Name:

Save this packet so you can use it on the Final Exam!

3.1 Identify Pairs of Lines and Angles

Goal • Identify angle pairs formed by three intersecting lines.

Complete the vocab. with definitions or pictures that make sense to you.

Your Notes

Rewrite the Goal as an "I can" statement!

VOCABULARY

Parallel lines

Skew lines

Parallel planes

Transversal

Corresponding angles

Alternate interior angles

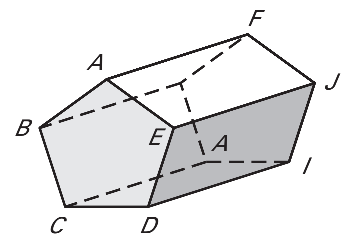
Alternate exterior angles

Consecutive interior angles

Your Notes

Example 1 *Identify relationships in space*

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*

Solution

a. ______________ all appear parallel to $\overleftrightarrow{AF}$, but only ____ contains point *E*.

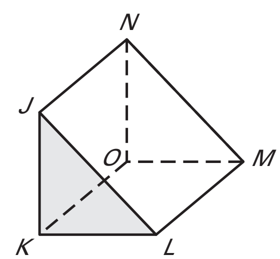
b. ____________________ all appear skew to $\overleftrightarrow{AF}$, but only ____ contains point *E*.

c. ______________ all appear perpendicular to $\overleftrightarrow{AF}$, but only ____ contains point *E*.

d. Plane ______ appears parallel to plane *FGH* and contains point *E*.

Stop and get the teacher's signature before you move on.

Checkpoint **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?**



1. parallel to $\overleftrightarrow{MN}$ and contains *J*

____

2. skew to $\overleftrightarrow{MN}$ and contains *J*

____

3. perpendicular to $\overleftrightarrow{MN}$ and contains *J*

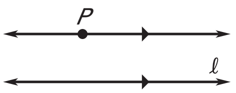
____

4. Name the plane that contains *J* and appears to be parallel to plane *MNO*.

Your Notes

POSTULATE 13 PARALLEL POSTULATE

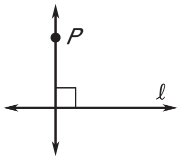
If there is a line and a point not on the line, then there is ______________ line through the point parallel to the given line.



There is exactly one line through P parallel to ℓ.

POSTULATE 14 PERPENDICULAR POSTULATE

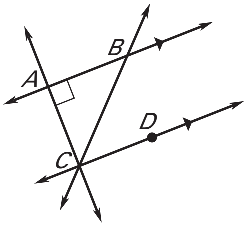
If there is a line and a point not on the line, then there is ______________ line through the point perpendicular to the given line.



There is exactly one line through P perpendicular to ℓ.

Example 2 ***Identify parallel and perpendicular lines***

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 $\overleftrightarrow{AB} \perp \overleftrightarrow{BC}$? *Explain.*

Solution

a.

b.

c. $\overleftrightarrow{AB}$ ________ perpendicular to $\overleftrightarrow{BC}$, because $\overleftrightarrow{AB}$ is perpendicular to $\overleftrightarrow{AC}$ and by the ________________ Postulate there is exactly one line perpendicular to _____ through ___.

Stop and get the teacher's signature before you move on.

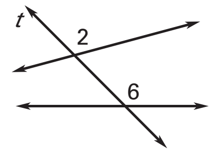
✔ ***Checkpoint*** **Complete the following exercise.**

5. In Example 2, can you use the Perpendicular Postulate to show that $\overleftrightarrow{AC} \perp \overleftrightarrow{CD}$? *Explain.*

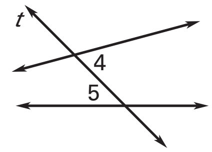
Your Notes

ANGLES FORMED BY TRANSVERSALS

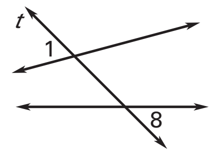
Two angles are _______________ angles if they have corresponding positions. For example, ∠2 and ∠6 are above the lines and to the right of the transversal *t*.



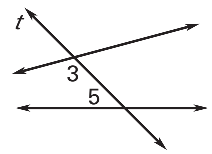
Two angles are _______________ angles if they lie between the two lines and on opposite sides of the transversal.



Two angles are _______________ angles if they lie outside the two lines and on opposite sides of the transversal.



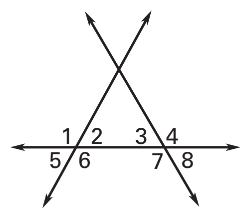
Two angles are _______________ angles if they lie between the two lines and on the same side of the transversal.



