

Name: \_\_\_\_\_

# **Chapter 3:** **Parallel and Perpendicular Lines**

## **Guided Notes**

### 3.1 Identify Pairs of Lines and Angles

| Term                                       | Definition  | Example |
|--|---|---------|
| parallel lines<br>(// or   )               |   |         |
| skew lines                                 |   |         |
| parallel planes                            |   |         |
| Postulate 13<br>Parallel<br>Postulate      | If there is a line and a point not on the line, then there is exactly one line through the point parallel to the given line.      |         |
| Postulate 14<br>Perpendicular<br>Postulate | If there is a line and a point not on the line, then there is exactly one line through the point perpendicular to the given line. |         |
| Transversal                                | The lines the transversal intersects do not need to be parallel; the transversal can also be a ray or line segment.               |         |

| Angles formed by Transversals                           |  |  |
|---|--|--|
| exterior angles   |  |  |
| interior angles   |  |  |
| corresponding angles                                    |  |  |
| alternate interior angles                               |  |  |
| alternate exterior angles                               |  |  |
| consecutive interior angles (same-side interior angles) |  |  |

Examples:

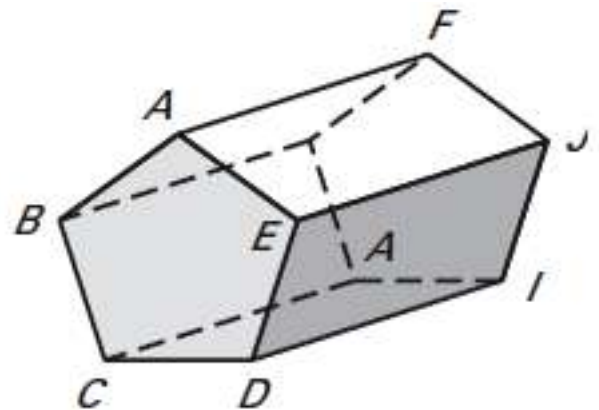
1. Think of each segment in the figure as part of a line. Which line(s) or plane(s) in the figure appear to fit the description?

a) Line(s) parallel to  $\overleftrightarrow{AF}$  and containing point E.

b) Line(s) skew to  $\overleftrightarrow{AF}$  and containing point E.

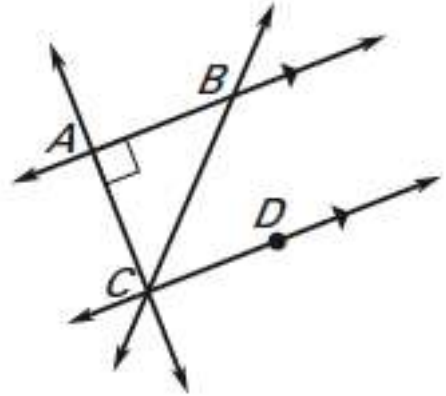
c) Line(s) perpendicular to  $\overleftrightarrow{AF}$  and containing point E.

d) Plane(s) parallel to plane  $FGH$  and containing point E.

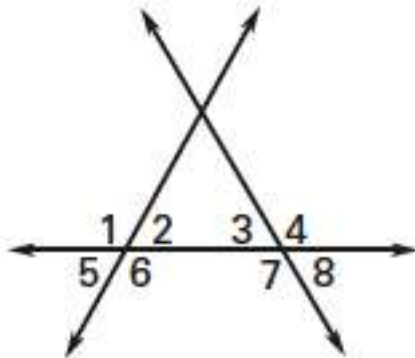


2. Use the diagram at the right to answer each question.

- a) Name a pair of parallel lines.
- b) Name a pair of perpendicular lines.
- c) Is  $\overleftrightarrow{AB} \perp \overleftrightarrow{BC}$  ?



