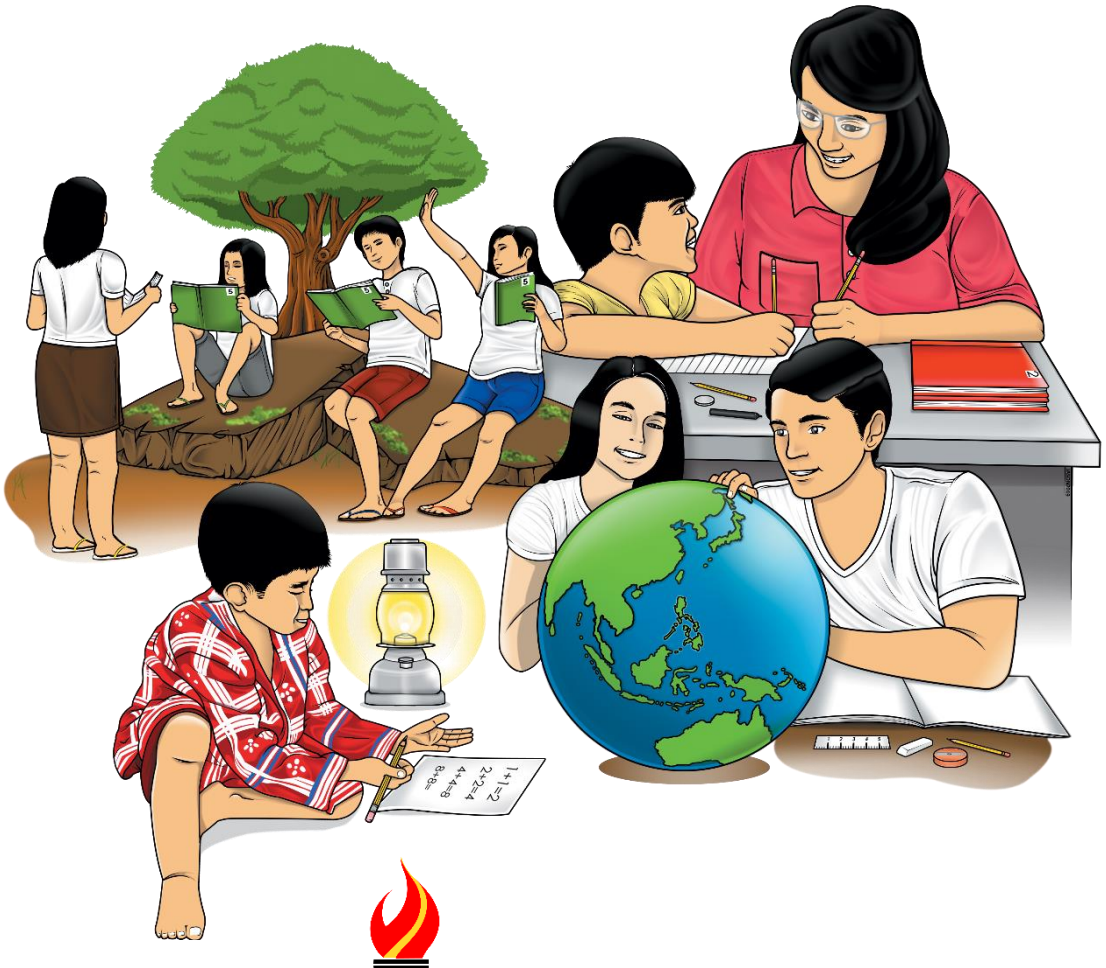
7

DepED
DEPARTMENT OF EDUCATION

Mathematics 7

Quarter 3 – Module 4:
Geometric Construction: Bisectors, Perpendicular Lines and Parallel Lines



ALTERNATIVE DELIVERY MODE
ADM

Mathematics – Grade 7
Alternative Delivery Mode
Quarter 3 – Module 4: Geometric Construction: Bisectors, Parallel Lines, and Perpendicular Lines
First Edition, 2020

Published by the Department of Education
Secretary: Leonor Magtolis Briones
Undersecretary: Diosdado M. San Antonio

Development Team of the Module

Writer:	Eliza B. Aguelo
Editor:	Venus Jane E. Rosete
Reviewer:	Reynaldo C. Tagala
Layout Artist:	Maylene F. Grigana
Management Team:	Allan G. Farnazo
	Gilbert B. Barrera
	Arturo D.Tingson Jr.
	Peter Van C. Ang-ug
	Donna S. Panes
	Elizabeth G. Torres
	Judith B. Alba

