3.1 Pairs of Lines and Angles

Monday, October 26, 2015 6:32 AM

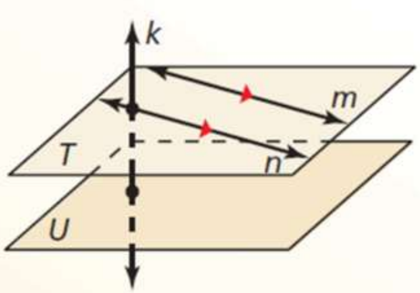
Essential Question

What does it mean when two lines are parallel, intersecting, ~~coincident~~, or skew?

Core Concept

Parallel Lines, Skew Lines, and Parallel Planes

Two lines that do not intersect are either *parallel lines* or *skew lines*. Two lines are **parallel lines** when they do not intersect and are coplanar. Two lines are **skew lines** when they do not intersect and are not coplanar. Also, two planes that do not intersect are **parallel planes**.

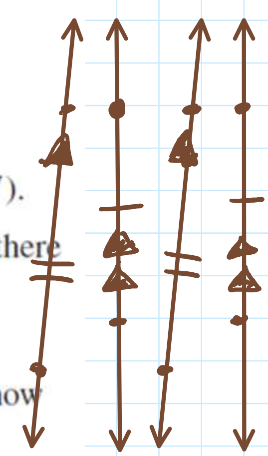


Lines m and n are parallel lines ($m \parallel n$).

Lines m and k are skew lines. $\perp$

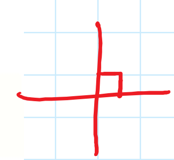
Planes T and U are parallel planes ($T \parallel U$).

Lines k and n are intersecting lines, and there is a plane (not shown) containing them.

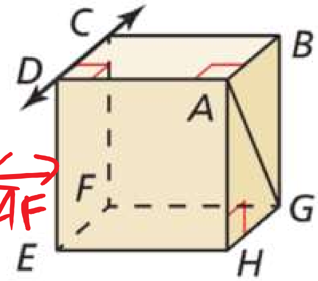


Small directed arrows, as shown in red on lines m and n above, are used to show that lines are parallel. The symbol $\parallel$ means "is parallel to," as in $m \parallel n$.

Segments and rays are parallel when they lie in parallel lines. A line is parallel to a plane when the line is in a plane parallel to the given plane. In the diagram above, line n is parallel to plane U.



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



a. line(s) parallel to $\overleftrightarrow{CD}$ and containing point A $\overleftrightarrow{AB}$

b. line(s) skew to $\overleftrightarrow{CD}$ and containing point A $\overleftrightarrow{AH}$ $\overleftrightarrow{AG}$ $\overleftrightarrow{AE}$ $\overleftrightarrow{AF}$

c. line(s) perpendicular to $\overleftrightarrow{CD}$ and containing point A $\overleftrightarrow{DA}$

d. plane(s) parallel to plane EFG and containing point A

DAB ADC

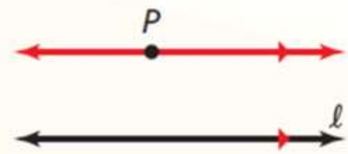
DCB Just fine

Postulates

Postulate 3.1 **Parallel 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.

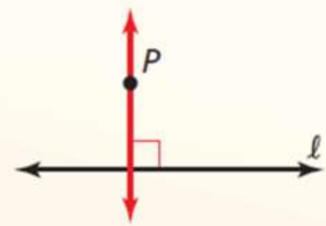
There is exactly one line through P parallel to ℓ.



Postulate 3.2 **Perpendicular 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.

There is exactly one line through P perpendicular to ℓ.



The given line markings show how the roads in a town are related to one another.

a. Name a pair of parallel lines. $\overleftrightarrow{DM} \parallel \overleftrightarrow{EF}$

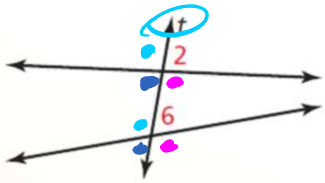
b. Name a pair of perpendicular lines. $\overleftrightarrow{DM} \perp \overleftrightarrow{BF}$

c. Is $\overleftrightarrow{FE} \parallel \overleftrightarrow{AC}$? Explain. No.

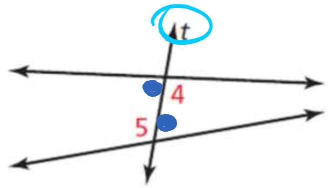
Diagram Notation

Core Concept

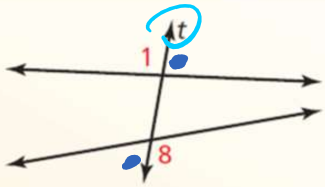
Angles Formed by Transversals



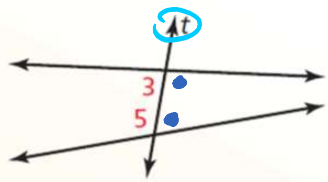
Two angles are **corresponding angles** when they have corresponding positions. For example, ∠2 and ∠6 are above the lines and to the right of the transversal *t*.



