MEA 2013-2014
Teacher: Claudia Valle
Start Date:

Course: Geometry A
Student: ________________
Completed Date:

Unit 3: Parallel and Perpendicular Lines

Objectives: Students will understand the properties of parallel and perpendicular lines and how they are relevant in real life. Students will understand how to justify that lines are parallel using algebra and geometric proofs.

Essential Questions: What are some real life examples of parallel, perpendicular, and skew lines? How can the slope be used to identify parallel and perpendicular lines in a coordinate plane?

TEKS Standards: G.1.A, G.2.A, G.3.C, G.7.B, G.7.C, G.9.A

Geometry

(1) Geometric structure. The student understands the structure of, and relationships within, an axiomatic system. The student is expected to:

(A) develop an awareness of the structure of a mathematical system, connecting definitions, postulates, logical reasoning, and theorems;

(2) Geometric structure. The student analyzes geometric relationships in order to make and verify conjectures. The student is expected to:

(A) use constructions to explore attributes of geometric figures and to make conjectures about geometric relationships; and

(3) Geometric structure. The student applies logical reasoning to justify and prove mathematical statements. The student is expected to:

(C) use logical reasoning to prove statements are true and find counter examples to disprove statements that are false;

(7) Dimensionality and the geometry of location. The student understands that coordinate systems provide convenient and efficient ways of representing geometric figures and uses them accordingly. The student is expected to:

(B) use slopes and equations of lines to investigate geometric relationships, including parallel lines, perpendicular lines, and special segments of triangles and other polygons; and

(C) derive and use formulas involving length, slope, and midpoint.

(9) Congruence and the geometry of size. The student analyzes properties and describes relationships in geometric figures. The student is expected to:

(A) formulate and test conjectures about the properties of parallel and perpendicular lines based on explorations and concrete models;

Turn In:

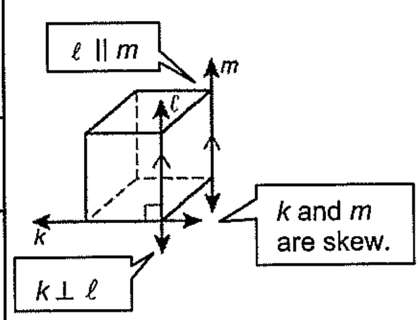
Assignment #	Activity	TEKS
15	Lines and Angles	G.1.A
16	Angles Formed by Parallel Lines and Transversals	G.3.C, G.9.A
17	Proving Lines Parallel	G.1.A, G.3.C, G.7.C
18	Perpendicular Lines	G.1.A, G.2.A, G.3.C, G.9.A
19	Slopes of Lines	G.7.B, G.7.C
20	Lines in the Coordinate Plane	G.3.C, G.7.B
21	Unit 3 Test	G.1.A, G.2.A, G.3.C, G.7.B, G.7.C, G.9.A

Name ______________________ Date ______________ Class ______________

LESSON 3-1

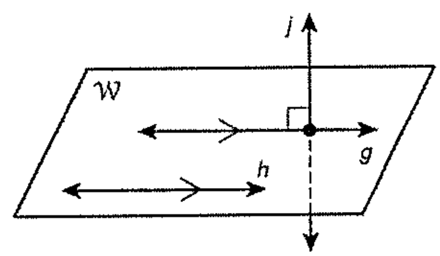
Reteach

Lines and Angles

Lines	Description	Examples
parallel	lines that lie in the same plane and do not intersect **symbol:** ∥	
perpendicular	lines that form 90° angles **symbol:** ⊥	
skew	lines that do not lie in the same plane and do not intersect	

Parallel planes are planes that do not intersect. For example, the top and bottom of a cube represent parallel planes.

Use the figure for Exercises 1–3. Identify each of the following.



1. a pair of parallel lines

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2. a pair of skew lines

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3. a pair of perpendicular lines

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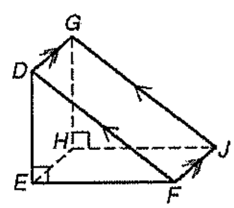
Use the figure f or Exercises 4–9. Identify each of the following.



