



7th  
Basic

8th  
Advanced

# Helping With Math

USA  
GRADES

## Vertical Angles

*Suitable for students  
aged 11-13*



This pack is suitable for learners aged 11-13 years old or 7th to 8th grades (USA). The content covers fact files and relevant basic and advanced activities involving vertical angles.

## Inauguration Day!



**Inauguration Day** happens every four years on January 20. The inauguration is being held at the U.S. Capitol building in Washington, DC. On this federal day, the elected president and vice-president are sworn in and take office.

The event includes:

- the swearing-in ceremony
- the inaugural address, and;
- the pass in review.



# ANGLES

In geometry, an angle can be defined as the figure formed by two rays meeting at a common endpoint called a vertex. Angle measures the amount of turn of its rays in degrees.



## TYPES OF ANGLES

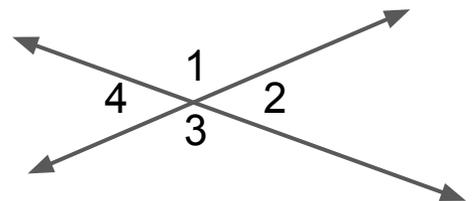
<b>Acute Angles</b>	angles which measure less than $90^\circ$
<b>Right Angles</b>	angles which measure exactly $90^\circ$
<b>Obtuse Angles</b>	angles which measure greater than $90^\circ$ but less than $180^\circ$
<b>Straight Angles</b>	angles which measure exactly $180^\circ$
<b>Reflex Angles</b>	angles which measure greater than $180^\circ$ but less than $360^\circ$

### Remember:

A full rotation is an angle which measures exactly  $360^\circ$ .

## VERTICAL ANGLES

When two straight lines intersect, the angles that are opposite each other are called **vertical angles**. Any two intersecting lines form two pairs of vertical angles.



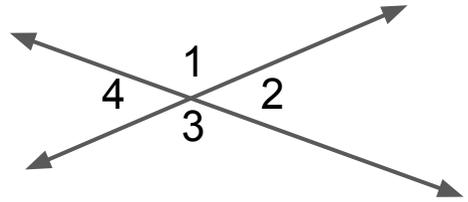
### Vertical Angles

- $\angle 1$  and  $\angle 3$
- $\angle 2$  and  $\angle 4$



## MEASUREMENT OF VERTICAL ANGLES

Based on the Vertical Angle Theorem, if two angles are vertical then they are **CONGRUENT** or **EQUAL**.

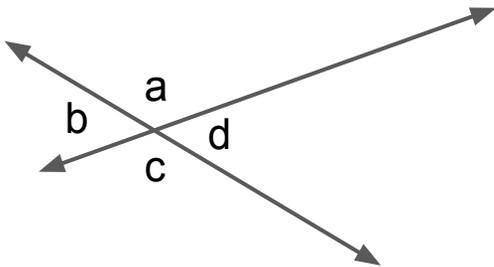


On the example above,  $\angle 1$  and  $\angle 3$  are vertical angles, therefore they are congruent.

**Example:**

If  $\angle 1 = 120^\circ$  then  $\angle 3 = 120^\circ$ .

## ILLUSTRATIVE EXAMPLES



Name the vertical angles

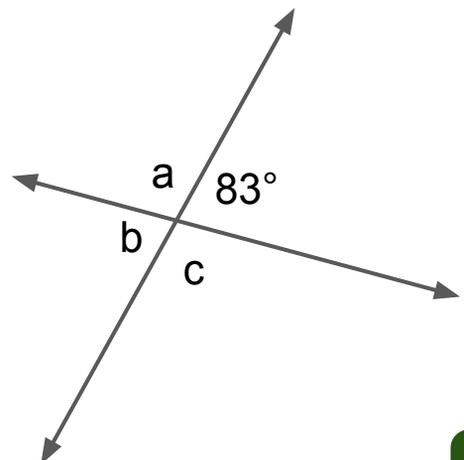
1. \_\_\_\_\_
2. \_\_\_\_\_

If  $\angle d$  measures  $83^\circ$ , what are the measurements of  $\angle b$ ,  $\angle c$ , and  $\angle a$ ?

