# Ch 2

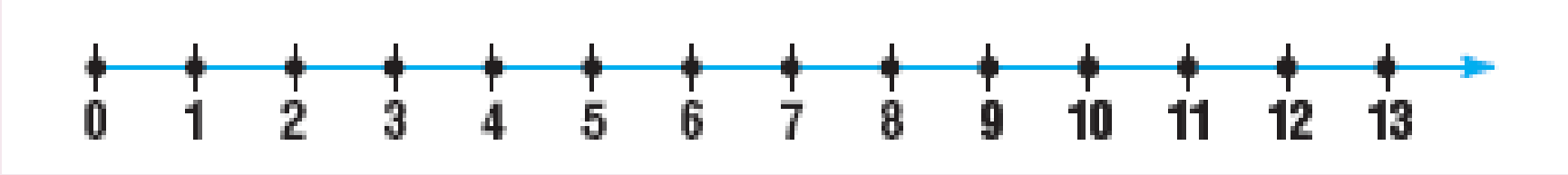
## SEGMENT MEASURE AND COORDINATE GRAPHING

# 2-1

## REAL NUMBERS AND NUMBER LINES

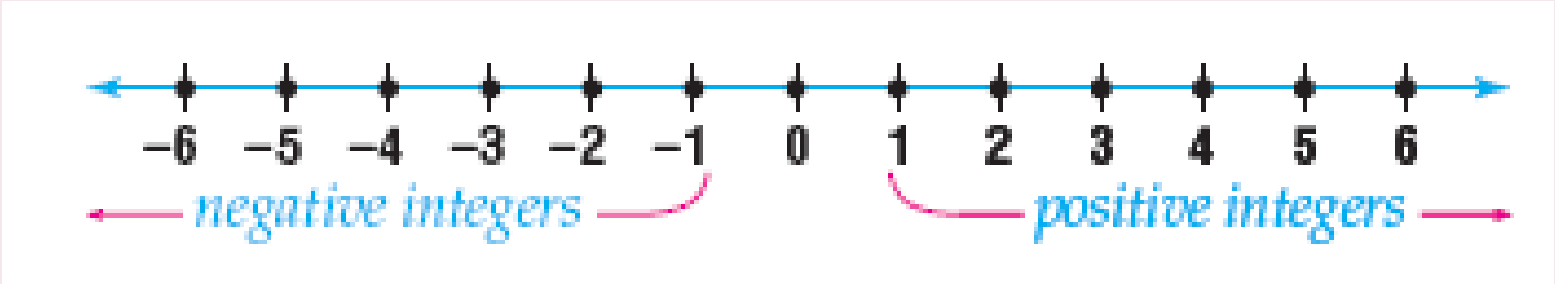
# Whole Numbers

- Whole Numbers –
  - The set of numbers that include zero and the natural, or counting, numbers



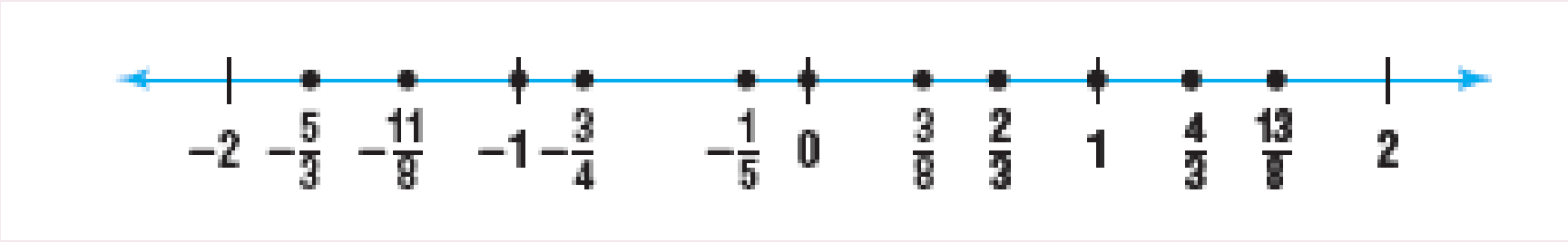
# Integers

- Integers –
  - The set of numbers that include zero and positive and negative whole numbers