Two angles are **alternate interior angles** when they lie between the two lines and on opposite sides of the transversal *t*.

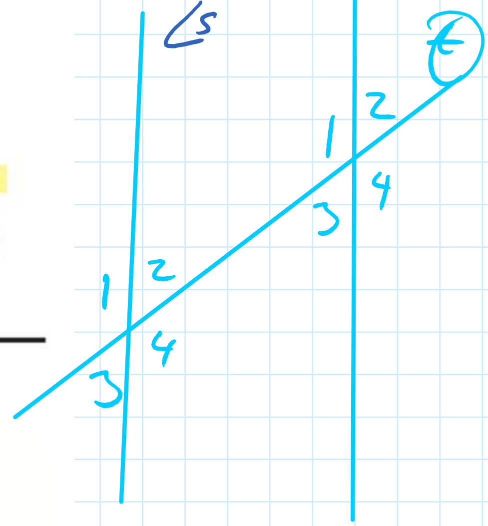


Two angles are **alternate exterior angles** when they lie outside the two lines and on opposite sides of the transversal *t*.



Two angles are **consecutive interior angles** when they lie between the two lines and on the same side of the transversal *t*.

Corresponding



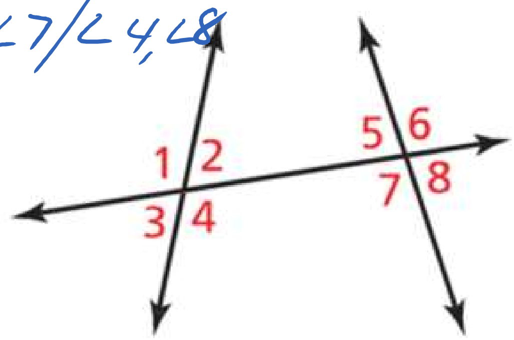
Identify all pairs of angles of the given type.

a. corresponding ∠1, ∠5 / ∠2, ∠6 / ∠3, ∠7 / ∠4, ∠8

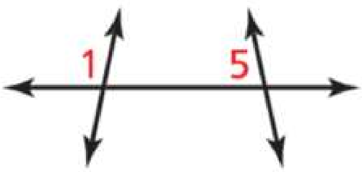
b. alternate interior ∠2, ∠7 / ∠4, ∠5

c. alternate exterior ∠1, ∠8 / ∠3, ∠6

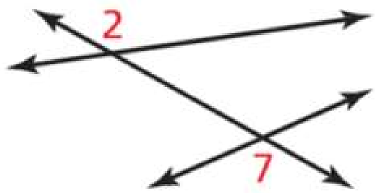
d. consecutive interior ∠2, ∠5 / ∠4, ∠7



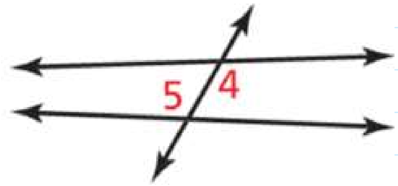
Classify the pair of numbered angles.

3. 

Corr. ∠s

4. 

Alt. Ext. ∠s

5. 

