CHAPTER 9
CIRCLES

Unit 9.1 Parts of Circles and Spheres E.E. 58(i), 58(iii)

(61) **Circle** - The set of all points in a plane a given distance from a given point in that plane.

(62) **center** - The given point.

(63) **radius** - The given distance. [Segment from the center to a point on the circle.]

(64) **Chord** - A segment that joins two points on a circle.

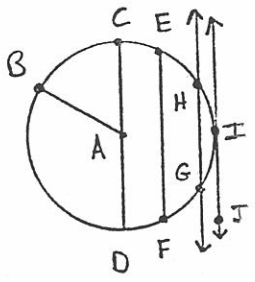
(65) **Diameter** - The distance across the circle. [A chord that passes through the center]

(66) **Secant** - A line that passes through a circle. [It intersects it at two points.]

(67) **Tangent** - A line that lies in the plane of the circle and intersects the circle in only one point. (Point of Tangency) [It is on the outer surface of the circle.]

Examples:

Circle A
Named by center.



point A

$\overline{CA}$, $\overline{BA}$, $\overline{DA}$

$\overline{CD}$, $\overline{EF}$, $\overline{HG}$

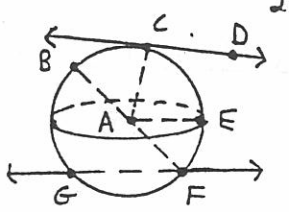
$\overline{CD}$

$\overleftrightarrow{HG}$

$\overleftrightarrow{IJ}$

point I

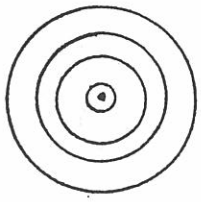
(68) **Sphere** – The set of all points that are a given distance from a given point.



Sphere A ; Center – point A ; Radii – $\overline{BA}$, $\overline{FA}$, $\overline{CA}$; Diameter – $\overline{BF}$; Chords – $\overline{BF}$, $\overline{GF}$; Secant – $\overleftrightarrow{GF}$; Tangent – $\overleftrightarrow{CD}$; Point of Tangency – point C

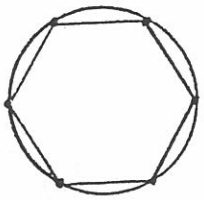
(69) **Congruent Circles or Spheres** – have equal radii.

(70) **Concentric Circles** – lie in the same plane and have the same center.

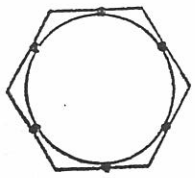


(71) **Concentric Spheres** – have the same center.

(72) A **polygon is inscribed** in a circle and the circle is circumscribed about the polygon when each vertex of the polygon lies on the circle.



(73) A **polygon is circumscribed** about a circle and the circle is inscribed in the polygon when each side of the polygon is a tangent to the circle.



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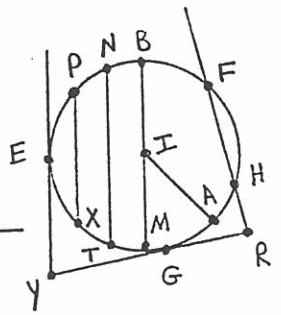
Daily Work Unit 9.1 Geometry



① Name a circle - _____

② Name its center - _____

③ Name 3 radii - _____, _____, _____

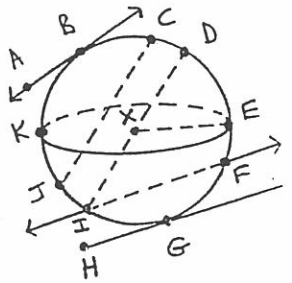
④ Name 4 chords - _____, _____, _____, _____

⑤ Name a diameter - _____

⑥ Name a secant - _____

⑦ Name 2 tangents - _____, _____

⑧ Name 2 points of tangency - _____, _____



⑨ Name a sphere - _____

⑩ Name its center - _____

⑪ Name 3 radii - _____, _____, _____

⑫ Name 3 chords - _____, _____, _____

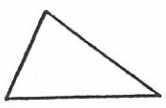
⑬ Name a diameter - _____

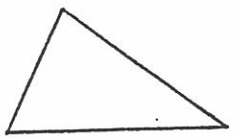
⑭ Name a secant - _____

⑮ Name 2 tangents - _____, _____

⑯ Name 2 points of tangency - _____, _____

⑰ Circumscribe a circle about the Δ ⑱ Inscribe a circle in the Δ.

