7

Republic of the Philippines
Department of Education
NATIONAL CAPITAL REGION
Misamis Street, Bago-Bantay, Quezon City

UNIFIED SUPPLEMENTARY LEARNING MATERIALS (USLeM)

MATHEMATICS

Week 7

EXPECTATIONS:

You will **illustrate a circle and the terms related to it: radius, diameter chord, center, arc, chord, central angle, and inscribed angle.**
Specifically, this learning material will help you to:

- Define and illustrate the following:
  - Circle
  - Radius
  - Diameter
  - Center
  - Chord
  - Central Angle
  - Inscribed Angle
  - Interior and exterior point of a circle
  - Arc
- Find the measure of the following parts of a circle:
  - central angle
  - arc intercepted by the central angle
  - radius or diameter of a circle

Let us start your journey in learning more about Circles. I am sure you are ready and excited to answer the Pretest. Smile and cheer up!

PRE-TEST

Directions: Read the questions carefully. Encircle the letter of the correct answer.

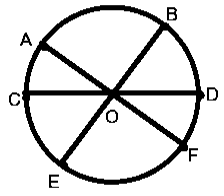
1.) What do you call a set of points in a plane equidistant (of equal distance) from a fixed point in which the fixed point is the center while the fixed distance is the radius?
a.) Square b.) Rectangle c.) Triangle d.) Circle

2.) What do you call a line segment from any point on the circle to its center?
a.) Radius b.) Chord c.) Diameter d.) Secant

3.) Which condition/s would satisfy that an angle intercept an arc?
Condition 1: The endpoints of the arc lie on the angle.
Condition 2: Each side of the angle contains the endpoint of the arc.
Condition 3: Except for its endpoints the arc lies in the interior of the angle.
a.) Condition 1 only c.) Conditions 1, 2 and 3
b.) Conditions 1 and 3 d.) Conditions 1 and 2

4.) Which statement is always true about circles?
a.) Every radius of a circle is a chord of the circle.
b.) The diameter is the longest chord of the circle.
c.) A semicircle is an arc which is one fourth of a circle.
d.) A central angle of a given circle is an angle whose vertex is at the arc of the circle.

For items 5 - 7, refer to the adjoining figure.

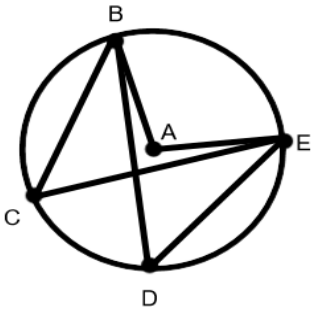


5.) Given ⊙O, what kind of arc is formed by $\widehat{ABD}$?
a.) Minor Arc b.) Major Arc c.) Semicircle d.) Quadrant

6.) Given ⊙O, which is a major arc?
a.) $\widehat{CED}$ b.) $\widehat{AC}$ c.) $\widehat{CAD}$ d.) $\widehat{CFB}$

7.) Given ⊙O, what is the arc intercepted by central angle ∠EOF?
a.) $\widehat{AC}$ b.) $\widehat{EF}$ c.) $\widehat{EAF}$ d.) $\widehat{AE}$

For items 8 – 13, refer to the given figure.



8.) Given ⊙ A, which is the central angle?
a.) ∠BAE b.) ∠BCE c.) ∠BDE d.) ∠CBD

9.) Given ⊙ A, which angle pair intercepted the same arc $\widehat{CD}$?
a.) ∠CBD and ∠BCE c.) ∠CBD and ∠CED
b.) ∠BCE and ∠BDE d.) ∠BDE and ∠CED

10.) Given ⊙ A, what is m∠BAE if $\widehat{BCE}$ = 300°?
a.) 30° b.) 60° c.) 150° d.) 300°

11.) Given ⊙ A, which angle is inscribed in arc $\overset{\frown}{CED}$?

a.) ∠CED b.) ∠BDE c.) ∠BAE d.) ∠BCE

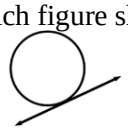
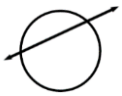
12.) Given ⊙ A, what is the measure of $\overset{\frown}{BE}$ if m∠BAE = 85?

a.) 42.5 b.) 85 c.) 170 d.) cannot be determined

13.) Given ⊙ A, what is the measure of $\overset{\frown}{BCE}$ of m∠BAE = 85?

a.) 42.5 b.) 85 c.) 170 d.) 275

14.) Which figure shows a secant?

a.)  b.)  c.)  d.) 