Alt Int. ∠s

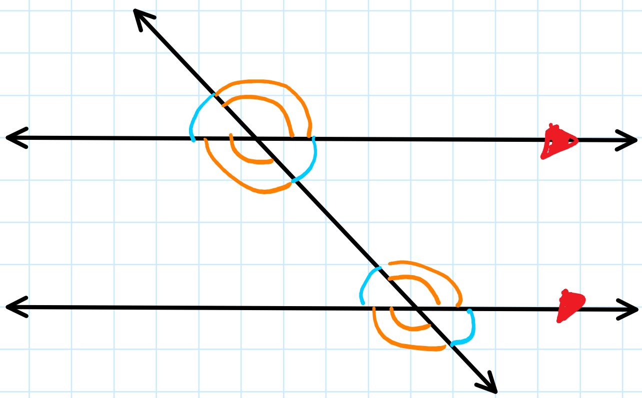
Practice *sec 3.1* **pg.**
129: 1-18A

3.2 Parallel Lines and Transversals

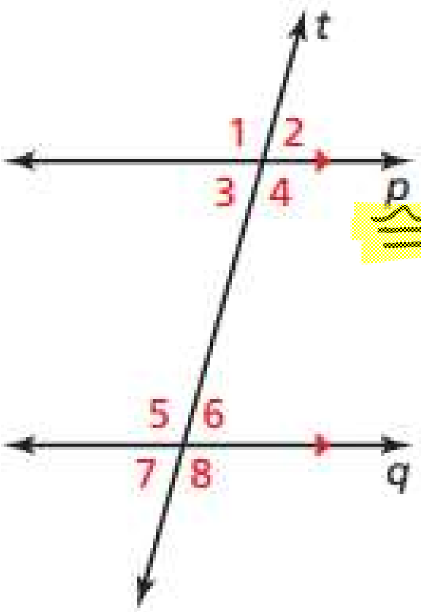
Tuesday, October 27, 2015 6:14 PM

What You Will Learn

- Use properties of parallel lines.
- Prove theorems about parallel lines.
- Solve real-life problems.



Vertical ∠s



Linear Pair

Supplementary

Theorems

Theorem 3.1 Corresponding Angles Theorem

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

Examples In the diagram at the left, $\angle 2 \cong \angle 6$ and $\angle 3 \cong \angle 7$.

Proof Ex. 36, p. 180

Theorem 3.2 Alternate Interior Angles Theorem

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

Examples In the diagram at the left, $\angle 3 \cong \angle 6$ and $\angle 4 \cong \angle 5$.

Proof Example 4, p. 134

Theorem 3.3 Alternate Exterior Angles Theorem

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

Examples In the diagram at the left, $\angle 1 \cong \angle 8$ and $\angle 2 \cong \angle 7$.

Proof Ex. 15, p. 136

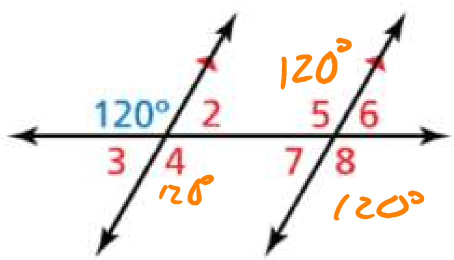
Theorem 3.4 Consecutive Interior Angles Theorem

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

Examples In the diagram at the left, $\angle 3$ and $\angle 5$ are supplementary, and $\angle 4$ and $\angle 6$ are supplementary.

Proof Ex. 16, p. 136

The measures of three of the numbered angles are 120°. Identify the angles. Explain your reasoning.



$m\angle 5 = 120°$ Corr. ∠s

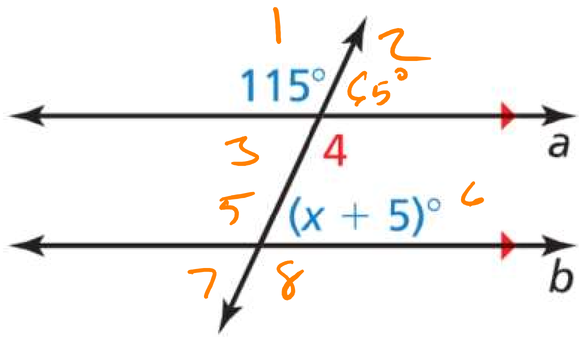
$m\angle 8 = 120°$ Alt. Ext ∠s OR Vertical ∠s

$m\angle 4 = 120°$ Alt. Int. ∠s OR Vert ∠s OR Corr. ∠s

Find the value of x.

~~X = 65~~

X = 60



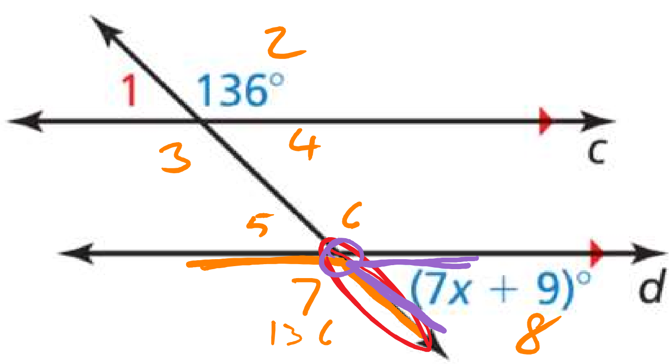
∠ L.P. ↓ Corr. ∠s

Vert. ∠s ↓ Consec. Int. ∠s

∠ L.P. ↓ Alt. Int. ∠s

Find the value of x.

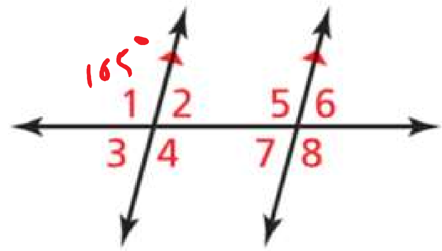
X = 5



∠2 ∠7 Alt Ext ∠s ≅

Use the diagram.