$\angle b =$  \_\_\_\_\_

$\angle c =$  \_\_\_\_\_

$\angle a =$  \_\_\_\_\_



# TABLE OF ACTIVITIES

<b>Ages 11-12</b> (Basic)		<u>7th Grade</u>
1	Inauguration Day Ceremony	
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3	Inside The White House	
4	President's Parade Across America	
5	Procession To The Capitol	
<b>Ages 12-13</b> (Advanced)		<u>8th Grade</u>
6	White House's Red Carpet	
7	Media Coverage	
8	The White House's Table	
9	A President Is A Problem Solver	
10	A Question To The President	



# INAUGURATION DAY CEREMONY

G7  
Basic

Since Inauguration Day is a special day for all Americans, visitors in the White House want to have a good angle view in watching the ceremony. Determine which angle view is best by identifying the type of angle being described.

1. An angle which measures exactly  $180^\circ$ .

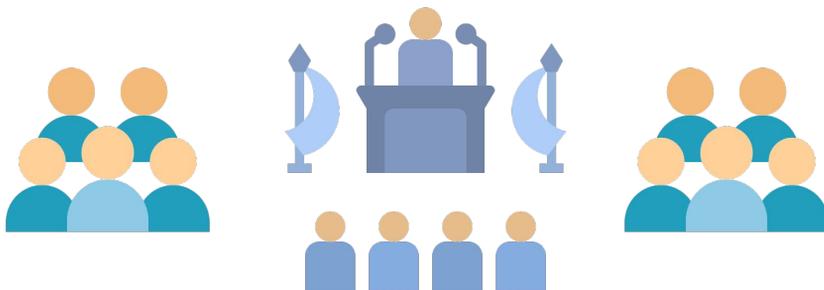
2. An angle which measures exactly  $90^\circ$ .

3. An angle which measures less than  $90^\circ$ .

4. It is an angle which has a measure of  $115^\circ$ .

5. An angle which measures greater than  $90^\circ$  but less than  $180^\circ$ .

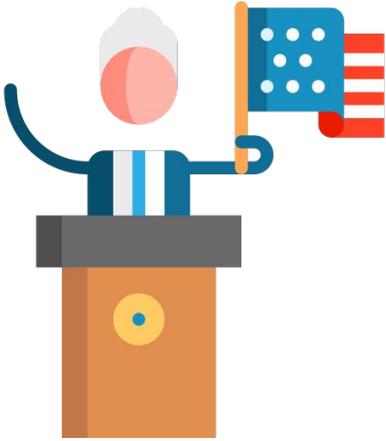
6. It is an angle which has a measure of  $229^\circ$ .



# PRESIDENT'S INAUGURAL ADDRESS

G7  
Basic

Inaugural speeches set the tone for the incoming administration. Most of the time, they are intended to persuade. A true and honest president knows how to identify facts. Let's see if you can identify whether the statements are true. If not, make it correct.



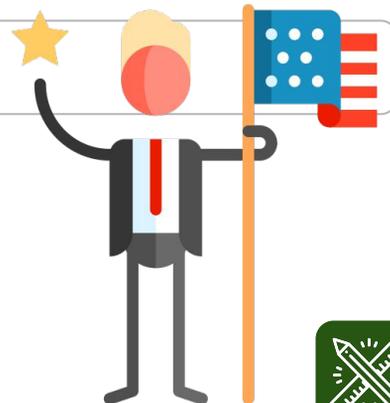
1. Angles are formed by two rays intersecting at one point.

2. Period is the point where the two rays intersect forming an angle.

3. According to the Vertical Angle Theorem, two angles are vertical then they have a sum of  $180^\circ$ .

4. Vertical angles are the opposite angles formed by two intersecting lines.

5. If angles A and B are vertical angles and angle B is  $70^\circ$ , then angle A is  $110^\circ$ .



# INSIDE THE WHITE HOUSE

G7  
Basic

During the inaugural day, guests are seated at a circular table. The organizers need to place the chairs considering that one person is exactly opposite to the other. Construct the opposite (vertical) angles based on the given one of the measurements.

