

I. Radicals, Rationals and Irrationals

1. Circle the numbers below that represent RATIONAL numbers.

$\frac{4}{7}$

$3.4$

$0$

$\sqrt{5}$

$\frac{\pi}{6}$

$0.\overline{78}$

$\frac{\sqrt{81}}{10}$

$\sqrt[3]{12}$

The area of a circle if the radius is 5.

2. Calculate. No calculator needed.

a.  $-2\sqrt{64}$

b.  $\sqrt[3]{-64}$

c.  $\sqrt{-9}$

d.  $\frac{\sqrt{25}}{\sqrt{4}}$

e.  $5\sqrt[4]{16}$

3. Write in simple radical form.

a.  $\sqrt{45}$

b.  $\sqrt{648}$

c.  $5\sqrt{3000}$

II. Midpoint, Distance, Parallel and Perpendicular Lines

4. Use the points  $A(2, 3)$ ,  $B(8, 7)$ , and  $C(6, -3)$ , to answer the questions below.

a. Find the midpoint of $\overline{AB}$ .	b. Find the length of $\overline{BC}$ in simple radical form.
c. Determine if $\triangle ABC$ is a right triangle	d. Find the equation of a line that is parallel to $\overline{AB}$ and passes through the point C.

5. In  $\triangle ABC$ ,  $A = (2, 3)$ ,  $B = (12, 5)$ , and  $C = (9, 8)$ . The median of a triangle is drawn from the vertex to the MIDPOINT of the opposite side.

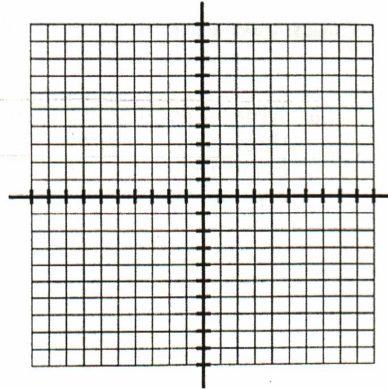
a. Sketch a picture of the triangle in the space below.	b. Find the length of the median from C to $\overline{AB}$ .
c. Find the equation of the perpendicular bisector of $\overline{AB}$ .	d. Find the equation of the altitude (height) from vertex C to the side $\overline{AB}$ .

6. Find the equations of the lines requested.
- a. Find the equation of the line that is parallel to  $y = 5x + 4$  and passes through the point  $(-2, -3)$ . Write your answer in slope-intercept form ( $y = mx + b$ ).
- b. Find the equation of the line that is perpendicular to  $2x - 3y = 9$  and passes through the origin. Write your equation in slope intercept form.
- c. Find the equation of the line that is perpendicular to the line  $x = 5$  and passes through the point  $(-5, 6)$ .
7. What does the value of  $b$  need to be so that the lines  $\begin{cases} y = 2x + 10 \\ 4x + by = 12 \end{cases}$  are parallel?
8. Are the points  $(2, 4)$ ,  $(5, 13)$  and  $(26, 76)$  collinear (do they lie on the same line)?
9. Find the coordinates of the point that is one-third ( $1/3$ ) of the way from  $(-5, 0)$  to  $(7, 8)$ .

### III. Transformations

10. The coordinates of  $\triangle CAT$  are  $C = (-1, 2)$ ,  $A = (3, 2)$ , and  $T = (0, 3)$ .

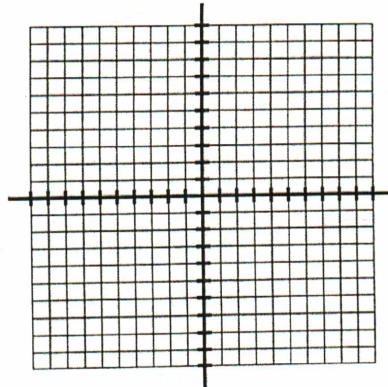
- Graph  $\triangle CAT$ .
- Determine the coordinates of  $\triangle CAT$  after the transformation given below.  
 $(x, y) \rightarrow (x - 2, y + 3)$



- Graph the image from b, and describe the transformation in words.

11. The coordinates of  $\triangle DOG$  are  $D = (-2, -1)$ ,  $O = (-3, -2)$ , and  $G = (-1, -3)$ .

- Graph  $\triangle DOG$ .
- Determine the points of and graph  $\triangle DOG$  after the transformation  $(x, y) \rightarrow (-2x, y)$ .



