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Mathematics

Quarter 3 – Module 4:
Geometric Construction Using a Compass and Straightedge

SELF-LEARNING MODULE

Mathematics – Grade 7
Quarter 3 – Module 4: Geometric Construction Using a Compass and Straightedge
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Mathematics

Quarter 3 – Module 4:
Geometric Construction Using a Compass and Straightedge

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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!

After going through this module, you are expected to:

Use a compass and straightedge to bisect line segments and angles and construct perpendiculars and parallels – **M7GE-IIId-e-1(MELCs).**

Specifically, you will:

1. recognize the Euclidean tools (compass and unmarked straightedge);
2. use a compass and a straightedge to copy segments and angles;
3. bisect line segments and angles using the Euclidean tools; and
4. construct perpendiculars and parallels using the Euclidean tools.

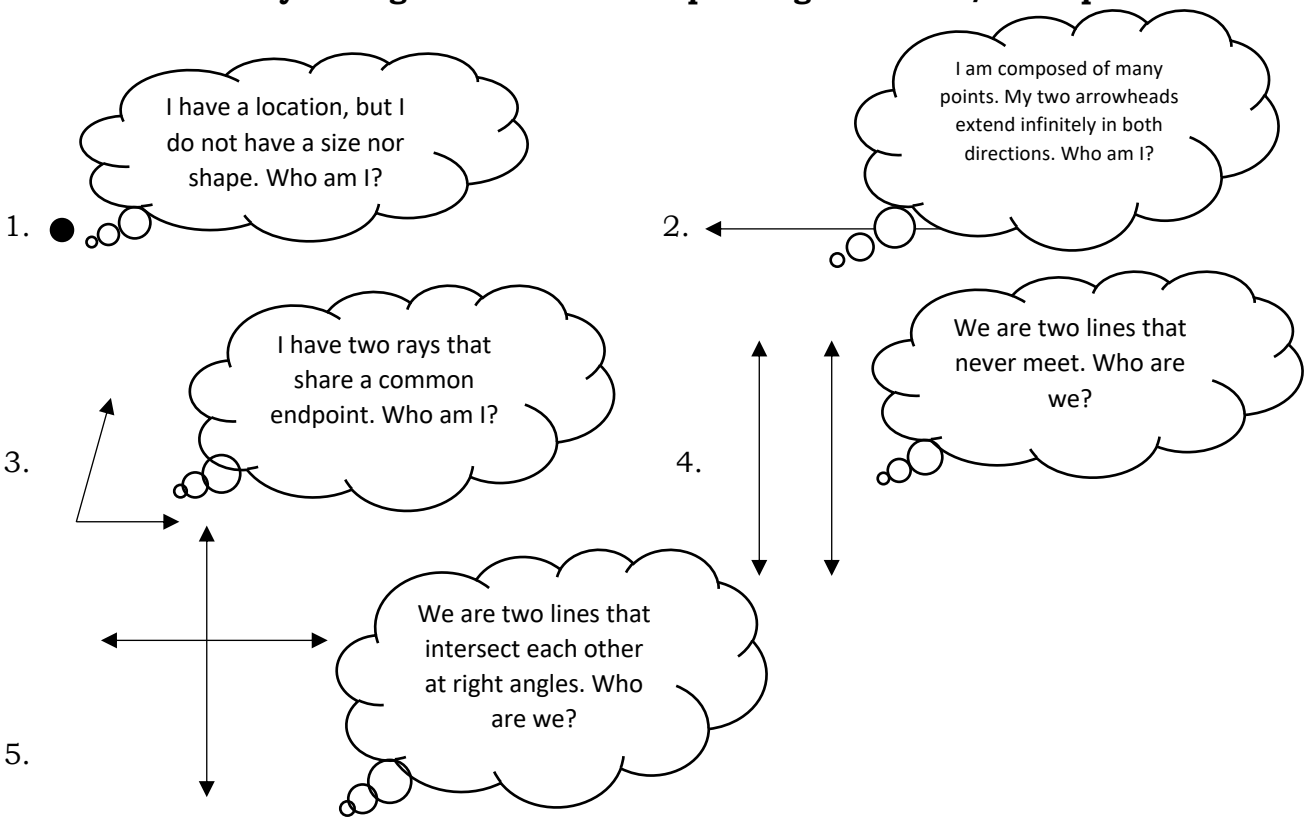
Let Us Try!

