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 Adv Geo - 7

AMDG

2.8: Vertical Angles

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 Date: 29 Sep 15

**Objectives**

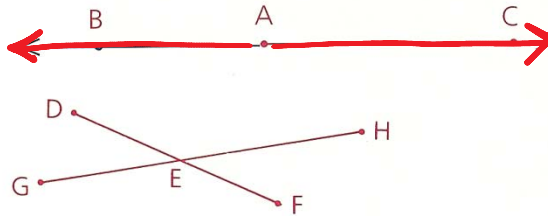
After studying this section, you should be able to

- Recognize opposite rays
- Recognize vertical angles

**Opposite Rays**

$\vec{AB}$  and  $\vec{AC}$  are **opposite rays**.

$\vec{ED}$  and  $\vec{EF}$  are also opposite rays,  
 as are  $\vec{EG}$  and  $\vec{EH}$ .



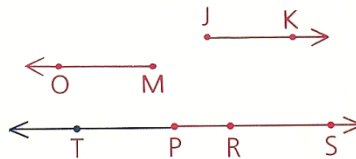
**Definition** Two collinear rays that have a common endpoint and extend in different directions are called opposite rays.

term not used  
 in our proofs

Some pairs of rays that are not opposite rays are shown below.

$\vec{JK}$  and  $\vec{MO}$  are not parts of the same line.

$\vec{PT}$  and  $\vec{RS}$  are not opposite, since they do not have a common endpoint.



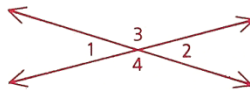
**Vertical Angles**

Whenever two lines intersect, two pairs of **vertical angles** are formed.

**Definition** Two angles are **vertical angles** if the rays forming the sides of one and the rays forming the sides of the other are opposite rays.

$\angle 1$  and  $\angle 2$  are vertical angles.

$\angle 3$  and  $\angle 4$  are vertical angles.

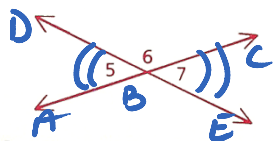


Are  $\angle 3$  and  $\angle 2$  vertical angles? How do vertical angles compare in size?

**Theorem 18** Vertical angles are congruent.

Given: Diagram as shown

Prove:  $\angle 5 \cong \angle 7$



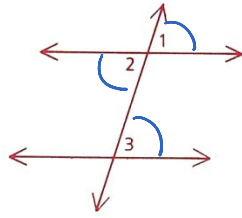
~~We proved Theorem 18 in Section 2.4, sample problem 3.~~

Statements	Reasons
1. Diag	1. Given
2. $\angle ABC$ & $\angle DBE$ st $\angle$ s	2. Diag $\Rightarrow$ st $\angle$
3. $\angle 5$ supp $\angle 6$ $\angle 7$ supp $\angle 6$	3. st $\angle \Rightarrow$ suppl s
4. $\angle 5 \cong \angle 7$	4. $\angle$ s supp same $\angle$ then $\cong$ $\angle$ s

~~Diagram~~ VERT  $\angle$ s  $\Rightarrow$   $\cong$   $\angle$ s

## Part Two: Sample Problems

**Problem 1** Given:  $\angle 2 \cong \angle 3$   
 Prove:  $\angle 1 \cong \angle 3$

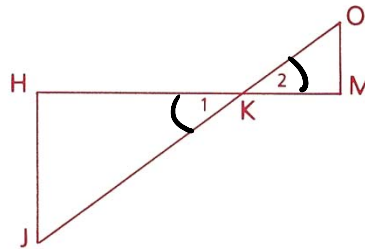


**Proof**

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

Statements	Reasons
1 $\angle 2 \cong \angle 3$	1 Given
2 $\angle 1 \cong \angle 2$	2 <i>Vert <math>\angle</math>s <math>\Rightarrow</math> <math>\cong</math> <math>\angle</math>s</i>
3 $\angle 1 \cong \angle 3$	3 <i>Trans (1,2)</i>

**Problem 2** Given:  $\angle O$  is comp. to  $\angle 2$ .  
 $\angle J$  is comp. to  $\angle 1$ .  
 Conclusion:  $\angle O \cong \angle J$

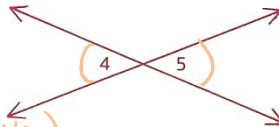


**Proof**

Statements	Reasons
1 $\angle O$ is comp. to $\angle 2$ .	1 Given
2 $\angle J$ is comp. to $\angle 1$ .	2 Given
3 $\angle 1 \cong \angle 2$	3 <i>Vert <math>\angle</math>s <math>\Rightarrow</math> <math>\cong</math> <math>\angle</math>s</i>
4 $\angle O \cong \angle J$	4 <i><math>\angle</math>s comp to <math>\cong</math> <math>\angle</math>s <math>\Rightarrow</math> <math>\cong</math> <math>\angle</math>s</i>

**Problem 3** Given:  $m\angle 4 = 2x + 5$ ,  
 $m\angle 5 = x + 30$

Find:  $m\angle 4$   
 $\angle 4 \cong \angle 5$  (verticals)  
 $2x + 5 = x + 30$  (substitute)  
 $x = 25$



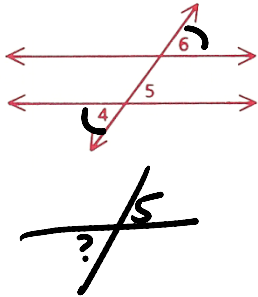
**Solution**

Therefore,  $m\angle 4 = 2(25) + 5$ , or 55.