# Rational Numbers

- Rational Number –
  - Any number that can be written as a fraction



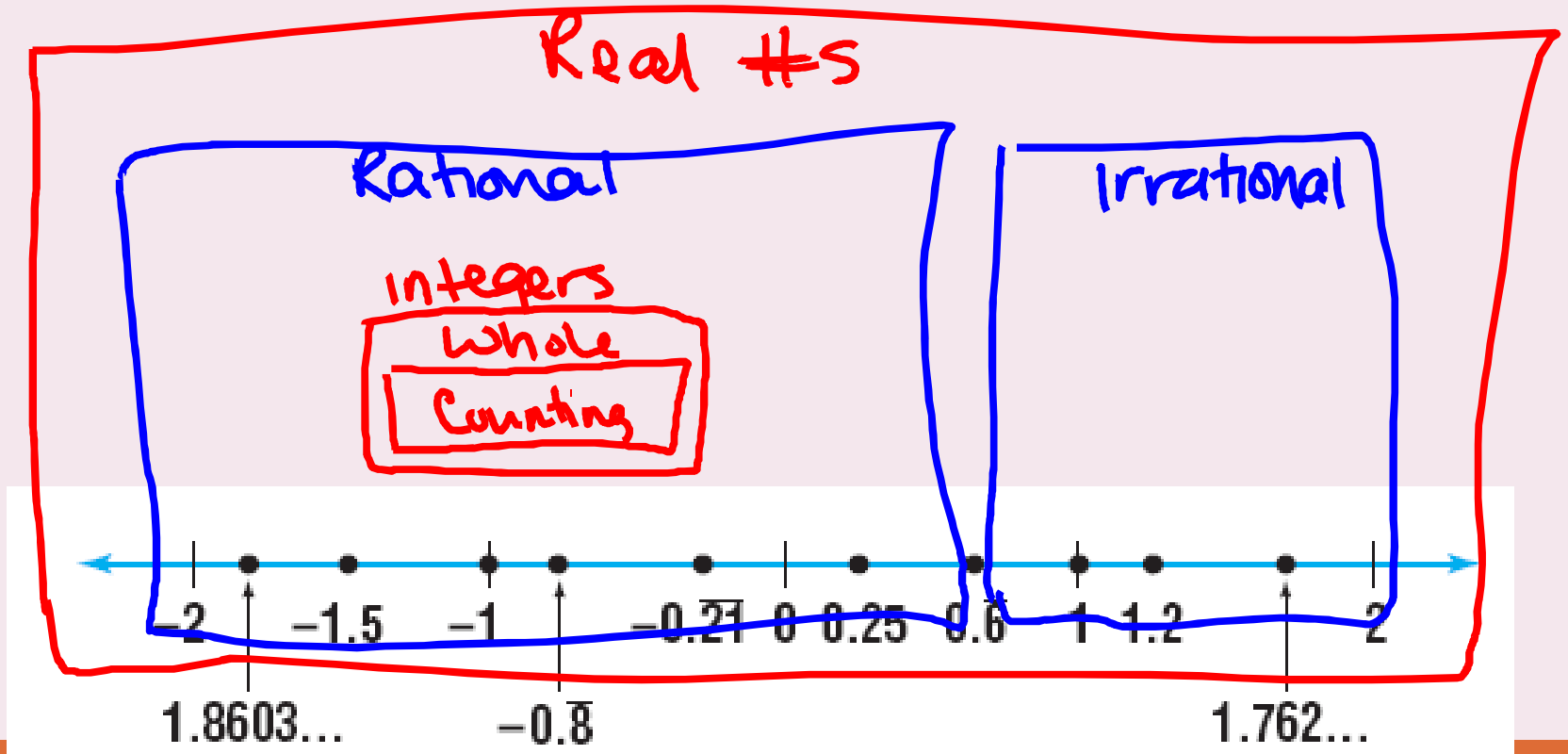

  - Rational numbers can also be written as Decimal
    - Terminating decimals –
      - Stop or terminate at a specific place value $\frac{1}{4} = .25$
    - Nonterminating decimals –
      - Never stop $\frac{1}{9} = .\overline{1}$

# Irrational Numbers

- Irrational Numbers –
  - Decimals that are nonterminating and do not repeat
  - Examples: $\pi$ $\sqrt{2}$

# Real Numbers

- Real Numbers –
  - Group that includes rational and irrational numbers



# Number Line Postulate

| | |
|---|---|
| **Postulate 2–1 Number Line Postulate** | Each real number corresponds to exactly one point on a number line. Each point on a number line corresponds to exactly one real number. |

# Example

- For each situation, write a real number with ten digits to the right of the decimal point.
  - A rational number between 6 and 8 with a 2-digit repeating pattern.