Geometry comes from two Greek words, *geo* which means earth and *metri* which means measurement. Therefore, geometry means *earth measurement.*

Geometry of the physical world can be seen and touched. Everyone experiences physical geometry. It shapes our visual views and at the same time, influences the things that we do. For example, architects as well as designers experience it as they make their new works. Carpenters and engineers experience it as they construct plans and execute designs (Oronce, O. & Mendoza, Marilyn O. 2003). In this module, we will learn how to construct basic geometric figures which are necessary foundation for later geometrical ideas.

Before we go further, let us first review of the basic geometric figures that you had learned on previous lesson which you will construct later using the Euclidean tools.

Who am I? Identify the figure with its corresponding definition/description.



Have you correctly identified the basic geometric figures? Now, you are ready to construct these geometric figures using the Euclidean tools.

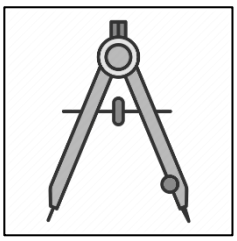
Let Us Study

Euclidean Geometry is the study of geometry based on the assumptions of Euclid. In his work *Element*s, Euclid established the basic rules for constructions using only a compass and a straightedge, which are called as Euclidean Tools (Nivera 2014, 386).

Geometric construction is a method of drawing of geometric figures such as lines and angles using only a ***compass and straightedge***. No measurement of lengths or angles is allowed in constructing the various figures, you are not allowed to measure angles with a protractor, or measure lengths with a ruler. (Page, 2011).

In dealing with this lesson, you need to have these two Euclidean tools (***compass and straightedge***) to do the next activities.

1. **COMPASS** – a drawing instrument used for drawing circles and arcs. It has two legs, one with a point and the other with a pencil or lead. You can adjust the distance between the point and the pencil and that setting will remain you change it.



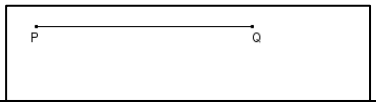
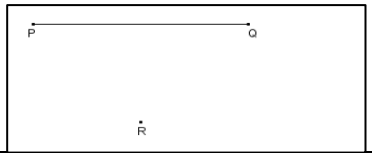
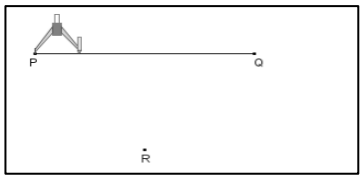
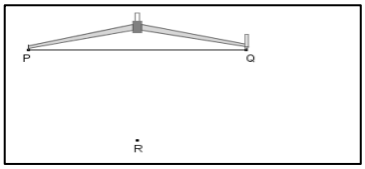
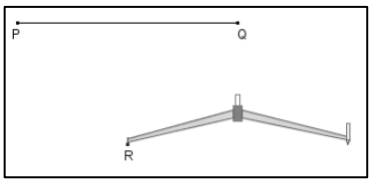
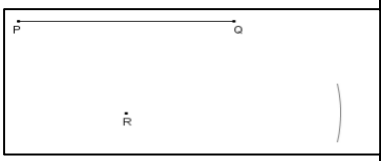
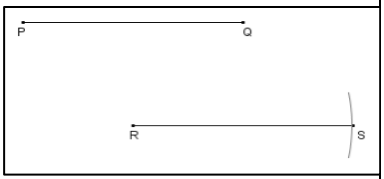
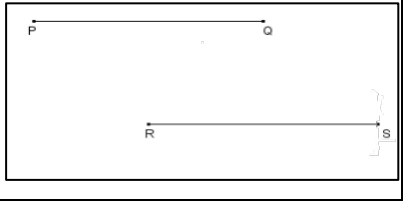
2. **STRAIGHTEDGE –** a drawing instrument which is used as a guide for the pencil when drawing a straight line. In most cases, you may use a ruler as a straightedge, since it is the most likely to be availble, but remember: *you must not use the markings on the ruler during the constructions.*

If you already have a compass and a straightedge, you are now ready to do basic geometric constructions.