- Describe the transformation in words. Is it the same figure?

- Determine a rule for a transformation that would rotate the figure entirely into Quadrant I. Write the rule below, graph the new figure, and state the coordinates below.

12. A line segment has coordinates given by  $K(-4, 10)$  and  $O(6, 0)$ .

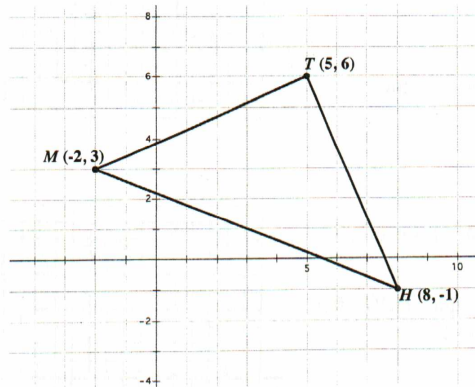
a. What are the coordinates of  $\overline{KO}$  after a translation up 6 and left 2?

b. What are the coordinates of  $\overline{KO}$  after a rotation of 270 degrees around the origin?

c. Write the new coordinates  $\overline{KO}$  after a reflection in the line  $y = -x$ .

d. What are the coordinates of  $\overline{KO}$  after a rotation of 90° around the origin and a reflection in the y-axis?

6. Write the equation of the **altitude** of triangle HMT from H to MT.  
(Remember: an **altitude** is a segment drawn from a vertex of a triangle to the line containing the opposite side ... so that it is **perpendicular** to the line containing the opposite side. - Ch.4 of Textbook)



7. Give the coordinates of HMT under each of the following transformations:
- Reflection over  $x - axis$
  - Reflection over  $y = x$
  - Rotation of  $180^\circ$  about the origin
  - Reflection over  $y - axis$
  - Rotation of  $270^\circ$  about the origin
  - Reflection over  $y = -x$
  - Rotation of  $90^\circ$  about the origin

8. Determine the rule to rotate a figure  $90^\circ$  about the point  $(-5, -3)$ .
9. For each of the following, answer the questions:
- What is the effect of each of the following transformations on a figure?
  - Is this a rigid transformation? Explain why or why not.
- a)  $(x, y) \rightarrow (x + 3, y - 4)$
- b)  $(x, y) \rightarrow (x, 2y)$

### Things to Keep in Mind

**Midpoint:** Average the x's and Average the y's  $\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

**Slope:**  $\frac{y_2 - y_1}{x_2 - x_1}$  Parallel lines have the same slope.  
Perpendicular lines have opposite

**Distance:** Think Pythagorean Theorem!!  $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

**Equations of Lines:**  $y = mx + b$   $y - y_1 = m(x - x_1)$

#### Translations

To Translate horizontally by "a" and vertically by "b":  $(x,y) \rightarrow (x + a, y + b)$

#### Reflections

To reflect in the x-axis:  $(x,y) \rightarrow (x, -y)$   
To reflect in the y-axis:  $(x,y) \rightarrow (-x, y)$   
To reflect in the line  $y = x$ :  $(x,y) \rightarrow (y, x)$   
To reflect in the line  $y = -x$ :  $(x,y) \rightarrow (-y, -x)$

#### Rotations about the Origin

To rotate 90° (counterclockwise)  $(x,y) \rightarrow (-y, x)$   
For 180° and 270° simply apply the rule for 90° multiple times to get:  
To rotate 180° (counterclockwise)  $(x,y) \rightarrow (-x, -y)$   
To rotate 270° (counterclockwise)  $(x,y) \rightarrow (y, -x)$