7.5353535353

  - An irrational number greater than 5.

6.1823526324

# Number Line

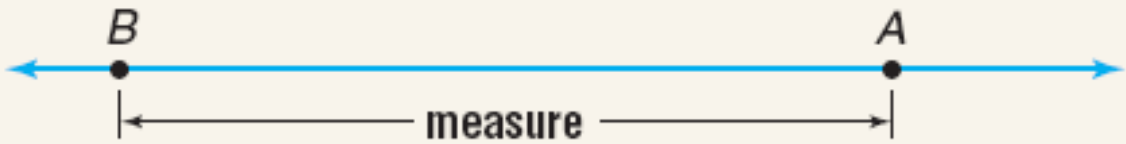
- Coordinate –
  - The number that corresponds to a point on a number line
- Origin –
  - The point with a coordinate of zero

# Postulates

**Postulate 2–2 Distance Postulate**

**Words:** For any two points on a line and a given unit of measure, there is a unique positive real number called the **measure** of the distance between the points.

**Model:**

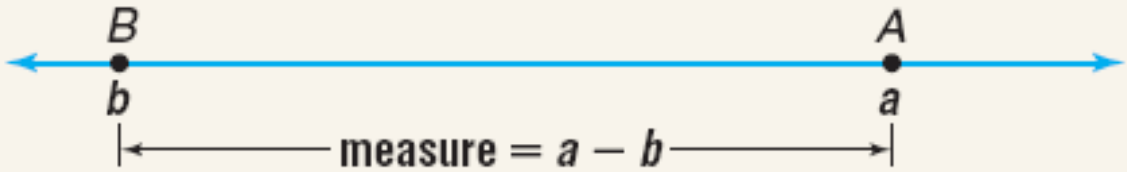



- The distance between two points is denoted by those endpoints – A to B is AB

**Postulate 2–3 Ruler Postulate**

**Words:** Points on a line are paired with the real numbers, and the measure of the distance between two points is the positive difference of the corresponding numbers.

**Model:**



# Absolute Value

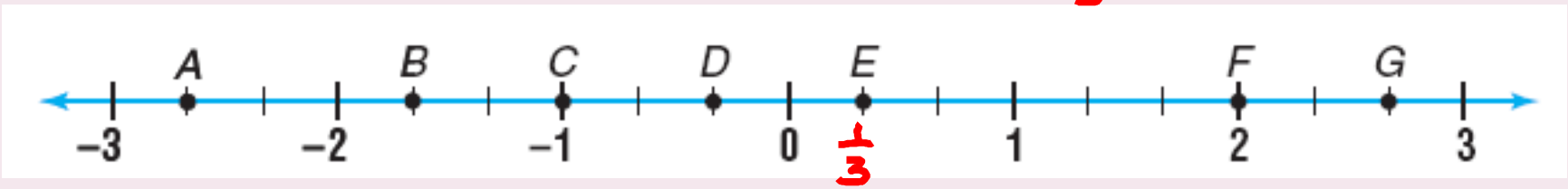
- Absolute Value –
  - The distance a number is from zero on a number line
  - Example:
    - |5| = 5
    - |-5| = 5
    - |11 – 3| = 8
    - |3 – 11| = 8

      |-8|

# Example

- Use the number line to find CE.

$1\frac{1}{3}$




$\frac{1}{3}$

  - Find CF 3
  - Find AD $2\frac{1}{3}$
  - Find BG $4\frac{1}{3}$

# Example

- Erin traveled on I-85 from Durham, NC to Charlotte. The Durham entrance to I-85 that she used is at the 173-mile marker, and the Charlotte exit she used at the 39-mile marker. How far did Erin travel on I-85?

$173 - 39 = 134$ mi

# Assignment

- P53: 1, 4 – 9, 12, 14, 16, 17 – 37

# 2-2

## SEGMENTS AND PROPERTIES OF REAL NUMBER

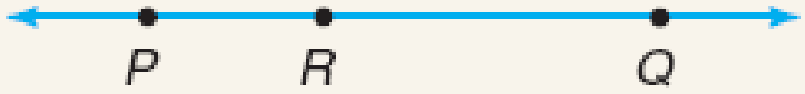
# Betweenness

- If three points are on a number line, then one has to be between the other two!

