Geometry
Chapter 3 – Unit 4
Parallel Lines and Perpendicular Lines

Name: ______________________________ Hour: _______

Unit 5 Chapter 3 Syllabus

Geometry - *Parallel and Perpendicular Lines**

Date	Lesson
Friday October 25	3.1 Parallel Lines and Transversals Assignment: 3.1 Practice WS
Monday October 28	3.2 Angles and Parallel Lines Assignment: 3.2 Practice WS
Tuesday October 29	3.3 Slopes of lines Assignment: 3.3 Practice WS
Block October 30/31	3.4 Equations of lines – day 1 Different representations of the equation of a line: Standard form, slope-intercept form, point-slope form **Quiz 3-1 and 3-2**
Friday November 1	3.4 Equations on lines – day 2 Equation of a line perpendicular or parallel to a given line
Monday November 4	3.4 Equations on lines – day 3 Review all of 3.4 Assignment: 3.4 Practice WS
Tuesday November 5	3.5 Proving Lines Parallel – day 1
Block Day November 6/7	3.5 Proving Lines Parallel – day 2 **Quiz 3-3 and 3-4**
Friday November 8	Partner Quiz 3-5
Monday November 11	Review for Chapter 3 Test DUE ON DAY OF TEST
Tuesday November 12	Review for Chapter 3 Test
Block Day Nov 13/14	Chapter 3 TEST
Friday November 15	

* Schedule subject to change at teacher discretion.

3.1 Parallel Lines and Transversals

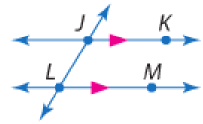
Objective: Identify the relationships between two lines or two planes; Name angle pairs formed by parallel lines and transversals

What is the difference…

KeyConcepts Parallel and Skew

Parallel lines are coplanar lines that do not intersect.

Example $\overleftrightarrow{JK} \parallel \overleftrightarrow{LM}$



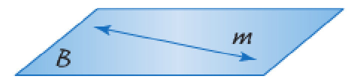
Arrows are used to indicate that lines are parallel.

Skew lines are lines that do not intersect and are not coplanar.

Example Lines ℓ and m are skew.

Parallel planes are planes that do not intersect.

Example Planes $\mathcal{A}$ and $\mathcal{B}$ are parallel.



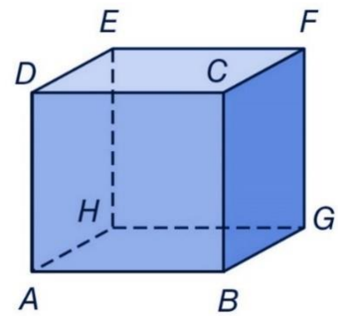
$\overleftrightarrow{JK} \parallel \overleftrightarrow{LM}$ is read as *line JK is parallel to line LM.*

Example: 3-1-1 Identify Parallel and Skew Relationships

A. Name all segments parallel to $\overline{BC}$.

B. Name a segment skew to $\overline{EH}$.

C. Name a plane parallel to plane ABG.



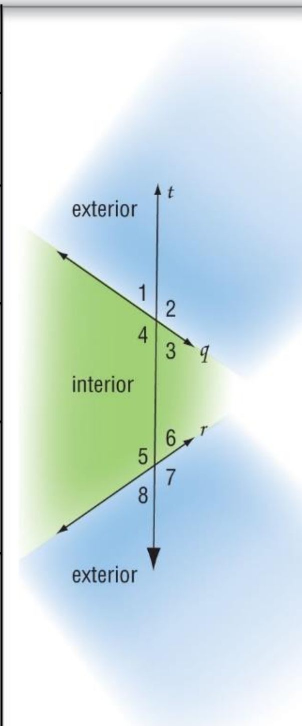
Transversal –

Compare the …

How many…

KeyConcept Transversal Angle Pair Relationships

Four **interior angles** lie in the region between lines q and r.	$\angle 3, \angle 4, \angle 5, \angle 6$
Four **exterior angles** lie in the two regions that are not between lines q and r.	$\angle 1, \angle 2, \angle 7, \angle 8$
Same side interior angles are interior angles that lie on the same side of transversal t.	$\angle 4$ and $\angle 5$, $\angle 3$ and $\angle 6$
Alternate interior angles are nonadjacent interior angles that lie on opposite sides of transversal t.	$\angle 3$ and $\angle 5$, $\angle 4$ and $\angle 6$
Alternate exterior angles are nonadjacent exterior angles that lie on opposite sides of transversal t.	$\angle 1$ and $\angle 7$, $\angle 2$ and $\angle 8$
Corresponding angles lie on the same side of transversal t and on the same side of lines q and r.	$\angle 1$ and $\angle 5$, $\angle 2$ and $\angle 6$ $\angle 3$ and $\angle 7$, $\angle 4$ and $\angle 8$



How do transversals…

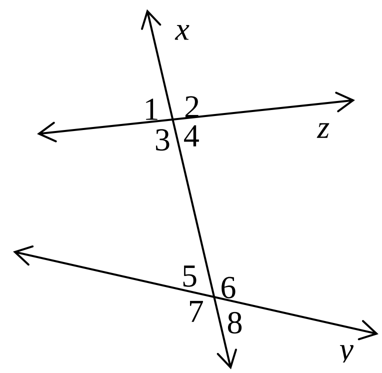
Example 3-1-2 Classify Angle Pair Relationships
Classify the relationship between the given angle pair as alternate interior, alternate exterior, corresponding, or same side interior angles.