4. a segment that is parallel to $\overline{DG}$

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5. a segment that is perpendicular to $\overline{GH}$

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6. a segment that is skew to $\overline{JF}$

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7. one pair of parallel planes

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8. one pair of perpendicular segments, not including $\overline{GH}$

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9. one pair of skew segments, not including $\overline{JF}$

____

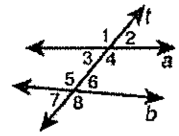
Name ______________________ Date ______________ Class ______________

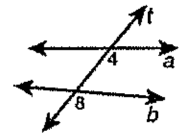
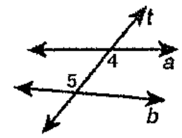
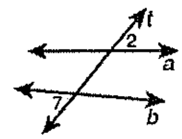
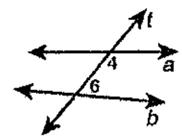
LESSON 3-1

Reteach

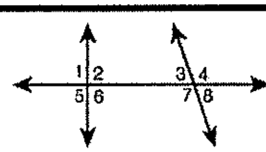
Lines and Angles continued

A transversal is a line that intersects two lines in a plane at different points. Eight angles are formed. Line *t* is a transversal of lines *a* and *b*.



Angle Pairs Formed by a Transversal		
Angles	**Description**	**Examples**
corresponding	angles that lie on the same side of the transversal and on the same sides of the other two lines	
alternate interior	angles that lie on opposite sides of the transversal, between the other two lines	
alternate exterior	angles that lie on opposite sides of the transversal, outside the other two lines	
same-side interior	angles that lie on the same side of the transversal, between the other two lines; also called *consecutive interior angles*	

Use the figure for Exercises 10–13. Give an example of each type of angle pair.



10. corresponding angles

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11. alternate exterior angles

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12. same-side interior angles

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13. alternate interior angles

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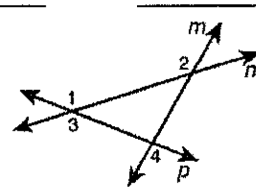
Use the figure for Exercises 14–16. Identify the transversal and classify each angle pair.



14. ∠1 and ∠2

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15. ∠2 and ∠4

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16. ∠3 and ∠4

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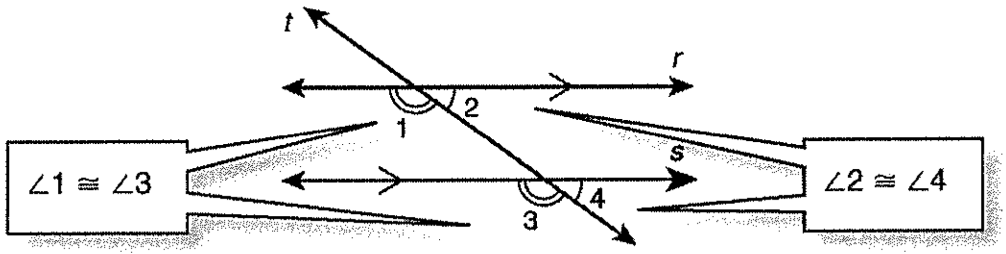
LESSON 3-2

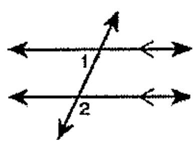
Reteach

Angles Formed by Parallel Lines and Transversals

According to the **Corresponding Angles Postulate,** if two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent.



Determine whether each pair of angles is congruent according to the Corresponding Angles Postulate.



1. ∠1 and ∠2

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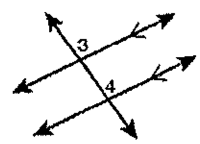

2. ∠3 and ∠4

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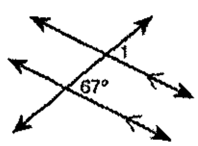
Find each angle measure.



3. m∠1

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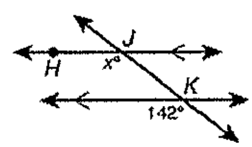

4. m∠*HJK*

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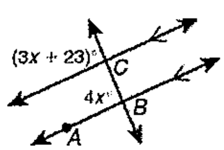

5. m∠*ABC*

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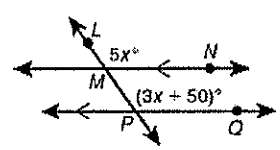

6. m∠*MPQ*

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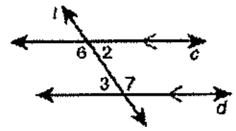
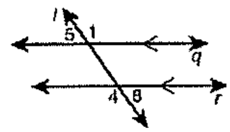
LESSON 3-2

Reteach

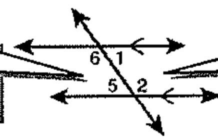
Angles Formed by Parallel Lines and Transversals continued

If two parallel lines are cut by a transversal, then the following pairs of angles are also congruent.

