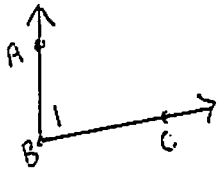


Section 3: Angles and Angle Relationships

Angle: two rays that have a common endpoint (vertex)



Names of angle:

All angles have a first and last name:

Types of Angles:

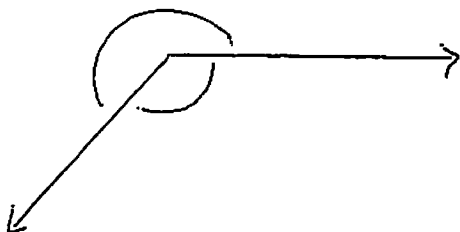
Acute angle:

Right angle:

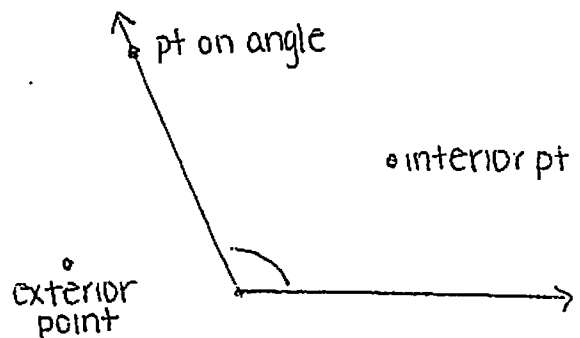
Obtuse angle:

Straight angle:

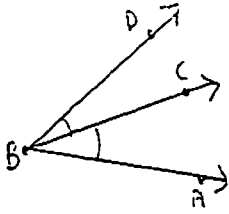
What if the angle is like this? What do you measure?



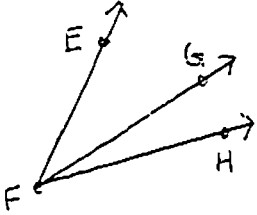
measure this angle w/ a protractor



Angle Addition Postulate: (sum of parts equal the whole)



Ex 1: $m\angle HFG = 2x - 1$ $m\angle GFE = 5x - 2$ $m\angle HFE = 46$ Solve for x .



Angle Relationships:

1.) **Adjacent angles** – angles that share a side and have a common vertex.

2.) **Linear pair** – adjacent angles where the non-common sides are opposite rays.

3.) **Supplementary angles** – describes two angles whose measure sums to 180° .

4.) **Complementary angles** – describes two angles whose measure sums to 90° .

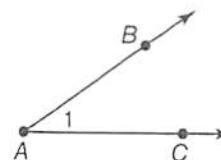
*** Remember: C before S, 90 before 180

5.) **Vertical angles** – two non adjacent angles formed by two intersecting lines.

1-4 Study Guide and Intervention

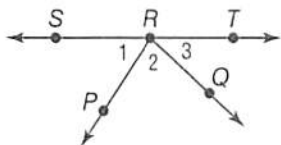
Angle Measure

Measure Angles If two noncollinear rays have a common endpoint, they form an **angle**. The rays are the **sides** of the angle. The common endpoint is the **vertex**. The angle at the right can be named as $\angle A$, $\angle BAC$, $\angle CAB$, or $\angle 1$.



A **right angle** is an angle whose measure is 90. An **acute angle** has measure less than 90. An **obtuse angle** has measure greater than 90 but less than 180.

Example 1



- a. Name all angles that have R as a vertex.

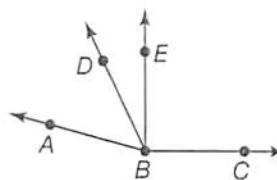
Three angles are $\angle 1$, $\angle 2$, and $\angle 3$. For other angles, use three letters to name them: $\angle SRQ$, $\angle PRT$, and $\angle SRT$.

- b. Name the sides of $\angle 1$.