15.) Which statement is **not** always true about the circle?

a.) The radius is one-half the length of the diameter.
b.) The intersection of all the diameters is the center.
c.) A secant always contains a chord.
d.) A tangent may contain the center.

Great, you finished answering the questions. You may request your facilitator to check your work. Congratulations and keep on learning!

LOOKING BACK TO YOUR LESSON

This activity will give you some ideas on the terms you will encounter in this lesson.

CIRCLE GUIDE CARD

Directions: Read each statement. Decide whether the statement is true or false. Then, check the proper box under "BEFORE". At the end of the lesson/game, answers will be verified by checking again the proper box under "AFTER".

BEFORE		STATEMENT	AFTER	
TRUE	FALSE		TRUE	FALSE
		1. A **circle** is a set of points in a plane equidistant (of equal distance) from a fixed point.		
		2. A **secant** is a line that intersects a circle at exactly one point.		
		3. The **semicircle** is the union of the endpoints of a diameter and all points of the circle that lie on one side of the diameter.		
		4. A circle will be denoted by a symbol ⊙.		
		5. Any chord passing through the center of a circle is called **tangent.**		

BRIEF INTRODUCTION

Kilometer Zero

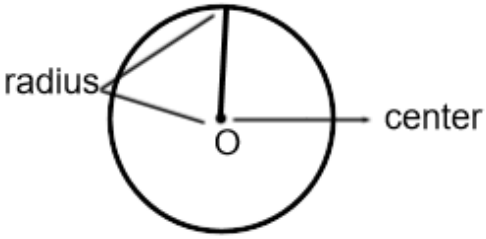
What is a kilometer zero? Kilometer zero is a particular location (usually in the nation's capital) from which distances are traditionally measured. Historically, they were markers where drivers could set their odometers to follow the directions in early guide books. In the Philippines, one of the kilometer zero is located in front of the Rizal Monument in Rizal Park.

Kilometer markers such as kilometer zero can be used for navigation. The bus system also uses it to calculate the bus fares. In other kilometer markers in the Philippines, you can see 3 important details: the distance from kilometer 0 in Luneta, the initial of the next town/city, and the distance to the next town/city.

Most people do not even know that there are kilometer markers that exist. Sometimes we see it, but we ignore it all because we do not know its purpose or why is it there in the first place.

How might the concept of circles have influenced the way kilometer zero was invented? What properties of a circle can you relate to the concept of a kilometer zero? How can your knowledge about circles help you in using navigation systems?

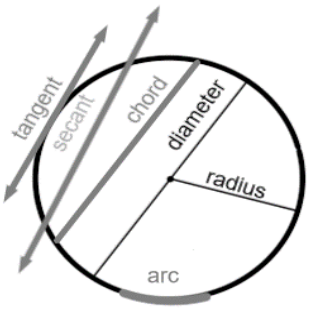
Circles are perhaps the most appealing of all simple geometric figures. For centuries, artists have used the simple elegance of it in their designs. Some have crafted intertwining patterns like a circle itself that has no beginning and no end.



A **circle** is a set of points in a plane equidistant (of equal distance) from a fixed point. The fixed point is the center while the fixed distance is the radius. A circle will be denoted by a symbol ⊙. It will be named after the center. In the given figure, you can call it ⊙ O (read as circle O) because the center is O.

A circle will be denoted by a symbol ⊙. It will be named after the center. In the given figure, you can call it ⊙ O (read as circle O) because the center is O.