A. ∠2 and ∠6

B. ∠1 and ∠8

C. ∠3 and ∠6

D. ∠3 and ∠5



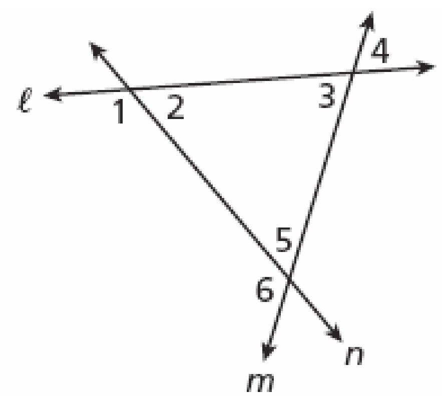
Example 3-1-3 Identify Transversals and Classify Angle Pairs
Identify the transversal connecting each pair of angles in the diagram. Then classify the relationship between each pair of angles.

A. $\angle 1 \; and \; \angle 3$

B. $\angle 2 \; and \; \angle 6$

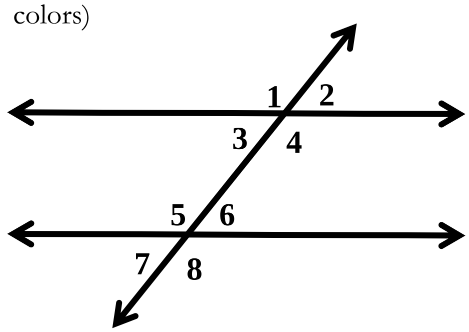
C. $\angle 4 \; and \; \angle 6$

D. $\angle 2 \; and \; \angle 5$

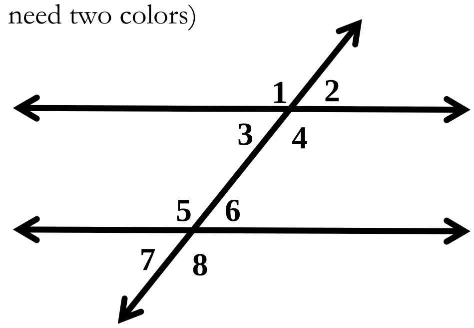


Coloring Activity

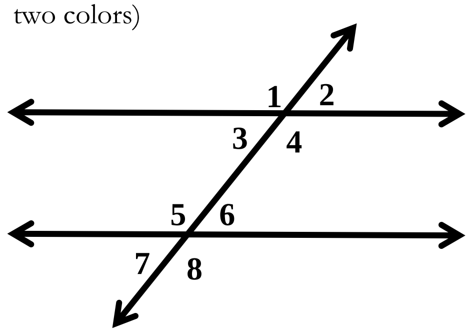
A. Color the **vertical angles**. Each set should be a different color. (You will need four colors)



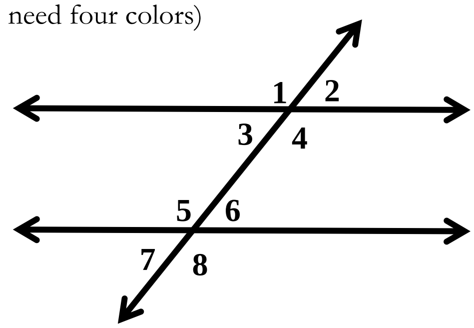
B. Color the **alternate exterior angles**. Color each set a different color. (You will need two colors)



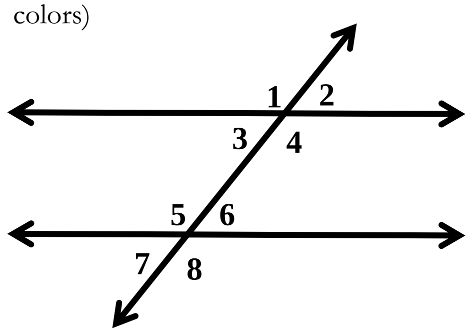
C. Color the **alternate interior angles**. Color each set a different color. (You will need two colors)



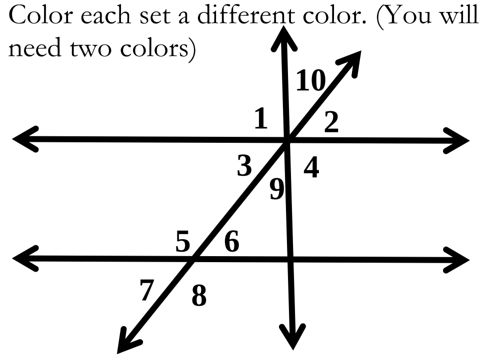
D. Color the **corresponding angles**. Color each set a different color. (You will need four colors)



E. Color the **supplementary angles**. Color each set a different color. (You will need 8 colors)



F. Color the **complementary angles**. Color each set a different color. (You will need two colors)



3.2 Angles and Parallel Lines

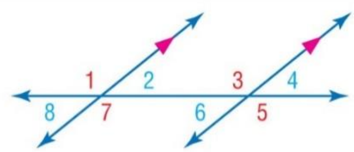
Objective: Use Theorems to determine the relationships between specific pairs of angles; Use algebra to find angle measurements.

