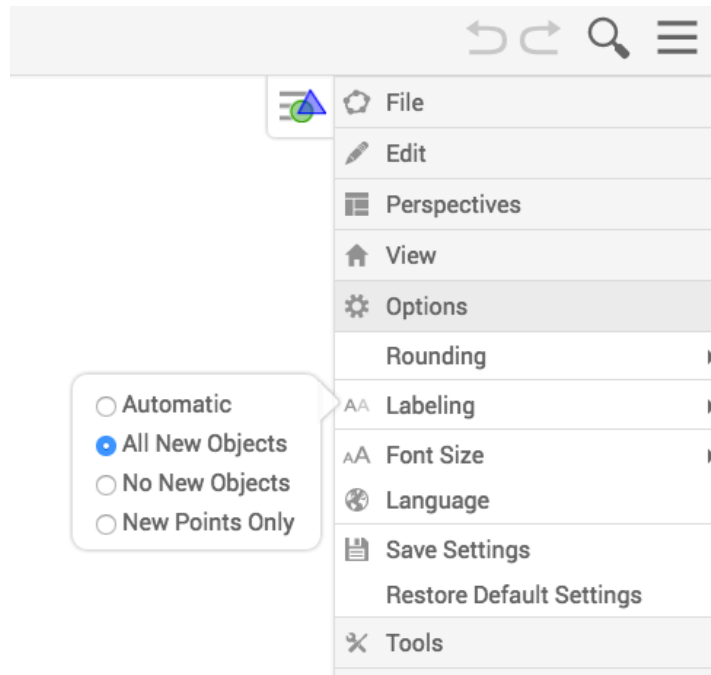


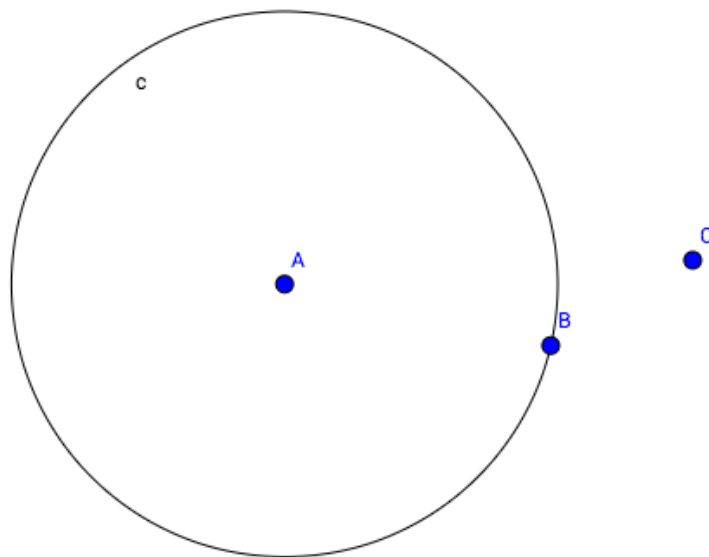
Properties of Tangents Drawn to Circles

Name _____

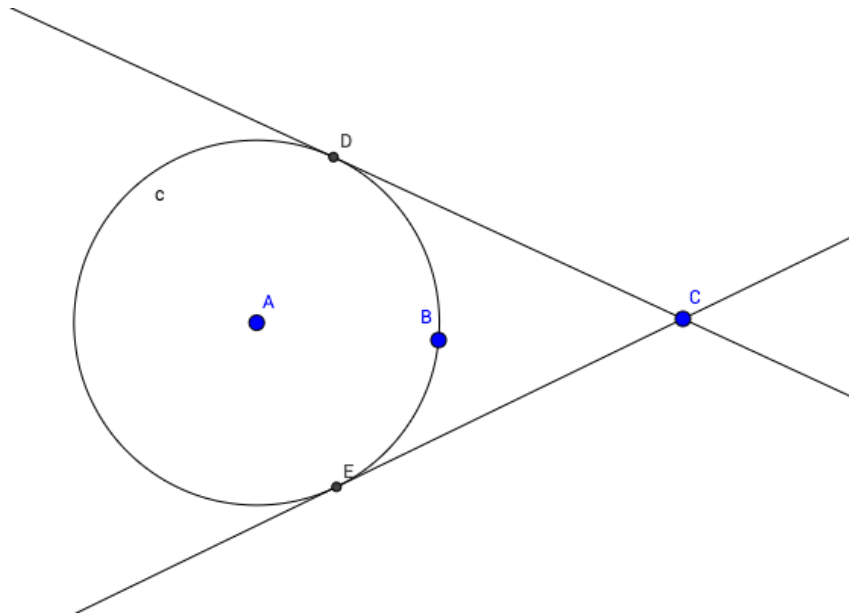
- 1) Go to <https://app.geogebra.org/#geometry>.
- 2) Go to **Options**. Under **Options**, select **Labeling**. Select **All New Objects**. (See figure.)