Lines Related to a Circle



A **radius** (plural, radii) of a circle is a line segment from any point on the circle to its center.

A **chord** is a line segment connecting any two points on the circle. Any chord passing through the center of a circle is called a **diameter.**

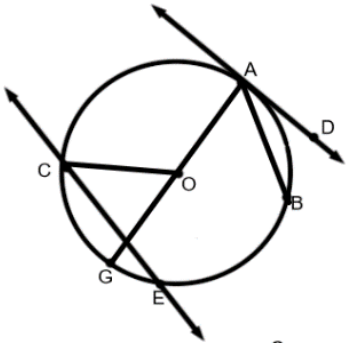
*****The length of the diameter is equal to twice the radius.

A **secant** is a line that intersects a circle at exactly two points

A **tangent** is a line that intersects a circle at exactly one point. This point is called the **point of tangency** or **point of contact.**

Example:

Refer to the given figure to give the correct term for the following:



1.) O	3.) $\overline{OA}$	5.) $\overline{AG}$	7.) $\overleftrightarrow{CE}$
2.) $\overline{AB}$	4.) A	6.) $\overline{CE}$	8.) $\overleftrightarrow{AD}$

Definition:

The **interior of a circle** is the collection of all points in the plane of the circle whose distances from the center are less than the radius. On the other hand, the **exterior of a circle** is the collection of all points in the plane of the circle whose distances from the center are greater than the radius.

In figure 1, some of the points on the interior of ⊙ A are D, C, and A. Note that the center is always in the interior of a circle.

Some of the points in the exterior of ⊙A are G, F, and H.

Note: The points on the circle are neither on the exterior nor on the interior of the same circle. In Figure 1, point B is neither in the interior nor in the exterior of ⊙A.

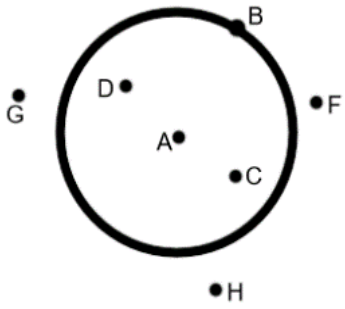


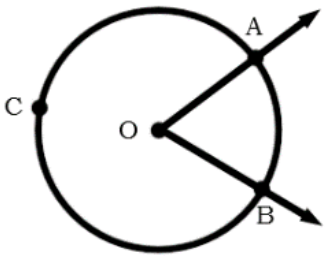
Figure 1

Arcs and Angles of Circles

In the given figure, the part of the circle from point A to point B is called an **arc** (⌒), and the angle whose vertex is O is called the **central angle**.

Definition of Parts of a Circle

A **central angle** is an angle whose vertex is at the center of the circle.



The **minor arc** $\overset{\frown}{AB}$ is the union of points A and B and all the points of the circle in the interior of central ∠AOB.

The **major arc** $\overset{\frown}{ACB}$ is the union of points A and B and all points of the circle in the exterior of central ∠AOB.

The **semicircle** is the union of the endpoints of diameter and all points of the circle that lies on one side of the diameter.

A quadrant is an arc that is one-fourth of a circle.

Note: A minor arc is named by its endpoints, while a major arc requires the use of three points.

Definitions of Degree Measures of an Arc of a Circle

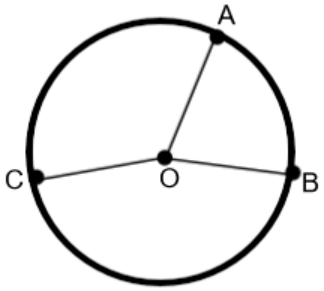
The **degree measure of the minor arc** is equal to the degree measure of the central angle.

The **degree measure of the major arc** is equal to 360 minus the degree measure of its related minor arc.

The **degree measure of a semicircle** is 180

An angle **intercepts an arc** if and only if:

1.) The endpoints of the arc lie on the angle.
2.) Each side of the angle contains the endpoint of the arc, and
3.) Except for its endpoints, the arc lies in the interior of the angle.