Another name for consecutive interior angles is _______________ _______________ _______________

Example 3 ***Identify angle relationships***

Identify all pairs of (a) corresponding angles, (b) alternate interior angles, (c) alternate exterior angles, and (d) consecutive interior angles.



a. ∠1 and _____, ∠2 and _____,
∠5 and _____, _____ and _____

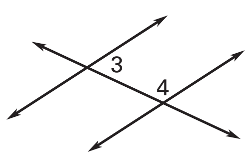
b. ∠2 and _____, _____ and _____

c. ∠5 and _____, _____ and _____

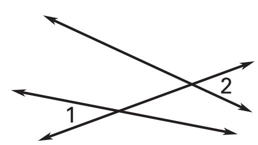
d. ∠2 and _____, _____ and _____

Checkpoint **Classify the pair of numbered angles.**

6.



7.



Stop and get the teacher's signature before you move on.

3.2 Use Parallel Lines and Transversals

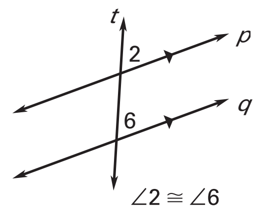
Goal • Use angles formed by parallel lines and transversals.

Your Notes

Rewrite the Goal as an "I can" statement!

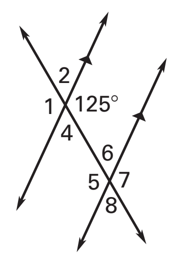
POSTULATE 15 CORRESPONDING ANGLES POSTULATE

If two parallel lines are cut by a transversal, then the pairs of corresponding angles are ____________.



Example 1 ***Identify congruent angles***

The measure of three of the numbered angles is 125°. Identify the angles. *Explain* your reasoning.



Solution

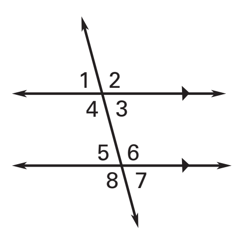
By the Corresponding Angles Postulate, ________ = 125°.

Using the Vertical Angles Congruence Theorem, ________ = 125°.

Because ∠1 and ∠5 are corresponding angles, by the ________________________________, you know that ________ = 125°.

✔ ***Checkpoint*** **Complete the following exercise using the diagram shown.**

1. If $m\angle 7 = 75°$, find $m\angle 1$, $m\angle 3$, and $m\angle 5$. Tell which postulate or theorem you use in each case.

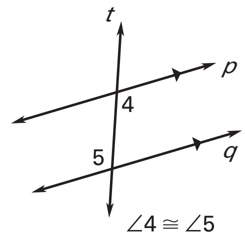


Stop and get the teacher's signature before you move on.

Your Notes

THEOREM 3.1 ALTERNATE INTERIOR ANGLES THEOREM

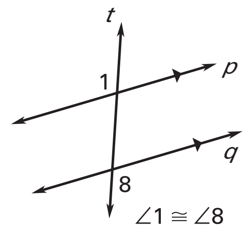
If two parallel lines are cut by a transversal, then the pairs of alternate interior angles are ____________.



$\angle 4 \cong \angle 5$

THEOREM 3.2 ALTERNATE EXTERIOR ANGLES THEOREM

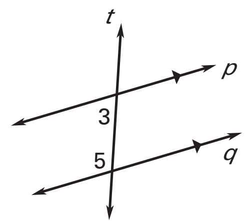
If two parallel lines are cut by a transversal, then the pairs of alternate exterior angles are ____________.



$\angle 1 \cong \angle 8$

THEOREM 3.3 CONSECUTIVE INTERIOR ANGLES THEOREM

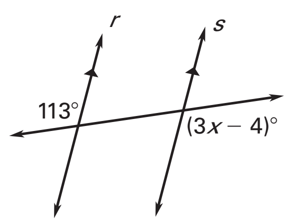
If two parallel lines are cut by a transversal, then the pairs of consecutive interior angles are ________________.



$\angle 3$ and $\angle 5$ are supplementary.

Example 2 ***Use properties of parallel lines***

Find the value of *x*.



Solution

Lines *r* and *s* are _________, so you can use the theorems about parallel lines.

______ = $(3x - 4)°$ __________________________ __________

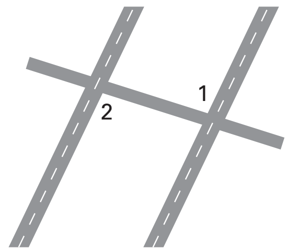
______ = $3x$ **Add ___ to each side.**

_____ = x **Divide each side by ___.**

The value of *x* is ____.

