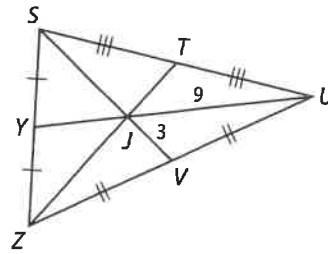


Examples 1–2 In  $\triangle SZU$ ,  $UJ = 9$ ,  $VJ = 3$ , and  $ZT = 18$ . Find each length.

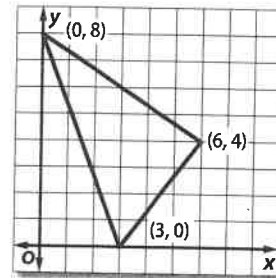
- |         |          |
|---------|----------|
| 5. $YJ$ | 6. $SJ$  |
| 7. $YU$ | 8. $SV$  |
| 9. $JT$ | 10. $ZJ$ |



Example 3 **COORDINATE GEOMETRY** Find the coordinates of the centroid of each triangle with the given vertices.

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 11. $A(-1, 11), B(3, 1), C(7, 6)$ | 12. $X(5, 7), Y(9, -3), Z(13, 2)$ |
|-----------------------------------|-----------------------------------|

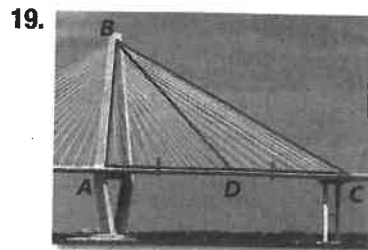
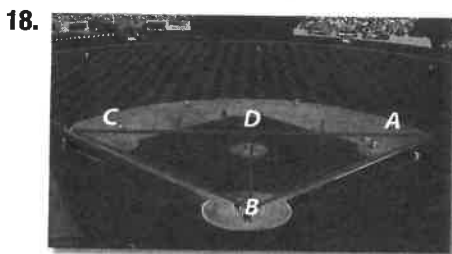
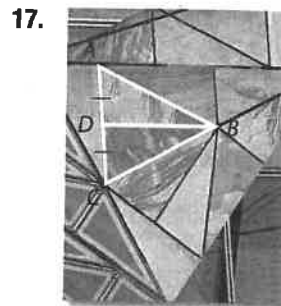
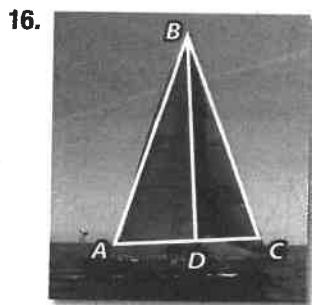
13 **INTERIOR DESIGN** Emilia made a collage with pictures of her friends. She wants to hang the collage from the ceiling in her room so that it is parallel to the ceiling. A diagram of the collage is shown in the graph at the right. At what point should she place the string?



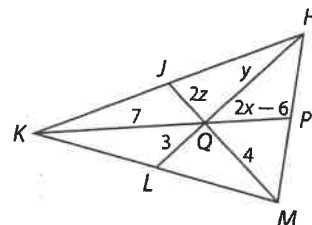
Example 4 **COORDINATE GEOMETRY** Find the coordinates of the orthocenter of each triangle with the given vertices.

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 14. $J(3, -2), K(5, 6), L(9, -2)$ | 15. $R(-4, 8), S(-1, 5), T(5, 5)$ |
|-----------------------------------|-----------------------------------|

Identify each segment  $\overline{BD}$  as a(n) altitude, median, or perpendicular bisector.



20. **CCSS SENSE-MAKING** In the figure at the right, if  $J$ ,  $P$ , and  $L$  are the midpoints of  $\overline{KH}$ ,  $\overline{HM}$ , and  $\overline{MK}$ , respectively, find  $x$ ,  $y$ , and  $z$ .



