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2–1 If-Then Statements; Converses

Objectives: Recognize hypotheses and conclusions. State the converse of an if-then statement. Use counterexamples. Understand *if and only if.*

A **conditional statement**, or **conditional**, is often written in if-then form. We often use p for the **hypothesis** and q for the **conclusion**.

Conditional statement	If p, then q. ↑ (hypothesis) ↑ (conclusion)	If it is snowing, then it is cold.
Other forms	p implies q.	It is snowing implies it is cold.
	p only if q.	It is snowing only if it is cold.
	q if p.	It is cold if it is snowing.

Example 1 In each of the following conditionals, underline the hypothesis once and the conclusion twice.

a. If it rains, then the game will be canceled. **b.** $\angle A$ is acute if $m\angle A = 60$.

Notice that *if*, *then*, *implies*, and *only if* are not part of the hypothesis or the conclusion.

In each of the following conditionals, underline the hypothesis once and the conclusion twice.

1. $AB = BC$ if B is the midpoint of $\overline{AC}$.
2. We will go only if it is sunny.
3. $\angle AOC$ is a right angle implies $m\angle AOC = 90$.
4. If $x = -2$, then $x^2 = 4$.

The **converse** of a conditional statement is formed by interchanging the hypothesis and the conclusion.

Conditional Statement	If p, then q.	If today is Tuesday, then tomorrow is Wednesday.
Converse	If q, then p.	If tomorrow is Wednesday, then today is Tuesday.

Example 2 Give the converse of each of the following conditionals.

a. If points are coplanar, then they lie in the same plane. (True)
b. If $m\angle X = 110$, then $\angle X$ is obtuse. (True)

Solution

a. If points lie in the same plane, then they are coplanar. (True)
b. If $\angle X$ is obtuse, then $m\angle X = 110$. (False)

Notice that you cannot assume a converse is true just because the original statement is true.

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2–1 If-Then Statements; Converses *(continued)*

One way of proving a statement false is to give a **counterexample.**

Example 3 Tell whether the statement is true or false. Then write the converse and tell whether it is true or false. If the statement or the converse is false, give a counterexample.

Two angles are adjacent if they have a common vertex.

Solution

Statement is false. (In if-then form, the statement would be: If two angles have a common vertex, then they are adjacent angles.)
Counterexample: The angles may not have a common side.
Converse: If two angles are adjacent angles, then they have a common vertex. True

Tell whether each statement is true or false. Then write the converse and tell whether it is true or false. If the statement or the converse is false, give a counterexample.

5. If two angles are right angles, then they are congruent.

6. $x > 7$ implies $x > 2$.

7. If a number is divisible by 2, then it is divisible by 4.

8. An animal is a penguin only if it is a bird.

A statement combining a conditional and its converse is called a **biconditional.** As is shown in Example 4, definitions are biconditionals.

Conditional statement	If p, then q.	If today is Tuesday, then tomorrow is Wednesday.
Converse	If q, then p.	If tomorrow is Wednesday, then today is Tuesday.
Biconditional	p if and only if q.	Today is Tuesday if and only if tomorrow is Wednesday.

Example 4 Write the biconditional as two conditionals that are converses.

Line k is a bisector of $\overline{XY}$ if and only if k intersects $\overline{XY}$ at its midpoint.

Solution

If line k is a bisector of $\overline{XY}$, then k intersects $\overline{XY}$ at its midpoint.
If line k intersects $\overline{XY}$ at its midpoint, then k is a bisector of $\overline{XY}$.

Write each biconditional as two conditionals that are converses of each other.

9. An angle is a right angle if and only if its measure is 90.

10. $DE = FG$ if and only if $\overline{DE} \cong \overline{FG}$.

11. B is on $\overline{AC}$ if and only if B is on $\overrightarrow{AC}$ and $\overrightarrow{CA}$.

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2–2 Properties from Algebra

Objective: Use properties from algebra and properties of congruence.

Properties of Equality

Addition Property	If $x = 7$, then $x + 3 = 10$.	If $AB = 4$ and $BC = 2$, then $AB + BC = 4 + 2$.
Subtraction Property	If $x = 10$, then $x - 3 = 7$.	If $m\angle A + 20 = 60$, then $m\angle A = 40$.
Multiplication Property	If $x = 2$, then $2x = 4$.	If $\frac{1}{2}AC = AB$, then $AC = 2AB$.
Division Property	If $2x = 4$, then $x = 2$.	If $2m\angle A = 40$, then $m\angle A = 20$.
Substitution Property	If $x = 3$ and $x + y = 7$, then $3 + y = 7$.	If $m\angle A = m\angle 1$ and $m\angle 1 + m\angle B = 90$, then $m\angle A + m\angle B = 90$.