Table 1 :  $60^\circ$

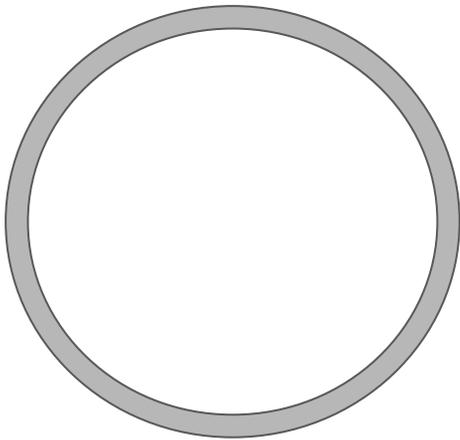


Table 2 :  $95^\circ$

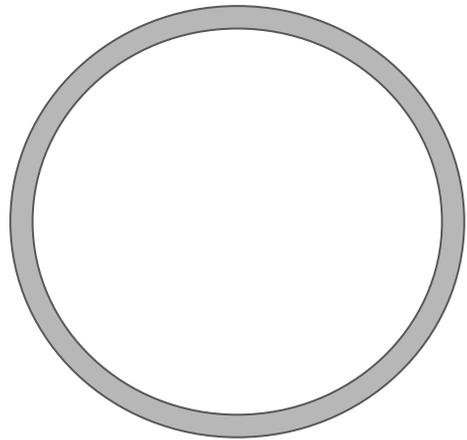


Table 3 :  $127^\circ$

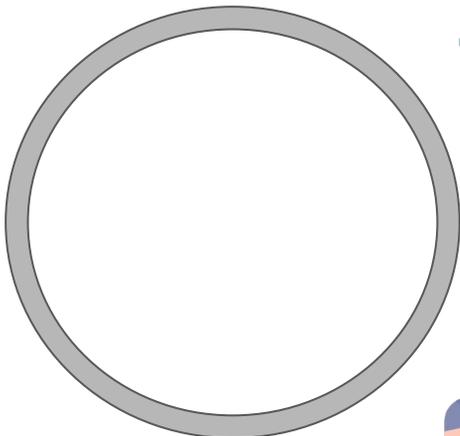
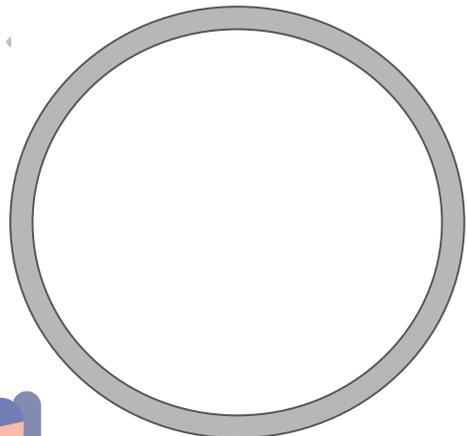


Table 4 :  $175^\circ$



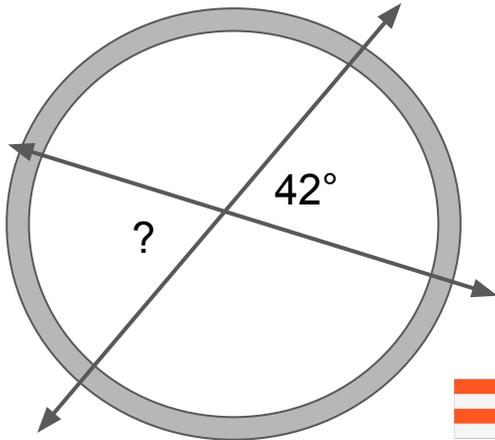
# PRESIDENT'S PARADE ACROSS AMERICA

G7  
Basic

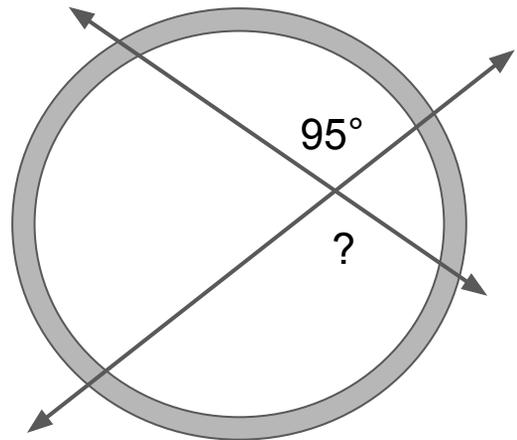
Due to a limited number of persons who can join the parade, there are only a few areas that will be occupied. Since physical distancing is observed, each group of people is seated opposite to the other group in a circular way. Find how many angles will each group occupy given the measurement of its opposite.



