Name: _____   Date: _____

SLOPE AND PARALLEL LINES
N-GEN MATH® GEOMETRY

*We now move into a portion of geometry where we explore space and shapes using the tools of **coordinate geometry**. One of the main tools we will use is that of the **slope** of a line or line segment. Recall the following:*

Slope of a Line (or Line Segment)

The **slope** of a line or segment is a **measurement** of how **much** its *y*-coordinate **changes** compared to its *x*-coordinate when moving from one point on the line to another point on the line. This **measurement** is expressed in the form of a **ratio** (expressed as a **fraction**) of the **change in *y*** to the **change in *x*.**

Exercise #1: Two line segments are shown below, $\overline{AB}$ and $\overline{CD}$.

(a) Write down the coordinate points for each of the four endpoints.

(b) For each line segment, find the following **graphically**. Express your slopes as fractions in simplest form.

$\overline{AB}$:
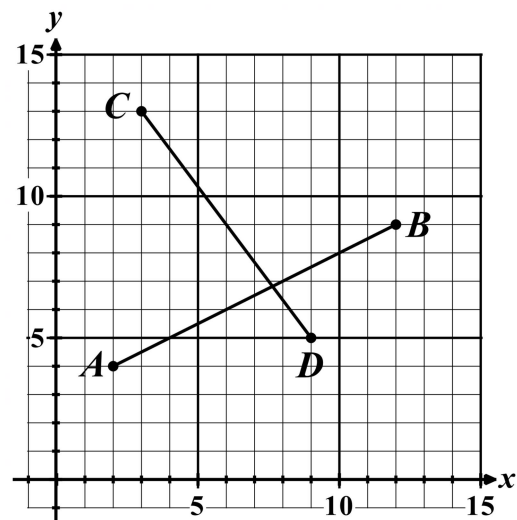
$\Delta x =$

$\Delta y =$

slope $= \dfrac{\Delta y}{\Delta x} =$

$\overline{CD}$:

$\Delta x =$

$\Delta y =$

slope $= \dfrac{\Delta y}{\Delta x} =$

(c) How could the change in *x* and change in *y* be calculated from the coordinates of the endpoints instead of found graphically? Illustrate.

The Slope Formula

If a line passes through the two points (x_1, y_1) and (x_2, y_2), then its slope can be calculated by:

$$\textbf{slope} = m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \ \text{ or } \ = \frac{y_1 - y_2}{x_1 - x_2}$$

Exercise #2: Use the slope formula above to calculate the slope of a line segment with endpoints given below. Express your slope in simplest form (fraction or whole number).

(a) $A(-2, 4)$ and $B(8, 10)$

(b) $C(-10, 3)$ and $D(11, -9)$

(c) $E(2, 11)$ and $F(-2, 3)$

*The **slope** of a line gives us its **direction** or **motion** in a certain sense. Due to this, we can see a simple, and yet important, relationship between the **slopes** of **parallel lines** or **parallel line segments**.*
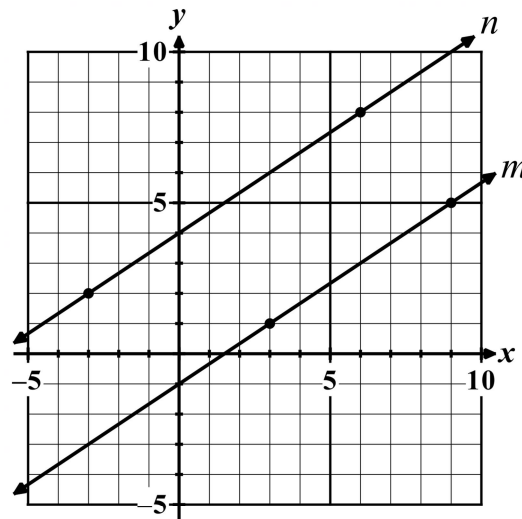
Exercise #3: Two parallel lines *m* and *n* are shown graphed below.

(a) What is the vertical distance between the two lines for any points that share the same *x*-coordinate? Illustrate.

(b) Using the marked points, calculate the slope of each of the lines.

line *m*:   line *n*:

(c) Why does it make sense that parallel lines must have slopes that are equal? Consider what would happen if they were not equal to the distance between the two lines.

Slope and Parallel Lines

1. Two non-vertical lines that are parallel will have equal slopes.
2. Two non-vertical lines that have equal slopes will be parallel.

Exercise #4: Given the points $A(-2,1)$, $B(6,7)$, $C(-4,-3)$, and $D(8,6)$ answer the following questions about segments that would connect these various points.

