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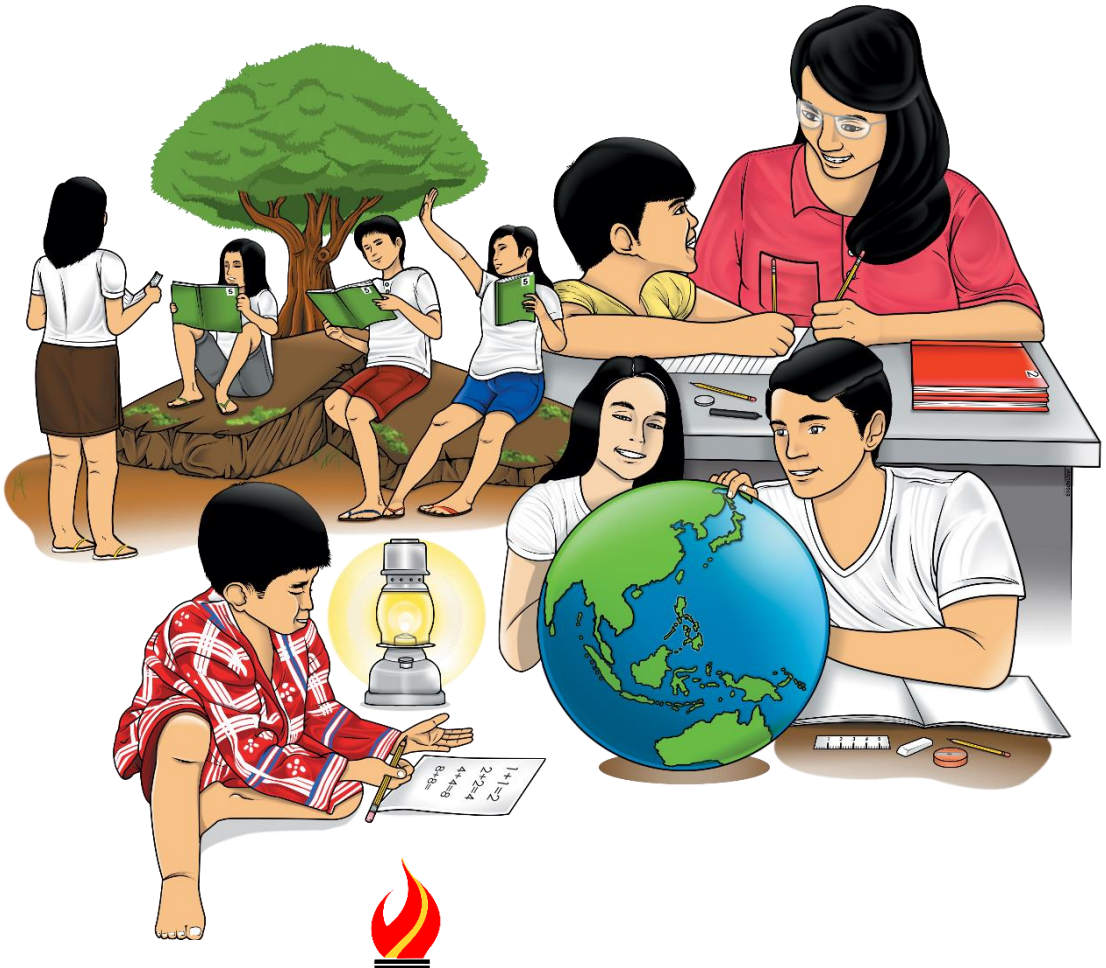
Mathematics

Quarter 4 – Module 1:
Finding the Area of a Circle



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Mathematics

Quarter 4 – Module 1:
Finding the Area of a Circle

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

Good day Mathletes! This module was designed and written to help you gain an understanding of and to test your ability in finding the area of a given circle. We know that formula serves as the guide in solving for the area of a circle. Knowing how to derive the formula and how to use them in real-life situations is important, especially in solving for the area of a circle. So, what are you waiting for? Stay focused and start-up.

At the end of this module, you are expected to:

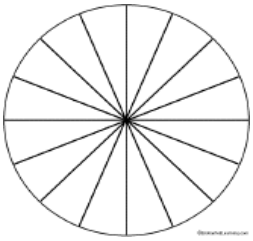
- describe the different terms used in the formula;
- appreciate the importance of formula in finding the area of a circle; and
- derive a formula in finding the area of a circle.