**Definition of Betweenness**

**Words:** Point $R$ is between points $P$ and $Q$ *if and only if* $R$, $P$, and $Q$ are collinear and $PR + RQ = PQ$.

**Model:**



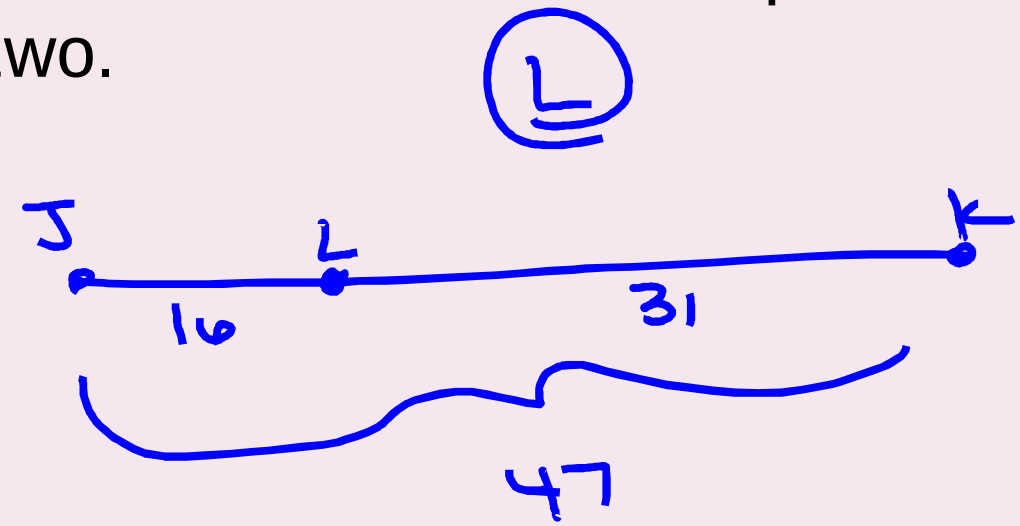

**Symbols:** $PR + RQ = PQ$

- If and only if means that both the statement and the converse are true. Called biconditional statements.

IFF

# Example

- Points K, L, and J are collinear. If KL = 31, JL = 16, and JK = 47, determine which point is between the other two.



# Properties of Real Numbers

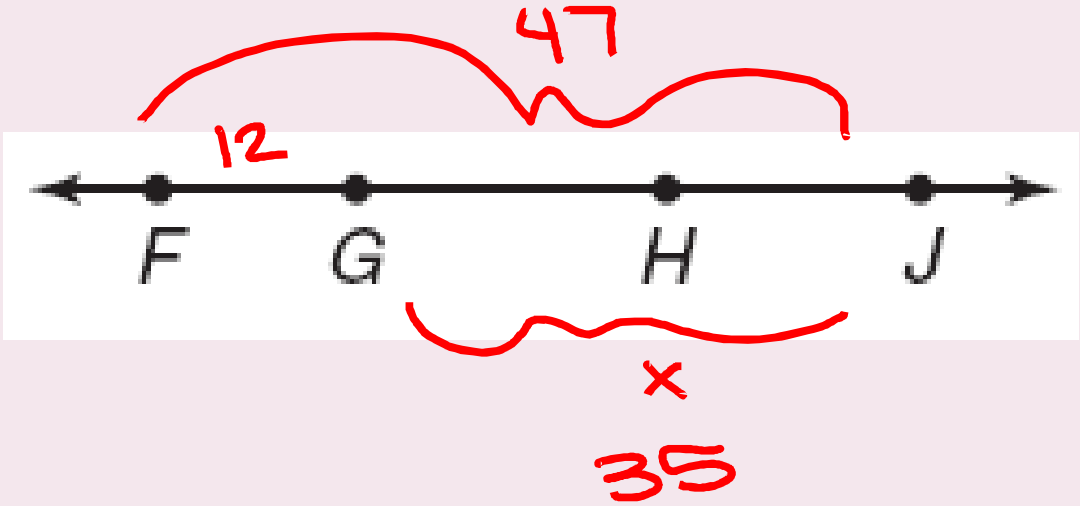
| | |
|---|---|
| **Reflexive Property** | For any number $a$, $a = a$. |
| **Symmetric Property** | For any numbers $a$ and $b$, if $a = b$, then $b = a$. |
| **Transitive Property** | For any numbers $a$, $b$ and $c$, if $a = b$ and $b = c$, then $a = c$. |
| **Addition and Subtraction Properties** | For any numbers $a$, $b$, and $c$, if $a = b$, then $a + c = b + c$ and $a - c = b - c$. |
| **Multiplication and Division Properties** | For any numbers $a$, $b$, and $c$, if $a = b$, then $a \cdot c = b \cdot c$, and if $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$. |
| **Substitution Property** | For any numbers $a$ and $b$, if $a = b$, then $a$ may be replaced by $b$ in any equation. |