(a) Is $\overline{AB}$ parallel to $\overline{CD}$? Justify.

(b) Is $\overline{AC}$ parallel to $\overline{BD}$? Justify.

(c) If $\overline{ED}$ is parallel to $\overline{AC}$ and point *E* has coordinates of $(12, k)$, then what is the value of *k*? Show how you arrived at your answer.
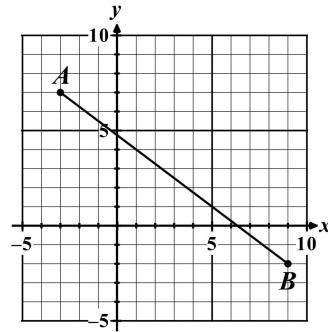
SLOPE AND PARALLEL LINES
N-GEN MATH® GEOMETRY HOMEWORK

FLUENCY

1. Which of the following is the slope of $\overline{AB}$ shown?

   (1) $\dfrac{4}{3}$ (3) $-\dfrac{4}{3}$

   (2) $\dfrac{3}{4}$ (4) $-\dfrac{3}{4}$

   _____

2. Which of the following is the slope of the line that passes through the points $(4, -5)$ and $(7, 10)$?

   (1) $\dfrac{5}{3}$ (3) 5

   (2) $-\dfrac{3}{5}$ (4) $\dfrac{1}{5}$

   _____

3. In each case below, the endpoints of a line segment have been given. Calculate the slope of the lines segment in simplest form. Show the calculations that lead to your answers.

   (a) $A(2,1)$ and $B(12,7)$ (b) $C(3,8)$ and $D(15,5)$ (c) $E(-1,-2)$ and $F(1,4)$

   (d) $G(9,-3)$ and $H(-6,3)$ (e) $I(-2,1)$ and $J(-10,-3)$ (f) $K(-2,4)$ and $L(6,4)$

4. It is known that $\overline{ST}$ is parallel to $\overline{CD}$, whose endpoints are at $C(-2,1)$ and $D(4,10)$. Which of the following is the slope of $\overline{ST}$?

   (1) $\dfrac{2}{3}$ (3) $\dfrac{1}{4}$

   (2) $\dfrac{3}{2}$ (4) $\dfrac{9}{2}$

   _____

5. Given the four points $A(-3,5)$, $B(1,13)$, $C(4,2)$, and $D(10,5)$, are $\overline{AB}$ and $\overline{CD}$ parallel? Justify.

6. Given the four points $E(2,5)$, $F(7,1)$, $G(2,-3)$, and $H(-8,5)$, is $\overline{EF} \parallel \overline{GH}$? Justify.

REASONING

7. Given line a and point C shown, do the following:

    (a) Draw a line through point C that is parallel to line a. Explain your method below.

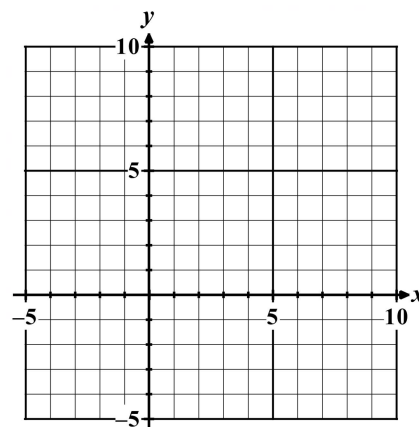   (b) Does the line you drew in (a) pass through the point $D(16,-24)$? Justify your yes/no response.
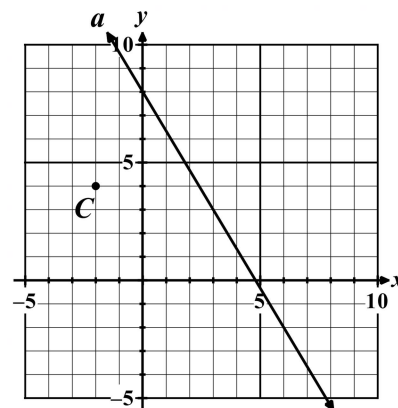
8. Quadrilateral $ABCD$ has vertices at $A(-4,-4)$, $B(6,-2)$, $C(8,6)$, and $D(-2,4)$.

    (a) Plot and label the four vertices. Then draw $ABCD$.

    (b) Calculate the slope of each of the four sides:

    $\overline{AB}$: $\overline{BC}$:

    $\overline{CD}$: $\overline{DA}$:

    (c) State the pairs of parallel sides based on (b).

    (d) What type of special quadrilateral is this?