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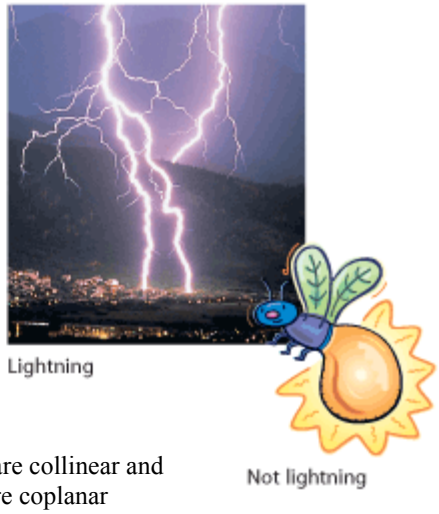
LESSON 1.5

# Triangles

*The difference between the right word and the almost right word is the difference between lightning and the lightning bug.*
MARK TWAIN

You have learned to be careful with geometry definitions. It turns out that you also have to be careful with diagrams.

When you look at a diagram, be careful not to assume too much from it. To **assume** something is to accept it as true without facts or proof.


Lightning

Not lightning

### Things you may assume:

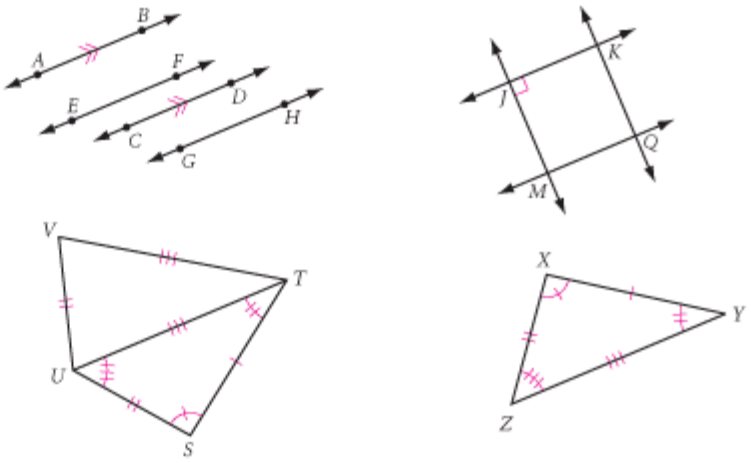
- You may assume that lines are straight, and if two lines intersect, they intersect at one point.
- You may assume that points on a line are collinear and that all points shown in a diagram are coplanar unless planes are drawn to show that they are noncoplanar.

### Things you may not assume:

- You may not assume that just because two lines or segments *look* parallel that they *are* parallel—they must be *marked* parallel!
- You may not assume that two lines *are* perpendicular just because they *look* perpendicular—they must be *marked* perpendicular!
- Pairs of angles, segments, or polygons are not necessarily congruent unless they are *marked* with information that tells you they must be congruent!

**EXAMPLE**

In the diagrams below, which pairs of lines are perpendicular? Which pairs of lines are parallel? Which pair of triangles is congruent?



**Solution** By studying the markings, you can tell that $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$, $\overleftrightarrow{JK} \perp \overleftrightarrow{JM}$, and $\triangle STU \cong \triangle XYZ$.

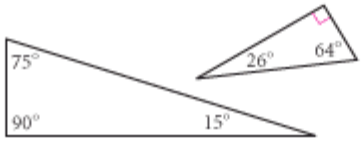
In this lesson you will write definitions that classify different kinds of triangles based on relationships among their sides and angles.

## Investigation
## Triangles

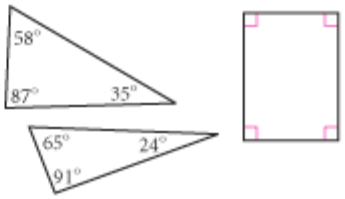
Write a good definition of each boldfaced term. Discuss your definitions with others in your group. Agree on a common set of definitions for your class and add them to your definition list. In your notebook, draw and label a figure to illustrate each definition.

### Right Triangle

What shape is the basis for the design on this textile from Uzbekistan?

