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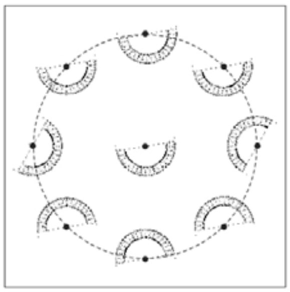
# CIRCULAR GEOBOARD

The circular geo board is a multipurpose demonstration tool for verifying many basic concepts in geometry specially theorems concerned to circle.

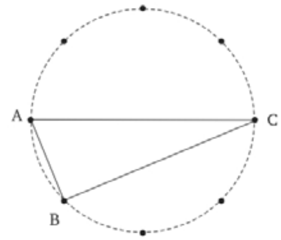


It is regular octagon circumscribed by a circle. Eight pegs are fixed as the vertices of the octagon and there is a peg at the centre representing the centre of the circle. There are movable protractors fixed with each peg.

Concepts to be well understood and to be verified :

1. Angle sum property of triangle, quadrilateral and polygons.
2. Properties of chords
3. Central angle is double the inscribed angle
4. Angles by a chord in the same segment are equal
5. Angle in the semicircle is always 90°
6. Opp. angles of cyclic quadrilaterals are supplementary.





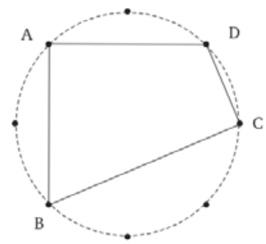

**1. The Angle sum property of a triangle :**

Take a rubber band and stretch it around any three pegs say A, B and C to make a triangle ABC (See fig)

Measure the angles with protractor at A, at B and at C. Now add these three angles and observe that the sum of is 180°.

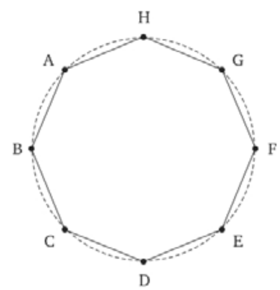
Therefore the sum of angles of triangle ABC is 180°

**2. The angle sum property of a quadrilateral :**




Construct a quadrilateral ABCD by stretching the rubber band around 4 pegs say A, B, C and D. Measure the angles at A, B, C and D

Now observe that sum of angles at A, B, C and D = 360°.




Make an octagon ABCDEFGH

Observe that sum of angles at A, B, C, D, E, F, G, H, = 1080°.

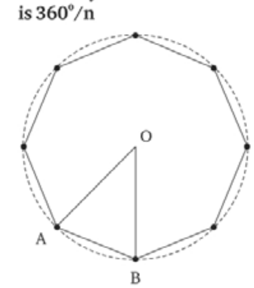
The relation between the no. of sides of a polygon and the angle sum of a polygon is given by, (2n - 4) 90

where 'n' is the no. of sides of a polygon.

Make any polygon of any sides and verify the above result using circular geo board.

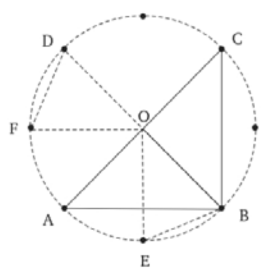
For the above fig. of octagon, Angle sum $= (2n - 4)\ 90^\circ$
$= (2 \times 8 - 4)\ 90^\circ$
$= (16 - 4)\ 90^\circ$
$= 12 \times 90^\circ = 1080^\circ$

**3. To verify that the central angle of side of a regular polygon is $360^\circ/n$**




The diagram here shows a regular octagon
AB is one side. Angle AOB is the central angle made by the side of a regular octagon.
Measure angle AOB with protractor at O
Observe and verify that
$360^\circ/8 = 45^\circ$