Printed in the Philippines by: _____

Department of Education – SOCCSKSARGEN - Region XII

Office Address: Regional Center, Brgy. Carpenter Hill, City of Koronadal
Telefax: (083) 2288825/ (083)2281893
E-mail Address: region12@deped.gov.ph

7

Mathematics

Quarter 3 – Module 4:
Geometric Construction: Bisectors, Perpendicular Lines and Parallel Lines

DepED
DEPARTMENT OF EDUCATION

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

This module was designed and written with you in mind. It is here to help you master basic skills in Geometric Construction. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

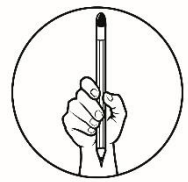
This module contains concepts on how to use a compass and straightedge to bisect line segments and angles and construct perpendicular lines and parallels.

After going through this module, you are expected to:

1. Identify the Euclidean tools.

2. Use a compass and straightedge to bisect line segments and angles and construct perpendiculars and parallels.

3. Copy segments and angles using Euclidean tools.



What I Know

Read each item below. Select your answer from the choices and write the letter of your choice on a separate sheet of paper.

1) These lines do not intersect each other and they lie on the same plane.

A) Line segments

B) Parallel lines

C) Perpendicular lines

D) Transversal lines

2)These are lines that intersect with each other and form right angles.

A) Line segments

A) Parallel lines

B) Perpendicular lines

C) Transversal lines

3) It is a line segment, or a ray that is perpendicular to the segment at its midpoint, thereby bisecting the segment into two congruent segments.

A) Angle bisector

B) Parallel lines

C) Perpendicular lines

D) Perpendicular bisector

4) What geometric figure are the sides of a triangle?

A) Line
B) Line Segment
C) Point
D) Ray

5) Which of the following is a Euclidean tool?

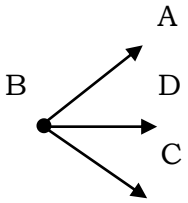
A) Clip
B) Compass
C) Pencil
D) Protractor

6). Which of the following is **ALWAYS TRUE**?

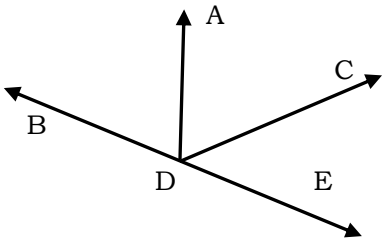
A) If two lines or segments intersect and form a right angle, then they are perpendicular.
B) If two lines or segments intersect and form an acute angle, then they are perpendicular.
C) If two lines or segments intersect and form an obtuse angle, then they are perpendicular.
D) If two lines or segments intersect, then they are perpendicular.

7) BD is an angle bisector of <ABC, forming <ABD and < DBC. Describe the relationship of <ABD and < DBC.

A) They are always congruent.
B) They are seldom congruent.
C) They are never congruent.
D) They are sometimes congruent.



For items 8-10, use the figure below.



8) If $\angle BDA \cong \angle ADC$, which of these is the angle bisector of $\angle BDC$?

A) $\overrightarrow{DA}$
B) $\overrightarrow{DB}$
C) $\overrightarrow{DC}$
D) $\overrightarrow{DE}$

9) If $\angle ADC \cong \angle CDE$, which of these is the angle bisector of $\angle ADE$?

A) $\overrightarrow{DA}$
B) $\overrightarrow{DB}$
C) $\overrightarrow{DC}$
D) $\overrightarrow{DE}$

10) If $\overrightarrow{DA}$ is an angle bisector of $\angle BDC$, which of the following is true?

A) $\overrightarrow{DB} \cong \overrightarrow{DA}$
B) $\angle ADC \cong \angle CDE$
C) $\angle BDA \cong \angle CDE$
D) $\angle BDA \cong \angle ADC$

Lesson 1

Using a Compass and Straightedge to Bisect Line Segments and Angles

In this lesson you will learn Euclidean Geometry which is the study of geometry based on the assumptions of Euclid. In his work Elements, Euclid established the basic rules for constructions using only a compass and a straightedge.

