+$	$+$	$+$
Sign of $x-1$	$-$	$-$	$+$	$+$
Sign of $x-3$	$-$	$-$	$-$	$+$
Sign of $(x+2)(x-1)(x-3)$	$-$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x \leq -2 \text{ or } 1 \leq x \leq 3\}$. Interval: $(-\infty,-2] \cup [1,3]$.

Graph: -2 1 3

45. $x^3 - 4x > 0 \Leftrightarrow x(x^2-4) > 0 \Leftrightarrow x(x+2)(x-2) > 0$. The expression on the left of the inequality changes sign where $x=0$, $x=-2$ and where $x=4$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,0)$	$(0,2)$	$(2,\infty)$
Sign of x	$-$	$-$	$+$	$+$
Sign of $x+2$	$-$	$+$	$+$	$+$
Sign of $x-2$	$-$	$-$	$-$	$+$
Sign of $x(x+2)(x-2)$	$-$	$+$	$-$	$+$

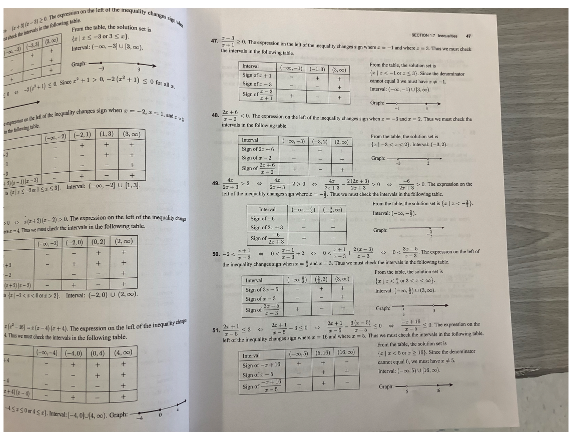
From the table, the solution set is $\{x \mid -2 < x < 0 \text{ or } x > 2\}$. Interval: $(-2,0) \cup (2,\infty)$.

Graph: -2 0 2

46. $16x \leq x^3 \Leftrightarrow 0 \leq x^3 - 16x = x(x^2-16) = x(x-4)(x+4)$. The expression on the left of the inequality changes sign when $x=-4$, $x=0$, and $x=4$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-4)$	$(-4,0)$	$(0,4)$	$(4,\infty)$
Sign of $x+4$	$-$	$+$	$+$	$+$
Sign of x	$-$	$-$	$+$	$+$
Sign of $x-4$	$-$	$-$	$-$	$+$
Sign of $x(x+4)(x-4)$	$-$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -4 \leq x \leq 0 \text{ or } 4 \leq x\}$. Interval: $[-4,0] \cup [4,\infty)$. Graph: -4 0



SECTION 1.7 Inequalities 47

47. $\frac{x-3}{x+1} \geq 0$. The expression on the left of the inequality changes sign where $x=-1$ and where $x=3$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-1)$	$(-1,3)$	$(3,\infty)$
Sign of $x+1$	$-$	$+$	$+$
Sign of $x-3$	$-$	$-$	$+$
Sign of $\frac{x-3}{x+1}$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x < -1 \text{ or } x \leq 3\}$. Since the denominator cannot equal 0 we must have $x \neq -1$. Interval: $(-\infty,-1) \cup [3,\infty)$.

Graph: -1 3

48. $\frac{2x+6}{x-2} < 0$. The expression on the left of the inequality changes sign when $x=-3$ and $x=2$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-3)$	$(-3,2)$	$(2,\infty)$
Sign of $2x+6$	$-$	$+$	$+$
Sign of $x-2$	$-$	$-$	$+$
Sign of $\frac{2x+6}{x-2}$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -3 < x < 2\}$. Interval: $(-3,2)$.

Graph: -3 2

49. $\frac{4x}{2x+3} > 2 \Leftrightarrow \frac{4x}{2x+3} - 2 > 0 \Leftrightarrow \frac{4x}{2x+3} - \frac{2(2x+3)}{2x+3} > 0 \Leftrightarrow \frac{-6}{2x+3} > 0$. The expression on the left of the inequality changes sign where $x = -\frac{3}{2}$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-\frac{3}{2})$	$(-\frac{3}{2},\infty)$
Sign of -6	$-$	$-$
Sign of $2x+3$	$-$	$+$
Sign of $\frac{-6}{2x+3}$	$+$	$-$

From the table, the solution set is $\{x \mid x < -\frac{3}{2}\}$. Interval: $(-\infty,-\frac{3}{2})$.

Graph: $-\frac{3}{2}$

50. $-2 < \frac{x+1}{x-3} \Leftrightarrow 0 < \frac{x+1}{x-3} + 2 \Leftrightarrow 0 < \frac{x+1}{x-3} + \frac{2(x-3)}{x-3} \Leftrightarrow 0 < \frac{3x-5}{x-3}$. The expression on the left of the inequality changes sign when $x = \frac{5}{3}$ and $x = 3$. Thus we must check the intervals in the following table.