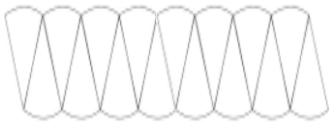
Before going any further, let us check your understanding about deriving the formula in finding the area of a circle.

What I Know

Directions: Choose the letter that corresponds to the best answer. Write the chosen letter on a separate sheet of paper.

1. A circle is cut into 16 identical sectors as shown in the figure. What will be formed if the 16 sectors are arranged in one row?





(A) circle (B) triangle (C) parallelogram

2. Which figure has a formula for finding area that can be used to derive a formula of a circle?
(A) triangle (B) trapezoid (C) parallelogram

3. The sectors of a circle are arranged in one row. Which part of the circle approximates the bases of the resembled figure?
   (A) area (B) diameter (C)circumference

4. The sectors of a circle are arranged in one row. Which part of the resembled shape approximates the radius of the circle?
   (A) base (B) height (C) diameter

5. Which is half of the diameter of a circle?
   (A) arc (B) radius (C) circumference

6. A circle with radius r is cut into several sectors which are then arranged in one row. Which is equal to the base of the resembled figure?
   (A) π (B) r (C) πr

7. If the diameter of a circle is given, what should you compute first to find its area?
   (A) pi (B) radius (C) circumference

8. What is the formula for finding the area of a circle?
   (A) $A = \pi \times r \times r$ (B) $A = 2 \times \pi \times r$ (C) $A = \pi \times d$

9. What is the area of a circle with a 5 cm radius? (use $\pi = 3.14$)
   (A) 78.5 cm^2 (B) 23.7 cm^2 (C) 15.7 cm^2

10. What is the area of a circle with a diameter of 48 m?
    (A) 24.8 m^2 (B) 48.2 m^2 (C) 50.24 m^2

CONGRATULATIONS! If you got a score of 9 or 10, you should not have any difficulty studying the lesson in this module.

If you got a score of 8 or below, you may need to study the lesson more carefully and do all the given activities.

Lesson 1 Finding the Area of a Circle

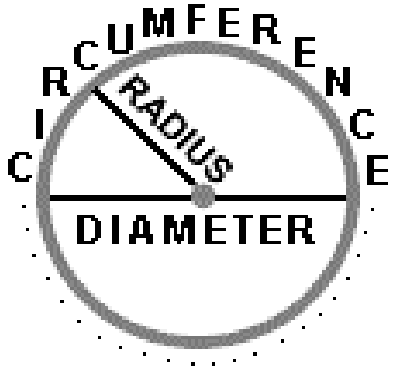
Learning how to find the areas of circles plays a vital role in our everyday lives. There are many real-life situations where you would need to calculate the areas of various shapes, such as circles.

Are you ready? Let's explore the lesson.

What's In

In the previous lessons, you learned that the distance around the circle is the circumference. Let us recall how to find the circumference of a circle.

The distance around a circle is called its **circumference**. The distance across a circle through its center is called its **diameter**. We use the Greek letter π *(read as "Pī" with a short i)* to represent the ratio of the circumference of a circle to its diameter. When rounded off, π = 3.14.



To get the **circumference** of a circle, we learned that the formula is:

$$\boldsymbol{C = \pi \times d} \text{ or } \boldsymbol{C = 2 \times \pi \times r}.$$

For simplicity, we use π = 3.14. Note that the diameter of a circle is twice as long as the radius. This relationship is expressed as $d = 2 \times r$.

Answer the following exercises below. Solve for the **circumference** given the radius or diameter of a circle. Fill in the table. Write your answer on a separate sheet of paper.

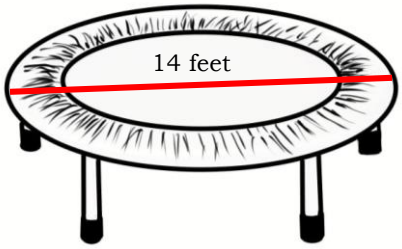
	Radius	**Diameter**	**Circumference**
1	4 m		
2		9 m	
3		24 m	
4	7 dm		
5	35 cm		

What's New

In this lesson, you are going to derive the area formula of a circle. Do you know that finding the area of a circle is easier if we use a formula?

