

Mathematics

Quarter 3 – Module 7:

Constructing Triangles, Squares, Rectangles, Regular Pentagons and Regular Hexagons; and Solving Problems Involving Sides and Angles of a Polygon



Mathematics – Grade 7

Quarter 3 – Module 7: Constructing Triangles, Squares, Rectangles, Regular Pentagons and Regular Hexagons; and Solving Problems involving Sides and Angles of a Polygon **First Edition, 2020**

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Solving Problems Involving Sides and
Angles of a Polygon**

Introductory Message

For the facilitator:

As a facilitator, you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning at home. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

For the learner:

As a learner, you must learn to become responsible of your own learning. Take time to read, understand, and perform the different activities in the module.

As you go through the different activities of this module, be reminded of the following:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *Let Us Try* before moving on to the other activities.
3. Read the instructions carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are done.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone. We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!



Let Us Learn

Learning Competencies:

The learner:

- constructs triangles, squares, rectangles, regular pentagons, and regular hexagons. **(M7GE-IIIh-i1)**
- solves problems involving sides and angles of a polygon. **(M7GE-IIIj-1)**

Specifically, after the lesson, you will be able to:

1. identify simple tools in constructing and understand how they are used;
2. construct triangles, squares, rectangles, regular pentagons, and regular hexagon using compass and straightedge; and
3. solve problems involving sides and angles of polygons in real life situations.



Let Us Try

Read each item carefully. Write the letter of the best answer on a separate sheet of paper.

- 1) All of these tools are used in basic geometric construction of polygons, except one. Which one is not?
A. calculator
B. pencil
C. compass
D. straightedge
- 2) A flag of a country contains a geometric figure, whose sum of the measures of the interior angles is 180° . What geometric figure is it?
A. triangle
B. quadrilateral
C. pentagon
D. hexagon
- 3) In solving problems, which of the following will be the first step you can do?
A. Solve the problem using any plan.
B. Understand the problem by identifying what the problem is asking.
C. Make a plan to use in solving the problem.
D. Make an interpretation and conclusions without doing A to C.

- 4) The following can be used as a straightedge except _____.
- | | |
|------------------------|---------------------|
| A. Cover of a notebook | C. ID protector |
| B. Index Card | D. Pair of Scissors |
- 5) A potter wants to create a pot with a regular pentagon as a base. What will be the measurement of each interior angle of the pot?
- | | | | |
|---------------|----------------|----------------|----------------|
| A. 90° | B. 108° | C. 140° | D. 180° |
|---------------|----------------|----------------|----------------|
- 6) Dante is planning to make a gazebo with a regular polygon as the base. If the exterior angle of the polygon is 60° , what will be the shape of the regular polygon of the gazebo?
- | | |
|------------------|-------------|
| A. triangle | C. pentagon |
| B. quadrilateral | D. hexagon |
- 7) Joy and Jay are on the beach watching John build a sandcastle. From where Joy is standing, there is a 50° angle between Jay and John. John sees a 75° angle between Joy and Jay. What is the angle measure from Jay's point between Joy and John?
- | | | | |
|---------------|---------------|----------------|----------------|
| A. 25° | B. 55° | C. 125° | D. 180° |
|---------------|---------------|----------------|----------------|
- 8) The parking space of the Tower Mall at BGC has 360° total measure of interior angles. What is the shape of the parking space?
- | | |
|-------------|------------------|
| A. Hexagon | C. Quadrilateral |
| B. Pentagon | D. Triangle |
- 9) Mrs. Cruz has a pottery business. Most of her clients wanted pots, which are regular octagons. What will be the measurement of each angle of the regular octagonal pots?
- | | | | |
|----------------|-----------------|-----------------|-----------------|
| A. 135° | B. 1000° | C. 1080° | D. 1440° |
|----------------|-----------------|-----------------|-----------------|
- 10) Cris is an artist who makes a convex quadrilateral as his main design. If the measures of the angles are 60° , 105° and 70° , what will be the measurement of the remaining interior angle?
- | | | | |
|----------------|----------------|----------------|----------------|
| A. 100° | B. 125° | C. 180° | D. 210° |
|----------------|----------------|----------------|----------------|