CONSTRUCTION 1: <u>CONSTRUCTING CONGRUENT LINE SEGMENTS</u>

Task: Construct a line segment RS that is congruent to line segment PQ.

Recall: Two segments having the same measure or length are called CONGRUENT SEGMENTS.

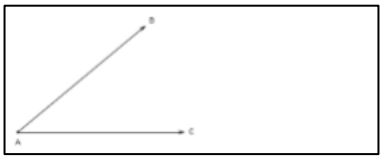
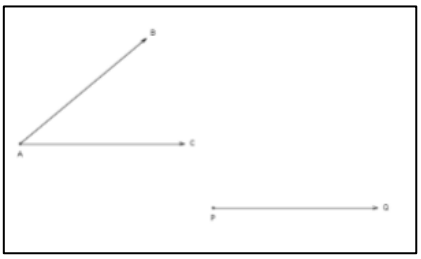
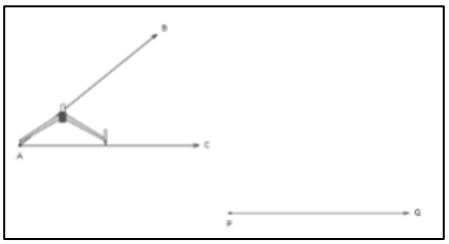
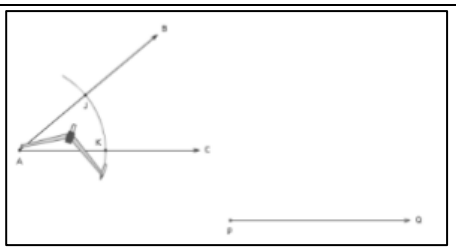
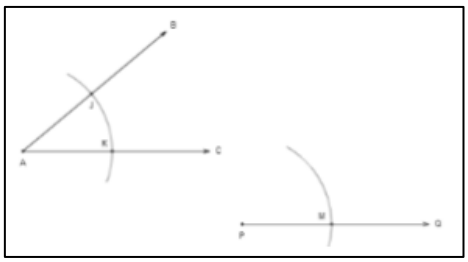
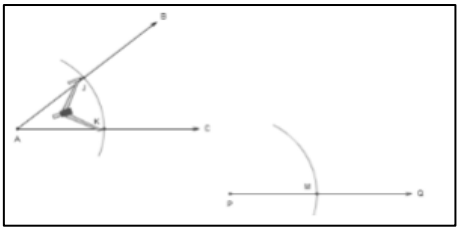
Given: Line Segment PQ	
1. Mark a point R that will be one of the endpoints of the new line segment.	
2. Place the compass' point on point P .	
3. Adjust the compass' width such that the compass pencil is placed on point Q. The compass' width is now equal to the length of the line segment PQ.	
4. Without changing the compass width, place the compass' point on point R you made on step 1.	
5. Without changing the compass' width, draw an arc roughly where the other endpoint will be.	
6. Mark any point point on the arc and name it point S. That will be the other endpoint of the new line segment.	
7. Using a straightedge, draw a straight line that connects point R to point S.	
Done! You had already constructed a line segment RS congruent to line segment PQ.	

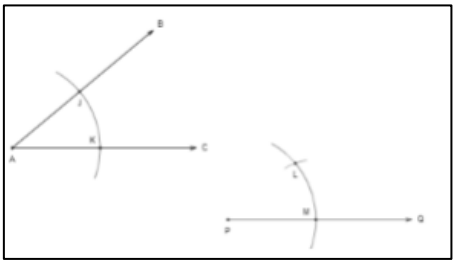
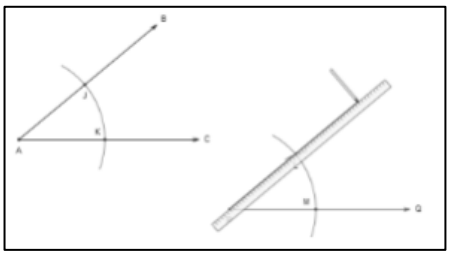
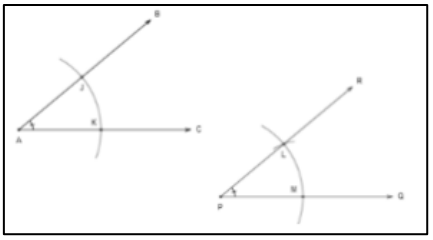
Reference: *https://www.mathopenref.com/constcopysegment.html*