Which angles…

Postulate 3.1 Corresponding Angles Postulate

If two parallel lines are cut by a transversal, then each pair of corresponding angles is congruent.

Examples $\angle 1 \cong \angle 3$, $\angle 2 \cong \angle 4$, $\angle 5 \cong \angle 7$, $\angle 6 \cong \angle 8$



Example 3-2-1 Use Corresponding Angles Postulate

In the figure, if the m∠11 = 51°, find the measure of each angle.
Tell which postulate(s) or theorem(s) you used.

m∠10 ____________

m∠12 ____________

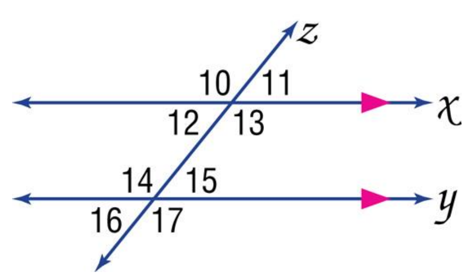
m∠13 ____________

m∠14 ____________

m∠15 ____________

m∠16 ____________

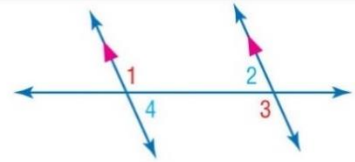
m∠17 ____________



Theorems Parallel Lines and Angle Pairs

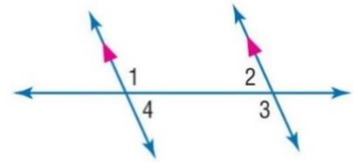
3.1 Alternate Interior Angles Theorem If two parallel lines are cut by a transversal, then each pair of alternate interior angles is congruent.

Examples ∠1 ≅ ∠3 and ∠2 ≅ ∠4



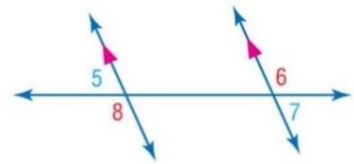
3.2 Consecutive Interior Angles Theorem If two parallel lines are cut by a transversal, then each pair of consecutive interior angles is supplementary.

Examples ∠1 and ∠2 are supplementary.
∠3 and ∠4 are supplementary.

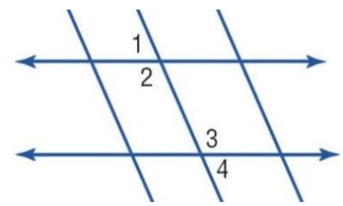


3.3 Alternate Exterior Angles Theorem If two parallel lines are cut by a transversal, then each pair of alternate exterior angles is congruent.

Examples ∠5 ≅ ∠7 and ∠6 ≅ ∠8



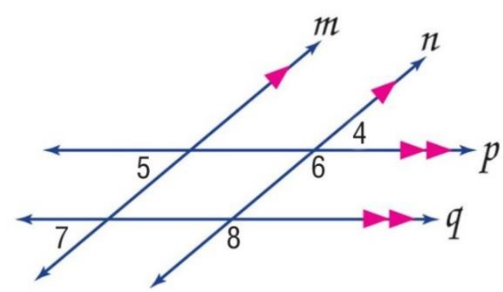
Example 3-2-2 Use Theorems about Parallel Lines
FLOOR TILES – The diagram represents the floor tiles in Michelle's house. If $m\angle 2 = 125$, find $m\angle 3$.



Example 3-2-3 Find Values of Variables
Use the figure to find the indicated variable. Explain your reasoning.

A. If $m\angle 5 = 2x - 10$, and $m\angle 7 = x + 15$, find x.

What would be true about a transversal that is perpendicular to a pair of parallel lines?

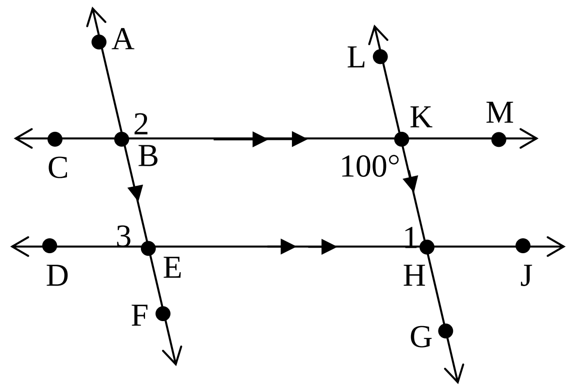


B. If $m\angle 4 = 4(y - 25)$, and $m\angle 8 = 4y$, find y.

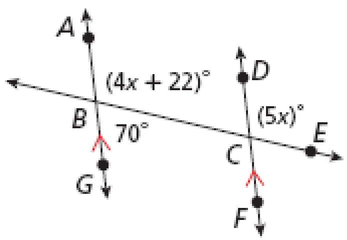
C. If $m\angle 4 = 5x - 12$, and $m\angle 5 = 3x + 16$, find x.