Let Us Study

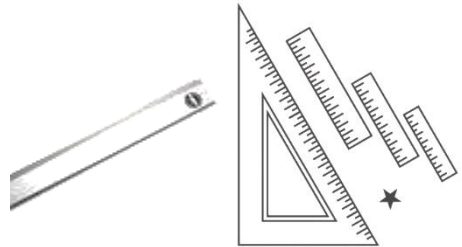
Geometric concepts like constructing polygons are some of the basic mathematical applications we can see around us, which we somehow don't give any recognition or realization. In this module, one of the things that we are going to explore is about the construction of *triangles*, *squares*, *rectangles*, *regular pentagons* and *regular hexagons* using a compass and a straightedge.

Let's begin with the preparation of your materials.

Compass - an instrument for drawing circles and arcs and measuring distances between points, consisting of two arms linked by a movable joint, one arm ending in a point and the other usually carrying a pencil or pen.

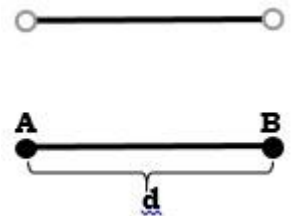


Straightedge - is any material you can use that can make a straight line. (Ex. ruler, index card, ID, etc.)

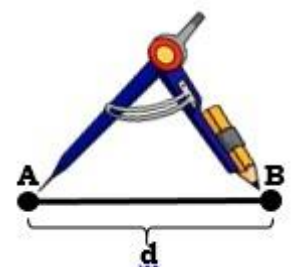


A. Procedure in constructing a TRIANGLE:

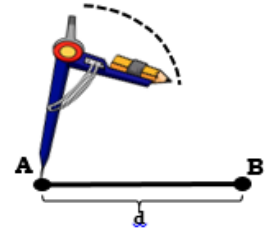
1. Use a straightedge to make a line segment. Name the endpoints of your line segment as point **A** and point **B**. Let **d** be the distance between A and B.



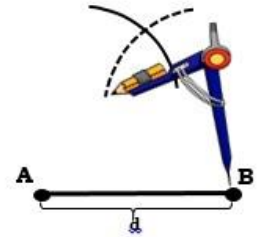
2. Adjust your compass and put its tip to one of the endpoints (A or B) and its pencil tip on the other endpoint. This will measure the length of AB.



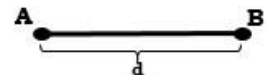
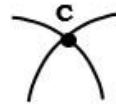
- Adjust your compass and move it above the line segment making a partial circle of the points that are the length of away from point A.



- Adjust your compass and move it above the line segment making a partial circle of the points that are the length of away from point B.

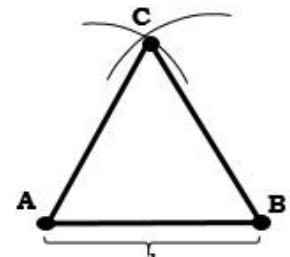


- Name the point of intersection as point C.



- Join intersection point C to point A and point B to form an equilateral triangle.

Triangle ABC is formed. \overline{AB}

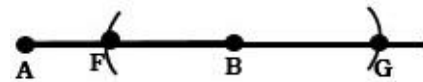
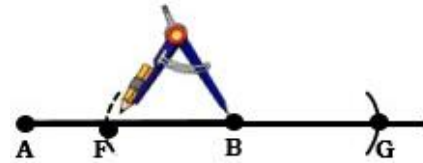
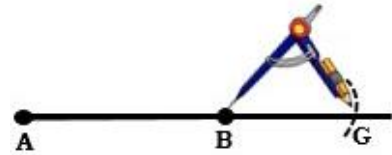


B. Procedure in constructing a SQUARE:

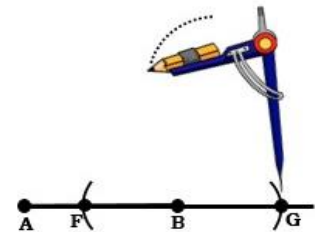
- Use a straightedge to make a line segment AB. This will become one side of the square. \overline{AB}
- Extend the line AB to the right.