Angle Pairs	Hypothesis	Conclusion
alternate interior angles		$\angle 2 \cong \angle 3$ $\angle 6 \cong \angle 7$
alternate exterior angles		$\angle 1 \cong \angle 4$ $\angle 5 \cong \angle 8$

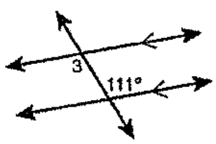
If two parallel lines are cut by a transversal, then the pairs of same-side interior angles are supplementary.

$m\angle 5 + m\angle 6 = 180°$

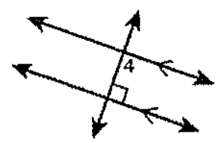


$m\angle 1 + m\angle 2 = 180°$

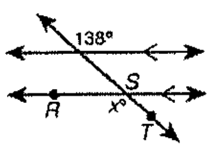
Find each angle measure.



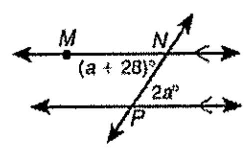
7. $m\angle 3$ ______________________



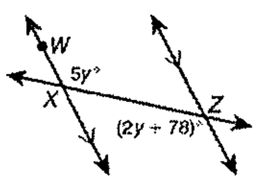
8. $m\angle 4$ ______________________



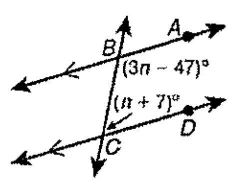
9. $m\angle RST$ ______________________



10. $m\angle MNP$ ______________________



11. $m\angle WXZ$ ______________________



12. $m\angle ABC$ ______________________

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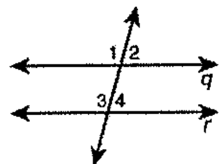
LESSON 3-3

Reteach

Proving Lines Parallel

Converse of the Corresponding Angles Postulate	If two coplanar lines are cut by a transversal so that a pair of corresponding angles are congruent, then the two lines are parallel.

You can use the Converse of the Corresponding Angles Postulate to show that two lines are parallel.



Given: $\angle 1 \cong \angle 3$

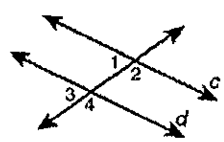
$\angle 1 \cong \angle 3$	$\angle 1 \cong \angle 3$ are corresponding angles.
$q \parallel r$	Converse of the Corresponding Angles Postulate

Given: $m\angle 2 = 3x°$, $m\angle 4 = (x + 50)°$, $x = 25$

$m\angle 2 = 3(25)° = 75°$	Substitute 25 for *x*.
$m\angle 4 = (25 + 50)° = 75°$	Substitute 25 for *x*.
$m\angle 2 = m\angle 4$	Transitive Property of Equality
$\angle 2 \cong \angle 4$	Definition of congruent angles
$q \parallel r$	Converse of the Corresponding Angles Postulate

For Exercises 1 and 2, use the Converse of the Corresponding Angles Postulate and the given information to show that $c \parallel d$.

1. **Given:** $\angle 2 \cong \angle 4$



2. **Given:** $m\angle 1 = 2x°$, $m\angle 3 = (3x - 31)°$, $x = 31$

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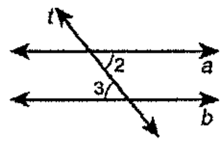
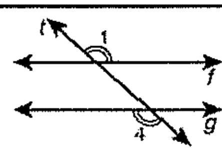
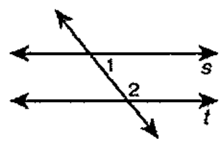
LESSON 3-3

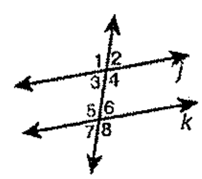
Reteach

Proving Lines Parallel continued

You can also prove that two lines are parallel by using the converse of any of the other theorems that you learned in Lesson 3-2.