Your Notes

Example 3 ***Solve a real-world problem***



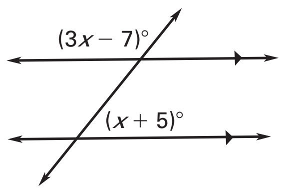
Runways A taxiway is being constructed that intersects two parallel runways at an airport. You know that $m\angle 2 = 98°$. What is $m\angle 1$? How do you know?

Solution

Because the runways are parallel, $\angle 1$ and $\angle 2$ are ____________________. By the Alternate Interior Angles Theorem, $\angle 1 \cong$ _____. By the definition of congruent angles, $m\angle 1 =$ _______ $=$ _____.

Checkpoint **Complete the following exercises.**

2. Find the value of x.



3. In Example 3, suppose $\angle 3$ is the consecutive interior angle with $\angle 2$. What is $m\angle 3$?

Stop and get the teacher's signature before you move on.

Homework

3.3 Prove Lines are Parallel

Goal • Use angle relationships to prove that lines are parallel.

Complete the vocab. with definitions or pictures that make sense to you.

Your Notes

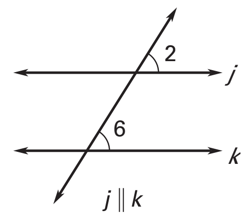
Rewrite the Goal as an "I can" statement!

VOCABULARY

Paragraph proof

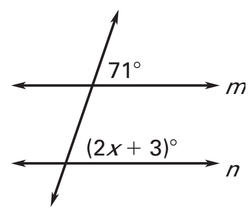
POSTULATE 16 CORRESPONDING ANGLES CONVERSE

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



Example 1 ***Apply the Corresponding Angles Converse***

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



Solution

Lines m and n are parallel if the marked corresponding angles are congruent.

$(2x + 3)° =$ _____ **Use Postulate 16 to write an equation.**

$2x =$ _____ **Subtract ___ from each side.**

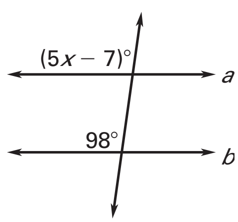
$x =$ _____ **Divide each side by ___.**

The lines m and n are parallel when $x =$ _____.

Stop and get the teacher's signature before you move on.

Checkpoint **Find the value of x that makes $a \parallel b$.**

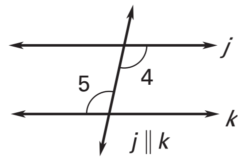
1.



Your Notes

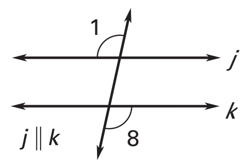
THEOREM 3.4 ALTERNATE INTERIOR ANGLES CONVERSE

If two lines are cut by a transversal so the alternate interior angles are congruent, then the lines are __________.



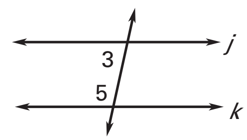
THEOREM 3.5 ALTERNATE EXTERIOR ANGLES CONVERSE

If two lines are cut by a transversal so the alternate exterior angles are congruent, then the lines are __________.



THEOREM 3.6 CONSECUTIVE INTERIOR ANGLES CONVERSE

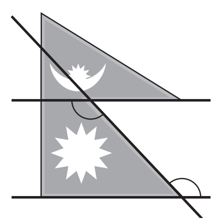
If two lines are cut by a transversal so the consecutive interior angles are supplementary, then the lines are __________.



If $\angle 3$ and $\angle 5$ are supplementary, then $j \parallel k$.

Example 2 ***Solve a real-world problem***

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



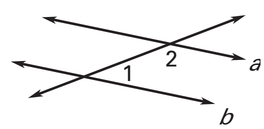
Solution

Because the ______________________________ are congruent, you know that the sides of the flag are __________.

✔ ***Checkpoint*** **Can you prove that lines *a* and *b* are parallel? *Explain* why or why not.**

Stop and get the teacher's signature before you move on.

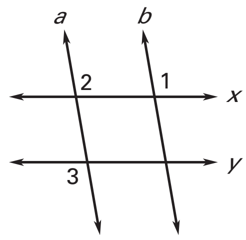
2. $m\angle 1 + m\angle 2 = 180°$



Your Notes

Example 3 *Write a paragraph proof*

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

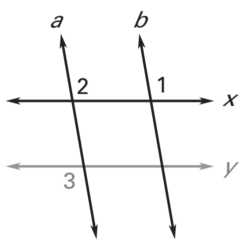


Solution

Look at the diagram to make a plan. The diagram suggests that you look at angles 1, 2, and 3. Also, you may find it helpful to focus on one pair of lines and one transversal at a time.