**Problem 4**

Given:  $\angle 4 \cong \angle 6$

Prove:  $\angle 5 \cong \angle 6$

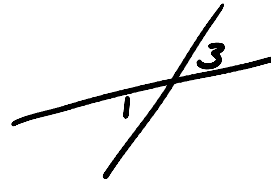
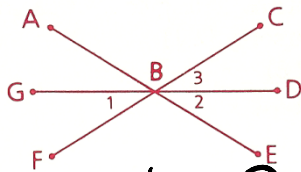


Statements	Reasons
1. $\angle 4 \cong \angle 6$	1. Given
2. $\angle 5 \cong \angle 4$	2. Vert $\angle$ s $\Rightarrow \cong \angle$ s
3. $\angle 5 \cong \angle 6$	3. trans (1,2)

**Problem 5**

Given:  $\overleftrightarrow{GD}$  bisects  $\angle CBE$ .

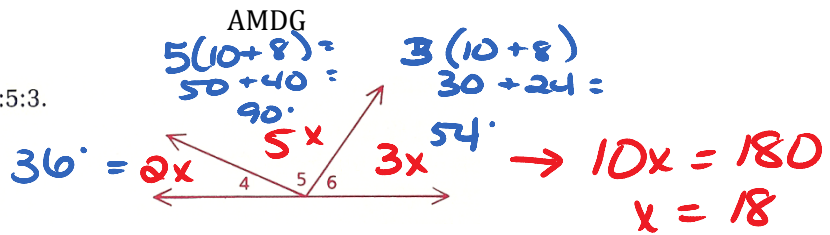
Conclusion:  $\angle 1 \cong \angle 2$



Statements	Reasons
1. $\overleftrightarrow{GD}$ bis $\angle CBE$	1. Given
2. $\angle 3 \cong \angle 2$	2. bis $\Rightarrow \cong \angle$ s (1)
3. $\angle 1 \cong \angle 3$	3. Vert $\angle$ s $\Rightarrow \cong \angle$ s
4. $\angle 1 \cong \angle 2$	4. trans (2,3)

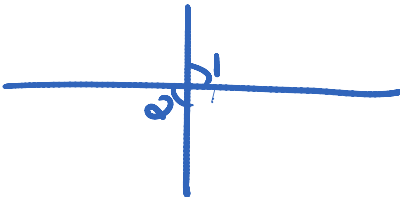
**Problem 6**

Angles 4, 5, and 6 are in the ratio 2:5:3.  
Find the measure of each angle.



**Problem 7 ?**

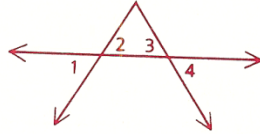
If a pair of vertical angles are supp., what can we conclude about the angles?



$$\begin{aligned} \angle 1 + \angle 2 &= 180 \\ x + x &= 180 \\ 2x &= 180 \\ x &= 90^\circ \end{aligned}$$

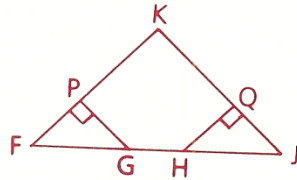
**Homework**

- 5 Given:  $\angle 1 \cong \angle 4$   
 Conclusion:  $\angle 2 \cong \angle 3$

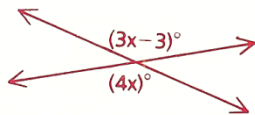


Statements	Reasons
1. $\angle 1 \cong \angle 4$	1.
2. $\angle 1 \cong \angle 2$ & 3. $\angle 4 \cong \angle 3$	2.
4. $\angle 2 \cong \angle 3$	3.

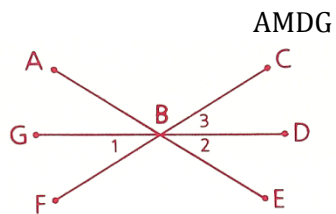
- 6 Given:  $\overline{FH} \cong \overline{GJ}$   
 Prove:  $\overline{FG} \cong \overline{HJ}$



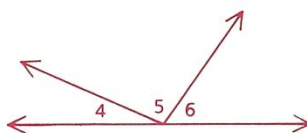
- 7 Is this possible?



- 11 Given:  $\overleftrightarrow{GD}$  bisects  $\angle CBE$ .  
 Conclusion:  $\angle 1 \cong \angle 2$



- 12 Angles 4, 5, and 6 are in the ratio 2:5:3.  
 Find the measure of each angle.



- 15 Find  $m\angle 1$ .