- 3) Select the **Circle With Center Through Point** tool to construct a circle.
- 4) Use the **Point** tool to plot a point C anywhere outside the circle.



- 5) Now use the **Tangents** tool to construct two lines that pass through C and are tangent to the circle.
- 6) Now, use the **Intersect** tool to plot and label the points of intersections of these tangents to the circle. Label these points D and E . (See figure.)



- 7) Now, right click on one of the two tangent lines. Uncheck the “Show Object” option to hide this tangent line. Do the same for the other tangent line.
- 8) Use the **Segment** tool to construct segment \overline{CD} and \overline{CE} .
- 9) Use the **Distance** tool to measure and display the lengths CD and CE . What do you initially notice?
- 10) Now, select the **Move** tool and experiment by moving point C around the screen. (Just make sure C stays *outside* the circle!) What do notice about the lengths CD and CE ?
- 11) Let’s generalize now. Fill in the blanks:

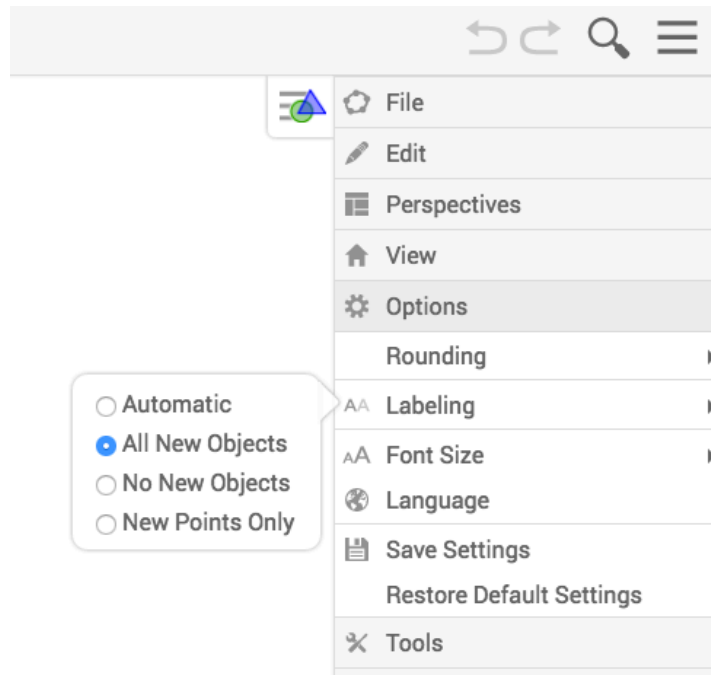
_____ segments drawn to a _____ from a
 _____ outside that _____ are _____.

- 12) Use the **Segment** tool to construct radii \overline{AD} and \overline{AE} .
- 13) Now use the **Angle** tool to find the measure of $\angle ADC$ and the measure of $\angle CEA$. (When using this tool to measure these angles, be sure to select either the three vertices or the two segments in a *counterclockwise orientation!*)
- 14) What do you notice about these two angles?
- 15) Now, use the **Move** tool to move point C around the screen again. Also move points A and B around. What do you always notice to be true about $\angle ADC$ and $\angle CEA$?
- 16) Use your observations to complete the following statement by filling in the blanks:
- If a _____ is drawn to a _____, then a radius drawn to the _____ of tangency makes a _____ angle with that _____ segment. We can also say that a _____ drawn to any line _____ to a circle is _____ to that _____ line.
- 17) Now go to <http://tube.geogebra.org/m/z7QUMhmr>. Interact with the applet you see for a few minutes, then answer the questions that you see beneath the applet.