How could the Corresponding Angles Postulate be used to prove these theorems?

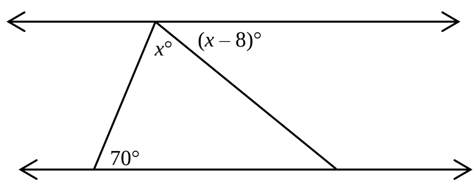
Example 3-2-4 In the diagram below, how many other angles have measure of 100°? Name them.



Example 3-2-5 Use the properties of parallel lines to find the value of x.

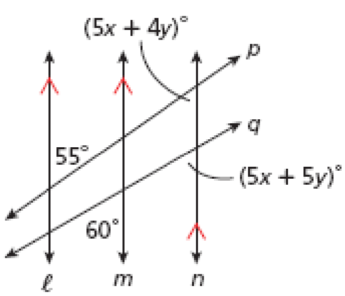


Example 3-2-6 Use the properties of parallel lines to find the value of x.



Why does systems of equations have to be used to solve example 3-2-7?

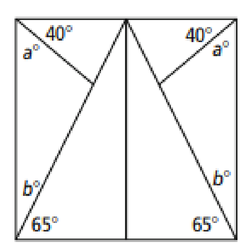
Example 3-2-7 Use the properties of parallel lines to find the value of x and y.



Theorem 3.4 – In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.

Example 3-2-7 Use the properties of parallel & perpendicular lines to find the value of x.

An artist is building a mosaic. The mosaic consists of the repeating pattern shown at the right. What must be true of a and b to ensure that the sides of the mosaic are parallel?



3.3 Slopes of Lines

Objective: find the slope of a line; use slopes to identify parallel and perpendicular lines

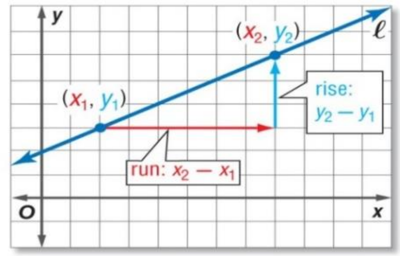
- Slope / rate of change

KeyConcept Slope of a Line

In a coordinate plane, the **slope** of a line is the ratio of the change along the y-axis to the change along the x-axis between any two points on the line.

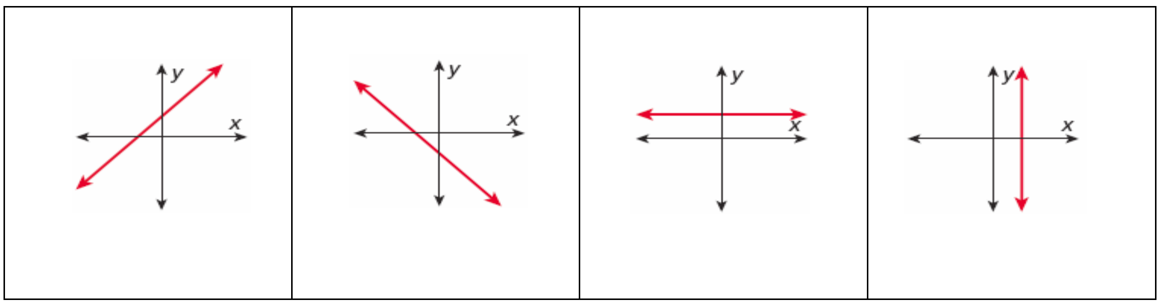
The slope m of a line containing two points with coordinates (x_1, y_1) and (x_2, y_2) is given by the formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}, \text{ where } x_1 \neq x_2.$$



$$m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

What does it mean if the denominator of a slope ratio is zero?



Example 3-3-1 Determine the slope of each line or the slope of the line containing the given points.

A. $\overleftrightarrow{AB}$

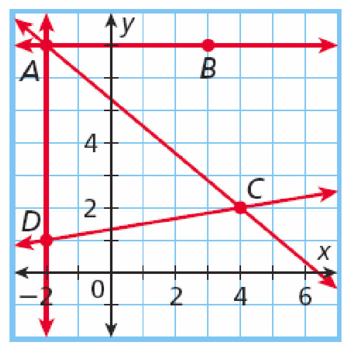
B. $\overleftrightarrow{AC}$

C. $\overleftrightarrow{AD}$

D. $\overleftrightarrow{CD}$

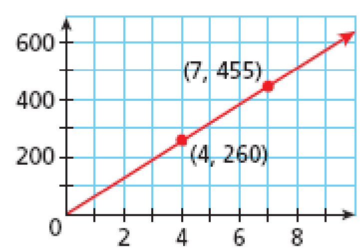
E. $(3, 6)\quad(-2, 5)$

F. $(-4, 2)\quad(7, 0)$



Why does slope need to be interpreted in real world problems?