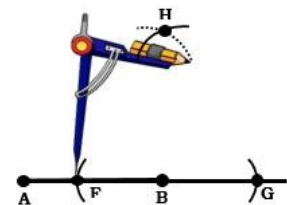
3. Set the compasses on B and any convenient width. Scribe an arc on each side of B, creating the two points F and G.



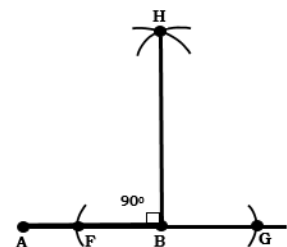
4. With the compasses on G and any convenient width, draw an arc above the point B.



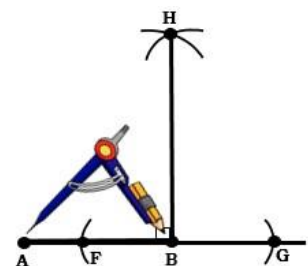
5. Without changing the compasses' width, place the compasses on F and draw an arc above B, crossing the previous arc, and creating point H.



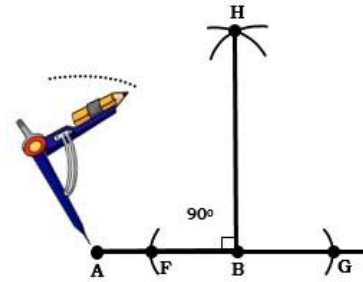
6. Draw a line from B through H. This line is perpendicular to AB, so the angle ABH is a right angle (90°). This will become the second side of the square.



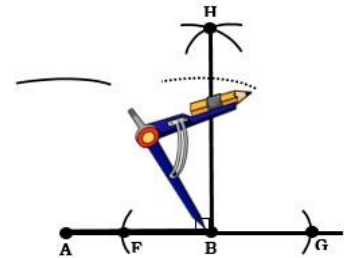
7. Set the compasses on A and set its width to AB. This width will be held unchanged as we create the square's other three sides.



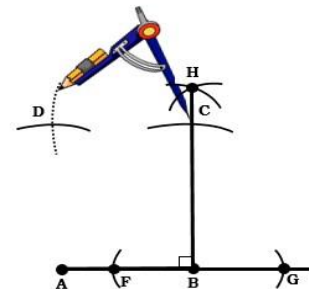
8. Draw an arc above point A.



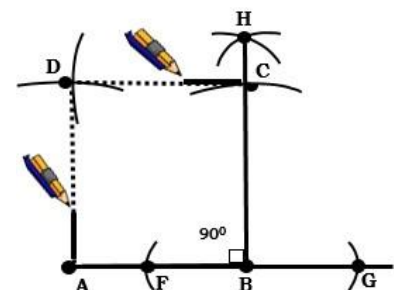
9. Without changing the width, move the compasses to point B. Draw an arc across BH creating point C - a vertex of the square.



10. Without changing the width, move the compasses to C. Draw an arc to the left of C across the exiting arc, creating point D - a vertex of the square.



11. Draw the lines CD and AD.
Square ABCD is formed.



C. Procedures in constructing a RECTANGLE:

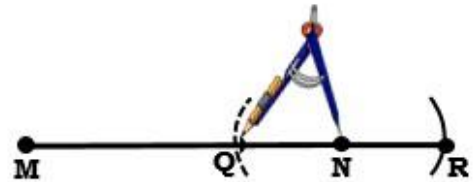
1. Use a straightedge to make a line segment MN. This will become one side of the rectangle.



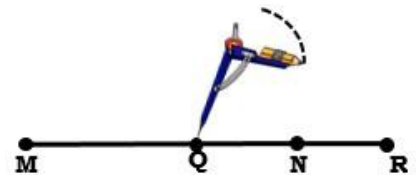
2. Extend the line MN to the right.



