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## Section 9.4 - More Angle Relationships in Circles

## Tangent Angles and Arc Theorem

If a tangent and a chord intersect at a point on a circle, then the measure of each angle formed is one half the measure of the arc inside the angle.

$$
\mathrm{m} \angle 1=\frac{1}{2} \mathrm{~m} \overparen{\mathrm{AB}} \quad \mathrm{~m} \angle 2=\frac{1}{2} \mathrm{~m} \overparen{\mathrm{ACB}}
$$



## Ex 1:

Line k is tangent to the circle.
a) Find $m \angle 1$.

b) Find mRST .

c) Find $x$.


Ex 2:
a) $\overleftrightarrow{\mathrm{BC}}$ is tangent to the circle. Find $\mathrm{m} \angle \mathrm{CBD}$.


## Intersecting Chords and Angles Theorem

If two chords intersect in the interior of a circle, then the measure of each angle is one half the sum of the measures of the arcs inside the angle and its vertical angle.

$$
\mathrm{m} \angle 1=\frac{1}{2}(\mathrm{~m} \overparen{\mathrm{CD}}+\mathrm{m} \overparen{\mathrm{AB}}), \quad \mathrm{m} \angle 2=\frac{1}{2}(\mathrm{mBC}(\mathrm{~m} \overparen{\mathrm{AD}})
$$



## Ex 3:

Find the value of $x$. Note: $\angle S O T$ is NOT a central angle.
a)

b)


## Tangents and Secant Angles Theorem

If a tangent and a secant, two tangents, or two secants intersect in the exterior of a circle, then the measure of the angle formed is one half the difference of the measures of the arcs inside the angle.

$\mathrm{m} \angle 1=\frac{1}{2}(\mathrm{~m} \overparen{B C}-\mathrm{m} \overparen{\mathrm{AC}})$

$\mathrm{m} \angle 2=\frac{1}{2}(\mathrm{mPQR}-\mathrm{mPR})$

$\mathrm{m} \angle 3=\frac{1}{2}(\mathrm{~m} \overparen{\mathrm{XY}}-\mathrm{m} \overparen{\mathrm{WZ}})$

Easy Method: Take the big arc inside the angle minus the small arc inside the angle and multiply the result by one-half.

Ex 4: Find x.