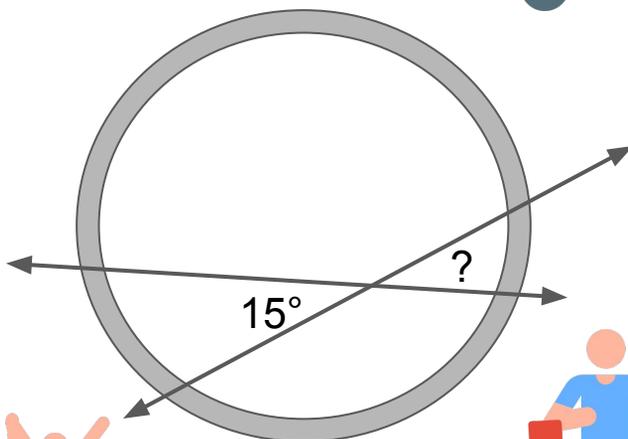
Audience 1



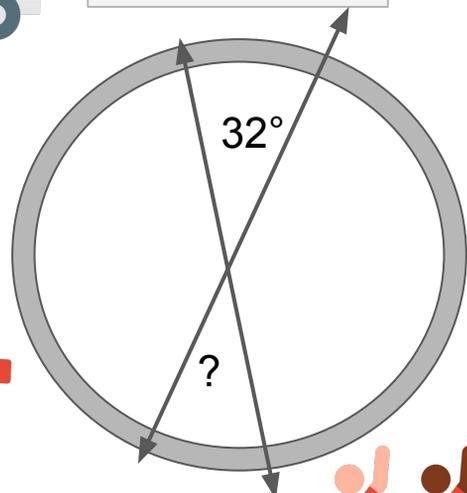
Audience 2



Audience 3



Audience 4

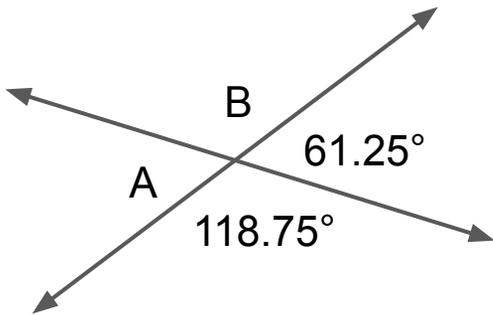


# PROCESSION TO THE CAPITOL

G7  
Basic

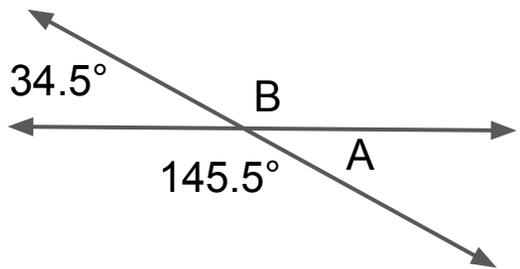
The president-elect and vice president-elect and their spouses are accompanied to the White House. The driver of the limousine will take the crossing to go easily to the Capitol. The intersecting lines below represent the different routes the driver can choose. Find the indicated measurements.

1.)



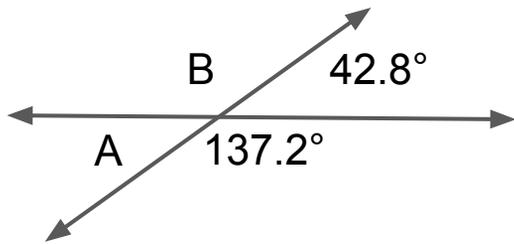
A = \_\_\_\_\_ , B = \_\_\_\_\_

2.)



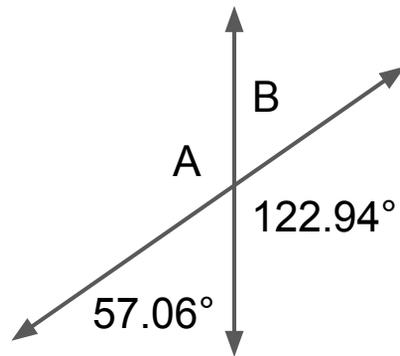
A = \_\_\_\_\_ , B = \_\_\_\_\_

3.)



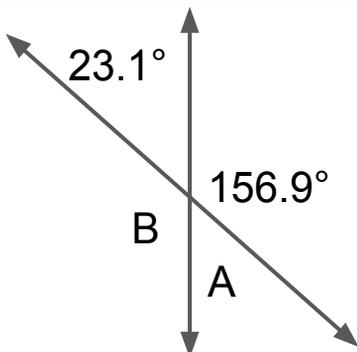
A = \_\_\_\_\_ , B = \_\_\_\_\_

4.)