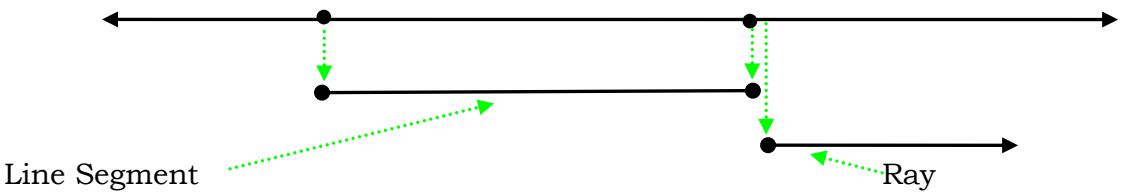
What's In

Before we use a compass and straightedge to bisect a line segment and angle and construct perpendiculars and parallels, let us first review subsets of a line. This will help us do Geometric constructions using compass and straightedge.

Recall that:

A line has two subsets. Below is an illustration of how the subsets of a line are formed.

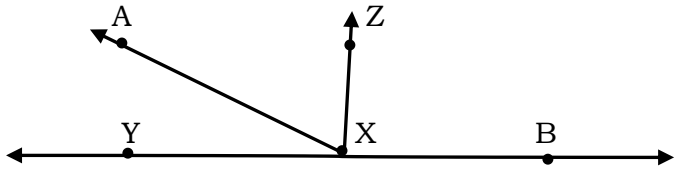
Every 2 points determine a line. If we take this part of a line with the two endpoints, a **line segment** is formed. And if we take one endpoint and all the points to either side of the given point, a **ray** is formed.



Model	How to name	Words/Symbol	Definition
Line Segment X Y	Using two capital letters with the segment symbol on top of them	$\overline{XY}$ or $\overline{YX}$	It does not extend without end. It has endpoints. In this case X and Y. The segment contains all the points on the line between X and Y.
Ray X Y	Using two capital letters with the initial point as the first letter to be written In the model, X is the initial point.	$\overrightarrow{XY}$	It consist of one endpoint and all the points of the line on either side of the endpoint.

Try This!

Name all the segments and rays in the figure below.



What's New

Explore:

Sketch, Draw, and Construct

Activity 1

Sketch a triangle with 2 equal sides. Do not use any geometry tools. Do a freehand sketch.

To check the measurement, use a ruler. Did you sketch triangle with 2 equal sides?

Activity 2

Draw a triangle with 2 equal sides. Use geometry tools such as protractor and ruler to ensure that the measurements are accurate.

Are you more certain that the triangle you have drawn has 2 equal sides?

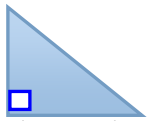
Activity 3

Construct a triangle with 2 equal sides using a compass and straightedge. Do not use a protractor or ruler.

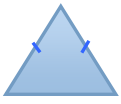
Are you confident that the triangle you have constructed has 2 equal sides?

As you observed in the activities, the words sketch, draw, and construct have specific meanings in geometry.

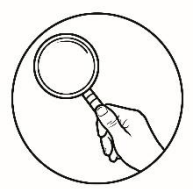
When sketching or drawing, remember to use special marks that indicate right angles, congruent angles, congruent segments, and parallel segments.


right angle


congruent angles


congruent segments


parallel segments

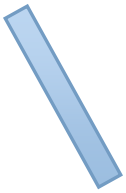


What is It

At this point, you will do geometric construction. Euclid stated explicitly that a formal construction is to be done using only an unmarked straightedge and a compass. Thus, the compass and straightedge are known as the **Euclidean Tools**.

Euclidean Tools

Straightedge



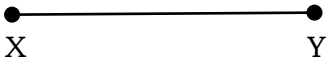
compass

A **Construction** is a geometric drawing that uses a limited set of tools, usually a compass and straightedge. A **Straightedge** is (a ruler without marks) used to guide for the pencil when drawing straight lines. A **Compass** is a geometric tool used to draw circles and parts of a circle called arcs.

Using only a compass and straightedge, how will you accurately copy a segment? In other words, how will you construct congruent segments? Read, study, and do each exploration below.

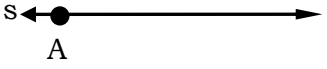
Exploration # 1: Constructing Congruent Segments

Task: Construct a line segment AD that is congruent to $\overline{XY}$.



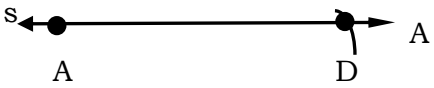
Recall that a line can be named using a lower case letter. Some parts of the texts here are not wholly written.