Example 3-3-2 Justin is driving from home to his college dormitory. At 4:00 p.m., he is 260 miles from home. At 7:00 p.m., he is 455 miles from home. Graph the line that represents Justin's distance from home at a given time. Find and interpret the slope of the line.



Slopes of Parallel and Perpendicular Lines

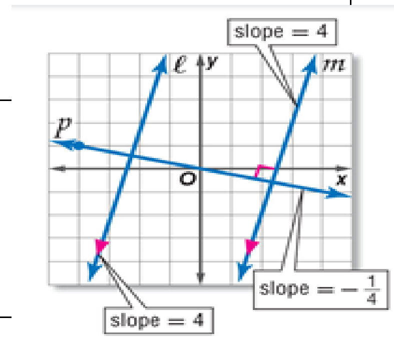
Parallel Lines Postulate

In a coordinate plane, two non-vertical lines are parallel if and only if they have the same slope. Any two vertical lines are parallel.

Perpendicular Lines Postulate

In a coordinate plane, two non-vertical lines are perpendicular if and only if the product of their slopes is ________________.

Vertical and horizontal lines are perpendicular.



If a line has a slope of $\frac{a}{b}$, then the slope of a perpendicular line would be ____________.

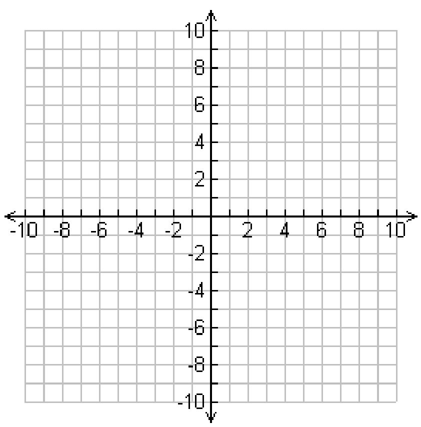
If a line has a slope of $\frac{a}{b}$, then the slope of a parallel line would be ____________.

The ratios $\frac{a}{b}$ and $-\frac{b}{a}$ are called ______________________________

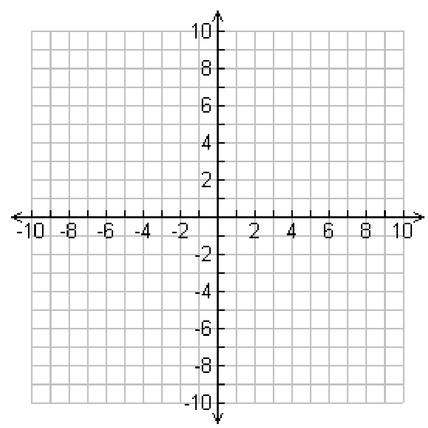
________________________________.

Example 3-3-3 Graph each pair of lines. Label each point.
Use their slopes to determine whether they are parallel, perpendicular, or neither.

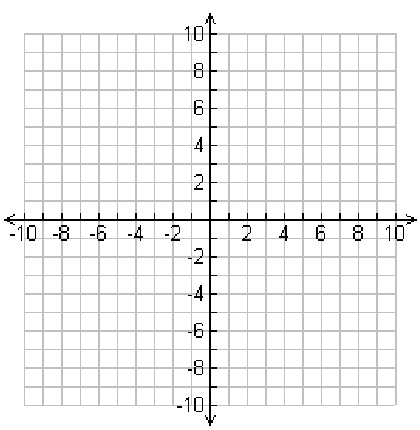
A. $\overleftrightarrow{UV}$ and $\overleftrightarrow{XY}$
U(0, 2), V(-1, -1), X(3, 1), and Y(-3, 3)



B. $\overleftrightarrow{GH}$ and $\overleftrightarrow{IJ}$
G(-3, -2), H(1, 2), I(-2, 4), and J(2, -4)



Example 3-3-4 Use slope to graph a line.
Graph the line that contains *Q*(5, 1) and is parallel to *MN* with *M*(–2, 4) and *N*(2, 1).



Pairs of Lines

PARALLEL LINES	INTERSECTING LINES	COINCIDING LINES
$y = 5x + 8$ $y = 5x - 4$	$y = 2x - 5$ $y = 4x + 3$	$y = 2x - 4$ $y = 2x - 4$
Same slope different y-intercept	Different slopes	Same slope, same y-intercept

Example 3-3-5 Classifying Pairs of Lines: Parallel, Intersect, Coincide?

A. $y = 3x + 7,$
$y = -3x - 4$

B. $y = -\frac{1}{3}x + 5,$
$6y = -2x + 12$

C. $2y - 4x = 16,$
$y - 10 = 2(x - 1)$

Slope	Parallel Slope	Perpendicular Slope
7		
6		
$\frac{3}{4}$		
$\frac{10}{11}$		
-2		
$-\frac{1}{3}$		