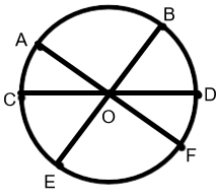
In the figure, ∠AOB is a central angle having its vertex at O, the center of the circle. ∠AOC and ∠COB are central angles.

In the figure, $\overset{\frown}{AB}$ is intercepted by ∠AOB. Likewise, $\overset{\frown}{CB}$ is the intercepted arc of ∠COB.

Example:

A. Refer to the figure and state whether each arc named is a minor arc, a major arc, or a semicircle.

1.) $\overset{\frown}{AB}$ 3.) $\overset{\frown}{AED}$ 5.) $\overset{\frown}{EDB}$
2.) $\overset{\frown}{AEF}$ 4.) $\overset{\frown}{EFD}$ 6.) $\overset{\frown}{BD}$



B. Refer to the figure and give the missing measures.

1.) m∠BOD = 30° ; m $\overset{\frown}{BD}$ = _____ 4.) m $\overset{\frown}{DF}$ = 40° ; m$\overset{\frown}{DCF}$ = _____
2.) m∠AOC = 20° ; m $\overset{\frown}{CFA}$ = _____ 5.) m $\overset{\frown}{BEF}$ = 260° ; m $\overset{\frown}{BF}$ = _____
3.) m $\overset{\frown}{AD}$ = 160°; m∠AOD = _____ 6.) m $\overset{\frown}{AC}$ = 20° ; m $\overset{\frown}{ABD}$ = _____

Answer:

A. 1.) Minor arc 4.) minor arc B. 1.) 30° 4.) 320°
2.) Semicircle 5.) semicircle 2.) 340° 5.) 100°
3.) Major arc 6.) minor arc 3.) 160° or 200° 6.) 160°

INSCRIBED ANGLES OF A CIRCLE

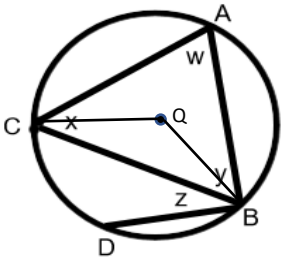
An angle is **inscribed** in an arc if its vertex is on the arc and its sides are chords joining the vertex to the endpoints of the arc.

In the figure, ∠BAC is inscribed in arc $\overset{\frown}{BAC}$. Note that ∠BQC intercepts $\overset{\frown}{BC}$ and it is a central angle. But the inscribed angle ∠BAC is also intercepting $\overset{\frown}{BC}$.

Example:

Given the figure, identify the following:

1.) The arc in which ∠z is inscribed 4.) The angle inscribed in $\overset{\frown}{ABD}$
2.) The arc in which ∠x intercepts 5.) The angle intercepted by $\overset{\frown}{AC}$
3.) The arc in which ∠ABD intercepts

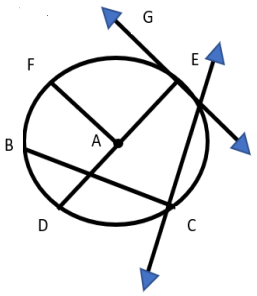


Answer:

1.) $\overset{\frown}{CBD}$ 2.) $\overset{\frown}{AB}$ 3.) $\overset{\frown}{ACD}$ 4.) ∠ABD 5.) ∠ABC

ACTIVITIES

Activity 1: Identify each of the following as related to the given circle.