Theorem	Hypothesis	Conclusion
Converse of the Alternate Interior Angles Theorem	 $\angle 2 \cong \angle 3$	$a \parallel b$
Converse of the Alternate Exterior Angles Theorem	 $\angle 1 \cong \angle 4$	$f \parallel g$
Converse of the Same-Side Interior Angles Theorem	 $m\angle 1 + m\angle 2 = 180°$	$s \parallel t$

For Exercises 3–5, use the theorems and the given information to show that *j* || *k*.



3. **Given:** $\angle 4 \cong \angle 5$

4. **Given:** $m\angle 3 = 12x°$, $m\angle 5 = 18x°$, $x = 6$

5. **Given:** $m\angle 2 = 8x°$, $m\angle 7 = (7x + 9)°$, $x = 9$

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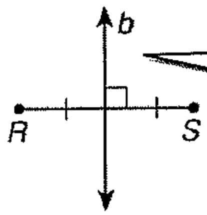
LESSON 3-4

Reteach
Perpendicular Lines

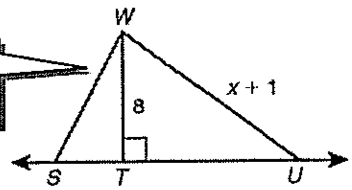
The **perpendicular bisector** of a segment is a line perpendicular to the segment at the segment's midpoint.



Line b is the perpendicular bisector of $\overline{RS}$.

The **distance from a point to a line** is the length of the shortest segment from the point to the line. It is the length of the perpendicular segment that joins them.

The shortest segment from W to $\overline{SU}$ is $\overline{WT}$.



You can write and solve an inequality for x.

$WU > WT$	$\overline{WT}$ is the shortest segment.
$x + 1 > 8$	Substitute $x + 1$ for WU and 8 for WT.
$\underline{-1 \quad -1}$	Subtract 1 from both sides of the equality.
$x > 7$	

Use the figure for Exercises 1 and 2.

1. Name the shortest segment from point K to $\overline{LN}$.

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2. Write and solve an inequality for x.

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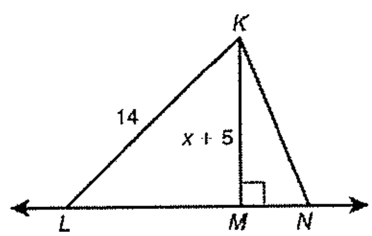

Use the figure for Exercises 3 and 4.

3. Name the shortest segment from point Q to $\overline{GH}$.

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4. Write and solve an inequality for x.

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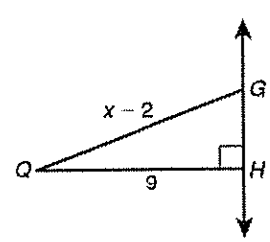
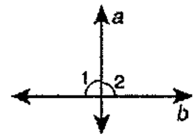
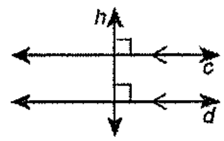
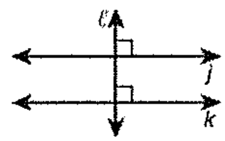


LESSON 3-4

Reteach

Perpendicular Lines continued

You can use the following theorems about perpendicular lines in your proofs.

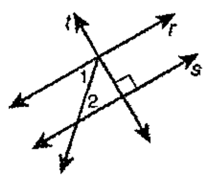
Theorem	Example
If two intersecting lines form a linear pair of congruent angles, then the lines are perpendicular. **Symbols:** 2 intersecting lines form lin. pair of ≅ ∠s → lines ⊥.	 ∠1 and ∠2 form a linear pair and ∠1 ≅ ∠2, so $a \perp b$.
Perpendicular Transversal Theorem In a plane, if a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other line. **Symbols:** ⊥ Transv. Thm.	 $h \perp c$ and $c \parallel d$, so $h \perp d$.
If two coplanar lines are perpendicular to the same line, then the two lines are parallel to each other. **Symbols:** 2 lines ⊥ to same line → 2 lines ||.	 $j \perp \ell$ and $k \perp \ell$, so $j \parallel k$.