3. From the diagram, identify all pairs of . . .



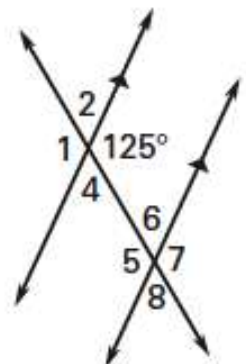
- a) corresponding angles \_\_\_\_\_
- b) alternate interior angles \_\_\_\_\_
- c) alternate exterior angles \_\_\_\_\_
- d) consecutive (same-side) interior angles \_\_\_\_\_

### 3.2 Use Parallel Lines and Transversals

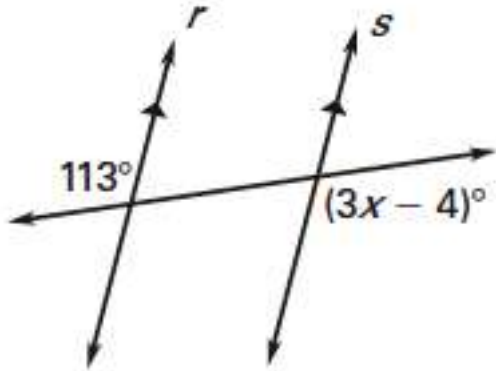
| Term   | Definition   | Example |
|--|--|---------|
| <b>Postulate 15<br/>Corresponding<br/>Angles Postulate</b>         | If two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent.          |         |
| <b>Theorem 3.1<br/>Alternate<br/>Interior Angles<br/>Theorem</b>   | If two parallel lines are cut by a transversal, then the pairs of alternate interior angles are congruent.     |         |
| <b>Theorem 3.2<br/>Alternate<br/>Exterior Angles<br/>Theorem</b>   | If two parallel lines are cut by a transversal, then the pairs of alternate exterior angles are congruent.     |         |
| <b>Theorem 3.3<br/>Consecutive<br/>Interior Angles<br/>Theorem</b> | If two parallel lines are cut by a transversal, then the pairs of same side interior angles are supplementary. |         |

Examples:

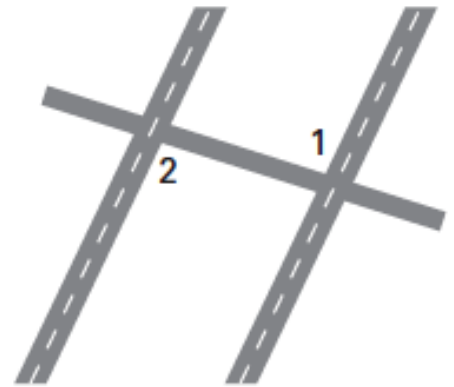
- Given the diagram at right, which numbered angles have a measure of  $125^\circ$ ?



2. Find the value of  $x$ .



3. A taxiway is being constructed that intersects two parallel runways at an airport. You know that  $m\angle 2 = 98^\circ$ . What is  $m\angle 1$ ? How do you know?

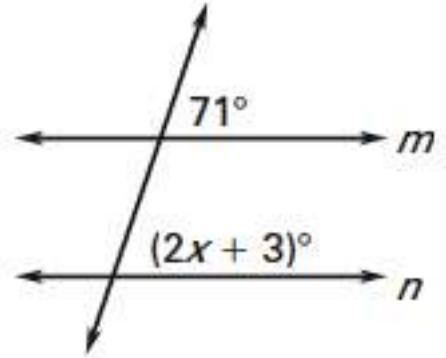


### 3.3 Prove Lines are Parallel

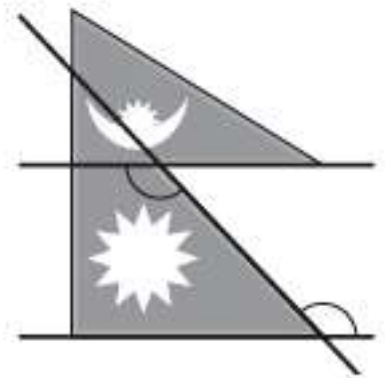
| Term   | Definition   | Example |
|--|--|---------|
| <b>Postulate 16<br/>Corresponding<br/>Angles Converse</b>            | If two lines are cut by a transversal so the corresponding angles are congruent, then the lines are parallel.            |         |
| <b>Theorem 3.4<br/>Alternate<br/>Interior Angles<br/>Converse</b>    | If two lines are cut by a transversal so the alternate interior angles are congruent, then the lines are parallel.       |         |
| <b>Theorem 3.5<br/>Alternate<br/>Exterior Angles<br/>Converse</b>    | If two lines are cut by a transversal so the alternate exterior angles are congruent, then the lines are parallel.       |         |
| <b>Theorem 3.6<br/>Consecutive<br/>Interior Angles<br/>Converse</b>  | If two lines are cut by a transversal so the consecutive interior angles are supplementary, then the lines are parallel. |         |
| <b>paragraph proof</b>   |  |         |
| <b>Theorem 3.7<br/>Transitive<br/>Property of<br/>Parallel Lines</b> | If two lines are parallel to the same line, then they are parallel to each other.  |         |