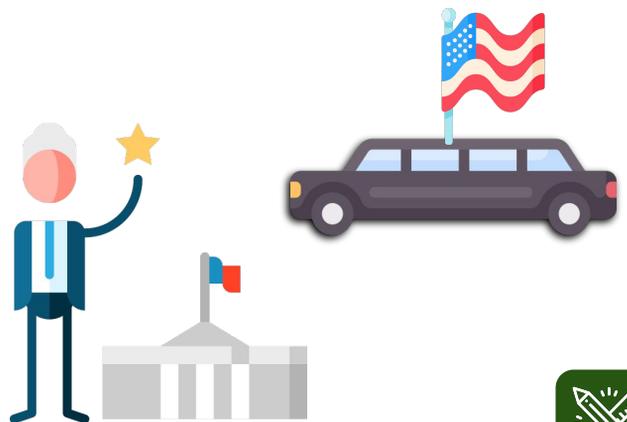


A = \_\_\_\_\_ , B = \_\_\_\_\_

5.)



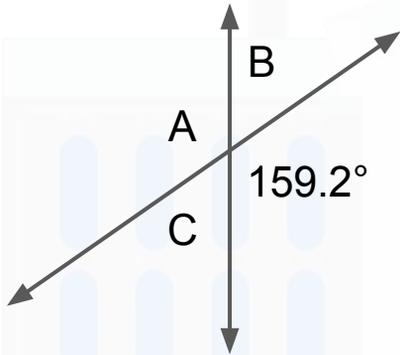
A = \_\_\_\_\_ , B = \_\_\_\_\_



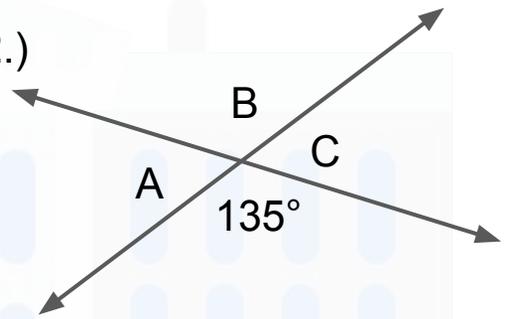
# WHITE HOUSE'S RED CARPET

The White House's red carpet has lines on it as design. The lines intersect with each other and create opposite angles. The figures below represent the lines on the carpet. Find the measurements of the missing angles.

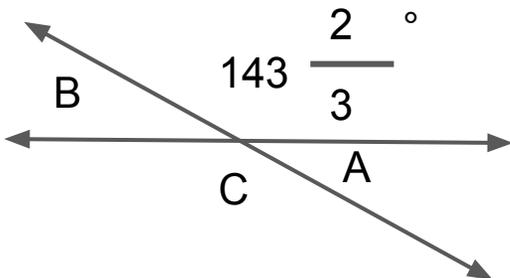
1.)



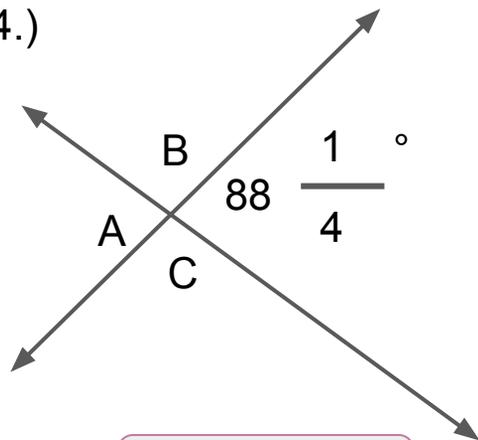

2.)




3.)




4.)

