CK-12 Texas Instruments Geometry

Student Edition

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1.1 Geometry TI Resources

Student Edition

Introduction

This FlexBook® resource contains Texas Instruments (TI) Resources for the TI-83, TI-83 Plus, TI-84, and TI-84 SE. All the activities in this resource supplement the lessons in the student edition. Teachers may need to download programs from www.timath.com that will implement or assist in the activities. All activities are listed in the same order as the Teacher's Edition. Each activity included is print-ready.

There are also corresponding links in CK-12 Geometry - Second Edition and CK-12 Geometry - Basic.

- CK-12 Geometry - Second Edition: http://www.ck12.org/book/CK-12-Geometry-Second-Edition/
- CK-12 Geometry - Basic: http://www.ck12.org/book/CK-12-Geometry-Basic/

CHAPTER 2 SE Basics of Geometry - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 1
- CK-12 Geometry - Basic: Chapter 1

2.1 Midpoints in the Coordinate Plane

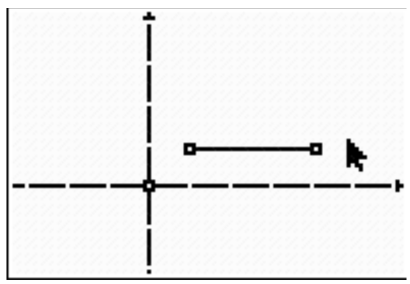
This activity is intended to supplement Geometry, Chapter 1, Lesson 4.

ID: 8614

Problem 1 –Midpoints of Horizontal or Vertical Segments

Step 1:

- Open a new Cabri Jr. file. If the axes are not currently showing, they should select **Hide/Show >Axes.**
- Construct a horizontal segment in the first quadrant using the **Segment** tool.



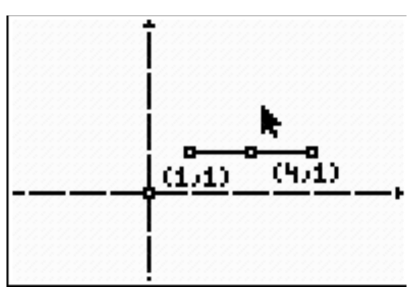
Step 2:

- Select **Coord. Eq.** and show the coordinates for the endpoints of the segment.

If the coordinates of the endpoints are not integers, they need to use the **Hand** tool to drag the endpoints until the coordinates are integers.

Step 3:

- Make a prediction about the coordinates for the midpoint of the segment.
- To check your predictions, select **Midpoint**, construct the midpoint of the segment, and then show its coordinates.



Step 4:

- Before moving on, hide the coordinates of the midpoint with the **Hide/Show >Object** tool.

- Use the **Hand** tool to drag the segment to another location. If you drag the entire segment, it will remain horizontal.

Make a prediction about the new coordinates of the midpoint and check your prediction by showing the coordinates of the midpoint.

Step 5:

- Repeat this exploration with a vertical segment.

Problem 2 –Midpoints of Diagonal Segments

Step 1:

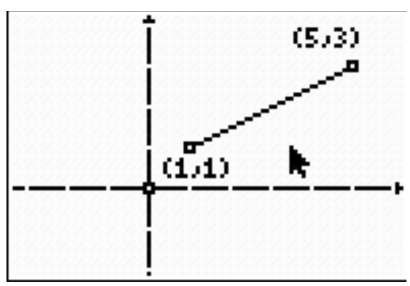
- Open a new Cabri Jr. file. If needed, select **Hide/Show >Axes** to show the coordinate axes.

Use the **Segment** tool to construct a diagonal segment in the first quadrant.

Step 2:

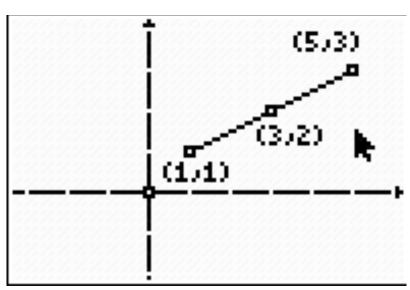
- Select **Coord. Eq.** and show the coordinates for the endpoints of the segment.

- If the coordinates of the endpoints are not integers, use the **Hand** tool to drag the endpoints to make the coordinates integers.



Step 3:

- Make a prediction about the coordinates for the midpoint of the segment.
- To check your prediction, construct the midpoint of the segment and show the coordinates of the midpoint.



Step 4:

- Hide the coordinates of the midpoint with the **Hide/Show >Object** tool.
- Using the **Hand** Tool, drag the segment to another location. If the entire segment is selected, it will keep the same diagonal slant.

Make a prediction about the new coordinates of the midpoint and check their prediction by showing the coordinates of the midpoint.

Step 5:

- Repeat this exploration with a new segment.

Step 6: *Describe in words how to find the coordinates of the midpoint of a segment if you know the coordinates of the endpoints. Try to write a formula or a rule for midpoints.*

2.2 Vertical and Adjacent Angles

This activity is intended to supplement Geometry, Chapter 1, Lesson 5.

Problem 1 –Exploring Vertical Angles

1. Define **Vertical (or Opposite) Angles.**

2. Open the Cabri Jr. file VERTICAL. $\overleftrightarrow{AC}$ intersects $\overleftrightarrow{BD}$ at point O.

Name two pairs of vertical angles.

3. Move point B or point C to four different locations where the angles have different measures. Record $m\angle AOB$, $m\angle BOC$, $m\angle COD$, and $m\angle AOD$ for each of your four locations.

TABLE 2.1:

Location	1^{st}	2^{nd}	3^{rd}	4^{th}
$m\angle AOB$				
$m\angle BOC$				
$m\angle COD$				
$m\angle AOD$				

What patterns do you notice?

4. If $\angle AOD$ and ______ are vertical angles, then the $m\angle AOD$ ______.

5. If $\angle AOB$ and ______ are vertical angles, then the $m\angle AOB$ ______.

6. Based on your data from Question 3, make a conjecture about vertical angles in general.

Problem 2 –Exploring Adjacent Angles

7. Define **Adjacent Angles.**

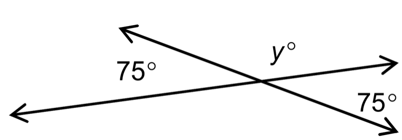
8. Use the file VERTICAL from Problem 1. Identify all four pair of adjacent angles.

9. Move point B or point C and make a conjecture about adjacent angles formed by two intersecting lines. Hint: You may have to do a calculation.

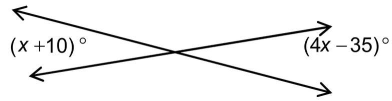
10. If $\angle AOB$ and ___________ are adjacent angles formed by two intersecting lines, then the $m\angle AOB$ and _______-_______ are _______________.

Complete the following problems.

11. Find the value of x and y.



12. Find the value of x.



Chapter 3 SE Reasoning and Proof - TI

Chapter Outline

The activity below is intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 2
- CK-12 Geometry - Basic: Chapter 2

3.1 Conditional Statements

Problem 1 –Slopes of lines

Open a new *Cabri Jr.* file for each part (A, B, and C).

A. Construct a line and a point not on the line. Construct a second line through the point that is parallel to the first line. Find the slopes of both lines.

If two lines are parallel, then the slopes of the lines are ______________

Converse: ______________________________

Inverse: ______________________________

Contrapositive: ______________________________

Determine whether the above conditional statements are true or false. If you decide a statement is false, sketch a counterexample.

B. Construct a line and a point not on the line. Construct a second line through the point that is perpendicular to the first line. Find the slopes of both lines.

If two lines are perpendicular, then the slopes of the lines are ______________

Converse: ______________________________

Inverse: ______________________________

Contrapositive: ______________________________

Determine whether the above conditional statements are true or false. If you decide a statement is false, sketch a counterexample.

C. Construct two lines that have the same $y-$intercept.

If two different lines have the same $y-$intercept, then the lines have different slopes.

Converse: ______________________________

Inverse: ______________________________

Contrapositive: ______________________________

Determine whether the above conditional statements are true or false. If you decide a statement is false, sketch a counterexample.

Problem 2 –Collinear and noncollinear segments

A. Use the *Cabri Jr.* file **COLSEG** to complete the following.

Find the distances AB, BC, and AC. Drag the points to create different lengths.

AB ______	BC ______	AC ______	$AB+BC$ ______
AB ______	BC ______	AC ______	$AB+BC$ ______
AB ______	BC ______	AC ______	$AB+BC$ ______

When do the lengths AB and BC add up to equal AC? ____________________

Write a conditional statement to express your conclusion:

If ____________________, then ____________________

B. Use the *Cabri Jr.* file **NOCOLSEG** to complete the following.

Now explore what happens if AB, BC, and AC are not collinear.

AB ______	BC ______	AC ______	$AB+BC$ ______
AB ______	BC ______	AC ______	$AB+BC$ ______
AB ______	BC ______	AC ______	$AB+BC$ ______

What is the relationship between $AB+BC$ and AC? ___________________

Write a conditional statement to express your conclusion:

If ____________________, then ____________________

CHAPTER 4 SE Parallel and Perpendicular Lines - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 3
- CK-12 Geometry - Basic: Chapter 3

4.1 Parallel Lines Cut By A Transversal

This activity is intended to supplement Geometry, Chapter 3, Lesson 2.

Problem 1 - Exploring Parallel Lines

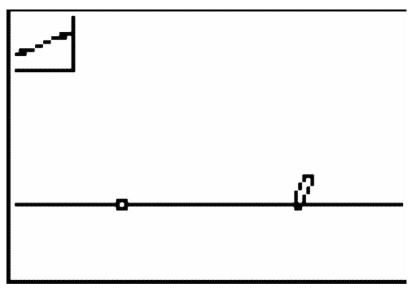
In this activity, students will develop and strengthen their knowledge about the angles formed when parallel lines are cut by a transversal. The measurement tool helps them discover the relationships between and among the various angles in the figure. Students will draw parallel lines, draw a transversal, and explore angle relationships.