5. Complete the two-column proof.

Given: ∠1 ≅ ∠2, $s \perp t$

Prove: $r \perp t$

Proof:



Statements	Reasons
1. ∠1 ≅ ∠2	1. Given
2. a.________________	2. Conv. of Alt. Int. ∠s Thm.
3. $s \perp t$	3. b.________________
4. $r \perp t$	4. c.________________

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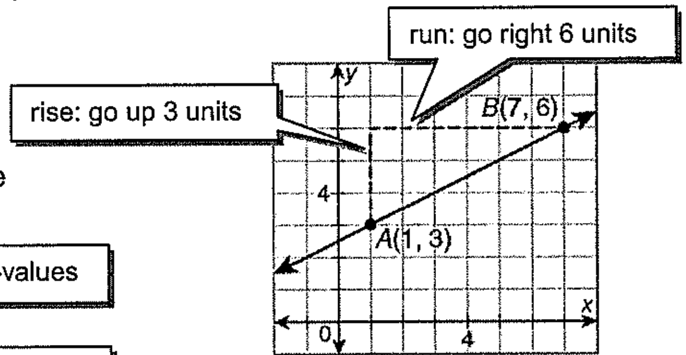
LESSON 3-5

Reteach

Slopes of Lines

The **slope** of a line describes how steep the line is. You can find the slope by writing the ratio of the **rise** to the **run.**

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{3}{6} = \frac{1}{2}$$



You can use a formula to calculate the slope *m* of the line through points (x_1, y_1) and (x_2, y_2).

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

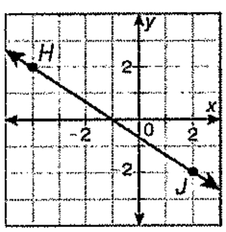
Change in *y*-values

Change in *x*-values

To find the slope of $\overleftrightarrow{AB}$ using the formula, substitute (1, 3) for (x_1, y_1) and (7, 6) for (x_2, y_2).

$m = \frac{y_2 - y_1}{x_2 - x_1}$	Slope formula
$= \frac{6-3}{7-1}$	Substitution
$= \frac{3}{6}$	Simplify.
$= \frac{1}{2}$	Simplify.

Use the slope formula to determine the slope of each line.



1. $\overleftrightarrow{HJ}$

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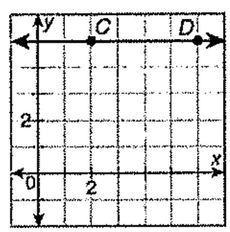

2. $\overleftrightarrow{CD}$

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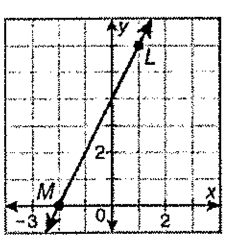

3. $\overleftrightarrow{LM}$

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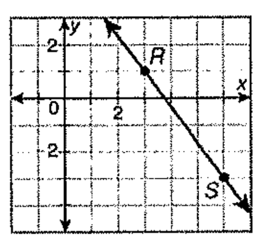

4. $\overleftrightarrow{RS}$

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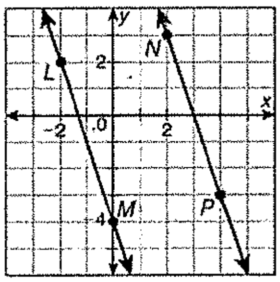
LESSON 3-5

Reteach

Slopes of Lines continued

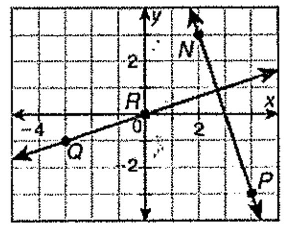
Slopes of Parallel and Perpendicular Lines



slope of $\overleftrightarrow{LM} = -3$

slope of $\overleftrightarrow{NP} = -3$

Parallel lines have the same slope.



slope of $\overleftrightarrow{NP} = -3$

slope of $\overleftrightarrow{QR} = \frac{1}{3}$

product of slopes:

$-3\left(\frac{1}{3}\right) = -1$

Perpendicular lines have slopes that are *opposite reciprocals*. The product of the slopes is –1.