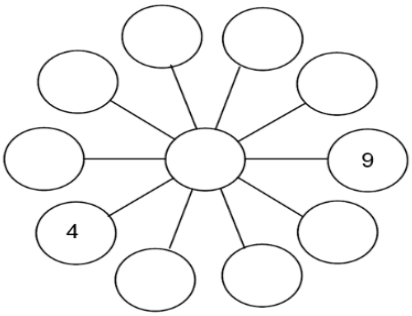


_____1. $\overline{AF}$ _____6. E
_____2. $\overline{BC}$ _____7. $\overleftrightarrow{EG}$
_____3. $\overline{DE}$ _____8. ∠FAE
_____4. A _____9. $\overset{\frown}{DFE}$
_____5. $\overleftrightarrow{CE}$ _____10. $\overset{\frown}{DGC}$

Activity 2: Magic Circles

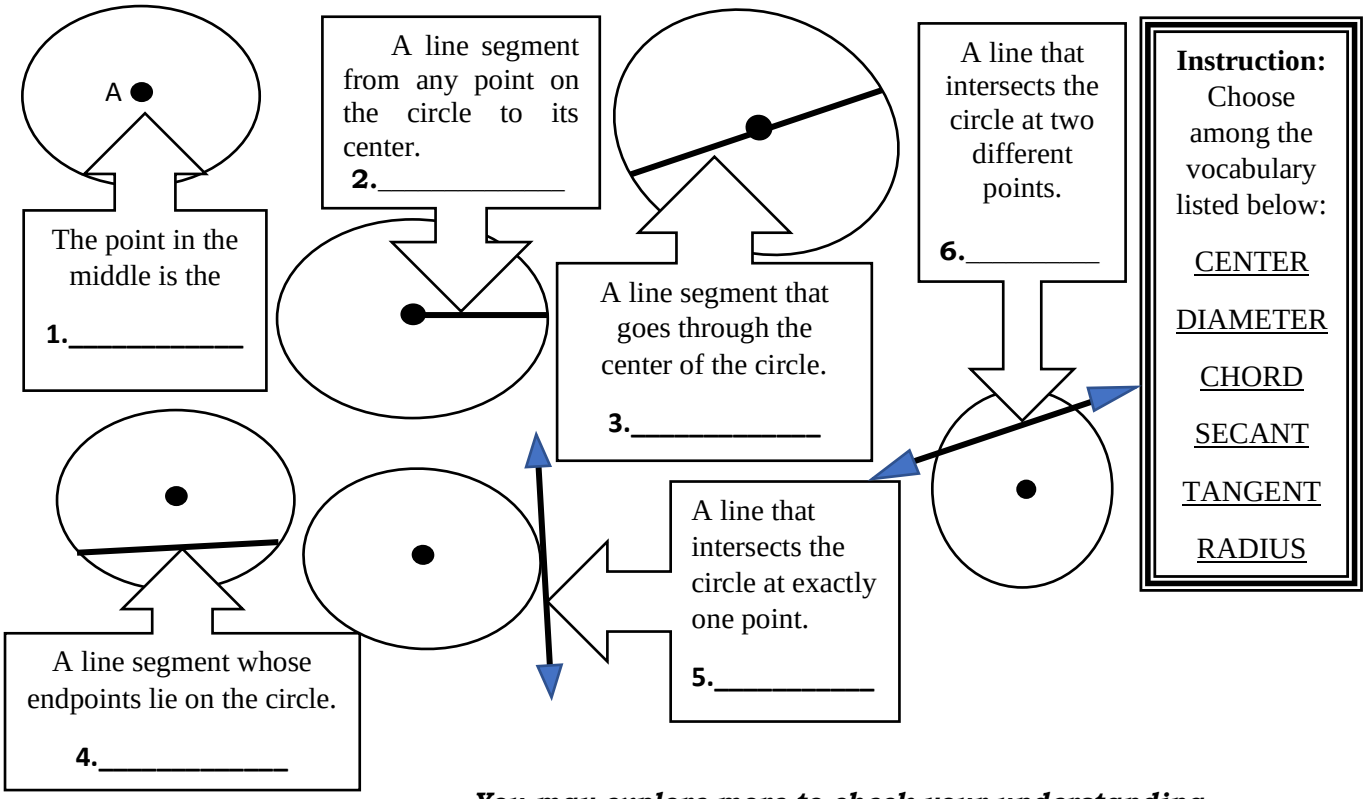
A magic circle is a circular array of numbers arranged in a special manner. When the numbers along each diameter are added, their sums are equal.