Justify each statement with a property from algebra, or a definition or postulate from geometry.

1. If $AB = CD$ and $BC = BC$, then $AB + BC = CD + BC$.
2. If $2m\angle 1 = 72$, then $m\angle 1 = 36$.
3. If $m\angle A = \frac{1}{2}m\angle X$ and $\frac{1}{2}m\angle X = m\angle B$, then $m\angle A = m\angle B$.
4. If point B is in the interior of $\angle XOY$, then $m\angle XOB + m\angle BOY = m\angle XOY$.
5. If $2 + YZ = 8$, then $YZ = 6$.

Notice that the properties of equality listed above are used only on numbers and variables. Some properties used in geometry apply to both equality and congruence.

Properties of Equality and Congruence

	Equality (numbers, variables, lengths, angle measures)	**Congruence** (segments, angles, polygons)
Reflexive Property	$DE = DE \quad m\angle 1 = m\angle 1$	$\overline{DE} \cong \overline{DE} \quad \angle 1 \cong \angle 1$
Symmetric Property	If $DE = AB$, then $AB = DE$. If $m\angle 1 = m\angle 2$, then $m\angle 2 = m\angle 1$.	If $\overline{DE} \cong \overline{AB}$, then $\overline{AB} \cong \overline{DE}$. If $\angle 1 \cong \angle 2$, then $\angle 2 \cong \angle 1$.
Transitive Property	If $m\angle 1 = m\angle 2$ and $m\angle 2 = m\angle 3$, then $m\angle 1 = m\angle 3$.	If $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$.

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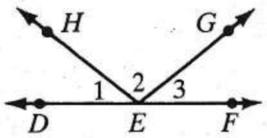
2–2 Properties from Algebra *(continued)*

Example Complete the proof by supplying the missing statements and reasons.

Given: $m\angle 1 = m\angle 3$

Prove: $m\angle DEG = m\angle HEF$

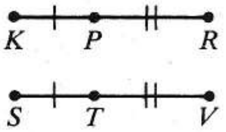


Statements	Reasons
1. $m\angle 1 = m\angle 3$	1. Given
2. $m\angle 2 = m\angle 2$	2. Reflexive Prop.
3. $m\angle 1 + m\angle 2 = m\angle 3 + m\angle 2$	3. Addition Prop. of =
4. $m\angle DEG = m\angle 1 + m\angle 2$; $m\angle HEF = m\angle 3 + m\angle 2$	4. Angle Addition Post.
5. $m\angle DEG = m\angle HEF$	5. Substitution Prop.

Complete the following proofs by supplying the missing statements and reasons.

6. Given: $KP = ST$; $PR = TV$

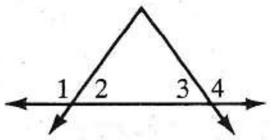
Prove: $KR = SV$



Statements	Reasons
1. ________	1. Given
2. $KP + PR = ST + TV$	2. ________
3. $KP + PR = KR$; $ST + TV = SV$	3. ________
4. ________	4. Substitution Prop.

7. Given: $m\angle 1 = m\angle 4$

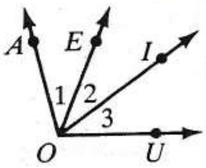
Prove: $m\angle 2 = m\angle 3$



Statements	Reasons
1. $m\angle 1 + m\angle 2 = 180$; $m\angle 3 + m\angle 4 = 180$	1. Angle Addition Post.
2. $m\angle 1 + m\angle 2 = m\angle 3 + m\angle 4$	2. ________
3. ________	3. Given
4. $m\angle 2 = m\angle 3$	4. ________

8. Given: $m\angle AOI = m\angle EOU$

Prove: $m\angle 1 = m\angle 3$



Statements	Reasons
1. ________	1. Given
2. $m\angle 2 = m\angle 2$	2. ________
3. $m\angle 1 + m\angle 2 = m\angle AOI$; $m\angle 2 + m\angle 3 = m\angle EOU$	3. ________
4. $m\angle 1 + m\angle 2 = m\angle 2 + m\angle 3$	4. ________
5. ________	5. ________

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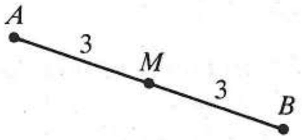
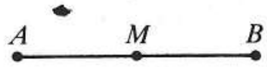
2–3 Proving Theorems

Objective: Use the Midpoint Theorem and the Angle Bisector Theorem.

