

In Exercises 19–21 begin with two circles  $P$  and  $Q$  such that  $\odot P$  and  $\odot Q$  do not intersect and  $Q$  is not inside  $\odot P$ . Let the radii of  $\odot P$  and  $\odot Q$  be  $p$  and  $q$  respectively, with  $p > q$ .

19. Construct a circle, with radius equal to  $PQ$ , that is tangent to  $\odot P$  and  $\odot Q$ .
20. Construct a common external tangent to  $\odot P$  and  $\odot Q$ . One method is suggested below.
  1. Draw a circle with center  $P$  and radius  $p - q$ .
  2. Construct a tangent to this circle from  $Q$ , and call the point of tangency  $Z$ .
  3. Draw  $\overrightarrow{PZ}$ .  $\overrightarrow{PZ}$  intersects  $\odot P$  in a point  $X$ .
  4. With center  $X$  and radius  $ZQ$ , draw an arc that intersects  $\odot Q$  in a point  $Y$ .
  5. Draw  $\overrightarrow{XY}$ .

As a justification for this construction, you could begin by drawing  $\overrightarrow{QY}$ . Then show that  $XZQY$  is a rectangle. The rest of the justification is easy.

21. Construct a common internal tangent to  $\odot P$  and  $\odot Q$ . (Hint: Draw a circle with center  $P$  and radius  $p + q$ .)

## 10-5 Special Segments

### Construction 12

**Given a segment, divide the segment into a given number of congruent parts.**  
(3 shown)

Given:  $\overline{AB}$

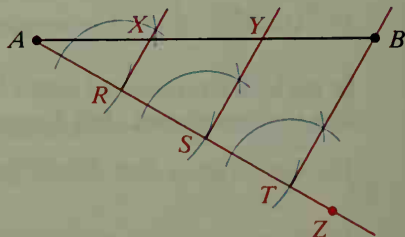


Construct: Points  $X$  and  $Y$  on  $\overline{AB}$  so that  
 $AX = XY = YB$

Procedure:

1. Choose any point  $Z$  not on  $\overline{AB}$ . Draw  $\overrightarrow{AZ}$ .
2. Using any radius, start with  $A$  as center and mark off  $R$ ,  $S$ , and  $T$  so that  $AR = RS = ST$ .
3. Draw  $\overline{TB}$ .
4. At  $R$  and  $S$  construct lines parallel to  $\overline{TB}$ , intersecting  $\overline{AB}$  in  $X$  and  $Y$ .

$\overline{AX}$ ,  $\overline{XY}$ , and  $\overline{YB}$  are congruent parts of  $\overline{AB}$ .



Justification: Since the parallel lines you constructed cut off congruent segments on transversal  $\overrightarrow{AZ}$ , they cut off congruent segments on transversal  $\overrightarrow{AB}$ . (It may help you to think of the parallel to  $\overline{TB}$  through  $A$ .)