Understanding the Angle Measures of Triangles

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8.2 Understanding the Angle Measures of Triangles

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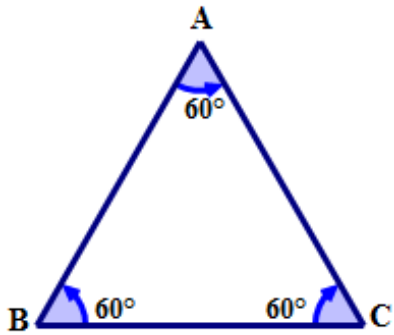
[Figure 1]

A roof truss is a pre-fabricated, triangular wooden structure used to support the roof of a home or building. The triangular shape is used because it is incredibly strong. A particular roof truss is an isosceles triangle such that the base angle has a measure of 50°. How can the worker figure out the measure of the other angles of the triangular roof truss to ensure that all trusses for this roof are identical?

In this concept, you will learn to understand the angle measures of triangles.

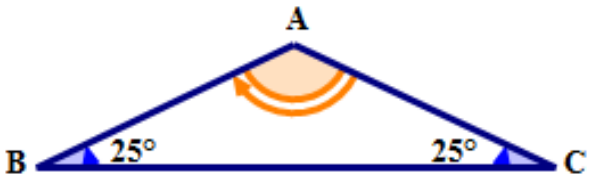
Equiangular Triangles

The sum of the interior angles of a triangle is 180°. This fact is true for all triangles regardless of the type of triangle. An equiangular triangle has three equal angles which each measure 60°. The following diagram is an equiangular triangle.



[Figure 2]

Let's look at another triangle to see how this information can be applied.



[Figure 3]

The above triangle has two acute angles that each measure 25° and one obtuse angle. The measure of the obtuse angle is not known.

The sum of the three angles of the triangle equals 180°. Write an equation to represent this statement.

$$m\angle A + m\angle B + m\angle C = 180^\circ$$

Next, substitute the known information into the equation.

$$m\angle A + 25^\circ + 25^\circ = 180^\circ$$

Next, simplify the left side of the equation.

$$\begin{aligned} m\angle A + 25^\circ + 25^\circ &= 180^\circ \\ m\angle A + 50^\circ &= 180^\circ \end{aligned}$$

Then, subtract 50° from both sides of the equation to solve for $m\angle A$.

$$\begin{aligned} m\angle A + 50^\circ &= 180^\circ \\ m\angle A + 50^\circ - 50^\circ &= 180^\circ - 50^\circ \\ m\angle A &= 130^\circ \end{aligned}$$

The answer is 130.

The measure of the obtuse angle is 130°.

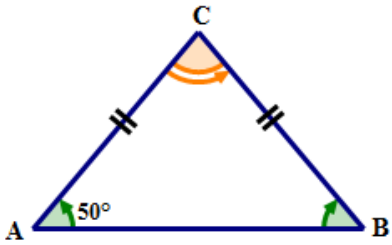
Examples

Example 1

Earlier, you were given a problem about the worker with the roof truss. He needs to figure out the measure of the interior angles in the roof truss. How can he do this?

He can use the facts that the triangle is isosceles and the sum of the interior angles of the triangle equals 180°.

First, draw and label an isosceles triangle to model the roof truss.



[Figure 4]

The triangular roof truss is an isosceles triangle. The angles opposite the equal sides are equal in measure.

$$\begin{aligned} m\angle A &= 50^\circ \\ m\angle A &= m\angle B \\ m\angle B &= 50^\circ \end{aligned}$$

Next, write an equation to represent the sum of the interior angles of the triangle.

$$\angle A + \angle B + \angle C = 180^\circ$$

Next, fill into the equation, the measures of the equal angles.

$$\begin{aligned} \angle A + \angle B + \angle C &= 180^\circ \\ 50^\circ + 50^\circ + \angle C &= 180^\circ \end{aligned}$$

Next, simplify the left side of the equation.

$$\begin{aligned} 50^\circ + 50^\circ + \angle C &= 180^\circ \\ 100^\circ + \angle C &= 180^\circ \end{aligned}$$

Next, subtract 100° from both sides of the equation to determine the measure of $\angle C$.

$$\begin{aligned} 100^\circ + \angle C &= 180^\circ \\ 100^\circ - 100^\circ + \angle C &= 180^\circ - 100^\circ \\ \angle C &= 80^\circ \end{aligned}$$

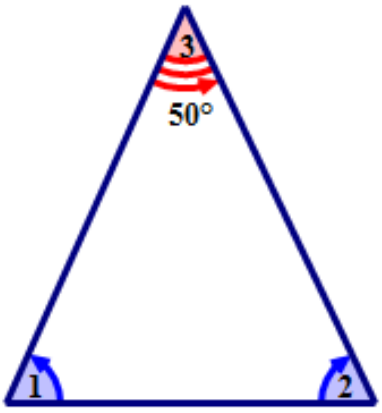
The answer is 80.