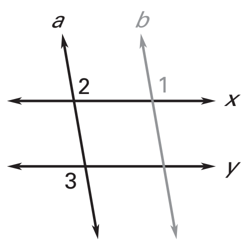
Plan for Proof

a. Look at $\angle 1$ and $\angle 2$.



_____________ because $a \parallel b$.

b. Look at $\angle 2$ and $\angle 3$.



If $\angle 2 \cong \angle 3$ then _______.

In paragraph proofs, transitional words such as *so, then*, and *therefore* help to make the logic clear.

Plan in Action

a. It is given that $a \parallel b$, so by the ____________________ ____________________, $\angle 1 \cong \angle 2$.

b. It is also given that $\angle 1 \cong \angle 3$. Then _____________ by the Transitive Property of Congruence for angles. Therefore, by the ____, $x \parallel y$.

Checkpoint **Complete the following exercise.**

3. In Example 3, suppose it is given that $\angle 1 \cong \angle 3$ and $x \parallel y$. Complete the following paragraph proof showing that $a \parallel b$.

It is given that $x \parallel y$. By the Exterior Angles Postulate, _____________.

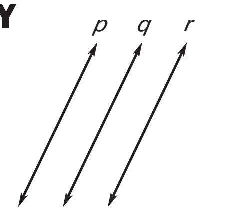
It is also given that $\angle 1 \cong \angle 3$. Then _____________ by the Transitive Property of Congruence for angles. Therefore, by the ____________________________ ____________, $a \parallel b$.

Stop and get the teacher's signature before you move on.

Your Notes

THEOREM 3.7 TRANSITIVE PROPERTY OF PARALLEL LINES

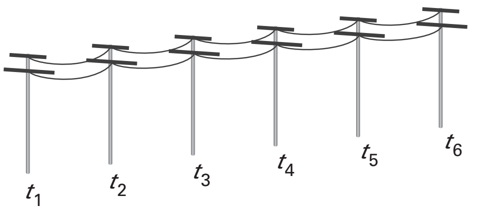
If two lines are parallel to the same line, then they are ______ to each other.



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

Example 4 *Use the Transitive Property of Parallel Lines*

Utility poles Each utility pole shown is parallel to the pole immediately to its right. *Explain* why the leftmost pole is parallel to the rightmost pole.



When you name several similar items, you can use one variable with subscripts to keep track of the items.

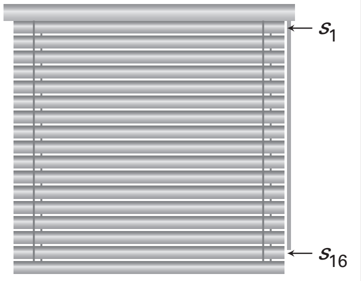
Solution

The poles from left to right can be named $t_1, t_2, t_3, \ldots, t_6$. Each pole is parallel to the one to its right, so $t_1 \parallel$ ___, $t_2 \parallel$ ___, and so on. Then $t_1 \parallel t_3$ by the ________ ____________________. Similarly, because $t_3 \parallel t_4$, it follows that $t_1 \parallel$ ___. By continuing this reasoning, $t_1 \parallel$ ___. So, the leftmost pole is parallel to the rightmost pole.

✔ ***Checkpoint*** **Complete the following exercise.**

Stop and get the teacher's signature before you move on.

4. Each horizontal piece of the window blinds shown is called a slat. Each slat is parallel to the slat immediately below it. *Explain* why the top slat is parallel to the bottom slat.



Homework

3.4 Find and Use Slopes of Lines

Goal • Find and compare slopes of lines.

Complete the vocab. with definitions or pictures that make sense to you.

Your Notes

Rewrite the Goal as an "I can" statement!

VOCABULARY
Slope

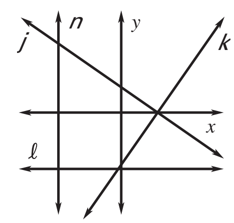
SLOPE OF LINES IN THE COORDINATE PLANE

Negative slope: ______ from left to right, as in line *j*

Positive slope: ______ from left to right, as in line *k*

Undefined slope: __________, as in line *n*

Zero slope (slope of 0): ____________, as in line ℓ



Slope

$m = \frac{\text{rise}}{\text{run}}$

$= \frac{y_2 - y_1}{x_2 - x_1}$

Example 1 ***Find slopes of lines in a coordinate plane***

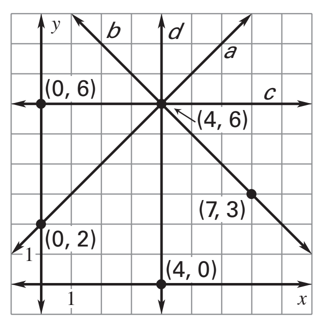
Find the slope of line *a* and line *c*.