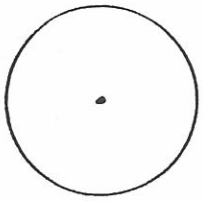




p.s. See theorem 5-8

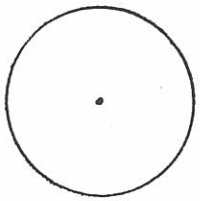
p.s. See theorem 5-7

(19) Inscribe a parallelogram.

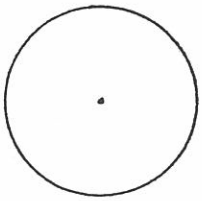


Try a rhombus.
Try any thing whoompy jawed.
Why will only a rectangle and square work?

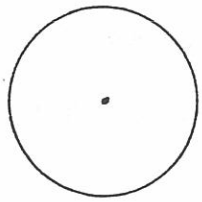
(20) Inscribe a rectangle.



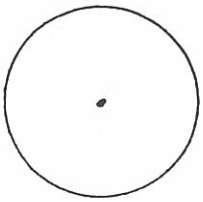
(21) Inscribe a square.



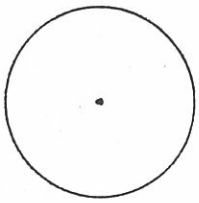
(22) Inscribe a right Δ.



(23) Inscribe an obtuse Δ

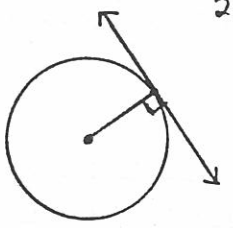


(24) Inscribe an acute Δ.



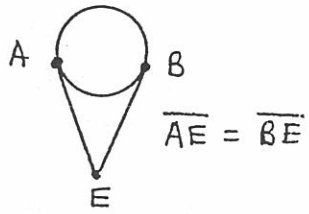
Unit 9.2 Tangents E.E. 5B(i), 5B(iii)

Theorem 9-1 A radius drawn to a point of tangency is perpendicular to the tangent line.



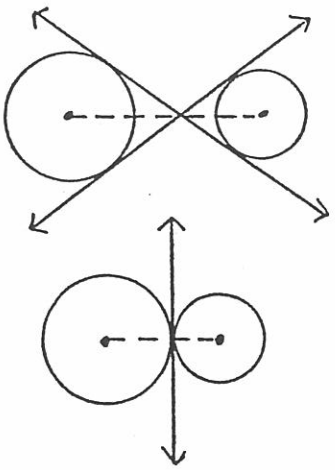
[Think – Right Δ Chapter 8]

Corollary 1 Tangents to a circle from a point are equal. [Snow Cone Effect]

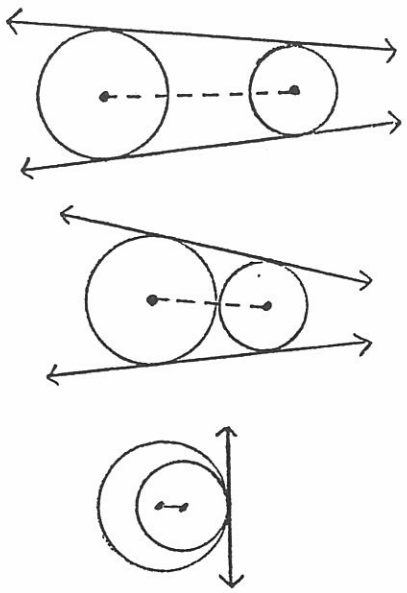


(74) **Common Tangent** – A line that is tangent to two coplanar circles.

(75) **Common Internal Tangent Lines** Pass through the segment that joins the centers.

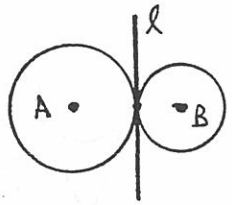


(76) **Common External Tangent** Do not pass through the segment of centers



(77) **Tangent Circles** - Coplanar circle that are tangent to the same line at the same point.

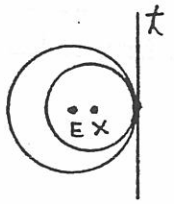
(78) **Externally Tangent Circles**
Out side of each other.



⊙A is externally tangent to ⊙B.

ℓ is a common internal tangent line.

(79) **Internally Tangent Circles**
One inside the other.