CONSTRUCTION 2: <u>CONSTRUCTING CONGRUENT ANGLES</u>

Task: Construct angle RPQ that is congruent to angle BAC.

Recall: Two angles having the same angle measure are called CONGRUENT ANGLES.

Given: Angle BAC	
1. Draw ray PQ. This will become one side of the new angle.	
2. Place the compass point on point A, set the opening of the compass to any convenient width.	
3. Draw an arc across both sides of the angle, creating the points J and K as shown in the figure.	
4. Without changing the compass' width, place the compass' point on P and draw a similar arc, creating point M as shown in the figure.	
5. Place the compass point on K and adjust its width such that compass pencil is placed on point J.	

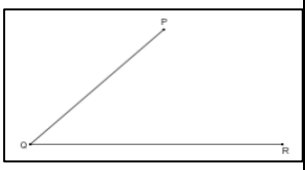
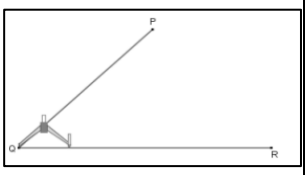
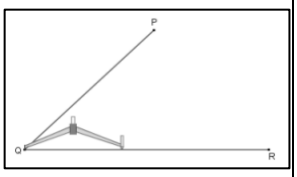
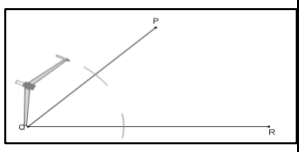
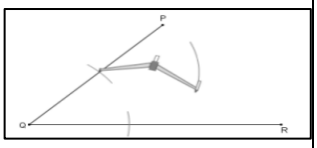
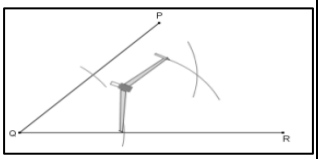
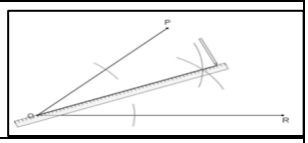
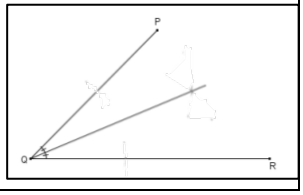
6. Without changing the compass' width, place the compass point on point M and draw an arc across the first one, marking point L where the arcs intersect.	
7. Draw a ray PR from point P trough point L and onward a little further. The exact length is not important.	
Done! You had already constructed an angle RPQ congruent to angle BAC.	

Reference: *https://www.mathopenref.com/constcopyangle.html*

CONSTRUCTION 3: <u>CONSTRUCTING AN ANGLE BISECTOR</u>

Task: Construct an angle bisector of angle PQR.

Recall: A ray is an ANGLE BISECTOR if it contains the vertex and divides the angle into two congruent angles.

