## 10-3 *Concurrent Lines*

When two or more lines intersect in one point, the lines are said to be **concurrent.** For example, as you saw in Exercise 15, page 378, the bisectors of the angles of a triangle are concurrent.

### Theorem 10-1

**The bisectors of the angles of a triangle intersect in a point that is equidistant from the three sides of the triangle.**

Given: $\triangle ABC$; the bisectors of $\angle A$, $\angle B$, and $\angle C$

Prove: The angle bisectors intersect in a point; that point is equidistant from $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$.

#### Proof:

The bisectors of $\angle A$ and $\angle B$ intersect at some point $I$. We will show that point $I$ also lies on the bisector of $\angle C$ and that $I$ is equidistant from $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$.
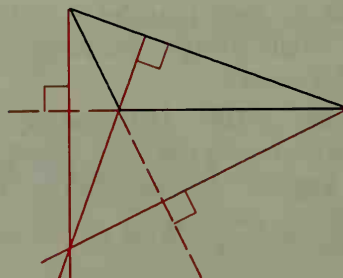
Draw perpendiculars from $I$ intersecting $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$ at $R$, $S$, and $T$, respectively. Since any point on the bisector of an angle is equidistant from the sides of the angle (Theorem 4-7, page 154), $IT = IR$ and $IR = IS$. Thus $IT = IS$. Since any point equidistant from the sides of an angle is on the bisector of the angle (Theorem 4-8, page 154), $I$ is on the bisector of $\angle C$. Since $IR = IS = IT$, point $I$ is equidistant from $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$.
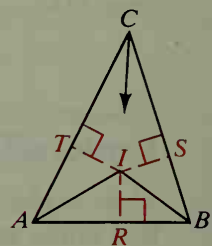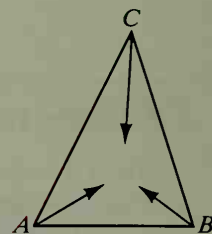
In Exercises 14–16, page 384, you discovered three other sets of concurrent lines related to triangles: the perpendicular bisectors of the sides, the lines containing the altitudes, and the medians. As you can see in the diagrams below, concurrent lines may intersect in a point outside the triangle. The intersection point may also lie on the triangle (see Classroom Exercise 4, page 388).
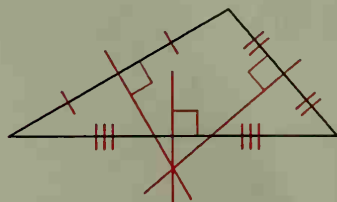
Perpendicular bisectors                    Lines containing altitudes