\overrightarrow{RS} , \overrightarrow{RP}

Example 2

Classify each angle as **right**, **acute**, or **obtuse**. Then use a protractor to measure the angle to the nearest degree.



- a. $\angle ABD$

Using a protractor, $m\angle ABD = 50$.
 $50 < 90$, so $\angle ABD$ is an acute angle.

- b. $\angle DBC$

Using a protractor, $m\angle DBC = 115$.
 $180 > 115 > 90$, so $\angle DBC$ is an obtuse angle.

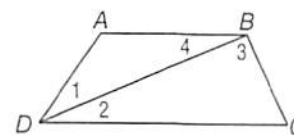
- c. $\angle EBC$

Using a protractor, $m\angle EBC = 90$.
 $\angle EBC$ is a right angle.

Exercises

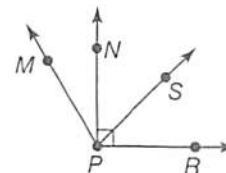
Refer to the figure at the right.

- Name the vertex of $\angle 4$.
- Name the sides of $\angle BDC$.
- Write another name for $\angle DBC$.



Classify each angle as **right**, **acute**, or **obtuse**. Then use a protractor to measure the angle to the nearest degree.

- $\angle MPR$
- $\angle RPN$
- $\angle NPS$

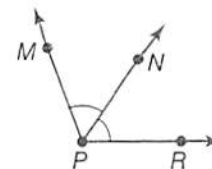


Lesson 1-4

1-4 Study Guide and Intervention *(continued)*

Angle Measure

Congruent Angles Angles that have the same measure are **congruent angles**. A ray that divides an angle into two congruent angles is called an **angle bisector**. In the figure, \overrightarrow{PN} is the angle bisector of $\angle MPR$. Point N lies in the interior of $\angle MPR$ and $\angle MPN \cong \angle NPR$.



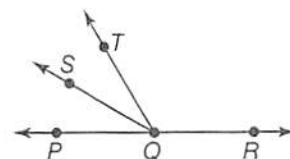
Example Refer to the figure above. If $m\angle MPN = 2x + 14$ and $m\angle NPR = x + 34$, find x and find $m\angle NPR$.

Since \overrightarrow{PN} bisects $\angle MPR$, $\angle MPN \cong \angle NPR$, or $m\angle MPN = m\angle NPR$.

$$\begin{aligned} 2x + 14 &= x + 34 & m\angle NPR &= 2x + 14 \\ 2x + 14 - x &= x + 34 - x & &= 2(20) + 14 \\ x + 14 &= 34 & &= 40 + 14 \\ x + 14 - 14 &= 34 - 14 & &= 54 \\ x &= 20 & & \end{aligned}$$

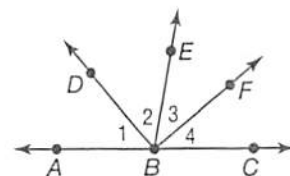
Exercises

ALGEBRA In the figure \overrightarrow{QP} and \overrightarrow{QR} are opposite rays. \overrightarrow{QS} bisects $\angle PQT$.



- If $m\angle PQT = 60$ and $m\angle PQS = 4x + 14$, find the value of x .
- If $m\angle PQS = 3x + 13$ and $m\angle SQT = 6x - 2$, find $m\angle PQT$.

ALGEBRA In the figure \overrightarrow{BA} and \overrightarrow{BC} are opposite rays. \overrightarrow{BF} bisects $\angle CBE$.



- If $m\angle EBF = 6x + 4$ and $m\angle CBF = 7x - 2$, find $m\angle EBF$.
- If $m\angle 3 = 4x + 10$ and $m\angle 4 = 5x$, find $m\angle 4$.
- If $m\angle 3 = 6y + 2$ and $m\angle 4 = 8y - 14$, find $m\angle CBE$.
- Let $m\angle 1 = m\angle 2$. If $m\angle ABE = 100$ and $m\angle ABD = 2(r + 5)$, find r and $m\angle DBE$.