The measures of the other two interior angles of the roof truss are 50° and 80°.

Example 2

If the measure of the vertex angle of an isosceles triangle is 50°, what is the measure of the base angles of the triangle?

First, draw and label a triangle to represent the given information.



[Figure 5]

Next, write down what you know from the problem.

$$\begin{aligned} m\angle 1 + m\angle 2 + m\angle 3 &= 180^\circ && \text{Sum of the angles of a triangle} \\ m\angle 3 &= 50^\circ && \text{Measure of the vertex angle} \\ m\angle 1 &= m\angle 2 && \text{Equal angles of an isosceles triangle} \end{aligned}$$

Next, write down an equation to represent the information.

$$m\angle 1 + m\angle 2 + 50^\circ = 180^\circ$$

Next, let 'x' represent each of the equal angles of the isosceles triangle.

$$x + x + 50^\circ = 180^\circ$$

Next, simplify the left side of the equation.

$$2x + 50^\circ = 180^\circ$$

Next, subtract 50° from both sides of the equation and simplify to isolate the variable.

$$\begin{aligned} 2x + 50^\circ &= 180^\circ \\ 2x + 50^\circ - 50^\circ &= 180^\circ - 50^\circ \\ 2x &= 130^\circ \end{aligned}$$

Then, divide both sides of the equation by '2' to solve for 'x.'

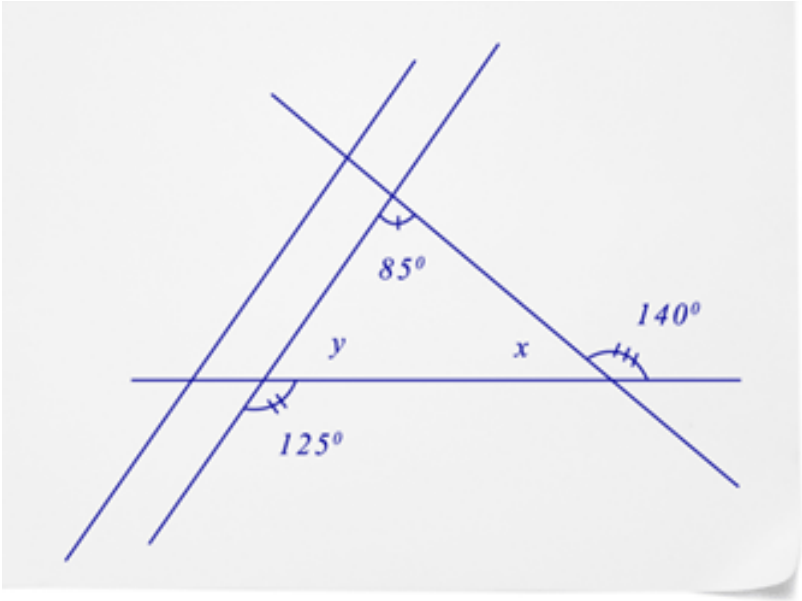
$$\begin{aligned} 2x &= 130^\circ \\ \frac{\overset{1}{\cancel{2}}x}{\cancel{2}} &= \frac{130^\circ}{2} \\ x &= 65^\circ \end{aligned}$$

The answer is 65.

$m\angle 1 = 65^\circ$ and $m\angle 2 = 65^\circ$.

Example 3

For the following diagram, determine the measure of angles 'x' and 'y.'



[Figure 6]

First, write down what you know from the diagram.

$$\begin{aligned} m\angle x + 140^\circ &= 180^\circ && \text{Straight angle formed by adjacent angles} \\ m\angle y + 125^\circ &= 180^\circ && \text{Straight angle formed by adjacent angles} \\ m\angle x + m\angle y + 85^\circ &= 180^\circ && \text{Sum of the angles of a triangle} \end{aligned}$$

Next, use what you have written down to determine the measure of $\angle x$.

$$m\angle x + 140^\circ = 180^\circ$$

Next, subtract 140° from both sides of the equation.

$$\begin{aligned} m\angle x + 140^\circ &= 180^\circ \\ m\angle x + 140^\circ - 140^\circ &= 180^\circ - 140^\circ \end{aligned}$$

Next, simplify both sides of the equation.

$$\begin{aligned} m\angle x + 140^\circ - 140^\circ &= 180^\circ - 140^\circ \\ m\angle x &= 40^\circ \end{aligned}$$

The answer is 40.