⊙E is internally tangent to ⊙X

t is a common externall tangent line

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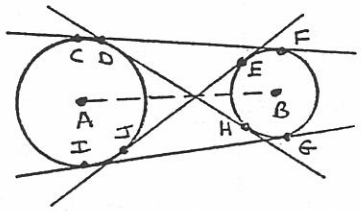
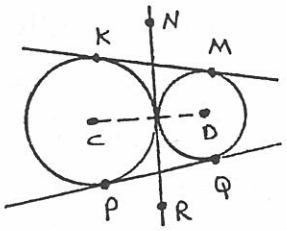
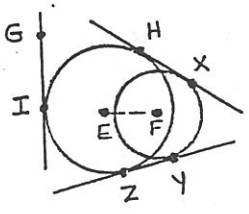
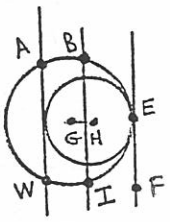
Daily Work Unit 9.2 Geometry

Name common internal & external tangent lines from the followi









① Int. - _____ ③ Int. - _____ ⑤ Int. - _____ ⑦ Int. - _____

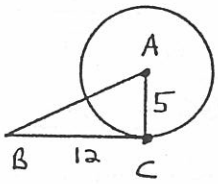
② Ext. - _____ ④ Ext. - _____ ⑥ Ext. - _____ ⑧ Ext. - _____

⑨ Name a pair of internally tangent circles - _____

⑩ Name a pair of externally tangent circles - _____

Find the missing lengths or angle measures.

$\overline{BC}$ is tangent to ⊙A

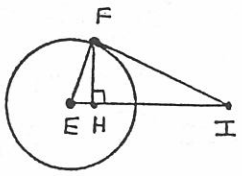


⑪ ∠ACB = _____ °

⑫ AB = _____

⑬ ∠B = _____ °

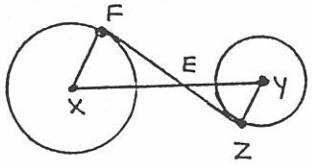
$\overline{FI}$ is tangent to ⊙E



⑭ ∠EFI = _____ °

⑮ If EH = 2 and HI = 18 then FH = _____

$\overline{FZ}$ is tangent to ⊙X and ⊙Y

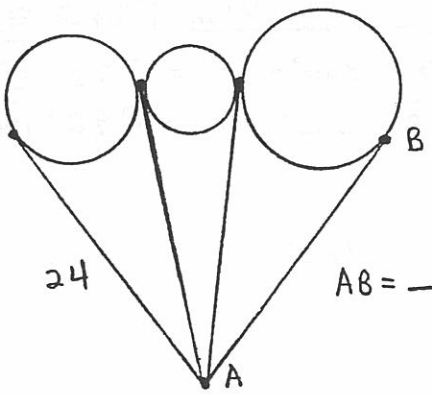


⑯ ∠XFE = _____ ° ⑰ ∠YZF = _____ °

⑱ △XFE ~ △ _____ by _____

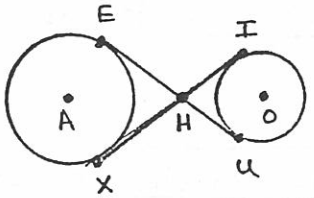
⑲ If $\overline{XF} = 6$, $\overline{FE} = 8$, and $\overline{ZY} = 3$ then $\overline{ZE}$ = _____

⑳



AB = _____

㉑ $\overline{EU}$ & $\overline{XI}$ are common internal tangents to ⊙A and ⊙O

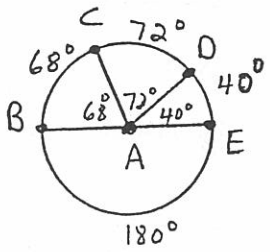


If $\overline{EH} = 3.7$ and $\overline{HI} = 1.6$ then $\overline{EU}$ = _____

Unit 9.3 Arcs and Central Angles F.E. 5B(i),(iii), 5C

Short cut Study Chart for Upcoming Units			
Angle Description	Theorem/Def.#	Vertex	Rule
Central Angle	Definition #80	Center	= arc°
Inscribed Angle	Theorem 9-5	On Circle	½ arc°
Formed by chord & tangent	Theorem 9-6	On Circle	½ arc°
2 Chords	Theorem 9-7	Inside	½ (arc° + arc°)
Formed by 2 secants, 2 tangents, 1 secant 1 tangent	Theorem 9-8	Outside	½ (arc° − arc°)

Examples:



(80) **Central Angle** – vertex is center of circle ∠BAC, ∠CAD, ∠DAE, ∠BAD, ∠CAE

Rule – A central ∠ is equal to the measure of its intercepted arc. (see picture)