1. Given $m\angle 1 = 105°$, find $m\angle 4$, $m\angle 5$, and $m\angle 8$. Tell which theorem you use in each case.

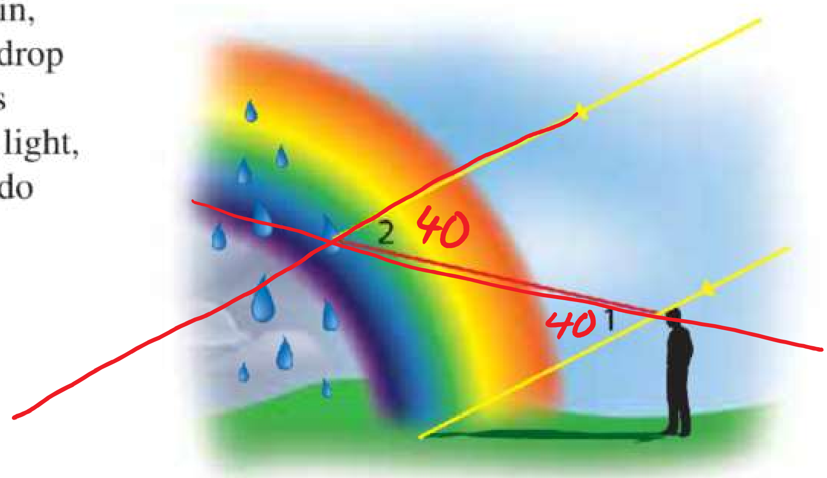


m∠4 = 105°   Vertical ∠s

m∠5 = 105°   Corr. ∠s.

m∠8 = 105°   Vert. ∠s

When sunlight enters a drop of rain, different colors of light leave the drop at different angles. This process is what makes a rainbow. For violet light, $m\angle 2 = 40°$. What is $m\angle 1$? How do you know?



Practice sec. 3.2
Pg. 135
1, 2, 3-13 odd, 14, 15, 23, 25-28

3.3 Proofs with Parallel Lines

Thursday, October 29, 2015 7:16 AM

Essential Question

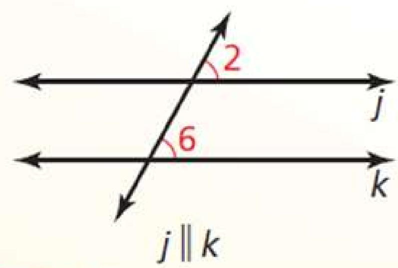
For which of the theorems involving parallel lines and transversals is the converse true?

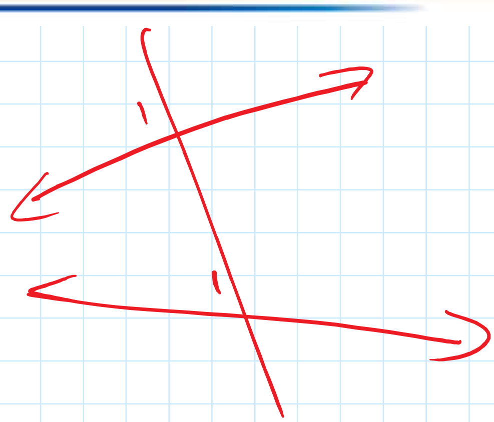
Theorem

Theorem 3.5 Corresponding Angles Converse

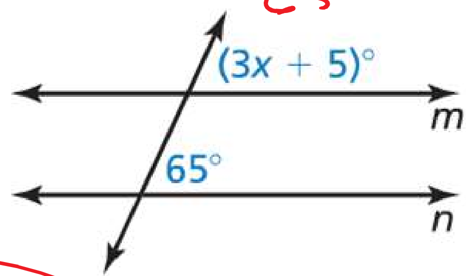
If two lines are cut by a transversal so the corresponding angles are congruent, then the lines are parallel.

Proof Ex. 36, p. 180





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



$3x + 5 = 65$

$-5 \quad -5$

$\frac{3x}{3} = \frac{60}{3}$

$\boxed{x = 20}$

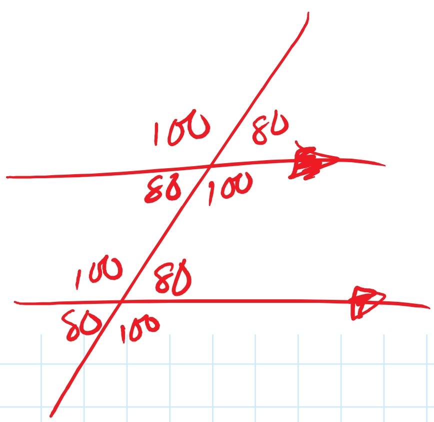
$x = 21$

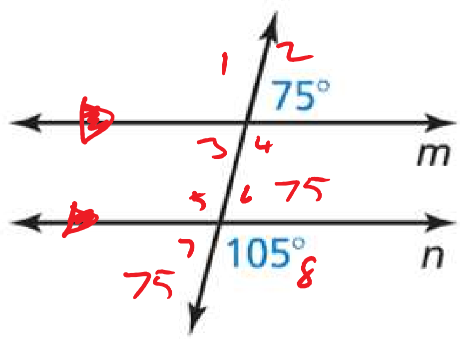
$3 \cdot 21 + 5$

$63 + 5$

68

Is there enough information in the diagram to conclude that $m \parallel n$? Explain.





yes,

∠.P.

