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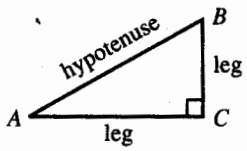
Triangles

Objective: To learn some properties of triangles.

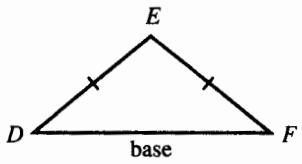
Vocabulary

Triangle A figure formed by three segments joining three points not on the same line. Each segment is a *side* of the triangle. Each of the three points is a *vertex* of the triangle. *Angles* of the triangle are formed by two sides and a vertex. The sum of the angles of a triangle is 180°.

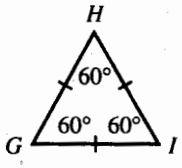


Right triangle A triangle having one right angle.

Isosceles triangle A triangle having two sides equal in length. The third side is called the *base*. The angles on either side of the base are called *base angles* and have equal measures.



Equilateral triangle A triangle with all sides of equal length. The angles of an equilateral triangle all measure 60°.



Example 1 The measures of two angles of a triangle are 26° and 64°. Find the measure of the third angle.

Solution In $\triangle ABC$, $\angle A + \angle B + \angle C = 180°$.

Let x = the measure of the third angle.

$$x + 26 + 64 = 180$$
$$x + 90 = 180$$
$$x = 90$$

The check is left for you.

The third angle has a measure of 90°.

The measure of two angles of a triangle are given. Find the measure of the third angle.

1. 35°, 65°

2. 110°, 40°

3. 78°, 48°

4. 90°, 21°

5. 25°, 36°

6. 116°, 23°

Example 2 Use the converse of the Pythagorean theorem to determine whether a triangle with sides 8, 15, and 17 is a right triangle.

Solution $a^2 + b^2 = c^2$ (in a right triangle)

$$8^2 + 15^2 \stackrel{?}{=} 17^2$$
$$64 + 225 \stackrel{?}{=} 289$$
$$289 = 289 \surd$$

A triangle with sides 8, 15, and 17 is a right triangle.

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Triangles *(continued)*

In Exercises 7–12, use the converse of the Pythagorean theorem to determine whether or not the triangle is a right triangle.

7. $\triangle ABC$: $AB = 16$, $BC = 12$, $AC = 20$

8. $\triangle DEF$: $EF = 29$, $FD = 21$, $DE = 20$

9. $\triangle GHI$: $GH = HI = 10$, $GI = 15$

10. $\triangle JKL$: $JK = 7$, $KL = 10$, $JL = 13$

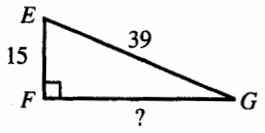
11. $\triangle MNO$: $MN = 10$, $MO = 8$, $NO = 16$

12. $\triangle PQR$: $PQ = 16$, $QR = 34$, $PR = 30$

Example 3 If $\triangle EFG$ is a right triangle with $\angle F = 90°$, $EF = 15$, and $EG = 39$, find FG.

Solution Draw a sketch to help you solve the problem. Note that EG is the hypotenuse.

$$\begin{aligned} EF^2 + FG^2 &= EG^2 \\ 15^2 + FG^2 &= 39^2 \\ 225 + FG^2 &= 1521 \\ FG^2 &= 1296 \\ FG &= 36 \end{aligned}$$



13. If $\triangle STU$ is a right triangle with $\angle T = 90°$, $ST = 12$, and $SU = 15$, find TU.

14. If $\triangle XYZ$ is a right triangle with $\angle Z = 90°$, $XZ = 24$, and $YZ = 10$, find XY.

15. If $\triangle ABC$ is a right triangle with $\angle A = 90°$, $AB = 9$, and $AC = 40$, find BC.

16. If $\triangle DEF$ is isosceles, $DE = DF$, and $\angle D = 46°$, find $\angle E$.

17. If $\triangle GHI$ is isosceles, $GH = GI$ and $\angle H = 30°$, find $\angle G$.

18. If $\triangle ABC$ is a right isosceles triangle and $\angle C = 90°$, find the measures of $\angle A$ and $\angle B$.

In Exercises 19–24, $\angle C = 90°$ in $\triangle ABC$. Given the lengths of the other two sides, find the length of the third side in simplest radical form. Use the diagram shown below to help you.

19. $AC = 6$, $BC = 12$

20. $AC = 10$, $BC = 24$

21. $AC = 24$, $AB = 25$

22. $BC = 9$, $AC = 40$

23. $BC = 8$, $AB = 12$

24. $AC = 8$, $AB = 17$