(81) **Arc** – a part of a circle

$\overset{\frown}{BC}, \overset{\frown}{CD}, \overset{\frown}{DE}, \overset{\frown}{BD}, \overset{\frown}{CE}$ minor arcs

[Cover these up to find major arcs]

$\overset{\frown}{CEB}, \overset{\frown}{DEC}, \overset{\frown}{EBD}, \overset{\frown}{DEB}, \overset{\frown}{EBC}$ major arcs

[Look at a diameter to find a semicircle]

$\overset{\frown}{BCE}$, (You can't name the one on bottom)

(82) **Minor Arc** – less than 180° [= to its central angle]

$\overset{\frown}{BC} = \angle BAC = 68°$, $\overset{\frown}{CE} = \angle CAE = 112°$

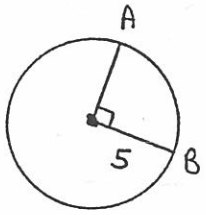
Postulate 11-1: Arc Addition – [$\overset{\frown}{CD} + \overset{\frown}{DE} = \overset{\frown}{CE}$]

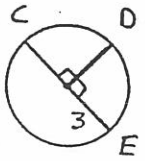
(83) **Major Arc** – more than 180° $\overset{\frown}{EBD} = 360° - 40° = 320°$ [$360° - \overset{\frown}{ED}$]

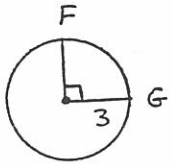
$\overset{\frown}{CEB} = 360° - 68° = 292°$ [$360° - \overset{\frown}{CB}$]

(84) **Semicircle** – exactly 180° (½ circle) $\overset{\frown}{BCE} = 180°$

(85) **congruent arcs** - are the same length if and only if they have equal measures and are in congruent circles or in the same circle. 233







$\overset{\frown}{CD} = \overset{\frown}{DE} = \overset{\frown}{FG} \neq \overset{\frown}{AB}$

Name: _____ Date: _____

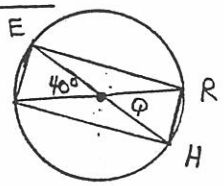
Daily Work Unit 9.3 Geometry

① Name 4 central angles- _____, _____, _____, _____

② Name 4 minor arcs- _____, _____, _____, _____

③ Name 4 major arcs- _____, _____, _____, _____

④ Name 4 semicircles- _____, _____, _____, _____



⑤ $\overset{\frown}{EF}$ = _____° ⑥ $\overset{\frown}{ER}$ = _____° ⑦ ∠RQH = _____° ⑧ ∠FQH = _____°

⑨ $\overset{\frown}{EHF}$ = _____° ⑩ $\overset{\frown}{EFR}$ = _____° ⑪ $\overset{\frown}{FER}$ = _____° ⑫ ∠EQR = _____°

⑬ ∠ERF = _____° ⑭ ∠QRH = _____° ⑮ ∠ERH = _____° ⑯ ∠RFH = _____°

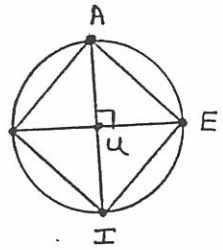
⑰ ∠EFR = _____° ⑱ ∠EFH = _____° ⑲ ▱ ERHF is a _____

If EF = 5 and ER = 12 then: ⑳ FR = _____ ㉑ QH = _____

㉒ ▱ AEIO is a _____

㉓ ∠OUI = _____° ㉔ ∠OAE = _____° ㉕ $\overset{\frown}{EI}$ = _____°

㉖ $\overset{\frown}{IAE}$ = _____° ㉗ ∠AIO = _____° ㉘ $\overset{\frown}{OAE}$ = _____°



If OE = 8 then: ㉙ AI = _____ ㉚ AU = _____

㉛ AE = _____ ㉜ EI = _____

Unit 9.4 Arcs and Chords E.E. 5B(i),(iii)

Theorem 9-2 In the same circle or in congruent circles:

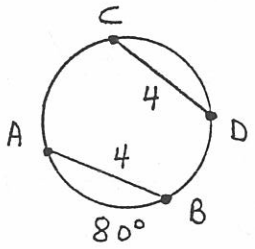
① = arcs have = chords

② = chords have = arcs

Example:

Since $\overline{CD} = \overline{AB}$, $\overset{\frown}{CD} = \overset{\frown}{AB}$ →

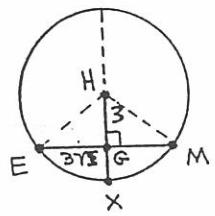
$\overset{\frown}{CD} = 80°$ and is the same length as $\overset{\frown}{AB}$.