Press **APPS**. Move down to the **Cabri Jr** application and press **ENTER**. Press **ENTER**, or any key, to begin using the application.

Press $Y =$ for the $F1$ menu and select **New**. (If asked to **Save changes?** press choose "No.")

Press **WINDOW** for $F2$, move to **Line** and press **ENTER**.

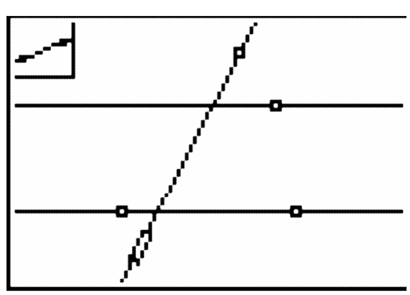
Move down and to the left and press **ENTER** to mark one point on the line. Move to the right and press **ENTER** to mark the second point defining the line.



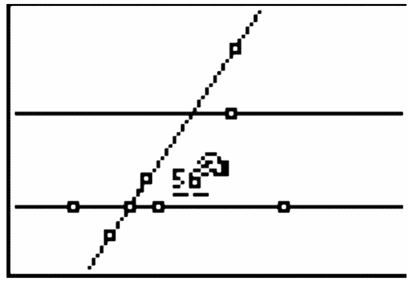
Press **ZOOM** for $F3$, move to **Parallel**, and press **ENTER**. Move the pencil until the line is blinking. Press **ENTER** then press $\uparrow$ until the second line is in the desired location. Press **ENTER** to mark the point through which the parallel line is drawn.

Press **WINDOW** for $F2$ and select **Line**. Move up and mark a point by pressing **ENTER**. Move down and left and press **ENTER** to mark the second point defining the transversal of the two parallel lines.

Now we will measure angles and explore angle relationships.



Press **GRAPH** for $F5$. Move down to **Measure**, then right and down to **Angle** then press **ENTER**. You must select three points to identify the angle. Move the pencil until one of the lines is flashing and press **ENTER** to select a point on that line. Move the pencil until one of the parallel lines and the transversal are both flashing and press **ENTER**. This will mark their intersection as the vertex of the angle. Move the pencil to the other line forming a side of the angle. Press **ENTER** when that line is flashing. Move the measurement to a convenient location. Press **CLEAR** to turn off the hand.



With the angle measuring tool active, measure some of the other angles formed—corresponding, alternate interior, alternate exterior...

Move each measurement to a convenient location. Press **CLEAR** to turn off the hand

Move the pointer to one of the points which defined the location of the transversal. Press **ALPHA** to activate the *hand* and move this point. Observe the angle measures as the position of the transversal changes.

Problem 2 - Extension

Move the transversal until one of the angles has "crossed over" and observe that you now have consecutive interior angles that are supplementary.

Measure the remaining angles and observe the relationships among the angle measures.

Load a background image of parallel lines but by a transversal with angles named. Instruct students to move their cursors to: the interior, the exterior, to an angle with a specific characteristic (congruent to a given angle, supplementary to a given angle, ...).

Press 2^{nd} **MODE** to exit the application.

4.2 Transversals

This activity is intended to supplement Geometry, Chapter 3, Lesson 3.

Problem 1 - Properties of Transversals

Use the below on the right to answer the following questions.

1. $\angle 3$ and $\angle 6$ is a pair of *alternate interior angles*

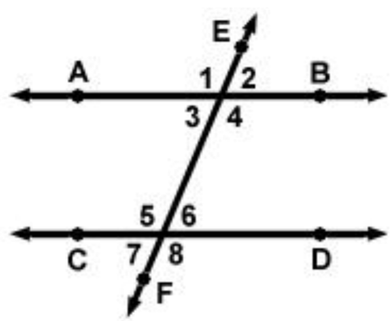
$\angle$___ and $\angle$___ is another pair

2. $\angle 3$ and $\angle 5$ is a pair of *same-side interior angles*

$\angle$___ and $\angle$___ is another pair

3. $\angle 3$ and $\angle 7$ is a pair of *corresponding angles*

$\angle$___ and $\angle$___ is another pair



Run the Cabri Jr. App and open the file **TRNSVRSL** showing two parallel lines, $\overleftrightarrow{AD} \| \overleftrightarrow{HE}$, cut by a transversal $\overleftrightarrow{CG}$.

4. The measure of $\angle ABC$ and $\angle HFB$ are given.

a. These two angles are ____________________ Angles.

b. Move point G to four different positions and record your measurements in the table.

TABLE 4.1:

	1^{st} **position**	2^{nd} **position**	3^{rd} **position**	4^{th} **position**
$m\angle ABC$				
$m\angle HFB$				

c. What is the relationship between the measurements of $\angle ABC$ and $\angle HFB$?

Congruent, complementary, or supplementary? _______________

5. The measure of $\angle ABF$ and $\angle HFB$ are given.

a. These two angles are ____________________ Angles.

b. Move point G to four different positions and record your measurements in the table.

TABLE 4.2:

	1^{st} **position**	2^{nd} **position**	3^{rd} **position**	4^{th} **position**
$m\angle ABF$				
$m\angle HFB$				

c. What is the relationship between the measurements of $\angle ABF$ and $\angle HFB$?

Congruent, complementary, or supplementary? _______________

6. The measure of $\angle DBF$ and $\angle HFB$ are given.

a. These two angles are ____________________ Angles.

b. Move point G to four different positions and record your measurements in the table.

TABLE 4.3:

	1^{st} **position**	2^{nd} **position**	3^{rd} **position**	4^{th} **position**
$m\angle DBF$				
$m\angle HFB$				

c. What is the relationship between the measurements of $\angle DBF$ and $\angle HFB$?

Congruent, complementary, or supplementary? _____________________

Problem 2 - Conjectures and Questions

Complete the following conjectures based on your answers above.

7. For parallel lines and a transversal, if two angles are corresponding angles, then...

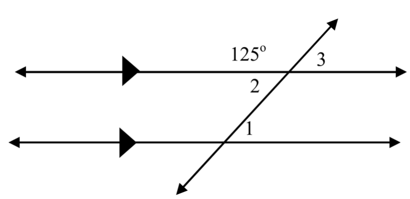
8. For parallel lines and a transversal, if two angles are alternate interior angles, then...

9. For parallel lines and a transversal, if two angles are same-side interior angles, then...

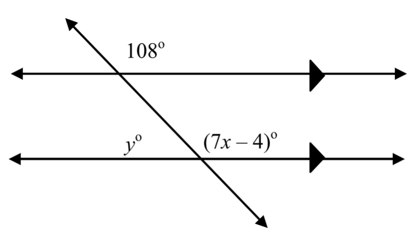
Complete the following problems.

The triangles in the middle of the lines tell us that the lines are parallel.

10. Find the measurement of $\angle 1$, $\angle 2$, and $\angle 3$.



11. Find the value of x and y.



4.3 Perpendicular Slopes

This activity is intended to supplement Geometry, Chapter 3, Lesson 4.

In this activity, you will explore:

- *an algebraic relationship between the slopes of perpendicular lines*
- *a geometric proof relating these slopes*

Problem 1 –An initial investigation

Open the **Cabir Jr**. app by pressing **APPS** and choosing it from the menu. Press **ENTER**. Press any key to begin.

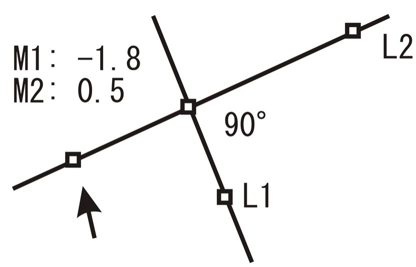
The calculator displays the Cabri Jr. window. Open the $F1$ **: File** menu by pressing $Y =$. Arrow down to the **Open...** selection and press **ENTER**.

Choose figure **PERP1** and press **ENTER**.

Two lines are displayed:

line $L1$ with a slope of $m1$ and line $L2$ with a slope of $m2$.

Notice that the angle formed by the intersection of the lines measures 90°; that is, the two lines are perpendicular.



Grab line $L1$ by moving the cursor over the point pressing **ALPHA** cursor turns into a hand to show that you have grabbed the point.

Rotate $L1$ by dragging the point using the arrow keys. Observe that as the slopes of the lines change, the two lines remain perpendicular. Explore the relationship between the slopes by answering the questions below.

1. Can you rotate $L1$ in such a way that $m1$ and $m2$ are both positive? Both negative?
2. Can you rotate $L1$ so that $m1$ or $m2$ equals 0? If so, what is the other slope?
3. Can you rotate $L1$ so that $m1$ or $m2$ equals 1? If so, what is the other slope?
4. Rotate $L1$ so that $m1$ is a negative number close to zero. What can be said $m2$?
5. Rotate $L1$ so that $m1$ is a positive number close to zero. What can be said about $m2$?

Problem 2 –A closer examination

Now that you have observed some of the general relationships between the slopes of two perpendicular lines, it is time to make a closer examination. Press 2^{nd} **[MODE]** to exit Cabri Jr.

Press **PRGM** to open the program menu. Choose **PERP2** from the list and press **ENTER** twice to execute it.

Enter a slope of 2 and press **ENTER**.

The program graphs a line $L1$ with the slope you entered and a line $L2$ that is perpendicular to $L1$. $m1$ is the slope of $L1$ and $m2$ is the slope of $L2$.

Press **ENTER** and the calculator prompts you for another slope. Use the graph to complete the following.

1. Enter 0 to make the slope of $L1$ equal to 0. What is the slope of $L2$?

2. What is the slope of $L2$ when the slope of $L1$ is 1?

3. What is the slope of $L2$ when the slope of $L1$ is -1?

Enter other values for the slope of $L1$ and examine the corresponding slope of $L2$. For each slope that you enter, $m1$ and its corresponding value of $m2$ are recorded in the lists L_1 and L_2. To see a history of your "captured" values, enter a slope of **86** to exit the program. Then press **STAT** and **ENTER** to enter the **List Editor**. The values of $m1$ are recorded in L_1 and the values of $m2$ are recorded in L_2.

