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 $\overleftrightarrow{XY}$.

As a justification for this construction, you could begin by drawing $\overline{QY}$. 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

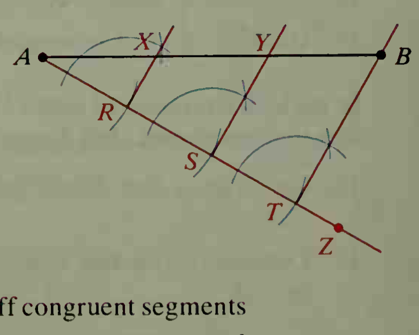
Given a segment, divide the segment into a given number of congruent parts. (3 shown)

Given: $\overline{AB}$

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

Procedure:

1. Choose any point Z not on $\overleftrightarrow{AB}$. 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 $\overleftrightarrow{AZ}$, they cut off congruent segments on transversal $\overleftrightarrow{AB}$. (It may help you to think of the parallel to $\overline{TB}$ through A.)