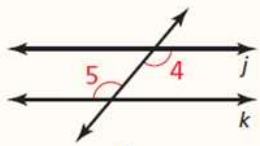
↓

Corr. Conv.

Theorems

Theorem 3.6 Alternate Interior Angles Converse

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

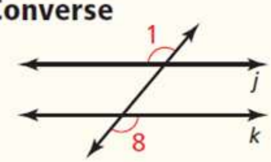


$j \parallel k$

Proof Example 2, p. 140

Theorem 3.7 Alternate Exterior Angles Converse

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

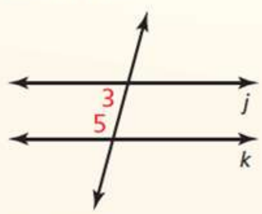


$j \parallel k$

Proof Ex. 11, p. 142

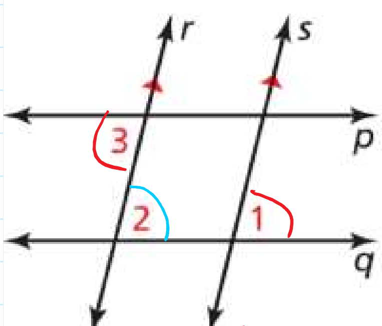
Theorem 3.8 Consecutive Interior Angles Converse

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



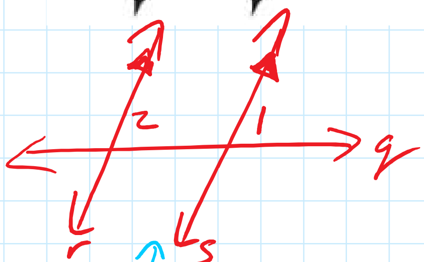
If $\angle 3$ and $\angle 5$ are supplementary, then $j \parallel k$.

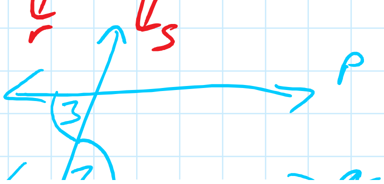
Proof Ex. 12, p. 142



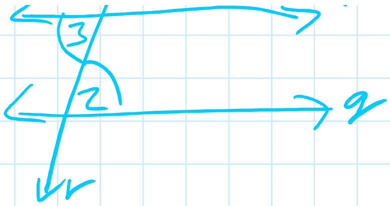
In the diagram, $r \parallel s$ and $\angle 1$ is congruent to $\angle 3$. Prove $p \parallel q$.

$r \parallel s$	given
$\angle 1 \cong \angle 3$	given
$\angle 2 \cong \angle 1$	Corr. ∠s Thm
$\angle 2 \cong \angle 3$	Trans. POC
$p \parallel q$	Alt Int Converse





$\angle 2 \cong \angle 1$

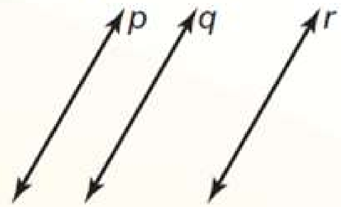


$\angle 2 \cong \angle 1$
$\angle 1 \cong \angle 3$
$\angle 2 \cong \angle 3$

Theorem

Theorem 3.9 Transitive Property of Parallel Lines

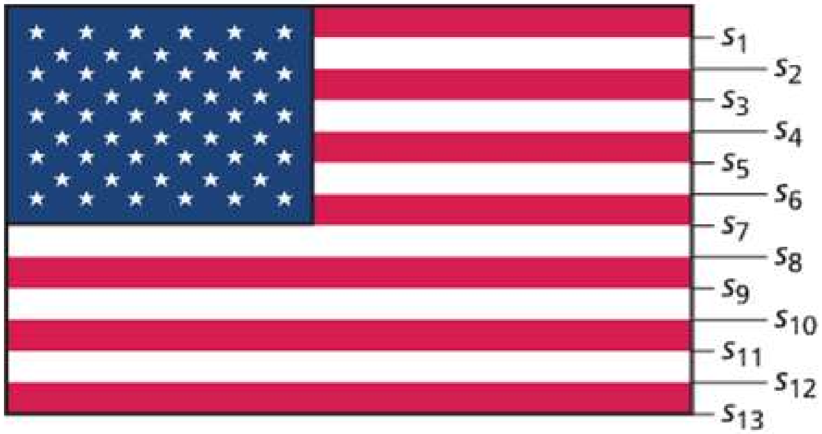
If two lines are parallel to the same line, then they are parallel to each other.