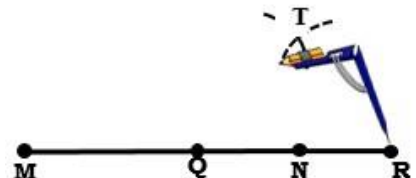
3. Set the compasses on N and any convenient width. Scribe an arc on each side of N, creating the two points Q and R.



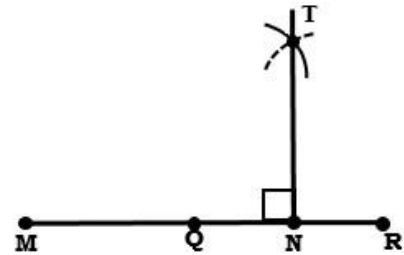
4. With the compasses on Q and any convenient width, draw an arc above the point N.



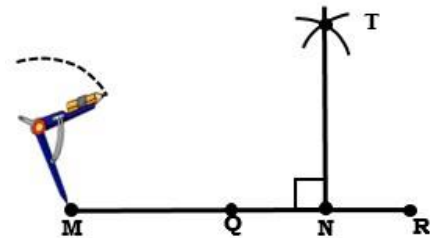
5. Without changing the compasses' width, place the compass on R and draw an arc above N, crossing the previous arc, and creating point T.



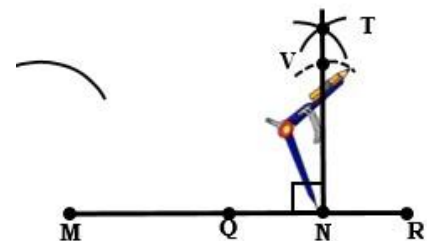
6. Draw a line from N through T. This line is perpendicular to MN, so the angle TNM is a right angle (90°). This will become the second side of the rectangle.



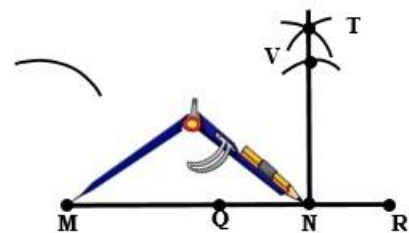
7. Draw an arc above point M.



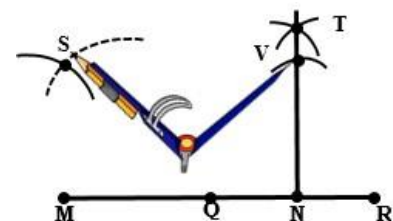
8. Without changing the width, move the compass to point N. Draw an arc across NT creating point V- a vertex of the rectangle.



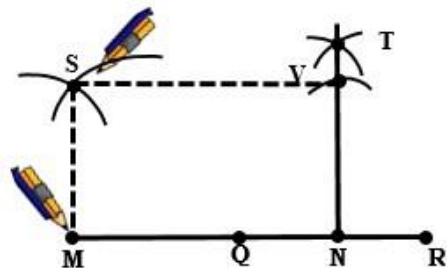
9. Set the compass on M and set its width to MN. This width will be held unchanged as we create the rectangle's other side.



10. Without changing the width, move the compass to V. Draw an arc to the left of V across the exiting arc, creating point S - a vertex of the square.

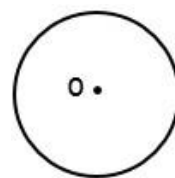


11. Draw the lines VS and SM.
Rectangle MNVS is formed

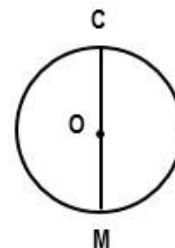


D. Procedures in constructing a REGULAR PENTAGON:

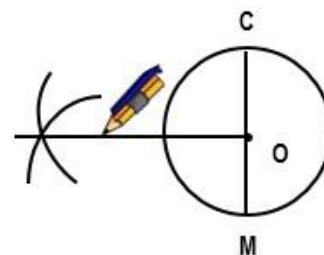
1. Using your compass, make a circle with point O at the center.