If M is the midpoint of $\overline{AB}$, you may conclude that $AM = MB$ by the definition of midpoint. If you are also told that $AB = 6$, you may realize that $AM = MB = \frac{1}{2}(6) = 3$. This idea is generalized in the **Midpoint Theorem.**

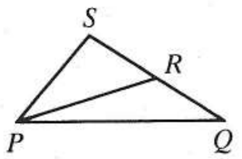


Midpoint Theorem **If M is the midpoint of $\overline{AB}$, then $AM = \frac{1}{2}AB$ and $MB = \frac{1}{2}AB$.**



Example 1

Given: R is the midpoint of $\overline{SQ}$. Name the definition, postulate, or theorem that justifies each statement about the diagram.



a. $\overline{SR} \cong \overline{RQ}$

b. $SR = \frac{1}{2}SQ$

c. $SR + RQ = SQ$

d. $\overline{PR}$ bisects $\overline{SQ}$.

Solution

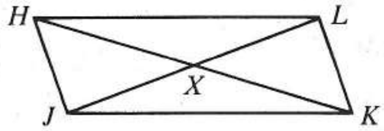
a. Def. of midpoint

b. Midpoint Thm.

c. Segment Addition Post.

d. Def. of segment bisector

Given: $\overline{HK}$ bisects $\overline{JL}$; X is the midpoint of $\overline{HK}$. State the definition, postulate, or theorem that justifies each statement about the diagram.



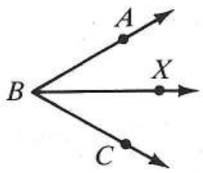
1. $HX = XK$

2. $HX = \frac{1}{2}HK$

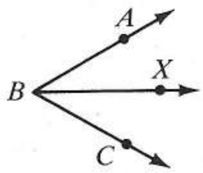
3. X is the midpoint of $\overline{JL}$.

4. $JL = JX + XL$

If $\overrightarrow{BX}$ bisects $\angle ABC$, you may conclude that $m\angle ABX = m\angle XBC$ by the definition of an angle bisector. If you are also told that $m\angle ABC = 60$, you may realize that $m\angle ABX = m\angle XBC = \frac{1}{2}(60) = 30$. This idea is generalized in the **Angle Bisector Theorem.**



Angle Bisector Theorem **If $\overrightarrow{BX}$ is the bisector of $\angle ABC$, then $m\angle ABX = \frac{1}{2}m\angle ABC$ and $m\angle XBC = \frac{1}{2}m\angle ABC$.**



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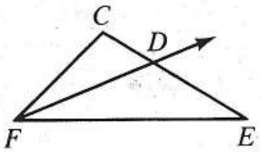
2–3 Proving Theorems *(continued)*

Example 2

Given: $\overrightarrow{FD}$ bisects $\angle CFE$.
Name the definition, postulate, or theorem that justifies each statement.

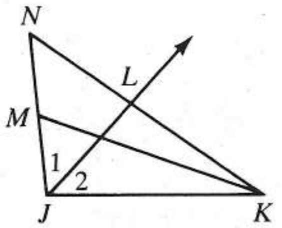
a. $m\angle CFD = \frac{1}{2}m\angle CFE$
b. $m\angle CFD = m\angle DFE$
c. $CD + DE = CE$



Solution

a. Angle Bisector Thm.
b. Def. of angle bisector
c. Segment Addition Post.

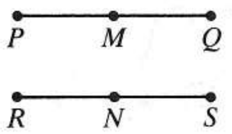
Given: $\overrightarrow{JL}$ bisects $\angle NJK$; M is the midpoint of $\overline{NJ}$. State the definition, postulate, or theorem that justifies each statement.



5. $m\angle 1 = \frac{1}{2}m\angle NJK$
6. $MJ = \frac{1}{2}NJ$
7. $m\angle 1 = m\angle 2$
8. $m\angle NJK = m\angle 1 + m\angle 2$
9. $\overline{NM} \cong \overline{MJ}$
10. $NL + LK = NK$

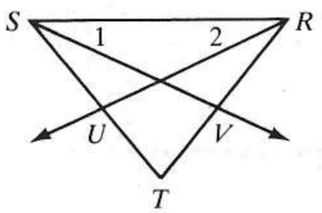
Complete the following proofs by supplying the missing statements and reasons.