Proof Ex. 39, p. 144; Ex. 48, p. 162

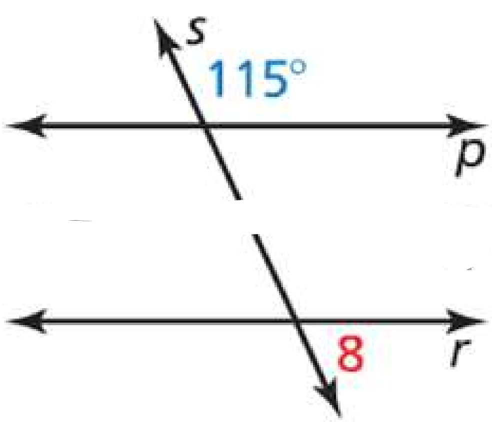
If $p \parallel q$ and $q \parallel r$, then $p \parallel r$.

The flag of the United States has 13 alternating red and white stripes. Each stripe is parallel to the stripe immediately below it. Explain why the top stripe is parallel to the bottom stripe.



In the diagram below, $p \parallel q$ and $q \parallel r$. Find $m\angle 8$. Explain your reasoning.

$p \parallel r$ trans. Prop. // lines



Practice sec. 3.3

Pg. 142

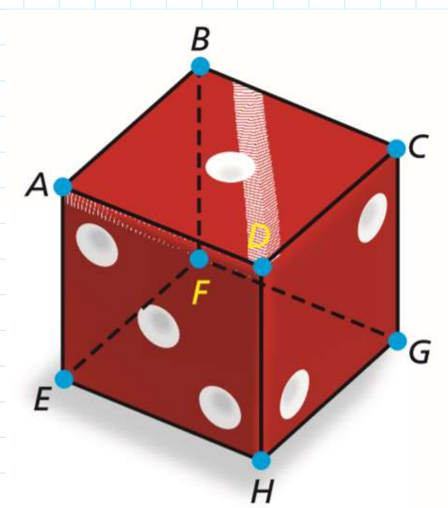
1, 2, 3-7 EO, 13-19 EO, 33, 34, 41, 43

Quiz Review!
Sections 3.1 - 3.3
Calculator allowed

Assuming every segment of the cube is part of a line, which line(s) or plane(s) contain point F and appear to fit the descriptions below? (all intersections are perpendicular.)

1. Line(s) parallel to $\overleftrightarrow{AD}$ $\overleftrightarrow{GF}$
2. Line(s) perpendicular to $\overleftrightarrow{BC}$ $\overleftrightarrow{BF}$
3. Line(s) skew to $\overleftrightarrow{AD}$ $\overleftrightarrow{EF}$ $\overleftrightarrow{BF}$
4. Plane(s) parallel to plane CGH

ADE



4

Identify all pairs of angles of the given type.

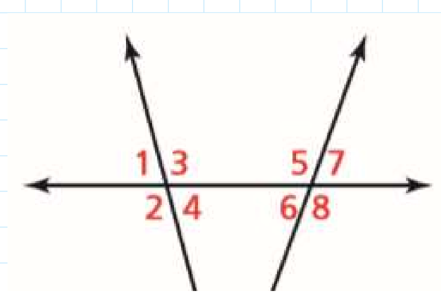
Consecutive Interior

$\angle 3, \angle 5$ / $\angle 4, \angle 6$

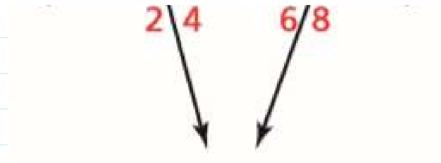
Alternate Exterior

$\angle 1, \angle 8$ / $\angle 2, \angle 7$

Alternate Interior



$\angle 1, \angle 8 / \angle 2, \angle 7$



Alternate Interior

$\angle 3, \angle 6 / \angle 4, \angle 5$

Corresponding

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

Vertical

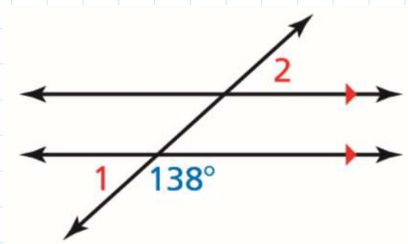
$\angle 1, \angle 4 / \angle 2, \angle 3 / \angle 5, \angle 8 / \angle 6, \angle 7$

5

Find the measure of angle 1 and angle 2. Justify each angle measure with a theorem or postulate.