**Triangle** - a polygon with three sides

**Scalene Triangle** - a triangle with no congruent sides

**Isosceles Triangle** - a triangle with at least two congruent sides

**Equilateral Triangle** - a triangle with exactly three congruent sides

**Right Triangle** - a triangle with a right angle

**Obtuse Triangle** - a triangle with an obtuse angle (greater than 90 degrees and less than 180 degrees)

**Acute Triangle** - a triangle with all acute angles (less than 90 degrees)

**Trapezoid** - a quadrilateral with at least two parallel sides

**Isosceles Trapezoid** - a trapezoid with pairs of congruent base angles

**Kite** - a quadrilateral with two pairs of congruent adjacent sides

**Parallelogram** - a trapezoid with two pairs of parallel sides

**Rhombus** - a parallelogram with all sides congruent

**Rectangle** - a parallelogram with at least one right angle (why do we only need one?)

**Square** - a rectangle with all sides congruent

**I. Radicals, Rationals and Irrationals**

1. Circle the numbers below that represent RATIONAL numbers.

$\frac{4}{7}$

3.4

0

$\sqrt{5}$

$\frac{\pi}{6}$

0.78

$\frac{\sqrt{81}}{10}$

$\sqrt[3]{12}$

The area of a circle if the radius is 5.

2. Calculate. No calculator needed.

a. $-2\sqrt{64}$  -16	b. $\sqrt[3]{-64}$  -4	c. $\sqrt{-9}$  np not real #	d. $\frac{\sqrt{25}}{\sqrt{4}}$  $\frac{5}{2}$	e. $5\sqrt[4]{16}$  5.2 10
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3. Write in simple radical form.

a. $\sqrt{45}$  $3\sqrt{5}$	b. $\sqrt{648}$  $  \begin{array}{l}  2 \swarrow 324 \\  2 \swarrow 162 \\  2 \swarrow 81 \\  9 \cdot 9 \\  \hline  18\sqrt{2}  \end{array}  $	c. $5\sqrt{3000}$  $  \begin{array}{l}  100 \swarrow 3000 \\  2 \swarrow 1500 \\  \hline  50\sqrt{30}  \end{array}  $
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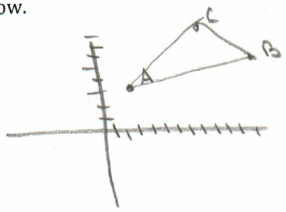


II. Midpoint, Distance, Parallel and Perpendicular Lines

4. Use the points A(2, 3), B(8, 7), and C(6, -3), to answer the questions below.

<p>a. Find the midpoint of <math>\overline{AB}</math>.</p> $M_{\overline{AB}} = \left( \frac{2+8}{2}, \frac{3+7}{2} \right)$ $(5, 5)$	<p>b. Find the length of <math>\overline{BC}</math> in simple radical form.</p> $BC = \sqrt{(8-6)^2 + (7-(-3))^2}$ $= \sqrt{2^2 + 10^2}$ $= \sqrt{104}$ $= 2\sqrt{26}$
<p>c. Determine if <math>\triangle ABC</math> is a right triangle</p> $m_{\overline{AB}} = \frac{7-3}{8-2} = \frac{4}{6} = \frac{2}{3} \checkmark$ $m_{\overline{BC}} = \frac{7-(-3)}{8-6} = \frac{10}{2} = 5$ $m_{\overline{AC}} = \frac{3-(-3)}{2-6} = \frac{6}{-4} = -\frac{3}{2} \checkmark$ $m_{\overline{AB}} \cdot m_{\overline{AC}} = \frac{2}{3} \cdot -\frac{3}{2} = -1$ <p><math>\therefore \overline{AB} \perp \overline{AC}</math> <math>\therefore \angle BAC</math></p>	<p>d. Find the equation of a line that is parallel to <math>\overline{AB}</math> and passes through the point C.</p> $m = \frac{2}{3} \quad (6, -3)$ $y + 3 = \frac{2}{3}(x - 6)$ $y + 3 = \frac{2}{3}x - 4$ $y = \frac{2}{3}x - 7$

5. In  $\triangle ABC$ , A = (2, 3), B = (12, 5), and C = (9, 8). The median of a triangle is drawn from the vertex to the MIDPOINT of the opposite side.

