Notes: PARALLEL & PERPENDICULAR SLOPES

**Content Objective:** I will be able to calculate and use slope to determine whether two lines are parallel or perpendicular as well as generate parallel and perpendicular lines.

<table>
<thead>
<tr>
<th>TERM</th>
<th>DESCRIPTION</th>
<th>FORMULA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOPE</td>
<td>The ratio of _________ change (&quot;rise&quot;) to _________ change (&quot;run&quot;) between any two points on a line. Slope describes how _________ a line is.</td>
<td>[ m = \frac{y_2 - y_1}{x_2 - x_1} ]</td>
</tr>
</tbody>
</table>

*Slope is also the “steepness” or “inclination” of a line and “rate of change”.*

<table>
<thead>
<tr>
<th>horizontal</th>
<th>rise</th>
<th>run</th>
<th>vertical</th>
<th>x</th>
<th>y</th>
</tr>
</thead>
</table>

For items a. - e, use the Word Bank above to fill in the blanks in the ratios that represent slope.

a. _________ change  
b. _________  
c. change in _____  
________ change  
________ change  
change in _____

d. d_____  
e. Δ_____  
f. d_____  
Δ_____  

**EXAMPLE 1:** To find the slope count the vertical ("rise") then the horizontal ("run") distance used to “travel” from one point to another. Your “path” will form a right triangle.

In the graph on the right, the “rise” is _____ units and the “run” is _____ units so the slope, \( m \), is ______.
Quick Check:
What is the slope of the linear function shown in the graph?

What type of slope is shown? __________
The rise is _____ and the run is _______.
m = __________.

Example 2: What is the slope of the line containing the points (−1, 4) and (3, 2)?

To find the slope:

1st Label the coordinates of the two given points as \((x_1, y_1)\) and \((x_2, y_2)\).

\[
\begin{array}{cccc}
x_1 & y_1 & x_2 & y_2 \\
-1 & 4 & 3 & 2
\end{array}
\]

2nd Substitute these values into the slope formula.

\[
\frac{(2 - 4)}{(3 - (-1))} =
\]

3rd Simplify the expression using the order of operations. \(m = \)__________

Quick Check:
What is the slope of the linear function that includes the points (−3, 1) and (−2, 4)? \(m = \)_______

The formula for a slope is \(m = \frac{(y_2 - y_1)}{(x_2 - x_1)}\).
EXAMPLE 3: Use the graph to find the slope of $\overline{AB}$.

QUICK CHECK: Use the graph to find the slope of $\overline{CD}$.

<table>
<thead>
<tr>
<th>TERM</th>
<th>DESCRIPTION</th>
<th>EXAMPLE</th>
<th>HOW TO NAME IT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two coplanar lines that never _________.</td>
<td>$l \parallel m$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two lines that ________ to form four ________ _________.</td>
<td>$l \perp m$</td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLE 4: Use the graph below to find the slope of each line.

<table>
<thead>
<tr>
<th>line</th>
<th>slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td></td>
</tr>
<tr>
<td>$b$</td>
<td></td>
</tr>
<tr>
<td>$c$</td>
<td></td>
</tr>
<tr>
<td>$d$</td>
<td></td>
</tr>
</tbody>
</table>

What can you conclude about:

Lines that are parallel? ____________________________

Lines that are perpendicular? ____________________________
EXAMPLE 5: Based on your conclusion from Example 4, fill in the chart below.

<table>
<thead>
<tr>
<th>SLOPE OF A LINE</th>
<th>SLOPE FOR A PARALLEL LINE</th>
<th>SLOPE FOR A PERPENDICULAR LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{2}{3}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$-4$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$-\frac{1}{4}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The slopes of parallel lines are __________.
The slopes of _________ lines are opposite reciprocals.

EXAMPLE 6: Find the slopes of the following lines to determine if the lines are parallel.

Slope of line $a =$ _____

Slope of line $b =$ _____

Are the lines parallel? ______________

QUICK CHECK: Find the slopes of the following lines to determine if the lines are parallel.

Slope of line $a =$ _____

Slope of line $b =$ _____

Are the lines parallel? ______________
EXAMPLE 7: Find the slopes of the following lines to determine if the lines are perpendicular.

Slope of line $a = \underline{______}$

Slope of line $b = \underline{______}$

Are the lines perpendicular? \underline{____________}

QUICK CHECK: Find the slopes of the following lines to determine if the lines are perpendicular.

Slope of line $a = \underline{______}$

Slope of line $b = \underline{______}$

Are the lines perpendicular? \underline{____________}

EXAMPLE 8: Tell whether the lines through the given slopes are parallel, perpendicular, or neither.

a. \underline{___________________} Line 1: (0, 1), (2, 3) ; Line 2: (4, -1), (5, 2)

b. \underline{___________________} Line 1: (-5, 0), (-3, -2) ; Line 2: (-2, 2), (0, 4)

c. \underline{___________________} Line 1: (1, 0), (2, 0) ; Line 2: (5, -5), (-10, -5)
Example 9: Tell whether the intersection of $\overrightarrow{AB}$ and $\overrightarrow{CD}$ forms a right angle.

a. ____________________  $A(5, 6), B(-3, 22), C(9, -2), D(6, 4)$

b. ____________________  $A(7, 12), B(1, 5), C(11, -7), D(4, -1)$

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Example 10: Is $\angle DEB$ a right angle?

Quick Check: Is $\angle AED$ a right angle?