11. Given:
M is the midpoint of $\overline{PQ}$;
N is the midpoint of $\overline{RS}$;
$PQ = RS$
Prove: $PM = RN$



Statements	Reasons
1. M is the midpt. of $\overline{PQ}$; N is the midpt. of $\overline{RS}$.	1. ________________
2. $PM = \frac{1}{2}PQ$; $RN = \frac{1}{2}RS$	2. ________________
3. ________________	3. Given
4. $\frac{1}{2}PQ = \frac{1}{2}RS$	4. ________________
5. ________________	5. Substitution Prop. (Steps _____ and _____)

12. Given:
$\overrightarrow{SV}$ bisects $\angle RST$;
$\overrightarrow{RU}$ bisects $\angle SRT$;
$m\angle RST = m\angle SRT$
Prove: $m\angle 1 = m\angle 2$



Statements	Reasons
1. $\overrightarrow{SV}$ bisects $\angle RST$; $\overrightarrow{RU}$ bisects $\angle SRT$.	1. ________________
2. $m\angle 1 = \frac{1}{2}m\angle RST$; $m\angle 2 = \frac{1}{2}m\angle SRT$	2. ________________
3. ________________	3. Given
4. $\frac{1}{2}m\angle RST = \frac{1}{2}m\angle SRT$	4. ________________
5. ________________	5. ________________

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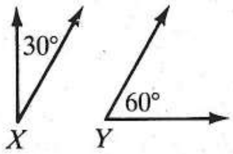
2–4 Special Pairs of Angles

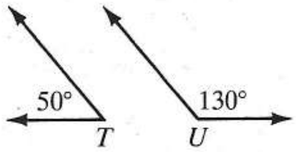
Objectives: Apply the definitions of complementary and supplementary angles.
State and use the theorem about vertical angles.

complementary angles Two angles whose measures have the sum 90 are complementary.

supplementary angles Two angles whose measures have the sum 180 are supplementary.

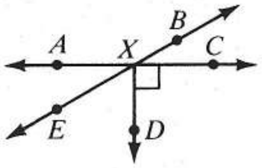


$m\angle X + m\angle Y = 90$
$\angle X$ and $\angle Y$ are complementary.
$\angle X$ is a complement of $\angle Y$.



$m\angle T + m\angle U = 180$
$\angle T$ and $\angle U$ are supplementary.
$\angle T$ is a supplement of $\angle U$.

In the diagram, $\angle CXD$ is a right angle. Name:



1. another right angle.
2. two congruent supplementary angles.
3. two noncongruent supplementary angles.
4. two complementary angles.

Example 1

$\angle C$ and $\angle D$ are complementary, $m\angle C = 3y - 5$, and $m\angle D = y + 15$. Find the value of y, $m\angle C$, and $m\angle D$.

Solution

$$m\angle C + m\angle D = 90$$
$$(3y - 5) + (y + 15) = 90$$
$$4y + 10 = 90$$
$$4y = 80$$
$$y = 20$$

$$m\angle C = 3y - 5 = 3(20) - 5 = 60 - 5 = 55$$

$$m\angle D = y + 15 = 20 + 15 = 35$$

Example 2

A supplement of an angle is seven times a complement of the angle. Find the measures of the angle, its complement, and its supplement.

Solution

Let x be the measure of the angle. Then $90 - x$ is the measure of its complement, and $180 - x$ is the measure of its supplement.

$$180 - x = 7(90 - x)$$
$$180 - x = 630 - 7x$$
$$6x = 450$$
$$x = 75$$

measure of angle $= 75$
measure of complement $= 90 - x = 90 - 75 = 15$
measure of supplement $= 180 - x = 180 - 75 = 105$

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2–4 Special Pairs of Angles *(continued)*

$\angle A$ and $\angle B$ are supplementary. Find the value of x, $m\angle A$, and $m\angle B$.

5. $m\angle A = 3x, m\angle B = x + 20$

6. $m\angle A = x + 11, m\angle B = 2x - 5$

$\angle C$ and $\angle D$ are complementary. Find the value of y, $m\angle C$, and $m\angle D$.