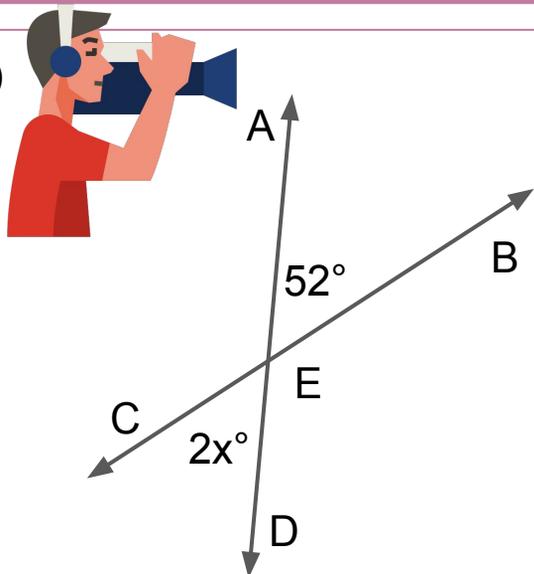




# MEDIA COVERAGE

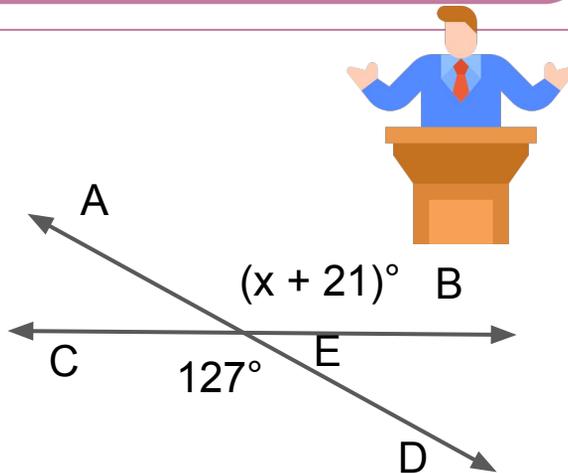
Inauguration Day is one of the most important events that must be covered by the media. Find the best camera and video angle to cover the president's inaugural speech by answering the missing angles below.

1.)



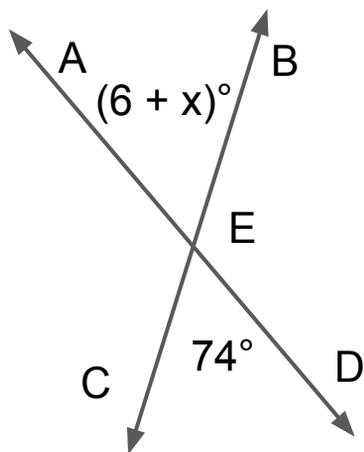
$x = \underline{\hspace{2cm}}$ ,  $m\angle BED = \underline{\hspace{2cm}}$

2.)



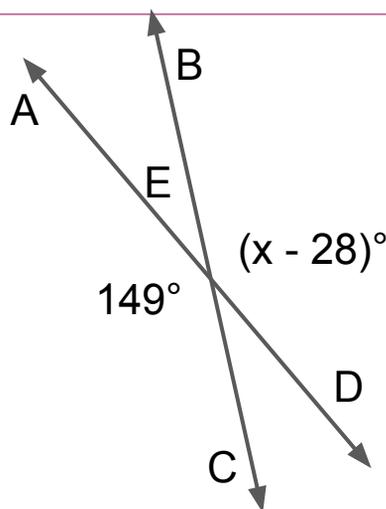
$x = \underline{\hspace{2cm}}$ ,  $m\angle BED = \underline{\hspace{2cm}}$

3.)



$x = \underline{\hspace{2cm}}$ ,  $m\angle AEC = \underline{\hspace{2cm}}$

4.)



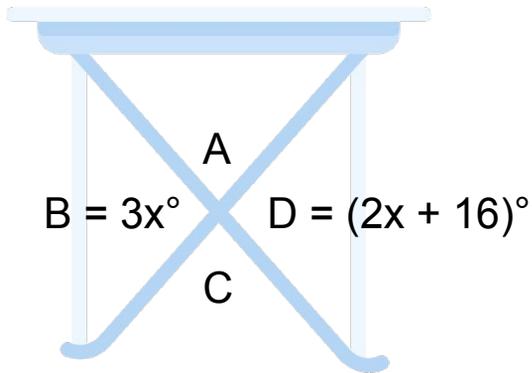
$x = \underline{\hspace{2cm}}$ ,  $m\angle AEB = \underline{\hspace{2cm}}$



# THE WHITE HOUSE'S TABLE

Different tables in the White House are used by the officials. Find the measurements of the angles formed by the legs of the table.

1.)



$$x = \underline{\hspace{2cm}}$$

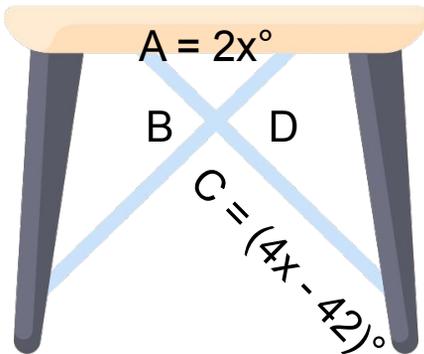
$$m\angle A = \underline{\hspace{2cm}}$$

$$m\angle B = \underline{\hspace{2cm}}$$

$$m\angle C = \underline{\hspace{2cm}}$$

$$m\angle D = \underline{\hspace{2cm}}$$

2.)



