

Chapter Six
Section one

Definitions:

- **Natural Numbers (Counting Numbers)**

{1, 2, 3, 4, ...} is the set of natural numbers.

- **Whole Numbers**

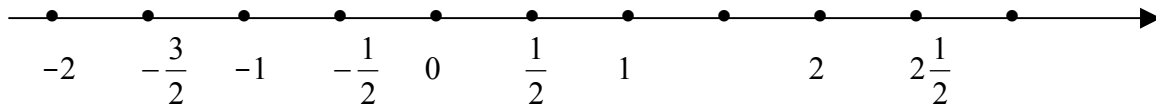
{0, 1, 2, 3, 4, ...} is the set of whole numbers.

- **Integers**

{..., -3, -2, -1, 0, 1, 2, 3, ...} is the set of integers.

- **Rational Numbers**

All numbers that can be written as $\frac{p}{q}$ form, where p, q are integers and $q \neq 0$.



$$0.1111\dots = \frac{1}{9}, \quad 2 = \frac{1}{2}, \quad 3.27 = \frac{327}{100}, \quad 2\frac{1}{2} = \frac{2 \times 2 + 1}{2} = \frac{5}{2}$$

$$-0.252525\dots = -\frac{25}{99} = \frac{-25}{99}, \quad 0.122222\dots = \frac{12-1}{90} = \frac{11}{90}$$

$$0.45676767\dots = \frac{4567 - 45}{9900} = \frac{4522}{9900} = \frac{2261}{4950}$$

- **Irrational Numbers**

All numbers that are on the number line, but not rational.

0.1236139823..... (no repeated, no terminated decimal numbers)

The number $\sqrt{2}$ is **unable** to be written as $\frac{p}{q}$. This number is less than 2 and greater

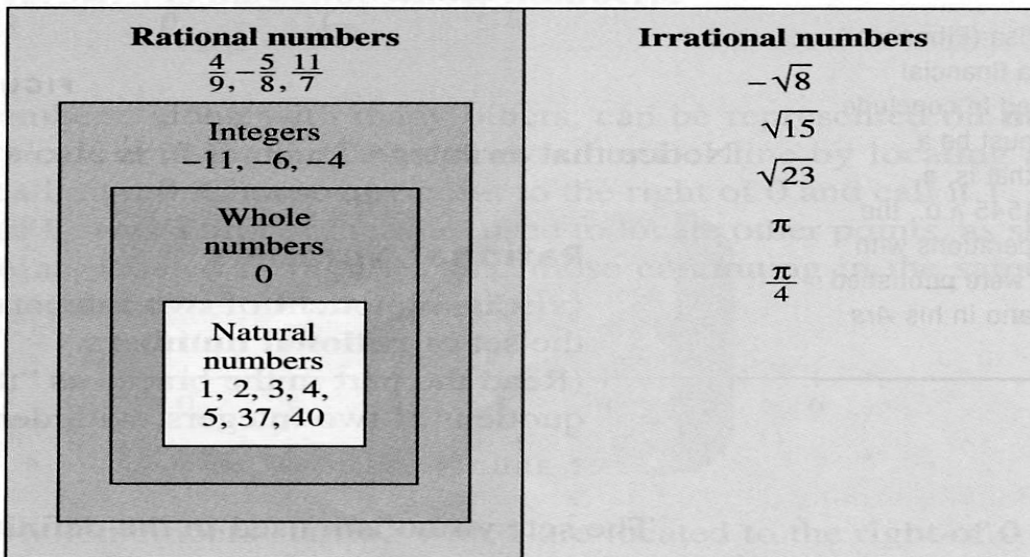
than 1 since $1 = \sqrt{1} < \sqrt{2} < \sqrt{4} = 2$.

- **Real Numbers**

All numbers that can be represented by a point on the number line.

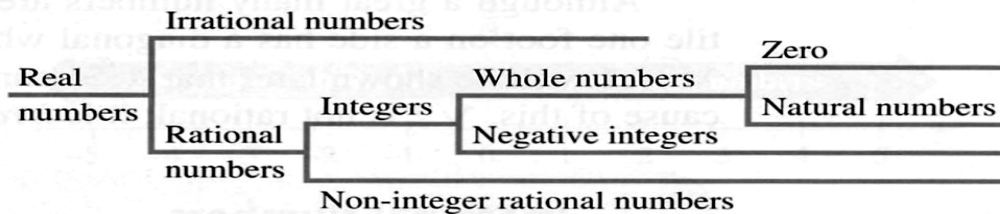
Any two real numbers can be compared.