7. $m\angle C = y + 11, m\angle D = 2y - 5$

8. $m\angle C = 3y + 5, m\angle D = 2y + 10$

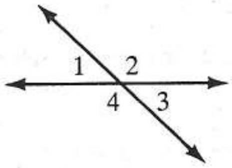
Use the given information to write an equation and solve the problem.

9. Find the measure of an angle that is twice as large as its complement.

10. A supplement of an angle is four times as large as the angle. Find the measure of the angle.

11. The measure of a complement of an angle is three more than twice the measure of the angle. Find the measures of the angle and its complement.

When two lines intersect, **vertical angles** are formed. In the figure, $\angle 1$ and $\angle 3$ are vertical angles. $\angle 2$ and $\angle 4$ are vertical angles.



Vertical angles are congruent.

Example 3 In the diagram, $\overrightarrow{AZ}$ bisects $\angle YAU$.

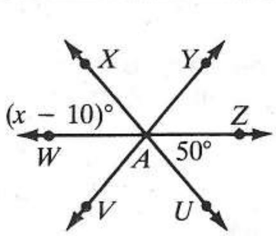
a. Name three angles congruent to $\angle YAZ$.

b. Find the value of x.

Solution

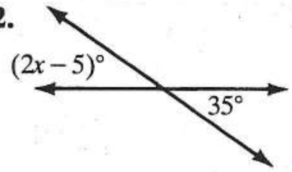
a. $\angle YAZ \cong \angle ZAU \cong \angle WAX \cong \angle WAV$

b. $x - 10 = 50$, so $x = 60$.

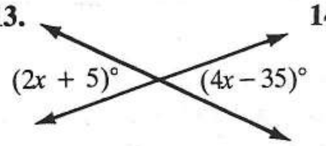


Find the value of x.

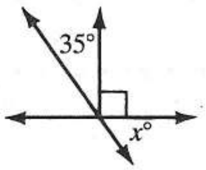
12.



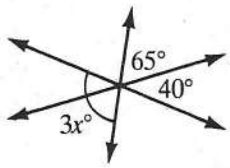
13.



14.



15.



In the diagram, $\overrightarrow{OC}$ bisects $\angle BOD$, $m\angle BOD = 90$, and $m\angle BOA = 40$. Find:

16. $m\angle BOC$

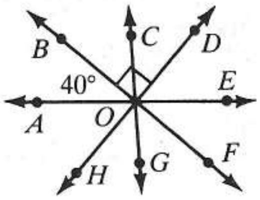
17. $m\angle FOG$

18. $m\angle AOH$

19. $m\angle HOE$

20. $m\angle DOE$

21. $m\angle AOE$



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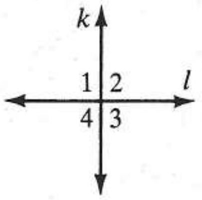
2–5 Perpendicular Lines

Objective: Apply the definition and theorems about perpendicular lines.

Two lines that intersect to form right angles are **perpendicular lines.** If $k \perp l$, then $\angle 1$, $\angle 2$, $\angle 3$, and $\angle 4$ are right angles.

The definition of perpendicular lines, like all definitions, is a biconditional. It is given below as two conditionals.

If two lines are perpendicular, then they form right angles.
If two lines form right angles, then the lines are perpendicular.



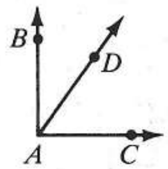
Perpendicular lines have the following properties.

If two lines are perpendicular, then they form congruent adjacent angles.

If two lines form congruent adjacent angles, then the lines are perpendicular.

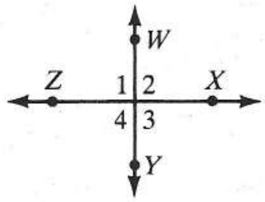
If the exterior sides of two adjacent acute angles are perpendicular, then the angles are complementary.

If $\overrightarrow{AB} \perp \overrightarrow{AC}$,
then $\angle BAD$ and $\angle DAC$ are complementary.



Example 1 Name the definition or state the theorem that justifies the statement about the diagram.

a. If $\overleftrightarrow{WY} \perp \overleftrightarrow{ZX}$, then $\angle 1$, $\angle 2$, $\angle 3$, and $\angle 4$ are right angles.
b. If $\angle 1 \cong \angle 4$, then $\overleftrightarrow{WY} \perp \overleftrightarrow{ZX}$.
c. If $m\angle 1 = 90$, then $\overleftrightarrow{WY} \perp \overleftrightarrow{ZX}$.