Step 1:
Using a straightedge, draw a line s.
On the line, choose a point and name it A.



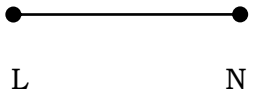
Step 2:
Adjust the compass such that the tips of its needle and pencil are on points X and Y.
Step 3:

Without changing the setting of the compass, place the tip of the needle on point A and draw an arc which intersects line s. Name the point of intersection as D. Now, you have $\overline{XY} \cong \overline{AD}$.



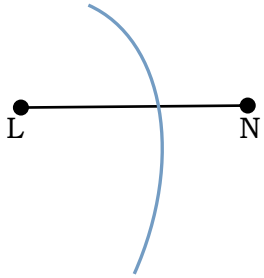
Exploration # 2: Dividing a Line Segment into Two Congruent Segment (perpendicular bisector)

Task : Construct the bisector of $\overline{LN}$.

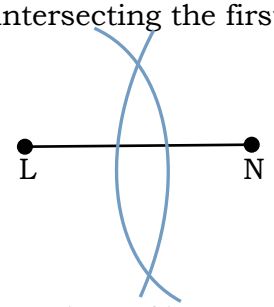


Step 1: Construct any line segment $\overline{LN}$.

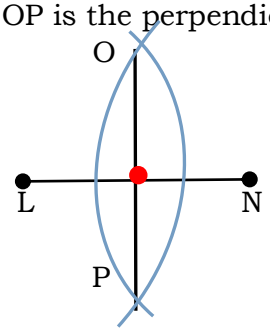
Step 2: Set the compass such that the opening is slightly more than half of the length of $\overline{LN}$. Then, with the tip of the needle on point L, draw an arc that intersects LN. The arc should be big enough so that when Step 3 is done there will be two intersecting arcs.



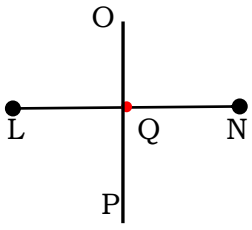
Step 3: Without changing the compass setting, place the tip of the needle on point N and draw another arc intersecting the first arc.



Step 4: Connect the points of intersections of the two arcs using the straightedge. Name this $\overline{OP}$. Note that $\overline{OP}$ is the perpendicular bisector of $\overline{LN}$.

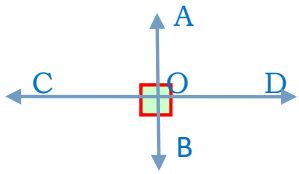


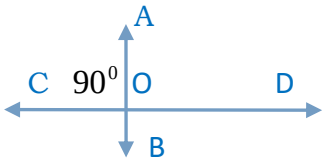
Step 4: Name the point of intersection of $\overline{LN}$ and $\overline{RS}$ as Q. Point Q now divides $\overline{LN}$ into two congruent segments $\overline{LQ}$ and $\overline{QN}$. Point Q is the bisector or midpoint of $\overline{LN}$.



Perpendicular Lines are two lines that intersect to form right angles. The symbol ⊥ is read as "is perpendicular to".

Examples:

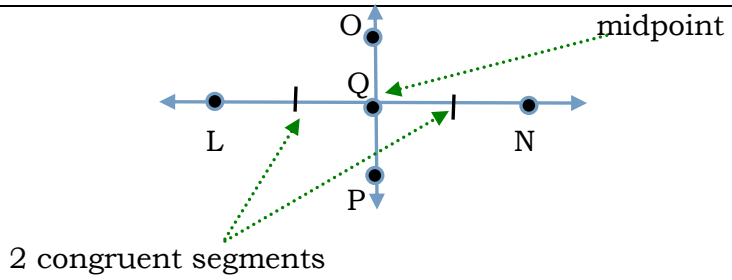




AB ⊥ CD at O, so that <AOB, <AOD, <DOB, and <COB are right angles.

A **Perpendicular Bisector** of segment is a line, segment, or a ray that is perpendicular to the given segment at its ***midpoint***, thereby bisecting the segment into two congruent segments.

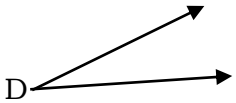
Example:



In Exploration 2, OP is a perpendicular bisector of LN at Q. Hence, LQ is congruent to QN and <OQN, <NQP, <PQL, and <OQL are right angles.