$$x = \underline{\hspace{2cm}}$$

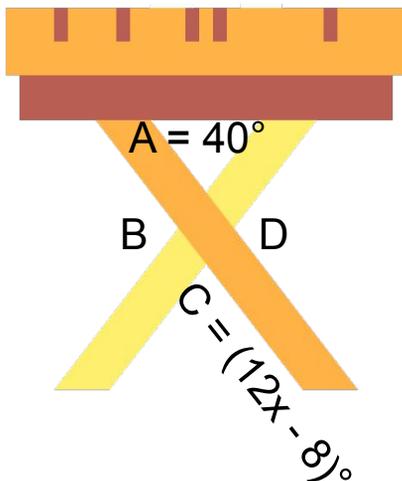
$$m\angle A = \underline{\hspace{2cm}}$$

$$m\angle B = \underline{\hspace{2cm}}$$

$$m\angle C = \underline{\hspace{2cm}}$$

$$m\angle D = \underline{\hspace{2cm}}$$

3.)



$$x = \underline{\hspace{2cm}}$$

$$m\angle A = \underline{\hspace{2cm}}$$

$$m\angle B = \underline{\hspace{2cm}}$$

$$m\angle C = \underline{\hspace{2cm}}$$

$$m\angle D = \underline{\hspace{2cm}}$$

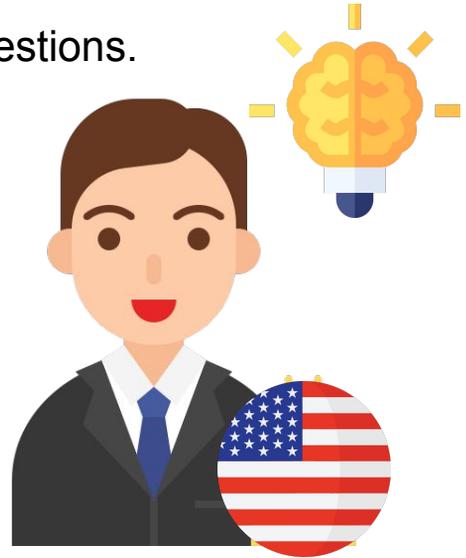
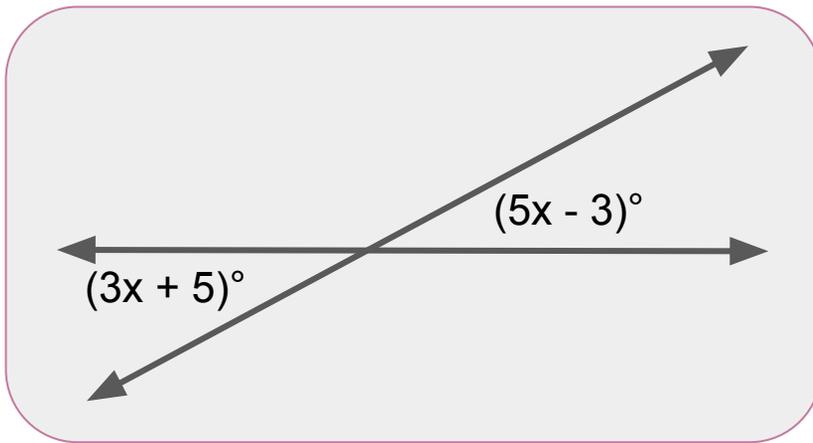


# A PRESIDENT IS A PROBLEM-SOLVER

G8  
Advanced

Being a president has many responsibilities. One of the qualities of a president-elect is having a good plan to solve a problem. Try to solve the problem below and see if you have this quality.

Refer to the diagram below to answer the questions.



1.) Use the Vertical Angle Theorem to write an equation.

2.) Solve your equation to find the value of  $x$ .

3.) Find the measures of the acute angles formed by the lines.

4.) Find the measures of the obtuse angles formed by the lines.