$m\angle 1 = 42°$ L.P.

$m\angle 2 = 42°$ Alt. Ext $\angle$s



$m\angle 1 + 138 = 180$

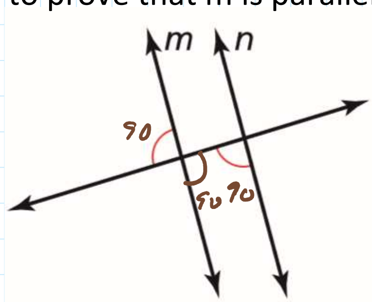
$-138 \quad -138$

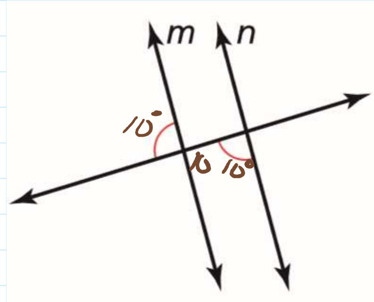
$m\angle 1 = 42°$

2

Decide whether there is enough information to prove that m is parallel to n. If so, state the theorem you would use.

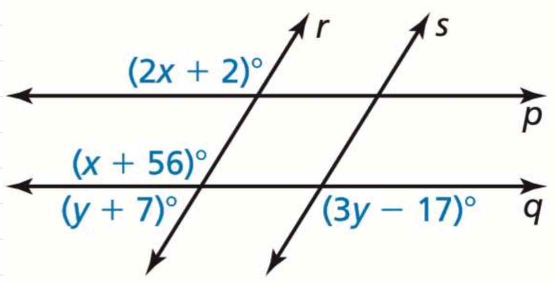
Not enough Info.

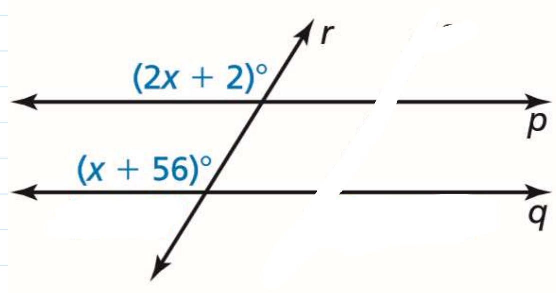




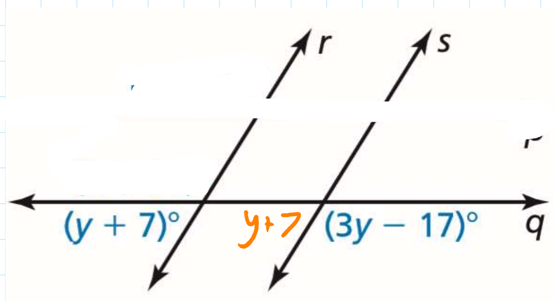
2

Assuming that r is parallel to s and p is parallel to q, find x and y.





$2x+2 = x+56$
$-x \quad\quad -x$
$x+2 = 56$
$-2 \quad\quad -2$
$\boxed{x = 54}$



$y+7+3y-17 = 180$
$4y$

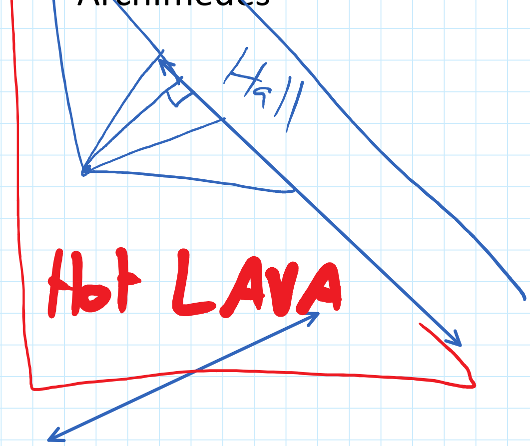
2

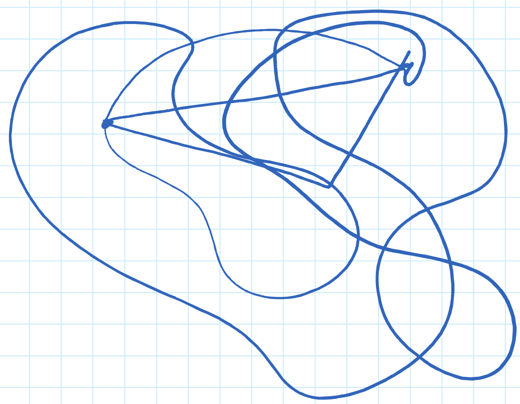
15 total questions
Good Luck!!