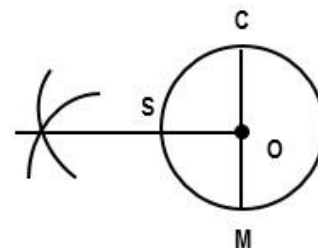
2. Draw a diameter of the circle through the center point and mark its endpoints C and M. It does not have to be vertical.



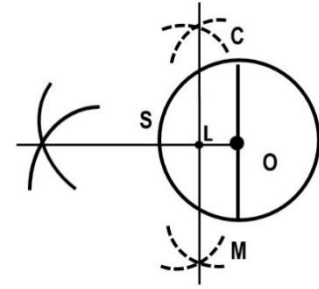
3. Construct a perpendicular to CM at the point O.



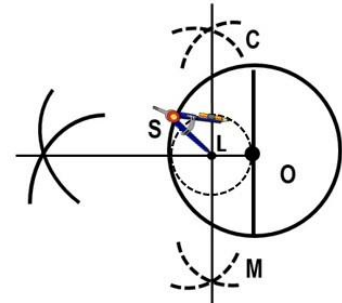
4. Mark the point S where it crosses the circle.



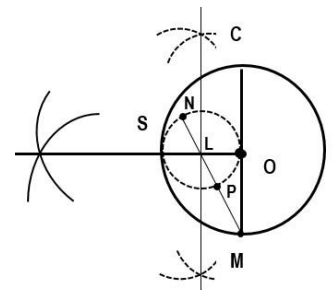
- Find the midpoint L of the segment SO by constructing its perpendicular bisector.



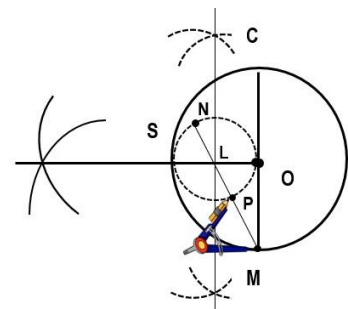
- Set the compasses on L, adjust its width to S or O, and draw a circle.



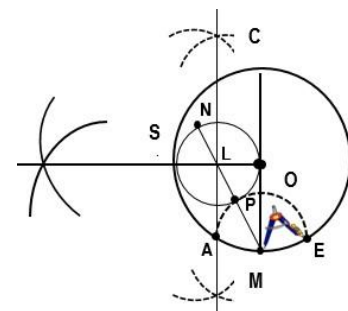
- Draw a line from M, through L so it crosses the small circle in two places. Label them N and P.



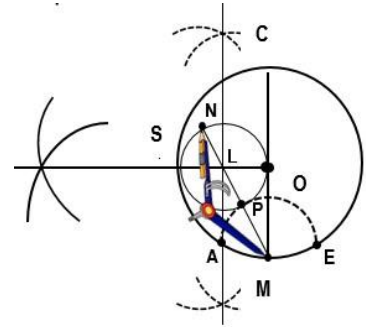
- Set the compasses on M and adjust its width to P. Draw a circle.



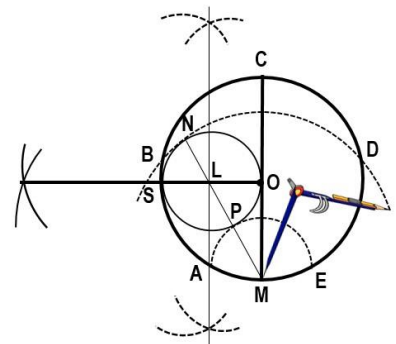
- Draw a broad arc that crosses the given circle in two places. Label them A and E.