<p>a. Sketch a picture of the triangle in the space below.</p> 	<p>b. Find the length of the median from C to <math>\overline{AB}</math>.</p> $M_{\overline{AB}} = \left( \frac{2+12}{2}, \frac{3+5}{2} \right)$ $= (7, 4)$ <p>C (9, 8)</p> $d = \sqrt{(9-7)^2 + (8-4)^2} = \sqrt{4+16} = \sqrt{20} = 2\sqrt{5}$
<p>c. Find the equation of the perpendicular bisector of <math>\overline{AB}</math>.</p> $m_{\overline{AB}} = \frac{5-3}{12-2} = \frac{2}{10} = \frac{1}{5}$ $m_{\perp} = -5 \quad \text{Center } (7, 4)$ $y - 4 = -5(x - 7)$ $y = -5x + 39$	<p>d. Find the equation of the altitude (height) from vertex C to the side <math>\overline{AB}</math>.</p> $m_{\overline{AB}} = \frac{5-3}{12-2} = \frac{2}{10} = \frac{1}{5}$ $m_{\perp} = -5$ $y - 8 = -5(x - 9)$ $y - 8 = -5x + 45$

6. Find the equations of the lines requested.  
 a. Find the equation of the line that is parallel to  $y = 5x + 4$  and passes through the point  $(-2, -3)$ . Write your answer in slope-intercept form ( $y = mx + b$ ).

11 lines  $\rightarrow$  same slope  
 $y + 3 = 5(x + 2)$   
 $y + 3 = 5x + 10$   
 $y = 5x + 7$

- b. Find the equation of the line that is perpendicular to  $2x - 3y = 9$  and passes through the origin. Write your equation in slope intercept form.

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

$-\frac{2}{3}y = -\frac{2}{3}x + \frac{9}{3}$   
 $y = \frac{2}{3}x - 3$

- c. Find the equation of the line that is perpendicular to the line  $x = 5$  and passes through the point  $(-5, 6)$ .

$y = 6$

$x = 5$   
 vertical

7. What does the value of  $b$  need to be so that the lines  $\begin{cases} y = 2x + 10 \\ 4x + by = 12 \end{cases}$  are parallel?

$-\frac{4}{b} = 2$   
 $2b = -4$   
 $b = -2$

$by = 12 - 4x$   
 $y = \frac{12}{b} - \frac{4}{b}x$

8. Are the points  $(2, 4)$ ,  $(5, 13)$  and  $(26, 76)$  collinear (do they lie on the same line)?

Slope must be the same

$\frac{13-4}{5-2} = \frac{9}{3} = 3$        $\frac{76-13}{26-5} = \frac{63}{21} = 3$

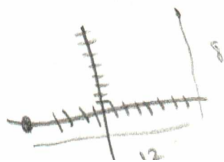
yes

9. Find the coordinates of the point that is one-third ( $1/3$ ) of the way from  $(-5, 0)$  to  $(7, 8)$ .

ratio of 1:2

vertical  
 $\frac{8}{3}$

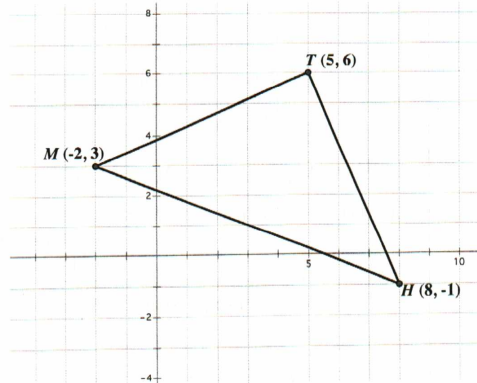
horizontal  
 $\frac{12}{3} = 4$



$(-5 + 4, 0 + \frac{8}{3})$   
 $(-1, \frac{8}{3})$

$(7 + 4, 8 - \frac{8}{3})$   
 $(3, \frac{16}{3})$

6. Write the equation of the **altitude** of triangle HMT from H to MT.  
 (Remember: an **altitude** is a segment drawn from a vertex of a triangle to the line containing the opposite side ... so that it is **perpendicular** to the line containing the opposite side. - Ch.4 of Textbook)