Examples:

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

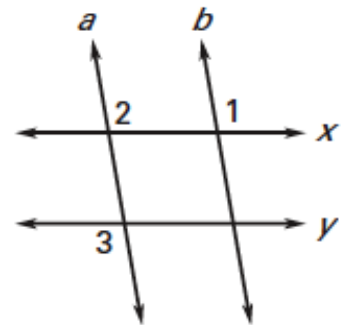
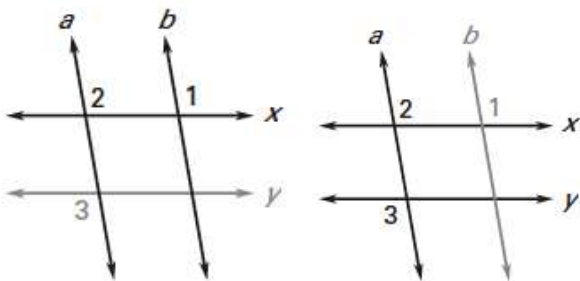


2. How can you tell whether the sides of the flag of Nepal are parallel?



3. Write a paragraph proof. In the figure,  $a \parallel b$  and  $\angle 1$  is congruent to  $\angle 3$ .  
Prove  $x \parallel y$ .

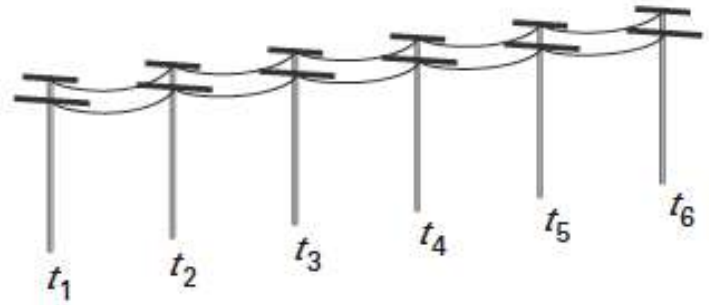
Plan:



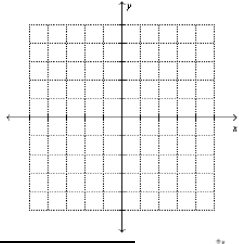
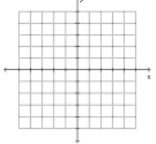
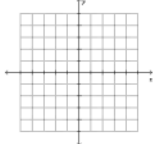
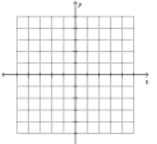
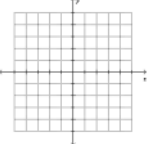
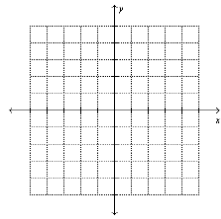
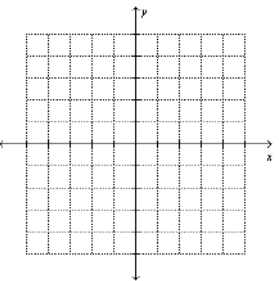
Proof:



4. Each utility pole shown is parallel to the pole immediately to its right. Use the Transitive Property of Parallel Lines to explain why the leftmost pole is parallel to the rightmost pole.