Consider the figure below

Mr. Suarez is purchasing materials to build a do-it-yourself trampoline for his kids. If he wants the diameter of the mat to be 14 feet long, how much nylon does he need to purchase?



The red line through the center of this trampoline shows its diameter and can be used to calculate its area.

What Is It

Areas have many practical applications even in the past centuries.

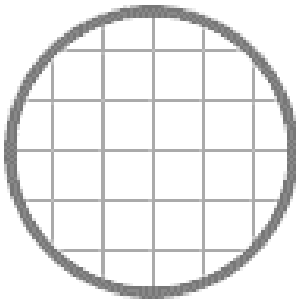
- The *Chinese* knew how to calculate the area of many different two-dimensional shapes by about 100 B.C.
- *Johannes Keppler,* 1571 to 1630, measured the areas of sections of planetary orbits using formulas for calculating areas of ovals or circles.
- *Sir Isaac Newton* used the concept of area to develop *Calculus*.

The concept of area became even more useful when formulas in finding areas of different shapes were developed.

The area of a circle is the total region that is bounded by the circumference. Think of the area of a circle as the amount of surface enclosed inside the circle. The formula in finding the area of a circle is:

$$A = \pi \times r^2 \text{ or } A = \pi \times r \times r$$

In this formula, "*A*," is the *area*, "*r*" is the *radius*, and "π" is a Greek letter pronounced as "*pi*" which is constant and approximately equal to **3.14,** the ratio of the circumference to its diameter. Recall that the radius (*r)* of a circle is the distance from its center to any point on the circle.



The area of a circle is the number of square units inside that circle. If each square in the circle has an area of 1 cm^2, you could count the total number of squares to get the area of this circle. Thus, if there were a total of 28.26 squares, the area of this circle would be 28.26 cm^2.

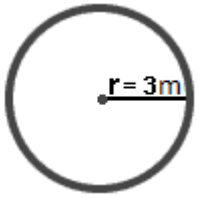
Let's look at some examples involving areas of circles. Use π = 3.14 in all examples and calculations.

Example 1:

The radius of a circle is 3 meters. What is the area of the circle?

Solution:

$A = \pi \times r \times r$
A = 3.14 x (3 m) x (3 m)
A = 3.14 x (9 m^2)
A = 28.26 m^2



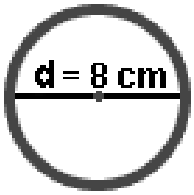
Example 2:

The diameter of a circle is 8 centimeters. What is the area of the circle?

Solution:

$d = 2 \times r$
8 cm = 2 x r
8 cm ÷ 2 = r
r = 4 cm

$A = \pi \times r \times r$
A = 3.14 x (4 cm) x (4 cm)
A = 3.14 x (16 cm^2)
A = 50.24 cm^2



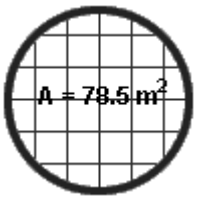
What if the area is given? How will you find the radius of the circle?

Example 3:

If a circular pool has an area of 78.5 square meters. What is the radius of the pool?

Solution:

$A = \pi \text{ x } r \text{ x } r$
$78.5 \text{ m}^2 = 3.14 \text{ x } r \text{ x } r$
$78.5 \text{ m}^2 \div 3.14 = r \text{ x } r$
$25 \text{ m}^2 = r \text{ x } r$
$r = 5 \text{ m}$



Example 4:

Let's answer the problem given in the previous part of the lesson.

Mr. Suarez is purchasing materials to build a do-it-yourself trampoline for his kids. If he wants the diameter of the mat to be 14 feet long, what is the area of the nylon that he needs to purchase?

Solution:

$d = 2 \text{ x } r$
$14 \text{ ft} = 2 \text{ x } r$
$14 \text{ ft} \div 2 = r$
$r = 7 \text{ ft}$

$A = \pi \text{ x } r \text{ x } r$
$A = 3.14 \text{ x } (7 \text{ ft}) \text{ x } (7 \text{ ft})$
$A = 3.14 \text{ x } (49 \text{ ft}^2)$
$A = 153.86 \text{ ft}^2$

Therefore, the length of nylon that Mr. Suarez needs for his trampoline is 153.86 square feet.