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4

1-5 Study Guide and Intervention

Angle Relationships

Pairs of Angles **Adjacent angles** are two angles that lie in the same plane and have a common vertex and a common side, but no common interior points. A pair of adjacent angles with noncommon sides that are opposite rays is called a **linear pair**. **Vertical angles** are two nonadjacent angles formed by two intersecting lines.

Example Name an angle or angle pair that satisfies each condition.

a. two vertical angles

$\angle EFI$ and $\angle GFH$ are nonadjacent angles formed by two intersecting lines. They are vertical angles.

b. two adjacent angles

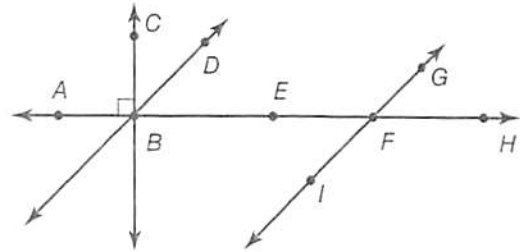
$\angle ABD$ and $\angle DBE$ have a common vertex and a common side but no common interior points. They are adjacent angles.

c. two supplementary angles

$\angle EFG$ and $\angle GFH$ form a linear pair. The angles are supplementary.

d. two complementary angles

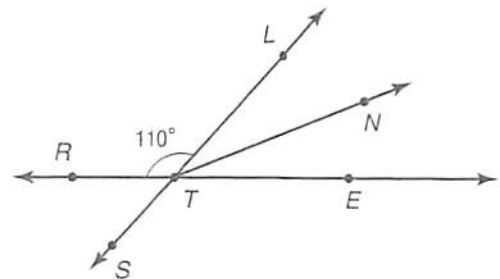
$m\angle CBD + m\angle DBE = 90$. These angles are complementary.



Exercises

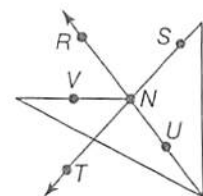
Name an angle or angle pair that satisfies each condition.

- two adjacent angles
- two acute vertical angles
- two supplementary adjacent angles
- an angle supplementary to $\angle RTS$



For Exercises 5-7, use the figure at the right.

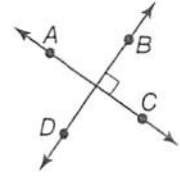
- Identify two obtuse vertical angles.
- Identify two acute adjacent angles.
- Identify an angle supplementary to $\angle TNU$.
- Find the measures of two complementary angles if the difference in their measures is 18.



1-5 Study Guide and Intervention *(continued)*

Angle Relationships

Perpendicular Lines Lines, rays, and segments that form four right angles are **perpendicular**. The right angle symbol indicates that the lines are perpendicular. In the figure at the right, \overleftrightarrow{AC} is perpendicular to \overleftrightarrow{BD} , or $\overleftrightarrow{AC} \perp \overleftrightarrow{BD}$.



Example Find x so that \overleftrightarrow{DZ} and \overleftrightarrow{ZP} are perpendicular.

If $\overleftrightarrow{DZ} \perp \overleftrightarrow{ZP}$, then $m\angle DZP = 90$.

$$m\angle DZQ + m\angle QZP = m\angle DZP$$

$$(9x + 5) + (3x + 1) = 90$$

$$12x + 6 = 90$$

$$12x = 84$$

$$x = 7$$

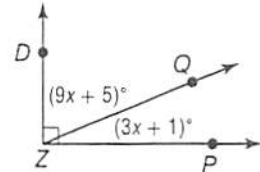
Sum of parts = whole

Substitution

Combine like terms.