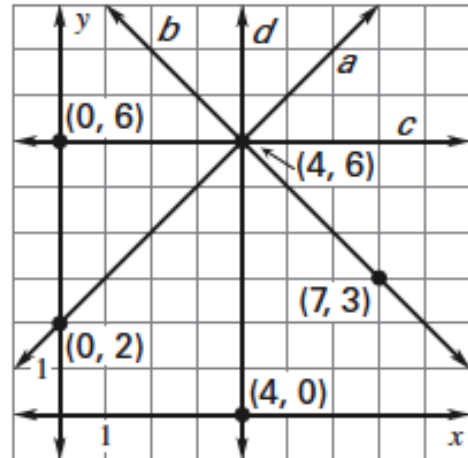


### 3.4 Find and Use Slopes of Lines

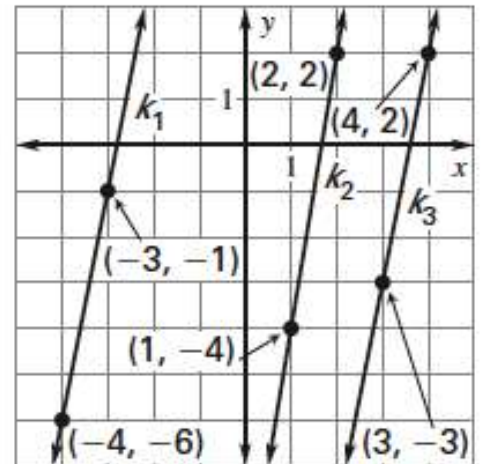
| Term  | Definition  | Example   |
|---|---|---|
| slope   |   |    |
| positive slope                                      |   |    |
| negative slope                                      |   |    |
| zero slope<br>(slope of zero)<br>(no slope)         | A horizontal line.  |   |
| undefined slope                                     | A vertical line.  |  |
| Postulate 17<br>Slopes of<br>Parallel Lines         | In a coordinate plane, two nonvertical lines are parallel if and only if they have the same slope.<br><br>Any two vertical lines are parallel.  |  |
| Postulate 18<br>Slopes of<br>Perpendicular<br>Lines | In a coordinate plane, two nonvertical lines are perpendicular if and only if the product of their slopes is $-1$ .<br><br>The slopes of the two lines that are perpendicular are negative reciprocals of each other. Horizontal lines are perpendicular to vertical lines. |  |
| "if and only if"<br>form<br>(iff)                   | The form used when both a conditional and its converse are true.  |   |

Examples:

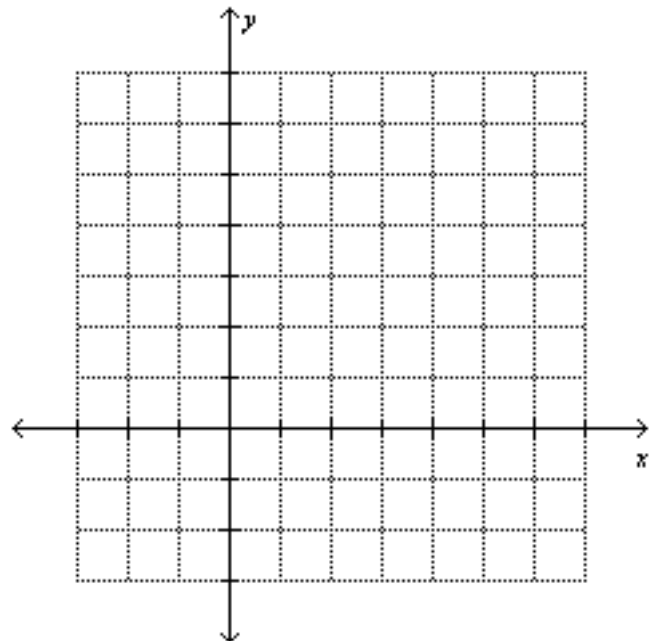
1. Find the slope of line  $a$  and line  $c$ .