**Properties of chords :**

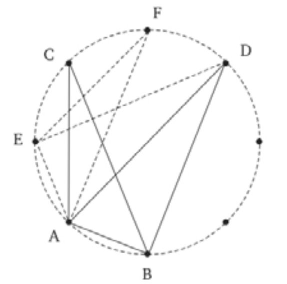



**A) Equal chords subtend equal angles at the centre.**
Conversely, the chords subtending equal angles at the centre are equal
AB and BC are equal chords formed by the stretched rubber bands between pegs A and B and between B and C (skip one peg in between them.) (pegs on the circumference are equidistant from each other consecutively on the board)

Now, AB = BC
Measure $\angle AOB$ and $\angle BOC$ and check whether $\angle AOB = \angle BOC$
Similarly, the chords FD and EB (dotted in fig.) are also equal.
So, $\angle FOD$ must be equal to $\angle EOB$
Try to prove the converse of this property yourself.

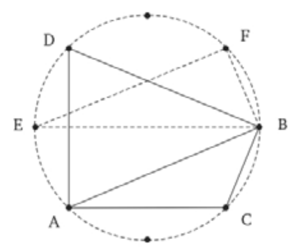


**B) A chord subtends equal angles at different points on the circumference in the same segment.**
Stretch the rubber band between any two pegs on the circumference of the circle, say A & B (or A & E). Make triangle ACB by stretching one part of the rubber band around C (at the circumference). Similarly make another triangle ABD



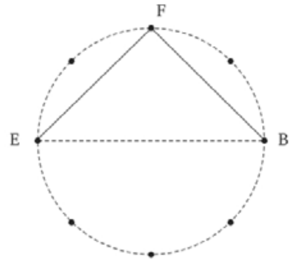

Measure $\angle ACB$ & $\angle ADB$
Now observe that
$\angle ACB = \angle ADB$
Angles ACB & ADB are subtended by the same chord AB in the same segment. Hence they are equal.
Similarly, try with other chords (AE dotted line in the fig) and other angles like $\angle AFE$ & $\angle ADE$)
Make sure that $\angle AFE = \angle ADE$

**C) Angles made by the same chord at different segments are supplementary :**



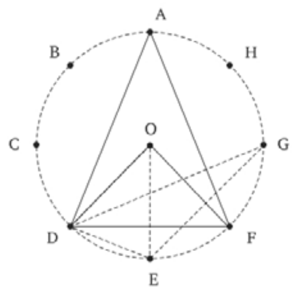

Stretch a rubber band around the two pegs A and B to form a chord.
Stretch one part of it around D at the circumference.
Now $\angle$ ADB is the angle subtended by the chord at the major segment.
Stretch another part of rubber band at another peg say C in the minor segment imagining the chord AB is still there.
Measure $\angle ADB$ and $\angle ACB$ and verify that
$\angle ADB + \angle ACB = 180^\circ$

**D) Angle made at the semicircle is 90°**




Stretch the rubber band along the diameter of the circle say EB i.e. between two pegs which are exactly opp. to each other (dotted EB in the figure).
Stretch one part of the rubber band around any peg say F. Now measure $\angle$ EFB. See that it is a right angle.

**E) In a circle, the central angle made by the chord is double the inscribed angle made by the same chord :**




Stretch the rubber band around any two pegs (except the centre) to form a chord (do not form a diameter) say DF.
Stretch one part of the rubber band around O. Measure $\angle$ DOF. Remove the stretch and now stretch it around any peg at the circumference, say A but in the same side of the chord (which contains the centre). Now measure $\angle$ DAF.

Observe that $\angle DOF = 2\ \angle DAF$
Try with other chords like $\angle DOE = 2\ \angle DGE$
(See the dotted lines in the figure).

**F) Opposite angles of the cyclic quadrilateral are supplementary :**
Stretch the rubber band around any four pegs on the circumference (except the centre) say ABCD (or AEFG dotted). both are cyclic quadrilaterals as the four vertices (pegs) are on the circumference of the same circle. Now measure the angles A, B, C and D by the protractor provided.



Observe that $\angle ABC + \angle BDC = \angle DAB + \angle BCD$.
Similarly verify that, $\angle AEF + \angle FGA = \angle GAE + \angle GFE$