Use the numbers from 1 to 11 to complete the magic circle below so that the sum of the numbers along each diameter is 18. Each number must be used only once. (Some numbers are filled in for you.)



Activity 3: Circle Vocabulary

"CIRCLE VOCABULARY"



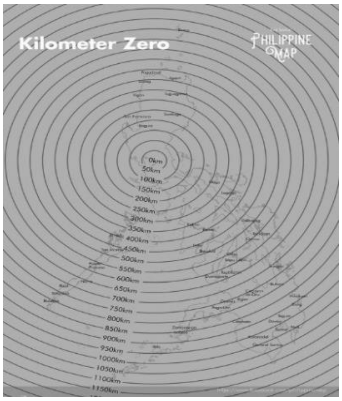
You may explore more to check your understanding.

REMEMBER

- A **circle** is a set of points in a plane equidistant (of equal distance) from a fixed point. The fixed point is the center while the fixed distance is the radius.
- A **radius** (plural, radii) of a circle is a line segment from any point on the circle to its center.
- A **chord** is a line segment connecting any two points on the circle.
- Any chord passing through the center of a circle is called a **diameter.**
- The length of the diameter is equal to twice the radius.
- A **secant** is a line that intersects a circle at exactly two points
- A **tangent** is a line that intersects a circle at exactly one point. This point is called the **point of tangency** or **point of contact.**
- The **interior of a circle** is the collection of all points in the plane of the circle whose distances from the center are less than the radius. On the other hand, the **exterior of a circle** is the collection of all points in the plane of the circle whose distances from the center are greater than the radius.
- A **central angle** is an angle whose vertex is at the center of the circle.

- The **minor arc** $\overset{\frown}{AB}$ is the union of points A and B and all the points of the circle in the interior of central ∠AOB.
- The **major arc** $\overset{\frown}{ACB}$ is the union of points A and B and all points of the circle in the exterior of central ∠AOB.
- The **semicircle** is the union of the endpoints of a diameter and all points of the circle that lie on one side of the diameter.
- The **degree measure of the minor arc** is equal to the degree measure of the central angle.
- The **degree measure of the major arc** is equal to 360 minus the degree measure of its related minor arc.
- The **degree measure of a semicircle** is 180
- An angle **intercepts an arc** if and only if:
  1.) The endpoints of the arc lie on the angle.
  2.) Each side of the angle contains the endpoint of the arc, and
  3.) Except for its endpoints, the arc lies in the interior of the angle
- An **angle** is **inscribed** in an arc if its vertex is on the arc and its sides are chords joining the vertex to the endpoints of the arc.

CHECK YOUR UNDERSTANDING



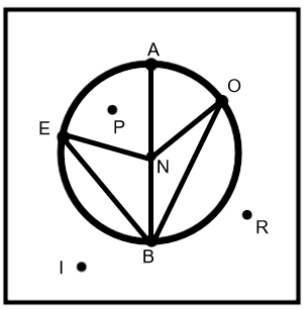
The picture shown here is how kilometer zero works. It is like a center of a circle where the major thoroughfares encompass. Radial roads are like a radius that is connected to a fixed point which is the kilometer 0 marker.

Have you ever wondered how the global positioning system (GPS) on your cellphone or car works? Satellite communication and geometry(circle) is the key. It is like how a kilometer marker worked.

Conduct research on how GPS works on your cellphone and how kilometer zero worked just like it.
Cite the source and the link.

ACTIVITIES

Activity 1: Answer the following:



Refer to the given figure on the right to answer the following:

1.) Name the interior points.
2.) Name the exterior points.
3.) Name all the radius
4.) Name the given circle.
5.) If AB = 12, what is EN?
6.) Name the arc intercepted by ∠ANO.
7.) Name the angle inscribed by $\overset{\frown}{EB}$.
8.) If m∠ANE = 70° what is m $\overset{\frown}{AE}$?
9.) If m $\overset{\frown}{EBA}$ = 300°, what is m∠ENA
10.) If m∠BNE = 127° what is m $\overset{\frown}{BAE}$?