L1	L2	L3 1
2	2	-------
3	3	
.5	.5	
1	1	
−1	−1	
.25	.25	
------	------	

L1(1)=2

4. Conjecture a formula that relates the slope of two perpendicular lines. Enter your formula in the top of L_3 (with variable L_1) to test your conjecture.

Problem 3 –A geometric look

Start the Cabri Jr. app and open the file **PERP3**.

This figure shows another way to examine the slopes of perpendicular lines, geometrically. There should be two lines, $L1$ and $L2$, with a slope triangle attached to each of them.

Grab line $L1$, rotate it, and compare the rise/run triangles.

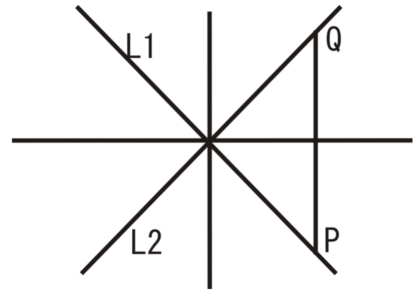
1. What do you notice about the two triangles?

Problem 4 –The analytic proof

We now will analytically verify that two lines with slopes $m1$ and $m2$ are perpendicular if and only if $m1 \cdot m2 = -1$.

(All of the following assumes $m1 \neq 0$. What can be said about the case when $m1 = 0$?)

Open the Cabri Jr file **PERP4**. This graph shows two perpendicular lines $L1$ and $L2$ with slopes $m1$ and $m2$ respectively, translated such that their point of intersection is at the origin. Refer to the diagram to answer the questions below.



1. What are the equations of these translated lines as shown in the diagram?
2. Let P be the point of intersection of line $L1$ and the vertical line $x = 1$ and let Q be the point of intersection of line $L2$ and the line $x = 1$. What are the coordinates of points P and Q?
3. Use the distance formula to compute the lengths of $\overline{OP}$, $\overline{OQ}$, and $\overline{PQ}$. (Your answers should again be in terms of $m1$ and $m2$.)
4. Apply the Pythagorean Theorem to triangle POQ and simplify. Does this match your conjecture from Problem 2?

Problem 5 –Extension activity #1

The Cabri Jr file **PERP5** shows a circle with center O and radius OR. Line T is tangent to the circle at point R.

The slopes of line T and segment OR are shown (mT and mOR, respectively.)

Your first task is to calculate $\frac{1}{mOR}$. Activate the **Calculate** tool, found in the $F5$: **Appearance** menu. Move the cursor over 1 and press **ENTER**. Repeat to select mOR, the slope of the segment OR.

Press / to divide the two numbers. Drag the quotient to a place on the screen where you can see it clearly and press **ENTER** again to place it.

1. Grab point R and drag it around the circle. Observe the changing values of mT, mOR, and $\frac{1}{mOR}$. What can you conjecture about the relationship between a tangent line to a circle and its corresponding radius?

Problem 6 –Extension activity #2

The Cabri Jr file **PERP6** shows a circle with an inscribed triangle QPR. The segment QR is a diameter of the circle.

The slopes of segments PR and PQ are shown (mPR and mPQ, respectively.)

Compute $\frac{1}{mPQ}$ using the **Calculate** tool.

1. Grab point P, drag it around the circle, and examine the changing values. What can you conjecture about a triangle inscribed in a circle such that one side is a diameter?

CHAPTER 5 SE Congruent Triangles - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 4
- CK-12 Geometry - Basic: Chapter 4

5.1 Interior & Exterior Angles

This activity is intended to supplement Geometry, Chapter 4, Lesson 1.

Problem 1 –Interior angles of a triangle

1. Record the measures of the interior angles of your triangle.

TABLE 5.1:

$\angle ABC$	$\angle BCA$	$\angle CAB$

2. What is the sum of the measures of the three interior angles of the triangle?
3. Does this result change when a vertex of the triangle is dragged?

Problem 2 –One exterior angle of a triangle

4. Record the measures of the interior angles and exterior angle $\angle BCD$ of your triangle.

TABLE 5.2:

$\angle ABC$	$\angle BCA$	$\angle CAB$	$\angle BCD$

5. Make some observations about the exterior angle $\angle BCD$ and its relationship to other angles in the chart.

Problem 3 –Three exterior angles of a triangle

6. List the measures of the exterior angles of your triangle (one at each vertex).

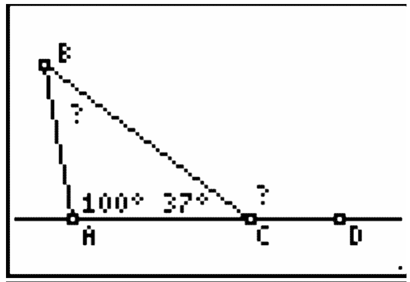
TABLE 5.3:

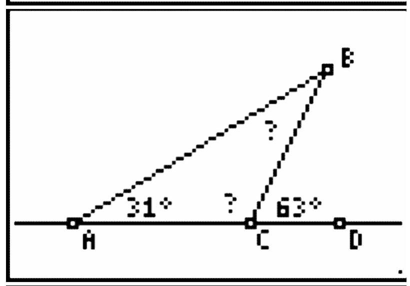
Ext $\angle$ at vertex A	**Ext $\angle$ at vertex B**	**Ext $\angle$ at vertex C**

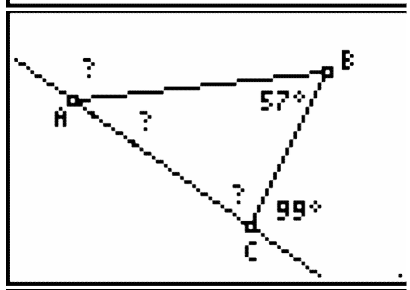
7. Calculate the sum of the three exterior angles.
8. Why do you think it is important to use one exterior angle at each vertex?

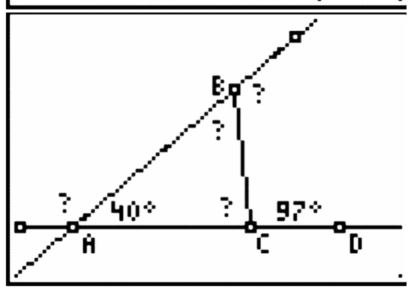
Additional Problems

Find the missing angle measures in each of the diagrams below.

1. 

2. 

3. 

4. 

5.2 Congruent Triangles

This activity is intended to supplement Geometry, Chapter 4, Lesson 4.

In this activity, you will explore:

- *Conditions that create congruent triangles.*

Use this document to record your answers.

Problem 1 –Three Corresponding Sides (SSS)

1. Based on your observations, are two triangles with three pairs of corresponding congruent sides (SSS) congruent?

2. Does this result change when a vertex of the triangle is dragged?

3. When the two compass circles are created, there are two points of intersection. Do you think it makes a difference which one you choose to be point F?

Problem 2 –Two Corresponding Sides and the Included Angle (SAS)

4. Based on your observations, are two triangles with two pairs of corresponding congruent sides and the included angle (SAS) congruent?

5. Do you think it matters whether the included angle $\angle ABC$ is acute, right, or obtuse?

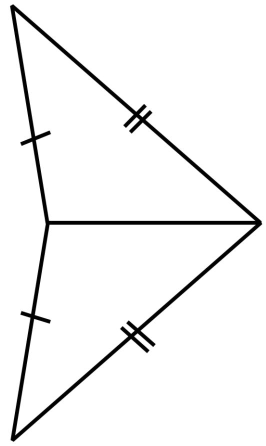
Problem 3 –Two Corresponding Angles and the Included Side (ASA)

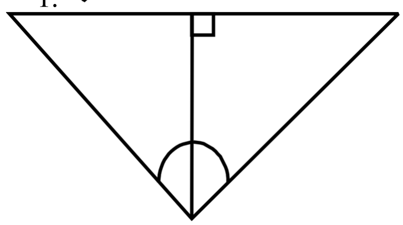
6. Based on your observations, are two triangles with two pairs of corresponding congruent angles and the included side (ASA) congruent?

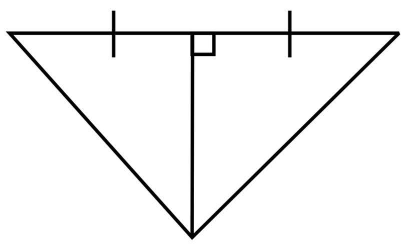
7. Why do you think the selection order of the angle vertices matters?

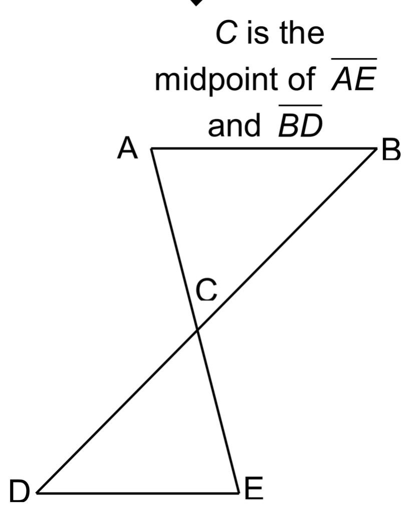
Apply The Math

Name the congruence postulate (SSS, SAS, or ASA) that shows the triangles to be congruent.

1. 

2. 

3. 

4. 

Extension –Two Corresponding Sides and the NON-Included Angle

Use the file you saved as *CongTri*. Investigate the results if you copy two sides of a triangle and the NON-included angle. Will the triangles be congruent?

5.3 Triangle Sides & Angles

This activity is intended to supplement Geometry, Chapter 4, Lesson 5.

In this activity, you will explore:

- *The size and location of sides and angles of a triangle*
- *Triangles that have two equal sides or two equal angles*
- *The number of acute, right, and obtuse angles in any one triangle*

Use this document to record your answers.