Example 5:

Gerry is making a circular glass top for a table with a radius of 6 dm. What is the smallest possible area of the glass that is needed to cover the top of the table?

Solution:

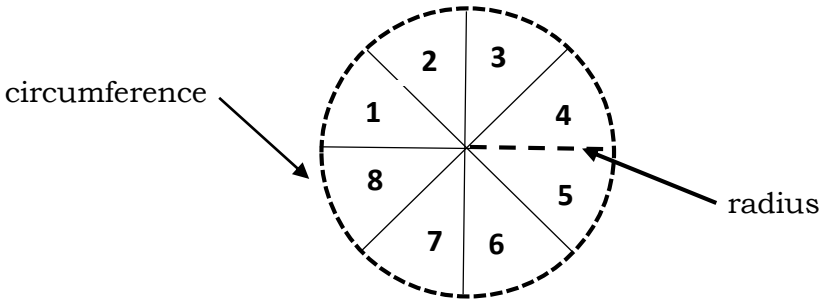
$$A = \pi \, x \, r^2$$
$$A = 3.14 \, x \, (6 \, dm)^2$$
$$A = 113.04 \, dm^2$$

Hence, the smallest possible area of the circular glass that is needed to cover the top of the table is $113.04 \, dm^2$.

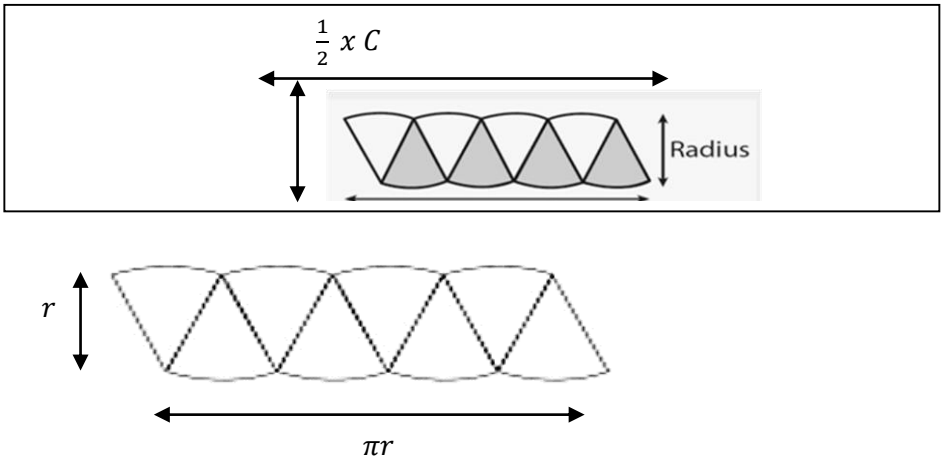
To answer all the examples above, we used the formula $A = \pi \, x \, r \, x \, r$ *or* $A = \pi \, x \, r^2$ in finding the areas of circles. Where did we get this formula?

Derivation of Formula of the Area of a Circle ($A = \pi\, x\, r^2$)

Consider a circle with circumference C and radius r. Divide it into 8 identical sectors as shown in the figure below.



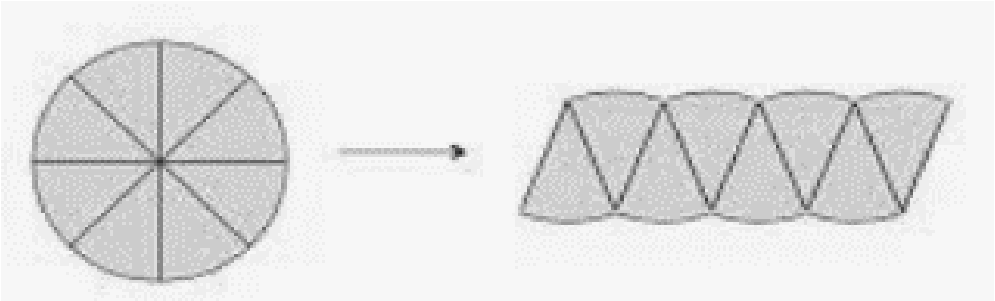
Then, arrange the 8 sectors of the circle as shown below.