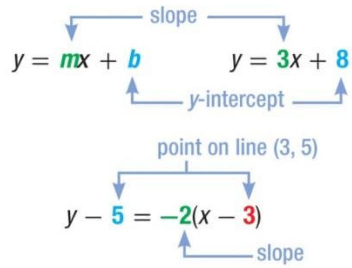
3.4 Equations of Lines

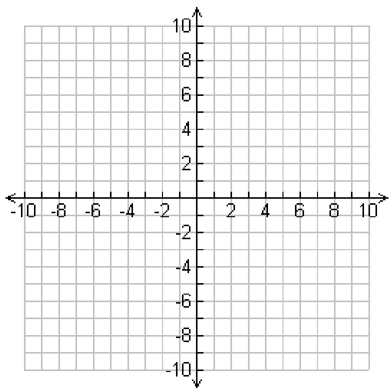
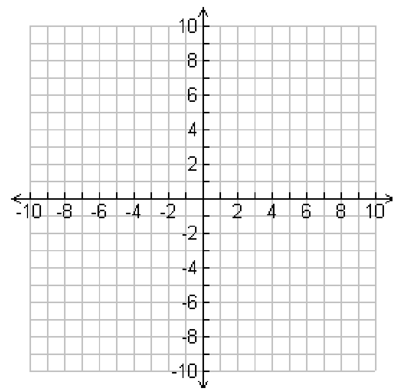
<u>Objective</u>: *Graph lines and write their equations in slope-intercept and point-slope form.*

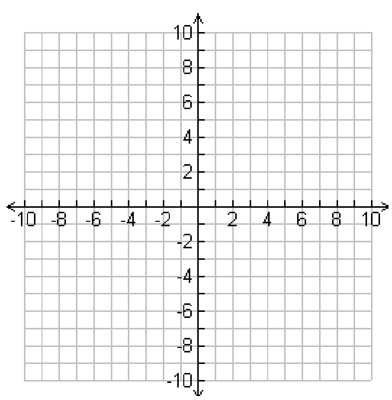
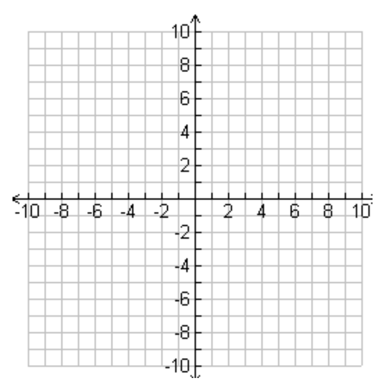
KeyConcept Nonvertical Line Equations

The **slope-intercept form** of a linear equation is $y = mx + b$, where m is the slope of the line and b is the y-intercept.

The **point-slope form** of a linear equation is $y - y_1 = m(x - x_1)$, where (x_1, y_1) is any point on the line and m is the slope of the line.



FORMS OF THE EQUATION OF A LINE - Write & Graph	
Slope Intercept Form	**EXAMPLE**
Write an equation in slope-intercept form of the line with slope 6 and y-intercept –3. Graph. $y =$ 	Write an equation in slope-intercept form of the line with slope –1 and y-intercept 4. Graph. $y =$ 

Point Slope Form	EXAMPLE
Write an equation in point-slope form of the line whose slope is $-\frac{3}{5}$ and contains (–10, 8). Graph. 	Write an equation in point-slope form of the line whose slope is $\frac{1}{3}$ and contains (6, –3). Graph. 

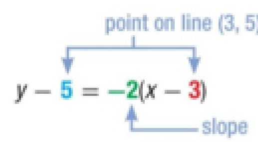
Two Points	EXAMPLE
Write an equation in slope-intercept form for a line containing (4, 9) and (–2, 0). Slope of given line: _______ Plug in slope and point $y - y_1 = m(x - x_1)$	Write an equation in slope-intercept form for a line containing (–3, –7) and (–1, 3). Slope of given line: _______ Plug in slope and point $y - y_1 = m(x - x_1)$

3.4 Equations of Lines Day 2

$Ax + By = C$

A shouldn't be negative, **A** and **B** shouldn't both be zero, and **A**, **B** and **C** should be integers.

The point-slope form of a linear equation is $y - y_1 = m(x - x_1)$, where (x_1, y_1) is any point on the line and m is the slope of the line.

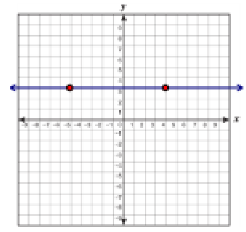


Standard Form from slope-intercept or point-slope form	EXAMPLE
Write an equation in standard form of the line whose slope is $-\frac{3}{5}$ and contains (–10, 8).	Write an equation of the line through $(7, -2)$ and $(5, 4)$ in standard form.

HORIZONTAL LINE

Horizontal lines have a slope of zero and are written y = b, where b is a constant. The line y = 3, is a horizontal line where every point on the line has a y coordinate of 3, (x,3).

$y = b$

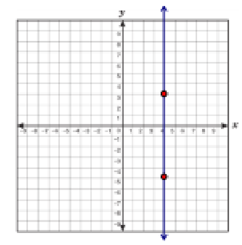


$y = 3$

VERTICAL LINE

Vertical lines have an undefined slopes and are written x = a, where a is a constant. The line x = 4, is a vertical line where every point on the line has a x coordinate of 4, (4,y).