What You Will Learn

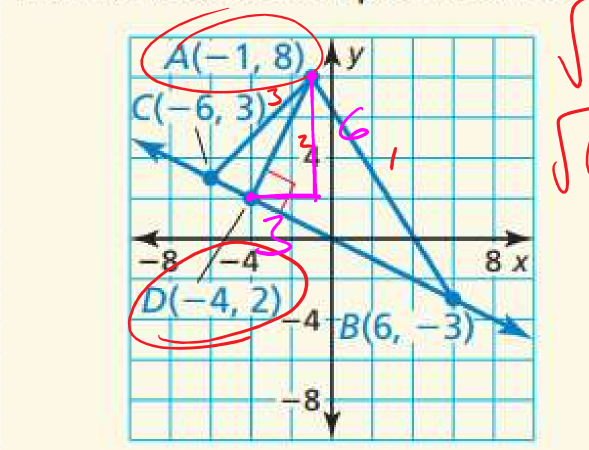
- Find the distance from a point to a line.
- ~~Construct perpendicular lines.~~
- Prove theorems about perpendicular lines.
- Solve real-life problems involving perpendicular lines.

"The shortest distance between two points is a straight line."
-Archimedes





Find the distance from point A to $\overleftrightarrow{BC}$.



$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$\sqrt{(-1+{}^{+}4)^2+(8-2)^2}$

$\sqrt{3^2+6^2}$

$\sqrt{9+36}$

$\sqrt{45}$

$\boxed{3\sqrt{5}}$

$a^2+b^2=c^2$

$3^2+6^2=c^2$

$9+36=c^2$

$\sqrt{45}=\sqrt{c^2}$

$\sqrt{45}=c$

$\boxed{3\sqrt{5}=c}$

45

9 5

3 3

$45=3\cdot3\cdot5$

$3\sqrt{5}$

Find the distance from point E to $\overleftrightarrow{FH}$.

$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$\sqrt{(1+{}^{+}4)^2+(2+{}^{+}3)^2}$

$\sqrt{5^2+5^2}$

$\sqrt{25+25}$

$\sqrt{50}$

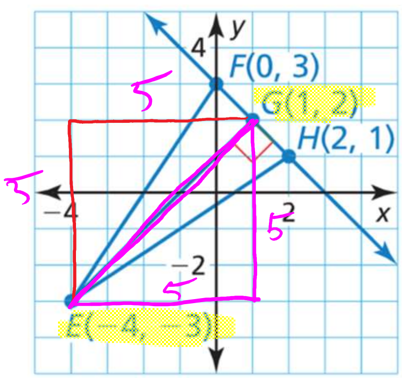
$5\sqrt{2}$

50

5 10

5 2

$5\cdot5\cdot2$



$\boxed{\frac{4}{8}=\frac{1}{2}}$

$a^2+b^2=c^2$

$5^2+5^2=c^2$

$25+25=c^2$

$\sqrt{50}=\sqrt{c^2}$

$\sqrt{50}=c$

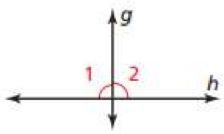
$\boxed{5\sqrt{2}=c}$

Theorem 3.10 Linear Pair Perpendicular Theorem

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

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

Proof Ex. 13, p. 153

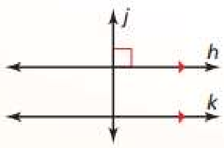


Theorem 3.11 Perpendicular Transversal Theorem

In a plane, if a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other line.

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

Proof Example 2, p. 150; Question 2, p. 150

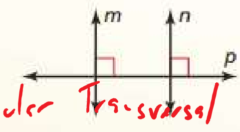


Theorem 3.12 Lines Perpendicular to a Transversal Theorem

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

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

Proof Ex. 14, p. 153; Ex. 47, p. 162



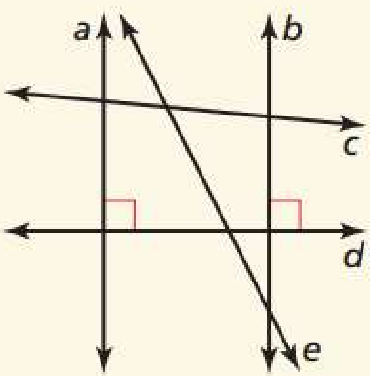
Converse

$\perp$ Trans. Conv.

Perpendicular Transversal Converse

The diagram shows the layout of walking paths in a town park. Determine which lines, if any, must be parallel in the diagram. Explain your reasoning.

$a \parallel b$ $\perp$ trans. Conv.



yes, ⊥ Trans. Conv.

3. Is $b \parallel a$? Explain your reasoning. yes, Consecutive int. ∠s Conv.

4. Is $b \perp c$? Explain your reasoning. yes, ⊥ Trans. Thm.

Practice *sec 3.4* **pg. 152: 3, 11, 15-25EO**