# Equation

- Equation –
  - A statement that includes an equal sign

# Example

- If FG = 12 and FJ = 47, find GJ.



# Measurements

- Measurements –
  - Consist of a number called a measure and a unit of measure
    - Measure – number of units
    - Unit of measure – standard quantity measured against

# Example

- Use a ruler to draw a segment 8 centimeters long. Then find the length of the segment in inches.

# Precision

- Precision –
  - Precision of a measurement depends on the smallest unit used to make the measurement
  - Greatest Possible Error –
    - Half the smallest unit used to make the measurement
  - Percent Error –
    - Comparison of greatest possible error with measurement itself

# Precision

$$\text{percent of error} = \frac{\text{greatest possible error}}{\text{measurement}} \times 100\%$$

| Centimeters | Inches |
|---|---|
| measurement: 5.7 cm or 57 mm | measurement: $2\frac{1}{4}$ (or 2.25) in. |
| precision: 1 mm | precision: $\frac{1}{16}$ in. |
| greatest possible error: $\frac{1}{2}$ mm | greatest possible error: $\frac{1}{32}$ in. |
| percent of error: $\frac{.5}{57} \times 100 = .877\%$ | percent of error: $\frac{.03125}{2.25} \times 100 = 1.389\%$ |

# Assignment

- P59: 1 – 34, 36, 37
  - All measurements in inches should be in mixed number form

# 2-3

## CONGRUENT SEGMENTS

# Congruent Segments

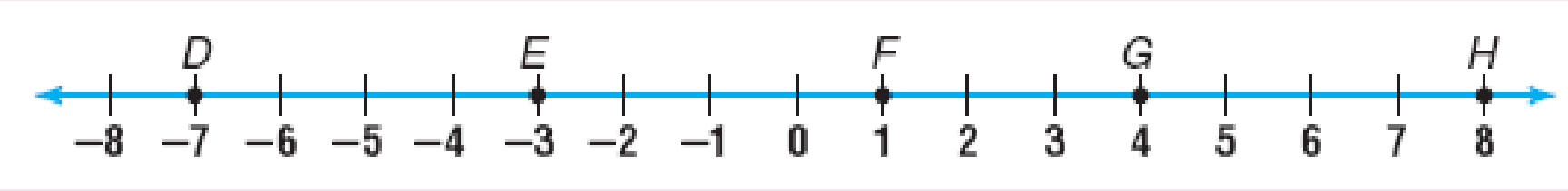
**Definition of Congruent Segments**

Two segments are congruent if and only if they have the same length.

- Symbol: $\cong$

# Example

- Use the number line to determine whether each statement is true or false.




$\overline{DE} \cong \overline{GH}$

true

$\overline{EF} \cong \overline{FG}$

false

# Theorems

- Theorems –
  - Statements that can be justified by using logical reasoning

| Theorem | Words | Symbols |
|---|---|---|
| 2–1 | Congruence of segments is reflexive. | $\overline{AB} \cong \overline{AB}$ |
| 2–2 | Congruence of segments is symmetric. | If $\overline{AB} \cong \overline{CD}$, then $\overline{CD} \cong \overline{AB}$. |
| 2–3 | Congruence of segments is transitive. | If $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$. |

# Example

- Determine whether the statement is true or false. Explain your reasoning.

$\overline{CD}$ is congruent to $\overline{CD}$ thm 2-1

true, Congruence in reflexive

$If\ \overline{AB} \cong \overline{CD}\ and\ \overline{DC} \cong \overline{EF}, then\ \overline{AB} \cong \overline{EF}$

true, congruence is transitive

# Midpoint

**Definition of Midpoint**

**Words:** A point $M$ is the midpoint of a segment $\overline{ST}$ if and only if $M$ is between $S$ and $T$ and $SM = MT$.