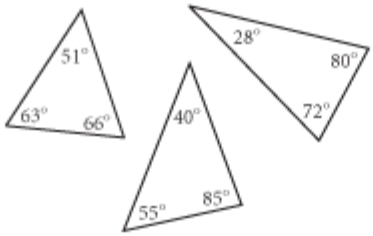



Right triangles

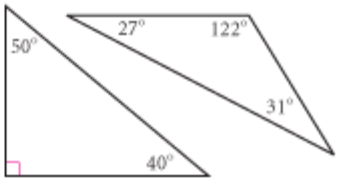



Not right triangles

### Acute Triangle

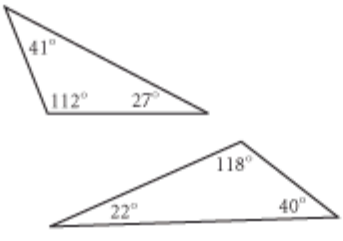



Acute triangles

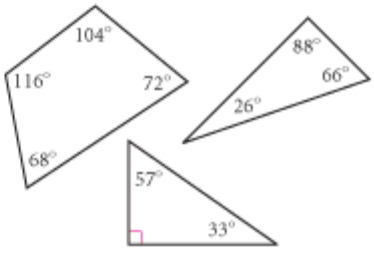



Not acute triangles

### Obtuse Triangle




Obtuse triangles

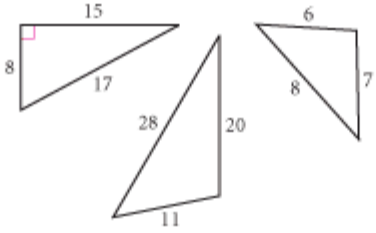



Not obtuse triangles

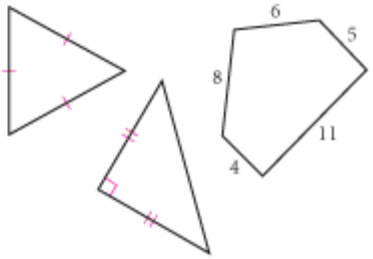
The Sol LeWitt (b 1928, United States) design inside this art museum uses triangles and quadrilaterals to create a painting the size of an entire room.

Sol LeWitt, *Wall Drawing #652—On three walls, continuous forms with color ink washes superimposed, color in wash.* Collection: Indianapolis Museum of Art, Indianapolis, IN. September, 1990. Courtesy of the artist.

### Scalene Triangle

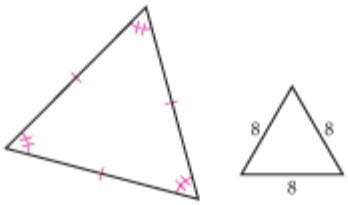



Scalene triangles

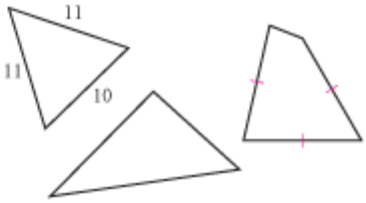



Not scalene triangles

### Equilateral Triangle

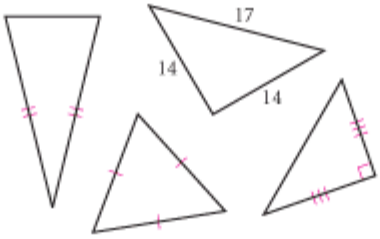



Equilateral triangles

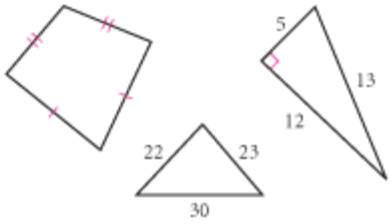



Not equilateral triangles

### Isosceles Triangle

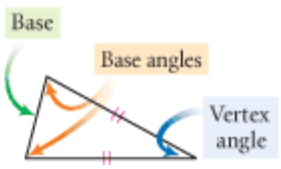



Isosceles triangles




Not isosceles triangles

In an isosceles triangle, the angle between the two sides of equal length is called the **vertex angle.** The side opposite the vertex angle is called the **base** of the isoceles triangle. The two angles opposite the two sides of equal length are called the **base angles** of the isoceles triangle.



## EXERCISES

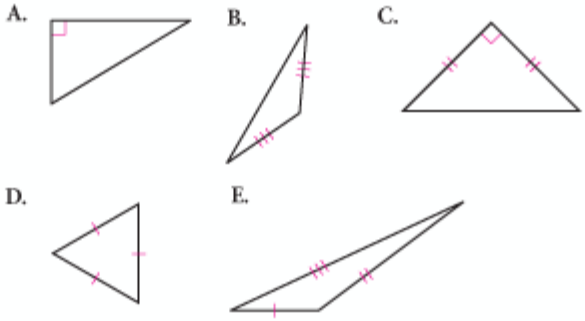
For Exercises 1–4, match the term on the left with its figure on the right.