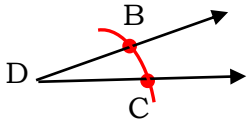
Exploration #3: Constructing an Angle Congruent to a Given Angle

Task: Construct an angle congruent to <D.

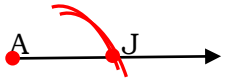


Step 1: Using a straightedge, draw a ray whose endpoint is A.

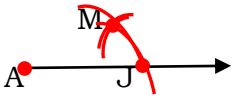
Step 2: With the tip of the needle of the compass at vertex D, draw an arc intersecting the sides of <D at points B and C.



Step 3: Without changing the compass setting, place the tip of its needle at point A and draw an arc intersecting the ray at point J.

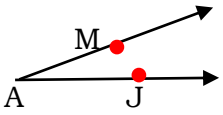


Step 4: Place the tips of the needle and pencil of the compass at point B and C. Again, without changing the compass setting, place the tip of the needle at point J and draw an arc intersecting the first arc. Name the intersection of the two arcs point M.



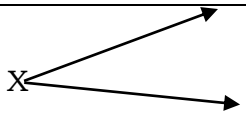
Step 5: Connect A and M using straightedge.

Thus, <BDC ≅ <MAJ.



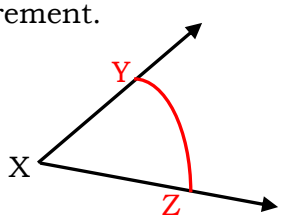
Exploration #4: Constructing the Bisector of a Given Angle

ask: Construct an angle bisector of <X.

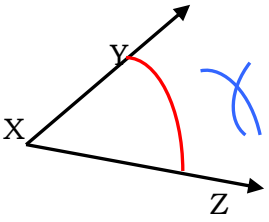


Step 1: Using a straightedge, construct <X of any measurement.

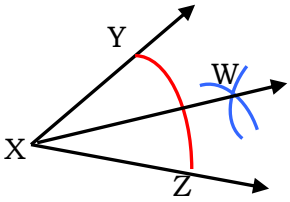
Step 2: With the tip of the needle of the compass at vertex X, draw an arc intersecting the sides of <X at points Y and Z.



Step 3: Put the tip of the needle of the compass on point Z. With the same compass setting, draw an arc using point Y. Be sure the arcs intersect. Label the intersection as W.



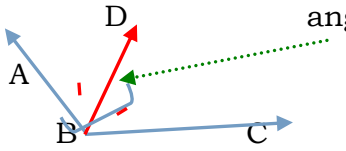
Step 4: Draw $\overrightarrow{XW}$.



Now, $\overrightarrow{XW}$ is the bisector of <YXZ. Thus, <YXW≅ <ZXW.

An **Angle Bisector** is a ray that divides an angle into *two* ***congruent coplanar angles***. Its endpoint is at the vertex of the angle. You may say that the ray or segment *bisects* the angle.

Example:



BD bisects <ABC so that <ABD is congruent to <DBC.

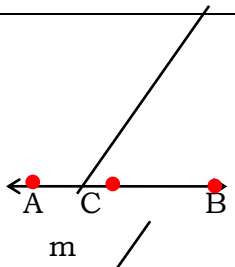
Lesson 2 Constructing Parallel Lines and Perpendicular Lines

Exploration #5: Constructing Parallel Line

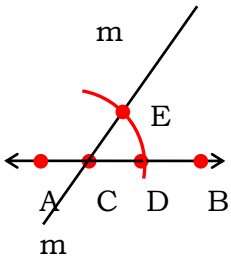
Task: Construct a line parallel to a given line

Step 1: Using a straightedge, draw line AB.

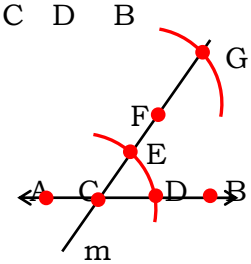
Step 2: Draw a line m intercepting line $\overleftrightarrow{AB}$ at any point C, that is between A & B.



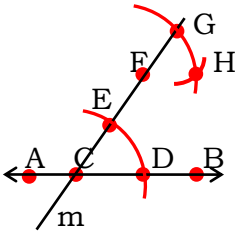
Step 3: With the tip of the needle of the compass at C, draw an arc intersecting $\overleftrightarrow{AB}$ and line m at points D and E, respectively.