10. Set the compasses on M and adjust its width to N.

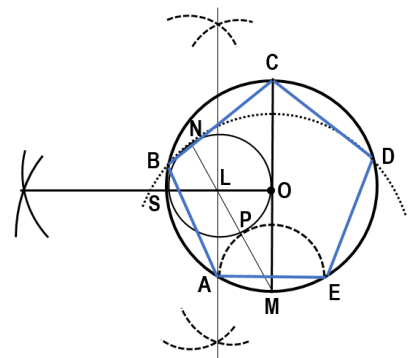


11. Draw a broad arc that crosses the given circle in two places. Label them



12. Draw a line from A to B, then B to C etc, until you have drawn all five sides of the pentagon.

ABCDE is a regular pentagon

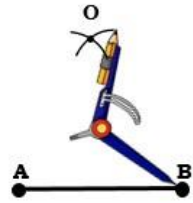


E. Procedures in constructing a REGULAR HEXAGON:

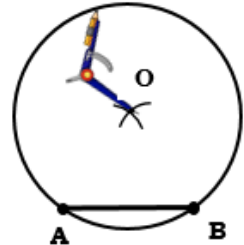
1. Use a straightedge to make a line segment AB. This will be one side of the hexagon.
2. Set the compasses' point on A, and set its width to B. *the compasses must remain at this width for the remainder of the construction.*



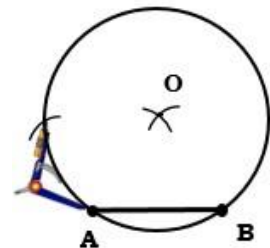
3. From points A and B, draw two arcs so that they intersect. Mark this as point O. This is the center of the hexagon's circumcircle.



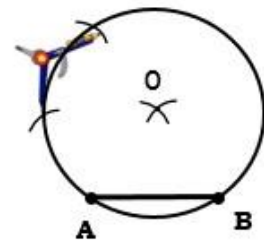
4. Move the compasses to O and draw a circle. This is the hexagon's circumcircle - the circle that passes through all six vertices



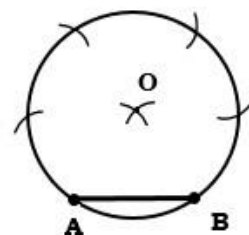
5. Move the compasses on to A and draw an arc across the circle. This is the next vertex of the hexagon.



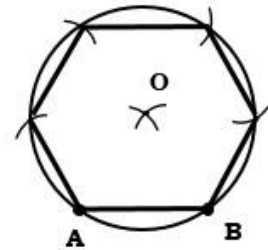
6. Move the compasses to this arc and draw an arc across the circle to create the next vertex.



7. Continue in this way until you have all six vertices. (Four new ones plus the points A and B you started with.)



8. Draw a line between each successive pairs of vertices. These lines form a regular hexagon where each side is equal in length to AB.



Solving Problems Involving Sides and Angles of a Polygon

In dealing daily life circumstances, we are using geometric concepts without giving so much of our attention. We need to keep in mind the different rules, properties and basic operations in dealing problems involving sides and angles.

In solving problems, there is no specific single strategy that fits and solves all kinds of problems. However, we can adopt and use a general way of solving problems made by some significant people like George Polya, a Hungarian mathematician who made fundamental contributions to combinatorics, number theory analysis and probability theory.

Polya's 4-Step Method in Solving Problems

U-nderstand the problem. Identify what the problem is asking.

❖ What do you know and what you need to find out?

P-lan. Create a strategy to use to solve the problem.

❖ What mathematical concepts or skills do you need?

S-olve. Carry out the right plan you created.

✓ - Check. Look back to check if your answer make sense to make sure it is correct.

❖ Do you understand the given problem correctly?

❖ Do you make any mathematical errors?

❖ Does your answer make sense?

EXAMPLES:

1. Mr. Jessie Mendiola is planning to build a gazebo whose base is a regular octagon. At what angle should he cut the lumber to frame the base?

U-nderstand

What do you know?

- Regular Octagon= 8 sides with equal measurements; 8 angle measurements are equal

What you need to find out?

- Measurement of each interior angle of a regular octagon

P- lan

What mathematical concepts or skills do you need?

$$\frac{(n-2)180}{n} \quad \text{where } n \text{ is the number of sides}$$

S- olve

$$\begin{aligned} \frac{(n-2)180}{n} &= \frac{(8-2)180}{8} && \text{Replace } n \text{ with } 8 \\ &= \frac{1080}{8} \\ &= 135^\circ \end{aligned}$$



Look back to **CHECK** if everything is right.