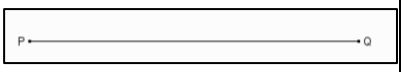
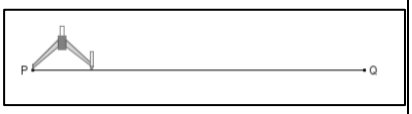
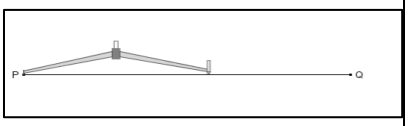
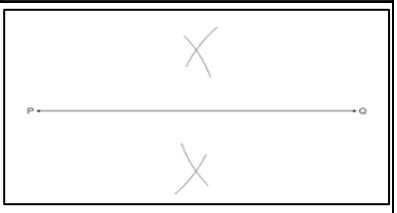
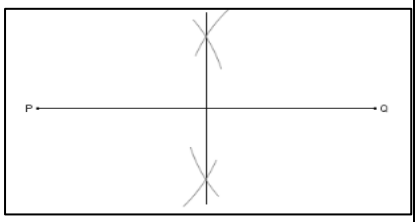
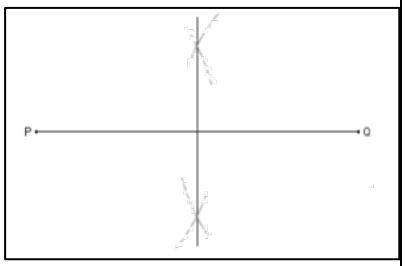
Given: Angle PQR	
1. Place the compass' point on the angle's vertex, point Q.	
2. Adjust the opening of compass to a medium wide setting. The exact width (measurement) is not important.	
3. Without changing the compass' width, draw an arc across each ray of the angle.	
4. Without changing the compass width, place the compass on the point where one arc crosses a leg and draw an arc in the interior of the angle.	
5. Without changing the compass setting, repeat step 4 for the other leg so that the two arcs intersect with each other.	
6.Using a straightedge, draw a line from the vertex to the point where the arcs intersect.	
Done! You had already constructed a line bisecting angle PQR. This line is known as angle bisector.	

Reference: *https://www.mathopenref.com/constbisectangle.html*

CONSTRUCTION 4: <u>CONSTRUCTING A PERPENDICULAR BISECTOR</u>

Task: Construct the perpendicular bisector of line segment PQ.

Recall: PERPENDICULAR BISECTOR is a line segment which intersects another line segment at 90° and divides it into two equal parts.

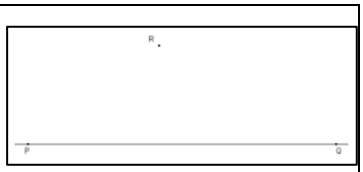
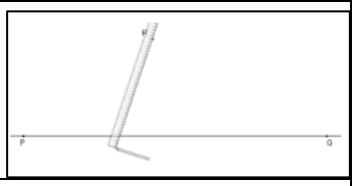
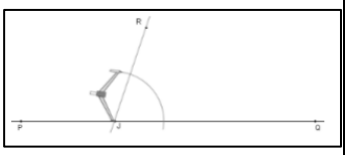
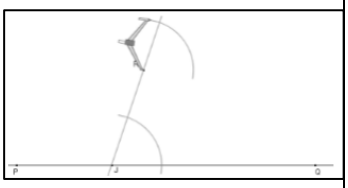
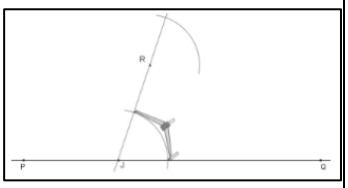
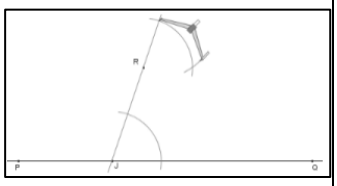
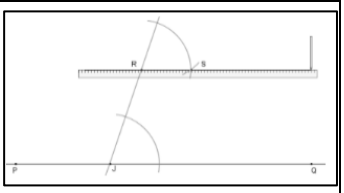
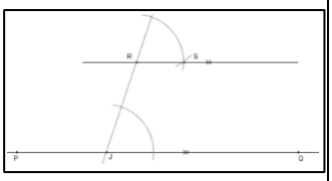
Given: Line segment PQ	
1. Place the compass point on point P.	
2. Adjust the compass' width to approximately two thirds the line length. The actual width (measurement) does not matter.	
3. Without changing the compass' width, draw an arc above and below the line.	
4. Again, without changing the compass' width, place the compass' point on the other end of the line. Repeat step 3 so that the arcs cross the first two.	
5. Using a straightedge, draw a line between the points where the arcs intersect.	
Done! You had already constructed a perpendicular bisector of line segment PQ.	

Reference: *https://www.mathopenref.com/constbisectline.html*

CONSTRUCTION 5: CONSTRUCTING PARALLEL LINES

Task: Construct a line parallel to line PQ.

