Topic 13: Properties of Circles (4048)

THE ABOUT

CHAPTER ANALYSIS

MASTERY

- Relatively challenging chapter for some students
- 2 **key** concepts

EXAM

- Concepts usually tested as a stand-alone topic
- Complicated chapter if questions are obscure and students are unable to think outside of the box

WEIGHTAGE

- High overall weightage
- Tested consistently every year
- Typically, an 10m question, 1 question in one of the papers

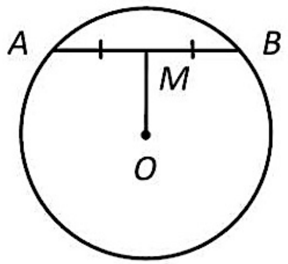
KEY CONCEPT

Symmetry Properties of Circles

Angle Properties of Circles

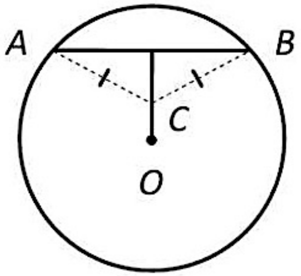
Additional Useful Theorems:

The line segment drawn from the centre to the midpoint of the chord is perpendicular to the chord



If $AM = MB$, then $AB \perp OM$

Every point on the perpendicular bisector of a line segment is equidistant from the endpoints of the segment

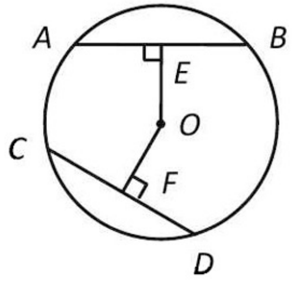


Symmetry Properties of Circles

4 Theorems to remember:

1. **Chord Theorem**

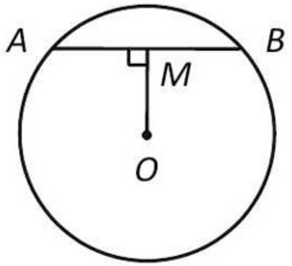
Chords equidistant from the centre of the circle are equal



If $AB = CD$, then $OE \perp AB$ and $OF \perp CD$

2. **Perpendicular Bisector Theorem**

A line from the centre, perpendicular to a chord that bisects the chord is known as the perpendicular bisector

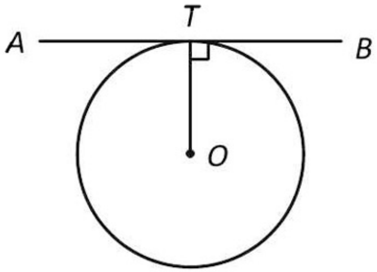


If $AB \perp OM$, then $AM = MB$

Symmetry Properties of Circles

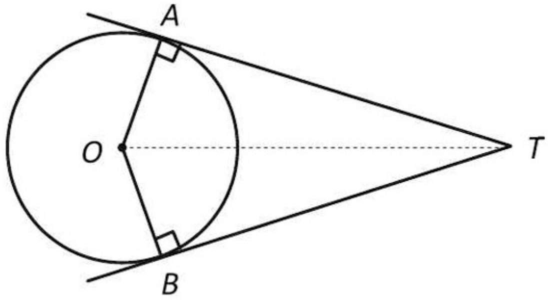
3. Tangent Theorem

The line perpendicular to the tangent at the point of contact passes through the centre of the circle



$$\angle OTA = \angle OTB = 90^\circ$$

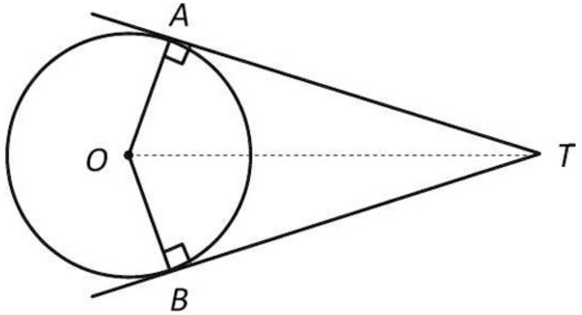
Tangents drawn from an external point to a circle are equal



$$AT = BT$$

Additional Useful Theorems:

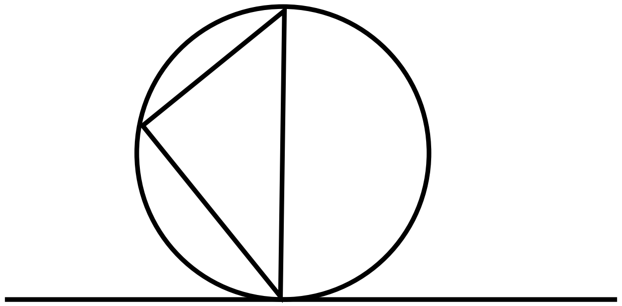
The line joining the external point to the centre of the circle bisects the angle between the tangents



$$\angle AOT = \angle BOT$$

Take Note:

This is a highly tested theorem! Many students struggle to find and use this Theorem in their solutions.