Use slopes to determine whether each pair of distinct lines is parallel, perpendicular, or neither.

5. slope of $\overleftrightarrow{PQ} = 5$

   slope of $\overleftrightarrow{JK} = -\frac{1}{5}$

   ____

6. slope of $\overleftrightarrow{EF} = -\frac{3}{4}$

   slope of $\overleftrightarrow{CD} = -\frac{3}{4}$

   ____

7. slope of $\overleftrightarrow{BC} = -\frac{5}{3}$

   slope of $\overleftrightarrow{ST} = \frac{3}{5}$

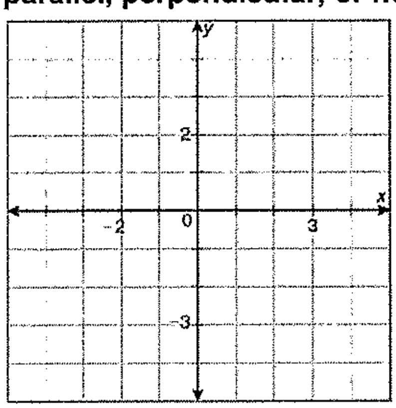
   ____

8. slope of $\overleftrightarrow{WX} = \frac{1}{2}$

   slope of $\overleftrightarrow{YZ} = -\frac{1}{2}$

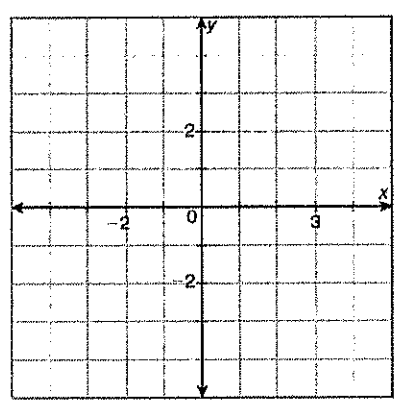
   ____

Graph each pair of lines. Use slopes to determine whether the lines are parallel, perpendicular, or neither.



9. $\overleftrightarrow{FG}$ and $\overleftrightarrow{HJ}$ for $F(-1, 2)$, $G(3, -4)$, $H(-2, -3)$, and $J(4, 1)$

   ____



10. $\overleftrightarrow{RS}$ and $\overleftrightarrow{TU}$ for $R(-2, 3)$, $S(3, 3)$, $T(-3, 1)$, and $U(3, -1)$

   ____

Name ______________________ Date ______________ Class ______________

LESSON 3-6

Reteach

Lines in the Coordinate Plane

Slope-Intercept Form	Point-Slope Form
$y = mx + b$ slope *y*-intercept $y = 4x + 7$	$y - y_1 = m(x - x_1)$ slope $y - 2 = \frac{1}{3}(x + 5)$ point on the line: $(x_1, y_1) = (-5, 2)$

Write the equation of the line through (0, 1) and (2, 7) in slope-intercept form.

Step 1: Find the slope.

$m = \frac{y_2 - y_1}{x_2 - x_1}$ Formula for slope

$= \frac{7-1}{2-0} = \frac{6}{2} = 3$

Step 2: Find the *y*-intercept.

$y = mx + b$ Slope-intercept form

$1 = 3(0) + b$ Substitute 3 for *m*, 0 for *x*, and 1 for *y*.

$1 = b$ Simplify.

Step 3: Write the equation.

$y = mx + b$ Slope-intercept form

$y = 3x + 1$ Substitute 3 for *m* and 1 for *b*.

Write the equation of each line in the given form.