Mr. Mendiola should measure **135°** for each angle of the lumber to frame the octagonal base.

2. Aliah has a project in Arts. She must make an artistic plate in the form of a convex pentagon. She already measured 100°, 105°, and 111° as interior angles of the pentagon. What will be the measurement of the other two interior angles if she wanted them to be equal?

U-nderstand

What do you know?

- Convex Pentagon = 5-sided polygon with 5 angles; Unequal side and angle measurements

- 3 out of 5 angles are measured 100° , 105° , and 111° . The remaining two interior angle measurements are equal.

What you need to find out?

- Measurement of the two remaining angles which are equal

P- lan

What mathematical concepts or skills do you need?

Polygon Interior Theorem:

$$(n-2)180 \quad \text{where } n \text{ is the number of sides}$$

S- olve

$$\begin{aligned} (n-2)180 &= (5-2)180 && \textbf{Replace } n \textbf{ with } 5 \\ &= (3)180 && \textbf{Simplify} \\ &= \mathbf{540^\circ} \end{aligned}$$

The sum of the measures of the interior angles of convex pentagon is $\mathbf{540^\circ}$.

Therefore,

$$\begin{aligned} m\angle A + m\angle B + m\angle C + m\angle D + m\angle E &= \mathbf{540^\circ} \\ 100^\circ + 105^\circ + 111^\circ + m\angle D + m\angle E &= \mathbf{540^\circ} \\ m\angle D + m\angle E &= \mathbf{540^\circ - 316^\circ} \\ m\angle D + m\angle E &= \mathbf{224^\circ} \end{aligned}$$

Since the sum of the remaining two equal angles is $\mathbf{224^\circ}$, divide $\mathbf{224^\circ}$ by 2. Therefore,

$$\frac{224^\circ}{2} = \mathbf{112^\circ}$$



Look back to **CHECK** if everything is right.

Aliah should measure 112° for each remaining two angles.



Let Us Practice

“Tip-to-Tip”

Direction: Construct an equilateral triangle, square, rectangle, regular pentagon and regular hexagon following the given instructions.

1. Prepare the needed materials: paper, pencil, compass and straightedge

2. Form a check figure using your fingers.
Adjust your compass in a way that one tip of it is on your thumb and the pencil tip is on your point finger (See the figure at your right). This will serve as the length of the radius or the distance from point A to point B.



Let Us Practice More

“I Am A Problem Solver!”

Read and understand the following Real-Life Application of exterior and interior angles of a polygon and write your answer on your answer sheet.
SHOW YOUR SOLUTION.

1. Regular hexagons are the figures formed from the cross-section of a beehive. Find the measure of each interior angle in the cross-section of a beehive regular hexagon.
2. The designer of an artistic mansion wants to use regular nonagon in her design. What interior angle measures should she set in the computer software to create a regular nonagon?
3. Peter drew a regular polygon and measured one of its interior angles using a protractor. He got a measure of 144° , what kind of regular polygon did Peter draw?



Let Us Remember

Constructing polygons using compass and straightedge with the right application of some basic mathematical concepts shows the proofs about the definitions about sides of triangles, rectangles, regular pentagons and regular hexagons.

Polya's 4-Step Method in Solving Problems

U- nderstand the problem. Identify what the problem is asking.

- ❖ What do you know and what you need to find out?

P- lan. Create a strategy to use to solve the problem.

- ❖ What mathematical concepts or skills do you need?

S- olve. Carry out the right plan you created.

- ✓ - Check. Look back to check if your answer make sense to make sure it is correct.

- ❖ Do you understand the given problem correctly?
- ❖ Do you make any mathematical errors?
- ❖ Does your answer make sense?