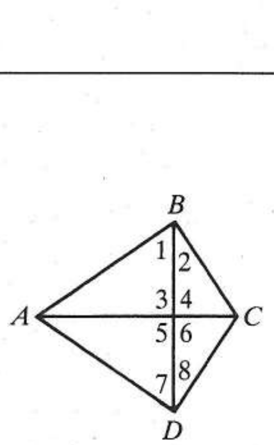


Solution

a. Def. of $\perp$ lines
b. If 2 lines form $\cong$ adj. $\measuredangle$s, then the lines are $\perp$.
c. Def. of $\perp$ lines

Name the definition or state the theorem that justifies each statement about the diagram.

1. If $\overline{AB} \perp \overline{BC}$, then $\angle ABC$ is a right angle.
2. If $\overline{BD} \perp \overline{AC}$, then $\angle 3 \cong \angle 4$.
3. If $\overline{DC} \perp \overline{DA}$, then $\angle 7$ and $\angle 8$ are complementary.
4. If $\angle 7$ and $\angle 8$ are complementary, then $m\angle 7 + m\angle 8 = 90$.
5. If $\angle 4 \cong \angle 6$, then $\overline{AC} \perp \overline{BD}$.
6. $\angle 4 \cong \angle 5$
7. If $\angle ADC$ is a right angle, then $m\ \angle ADC = 90$.



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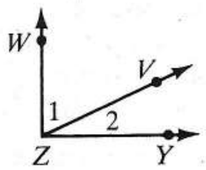
2–5 Perpendicular Lines *(continued)*

Example 2

If $\overrightarrow{ZW} \perp \overrightarrow{ZY}$, $m\angle 1 = 5x$, and $m\angle 2 = 2x - 1$, find the value of x.

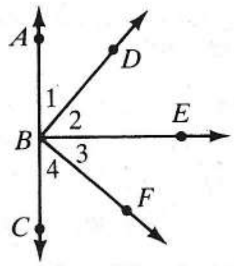


Solution

$\overrightarrow{ZW} \perp \overrightarrow{ZY}$, so $\angle 1$ and $\angle 2$ are complementary.

$$m\angle 1 + m\angle 2 = 90$$
$$(5x) + (2x - 1) = 90$$
$$7x - 1 = 90$$
$$7x = 91$$
$$x = 13$$

Given: $\overrightarrow{BE} \perp \overleftrightarrow{AC}$; $\overrightarrow{BD} \perp \overrightarrow{BF}$. Find the value of x.



8. $m\angle 2 = 2x + 10$, $m\angle 3 = 40$

9. $m\angle 3 = 2x + 5$, $m\angle 4 = 3x$

10. $m\angle 1 = 2x$, $m\angle 2 = 2x + 10$, $m\angle 3 = 3x - 20$, $m\angle 4 = 3x - 10$

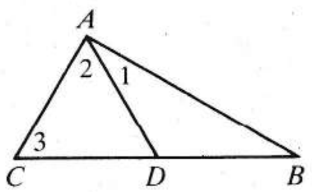
11. $m\angle 1 = 7x$, $m\angle 2 = 7x + 6$, $m\angle 3 = 5x + 12$, $m\angle 4 = 8x$

12. $m\angle 1 = 3x + 1$, $m\angle 2 = 4x + 5$, $m\angle 3 = 2x + 13$

Complete the proof by supplying the missing statements and reasons.

13. Given: $\overline{BA} \perp \overline{AC}$; $\angle 1$ is complementary to $\angle 3$.

Prove: $m\angle 2 = m\angle 3$



Statements	Reasons
1. $\overline{BA} \perp \overline{AC}$	1. ______
2. $\angle 1$ and $\angle 2$ are complementary.	2. ______
3. $\angle 1$ and $\angle 3$ are complementary.	3. ______
4. $m\angle 1 + m\angle 2 = 90$; $m\angle 1 + m\angle 3 = 90$	4. ______
5. $m\angle 1 + m\angle 2 = m\angle 1 + m\angle 3$	5. ______
6. ______	6. Reflexive Prop.
7. $m\angle 2 = m\angle 3$	7. ______

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2–6 Planning a Proof

Objectives: State and apply the theorems about angles supplementary to, or complementary to, congruent angles. Plan and write proofs.