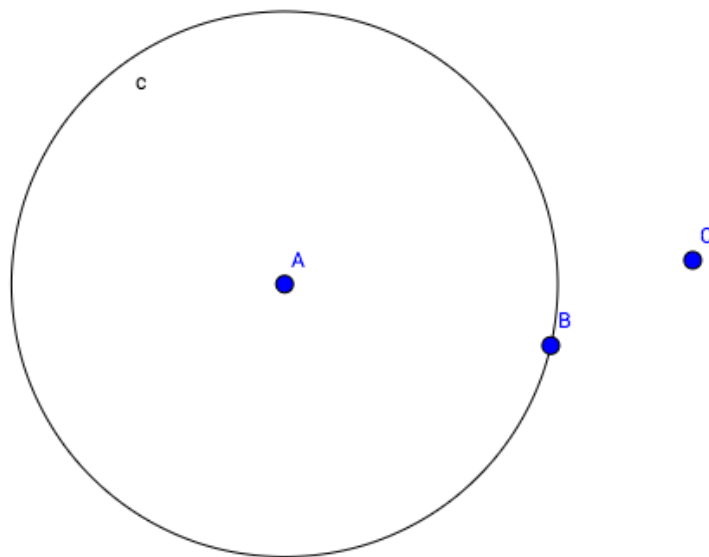
Properties of Tangents Drawn to Circles

Name _____ **KEY** _____

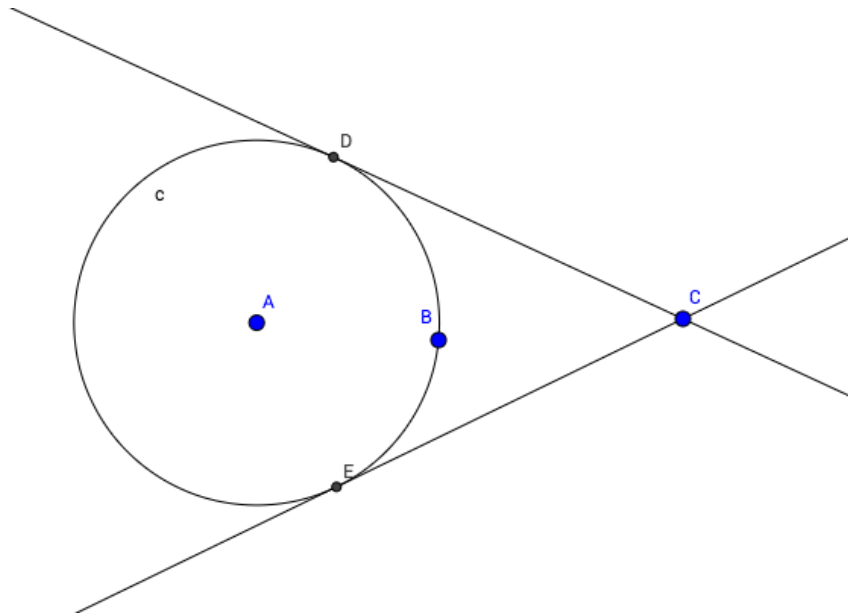
- 1) Go to <https://app.geogebra.org/#geometry>.
- 2) Go to **Options**. Under **Options**, select **Labeling**. Select **All New Objects**. (See figure.)



- 3) Select the **Circle With Center Through Point** tool to construct a circle.
- 4) Use the **Point** tool to plot a point *C* anywhere outside the circle.



- 5) Now use the **Tangents** tool to construct two lines that pass through C and are tangent to the circle.
- 6) Now, use the **Intersect** tool to plot and label the points of intersections of these tangents to the circle. Label these points D and E . (See figure.)



- 17) Now, right click on one of the two tangent lines. Uncheck the “Show Object” option to hide this tangent line. Do the same for the other tangent line.
- 18) Use the **Segment** tool to construct segment \overline{CD} and \overline{CE} .
- 19) Use the **Distance** tool to measure and display the lengths CD and CE . What do you initially notice?

The lengths CD and CE are equal !!!

- 20) Now, select the **Move** tool and experiment by moving point C around the screen. (Just make sure C stays *outside* the circle!) What do notice about the lengths CD and CE ?

These lengths *still* remain equal !!!

- 21) Let's generalize now. Fill in the blanks:

_____ **Tangent** _____ segments drawn to a **circle** _____ from a
 _____ **point** _____ outside that _____ **circle** _____ are **congruent** _____.

- 22) Use the **Segment** tool to construct radii \overline{AD} and \overline{AE} .
- 23) Now use the **Angle** tool to find the measure of $\angle ADC$ and the measure of $\angle CEA$. (When using this tool to measure these angles, be sure to select either the three vertices or the two segments in a *counterclockwise orientation!*)
- 24) What do you notice about these two angles?

These angles both measure 90 degrees. They are right angles.

- 25) Now, use the **Move** tool to move point C around the screen again. Also move points A and B around. What do you always notice to be true about $\angle ADC$ and $\angle CEA$?

These angles always remain right angles!

- 26) Use your observations to complete the following statement by filling in the blanks:

If a tangent is drawn to a circle, then a radius drawn to the point of tangency makes a right angle with that tangent line. We can also say that a radius drawn to any line tangent to a circle is perpendicular to that tangent line.

- 17) Now go to <http://tube.geogebra.org/m/z7QUMhmr>. Interact with the applet you see for a few minutes, then answer the questions that you see beneath the applet.