

MATHEMATICS 1007

CONSTRUCTION AND LOCUS

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MATHEMATICS 1007

CONSTRUCTION AND LOCUS

In your previous LIGHTUNITs you have represented geometric figures by sketching them on your paper. You had no particular concern for the accuracy of the figures, as long as they did not give misleading information.

Some of you may have made accurate drawings using a ruler, compass, and protractor. You may be surprised to learn that in

many situations you can make these figures with the same or greater accuracy using only the compass and an unmarked straightedge.

In this LIGHTUNIT you will learn how to construct a variety of figures using only the compass and straightedge. You will also learn a technique to locate and describe sets of points that satisfy one or more given conditions.

OBJECTIVES

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIGHTUNIT.

When you have finished this LIGHTUNIT, you should be able

1. To copy segments and angles.
2. To bisect angles, segments, and arcs.
3. To construct perpendiculars to a line.
4. To construct tangents to a circle.
5. To construct parallel lines.
6. To divide a segment into a given number of equal segments.
7. To construct a fourth proportional.
8. To construct a geometric mean.
9. To divide a segment into a given ratio.
10. To construct triangles.
11. To construct special circles.
12. To construct certain polygons.
13. To define locus.
14. To solve locus problems.
15. To construct figures using locus concepts.

Survey the LIGHTUNIT. Ask yourself some questions about this study. Write your questions here.

Note to student: You will need these tools: straight edge, compass, and several sharpened pencils.

Also some of the constructions do not allow enough room. You may wish to do some of them on other paper. Check with your teacher.

SECTION OBJECTIVES

Read these objectives. When you have completed this section, you should be able:

I. BASIC CONSTRUCTION

1. To copy segments and angles.
2. To bisect angles, segments, and arcs.
3. To construct perpendiculars to a line.
4. To construct tangents to a circle.
5. To construct parallel lines.
6. To divide a segment into a given number of equal segments.
7. To construct a fourth proportional.
8. To construct a geometric mean.
9. To divide a segment into a given ratio.

You will learn five basic constructions in this section: copying figures, bisecting figures, constructing perpendiculars, constructing parallels, and constructing with measurements. Each of these constructions will be done using only the compass and the straightedge. With these five basic constructions you can then construct other geometric figures such as triangles, rectangles, and parallelograms.

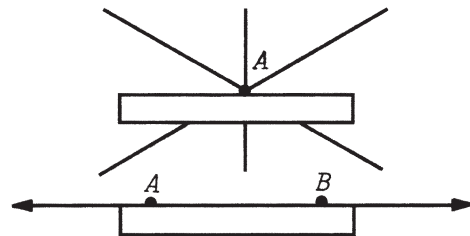
COPYING FIGURES

To copy a figure means to duplicate it on your paper so that the segments and angles of the copy are exactly the same size as the original. Copying is done with just two tools: a compass and an unmarked straightedge.

DEFINITION

Straightedge: an instrument used only to draw lines through one given point and draw the unique line through two given points.

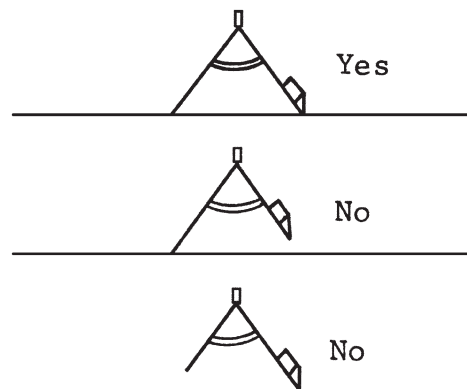
We can use many items to draw lines, if they are straight. The edge of a book, the edge of a piece of cardboard, a piece of plastic, or a ruler will all serve. We can use the ruler as long as we do not use the numbers on it for measuring.



DEFINITION

Compass: an instrument used only to draw circles or arcs of a circle having a given center and to draw the unique circle having a given center and a given radius.

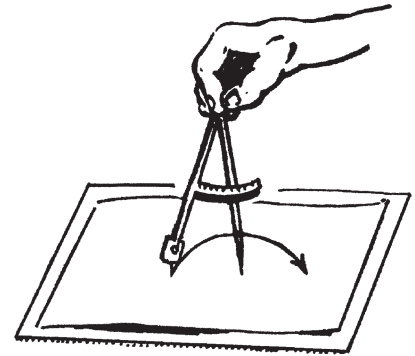
A compass can take many forms, but the two main parts of any compass are its points. One point is a fixed sharp metal point that you stick into your paper at the center of the circle. The other point contains the writing tool, usually a pencil. The pencil point is adjustable up and down. The compass should be adjusted so that the tip of the pencil is the same length as the tip of the center point. The distance between the two points will be the radius of the circle you are drawing. This distance varies depending on the circle you wish to draw.