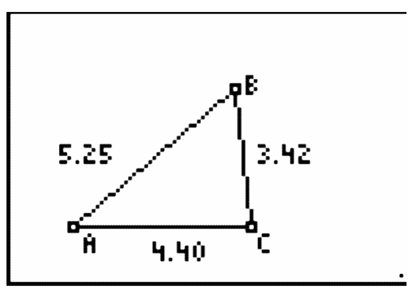
Problem 1 –Size and Location of Sides and Angles

1. Where is the largest angle of the triangle located relative to the largest side?
2. Where is the smallest angle of the triangle located relative to the smallest side?

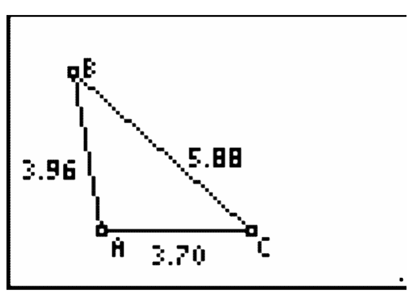
Apply The Math

List the angles in order from smallest to largest.

3.

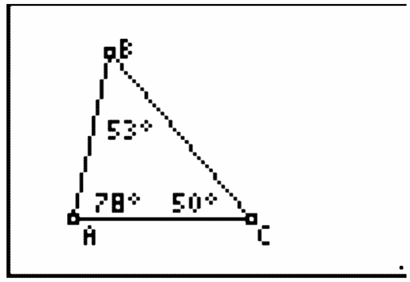


4.

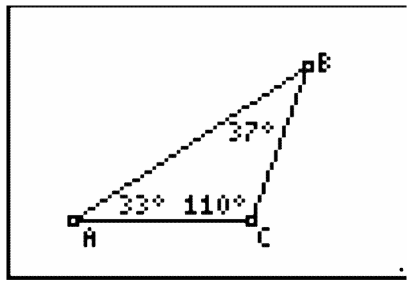


List the sides in order from shortest to longest.

5.



6.



Problem 2 –The Isosceles Triangle Theorem

7. Make a sketch of your triangle with the side lengths and angle measures labeled.

8. *Complete this statement:*

If two sides of a triangle are congruent, then ______________________.

9. *Complete this statement:*

If two angles of a triangle are congruent, then ______________________.

Problem 3 –Types of Angles in a Triangle

10. Drag a vertex of the triangle and classify the types of angles that exist (acute, right, obtuse).

TABLE 5.4:

$\angle A$	$\angle B$	$\angle C$

11. Can a triangle have three acute angles?

Make a sketch to support your answer.

12. Can a triangle have three right angles?

Make a sketch to support your answer.

13. Can a triangle have three obtuse angles?

Make a sketch to support your answer.

14. Look back at your answers for Exercises 8 and 9.

Can you explain why you got these answers?

CHAPTER 6 SE Relationships within Triangles - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 5
- CK-12 Geometry - Basic: Chapter 5

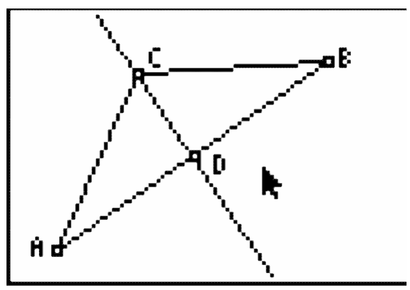
6.1 Perpendicular Bisector

This activity is intended to supplement Geometry, Chapter 5, Lesson 2.

Problem 1 –Exploring the Perpendicular Bisector Theorem

Start the *Cabri Jr.* application by pressing **APPS** and selecting **Cabri Jr**. Open the file **PERBIS** by pressing $Y =$, selecting **Open...**, and selecting the file.

Line CD is the perpendicular bisector of $\overline{AB}$. Find AC and BC using the **Distance and Length** tool (press **GRAPH** and select **Measure >D.Length**). Remember that AC means the length of $\overline{AC}$.



1. Move point C to 4 different positions and record the measurements in the table below. To move the point, move the cursor over the point, press a, move the point to the desired location, and then press a again to release the point.

TABLE 6.1:

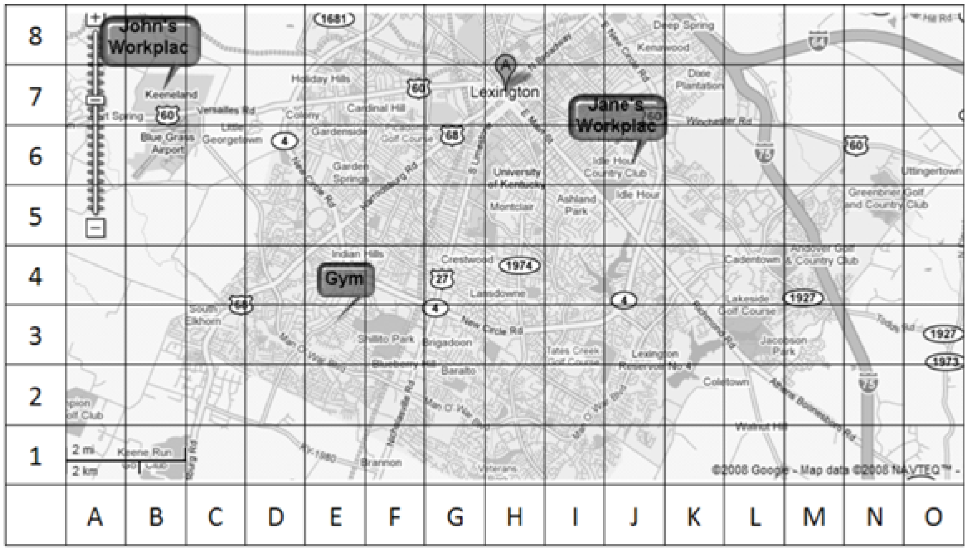
Position	1^{st} position	2^{nd} position	3^{rd} position	4^{th} position
AC				
BC				

2. What is the relationship between the measurements of AC and BC?

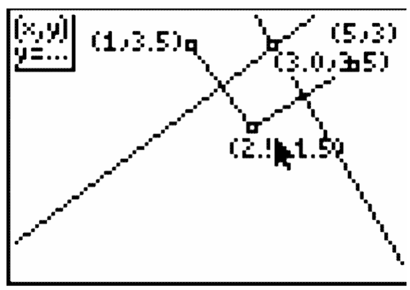
3. Make a conjecture based on your results above about a point on the perpendicular bisector and the endpoints of a segment.

Problem 2 –An Application of the Perpendicular Bisector Theorem

John and Jane are a young college graduate couple who are relocating to a new city. They have jobs at separate locations, but work out at the same gym. They would like to buy a house that is equidistant from their jobs and gym. They use the map below and see that John's workplace is located at $B7$, Jane's workplace is at $J6$, and their gym is located at $E3$.



Open the *Cabri Jr.* file **POINTS**. Three points are plotted: ordered pair (1, 3.5) represents *B*7; ordered pair (5, 3) represents *J*6; and ordered pair (2.5, 1.5) represents *E*3.



1. Use Perpendicular Bisector Theorem to decide where John and Jane should live.
2. Using the map's notation, where should the young couple live?

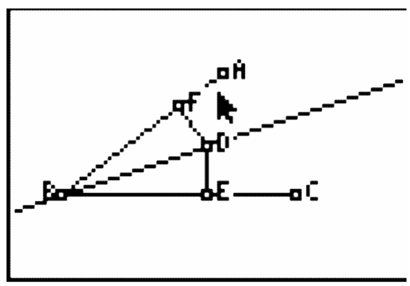
6.2 Hanging with the Incenter

This activity is intended to supplement Geometry, Chapter 5, Lesson 3.

Problem 1 –Exploring the Angle Bisector Theorem

Start the *Cabri Jr.* application by pressing **APPS** and selecting **Cabri Jr**. Open the file **ANGBIS** by pressing $Y =$, selecting **Open...**, and selecting the file.

Line BD is the angle bisector of $\angle ABC$. Find DE and DF using the **Distance and Length** tool (press **GRAPH** and select **Measure >D.Length**). Remember that DE means "the length of $\overline{DE}$."



1. Move point D to 4 different positions and record the measurements in the table below. To move the point, move the cursor over the point, press **ALPHA**, move the point to the desired location, then press **ALPHA** again to release the point.

TABLE 6.2:

Position	1^{st} **position**	2^{nd} **position**	3^{rd} **position**	4^{th} **position**
DE				
DF				

2. What is the relationship between the measurements of DE and DF?

3. Complete the following statement: If a point is on the bisector of an angle, then the point is __________________-_____ from the sides of the angle.

Problem 2 –Exploring the Incenter of a Triangle

Open a new *Cabri Jr.* file by pressing $Y =$, selecting **New**, and answer **no** if asked to save. Construct an acute $\triangle ABC$ and construct the angle bisector of all three angles. Using *Cabri Jr.*, answer the following questions.

4. What do you notice about the angle bisectors of all three angles?

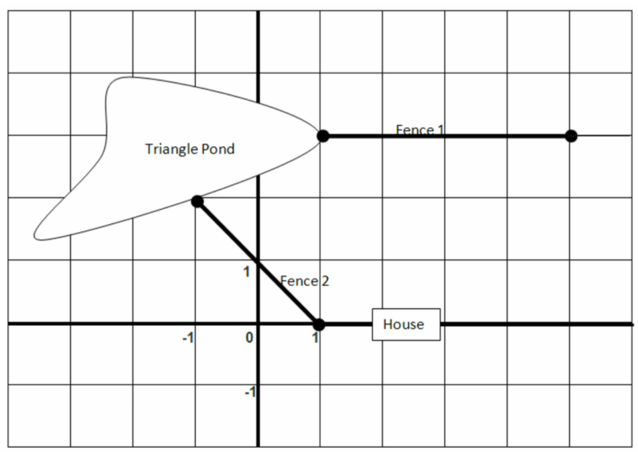
5. The point of concurrency for the angle bisectors is the incenter. Create and label this point R. Can you move vertex A so that the incenter is on a side of $\triangle ABC$? If so, what kind of triangle is ABC in this case?