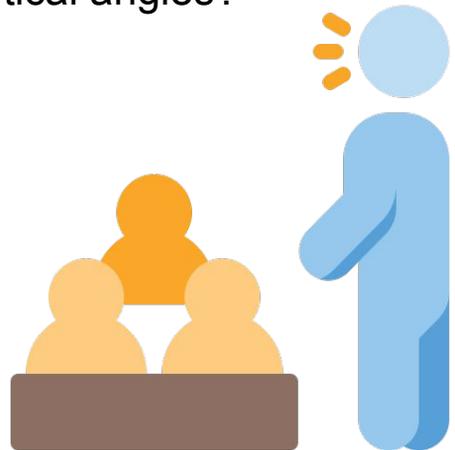


# A QUESTION TO THE PRESIDENT

G8  
Advanced

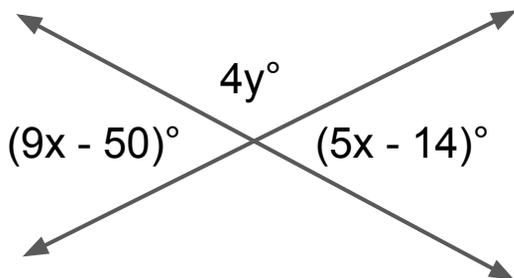
Few of the guests during the inaugural day will have a chance to ask a question about his administration for the succeeding years. To have that chance, they should answer the questions below.

- 1.) Are perpendicular lines also form vertical angles?  
Why or why not?



- 2.) Find the values of  $x$  and  $y$  in the diagram below.

Solution:



# ANSWER GUIDE

## Activity 1

- |                    |                  |                  |
|--------------------|------------------|------------------|
| 1.) straight angle | 3.) acute angle  | 5.) obtuse angle |
| 2.) right angle    | 4.) obtuse angle | 6.) reflex angle |

## Activity 2

- |            |                         |                |
|------------|-------------------------|----------------|
| 1.) True   | 3.) are congruent/equal | 5.) $70^\circ$ |
| 2.) Vertex | 4.) True                |                |

## Activity 3

Sketches may vary as long as the angles are exactly measured.

## Activity 4

- |                |                |                |                |
|----------------|----------------|----------------|----------------|
| 1.) $42^\circ$ | 2.) $95^\circ$ | 3.) $15^\circ$ | 4.) $32^\circ$ |
|----------------|----------------|----------------|----------------|

## Activity 5

- |                        |                    |
|------------------------|--------------------|
| 1.) $A = 61.25^\circ$  | $B = 118.75^\circ$ |
| 2.) $A = 34.5^\circ$   | $B = 145.5^\circ$  |
| 3.) $A = 42.8^\circ$   | $B = 137.2^\circ$  |
| 4.) $A = 122.94^\circ$ | $B = 57.06^\circ$  |
| 5.) $A = 23.1^\circ$   | $B = 156.9^\circ$  |

## Activity 6

- |                                |                            |                             |
|--------------------------------|----------------------------|-----------------------------|
| 1.) $A = 159.2^\circ$          | $B = 20.8^\circ$           | $C = 20.8^\circ$            |
| 2.) $A = 45^\circ$             | $B = 135^\circ$            | $C = 45^\circ$              |
| 3.) $A = 36 \frac{1}{3}^\circ$ | $B = 36 \frac{1}{3}^\circ$ | $C = 143 \frac{2}{3}^\circ$ |
| 4.) $A = 88 \frac{1}{4}^\circ$ | $B = 91 \frac{3}{4}^\circ$ | $C = 91 \frac{3}{4}^\circ$  |



# ANSWER GUIDE

## Activity 7

1.)  $x = 26$ ,  $m\angle BED = 128^\circ$

2.)  $x = 106$ ,  $m\angle BED = 53^\circ$

3.)  $x = 68$ ,  $m\angle BED = 112^\circ$

4.)  $x = 177$ ,  $m\angle BED = 31^\circ$

## Activity 8

1.)  $x = 16$

$m\angle A = 164^\circ$

$m\angle B = 48^\circ$

$m\angle C = 164^\circ$

$m\angle D = 48^\circ$

2.)  $x = 21$

$m\angle A = 42^\circ$

$m\angle B = 138^\circ$

$m\angle C = 42^\circ$

$m\angle D = 138^\circ$

3.)  $x = 4$

$m\angle A = 40^\circ$

$m\angle B = 140^\circ$

$m\angle C = 40^\circ$

$m\angle D = 140^\circ$

## Activity 9

1.)  $3x + 5 = 5x - 3$

2.)  $x = 4$

3.)  $17^\circ, 17^\circ$

4.)  $163^\circ, 163^\circ$

## Activity 10

1.) Yes, because they are also intersecting lines which form opposite or vertical angles with an angle measure of  $90^\circ$ .

2.)  $x = 9$ ,  $y = 37.25$



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