When using a compass, you may wish to back your paper with some thin cardboard so that the center point of the compass will stick in and not slide off your paper.

When drawing a circle, hold the compass at the top. Do not hold the legs of the compass, or you may change the radius of your circle.

Tip the compass slightly in the direction you are drawing so that it is not perpendicular to the paper and pull the compass through your circle. Never push the compass, because pushing may tear your paper.



Use your straightedge to construct lines through the given points. Use your compass to construct circles.

1.1 \overline{AB}

1.2 \overrightarrow{BC}

1.3 \overleftrightarrow{DC}

1.4 \overleftrightarrow{BD}

1.5 \overline{AD}

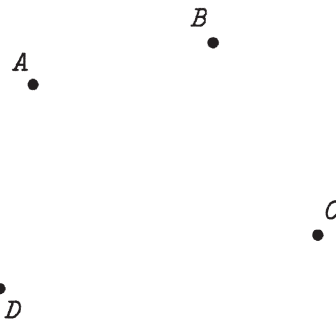
1.6 \overrightarrow{AC}

1.7 Circle A , any radius

1.8 Circle B , any radius













1.9 Circle C , same radius as circle B

1.10 Circle D , same radius as circle A





Construct circles with the given segment as radius and the given point as center.

	<u>Segments</u>	<u>Center Points</u>
1.11	 circle A	A 
1.12	 circle B	
1.13	 circle C	
1.14	 circle D	
1.15	 circle E	 
1.16	 circle F	

To copy any segment, use Construction 1.

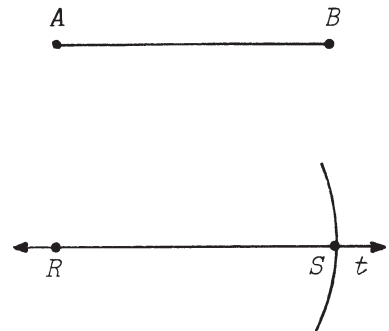
Construction 1

Given a segment, construct another segment with a length equal to the given segment.

Given: \overline{AB}

To Construct: segment \overline{RS} with
length equal to AB

Steps: Draw a work line t . Pick a point on t ; call it R . Put point of compass on A and pencil on B . This distance will be the radius of an arc. Place point of compass at R and, using radius from previous step, make an arc that intersects t at S . \overline{RS} is the required segment.



To copy any angle, use Construction 2.

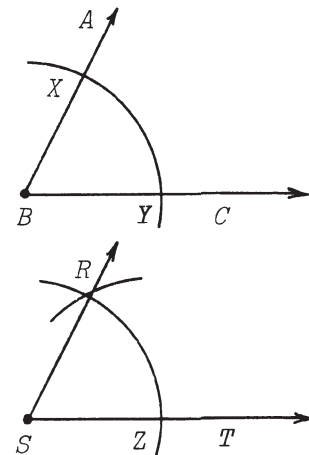
Construction 2

Given an angle, construct another angle with measure equal to the given angle.

Given: $\angle ABC$

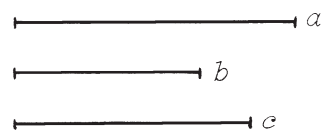
To construct: $\angle RST$ with measure
equal to $\angle ABC$

Steps: Construct a ray \overrightarrow{ST} . With B as center and a convenient radius, construct an arc that intersects \overrightarrow{BA} at X and \overrightarrow{BC} at Y . With the same radius and center at S , construct an arc intersecting \overrightarrow{ST} at Z . With center at Z and radius YX , construct an arc that intersects the arc from S . Call this point R . $\angle RST$ is the required angle.



Use segments a , b , and c to complete the following constructions of segments with length equal to the indicated segments.

1.17 $a + b$



1.18 $a - b$

1.19 $2b + a$

1.20 $a + b + c$

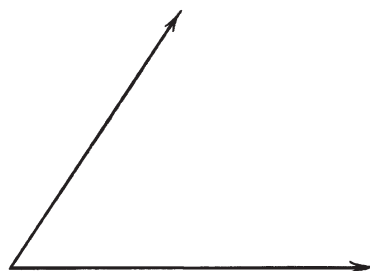
1.22 $a - b + c$

1.21 $a + 2b - c$

1.23 $a + c - b$

By construction, copy the angles given. Leave all construction arcs in your final figure.

1.24



1.25