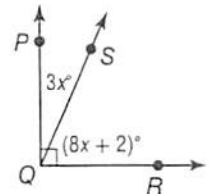
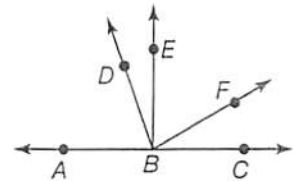
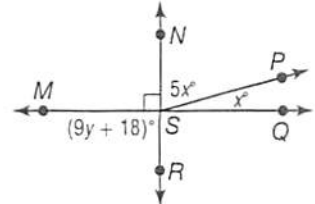
Subtract 6 from each side.

Divide each side by 12.

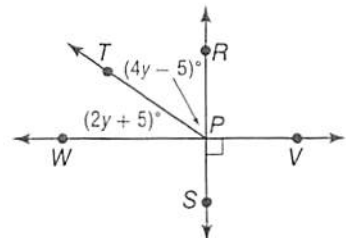


Exercises

- Find the value of x and y so that $\overleftrightarrow{NR} \perp \overleftrightarrow{MQ}$.
- Find $m\angle MSN$.
- $m\angle EBF = 3x + 10$, $m\angle DBE = x$, and $\overleftrightarrow{BD} \perp \overleftrightarrow{BF}$. Find the value of x .
- If $m\angle EBF = 7y - 3$ and $m\angle FBC = 3y + 3$, find the value of y so that $\overleftrightarrow{BE} \perp \overleftrightarrow{BC}$.
- Find the value of x , $m\angle PQS$, and $m\angle SQR$.



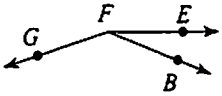
- Find the value of y , $m\angle RPT$, and $m\angle TPW$.



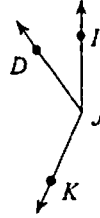
6

Unit 1.1: Section 3 - Angles and Angle Relationships Date _____ Period _____

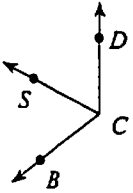
- 1) $m\angle EFG = 162^\circ$ and $m\angle BFG = 140^\circ$.
Find $m\angle EFB$.



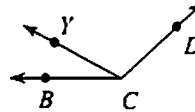
- 2) $m\angle KJD = 120^\circ$ and $m\angle DJI = 36^\circ$.
Find $m\angle KJI$.



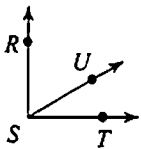
- 3) Find x if $m\angle BCD = 127^\circ$, $m\angle BCS = 2 + 9x$,
and $m\angle SCD = 8x + 6$.



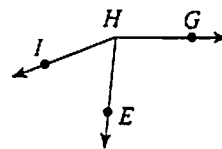
- 4) $m\angle BCY = 6x + 4$, $m\angle YCD = 26x + 5$,
and $m\angle BCD = 137^\circ$. Find x .



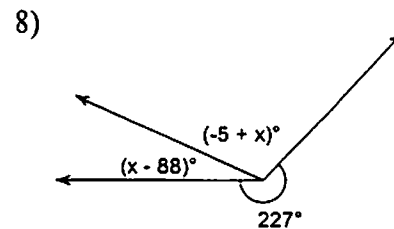
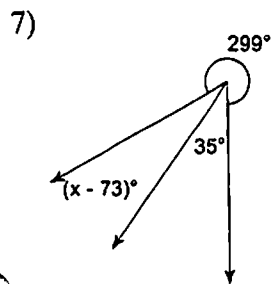
- 5) $m\angle UST = 10x$, $m\angle RSU = 60^\circ$,
and $m\angle RST = 29x + 3$. Find $m\angle RST$.



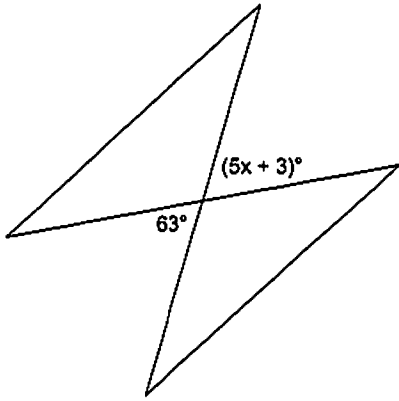
- 6) Find $m\angle GHE$ if $m\angle GHE = 23x + 4$,
 $m\angle GHI = 159^\circ$, and $m\angle EHI = 7 + 14x$.