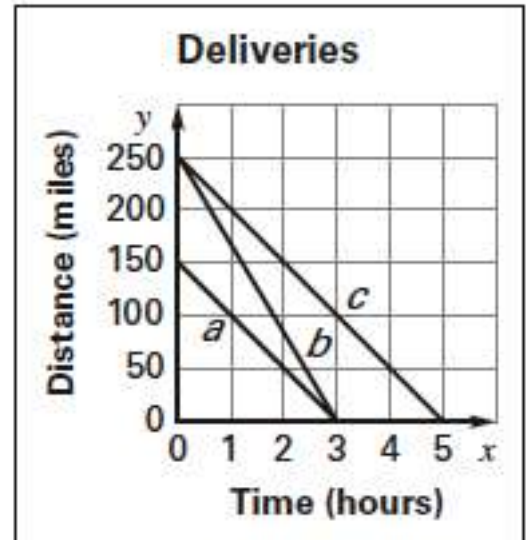
2. Find the slope of each line. Which lines are parallel?



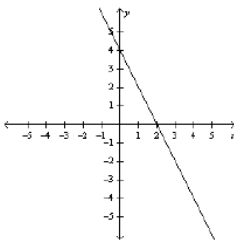
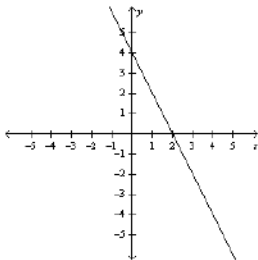
3. Line  $h$  passes through points  $(1, -2)$  and  $(5, 6)$ . Graph the line perpendicular to  $h$  that passes through the point  $(5, 2)$ .



4. Analyze the graph. A trucker made three deliveries. The graph shows the trucker's distance to the destination from the starting time to the arrival time for each delivery. Use the slopes of the lines to make a statement about the deliveries.

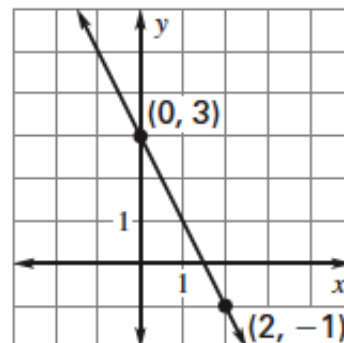


### 3.5 Write and Graph Equations of Lines

| Term                 | Definition | Example  |
|----------------------|------------|--|
| slope-intercept form |            |  |
| standard form        |            |  |
| x-intercept          |            |   |
| y-intercept          |            |  |

Examples:

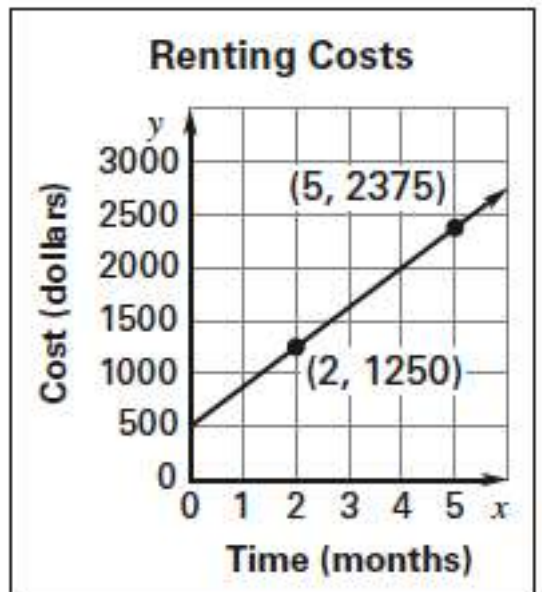
- Write an equation of the line in slope-intercept form.



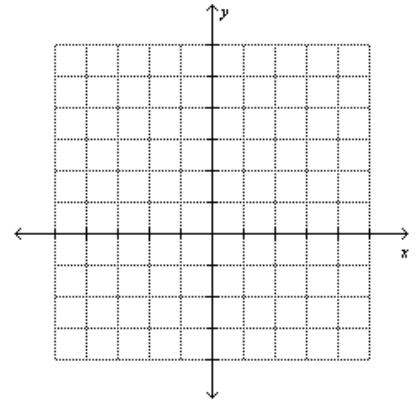
2. Write an equation of the line passing through the point  $(1,-1)$  that is parallel to the line with the equation  $y=2x-1$ .