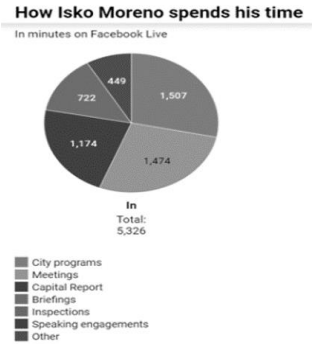
Activity 2: How do you spend your time?

A Pie Chart (or Pie Graph) is a special chart that uses "pie slices" to show relative sizes of data. The chart is divided into sectors, where each sector shows the relative size of each value.

The figure shown on the right is how Mayor Isko Moreno spends his time on Facebook live.

How do you spend your time in a day?

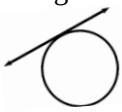
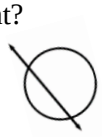
Make a pie chart showing how you spend your 24 hours in a day.



POST-TEST

Directions: Read the questions carefully. Encircle the letter of the correct answer.

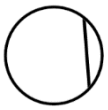
1.) Which figure shows a tangent?

a.)  b.)  c.)  d.) 

2.) Which condition/s would always be true if line is tangent to a circle?

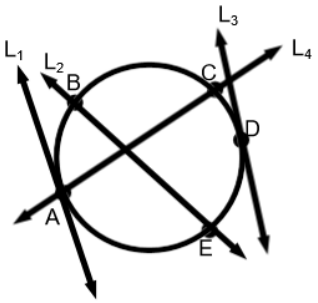
Condition 1: It intersect the circle at exactly one point.
Condition 2: Tangent passes through the center.
Condition 3: The point of tangency is in the exterior of the circle.

a.) Condition 1 only
b.) Conditions 1 and 2
c.) Condition 2 only
d.) Conditions 1 and 3

3.) From the given figure, which part of a circle is the given segment? 

a.) Radius b.) Diameter c.) Chord d.) Secant

For items 4 – 6, refer to the given figure.



4.) Given the figure, which lines are secant?

a.) L_1 and L_3
b.) L_2 and L_4
c.) L_3 and L_2
d.) L_4 and L_3

5.) Given the figure, what are the points of tangency?

a.) A and D
b.) B and E
c.) A and C
d.) A and E

6.) Given the figure, what are the chords?

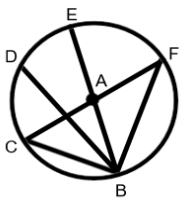
a.) $\overleftrightarrow{BE}$ and $\overleftrightarrow{AC}$
b.) $\overset{\frown}{BE}$ and $\overset{\frown}{AC}$
c.) B and C
d.) $\overline{BE}$ and $\overline{AC}$

7.) Which statement/s would always be true about the arc of a circle?

Statement 1: Any two points of a circle divide the circle into two arcs.
Statement 2: A semicircle is an arc which is one half of a circle.
Statement 3: A central angle and an inscribed angle may intercept the same arc.

a.) Statement 1 only
b.) Statements 1 and 2
c.) Statements 1, 2, and 3
d.) Statements 1 and 3

For items 8 – 10, refer to the given figure.



8.) Given ⊙ A, what are the diameters?

a.) $\overline{AF}$ and $\overline{AC}$
b.) $\overline{BD}$ and $\overline{BE}$
c.) $\overline{BC}$ and $\overline{BF}$
d.) $\overline{BE}$ and $\overline{CF}$

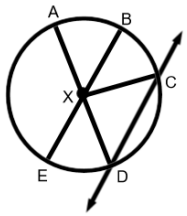
9.) Given ⊙ A, central angle ∠EAF and inscribed angle ∠EBF intercept the same arc $\overset{\frown}{EF}$. How true is this statement?

a.) always true
b.) sometimes true
c.) never true
d.) cannot be determined

10.) Given ⊙ A, which is **not** true about the figure?

a.) $\overline{CF}$ is both chord and a diameter.
b.) $\overline{BC}$ and $\overline{BF}$ are secants.
c.) Diameter $\overline{CF}$ contain radius $\overline{CA}$.
d.) $\overset{\frown}{CEF}$ and $\overset{\frown}{CBF}$ are both semicircles.