6. Can you move vertex A so that the incenter is outside of $\triangle ABC$? If so, what kind of triangle is ABC in this case?
7. What kind of a triangle guarantees that the incenter is on the inside of the triangle?
8. Measure the distance from the incenter to each side of the triangle. What relationship is true about the distances?

Problem 3 –Extension

A family purchases a house with the plot given below. The deed states that the backyard of their property is from Fence 2 to Triangle Pond, and equidistant from Fence 1 and Fence 2. The family would like to build a fence around their property. (Assume that the backyard of the property starts at the horizontal axis.)

9. Find at least two possible coordinates for fence posts for the new fence. Keep in mind that the new fence is equidistant from Fence 1 and Fence 2. Round your answer to the nearest tenth.

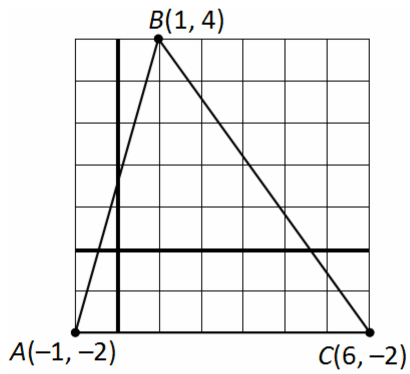


6.3 Balancing Point

This activity is intended to supplement Geometry, Chapter 5, Lesson 4.

Problem 1 –Exploring the Centroid of a Triangle

1. Cut out the triangle below (or use the triangle your teacher provides) and try to balance it on the eraser of your pencil. Mark the point on the triangle where the triangle was balanced. What are the coordinates of this point?



We will now explore how we can use our handhelds to find the point where the triangle will be balanced. The balancing point for an object is called the center of mass.

Problem 2 –Exploring the Medians of a Triangle

2. Define **Median of a Triangle**.

Open up the *Cabri Jr.* application, then open the figure *Centroid*. You are given a triangle with vertices at points A, B, and C as above. Use your calculator to create the three medians of $\triangle ABC$.

3. What do you notice about the three medians of $\triangle ABC$?

4. What is the coordinate of the point of intersection of the medians?

5. How does this compare to the balancing point of the triangle that you balanced on your pencil?

6. Using the coordinates of the vertices of the triangle, find the average of the three $x-$coordinates and the average of the three $y-$coordinates. How do these averages relate to the coordinates of the intersection of the medians?

7. Define **Centroid**.

Problem 3 –Extending the Centroid

The **medial triangle** is the triangle formed by connecting the midpoints of the sides of a triangle.

Open the figure *Medial*. You will see a triangle and its centroid. Find the medial triangle and the centroid of the medial triangle.

8. What do you notice about the centroid of the original triangle and the centroid of the medial triangle?

Problem 4 –Extending the Median

The **midsegment** is a line segment joining the midpoints of two sides of a triangle.

Open the figure *Midseg*. You will see $\triangle ABC$ with midpoints D, E, and F of sides $\overline{AC}$, $\overline{AB}$, and $\overline{BC}$, respectively. Midsegment DE is drawn.

- Create the median of A and construct the intersection point, G, of the median and the midsegment.
- Find the lengths of $\overline{AG}$, $\overline{FG}$, $\overline{DG}$, and $\overline{EG}$.

9. What do you notice about the relationship between the median and the midsegment?

6.4 Hey Ortho! What's your Altitude?

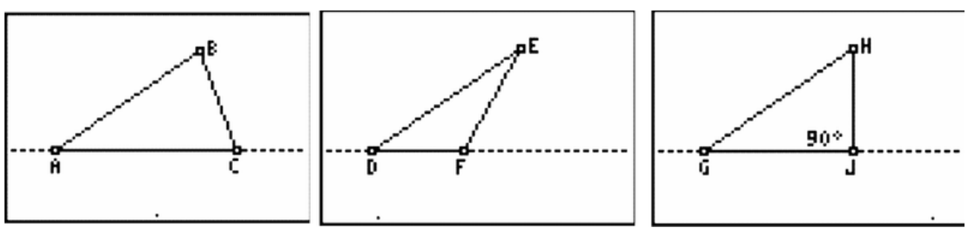
This activity is intended to supplement Geometry, Chapter 5, Lesson 4.

Problem 1 –Exploring the Altitude of a Triangle

1. Define **Altitude of a Triangle.**

Draw the altitudes of the triangles in the *Cabri Jr*. files *ACUTE, OBTUSE*, and *RIGHT* and then sketch the altitudes on the triangles below. To do this, start the *Cabri Jr*. application by pressing **APPS** and selecting **Cabri Jr**. Open the file *ACUTE* by pressing $Y =$, selecting **Open...**, and selecting the file. Construct the altitude of $\triangle ABC$ on your handheld by pressing **ZOOM**, selecting **Perp.**, clicking on the side of the triangle, and then clicking on the opposite vertex. Repeat for the files *OBTUSE* and *RIGHT*.

2. Draw the altitudes for $\triangle ABC$, $\triangle DEF$, and $\triangle GHJ$ below.



3. Fill in the blanks of the following statements about whether the altitude of a triangle is inside, outside, or on a side of the triangle.

a. For the acute $\triangle ABC$, the altitude of vertex B is _______________ the triangle.

b. For the obtuse $\triangle DEF$, the altitude of vertex E is _______________ the triangle.

c. For the right $\triangle GHJ$, the altitude of vertex H is ________________ the triangle.

Problem 2 –Exploring the Orthocenter

Open the file *TRIANGLE*. You are given $\triangle ABC$. Construct the altitude of each vertex of the triangle. Use your constructions to answer the following questions.

4. What do you notice about the altitudes of all three vertices?

5. The point of concurrency for the altitudes is the **orthocenter.** Create and label this point R. Is it possible to move vertex B so that the orthocenter is on a side of $\triangle ABC$? If so, what kind of triangle is ABC in this case?

6. Can you move vertex B so that the orthocenter is inside of $\triangle ABC$? If so, what kind of triangle is ABC in this case?

7. Can you move vertex B so that the orthocenter is outside of $\triangle ABC$? If so, what kind of triangle is ABC in this case?

Problem 3 –Exploring the Altitude of an Equilateral Triangle

Open the file *EQUILATE*. You are given an equilateral triangle ABC with altitude $\overline{BD}$ and point P on the inside of the triangle. Find the distance from point P to the three sides of the triangle using the **Length** tool found by pressing **GRAPH** and selecting **Measure >D. Length**. Also, find the length of $\overline{BD}$ and answer the following questions.

8. Use the **Calculate** tool to calculate $EP+FP+GP$. Move point A to 2 different positions and record the measurements in the table below. Next, move point P to 2 different positions and record the measurements in the table below.

TABLE 6.3:

Position	1^{st} **position**	2^{nd} **position**	3^{rd} **position**	4^{th} **position**
BD				
$EP+FP+GP$				

9. What is the relationship between the measurements of BD and $EP+FP+GP$?

10. Complete the following statement: The sum of the distances from any point in the interior of an equilateral triangle to the sides of the triangle is _______________.

Problem 4 –Exploring the Orthocenter of a Medial Triangle

The **medial triangle** is the triangle formed by connecting the midpoints of the sides of a triangle.

Open the file *MEDIAL2*. You are given a triangle, its medial triangle, and the orthocenter of the medial triangle.

11. What triangle center (centroid, circumcenter, incenter, or orthocenter) for $\triangle ABC$ is the orthocenter, O, of the medial $\triangle DEF$?

CHAPTER 7 SE Quadrilaterals

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 6
- CK-12 Geometry - Basic: Chapter 6

7.1 Properties of Parallelograms

This activity is intended to supplement Geometry, Chapter 6, Lesson 2.

Problem 1 –Properties of Parallelograms

In this problem, you will look at the definition of parallelogram and several properties of the parallelograms. Open the *Cabri Jr*. application by pressing **APPS** and selecting **Cabri Jr**.

1. Define *parallelogram*.

2. Open the file *PAR1* by pressing $F1$, selecting **Open...**, and selecting the file. *PAR1*, shows parallelogram ***QUAD***. Grab and drag point Q to two different positions and record the lengths of the segments in the table (rows 1 and 2). Then, grab and drag point U to two different positions and record the data in the table (rows 3 and 4).

TABLE 7.1:

Position	$\overline{QU}$	$\overline{UA}$	$\overline{AD}$	$\overline{DQ}$
1				
2				
3				
4				

3. What do you notice about the lengths of opposite sides of a parallelogram?

Angles of a polygon that share a side are consecutive angles. Angles that do not share a side are called opposite angles.

4. Open the file *PAR2*, which shows parallelogram ***QUAD***. Grab and drag point Q to four different positions and record the measurement of the angles in the table.

TABLE 7.2:

Position	$\angle Q$	$\angle U$	$\angle A$	$\angle D$
1				
2				
3				
4				

5. What do you notice about consecutive angles of a parallelogram?

6. What do you notice about opposite angles of a parallelogram?

Problem 2 –Diagonals of Parallelograms

For this problem, you will look at the properties of the diagonals of parallelograms.

7. Open the file *PAR3*, which shows parallelogram ***QUAD***. Record the lengths of the segments in the table (row 1). Then, grab and drag point U to three different positions and record the data in the table (rows 2, 3, and 4).

TABLE 7.3:

Position	$\overline{QR}$	$\overline{AR}$	$\overline{DR}$	$\overline{RU}$
1				
2				
3				
4				

8. What do you notice about the diagonals of the parallelogram?

Problem 3 –Extension: Proving Parallelograms

In this problem, you will explore various properties and see if they guarantee that a quadrilateral is a parallelogram.

9. Does having both pairs of opposite sides congruent guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

10. Does having one pair of opposite sides congruent and one pair of opposite sides parallel guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

11. Does having one pair of opposite sides parallel and one pair of opposite angles congruent guarantee that the quadrilateral is a parallelogram? Draw an example or counterexample.

Problem 4 –Extension: Extending the Properties

For this problem,

- Create any quadrilateral and name it *GEAR*.
- Find the midpoint of each side.
- Connect the midpoints to form a quadrilateral.