Let Us Assess

- Read each item carefully. Write the letter of the best answer.
 - In basic construction, what is an appropriate tool to make a circle?
A. Ruler B. Protractor C. Plate D. Compass
 - All of these tools are used in basic geometric construction of polygons, except one. Which one is not?
A. Calculator B. Pencil C. Compass D. Straightedge

3. The following can be used as a straightedge except _____.

A. Cover of a notebook	C. index card
B. ID sling	D. Cover of a book

4. Which of the following does not belong to the group according to Polya's 4-Step Method in solving problems?

A. Look back to check	C. Solve with or without planning
B. Plan or make a strategy	D. Understand the given problem

5. Three interior angles of a pentagonal room measure 60° , 80° , and 90° . Find the measures of the other two interior angles, assuming they are equal.

A. 90°	B. 120°	C. 155°	D. 180°
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6. Mr. Dela Cruz has a furniture business. His clients ordered the regular dodecagon for the tables. At what angle should he cut the lumber to frame the tables?

A. 100°	B. 150°	C. 180°	D. 200°
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7. A flag of a country contains a geometric figure, whose sum of the measures of the interior angles is 180° . What geometric figure is it?

A. triangle	C. pentagon
B. quadrilateral	D. hexagon

8. Bobby is planning to make a unique garden with a regular polygon as its shape. If the sum of the measures of the interior angles is 1080° , what will be the shape of the garden?

A. quadrilateral	C. heptagon
B. hexagon	D. octagon

9. Leo is an artist who wanted to make a convex quadrilateral as his main design. If three of the angles measure 60° , 100° and 50° , what will be the measurement of the remaining interior angle?

A. 100°	B. 150°	C. 180°	D. 210°
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10. Matteo wants to create a vase with an equilateral triangular base. What will be the measurement of each interior angle of the vase?

A. 60°	B. 90°	C. 100°	D. 180°
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Let Us Enhance

Construct to Create: *Artistic Creation from A Simple Construction*

Direction:

Draw a picture or setting by connecting or combining a triangle, square, rectangle, regular pentagon, and regular hexagon in one paper. (Example: A house with triangle as a roof, rectangle as base of the house, pentagon as the window and a hexagon as the brick design. The house is built in a meadow area surrounded by flowers and trees.)

After creating this with your constructed polygons, give a description and an explanation of your creation.

Rubric:

Category	4	3	2	1
Mathematical Accuracy (30%)	All the 5 required shapes are accurately constructed.	Only 4 required shapes are accurately constructed.	Only 2-3 required shapes are accurately constructed.	Only 1 required shape or no required shape at all is accurately constructed.
Use of Shapes (30%)	Used and identified 5 distinct shapes in the artwork	Used and identified 4 distinct shapes in the artwork	Used and identified 2-3 distinct shapes in the artwork	Used and identified only 1 or no distinct shapes in the artwork
Explanation (20%)	Explanation is detailed and clear	Explanation is clear	Explanation is a little bit difficult to understand, but include critical components.	Explanation is a little difficult to understand and is missing several components or was not included
Creativity, Neatness and Organization (20%)	The work is presented in an attractive, creative, neat, clear, organized fashion that is easy to understand	The work is presented in a creative, neat, and organized fashion that is usually easy to understand	The work is presented in neat, and clear fashion but difficult to understand.	The work appears sloppy and unorganized. It is hard to know what information goes together.



Let Us Reflect

Sides and angles of polygons are few of the essential basic concepts we have to learn for future higher mathematical concepts. The relationship between sides and angles creates theorems and rules which help us in solving problems in real life situation. These topics are usually used by many different types of professions like artists, engineers, surveyors, etc. particularly in manufacturing and construction.

In solving real life problems, one of the best and simple body gestures that we can make is our sincere smiles. By smiling, we can create an angle which shapes our positive disposition as problem solvers. Our smiles also show strength of our will and hope that whatever problem we are going through, we can handle it well in faith.



Answer Key

Let Us Try

- A
- A
- B
- D
- B
- D
- B
- C
- C
- B

Let Us Practice

Answers may vary.

Let Us Practice More

B.

- 120°
- 140°
- Decagon

Let Us Assess

- D
- A
- B
- C
- C
- B
- A
- A
- D
- A



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<https://www.mathopenref.com/printsquare.html>

<https://www.mathopenref.com/printinpentagon.html>

<https://www.mathopenref.com/consthexagon.html>

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