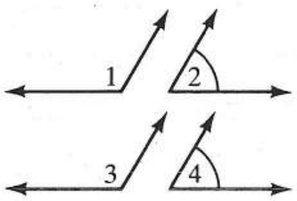
Before you can write a proof, you need to have a plan for the proof. Sometimes you will see immediately how to do the proof. Sometimes a previous proof will give you a plan, as in Exercise 1.

> **If two angles are supplements of congruent angles (or of the same angle), then the two angles are congruent.**

Example 1

Given: $\angle 1$ and $\angle 2$ are supplementary;
$\angle 3$ and $\angle 4$ are supplementary;
$\angle 2 \cong \angle 4$

Prove: $\angle 1 \cong \angle 3$



Solution

Plan for Proof:

From the given, you can conclude $m\angle 1 + m\angle 2 = 180$ and $m\angle 3 + m\angle 4 = 180$. By substitution, $m\angle 1 + m\angle 2 = m\angle 3 + m\angle 4$. $\angle 2 \cong \angle 4$, so $m\angle 2 = m\angle 4$, and by subtraction $m\angle 1 = m\angle 3$, or $\angle 1 \cong \angle 3$.

> **If two angles are complements of congruent angles (or of the same angle), then the two angles are congruent.**

1. Write a proof of the theorem above.

(*Hint:* It will be very similar to the proof of the previous theorem.)

Given: $\angle 5$ and $\angle 6$ are complementary; $\angle 7$ and $\angle 8$ are complementary; $\angle 5 \cong \angle 7$

Prove: $\angle 6 \cong \angle 8$

Sometimes you may need to try several times to find a plan that works. If you don't see immediately how to do a proof, here are two methods to try to find a plan.

Method 1	**Method 2**
Gather as much information as you can. Sometimes what you can see will show you a plan.	Work backward. Go to the conclusion, the part you would like to prove.
Reread the given. What does it tell you?	Think: This conclusion would be true if __?__.
Look at the diagram. What other information can you conclude?	And __?__ would be true if __?__. And so on, until you have a plan for a proof.

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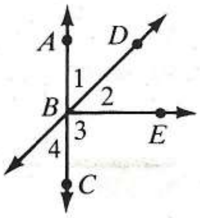
2–6 Planning a Proof *(continued)*

Example 2

Given: $\overrightarrow{BD}$ bisects $\angle ABE$.
Prove: $\angle 2 \cong \angle 4$



Solution

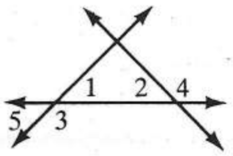
Plan for Proof (Method 1):
From the given, you can conclude that $\angle 1 \cong \angle 2$.
From the diagram, you can see that $\angle 1$ and $\angle 4$ are vertical angles, so $\angle 1 \cong \angle 4$.
From $\angle 1 \cong \angle 2$ and $\angle 1 \cong \angle 4$, you can conclude that $\angle 2 \cong \angle 4$.

2. Complete the proof of Example 2.

Statements	Reasons
1. ________	1. Given
2. $\angle$ ________ $\cong \angle$ ________	2. Def. of ________
3. $\angle 1 \cong \angle 4$	3. ________
4. ________	4. ________

Example 3

Given: $m\angle 1 = m\angle 2$
Prove: $\angle 4$ is supplementary to $\angle 5$.



Solution

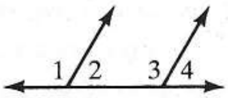
Plan for Proof (Method 2):
$\angle 4$ is supplementary to $\angle 5$ if $m\angle 4 + m\angle 5 = 180$. This is true if $m\angle 4 = m\angle 2$, since $m\angle 4 + m\angle 2 = 180$.
From the diagram $m\angle 1 = m\angle 5$, and $m\angle 1 = m\angle 2$, so $m\angle 2 = m\angle 5$.

3. Complete the proof of Example 3.

Statements	Reasons
1. $m\angle 1 = m\angle 2$	1. ________
2. $m\angle 1 = m\angle 5$	2. ________
3. ________	3. ________
4. $m\angle 2 + m\angle 4 = 180$	4. ________
5. $m\angle 5 + m\angle 4 = 180$	5. ________
6. ________	6. ________

Write a two-column proof.

4. Given: $\angle 2$ is supplementary to $\angle 3$.
Prove: $\angle 1 \cong \angle 3$



5. Given: $\angle 1 \cong \angle 3$
Prove: $\angle 3 \cong \angle 4$