12. What type of quadrilateral is formed after you connected the midpoints of *GEAR*?

13. How can you prove what type of figure is created by connecting the midpoints?

7.2 Properties of Trapezoids and Isosceles Trapezoids

This activity is intended to supplement Geometry, Chapter 6, Lesson 5.

In this activity, you will explore:

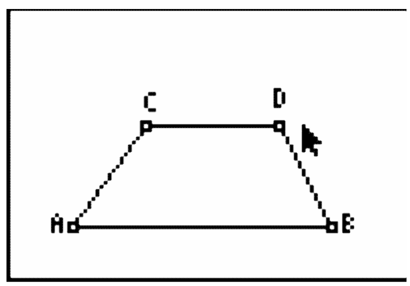
- *the properties of trapezoids, including isosceles trapezoids*

To begin, open up a blank Cabri Jr. document.

Let's start with a line segment, AB, and a point C above the segment.

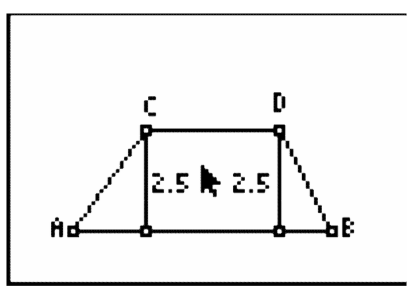
Create a line through C that is parallel to $\overline{AB}$. Construct a point on the new line and label it D.

Hide the parallel line and complete the trapezoid. Measure the interior angles. Are the base angles at C and D congruent? Will they ever be? What about the base angles at A and D? Measure the lengths of the diagonals $\overline{AD}$ and $\overline{BC}$. Will they ever be congruent?



To verify that the lines are parallel, construct lines through C and D that are perpendicular to $\overline{AB}$.

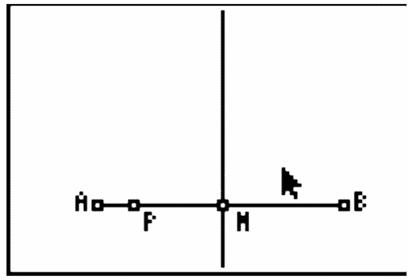
Construct the points of intersection of the new lines with $\overline{AB}$. Construct lines segments to connect C and D to the line through $\overline{AB}$ and measure the lengths of these segments. Will these segments always be equal? Should they be? Why?



Label the new points on $\overline{AB}$ as E and F and measure the lenghts of $\overline{AC}$ and $\overline{BD}$. Will $\overline{AC}$ ever be congruent to $\overline{BD}$?

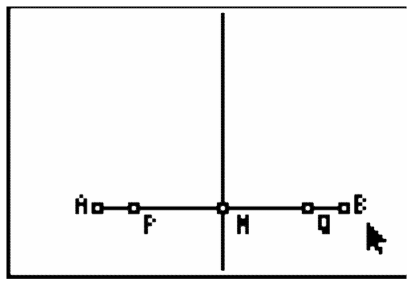
Try to drag point C or point D to make $AC = BD$. Due to the screen resolution, this can be very difficult. Construct $\overline{AE}$ and $\overline{BF}$. For an isosceles trapezoid, these segments should also be congruent. Can you explain why?

In order to construct an isosceles trapezoid, start with a line segment, AB. Construct the midpoint, M, and another point, P, on $\overline{AB}$. Construct a line through the M that is perpendicular to $\overline{AB}$.



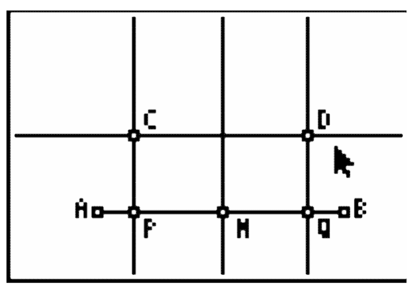
Press **TRACE/F4** and select the Reflection option. Click on the perpendicular line through M and then point P.

A new point will appear on the line segment on the right side. Label this point Q.



Construct perpendicular lines through P and Q. Construct point C on the perpendicular through P.

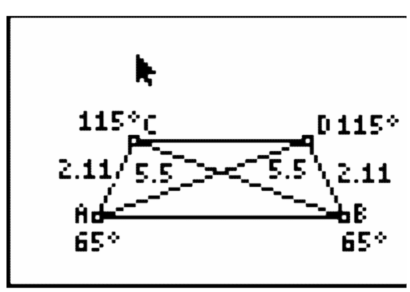
Construct a perpendicular to $\overline{AB}$ through point Q and a line through C that is parallel to $\overline{AB}$. Construct point D at the intersection of these two lines.



Hide the parallel and perpendicular lines and points M, P and Q. Complete the trapezoid and measure $\overline{AC}$ and $\overline{BD}$. Can you explain why these line segments are congruent? In an isosceles trapezoid, the diagonals are congruent and the adjacent base angles are congruent.

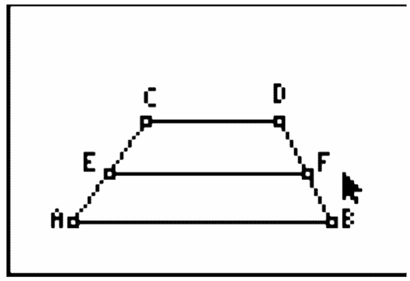
Measure the base angles—the interior angles at A, B, C and D. Which angles are congruent? Did you expect those angles to be congruent? Can you prove that they are?

Construct and measure the lengths of the two diagonals $\overline{AD}$ and $\overline{BC}$. Should they be congruent? Can you prove that they are?



Drag point C and watch the angles and sides. Are all of the properties established above preserved?

However, one property that is common to all trapezoids is that the line segment connecting the non-parallel sides is also parallel to these sides and its length is half the sum of the parallel sides. Construct a trapezoid $ABCD$. Construct the midpoints at E and F and construct $\overline{EF}$.



Measure the lengths of $\overline{CD}$, $\overline{EF}$ and $\overline{AB}$. How could you prove that $\overline{EF}$ is parallel to $\overline{CD}$ and $\overline{AB}$?

Use the Calculate tool to find the sum of the lengths of $\overline{CD}$ and $\overline{AB}$.

Place the number "2" on the screen and divide the sum by 2 using the calculate tool. Will this result always equal the length of $\overline{EF}$? Can you prove this result?

7.3 Properties of Rhombi, Kites, and Trapezoids

This activity is intended to supplement Geometry, Chapter 6, Lesson 5.

Problem 1 –Properties of Rhombi

You will begin this activity by looking at angle properties of rhombi. Open the *Cabri Jr.* application by pressing **APPS** and selecting **Cabri Jr**. Open the file **READ1** by pressing $Y =$, selecting **Open...**, and selecting the file. You are given rhombus *READ* and the measure of angles R, E, A, and D.

1. Move point E to four different positions. Record the measures of angles R, E, A, and D in the table below.

TABLE 7.4:

Position	$\angle R$	$\angle E$	$\angle A$	$\angle D$
1				
2				
3				
4				

2. Consecutive angles of a rhombus are ____________________.

3. Opposite angles of a rhombus are ____________________.

Next, you will look at the properties of the angles created by the diagonals of a rhombus. Open the file **READ2**. You are given rhombus *READ* and the measure of angles *ESR*, *ASE*, *RSD*, and *ASD*.

4. Move point E to four different positions. Angles formed by the intersection of the two diagonals of a rhombus are ____________________.

Open the file **READ3**. You are given rhombus *READ* and the measure of all angles created by the diagonals of the rhombus.

5. Move point E to four different positions. The diagonals of a rhombus _________ the vertices of the rhombus.

Problem 2 –Properties of Kites

You will begin this problem by looking at angle properties of kites. Open the file **KING1**. You are given kite *KING* and the measure of angles K, I, N, and G.

6. Move point I to two different positions and point K to two different positions. Record the measures of angles K, I, N, and G in the table below.

TABLE 7.5:

Position	$\angle K$	$\angle I$	$\angle N$	$\angle G$
1				
2				

TABLE 7.5: (continued)

Position	$\angle K$	$\angle I$	$\angle N$	$\angle G$
3				
4				

7. What do you notice about the opposite angles of a kite?

Next, you will look at the properties of the angles created by the diagonals of a kite. Open the file **KING2**. You are given kite $KING$ and the measure of angles ISK, GSN, ISN, and GSK.

8. Move point I to four different positions. Angles formed by the intersection of the two diagonals of a kite are ___________________.

Open the file **KING3**. You are given kite $KING$ and the measure of all angles created by the diagonals of the kite.

9. Move point I to four different positions. What do you notice about the angles created by the diagonals of a kite?

Problem 3 –Properties of Trapezoids

In this problem, you will look at angle properties of trapezoids. Open the file **TRAP**. You are given trapezoid $TRAP$ and the measure of angles T, R, A, and P.

10. Move point R to four different positions. Record the measures of angles T, R, A, and P in the table below.

TABLE 7.6:

Position	$\angle T$	$\angle R$	$\angle A$	$\angle P$
1				
2				
3				
4				

11. What do you notice about the angles of a trapezoid?

CHAPTER 8 SE Similarity - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 7
- CK-12 Geometry - Basic: Chapter 7

8.1 Construct Similar Triangles

This activity is intended to supplement Geometry, Chapter 7, Lesson 4.

Problem 1 –Similar Triangles using Dilation

- Open Cabri Jr. and open a new file.

Student A: Construct a triangle and label the vertices P, Q, and R. Send the file to Students B and C. Measure $\angle P$ and $\overline{PQ}$.

Student B: Measure $\angle Q$ and $\overline{QR}$.

Student C: Measure $\angle R$ and $\overline{PR}$.

Note: Place the measurements in the top right corner.

- Construct point C in the center of the triangle.
- Place the number 2 on the screen.
- Select the **Dilation** tool and then select point C, the triangle, and the number 2.
- Label the triangle that appears, XYZ, so that X corresponds to P, Y to Q and Z to R.