Recall: PARALLEL LINES are lines that do not intersect.

Given: Line PQ and point R not on the line.	
1. Draw a line through point R and across the line PQ at an angle, forming point J where it intersects the line PQ. The exact measurement of the angle is not important.	
2. Adjust the compass' width, set to about half the distance between R and J, place the compass point on point J, and draw an arc across both lines.	
3. Without adjusting the compass width, move the compass point to point R and draw a similar arc to the one in step 2.	
4. Set compass' width to the distance where the lower arc crosses the two lines.	
5. Move the compass to where the upper arc crosses the transverse line and draw an arc across the upper arc, marking point S.	
6. Using a straightedge, draw a straight line connecting points R and S.	
7. **Done! You had already constructed line RS parallel to line PQ.**	

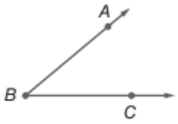
Reference: *https://www.mathopenref.com/constparallel.html*

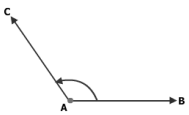
Let Us Practice

Using only a compass and a straightedge, copy the line segments and angles shown below. Label them as they are labeled below.

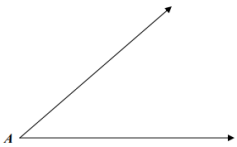
1. 

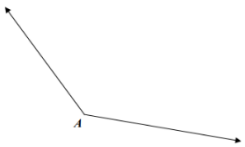
2. 

3. 

4. 

B. Construct the bisector of each angle.

5. 

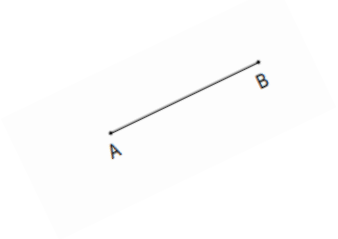
6. 

C. Construct the perpendicular bisector for each segment below.

7. 

8. 

D. Construct a line parallel to each segment below.

9. 

10. 

Rubrics for Geometric Construction

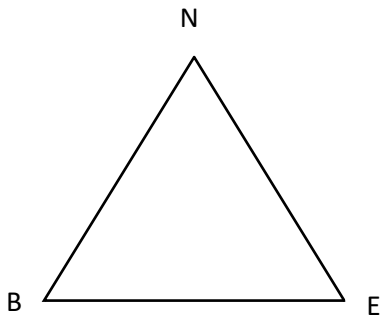
10 points	7 points	4 points	1 point
All lines are carefully drawn using a compass and a straightedge. The construction is accurate, neat, and detailed.	Most lines are carefully drawn using a compass and a straightedge. Some constructions are not accurate, with few erasures.	Some lines are carefully drawn using a compass and a straightedge. Most constructions are not accurate, with many erasures.	Lines are not drawn using a compass and a straightedge. Construction is incomplete and inaccurate.

Let Us Practice More

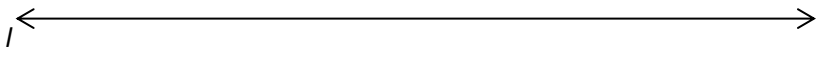
On a separate sheet of paper, construct what is asked in each number.

1. Using a compass and straightedge and segment AB below, construct an equilateral triangle with all sides congruent to segment AB.

2. Construct the perpendicular bisector of each side of ΔBEN.



3. Construct a line through point *P* parallel to line *l*.



Let Us Remember

Using only the compass and straightedge or the so-called Euclidean tools, we can perform the basic constructions in geometry. We use a compass to construct an arc (part of a circle) or a circle, given a center point and a radius length. We use a straightedge to construct a line, ray, or segment where two points are given. A ruler can be used as a straight edge, but the marks indicated in it may not be used for measurement. Remember, that in basic geometric constructions no measurement must be involved.

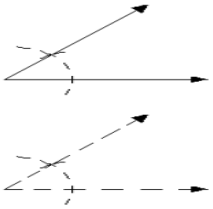
Let Us Assess

Multiple Choice. Choose the letter of the best answer.