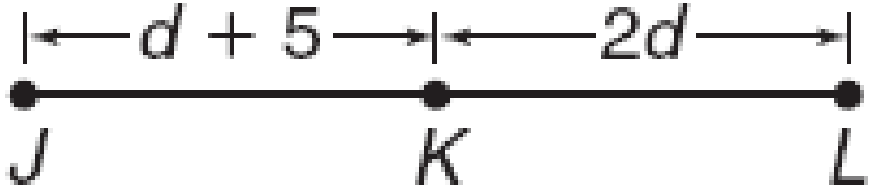
**Model:**


**Symbols:** $SM = MT$

- The midpoint of a segment separates the segment into two congruent segments

# Example

- In the figure, K is the midpoint of $\overline{JL}$. Find the value of d.




$d + 5 = 2d$

$-d \quad -d$

$5 = d$

# Bisect

- Bisect –
  - To separate into two congruent parts
  - A midpoint bisects a segment

- Hands-On Activity P65
  - Including three “Try These”

# Assignment

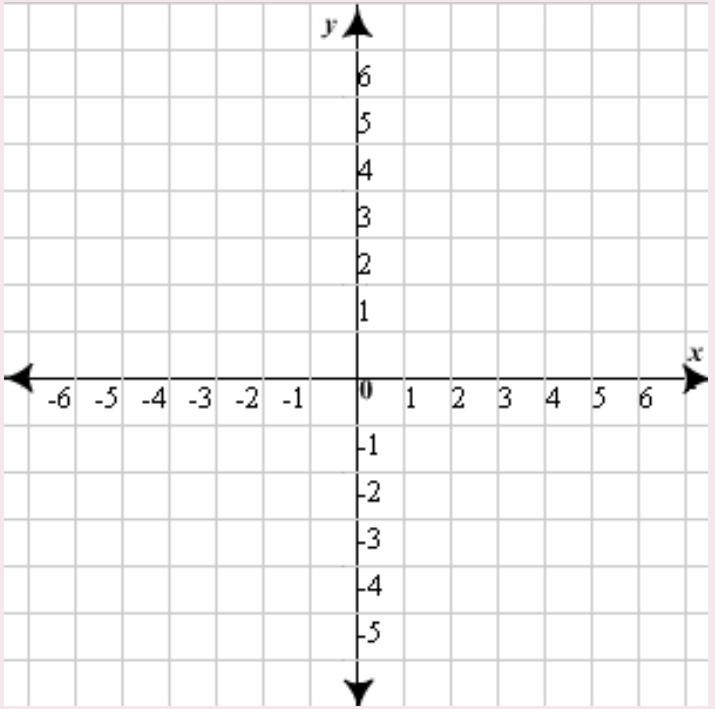
- P65: 1, 3 – 22 (#20 and #22 need compass), 24 – 28
  - #22 – find midpoints by using a compass

# 2-4

## THE COORDINATE PLANE

# Coordinate Plane

- Coordinate Plane –
  - Plane with grid to locate points
- Quadrants –
  - Four regions plane is separated into
- Ordered Pair –
  - Coordinates of a point
    - Locates a point on the grid
- Graph –
  - The point where an ordered pair is plotted (or graphed)