The measure of $\angle x$ is 40°.

Now, use what you know about the measures of the interior angles of the triangle to solve for the measure of $\angle y$.

$$m\angle x + m\angle y + 85^\circ = 180^\circ$$

Next, substitute the measure of $\angle x$ into the equation.

$$\begin{aligned} m\angle x + m\angle y + 85^\circ &= 180^\circ \\ 40^\circ + m\angle y + 85^\circ &= 180^\circ \end{aligned}$$

Next, simplify the left side of the equation.

$$\begin{aligned} 40^\circ + m\angle y + 85^\circ &= 180^\circ \\ 125^\circ + m\angle y &= 180^\circ \end{aligned}$$

Next, subtract 125° from both sides of the equation.

$$\begin{aligned} 125^\circ + m\angle y &= 180^\circ \\ 125^\circ - 125^\circ + m\angle y &= 180^\circ - 125^\circ \end{aligned}$$

Next, simplify both sides of the equation.

$$\begin{aligned} 125^\circ - 125^\circ + m\angle y &= 180^\circ - 125^\circ \\ m\angle y &= 55^\circ \end{aligned}$$

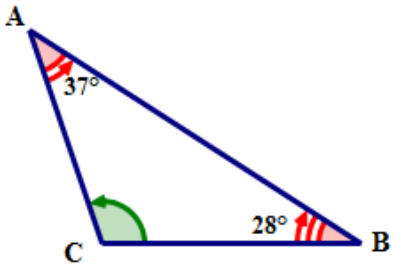
The answer is 55.

The measure of $\angle y$ is 55°.

Example 4

Given $\triangle ABC$, an obtuse scalene triangle with $\angle A = 37^\circ$ and $\angle b = 28^\circ$, what is the measure of the obtuse angle?

First, draw and label a triangle to model the problem.



[Figure 7]

Next, write an equation to represent the sum of the interior angles of the triangle.

$$\angle A + \angle B + \angle C = 180°$$

Next, fill into the equation, the measures of the angles given in the diagram.

$$\begin{aligned} \angle A + \angle B + \angle C &= 180° \\ 37° + 28° + \angle C &= 180° \end{aligned}$$

Next, simplify the left side of the equation.

$$\begin{aligned} 37° + 28° + \angle C &= 180° \\ 65° + \angle C &= 180° \end{aligned}$$

Then, subtract 65° from both sides of the equation to solve for the measure of $\angle C$.

$$\begin{aligned} 65° + \angle C &= 180° \\ 65° - 65° + \angle C &= 180° - 65° \\ \angle C &= 115° \end{aligned}$$

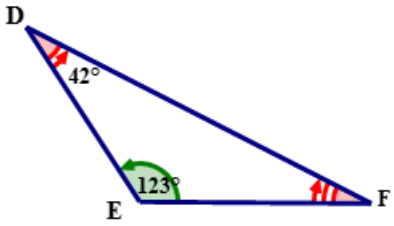
The answer is 115.

The measure of the obtuse angle is 115°.

Example 5

Given $\triangle DEF$, such that $\angle D = 42°$ and $\angle E = 123°$, what is the measure of $\angle F$?

First, draw and label a triangle to model the problem.



[Figure 8]

Next, write an equation to represent the sum of the measures of the interior angles of the triangle.

$$\angle D + \angle E + \angle F = 180^\circ$$

Next, fill into the equation, the measures of the angles given in the diagram.

$$\begin{aligned} \angle D + \angle E + \angle F &= 180^\circ \\ 42^\circ + 123^\circ + \angle F &= 180^\circ \end{aligned}$$

Next, simplify the left side of the equation.

$$\begin{aligned} 42^\circ + 123^\circ + \angle F &= 180^\circ \\ 165^\circ + \angle F &= 180^\circ \end{aligned}$$

Then, subtract 165° from both sides of the equation to solve for the measure of $\angle C$.

$$\begin{aligned} 165^\circ + \angle F &= 180^\circ \\ 165^\circ - 165^\circ + \angle F &= 180^\circ - 165^\circ \\ \angle F &= 15^\circ \end{aligned}$$

The answer is 15.

The measure of $\angle F = 15^\circ$.