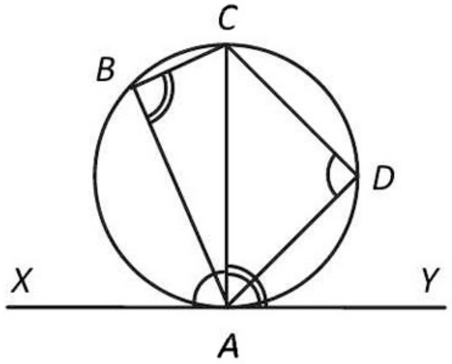


Always look out for a triangle with all 3 points touching the circle with one of the points at a tangent to the circle

Symmetry Properties of Circles

4. Alternate Segment Theorem

An angle between a tangent and a chord through the point of contact is equal to the angle in the alternate segment

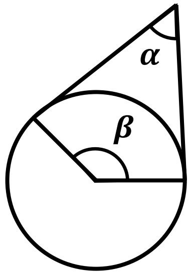


$$\angle XAC = \angle ADC$$

$$\angle CAY = \angle ABC$$

Take Note:

Many students get tricked by this figure



Many students think that $\alpha = 2\beta$ when in actual fact there is no special relationship between α and β

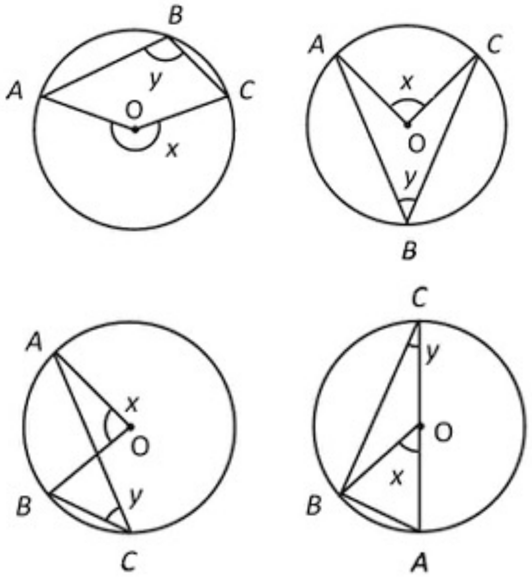
UNLESS: If the 2 lines above are tangents that extend to a point, then

$$\alpha + \beta = 180°$$

Angle Properties of Circles

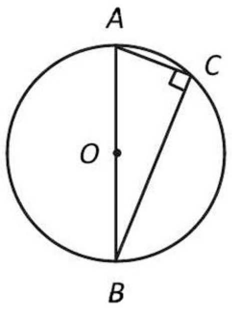
4 Angle Properties to remember:

1. Angle at centre is 2 times the angle at the circumference



$x = 2y$

2. Angles in a semicircle

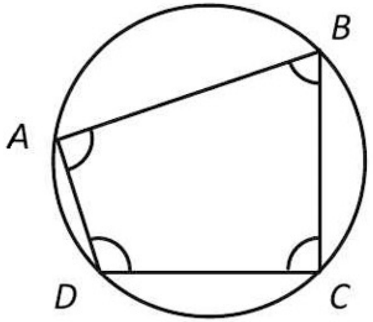


$\angle ACB = 90°$

Additional Useful Properties:

A **cyclic quadrilateral** is a quadrilateral drawn inside a circle such that all its 4 vertices lie on the circumference of the circle

The sum of the opposite angles of a cyclic quadrilateral is $\mathbf{180°}$

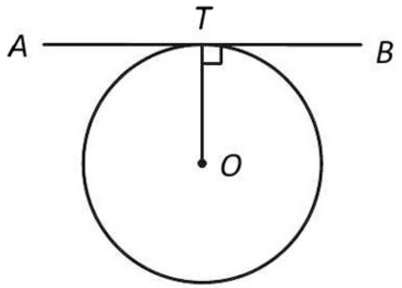


$$\angle CDA + \angle ABC = 180°$$

$$\angle DAB + \angle BCD = 180°$$

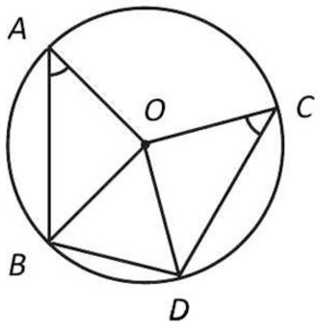
Angle Properties of Circles

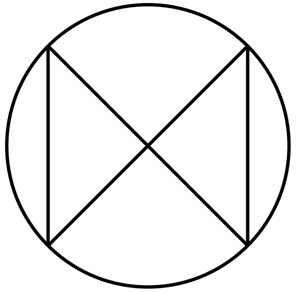
3. Angle between the tangent and radius is $90°$



$$\angle OTA = \angle OTB = 90°$$

4. Angles in same segment are equal





$$\angle BAO = \angle DCO$$

Always look for this “butterfly” shape

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