Interval	$(-\infty,\frac{5}{3})$	$(\frac{5}{3},3)$	$(3,\infty)$
Sign of $3x-5$	$-$	$+$	$+$
Sign of $x-3$	$-$	$-$	$+$
Sign of $\frac{3x-5}{x-3}$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x < \frac{5}{3} \text{ or } 3 < x < \infty\}$. Interval: $(-\infty,\frac{5}{3}) \cup (3,\infty)$.

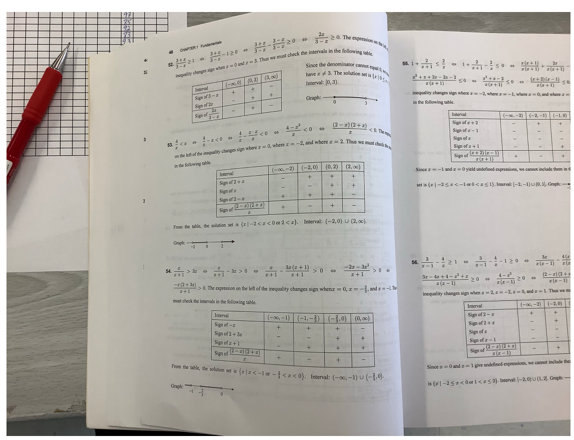
Graph: $\frac{5}{3}$ 3

51. $\frac{2x+1}{x-5} \leq 3 \Leftrightarrow \frac{2x+1}{x-5} - 3 \leq 0 \Leftrightarrow \frac{2x+1}{x-5} - \frac{3(x-5)}{x-5} \leq 0 \Leftrightarrow \frac{-x+16}{x-5} \leq 0$. The expression on the left of the inequality changes sign where $x=16$ and where $x=5$. Thus we must check the intervals in the following table.

Interval	$(-\infty,5)$	$(5,16)$	$(16,\infty)$
Sign of $-x+16$	$+$	$+$	$-$
Sign of $x-5$	$-$	$+$	$+$
Sign of $\frac{-x+16}{x-5}$	$-$	$+$	$-$

From the table, the solution set is $\{x \mid x < 5 \text{ or } x \geq 16\}$. Since the denominator cannot equal 0, we must have $x \neq 5$. Interval: $(-\infty,5) \cup [16,\infty)$.

Graph: 5 16



55. $1+\frac{2}{x+1}\le\frac{2}{x} \Leftrightarrow 1+\frac{2}{x+1}-\frac{2}{x}\le 0 \Leftrightarrow \frac{x(x+1)}{x(x+1)}+\frac{2x}{x(x+1)}-\frac{2(x+1)}{x(x+1)}\le 0 \Leftrightarrow \frac{x^2+x+2x-2x-2}{x(x+1)}\le 0 \Leftrightarrow \frac{x^2+x-2}{x(x+1)}\le 0 \Leftrightarrow \frac{(x+2)(x-1)}{x(x+1)}\le 0$. The expression on the left of the inequality changes sign where $x=-2$, where $x=-1$, where $x=0$, and where $x=1$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,-1)$	$(-1,0)$	$(0,1)$	$(1,\infty)$
Sign of $x+2$	$-$	$+$	$+$	$+$	$+$
Sign of $x-1$	$-$	$-$	$-$	$-$	$+$
Sign of x	$-$	$-$	$-$	$+$	$+$
Sign of $x+1$	$-$	$-$	$+$	$+$	$+$
Sign of $\frac{(x+2)(x-1)}{x(x+1)}$	$+$	$-$	$+$	$-$	$+$

Since $x=-1$ and $x=0$ yield undefined expressions, we cannot include them in the solution. From the table, the solution set is $\{x \mid -2\le x<-1 \text{ or } 0<x\le 1\}$. Interval: $[-2,-1)\cup(0,1]$. Graph: $-2 \quad -1 \quad 0 \quad 1$

56. $\frac{3}{x-1}-\frac{4}{x}\ge 1 \Leftrightarrow \frac{3}{x-1}-\frac{4}{x}-1\ge 0 \Leftrightarrow \frac{3x}{x(x-1)}-\frac{4(x-1)}{x(x-1)}-\frac{x(x-1)}{x(x-1)}\ge 0 \Leftrightarrow \frac{3x-4x+4-x^2+x}{x(x-1)}\ge 0 \Leftrightarrow \frac{4-x^2}{x(x-1)}\ge 0 \Leftrightarrow \frac{(2-x)(2+x)}{x(x-1)}\ge 0$. The expression on the left of the inequality changes sign when $x=2$, $x=-2$, $x=0$, and $x=1$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,0)$	$(0,1)$	$(1,2)$	$(2,\infty)$
Sign of $2-x$	$+$	$+$	$+$	$+$	$-$
Sign of $2+x$	$-$	$+$	$+$	$+$	$+$
Sign of x	$-$	$-$	$+$	$+$	$+$
Sign of $x-1$	$-$	$-$	$-$	$+$	$+$
Sign of $\frac{(2-x)(2+x)}{x(x-1)}$	$-$	$+$	$-$	$+$	$-$