Slope of line *a*:

$$m = \frac{6 - \square}{4 - \square} = \frac{\square}{\square} = \_\_\_$$

Slope of line *c*:

$$m = \frac{6 - \square}{4 - \square} = \frac{\square}{\square} = \_\_\_$$



Stop and get the teacher's signature before you move on.

Checkpoint **Use the graph in Example 1. Find the slope of the line.**

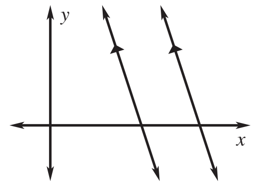
1. line *b*	**2.** line *d*

Your Notes

POSTULATE 17 SLOPES OF PARALLEL LINES

In a coordinate plane, two nonvertical lines are parallel if and only if they have the same _______.

Any two _________ lines are parallel.

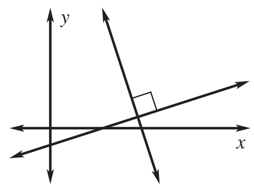


$m_1 = m_2$

POSTULATE 18 SLOPES OF PERPENDICULAR LINES

In a coordinate plane, two nonvertical lines are perpendicular if and only if the product of their slopes is _____.

Horizontal lines are _______________ to vertical lines.

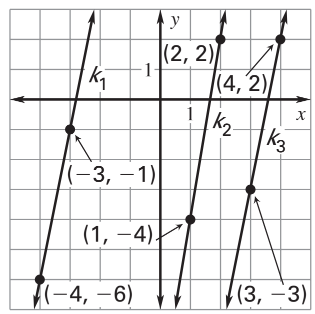


$m_1 \cdot m_2 = -1$

If the product of two numbers is -1, then the numbers are called *negative reciprocals*.

Example 2 *Identify parallel lines*

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



Solution

Find the slope of k_1.

$m = \frac{\_\_\_\_\_\_\_}{\_\_\_\_\_\_\_} = \frac{\_\_}{\_\_} = \_\_\_$

Find the slope of k_2.

$m = \frac{\_\_\_\_\_\_\_}{\_\_\_\_\_\_\_} = \_\_\_$

Find the slope of k_3.

$m = \frac{\_\_\_\_\_\_\_}{\_\_\_\_\_\_\_} = \_\_\_$

Compare the slopes. Because ____ and ____ have the same slope, they are _________. The slope of ____ is different, so ____ is ____________ to the other lines.

✔ ***Checkpoint*** **Complete the following exercise.**

3. Line c passes through $(2, -2)$ and $(5, 7)$. Line d passes through $(-3, 4)$ and $(1, -8)$. Are the two lines parallel? *Explain* how you know.

Stop and get the teacher's signature before you move on.

Your Notes

Example 3 *Draw a perpendicular line*

Line *h* passes through (1, −2) and (5, 6). Graph the line perpendicular to *h* that passes through the point (2, 5).

Step 1 **Find** the slope m_1 of *h* through (1, −2) and (5, 6).

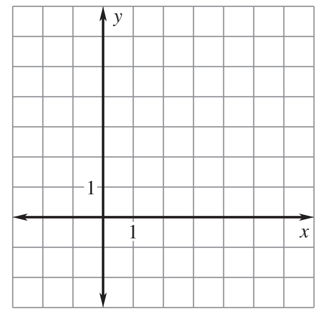
$$m_1 = \_\_\_\_\_\_\_\_ = \_\_\_ = \_\_\_$$

Step 2 **Find** the slope m_2 of a line perpendicular to *h*.

$$\_\_\_ \cdot m_2 = -1$$

$$m_2 = \_\_\_\_$$

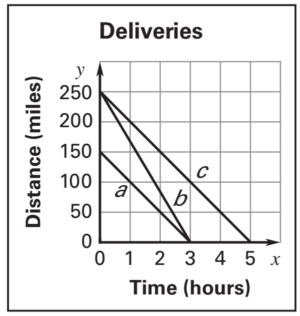
Step 3 **Use** the rise and run to graph the line.



Given a point on a line and the line's slope, you can use the rise and run to find a second point and draw the line.