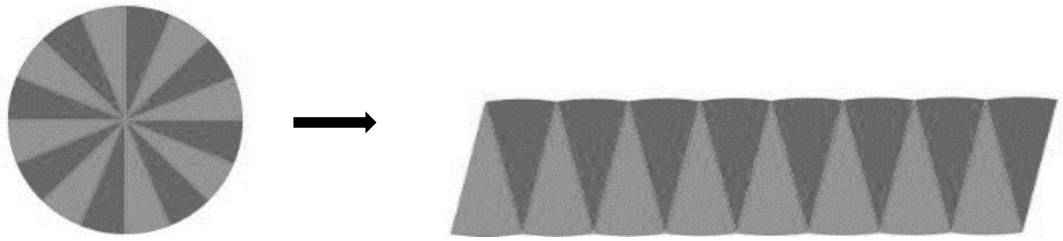
What figure does it resemble?

The sectors of a circle when arranged in a row resemble a parallelogram.

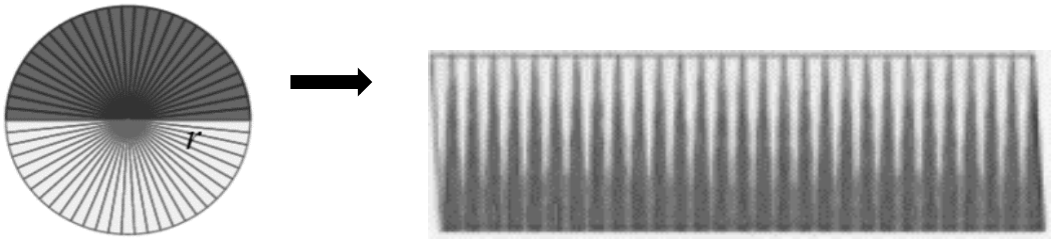
Will the area of the sectors of the circle change after rearranging them to look like a parallelogram?



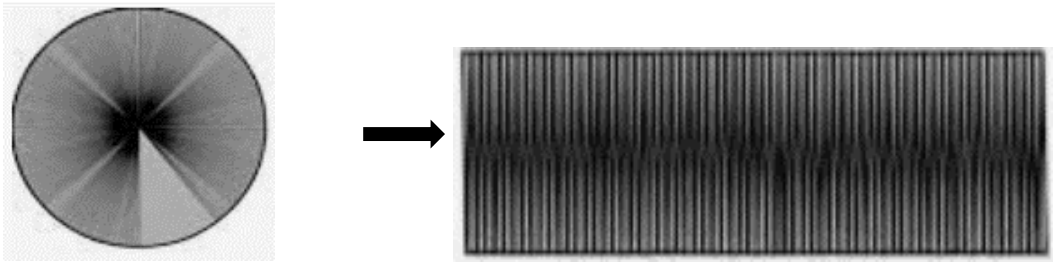
Let us increase the number of identical sectors to 16. Arrange the sectors in a row. Again, you form a figure that resembles a parallelogram.

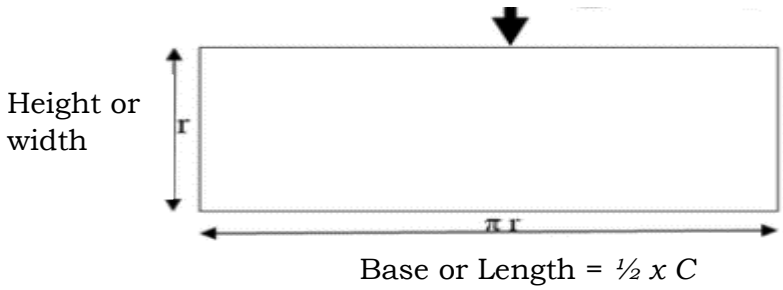


As we increase the number of identical sectors into which we cut the circle, the more the shape formed resembles a parallelogram. In particular, the shape looks like a rectangle.



As we further increase the number of identical sectors into which the circle is cut, the difference between the shape formed and a rectangle gets smaller and smaller. Hence, when the number of equal sectors is sufficiently large, the difference becomes practically zero.





Base or Length = ½ *x C*

The radius of the circle approximates the width of the rectangle. Half of the circumference approximates its length.