Review

Using what you have learned about the interior angles of a triangle, determine the missing angle in each triangle.

1. 45°, 45°, ?

2. 60°, 60°, ?

3. 90°, 50°, ?

4. 100°, 40°, ?

5. 110°, 30°, ?

6. 50°, 10°, ?

7. 145°, 15°, ?

8. 55°, 45°, ?

9. 70°, 35°, ?

10. 50°, 50°, ?

11. 63°, 42°, ?

12. 18°, 75°, ?

Identify three triangles in the room around you.

13.

14.

15.

Review (Answers)

To see the review answers, return to the Table of Contents and select 'Other Versions' or 'Resources'.

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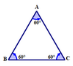	**Credit:** Great Valley Center;Elliot Brown **Source:** https://www.flickr.com/photos/greatvalleycenter/38286807/in/photolist-8sjwQt-4oekn-7krG8g-9wQjQH-7QHwkx-4sy88N-drrHfN-9e3W8Z-96sPRN-nsVkHD-nsVNTw-nbHuTQ-nbHhUt-fj22DA-oYUpA-e3PXxF-cC4Uij-bGcgJZ-bqtnD5-9v6iGs-vhdQbY-a4CZag-btsHzw-4yhxwh-fCNse4-npFkKN-axac8Y-4XYj1Z-opDkK3-9v6ii7-e3oEwY-fxF2nk-m9UXSU-cZaAmq-9cCLPe-hg466n-mp7qxT-bjv1i-fmGgWX-5UyMTL-9dtb8o-mp9eY1-6kWuQM-5YERDy-75mVza-9dq62F-9dtb73-oAPDQq-spGR26-bCWPuv ; https://www.flickr.com/photos/ell-r-brown/3639951854/in/photolist-6xDGSA-5wEtmK-7ztdDP-6jURUe-6jUSdc-8SL3Z6-ofitfs-o2ier1-6jZ6fs-65Uqfv-e5CMj8-6Vz9oS-gkcPn-2EYhU4-9eDpNd-pAePx8-aUaQsM-6jUUTX-cH3rgU-hfrpu7-66cnkD-7ayFFh-oiRKrn-kiwSzY-65vFN2-e5Jqts-6jUTVP-dJk5Yg-eVtVS-9nPvzg-2EuPD-9mjNV1-oXCYu8-9mjQxm-brvLxS-mK7BgB-6MU4ub-pE48tr-eSLqP9-4ndDbn-oiuZEB-iPLspo-8awuz3-pepv4y-a5YV8J-oyabu8-725hxm-6K4h9W-8fFEHN-cvxWUU
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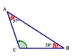	**Credit:** Great Valley Center;Elliot Brown **Source:** https://www.flickr.com/photos/greatvalleycenter/38286807/in/photolist-8sjwQt-4oekn-7krG8g-9wQjQH-7QHwkx-4sy88N-drrHfN-9e3W8Z-96sPRN-nsVkHD-nsVNTw-nbHuTQ-nbHhUt-fj22DA-oYUpA-e3PXxF-cC4Uij-bGcgJZ-bqtnD5-9v6iGs-vhdQbY-a4CZag-btsHzw-4yhxwh-fCNse4-npFkKN-axac8Y-4XYj1Z-opDkK3-9v6ii7-e3oEwY-fxF2nk-m9UXSU-cZaAmq-9cCLPe-hg466n-mp7qxT-bjv1i-fmGgWX-5UyMTL-9dtb8o-mp9eY1-6kWuQM-5YERDy-75mVza-9dq62F-9dtb73-oAPDQq-spGR26-bCWPuv ; https://www.flickr.com/photos/ell-r-brown/3639951854/in/photolist-6xDGSA-5wEtmK-7ztdDP-6jURUe-6jUSdc-8SL3Z6-ofitfs-o2ier1-6jZ6fs-65Uqfv-e5CMj8-6Vz9oS-gkcPn-2EYhU4-9eDpNd-pAePx8-aUaQsM-6jUUTX-cH3rgU-hfrpu7-66cnkD-7ayFFh-oiRKrn-kiwSzY-65vFN2-e5Jqts-6jUTVP-dJk5Yg-eVtVS-9nPvzg-2EuPD-9mjNV1-oXCYu8-9mjQxm-brvLxS-mK7BgB-6MU4ub-pE48tr-eSLqP9-4ndDbn-oiuZEB-iPLspo-8awuz3-pepv4y-a5YV8J-oyabu8-725hxm-6K4h9W-8fFEHN-cvxWUU
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