That is, for any real numbers, a, b , $a < b$ or $a = b$ or $a > b$.



All numbers shown are real numbers.

(a)



(b)

Example:

List the numbers in the set $\{-5, -\frac{2}{3}, 0, \sqrt{2}, \frac{13}{4}, 5, 5.8, 4.\bar{9}, 3.21367823\dots, \pi\}$ that belong to each of the following sets of numbers.

1. Natural numbers 5
2. Whole numbers 0 and 5
3. Integers -5, 0, and 5
4. Rational numbers $-5, -\frac{2}{3}, 0, \frac{13}{4}, 5, 5.8, 4.\bar{9}$
5. Irrational numbers $\sqrt{2}, 3.21367823\dots$, and π
6. Real numbers $-5, -\frac{2}{3}, 0, \sqrt{2}, \frac{13}{4}, 5, 5.8, 4.\bar{9}, 3.21367823\dots, \pi$

Double Negative Rule:

For any real number x , $-(-x) = x$

Absolute Value of a real number:

The distance between 0 and the number on the number line

Examples, absolute value of 6, $|6| = 6$.

Absolute value of -3 , $|-3| = 3$

$-|8| = -8$, $-|-8| = -8$

Exercises:

11. List all numbers from the set

$$\left\{-9, -\sqrt{7}, -1\frac{1}{4}, -\frac{3}{5}, 0, \sqrt{5}, 3, 5, 9, 7\right\}$$

that are

- a) natural numbers; b) whole numbers; c) integers;
d) rational numbers; e) irrational numbers; f) real numbers.

12. List all numbers from the set

$$\left\{-5.3, -5, -\sqrt{3}, -1, -\frac{1}{9}, 0, 1.2, 1.8, 3, \sqrt{11}\right\}$$

that are

- a) natural numbers; b) whole numbers; c) integers;
d) rational numbers; e) irrational numbers; f) real numbers.

Graph each group of numbers on a number line.

25. $-2, -6, -4, 3, 4$

26. $-5, -3, -2, 0, 4$

27. $\frac{1}{4}, 2\frac{1}{2}, -3\frac{4}{5}, -4, -1\frac{5}{8}$

28. $5\frac{1}{4}, 4\frac{5}{9}, -2\frac{1}{3}, 0, -3\frac{2}{5}$

Select the lesser of the two given numbers.

41. $-12, -4$

42. $-9, -14$

43. $-8, -1$

44. $-15, -16$

45. $3, |-4|$

46. $5, |-2|$

47. $|-3|, |-4|$

48. $|-8|, |-9|$

49. $-|-6|, -|-4|$

50. $-|-2|, -|-3|$

51. $|5 - 3|, |6 - 2|$

52. $|7 - 2|, |8 - 1|$

Decide whether each statement is true or false.

53. $6 > -(-2)$

54. $-8 > -(-2)$

55. $-4 \leq -(-5)$

56. $-6 \leq -(-3)$

57. $|-6| < |-9|$

58. $|-12| < |-20|$

59. $-|8| > |-9|$

60. $-|12| > |-15|$

61. $-|-5| \geq -|-9|$

62. $-|-12| \leq -|-15|$

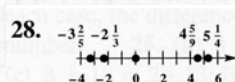
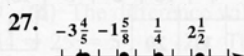
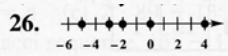
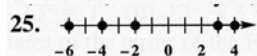
63. $|6 - 5| \geq |6 - 2|$

64. $|13 - 8| \leq |7 - 4|$

Answers:

11. (a) 3, 7 (b) 0, 3, 7 (c) $-9, 0, 3, 7$ (d) $-9, -1\frac{1}{4}, -\frac{3}{5}, 0, 3,$

$5, 9, 7$ (e) $-\sqrt{7}, \sqrt{5}$ (f) All are real numbers. 12. (a) 3 (b) 0, 3 (c) $-5, -1, 0, 3$ (d) $-5.3, -5, -1, -\frac{1}{9}, 0,$



41. -12 42. -14 43. -8 44. -16 45. 3

46. $|-2|$ or 2 47. $|-3|$ or 3 48. $|-8|$ or 8 49. $-|-6|$ or -6 50. $-|-3|$ or -3 51. $|5 - 3|$ or 2

52. $|7 - 2|$ or 5 53. true 54. false 55. true 56. true 57. true 58. true 59. false 60. false

61. true 62. false 63. false 64. false