$x = a$



$x = 4$

Horizontal Line	**Vertical Line**
Write an equation of the line through $(5, -2)$ and $(0, -2)$ in slope-intercept form. **Equation:** ___________	Write an equation of the line through $(5, -2)$ and $(5, 3)$ in slope-intercept form. **Equation:** ___________

What do you look at to check to see if two lines are perpendicular?

Do four points always yield two different lines? Explain why or why not.

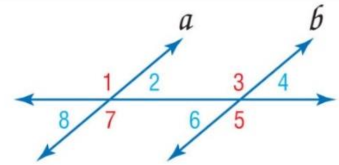
Perpendicular Line	**Parallel Line**
Write an equation in slope-intercept form for a line perpendicular to the line $y = \frac{1}{5}x + 2$ through $(2, 0)$. Slope of given line: ______ Slope to use: Is it for a parallel or perpendicular line? ______ Plug in slope and point $y - y_1 = m(x - x_1)$ **Equation:** ___________	Write an equation in slope-intercept form for a line parallel to $y = -\frac{1}{2}x - 3$ that contains $(4, 2)$. Slope of given line: ______ Slope to use: Is it for a parallel or perpendicular line? ______ Plug in slope and point $y - y_1 = m(x - x_1)$ **Equation:** ___________

3.5 Proving Lines Parallel – P. 207

Objective: Recognize angle pairs that occur with parallel lines; Prove that two lines are parallel.

Postulate 3.4 Converse of Corresponding Angles Postulate

If two lines are cut by a transversal so that corresponding angles are congruent, then the lines are parallel.



Examples If $\angle 1 \cong \angle 3$, $\angle 2 \cong \angle 4$, $\angle 5 \cong \angle 7$, $\angle 6 \cong \angle 8$, then $a \parallel b$.

Note: We will call Post 3.4 the "Corresponding Angles Converse"

Postulate 3.5 Parallel Postulate

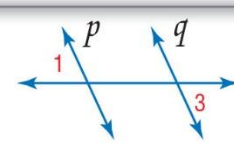
If given a line and a point not on the line, then there exists exactly one line through the point that is parallel to the given line.

How is a converse of a theorem made?

Does it need to be proven?

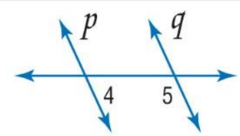
Theorems Proving Lines Parallel

3.5 Alternate Exterior Angles Converse
If two lines in a plane are cut by a transversal so that a pair of alternate exterior angles is congruent, then the two lines are parallel.



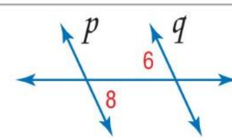
If $\angle 1 \cong \angle 3$, then $p \parallel q$.

3.6 Consecutive Interior Angles Converse
If two lines in a plane are cut by a transversal so that a pair of consecutive interior angles is supplementary, then the lines are parallel.



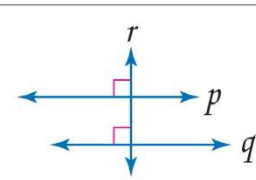
If $m\angle 4 + m\angle 5 = 180$, then $p \parallel q$.

3.7 Alternate Interior Angles Converse
If two lines in a plane are cut by a transversal so that a pair of alternate interior angles is congruent, then the lines are parallel.



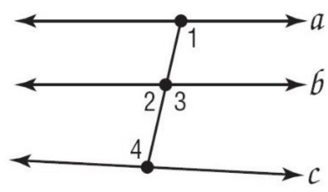
If $\angle 6 \cong \angle 8$, then $p \parallel q$.

3.8 Perpendicular Transversal Converse
In a plane, if two lines are perpendicular to the same line, then they are parallel.



If $p \perp r$ and $q \perp r$, then $p \parallel q$.

Example 3-5-1 Identify Parallel lines

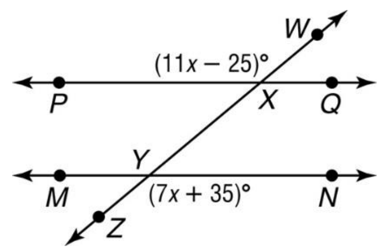


A. Given $m\angle 1 = 103$ and $m\angle 4 = 100$, is it possible to prove that any of the lines shown are parallel? If so, state the postulate or theorem that justifies your answer.

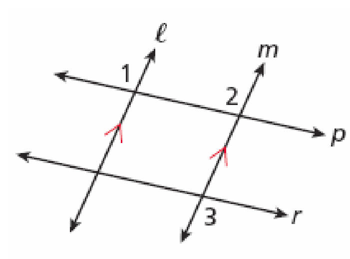
B. Given $\angle 1 \cong \angle 3$, is it possible to prove that any of the lines shown are parallel? If so, state the postulate or theorem that justifies your answer.

Write a question about this example that starts with the words: "How do…"

Example 3-5-2 Use Angle Relationships
STANDARDIZED TEST PRACTICE:
Find $m\angle ZYN$ so that $\overline{PQ} \parallel \overline{MN}$. Show your work.