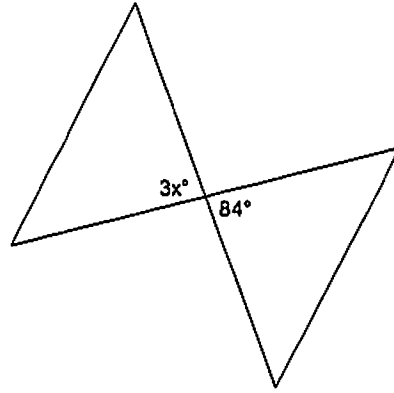
Find the value of x .



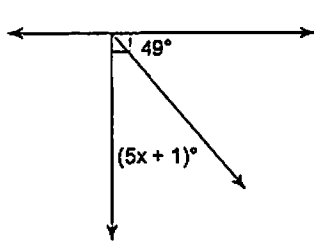
9)



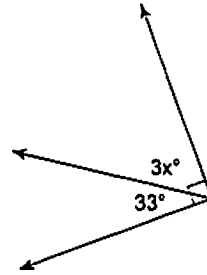
10)



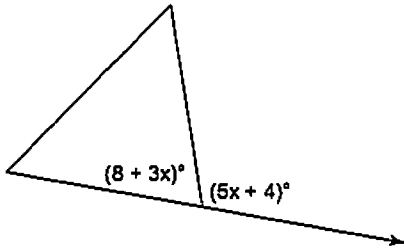
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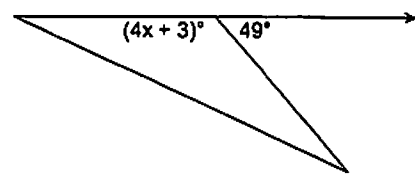
12)



13)

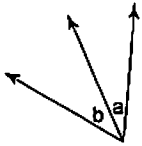


14)

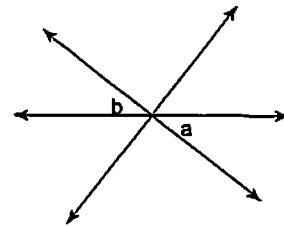


Name the relationship: complementary, linear pair, vertical, or adjacent.

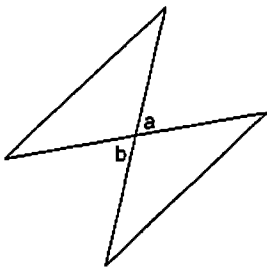
15)



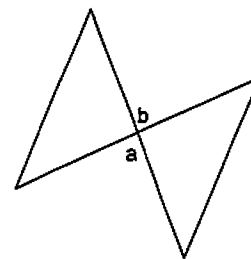
16)



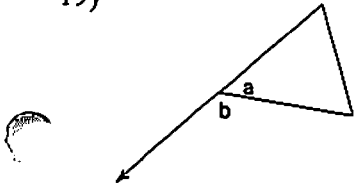
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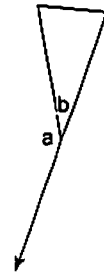
18)



19)

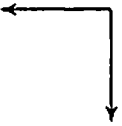


20)



Classify each angle as acute, obtuse, right, or straight.

21)



22)



23)

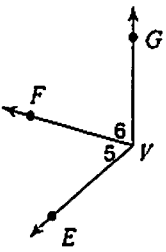


24)

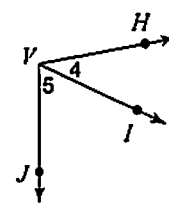


Name all the angles that have V as a vertex.

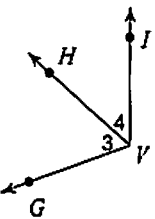
25)



26)



27)



28)