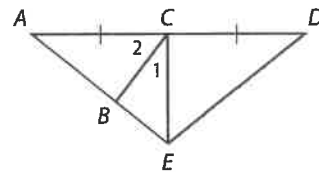
Copy and complete each statement for  $\triangle RST$  for medians  $\overline{RM}$ ,  $\overline{SL}$  and  $\overline{TK}$ , and centroid  $J$ .

21.  $SL = x(JL)$

22.  $JT = x(TK)$

23.  $JM = x(RJ)$

**ALGEBRA** Use the figure at the right.



24. If  $\overline{EC}$  is an altitude of  $\triangle AED$ ,  $m\angle 1 = 2x + 7$ , and  $m\angle 2 = 3x + 13$ , find  $m\angle 1$  and  $m\angle 2$ .

25. Find the value of  $x$  if  $AC = 4x - 3$ ,  $DC = 2x + 9$ ,  $m\angle ECA = 15x + 2$ , and  $\overline{EC}$  is a median of  $\triangle AED$ . Is  $\overline{EC}$  also an altitude of  $\triangle AED$ ? Explain.

26. **GAMES** The game board shown is shaped like an equilateral triangle and has indentations for game pieces. The game's objective is to remove pegs by jumping over them until there is only one peg left. Copy the game board's outline and determine which of the points of concurrency the blue peg represents: *circumcenter*, *incenter*, *centroid*, or *orthocenter*. Explain your reasoning.



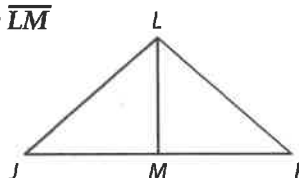
**CS ARGUMENTS** Use the given information to determine whether  $\overline{LM}$  is a *perpendicular bisector*, *median*, and/or an *altitude* of  $\triangle JKL$ .

27.  $\overline{LM} \perp \overline{JK}$

28.  $\triangle JLM \cong \triangle KLM$

29.  $\overline{JM} \cong \overline{KM}$

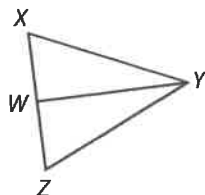
30.  $\overline{LM} \perp \overline{JK}$  and  $\overline{JL} \cong \overline{KL}$



31. **PROOF** Write a paragraph proof.

**Given:**  $\triangle XYZ$  is isosceles.  
 $\overline{WY}$  bisects  $\angle Y$ .

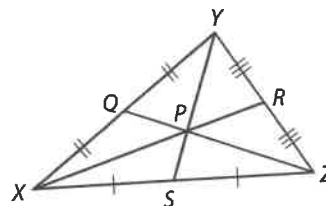
**Prove:**  $\overline{WY}$  is a median.



32. **PROOF** Write an algebraic proof.

**Given:**  $\triangle XYZ$  with medians  $\overline{XR}$ ,  $\overline{YS}$ ,  $\overline{ZQ}$

**Prove:**  $\frac{XP}{PR} = 2$



33. **MULTIPLE REPRESENTATIONS** In this problem, you will investigate the location of the points of concurrency for any equilateral triangle.

a. **Concrete** Construct three different equilateral triangles on tracing paper and cut them out. Fold each triangle to locate the circumcenter, incenter, centroid, and orthocenter.

b. **Verbal** Make a conjecture about the relationships among the four points of concurrency of any equilateral triangle.

c. **Graphical** Position an equilateral triangle and its circumcenter, incenter, centroid, and orthocenter on the coordinate plane using variable coordinates. Determine the coordinates of each point of concurrency.

**ALGEBRA** In  $\triangle JLP$ ,  $m\angle JMP = 3x - 6$ ,  $JK = 3y - 2$ , and  $LK = 5y - 8$ .

34. If  $\overline{JM}$  is an altitude of  $\triangle JLP$ , find  $x$ .

35. Find  $LK$  if  $\overline{PK}$  is a median.