1. the line through (4, 2) and (8, 5) in slope-intercept form

____

2. the line through (4, 6) with slope $\frac{1}{2}$ in point-slope form

____

3. the line through (–5, 1) with slope 2 in point-slope form

____

4. the line with *x*-intercept –5 and *y*-intercept 3 in slope-intercept form

____

5. the line through (8, 0) with slope $-\frac{3}{4}$ in slope-intercept form

____

6. the line through (1, 7) and (–6, 7) in point-slope form

____

Name ______________________ Date ______________ Class ______________

LESSON 3-6

Reteach

Lines in the Coordinate Plane continued

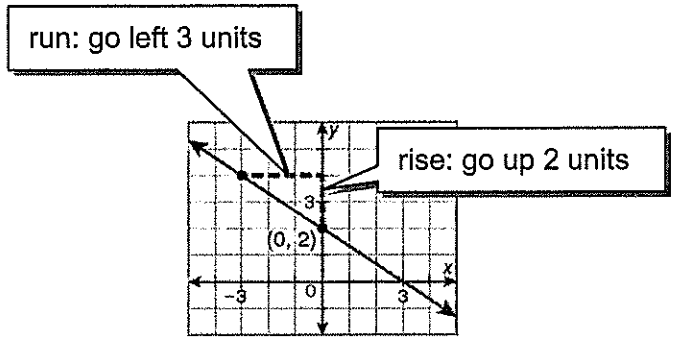
You can graph a line from its equation.

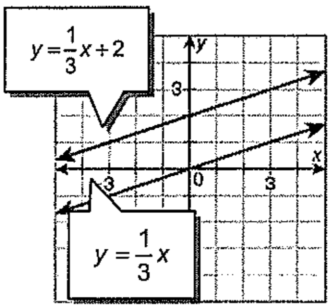
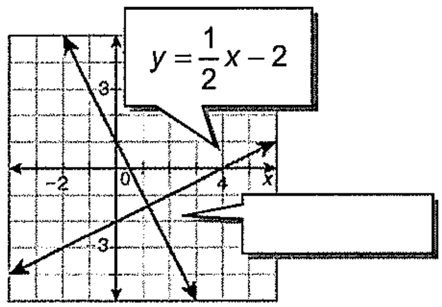
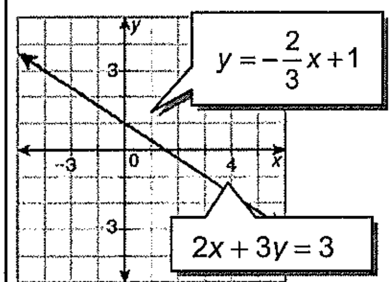
Consider the equation $y = -\frac{2}{3}x + 2$.

y-intercept = 2

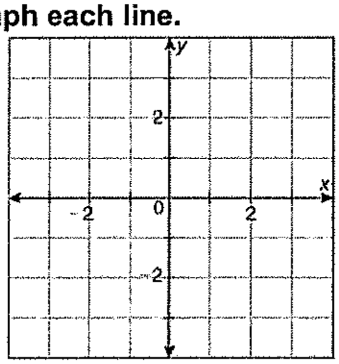
slope = $-\frac{2}{3}$

First plot the y-intercept (0, 2). Use rise 2 and run –3 to find another point. Draw the line containing the two points.

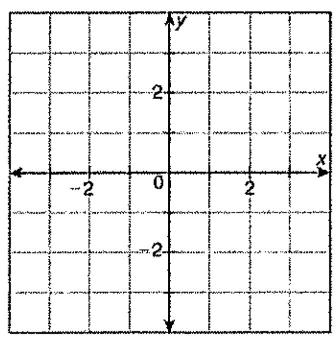


Parallel Lines	Intersecting Lines	Coinciding Lines
 same slope different y-intercepts	 different slopes	 same slope same y-intercept

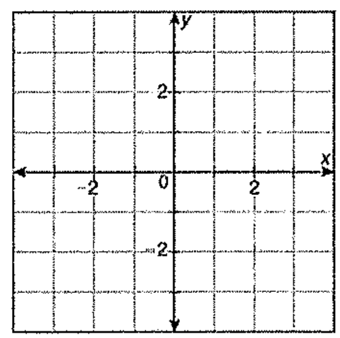
Graph each line.



7. $y = x - 2$



8. $y = -\frac{1}{3}x + 3$



9. $y - 2 = \frac{1}{4}(x + 1)$

Determine whether the lines are parallel, intersect, or coincide.

10. $y = 2x + 5$
    $y = 2x - 1$
    ____

11. $y = \frac{1}{3}x + 4$
    $x - 3y = -12$
    ____

12. $y = 5x - 2$
    $x + 4y = 8$
    ____

13. $5y + 2x = 1$
    $y = -\frac{2}{5}x + 3$
    ____