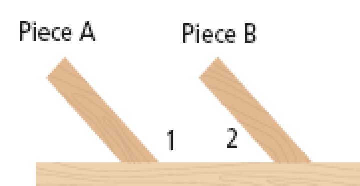
Example 3-5-3 Proving lines parallel
Given: $l \parallel m,\ \angle 1 \cong \angle 3$
Prove: $p \parallel r$



STATEMENTS	REASONS
1.	1.
2.	2.
3.	3.
4.	4.

For A and B to be parallel, what must be true about angles 1 and 2?

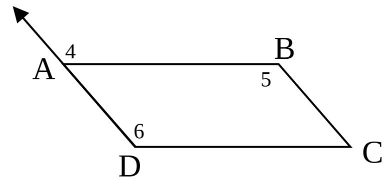
Example 3-5-3 Proving lines parallel
A carpenter is creating a wood work pattern and wants two long pieces to be parallel.
$m\angle 1 = (8x + 20)$ and $m\angle 2 = (2x + 10)$. If $x = 15$, show that pieces A and B are parallel.



Example 3-5-4 Proving lines parallel

Given: $\angle 5 \cong \angle 6$; $\angle 6 \cong \angle 4$

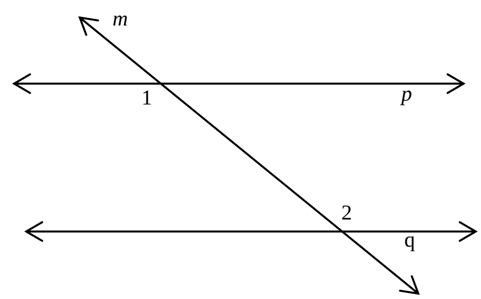
Prove: $\overline{AD} \parallel \overline{BC}$



Example 3-5-5 Proving lines parallel

Given: $m \perp p$; $m \perp q$.

Prove: $p \parallel q$.

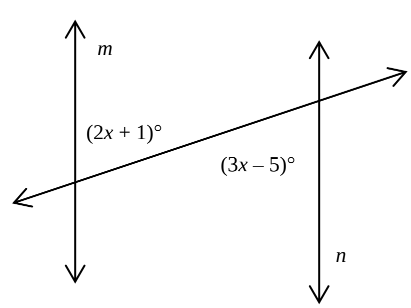


Statements	Reasons

Example 3-5-5 Using characteristics of parallel lines

Find the value of x that makes $m \parallel n$.

Write a question about this example that starts with "Why does…"



3.6 Perpendiculars and Distance – p. 215

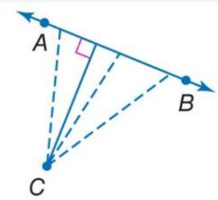
Objective: Find the distance between a point and a line; Find the distance between parallel lines.

Equidistant –

KeyConcept Distance Between a Point and a Line

Words The distance between a line and a point not on the line is the length of the segment perpendicular to the line from the point.

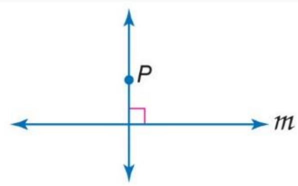
Model



Postulate 3.6 Perpendicular Postulate

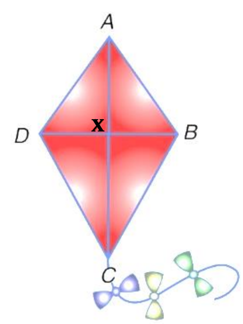
Words If given a line and a point not on the line, then there exists exactly one line through the point that is perpendicular to the given line.

Model



Example 3-6-1 Distance from a Point to a Line

Kites Which segment represents the shortest distance from point A to $\overline{DB}$?



KeyConcept Distance Between Parallel Lines

The distance between two parallel lines is the perpendicular distance between one of the lines and any point on the other line.

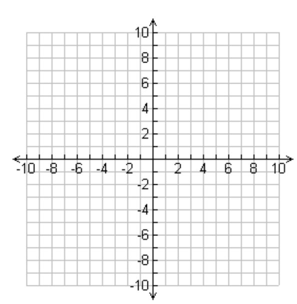
Theorem 3.9 Two Lines Equidistant from a Third

In a plane, if two lines are each equidistant from a third line, then the two lines are parallel to each other.

How do you find the distance from a point to a line?

Example 3-6-3 COORDINATE GEOMETRY

Line *s* contains points at (0, 0) and (–5, 5). Find the distance between line *s* and point *V*(1, 5).

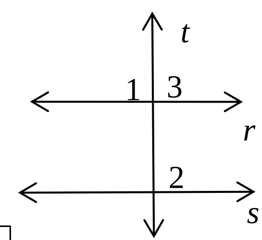


Example 3-6-5 Real World
A carpenter's square forms a right angle. A carpenter places the square so that one side is parallel to an edge of a board, and then draws a line along the other side of the square. Then he slides the square to the right and draws a second line. Why must the two lines be parallel?

Why does a carpenter have a "carpenter's square"?

Example 3-6-7 Proof

Write a two column proof.
Given: r ∥ s, ∠1 ≅ ∠2
Prove: r ⊥ t



Statements	Reasons

What formulas or theorems/postulates do you need to remember for the test? Write them here.