1. What are the two Euclidean tools needed to perform basic constructions in geometry?
   a. compass and protractor
   b. compass and straightedge
   c. protractor and straightedge
   d. ruler and protractor
2. What is a drawing instrument used for drawing circles and arcs? It has two legs, one with a point and the other with a pencil or lead.
   a. compass
   b. protractor
   c. straightedge
   d. meter Stick
3. What is a drawing instrument which is used as a guide for the pencil when drawing a straight line?
   a. compass
   b. protractor
   c. straightedge
   d. meter stick
4. When copying line segment AB using a straight edge and a compass, what is the use of a compass?
   a. to draw an arc above point A
   b. to draw an arc between points A and B.
   c. to measure the length of segment AB
   d. to measure half the length of line segment AB

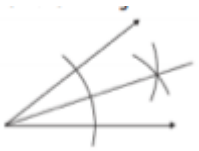
5. What construction is shown in the figure at the right?

a. copying a line segment
b. copying an angle
c. bisecting an angle
d. bisecting a line segment



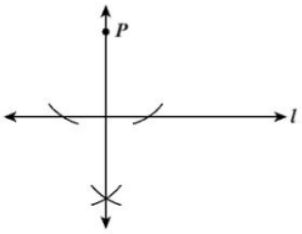
6. What does the word bisect mean?
   a. to copy a figure.
   b. to meet at a certain point.
   c. a shape that has two sides.
   d. to cut something into two congruent pieces.

7. Which of the following constructions is illustrated on the figure at the right?
   a. an angle is congruent to a given angle.
   b. the bisector of a given segment.
   c. the bisector of a given angle.
   d. the perpendicular bisector of a given segment.



8. When bisecting an angle, the straightedge should be used to:
   a. mark the point
   b. copy the angle with an arc
   c. measure the angle formed
   d. connect point and vertex

9. What construction is formed in the figure?
   a. congruent lines
   b. parallel lines
   c. intersecting lines
   d. perpendicular bisector

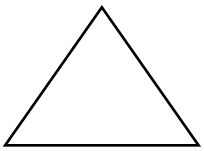


10. Is the statement “In constructing geometric figures, measurement is important.” true?
    a. always true
    b. sometimes true
    c. never true
    d. cannot be determined

Let Us Enhance

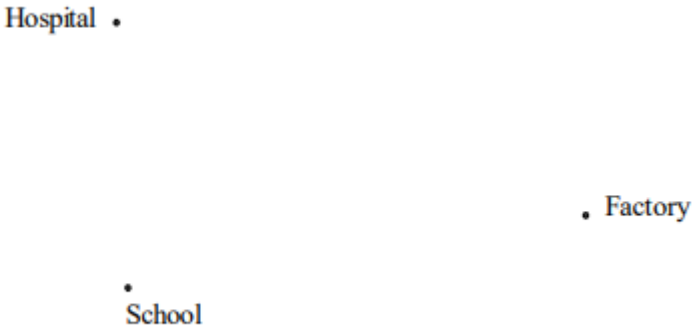
Answer what is asked in each number below.

1. Explain what basic geometric constructions you would use to copy the triangle below.



2. Explain what geometric constructions you would use to make a square from a given segment below.

3. A police station needs to be located so that it is exactly the same distance from each of the three places below. Find and label the point where the police station should be located and label it “Police Station”.



Let Us Reflect

#3Things

Using the three hashtags, explain what you have learned, where you can apply what you learned, and what you want to know more about our topic for this week.

1. #IlearnedSomethingToday

_____
_____
_____
_____

2. #ICanUseThis

_____
_____
_____
_____

3. #IWantToKnowMore

_____
_____
_____
_____

Answer key to Activities

Let Us Try

1. Point
2. Line
3. Angle
4. Parallel Lines
5. Perpendicular Lines

Let Us Practice/Let Us Practice More

Answers may vary. Refer to the rubric for giving points.

(Construction)

Let Us Enhance

Answers may vary

1. May include *copying a line or copying an angle.*
2. Must include *copying a line* and *constructing parallel lines.*
3. May include *constructing angle bisector or constructing perpendicular bisector.*

Let Us Assess

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

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