Since $x=0$ and $x=1$ give undefined expressions, we cannot include them in the solution. From the table, the solution set is $\{x \mid -2\le x<0 \text{ or } 1<x\le 2\}$. Interval: $[-2,0)\cup(1,2]$. Graph: $-2 \quad 0 \quad 1 \quad 2$

From the table, the solution set is $\{x \mid -2\le x<0 \text{ or } 1<x\le 3\}$. The points $x=0$ and $x=1$ are excluded from the solution set because they make the denominator zero. Interval: $[-2,0)\cup(1,3]$. Graph: $-2 \quad 0 \quad 1 \quad 3$

58. $\frac{x}{2}\ge\frac{5}{x+1}+4 \Leftrightarrow \frac{x}{2}-\frac{5}{x+1}-4\ge 0 \Leftrightarrow \frac{x(x+1)}{2(x+1)}-\frac{2\cdot 5}{2(x+1)}-\frac{4(2)(x+1)}{2(x+1)}\ge 0 \Leftrightarrow \frac{x^2+x-10-8x-8}{2(x+1)}\ge 0 \Leftrightarrow \frac{x^2-7x-18}{2(x+1)}\ge 0 \Leftrightarrow \frac{(x-9)(x+2)}{2(x+1)}\ge 0$. The expression on the left of the inequality changes sign when $x=9$, $x=-2$, and $x=-1$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,-1)$	$(-1,9)$	$(9,\infty)$
Sign of $x-9$	$-$	$-$	$-$	$+$
Sign of $x+2$	$-$	$+$	$+$	$+$
Sign of $x+1$	$-$	$-$	$+$	$+$
Sign of $\frac{(x-9)(x+2)}{2(x+1)}$	$-$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid -2\le x<-1 \text{ or } 9\le x\}$. The point $x=-1$ is excluded from the solution set because it makes the expression undefined. Interval: $[-2,-1)\cup[9,\infty)$. Graph: $-2 \quad -1 \quad 9$

59. $\frac{x+2}{x+3}<\frac{x-1}{x-2} \Leftrightarrow \frac{x+2}{x+3}-\frac{x-1}{x-2}<0 \Leftrightarrow \frac{(x+2)(x-2)}{(x+3)(x-2)}-\frac{(x-1)(x+3)}{(x-2)(x+3)}<0 \Leftrightarrow \frac{x^2-4-x^2-2x+3}{(x+3)(x-2)}<0 \Leftrightarrow \frac{-2x-1}{(x+3)(x-2)}<0$. The expression on the left of the inequality changes sign where $x=-\frac{1}{2}$, where $x=-3$, and where $x=2$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-3)$	$(-3,-\frac{1}{2})$	$(-\frac{1}{2},2)$	$(2,\infty)$
Sign of $-2x-1$	$+$	$+$	$-$	$-$
Sign of $x+3$	$-$	$+$	$+$	$+$
Sign of $x-2$	$-$	$-$	$-$	$+$
Sign of $\frac{-2x-1}{(x+3)(x-2)}$	$+$	$-$	$+$	$-$

From the table, the solution set is $\{x \mid -3<x<-\frac{1}{2} \text{ or } 2<x\}$. Interval: $(-3,-\frac{1}{2})\cup(2,\infty)$.

Graph: $-3 \quad -\frac{1}{2} \quad 2$

60. $\frac{1}{x+1}+\frac{1}{x+2}\le 0 \Leftrightarrow \frac{x+2}{(x+1)(x+2)}+\frac{x+1}{(x+1)(x+2)}\le 0 \Leftrightarrow \frac{x+2+x+1}{(x+1)(x+2)}\le 0 \Leftrightarrow \frac{2x+3}{(x+1)(x+2)}\le 0$. The expression on the left of the inequality changes sign where $x=-\frac{3}{2}$, $x=-1$, and $x=-2$. Thus we must check the intervals in the following table.

Interval	$(-\infty,-2)$	$(-2,-\frac{3}{2})$	$(-\frac{3}{2},-1)$	$(-1,\infty)$
Sign of $2x+3$	$-$	$-$	$+$	$+$
Sign of $x+1$	$-$	$-$	$-$	$+$
Sign of $x+2$	$-$	$+$	$+$	$+$
Sign of $\frac{2x+3}{(x+1)(x+2)}$	$-$	$+$	$-$	$+$

From the table, the solution set is $\{x \mid x<-2 \text{ or } -\frac{3}{2}\le x<-1\}$. The points $x=-2$ and $x=-1$ are excluded from the solution because the expression is undefined at those values. Interval: $(-\infty,-2)\cup[-\frac{3}{2},-1)$.

Graph: $-2 \quad -\frac{3}{2} \quad -1$