Example 4 *Analyze graphs*

Delivery 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 slopes to make a statement about the deliveries.



The rate at which the trucker drives is represented by the _______ of the segments. Segments ___ and ___ have the same slope, so deliveries *a* and *c* were driven at the same _____.

Stop and get the teacher's signature before you move on.

Homework

✔ ***Checkpoint*** **Complete the following exercises.**

4. Line *n* passes through (1, 6) and (8, 4). Line *m* passes through (0, 5) and (2, 12). Is $n \perp m$? *Explain.*

5. In Example 4, which delivery included the fastest rate of travel?

3.5 Write and Graph Equations of Lines

Goal • Find equations of lines.

Your Notes

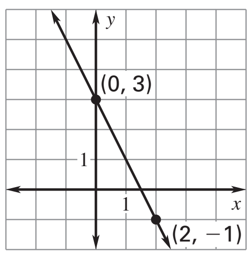
Rewrite the Goal as an "I can" statement!

VOCABULARY
Slope-intercept form
Standard form

Complete the vocab. with definitions or pictures that make sense to you.

Example 1 ***Write an equation of a line from a graph***

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



Solution

Step 1 **Find** the slope. Choose two points on the graph of the line, (0, 3) and (2, −1).

$m = \frac{\qquad}{\qquad} = \frac{\quad}{\quad} =$ ____

Step 2 **Find** the y-intercept. The line intersects the y-axis at the point ______, so the y-intercept is ___.

Step 3 **Write** the equation.

$y = mx + b$ **Use slope-intercept form.**

$y =$ __________ **Substitute _____ for *m* and ___ for *b*.**

Your Notes

The graph of a linear equation represents all the solutions of the equation. So, the given point must be a solution of the equation.

Stop and get the teacher's signature before you move on.

Example 2 *Write an equation of a parallel line*

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

Solution

Step 1 **Find** the slope m. The slope of a line parallel to $y = 2x - 1$ is the same as the given line, so the slope is ___.

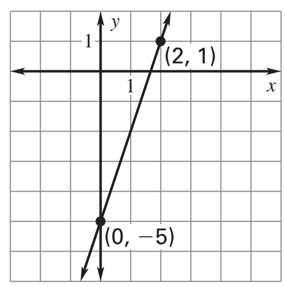
Step 2 **Find** the y-intercept b by using $m =$ ___ and $(x, y) =$ ________.

$y = mx + b$	**Use slope-intercept form.**
_____ = ___(___) + b	**Substitute for x, y, and m.**
_____ = b	**Solve for b.**

Because $m =$ ___ and $b =$ _____, an equation of the line is $y =$ ________.

Checkpoint **Complete the following exercises.**

1. Write an equation of the line in the graph at the right.



2. Write an equation of the line that passes through the point (−2, 5) and is parallel to the line with the equation $y = -2x + 3$.

Your Notes

Example 3 *Write an equation of a perpendicular line*

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

Solution

Step 1 **Find** the slope m of line j. The slope of k is _____.

_____ • m = _____ **The product of the slopes of perpendicular lines is _____.**

m = ___ **Divide each side by _____.**

Step 2 **Find** the y-intercept b by using m = ___ and (x, y) = _______.

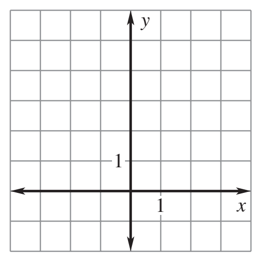
$y = mx + b$ **Use slope-intercept form.**

___ = ___(___) + b **Substitute for x, y, and m.**

___ = b **Solve for b.**

Because m = ___ and b = ___, an equation of line j is y = _________.

You can check that the lines j and k are perpendicular by graphing, then using a protractor to measure one of the angles formed by the lines.



Checkpoint **Complete the following exercise.**

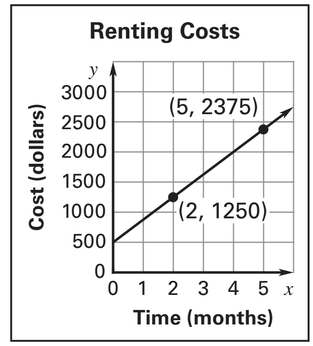
3. Write an equation of the line passing through the point (−8, −2) that is perpendicular to the line with the equation $y = 4x - 3$.

Stop and get the teacher's signature before you move on.

Your Notes

Example 4 *Write an equation of a line from a graph*

Rent The graph 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.



Step 1 **Find** the slope.