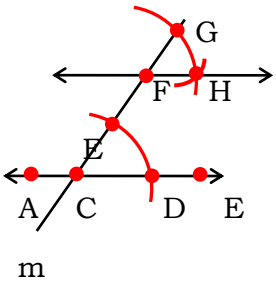
Step 3: Using the same compass opening, from F draw another arc intercepting line m at G.



Step 4: Open compass to the distance between E and D. With this opening, place the tip of the needle of the compass at G. Then, draw an arc intersecting the arc at point H.



Step 5: Draw a line passing through F and H.

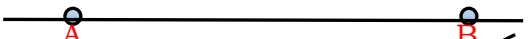


Step 6: Check with protractor if the pairs of corresponding angles are congruent to prove that the line drawn is parallel to the given line.

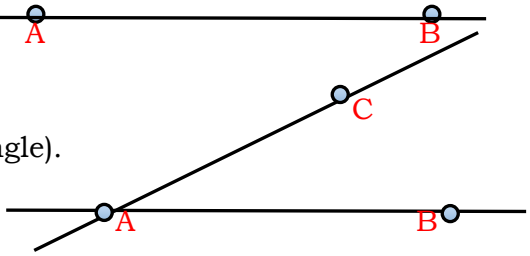
Exploration #6: Additional figures in constructing parallel lines.

Step by step guide

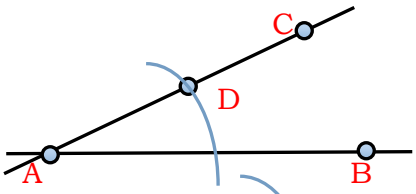
Step 1: Using a straight edge.
On this line put two points A and B.



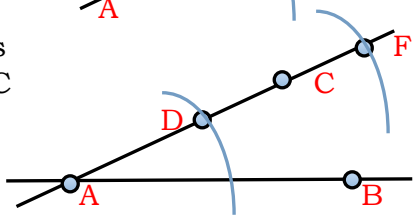
Step 2: Draw a diagonal line that goes through point A (approximately a 45 degree angle). Along this new line, add a point C.



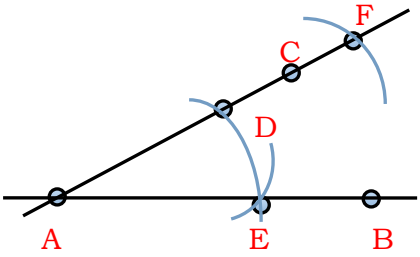
Step 3: With the tip of the needle of the compass, draw an arc, from point A, that is approximately half way to point C. Where the arc crosses AC and PQ,label a point D. Do not move the compass after making this arc!



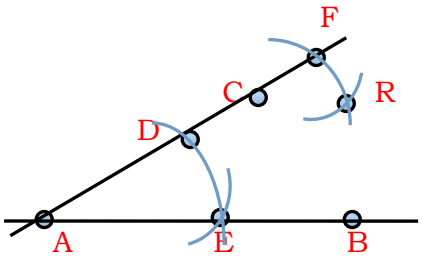
Step 4: Put the tip of the needle of the compass at point C. Repeat the arc that goes through AC And an imaginary line parallel to AB. Label the Point where the arc crosses AC as point F.



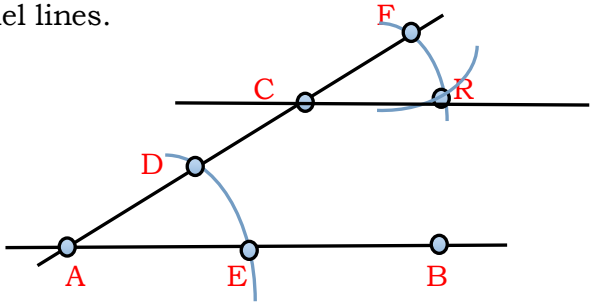
Step 5: Put the tip of the needle of the compass at point D. Draw an arc that has radius DE and Marks the intersection between arc DE and AB. Do not move the compass after making this mark.

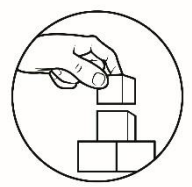


Step 6: with the same compass at the same as you mark you used in step 5, put the tip of the needle of the compass at point F. Draw Another arc that goes below line AF and label this intersection point R.



Step 7: Draw straight line that goes through points C and R. You have now constructed parallel lines. CR and AB are parallel.