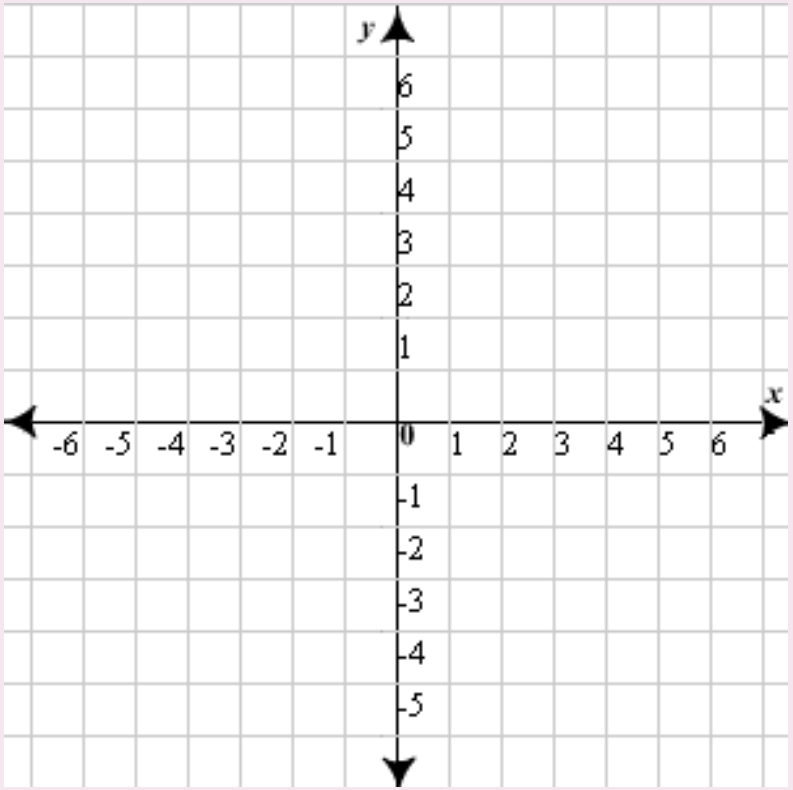
# Coordinate Plane

| Postulate 2–4 Completeness Property for Points in the Plane | Each point in a coordinate plane corresponds to exactly one ordered pair of real numbers. Each ordered pair corresponds to exactly one point in a coordinate plane. |
|---|---|

- X-Coordinate –
  - Tells number of units to the left or right of origin a point is.
- Y-Coordinate –
  - Tells number of units above or below the origin a point is.

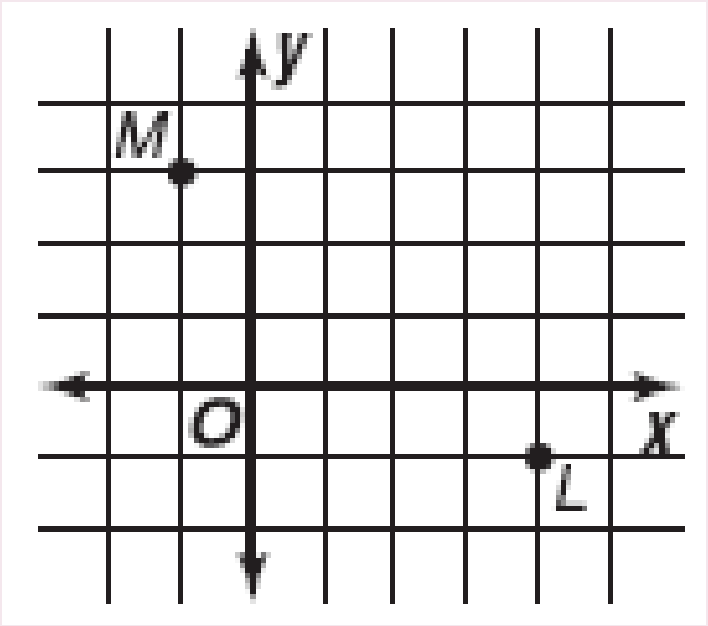
# Example

- Graph point K at (-4, 1).



# Example

- Name the coordinates of points L and M.