$m = \frac{\_\_\_\_\_\_}{\_\_\_\_\_\_}$

$= \frac{\_\_\_\_\_\_}{\_\_\_\_\_\_} = \_\_\_\_\_\_$

Step 2 **Find** the *y*-intercept. Use a point on the graph.

$y = mx + b$	**Use slope-intercept form.**
$\_\_\_\_ = \_\_\_\_ \cdot \_\_\_ + b$	**Substitute.**
$\_\_\_\_ = b$	**Simplify.**

Step 3 **Write** the equation. Because $m =$ ______ and $b =$ ______, an equation is $y =$ ______________.

The equation $y =$ ______________ models the cost. The slope is the ________________, and the ______________ is the initial cost to rent the apartment.

Example 5 *Graph a line with equation in standard form*

Graph $2x + 3y = 6$.

The equation is in standard form, so use the _____________.

Step 1 **Find** the intercepts.

To find the *x*-intercept, let $y =$ ___.

$2x + 3y = 6$

$2x + 3(\_\_\_) = 6$

$x =$ ___

To find the *y*-intercept, let $x =$ ___.

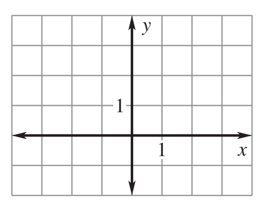
$2x + 3y = 6$

$2(\_\_\_) + 3y = 6$

$y =$ ___

Step 2 **Graph** the line.

The intercepts are _______ and _______. Graph these points, then draw a line through the points.



Your Notes

The point at which the costs are the same is sometimes called the *break-even point*.

Stop and get the teacher's signature before you move on.

Homework

Example 6 *Solve a real-world problem*

Subscriptions 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?

Solution

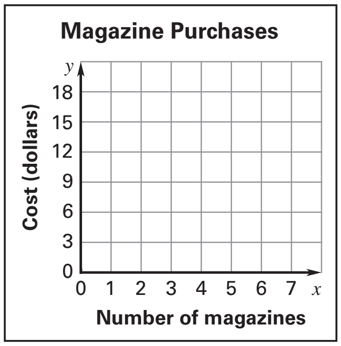
Step 1 **Model** each purchase with an equation.

Cost of yearly subscription: $y =$ ____

Cost of one magazine: $y =$ ___x, where x represents the number of magazines

Step 2 **Graph** each equation.

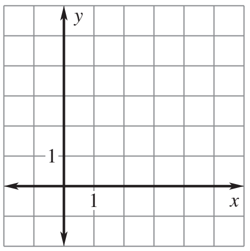
The point of intersection is ________. Using the graph, you can see that it is cheaper to buy magazines individually if you buy less than ___ magazines per year. If you buy more than ___ magazines per year, it is cheaper to buy a subscription.



✓ *Checkpoint* **Complete the following exercises.**

4. The equation $y = 650x + 425$ models the total cost of joining a health club for x years. What are the meaning of the slope and y-intercept of the line?

5. Graph $y = 3$ and $x = 3$.



6. In Example 6, suppose you can buy the magazine at a different store for \$2.50. After how many magazines is the subscription the better buy?

3.6 Prove Theorems About Perpendicular Lines

Goal • Find the distance between a point and a line.

Your Notes

Rewrite the Goal as an "I can" statement!

VOCABULARY

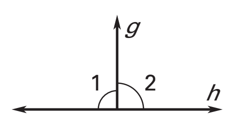
Distance from a point to a line

Complete the vocab. with definitions or pictures that make sense to you.

THEOREM 3.8

If two lines intersect to form a linear pair of congruent angles, then the lines are ______________.

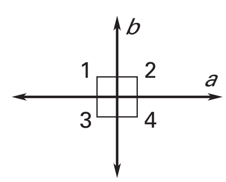
If $\angle 1 \cong \angle 2$, then g ___ h.



THEOREM 3.9

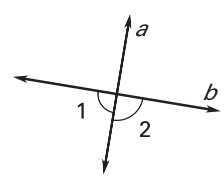
If two lines are perpendicular, then they intersect to form four ____________.

If $a \perp b$, then $\angle 1$, $\angle 2$, $\angle 3$, and $\angle 4$ are ____________.



Example 1 ***Draw conclusions***

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



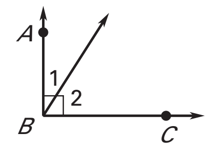
Solution

Lines a and b intersect to form a ____________ ________________, $\angle 1$ and $\angle 2$. So, by Theorem 3.8, ______.