Theorem 9-3 A diameter (or radius) that is ⊥ to a chord bisects the chord and the arc of the chord.

Example:

Since $HG \perp EM$, $EG = GM$ and $\overset{\frown}{EX} = \overset{\frown}{XM}$



$\triangle EHM$ is isosceles ($EH = HM$ radii)

$\triangle EHM$ is a $30°-60°-90°$ $\triangle$ ($ll = sl \cdot \sqrt{3}$)

$EH = 6$ ($h = sl \cdot 2$) $\angle EHG = 60°$ (opp. ll)

$\overset{\frown}{EX} = 60°$ (= cent. ∠) $\overset{\frown}{EXM} = 120°$ (thm. 9-3)

Theorem 9-4 In the same circle or in congruent circles:

① Chords equally distant from the center are =

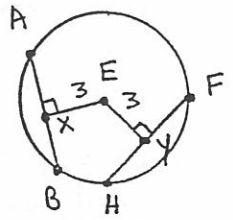
② = chords are equally distant from the center

Example:

$\overline{EX}$ is the distance from $\overline{AB}$ to point E

EY is the distance from $\overline{HF}$ to point E

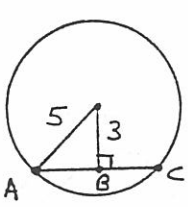
Since $EX = EY$, AB must be = to HF

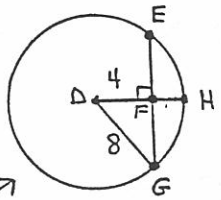


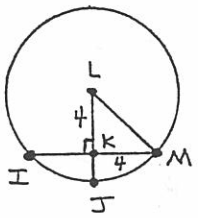
note: Remember isosceles Δ; right Δ Geometry

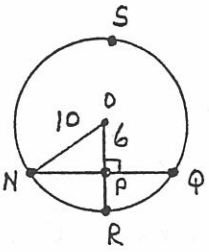
Name: _____ Date: _____

Daily Work Unit 9.4 Geometry









① AB = _____

② AC = _____

NOTICE

In a circle with radius 8, a chord 4 from the center is how long? (Answer #4)

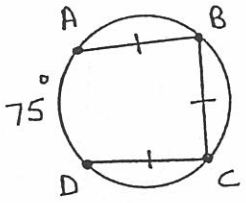
③ FG = _____ ⑧ LM = _____ ⑬ NP = _____

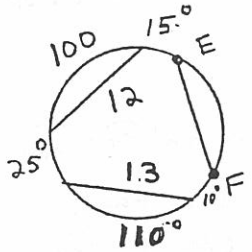
④ EG = _____ ⑨ IM = _____ ⑭ NQ = _____

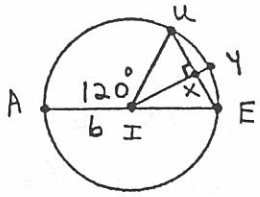
⑤ ∠DGF = _____° ⑩ ∠JLM = _____° ⑮ ∠NOP = _____°

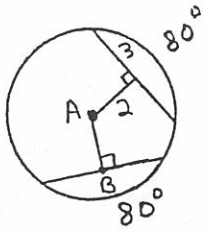
⑥ $\overset{\frown}{GH}$ = _____° ⑪ $\overset{\frown}{JM}$ = _____° ⑯ $\overset{\frown}{NR}$ = _____°

⑦ $\overset{\frown}{GE}$ = _____° ⑫ $\overset{\frown}{IJ}$ = _____° ⑰ $\overset{\frown}{NSQ}$ = _____°









⑱ $\overset{\frown}{ACD}$ = _____°

⑲ $\overset{\frown}{AB}$ = _____°

⑳ $\overset{\frown}{ADC}$ = _____°

㉑ $\overset{\frown}{EF}$ = _____

㉒ $\overset{\frown}{EF}$ = _____

㉒ ∠UIE = _____

㉓ ∠IUE = _____

㉔ $\overset{\frown}{UE}$ = _____

㉕ UX = _____

㉖ AB = _____

㉖ Draw a circle with radius 12mm Draw a chord 6mm from the center parallel to the radius. How long is the chord? _____ $\sqrt{3}$ mm (see # 4 Notice)

㉗ Draw a circle with radius 20mm., and a 12 mm chord parallel to the radius. How far is the chord from the center? _____ mm