# Hands-on Geometry

- P69
- Complete all tasks

# Theorem 2-4

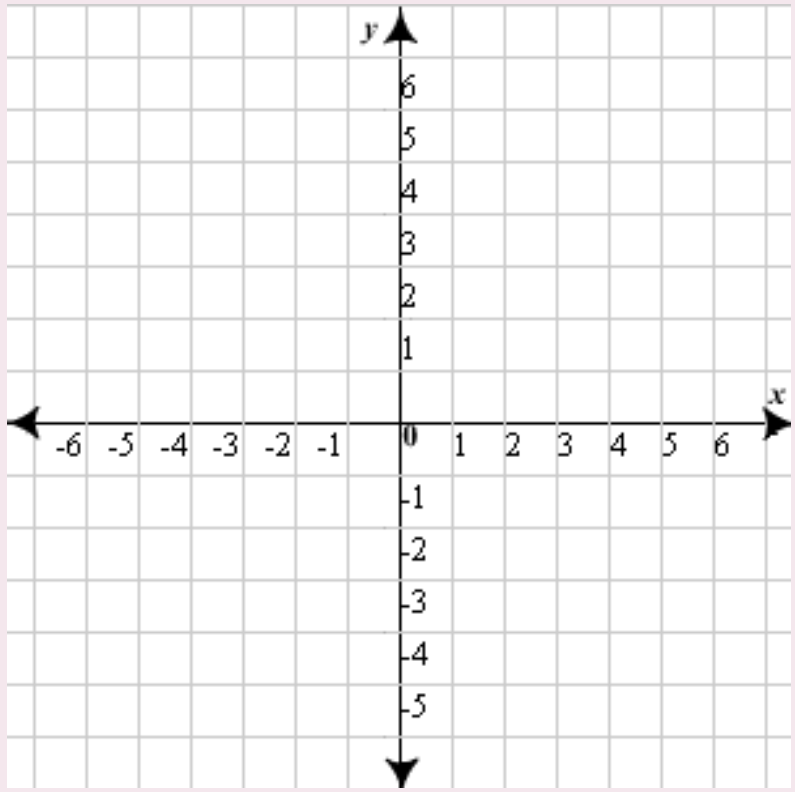
**Theorem 2–4**

If $a$ and $b$ are real numbers, a vertical line contains all points $(x, y)$ such that $x = a$, and a horizontal line contains all points $(x, y)$ such that $y = b$.

# Example

- Graph y = -2.

- Graph x = 3.



# Assignment

- P71: 2 – 34, 36 – 44
  - #35 is extra credit

# 2-5

## MIDPOINTS

# Theorems

**Theorem 2–5 Midpoint Formula for a Number Line**

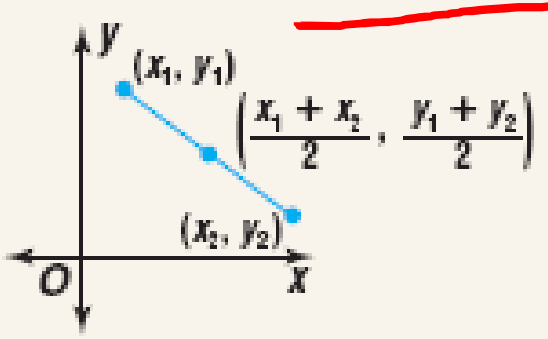
**Words:** On a number line, the coordinate of the midpoint of a segment whose endpoints have coordinates $a$ and $b$ is $\frac{a+b}{2}$.

**Model:**


**Theorem 2–6 Midpoint Formula for a Coordinate Plane**

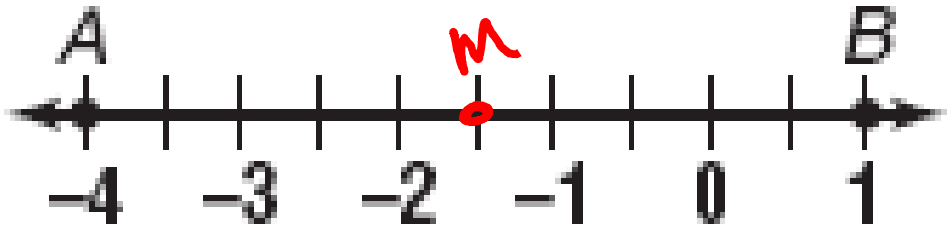
**Words:** On a coordinate plane, the coordinates of the midpoint of a segment whose endpoints have coordinates $(x_1, y_1)$ and $(x_2, y_2)$ are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$.

**Model:**



# Example

- Find the coordinates of the midpoint of $\overline{AB}$




$$\frac{A+B}{2} = \frac{-4+1}{2} = \frac{-3}{2} \text{ or } -1\frac{1}{2}$$

# Example

- Find the coordinates of D, the midpoint of $\overline{CE}$, given endpoints C(2, 1) and E(16, 8).

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

$$\left(\frac{2+16}{2}, \frac{1+8}{2}\right)$$

$$\left(9, \frac{9}{2}\right)$$

# Example

(8, -7)

- Suppose L(2, -5) is the midpoint of $\overline{KM}$ and the coordinates of K are (-4, -3). Find the coordinates of M.

$$\text{mdpt} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$(2,-5) = \left(\frac{-4+x_2}{2}, \frac{-3+y_2}{2}\right)$$

$$2 \cdot 2 = \frac{-4+x_2}{2} \cdot 2 \qquad 2 \cdot -5 = \frac{-3+y_2}{2} \cdot 2$$

$$4 = -4 + x_2 \qquad -10 = -3 + y_2$$
$$+4 \quad +4 \qquad +3 \quad +3$$
$$8 = x_2 \qquad -7 = y_2$$

# Assignment

- P79: 1 – 30, 32, 34, 36 – 42

# Review

- P82: 1 – 36, 38
- P85: 1 – 20