3. Write an equation of the line passing through the point  $(3,2)$  that is perpendicular to the line with the equation  $y=-3x+1$ .

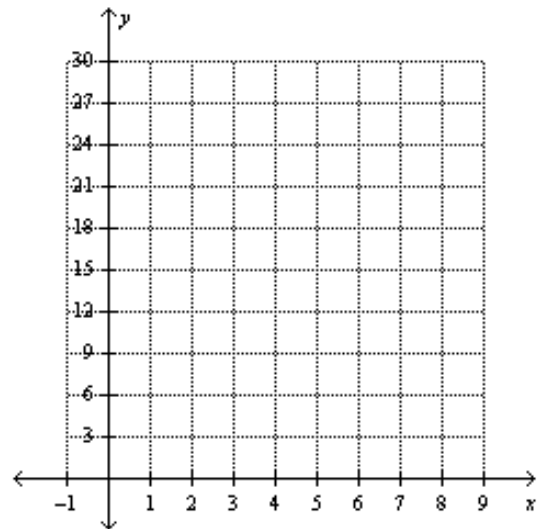
4. The graph at right models the total cost of renting an apartment. Write an equation of the line. Explain the meaning of the slope and the y-intercept of the line.



5. Graph  $2x+3y=6$ . The equation is in **STANDARD FORM**, so use the intercepts.



6. Solve a real world problem. You can buy a magazine at a store for \$3. You can subscribe yearly to the magazine for a flat fee of \$18. After how many magazines is the subscription a better buy?



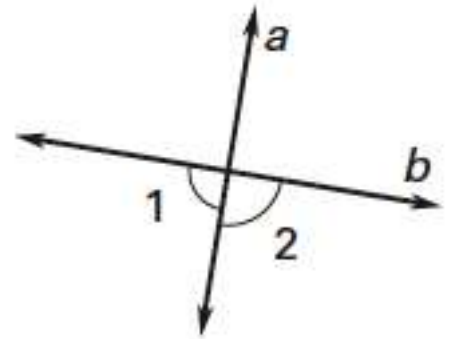
### 3.6 Prove Theorems about Perpendicular Lines

| Term  | Definition   | Example |
|---|--|---------|
| Theorem 3.8   | If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular.    |         |
| Theorem 3.9   | If two lines are perpendicular, then they intersect to form four right angles.                         |         |
| Theorem 3.10  | If two sides of two adjacent acute angles are perpendicular, then the angles are complementary.        |         |
| Theorem 3.11<br>Perpendicular<br>Transversal<br>Theorem               | If a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other. |         |
| Theorem 3.12<br>Lines<br>Perpendicular to<br>a Transversal<br>Theorem | In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.     |         |
| distance from a<br>point to a line                                    |  |         |
| distance<br>between two<br>parallel lines                             |  |         |



Examples:

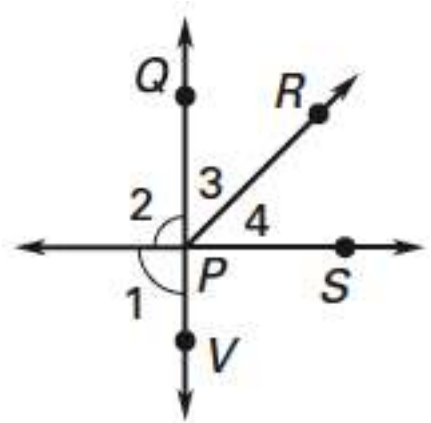
1. In the diagram at right,  $\angle 1 \cong \angle 2$ . What can you conclude about  $a$  and  $b$ ?



2. In the diagram at right,  $\angle 1 \cong \angle 2$ . Prove that  $\angle 3$  and  $\angle 4$  are complementary.

Given:

Prove:



Statements

Reasons

1.  $\angle 1 \cong \angle 2$

1. \_\_\_\_\_

2. \_\_\_\_\_

2. *lin.pr.*,  $\cong \angle s \rightarrow \perp$

3.  $\angle 3$  and  $\angle 4$  are complementary.

3. \_\_\_\_\_

3. Determine which lines, if any, are parallel in the diagram. Explain.

