

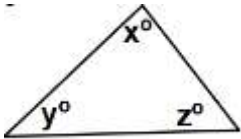
## Unit 4 Lesson 4 - Vertical Angles Theorem

**VERTICAL ANGLES** = Angles formed by intersecting lines (angles that are across from each other)  
Angles are CONGRUENT, which means they are equal

**LINEAR PAIR ANGLES** = Angles that form a straight line OR are adjacent to another angle  
Angles are SUPPLEMENTARY, which means the angles equal  $180^\circ$

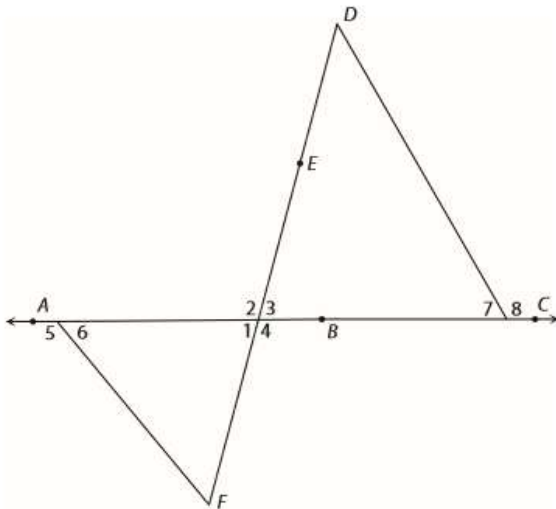
**COMPLEMENTARY ANGLES** – Angles that have sum of  $90^\circ$ , which is a right angle

**ANGLE SUM THEOREM** = The sum of the measures of the angles of a triangle equals  $180^\circ$ .



$$\text{Symbols: } x + y + z = 180$$

**Ex 1)** Look at the following diagram. List pairs of linear supplementary angles and pairs of vertical angles.



1. List pairs of supplementary angles.

Supplementary angles have a sum of  $180^\circ$ .

$\angle 5$  and  $\angle 6$  are adjacent supplementary angles. They form a linear pair.

$\angle 1$  and  $\angle 4$  are adjacent supplementary angles. They form a linear pair.

$\angle 2$  and  $\angle 3$  are adjacent supplementary angles. They form a linear pair.

$\angle 7$  and  $\angle 8$  are adjacent supplementary angles. They form a linear pair.

$\angle 1$  and  $\angle 2$  are adjacent supplementary angles. They form a linear pair.

$\angle 3$  and  $\angle 4$  are adjacent supplementary angles. They form a linear pair.

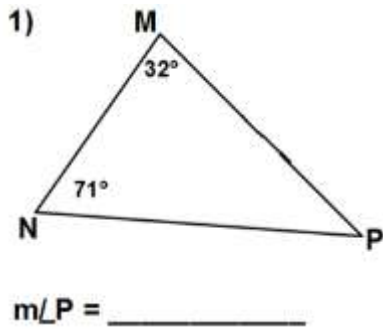
2. List the vertical angles.

Vertical angles are nonadjacent angles that are formed by a pair of intersecting lines.

$\angle 1$  and  $\angle 3$  are vertical angles. They are formed by the intersecting segments of  $\overleftrightarrow{AC}$  and  $\overleftrightarrow{DF}$ .

$\angle 2$  and  $\angle 4$  are vertical angles. They are formed by the intersecting segments of  $\overleftrightarrow{AC}$  and  $\overleftrightarrow{DF}$ .

Ex 2) Find the measure of the missing angle.



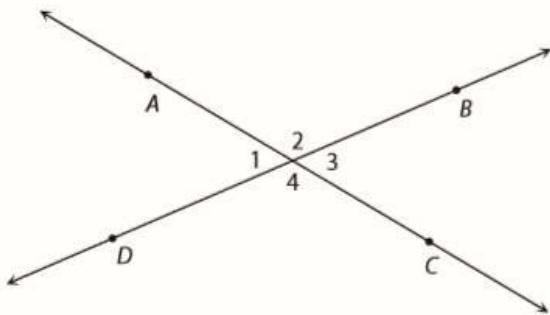
2) Remember....all angles of triangle equal  $180^\circ$

$$71 + 32 + x = 180$$

$$103 + x = 180$$

$$x = 77^\circ$$

Ex 3) In the following diagram,  $\overleftrightarrow{AC}$  and  $\overleftrightarrow{BD}$  are intersecting lines. If  $m\angle 1 = 3x + 14$  and  $m\angle 2 = 9x + 22$ , find  $m\angle 3$  and  $m\angle 4$ .



1. Use the Supplement Theorem.

Since  $\overleftrightarrow{BD}$  is a straight line,  $m\angle 1 + m\angle 2 = 180^\circ$ .

2. Use substitution to find the value of  $x$ .

Substitute the measures of  $\angle 1$  and  $\angle 2$  into the equation  $m\angle 1 + m\angle 2 = 180^\circ$ .

$$m\angle 1 = 3x + 14$$

$$m\angle 2 = 9x + 22$$

$$m\angle 1 + m\angle 2 = 180^\circ$$

$$(3x + 14) + (9x + 22) = 180$$

$$12x + 36 = 180$$

$$12x = 144$$

$$x = 12$$

Supplement Theorem

Substitute  $3x + 14$  and  $9x + 22$  for  $m\angle 1$  and  $m\angle 2$ .

Combine like terms.

Subtract 36 from both sides.

Divide both sides by 12.

3. Use substitution to find  $m\angle 1$ .

$$m\angle 1 = 3x + 14 \text{ and } x = 12 \quad \text{Given}$$

$$m\angle 1 = 3(12) + 14 \quad \text{Substitute 12 for } x.$$

$$m\angle 1 = 36 + 14 \quad \text{Multiply.}$$

$$m\angle 1 = 50^\circ \quad \text{Add.}$$

4. Use substitution to find  $m\angle 2$ .

$$m\angle 2 = 9x + 22 \text{ and } x = 12 \quad \text{Given}$$

$$m\angle 2 = 9(12) + 22 \quad \text{Substitute 12 for } x.$$

$$m\angle 2 = 108 + 22 \quad \text{Multiply.}$$

$$m\angle 2 = 130^\circ \quad \text{Add.}$$

5. Use the Vertical Angles Theorem to find  $m\angle 3$  and  $m\angle 4$ .

$\angle 1$  and  $\angle 3$  are vertical angles.

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

Vertical Angles Theorem

$$m\angle 1 = m\angle 3$$

Definition of congruent angles

$$50 = m\angle 3$$

Substitute 50 for  $m\angle 1$ .

$\angle 2$  and  $\angle 4$  are vertical angles.

$$\angle 2 \cong \angle 4$$

Vertical Angles Theorem

$$m\angle 2 = m\angle 4$$

Definition of congruent angles

$$130 = m\angle 4$$

Substitute 130 for  $m\angle 2$ .

$$m\angle 3 = 50^\circ; m\angle 4 = 130^\circ$$

The measure of  $\angle 3$  is  $50^\circ$  and the measure of  $\angle 4$  is  $130^\circ$ .