Recall the formula for finding the area of a parallelogram with base b and height h is $A = bxh$. A rectangle is a special kind of parallelogram, and so this formula also applies. The base is the length of the rectangle and the height is the width.

In the problem, the base is equal to $\frac{1}{2}x\ C$ and the height is equal to radius r. Therefore, we can find the area of a circle as follows:

$$A = \frac{1}{2}x\ C\ x\ r$$
$$A = \frac{1}{2}x\ 2\ x\ \pi\ x\ r\ x\ r, \qquad since\ C = 2\ x\ \pi\ x\ r$$
$$A = \pi\ x\ r\ x\ r$$
$$A = \pi\ x\ r^2$$

Hence, the formula in finding the area of a circle is now derived.

What's More

Activity 1: You Complete Me!

Directions: In the diagram, the circle has a radius of 6 cm. Find the area of the circle by filling out the blanks to complete the solution. Write your answer on a separate sheet of paper.

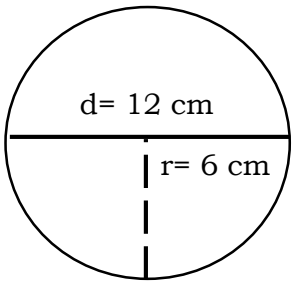
Solution:

$A = \pi$ x _____ x r
(1)

$A =$ _____ x (6 cm) x (_____ cm)
(2) (3)

$A = 3.14$ x (_____)
(4)

$A =$ _____ cm^2
(5)



Activity 2: Correct Me, If I'm Wrong!

Directions: Consider a circle cut into many sectors. The sectors are then arranged in a row to resemble a parallelogram. Write **T** if the statement is true and **F** if it is false. Write your answer on a separate sheet of paper.

_____ 1. We can use the area formula of a parallelogram to help us find the area of a circle.
_____ 2. Half of the circumference of the circle is equal to the height of the parallelogram.
_____ 3. Half of the circumference is equal to $\pi\, x\, r$.
_____ 4. The diameter of the circle will substitute for the height of the parallelogram.
_____ 5. The area formula of a circle is $A = \pi\, x\, r^2$.

Activity 3: Can You Measure Me?

Directions: Answer the following questions. Show your solutions. Write your answer on a separate sheet of paper.

1. The radius of a circle is 9 centimeters. What is the area of the circle?
2. The diameter of a circle is 12 meters. What is the area of the circle?
3. The radius of a circular rug is 4 feet. What is the area of the rug?
4. The area of a coin is 3.14 square centimeters. What is the radius of the coin?
5. The diameter of a bicycle wheel is 20 decimeters. What is the area of the wheel?

What I Have Learned

Directions: Fill in the blanks with the correct answers. Choose your answers in the box below. Write your answer on a separate sheet of paper.

area	*parallelogram*
interior	*radius*
$A = \pi \times r \times r$	$A = b \times h$

(1) _____ is the amount of inside the (2) _____ of the circle. The formula for the area of a circle is derived from the formula of the area of a (3) _____. The (4) _____ will be the height of the parallelogram.

The area of a parallelogram is $A = b \times h$. For the sectors of a circle which is made to resemble a parallelogram, the length of the base corresponds to πr and the height is r. Therefore, the formula in finding the area of a circle is (5) _____.

Excellent work! Just keep going!

What I Can Do

Directions: Do what is asked and answer the questions that follow. Write your answer on a separate sheet of paper.

- Cut out a circle. Draw a diameter. Fill the semicircles with two different colors.
- Cut the semi-circles. Cut each semicircle twice to have 8 identical sectors.
- Arrange the eight sectors in alternating colors, so they form a shape which resembles a parallelogram.

1. What quadrilateral did the shape resemble? _____
2. What is the area formula for a parallelogram? _____
3. The circumference is the distance around the circle. The formula to find-the circumference of a circle is _____.
4. Half of the circle goes to the top of the parallelogram, and the other half of the circle goes to the bottom. This is known as the base b of the parallelogram.

$$b = \frac{2x\pi xr}{2} \text{ or } b = \_\_\_\_\_ .$$

5. The height h of the parallelogram is the radius r of the circle.

$$h = r$$

Now let's substitute the information into the area formula of the parallelogram.

$$A = b\ x\ h$$
$$A = (\pi\ x\ r)x\ h$$
$$A = (\pi\ x\ r)\ x\ r$$
$$A = \_\_\_\_\_$$

You have derived the formula to find the area of a circle.