For items 11 – 15, refer to the given figure. Given ⊙ X



11.) Given ⊙ X, if $\widehat{AB}$ = 50°, what is the measure of central angle ∠AXB?
a.) 25^0 b.) 50° c.) 100° d.) 310°

12.) Given ⊙ X, name the longest chord.
a.) $\widehat{BE}$ b.) $\overleftrightarrow{CD}$ c.) $\overleftrightarrow{BE}$ d.) $\overline{BE}$

13.) Given ⊙ X, what is the measure of $\widehat{AEC}$ if m∠AXC = 89°?
a.) 271° b.) 171° c.) 89° d.) 44.5°

14.) Given ⊙ X, if $\overline{AD}$ is the longest chord, what is m$\widehat{ACD}$?
a.) 90° b.) 180° c.) 360° d.) cannot be determined

15.) Given ⊙ X. If the measure of $\overline{XC}$ = 15, what is the measure of $\overline{BE}$?
a.) 15 b.) 30 c.) 45 d.) 150

E-SITES

To further explore the concept learned today, you may visit the following links to enhance your knowledge.
https://www.mathsisfun.com/geometry/circle.html
https://www.mathplanet.com/education/geometry/circles/basic-information-about-circles
https://www.khanacademy.org/math/basic-geo/basic-geo-area-and-perimeter/area-circumference-circle/a/radius-diameter-circumference

https://www.google.com/search?q=circle+vocabulary&tbm=isch&ved=2ahUKEwjhit3Ip8HuAhUHXpQKHSJyCL4Q2-cCegQIABAA&oq=circle+vocabulary&gs_lcp=CgNpbWcQAzICCAAyAggAMgIIADICCAAyAggAMgIIADICCAAyAggAMgIIADIGCAAQBRAeOgQIABBDOgcIABCxAxBDOgoIABCxAxCDARBDOgUIABCxA1CDPFiXX2CeYWgAcAB4AIABVogB9QiSAQIxN5gBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=wxUUYKGdIoe80QSi5KHwCw&bih=610&biw=1280#imgrc=E5tx-Fv8HEMk3M

REFERENCE

Orines, Fernando B. et.al., (2008). Next Century Mathematics III 2nd edition. Phoenix Publishing House, Inc., Philippines

Malaborbor, Pastor B et.al. (2005). Geometry for the Basic Education Curriculum Educational Resources Corporation, Quezon City, Philippines

Oliva, Jacob (June 30, 2017). What do kilometer markers mean? Retreived May 16, 2020, from https://www.autodeal.com.ph/articles/car-features/what-do-kilometer-markers-mean

Reyes, Isaac (October 12, 2019) Data Storyteller Facebook Retrieved May 16, 2020 from https://www.facebook.com/isaac.reyes/posts/a-reader-just-sent-in-this-rappler-chart-that-shows-how-manila-mayor-isko-moreno/1200783920117146/

Wikipedia The free Encyclopedia (n.d) Lists of Roads in Metro Manila Retrieved May 16, 2020 from https://en.wikipedia.org/wiki/List_of_roads_in_Metro_Manila

Acknowledgements

Writer: Anancita L. Pollo, Teacher III
Emmanuel Vincent S. Espino, Teacher I

Editor: Cristina R. Solis , Head Teacher VI

Reviewer: Remylinda T. Soriano, EPS, Math
Angelita Z. Modesto, PSDS
George B. Borromeo, PSDS

Management Team: Maria Magdalena M. Lim-Schools Division Superintendent-Manila,
Aida H. Rondilla-Chief Education Supervisor,
Lucky S. Carpio-EPS and Lady Hannah C Gillo, Librarian II-LRMS