$$m_{MT} = \frac{6-3}{5-2} = \frac{3}{3} = 1$$

$$m_{\perp MT} = -\frac{1}{1} = -1$$

$$y+1 = -1(x-8)$$

$$y+1 = -1x + 8$$

$$y = -x + 7$$

7. Give the coordinates of HMT under each of the following transformations:

a) Reflection over  $x$ -axis  $(x, y) \rightarrow (x, -y)$

b) Reflection over  $y = x$   $(x, y) \rightarrow (y, x)$

c) Rotation of  $180^\circ$  about the origin  $(x, y) \rightarrow (-x, -y)$

d) Reflection over  $y$ -axis  $(x, y) \rightarrow (-x, y)$

e) Rotation of  $270^\circ$  about the origin  $(x, y) \rightarrow (y, -x)$

f) Reflection over  $y = -x$   $(x, y) \rightarrow (-y, -x)$

g) Rotation of  $90^\circ$  about the origin  $(x, y) \rightarrow (-y, x)$

1) Reflection over  $y = 3$   $(x, y) \rightarrow (x, 6-y)$

III. Transformations

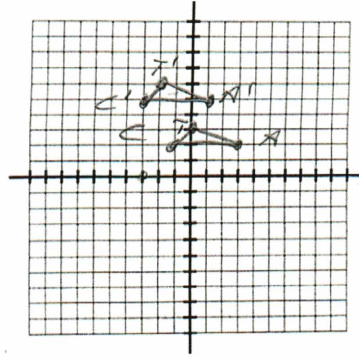
11. The coordinates of  $\triangle CAT$  are  $C = (-1, 2)$ ,  $A = (3, 2)$ , and  $T = (0, 3)$ .

- a. Graph  $\triangle CAT$ .  
 b. Determine the coordinates of  $\triangle CAT$  after the transformation given below.  
 $(x, y) \rightarrow (x - 2, y + 3)$

$C' = (-3, 5)$   $A' = (1, 5)$   
 $T' = (-2, 6)$

- c. Graph the image from b, and describe the transformation in words.

Shifted left 2 units,  
 Shifted up 3 units



12. The coordinates of  $\triangle DOG$  are  $D = (-2, -1)$ ,  $O = (-3, -2)$ , and  $G = (-1, -3)$ .

- a. Graph  $\triangle DOG$ .  
 b. Determine the points of and graph  $\triangle DOG$  after the transformation  $(x, y) \rightarrow (-2x, y)$ .

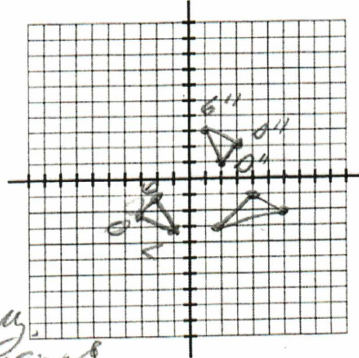
$D' = (4, -1)$   $O' = (6, -2)$   
 $G' = (2, -3)$

- c. Describe the transformation in words. Is it the same figure?

Reflected over y-axis  
 and stretched horizontally  
 The x axis is the same length

- d. Determine a rule for a transformation that would rotate the figure entirely into Quadrant I. Write the rule below, graph the new figure, and state the coordinates below.

Rule:  $(x, y) \rightarrow (-x, -y)$   
 $180^\circ$  rotation about the origin  
 $O'' = (2, 1)$   
 $O''' = (3, 2)$   
 $G'' = (1, 3)$



13. A line segment has coordinates given by  $K(-4, 10)$  and  $O(6, 0)$ .

- a. What are the coordinates of  $\overline{KO}$  after a translation up 6 and left 2?

$(-6, 16)$   $(4, 6)$

- b. What are the coordinates of  $\overline{KO}$  after a rotation of  $270^\circ$  degrees around the origin?

$(10, 4)$   $(0, -6)$

- c. What are the new coordinates  $\overline{KO}$  after a reflection in the line  $y = -x$ .

$(-10, 4)$   $(0, -6)$

- d. What are the coordinates of  $\overline{KO}$  after a rotation of  $90^\circ$  around the origin and a reflection in the y-axis?

①  $(-10, -4)$   $(0, 6)$   
 ②  $(10, -4)$   $(0, 6)$

8. Determine the rule to rotate a figure  $90^\circ$  about the point  $(-5, -3)$ .

$$(x, y) \rightarrow (-y, x)$$

$$(3, -5)$$

9. For each of the following, answer the questions:

- What is the effect of each of the following transformations on a figure?
- Is this a rigid transformation? Explain why or why not.

a)  $(x, y) \rightarrow (x + 3, y - 4)$      $\rightarrow 3$      $\downarrow 4$     yes shape  $\cong$

b)  $(x, y) \rightarrow (x, 2y)$     all y values  $\cdot$  by 2  
Vertical stretch -    no