Just two more activities to be done and you are ready for the next module.

Assessment

Directions: Choose the letter that corresponds to the best answer. Write the chosen letter on a separate sheet of paper.

1. The formula for the area of a parallelogram can be used to derive the formula for the area of a circle. Is this correct?
   (A) No (B) Yes (C) Maybe

2. Which will resemble the shape formed if the identical sectors of a circle are arranged in one row?
   (A) triangle (B) trapezoid (C) parallelogram

3. Half of the circle goes to the top of the parallelogram, and the other half goes to the bottom. What part of a parallelogram is this?
   (A) side (B) base (C) height

4. Which is equal to the base if a circle is made into parallelogram?
   (A) r (B) $\pi x r$ (C) $b \times h$

5. The sectors of a circle are arranged to resemble a parallelogram. Which part of the circle approximates the height of the parallelogram?
   (A) radius (B) diameter (C) circumference

6. The sectors of a circle are arranged to resemble a parallelogram. Which part of the parallelogram approximates half of the circumference?
   (A) base (B) area (C) height

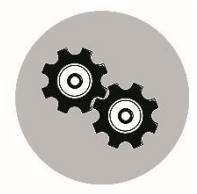
7. If the formula for finding the area of a parallelogram is $A = b\ x\ h$, what is the formula for the area of a circle?
   (A) $A = 2\ x\ \pi\ x\ r$ (B) $A = \pi\ x\ d$ (C) $A = \pi\ x\ r^2$

8. Kaye will compute for the area of a circle using the formula $A = \pi\ x\ r^2$. If the given is the diameter of a circle, what should be computed first?
   (A) base (B) radius (C) circumference

9. What is the area of a circle with a 5-meter radius? (Use $\pi = 3.14$)
   (A) 31.4 m^2 (B) 78.5 m^2 (C) 314 m^2

10. What is the area of a circle with a radius of 2 m? (Use $\pi = 3.14$)
    (A) 6.28 m^2 (B) 12.56 m^2 (C) 50.24 m^2

You made it! Finally, you're on the last activity. Answer it all correctly so you could climb at the top and get your trophy.



Additional Activities

Directions: Match Column A with Column B to complete each statement. Write your answer on a separate sheet of paper.

Column A	***Column B***
1. The formula for the area of a circle is _____.	a. radius
2. The formula for the area of a parallelogram is _____.	b. $A = \pi\ x\ r^2$
3. The base of the parallelogram is half of the _____ of a circle.	c. A = 50.24 cm^2
4. The height of the parallelogram is the ____ of the circle.	d. $A = 379.94\ cm^2$
5. The area of a circle with a radius of 11 cm is _____.	e. $A = bxh$
	f. circumference

Answer Key

What I Know

1. C
2. C
3. C
4. B
5. B
6. C
7. B
8. A
9. A
10. C

What's In

	r	D	C
1	**4m**	8m	**25.12**m^2
2	4.5m	**9m**	**28**.26m^2
3	12m	**24m**	**75**.36m^2
4	**7dm**	14dm	**43**.96dm^2
5	**35cm**	70cm	**219**.8cm^2

What's More

Activity 1: You Complete Me!

1. 1. r
2. 2. 3.14
3. 3. 6
4. 4. 36
5. 5. 113.04

Activity 2: Correct Me if I'm Wrong!

1. 1. T
2. 2. F
3. 3. T
4. 4. F
5. 5. T

Activity 3: Can You Measure Me?

1. 1. 254.34 cm^2
2. 2. 113. 04 in^2
3. 3. 50.24 ft^2
4. 4. 1 cm
5. 5. 314 in^2

What I Can Do

1. Parallelogram
2. A= b x h
3. $C = 2\pi r$ or C =d× π
4. $\pi \times r$
5. $A = \pi \times r \times r$ or $A = \pi r^2$

What I Have Learned

1. Area
2. Interior
3. Parallelogram
4. Radius
5. $A = \pi \times r \times r$

Additional Activities

1. B
2. E
3. F
4. A
5. D

Assessment

1. B
2. C
3. B
4. B
5. A
6. A
7. C
8. B
9. B
10. B

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