**1.** Equilateral triangle

**2.** Scalene right triangle

**3.** Isosceles right triangle

**4.** Isosceles obtuse triangle




For Exercises 5–9, sketch and label the figure. Mark the figures.

**5.** Isosceles acute triangle *ACT* with $AC = CT$

**6.** Scalene triangle *SCL* with angle bisector $\overline{CM}$

**7.** Isosceles right triangle *CAR* with $m\angle CRA = 90°$

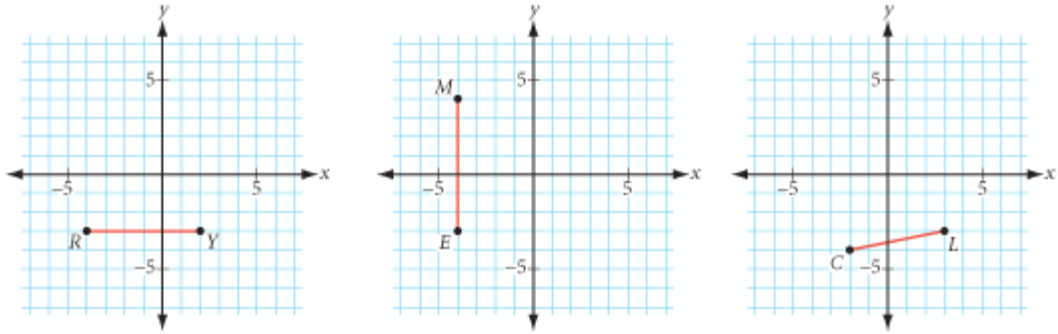
**8.** Two different isosceles triangles with perimeter $4a + b$

**9.** Two noncongruent triangles, each with side 6 cm and an angle measuring 40°

**10.** Use your ruler and protractor to draw an isosceles acute triangle with base *AC* and vertex angle *B*.

**11.** Use your ruler and protractor to draw an isosceles obtuse triangle *ZAP* with base angles *A* and *Z*.

For Exercises 12–14, use the graphs below. Can you find more than one answer?




**12.** Locate a point *L* so that $\triangle LRY$ is an isosceles triangle.

**13.** Locate a point *O* so that $\triangle MOE$ is an isosceles right triangle.

**14.** Locate a point *R* so that $\triangle CRL$ is an isosceles right triangle.

**15.** Use your ruler and protractor to draw a triangle with one side 9 cm long and an adjacent angle measuring 45°. Explain your method. Can you draw a second triangle with the given measures that is not congruent to the first?

**16.** Use your ruler and protractor to draw a triangle with one angle measuring 40° and an opposite side 10 cm long. Explain your method. Can you draw a second triangle with the given measures that is not congruent to the first?

## Review

For Exercises 17–21, tell whether the statement is true or false. For each false statement, sketch a counterexample or explain why the statement is false.

**17.** An acute angle is an angle whose measure is less than 90°.

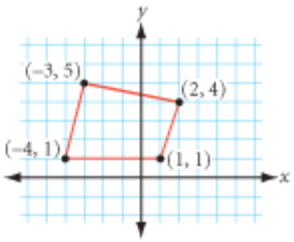
**18.** If two lines intersect to form a right angle, then the lines are perpendicular.

**19.** A diagonal is a line segment that connects any two vertices of a polygon.

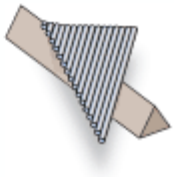
**20.** A ray that divides the angle into two angles is the angle bisector.

**21.** An obtuse triangle has exactly one angle whose measure is greater than 90°.

**22.** Use the ordered pair rule $(x, y) \rightarrow (x + 1, y - 3)$ to relocate the four vertices of the given quadrilateral. Connect the four new points to create a new quadrilateral. Do the two quadrilaterals appear congruent? Check your guess with tracing paper or patty paper.




**23.** Suppose a set of thin rods is glued together into a triangle as shown. How would you place the triangular arrangement of rods onto the edge of a ruler so that they balance? Explain why.



For Exercises 24–26, sketch and carefully label the figure. Mark the congruent parts.

**24.** Pentagon *PENTA* with $PE = EN$

**25.** Hexagon *NGAXEH* with $\angle HEX \cong \angle EXA$

**26.** Equiangular quadrilateral *QUAD* with $QU \neq QD$

### IMPROVING YOUR VISUAL THINKING SKILLS


***Pentominoes I***

In Polyominoes, you learned about shapes called polyominoes. Polyominoes with five squares are called pentominoes. Can you find all possible pentominoes? One is shown at right. Use graph paper or square dot paper to sketch them.