Student A: Measure $\angle X$ and $\overline{XY}$.

Student B: Measure $\angle Y$ and $\overline{YZ}$.

Student C: Measure $\angle Z$ and $\overline{XZ}$.

1. What do you notice about the two angles? Compare this to the other students in your group.

2. How do the lengths of the sides compare? Is this the result that you were expecting?

3. Drag your point in $\triangle PQR$. Do the corresponding angles remain congruent? Does the relationship between corresponding sides remain the same? Compare your results to others in your group.

4. Drag point C. Are the relationships preserved under this change? Compare your results to others in your group. Does it make any difference that each person may have constructed a different center point.

Problem 2 –Different Scale Factors

Using the **Alph-Num** tool, change the scale factor from 2 to 3.

5. What happens to your construction? Does this change the relationships you found in Problem 1?

6. Change the scale factor from 3 to 0.5. How does this affect your construction?

7. Summarize your findings by stating the effect of a dilation on corresponding angles and sides.

8. Drag $\triangle PQR$ to the lower left corner and drag point C to the right of the triangle. Change the scale factor to -2. Are the properties that you noted above preserved by these changes?

Problem 3 –Similar Triangles with a Parallel Line

Student A: Open a new file and construct a triangle PQR. Send the file to Students B and C. Measure $\angle P$ and $\overline{PQ}$.

Student B: Measure $\angle Q$ and $\overline{QR}$.

Student C: Measure $\angle R$ and $\overline{PR}$.

- Construct a point on $\overline{PQ}$ and label it S.
- Construct a line through S that is parallel to $\overline{QR}$.
- Label the point of intersection of side PR and the parallel line as T.
- Hide the parallel line and construct line segment ST.

9. Can you prove that all three pairs of corresponding angles are congruent? If so, then $\triangle PST$ is similar to $\triangle PQR$.

10. Calculate the ratio of $PQ : PS$. Then calculate the ratios of the other sides. If all the ratios are equivalent, then the sides are proportional. Are the sides in $\triangle PST$ and $\triangle PQR$ proportional?

8.2 Side-Splitter Theorem

This activity is intended to supplement Geometry, Chapter 7, Lesson 5.

Problem 1 –Side Splitter Theorem

In *SIDESP1.8xv*, you are given $\triangle CAR$. You are also given $\overline{DS}$ which is parallel to side CR.

1. Move point D to 2 different positions and point A to 2 different positions and collect the data in the table below. Calculate the ratios of AD to DC and AS to SR for each position and record the calculation in the table below.

TABLE 8.1:

Position	AD	DC	AS	SR	$\frac{AD}{DC}$	$\frac{AS}{SR}$
1						
2						
3						
4						

2. Make some observations about the ratios of the sides in the triangle. What relationships do you notice?

3. Use the table to complete the following conjecture about the relationship between $\frac{AD}{DC}$ and $\frac{AS}{SR}$. If side DS is parallel to side CR, then ______________.

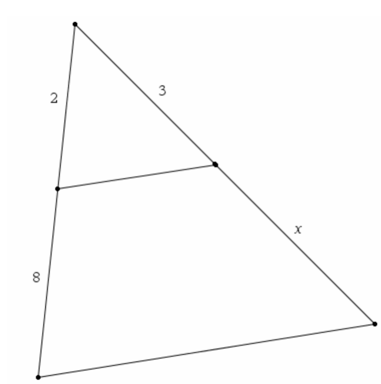
4. In *SIDESP2.8xv*, drag point A. Make some observations about the relationship of the ratios $\frac{AD}{DC}$ and $\frac{AS}{SR}$?

5. In *SIDESP2.8xv*, drag point D. Make some observations about the relationship of the ratios $\frac{AD}{DC}$ and $\frac{AS}{SR}$?

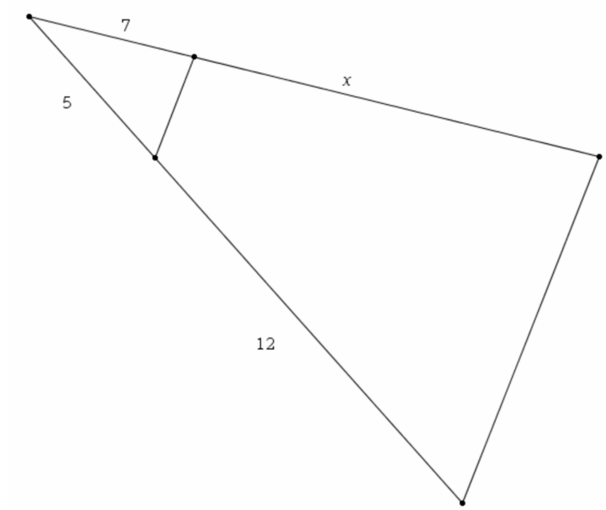
6. Why are the results different when moving point A versus moving point D?

Problem 2 –Application of the Side-Splitter Theorem

7. Find the value of x.



8. Find the value of x.



Problem 3 –Extension of the Side-Splitter Theorem

For this problem, we will look at a corollary of the side-splitter theorem.

9. In *SIDESP3.8xv*, move point U to 2 different positions and point N to 2 different positions and collect the data in the table on the accompanying worksheet.

TABLE 8.2:

Position	RN	NO	EA	AS	$\frac{RN}{NO}$	$\frac{EA}{AS}$
1						
2						
3						
4						

10. What do you notice about the ratios $\frac{RN}{NO}$ and $\frac{EA}{AS}$?

11. Use the table to complete the following conjecture about the relationship between $\frac{RN}{NO}$ and $\frac{EA}{AS}$. If lines RE, NA, and OS are parallel and cut by two transversals, then __________________________.

CHAPTER 9 SE Right Triangle Trigonometry - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

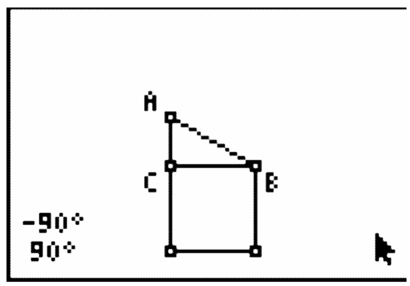
- CK-12 Geometry - Second Edition: Chapter 8
- CK-12 Geometry - Basic: Chapter 8

9.1 The Pythagorean Theorem

This activity is intended to supplement Geometry, Chapter 8, Lesson 1.

Problem 1 –Squares on Sides Proof

1. Why is the constructed quadrilateral a square?



2. Record three sets of area measurements you made by dragging points A, B, and/or C.

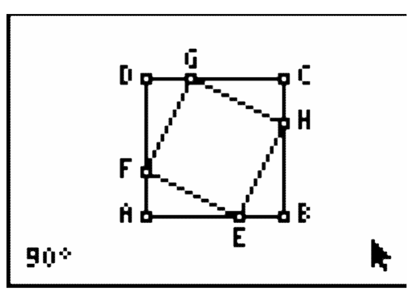
TABLE 9.1:

Square on $\overline{BC}$	**Square on $\overline{AC}$**	**Square on $\overline{AB}$**	**Sum of squares**

3. What conjecture can you make about the areas of the three squares? Does this relationship always hold when a vertex of $\triangle ABC$ is dragged to a different location?

Problem 2 –Inside a Square Proof

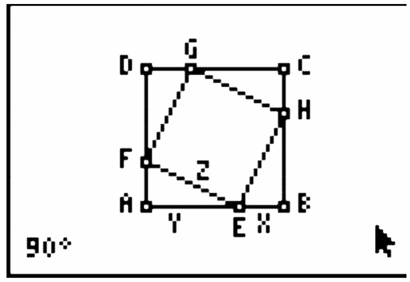
4. Prove that constructed quadrilateral $EFGH$ is a square.



5. $ABCD$ is a square with all sides of length $(x+y)$.

The area of the square $ABCD$ is $(x+y)^2 = x^2+2xy+y^2$

Each of the triangles, $\triangle EFA$, $\triangle FGD$, $\triangle GHC$ and $\triangle HEB$, is a right triangle with height x and base y. So, the area of each triangle is $\frac{1}{2}xy$.



$EFGH$ is a square with sides of length z. So the area of $EFGH$ is z^2.

Looking at the areas in the diagram we can conclude that:

$$ABCD = \triangle EFA + \triangle FGD + \triangle GHC + \triangle HEB + EFGH$$

Substitute the area expressions (with variables x, y, and z) into the equation above and simplify.

6. Record three sets of numeric values for $\triangle HEB$.

TABLE 9.2:

BE	BE^2	HB	HB^2	$BE^2 + HB^2$	EH	EH^2

7. Does $BE^2 + HB^2 = EH^2$ when E is dragged to a different locations?

8. Does $BE^2 + HB^2 = EH^2$ when A or B are dragged to different locations?

9.2 Investigating Special Triangles

This activity is intended to supplement Geometry, Chapter 8, Lesson 4.

Problem 1 –Investigation of

First, turn on your TI-84 and press **APPS**. Arrow down until you see **Cabri Jr** and press **ENTER**. Open the file **ISOSC**. This file has a triangle with an isosceles triangle with $AB = AC$.

Using the **Perpendicular** tool (**ZOOM >Perp.**), construct a perpendicular from point A to side BC. Label the point of intersection of this line with BC as D. To name the point, they need to select the **Alph-Num** tool (**GRAPH >Alph-Num**), select the point, and press x^{-1} **ENTER** for the letter D.

Construct line segments BD and CD (π **>Segment**) and then measure the segments (**GRAPH >Measure >D. Length**).

$BD =$ ________ $CD =$ ________

Would you have expected these segments to be equal in length?

Drag point C to see the effect on the lengths of the line segments. It appears that the perpendicular from the vertex always bisects the opposite side. Measure the angles BAD and CAD.