What's More

Let us complete the given construction in a separate sheet of paper.

A. Copy each segment below using your compass and straightedge.

1) A B

2) X Y

B. Bisect each segment you have constructed in task A using your compass and straightedge.

C. Copy each angle below using your compass and straightedge.

3)

A

4)

X

D. Bisect each angle you have constructed in task C using your compass and straightedge.

E. Draw any line and construct a line parallel to it using your compass and straightedge.

Excellent work! You're now ready for the next set of activities!

Assessment

Read each item below. Select your answer from the choices and write the letter of your choice on a separate sheet of paper.

1) What is a geometric drawing that uses a limited set of tools, usually a compass and straightedge?

   A) Compass
   B) Construction
   C) Ruler
   D) Straightedge

2) What are the two Euclidean Tools are;?

   A) compass and ruler

   B) compass and straightedge

   C) ruler and protractor

   D) protractor and straightedge

3) This is a ray that divides an angle into two congruent coplanar angles.

   A) parallels

   B) angle bisector

   C) perpendicular lines

   D) perpendicular bisector

4) It is a geometric drawing that uses a limited set of tools, usually a compass and straightedge.

   A) Construction

   B) Draw

   C) Euclidean Tools

   D) Sketch

5) Which of the following is the Euclidean Tools?

   A) Compass

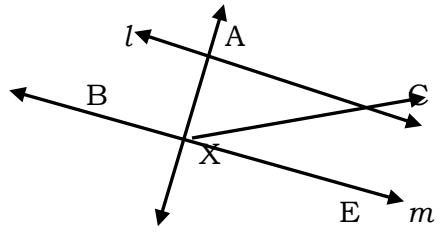
   B) pencil

   C) protractor

   D) ruler

For items 6-10

Use the figure below.



6) If $\angle BXA \cong \angle AXC$, which of these is the angle bisector of $\angle BXC$?

A) $\overrightarrow{XA}$

B) $\overrightarrow{XB}$

C) $\overrightarrow{XC}$

D) $\overrightarrow{XE}$

7) If $\angle AXC \cong \angle CXE$, which of these is the angle bisector of $\angle AXE$?

A) $\overrightarrow{XA}$

B) $\overrightarrow{XB}$

C) $\overrightarrow{XC}$

D) $\overrightarrow{XE}$

8) If $\overrightarrow{XA}$ is an angle bisector of $\angle BXC$, which of the following is true?

A) $\overrightarrow{XB} \cong \overrightarrow{XA}$

B) $\angle AXC \cong \angle CXE$

C) $\angle BXA \cong \angle CXE$

D) $\angle BXA \cong \angle AXC$

9) If point X is the midpoint of BE, which of the following is true?

A) $\overline{XB} \cong \overline{XA}$

B) $\overline{XB} \cong \overline{XE}$

C) $\overline{XA} \cong \overline{XE}$

D) $\overline{XA} \cong \overline{XC}$

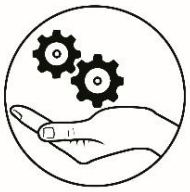
10) If ray AX is a perpendicular bisector of segment BE, which of the following is true?

A) $AX \perp BE$

B) $AC \perp AX$

C) $AX \perp XC$

D) $BE \perp AC$

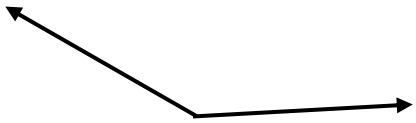


Additional Activities

A. Using the basic skills in Geometric construction you have just learned, show the step by step procedure in constructing the following. Do this in a separate clean sheet of paper.

1. Construct a line segment that is twice the measure of the given line segment.

2. Accurately copy the angle below. Then, divide it into four congruent parts.



Answer Key

What I Know

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

WHAT'S IN

Line Segments are XY, XB, BY, XA, and XZ.

What's More

Answers may vary

Assessment

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

Additional Activities

Answers may vary

References

1. Gladys C. Nivera,Ph.D. Updated Edition Grade 7 Mathematics Pattern and Practicalities (K to 120).
2. GETE0308(1).pdf and GETE0107.pdf
3. Construction Packet 1011
4. Lesson guide grade 3. Chapter III- Geometry v1.0

For inquiries or feedback, please write or call:

Department of Education - Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: blr.lrqad@deped.gov.ph * blr.lrpd@deped.gov.ph