Your Notes

THEOREM 3.10

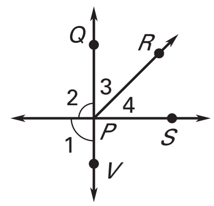
If two sides of two adjacent acute angles are perpendicular, then the angles are ______________.



If $\overrightarrow{BA} \perp \overrightarrow{BC}$, then $\angle 1$ and $\angle 2$ are ______________.

Example 2 ***Write a proof***

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



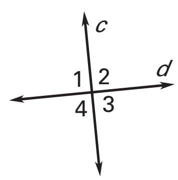
Given $\angle 1 \cong \angle 2$

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

Statements	Reasons
1. $\angle 1 \cong \angle 2$	1. ________
2. __________	2. Theorem 3.8
3. $\angle 3$ and $\angle 4$ are complementary.	3. ______________

Checkpoint **Complete the following exercises.**

1. If $c \perp d$, what do you know about the sum of the measures of $\angle 3$ and $\angle 4$? *Explain*.



2. Using the diagram in Example 2, complete the following proof that $\angle QPS$ and $\angle 1$ are right angles.

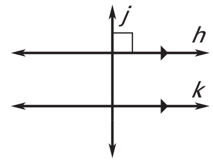
Statements	Reasons
1. $\angle 1 \cong \angle 2$	1. ________
2. $\overleftrightarrow{PS} \perp \overleftrightarrow{PQ}$	2. ______________
3. $\angle QPS$ and $\angle 1$ are right angles.	3. ______________

Stop and get the teacher's signature before you move on.

Your Notes

THEOREM 3.11 PERPENDICULAR TRANSVERSAL THEOREM

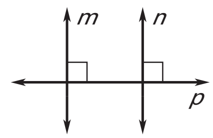
If a transversal is perpendicular to one of two parallel lines, then it is ______________ to the other.



If $h \parallel k$ and $j \perp h$, then j ___ k.

THEOREM 3.12 LINES PERPENDICULAR TO A TRANSVERSAL THEOREM

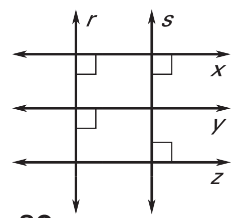
In a plane, if two lines are perpendicular to the same line, then they are ________ to each other.



If $m \perp p$ and $n \perp p$, then m __ n.

Example 3 *Draw conclusions*

Determine which lines, if any, must be parallel in the diagram. *Explain* your reasoning.



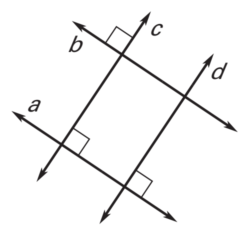
Solution

Lines *r* and *s* are both perpendicular to ___, so by Theorem 3.12, _____. Similarly, lines *x* and *y* are both perpendicular to *r*, so _____. Also, lines ___ and ___ are both perpendicular to *s*, so _____. Finally, because *y* and *z* are both parallel to ___, you know that _____ by the Transitive Property of Parallel Lines.

Checkpoint **Use the diagram to complete the following exercises.**

Stop and get the teacher's signature before you move on.

3. Is $c \parallel d$? *Explain.*

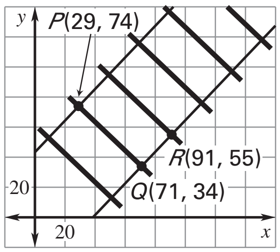


4. Is $b \perp d$? *Explain.*

Your Notes

Example 4 *Find the distance between two parallel lines*

Railroads The section of broad gauge railroad track at the right are drawn on a graph where units are measured in inches. What is the width of the track?



Solution

You need to find the length of a perpendicular segment from one side of the track to the other.

Using $Q(71, 34)$ and $R(91, 55)$, the slope of each rail is

$$\frac{55 - \square}{91 - \square} = \underline{\qquad}$$

The segment PQ has a slope of

$$\frac{74 - \square}{29 - \square} = \underline{\qquad} = \underline{\qquad}$$

The segment PQ is perpendicular to the rail so PQ is

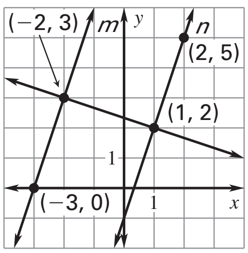
$d = \sqrt{(\underline{\qquad})^2 + (\underline{\qquad})^2} = \underline{\quad}$.

The width of the track is ___________.

Stop and get the teacher's signature before you move on.

Checkpoint **Complete the following exercise.**

5. What is the approximate distance from line m to line n?



Homework