

# 8.5 Sum of Interior Angles Theorem & Exterior Angle Theorem

Standard:

G.CO.10

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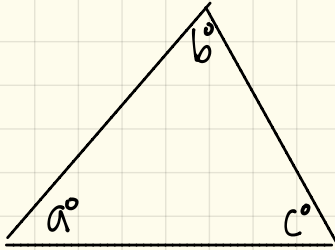
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# [Old] Sum of Interior Angles in a Triangle

Let's consider the following triangle.



Sum of Interior Angles in a Triangle:

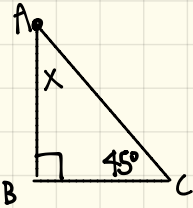
$$a^\circ + b^\circ + c^\circ = 180$$

(The sum of angles in any triangle is supplementary.)

"Triangle Sum Theorem"

[Examples] Find the missing angle in each triangle.

①

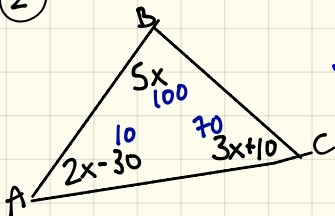


$$45^\circ + 90^\circ + x^\circ = 180^\circ$$

$$135^\circ + x^\circ = 180^\circ$$

$$x^\circ = 45^\circ$$

②



$$5x + (2x-30) + (3x+10) = 180^\circ$$

$$5x + 2x + 3x - 30 + 10 = 180^\circ$$

$$10x - 20 = 180$$

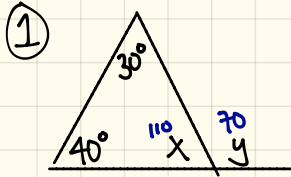
$$10x = 200$$

$$x = 20$$

$$5(20) = 100 \quad 2(20) - 30 = 10 \quad 3(20) + 10 = 70$$

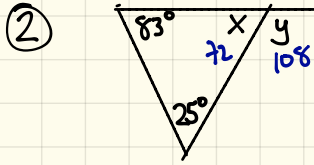
## new Exterior Angle Theorem

Let's consider the 3 triangles below. Find the unknown.



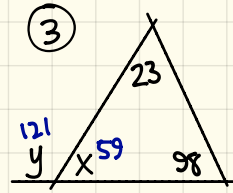
$$\begin{aligned}40^\circ + 30^\circ + x &= 180^\circ \\70^\circ + x &= 180^\circ \\x &= 110^\circ\end{aligned}$$

$$\begin{aligned}110^\circ + y &= 180^\circ \\y &= 70^\circ\end{aligned}$$



$$\begin{aligned}83^\circ + 25^\circ + x &= 180^\circ \\108^\circ + x &= 180^\circ \\x &= 72^\circ\end{aligned}$$

$$\begin{aligned}72^\circ + y &= 180^\circ \\y &= 108^\circ\end{aligned}$$



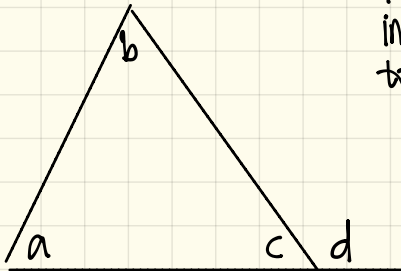
$$\begin{aligned}98^\circ + 23^\circ + x &= 180^\circ \\121^\circ + x &= 180^\circ \\x &= 59^\circ\end{aligned}$$

$$\begin{aligned}59^\circ + y &= 180^\circ \\y &= 121^\circ\end{aligned}$$

Can you see any patterns to make a conclusion?

There is a relationship between the exterior angle & 2 interior angles not next to the exterior angle. The sum of the 2 interior angles farthest away is equal to the exterior angle.

Exterior Angle Theorem:



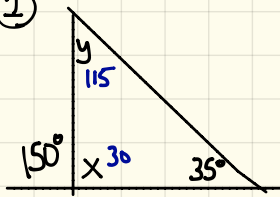
The sum of the 2 remote interior angles is equal to the exterior angle.

$$a^\circ + b^\circ = d^\circ$$

note: adjacent  $\rightarrow$  next to  
nonadjacent  $\rightarrow$  not next to (remote)

[Examples] Find all the missing angles.

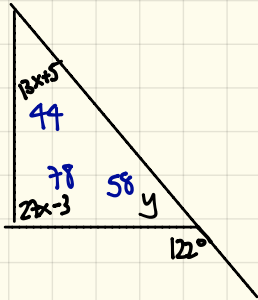
①



$$35^\circ + y = 150^\circ$$
$$y = 115^\circ$$

$$35^\circ + 115^\circ + x = 180^\circ$$
$$150^\circ + x = 180^\circ$$
$$x = 30^\circ$$

②



$$13x + 5 + 27x - 3 = 122^\circ$$
$$3x + 27x + 5 - 3 = 122^\circ$$
$$40x + 2 = 122^\circ$$
$$40x = 120^\circ$$
$$x = 3$$

$$13(3) + 5 = 44$$

$$27(3) - 3 = 78$$

$$44 + 78 + y = 180$$
$$122 + y = 180$$
$$y = 58^\circ$$