$\angle BAD =$ ________ $\angle CAD =$ ________

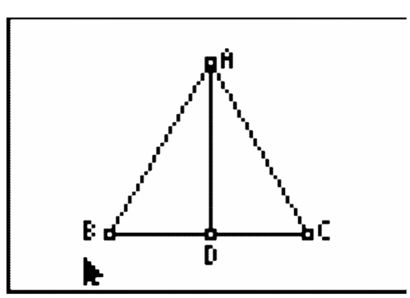
Will they always be equal? ______________________________

Problem 2 –Investigation of

Open the file **EQUIL**. Note that all three angles are 60° angles.

Construct the perpendicular from A to side BC. Label the point of intersection as D.

From the construction above, we know that D bisects BC and that $m\angle BAD = 30°$.



Construct segment BD. We now have triangle BAD where $m\angle D = 90^\circ$, $m\angle B = 60^\circ$ and $m\angle A = 30^\circ$. We also have triangle ACD where $m\angle A = 30^\circ$, $m\angle C = 60^\circ$ and $m\angle D = 90^\circ$.

This completes the construction of two $30^\circ - 60^\circ - 90^\circ$ triangles. We will work only with the triangle BAD.

Measure the three sides of triangle BAD.

$AB =$ ________ $BD =$ ________ $AD =$ ________

Press σ and select the **Calculate** tool. Click on the length of BD, then on the length of AB. Press the ∞ key. Move it to the upper corner. Repeat this step to find the ratio of $AD : AB$ and $AD : BD$. These ratios will become important when you start working with trigonometry.

$BD : AB =$ ________ $AD : AB =$ ________ $AD : BD =$ ________

Drag point C to another location. What do you notice about the three ratios?

Problem 3 –Investigation of

Press the o button and select **New** to open a new document.

To begin the construction of the $45^\circ - 45^\circ - 90^\circ$ triangle, construct line segment AB and a perpendicular to AB at A.

Use the compass tool with center A and radius AB. The circle will intersect the perpendicular line at C.

Hide the circle and construct segments AC and BC.

Explain why $AB = AC$ and why angle $ACB =$ angle ABC?

Why are these two angles 45° each?

Measure the sides of the triangle.

$AC =$ ________ $BC =$ ________ $AB =$ ________

Use the **Calculate** tool to find the ratio of $AC : BC$ and $AC : AB$. Once again, these ratios will be important when you study trigonometry.

Drag point B and observe what happens to the sides and ratios.

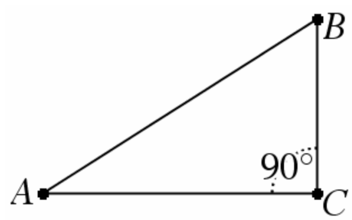
Why do the ratios remain constant while the sides change?

9.3 Ratios of Right Triangles

This activity is intended to supplement Geometry, Chapter 8, Lesson 5.

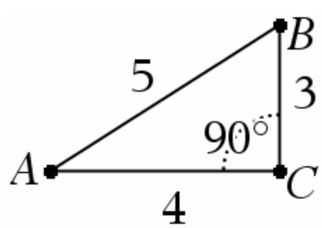
Problem 1 –Exploring Right Triangle Trigonometry

We will begin this activity by looking at the definitions of the sine, cosine, and tangent of a right triangle. Start the *Learning Check* application by pressing **APPS** and selecting **LearnChk**. Open the file *Right Triangle Trigonometry*. You are given the definition for the sine, cosine, and tangent of a right triangle. Copy the definitions onto your worksheet.



1. What is the definition of $\sin A$ for right $\triangle ABC$?
2. What is the definition of $\cos A$ for right $\triangle ABC$?
3. What is the definition of $\tan A$ for right $\triangle ABC$?

Answer the following questions about sine, cosine, and tangent for $\triangle ABC$.



4. What is $\sin A$?
5. What is $\cos A$?
6. What is $\tan A$?
7. What is $\sin B$?
8. What is $\cos B$?
9. What is $\tan B$?

Problem 2 –Exploring the Sine Ratio of a Right Triangle

For this problem, we will investigate the sine ratio. Start the *Cabri Jr.* application by pressing A and selecting **Cabri Jr**. Open the file *TRIG* by pressing $Y =$, selecting **Open...**, and selecting the file. You are given right triangle ABC.

10. Grab and drag point B. Record the data you collected in the table on the next page. Leave the last column blank for now.

TABLE 9.3:

Position	BC	AB	$\frac{BC}{AB}$	$\sin^{-1}\frac{BC}{AB}$
1				
2				
3				
4				

11. What do you notice about the ratio of BC to AB?

12. Did $\angle A$ change when you moved point B in $\triangle ABC$?

Because the ratio remains the same and $\angle A$ remains fixed, we can use the ratio of BC to AB to find the measurement of $\angle A$. To do this, we will use the definition of sine and the inverse of sine. By definition, $\sin A = \frac{BC}{AB}$. To find the measurement of $\angle A$, we use the inverse of sine to get the formula $A = \sin^{-1}\frac{BC}{AB}$. Exit *Cabri Jr.* and go to the home screen to find the inverse sine of $\frac{BC}{AB}$. Record this into the last column of the table above.

13. What is the measurement of $\angle A$?

14. What is the measurement of $\angle B$?

Problem 3 –Exploring the Cosine Ratio of a Right Triangle

For this problem, we will investigate the sine ratio. Start the *Cabri Jr.* application and open the file *TRIG*. You are given right triangle ABC.

15. Collect data for four positions of point B like that which was done in Problem 2.

TABLE 9.4:

Position	AC	AB	$\frac{AC}{AB}$	$\cos^{-1}\frac{AC}{AB}$
1				
2				
3				
4				

Because the ratio remains the same, and $\angle A$ remains fixed, we can use the ratio of AC to AB to find the measurement of $\angle A$. To do this, we will use the definition of cosine and the inverse of cosine. By definition, $\cos A = \frac{AC}{AB}$. To find the measurement of $\angle A$, we use the inverse of cosine to get the formula $A = \cos^{-1}\frac{AC}{AB}$. Exit *Cabri Jr.* and go to the home screen to find the inverse cosine of $\frac{AC}{AB}$. Record this into the last column of the table above.

16. What is the measurement of $\angle A$?

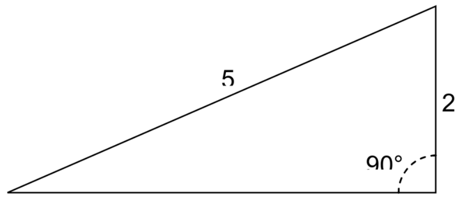
17. What is the measurement of $\angle B$?

18. How would you solve an equation of the form $\tan A = \frac{BC}{AC}$?

Problem 4 –Applying the Sine, Cosine, and Tangent Ratio of a Right Triangle

Find and label the measure of each angle given two sides of the right triangle.

19.



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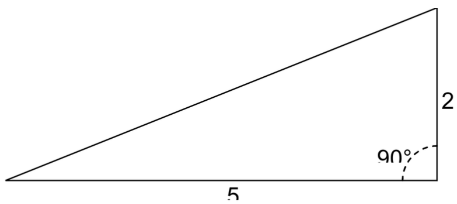

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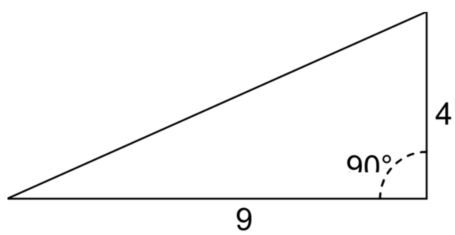

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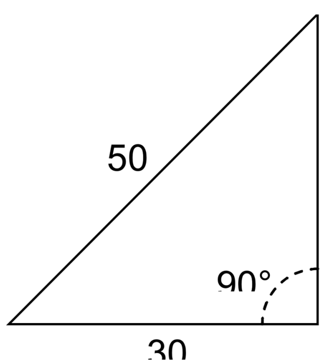

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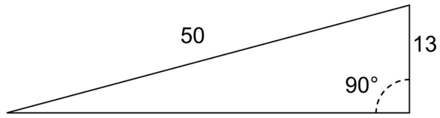

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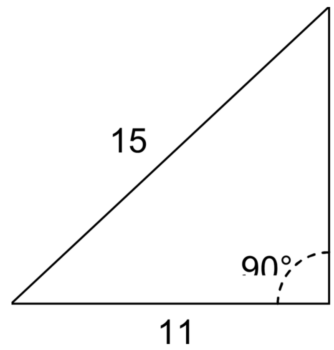

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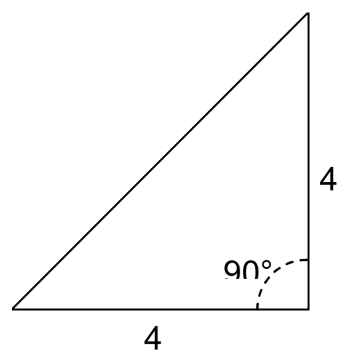

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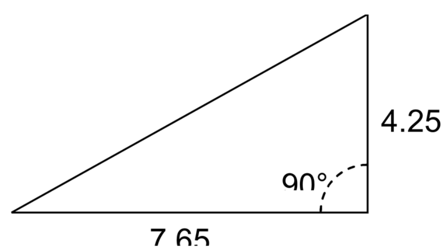


CHAPTER 10 SE Circles - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 9
- CK-12 Geometry - Basic: Chapter 9

10.1 Chords and Circles

This activity is intended to supplement Geometry, Chapter 9, Lesson 3.

Introduction

When hikers and skiers go into terrain where there is a risk of avalanches, they take safety equipment including avalanche rescue beacons. An avalanche rescue beacon sends and receives electromagnetic field signals that can travel up to about 30 meters. The search pattern used to locate a beacon buried in the snow is based on the properties of chords and diameters in circles.

Problem 1 –Relationship between a chord an its perpendicular bisector

1. Open Cabri Jr. and construct a circle to represent the beacon signal. Hide the center of the circle.

2. Construct any chord to represent the path of a rescuer as he walks a straight path, beginning at a point where the signal starts and ending where the signal disappears. Label the endpoints of this chord A and B.

3. The rescuer walks back to the midpoint of this path. Find the midpoint of segment AB and label it M.

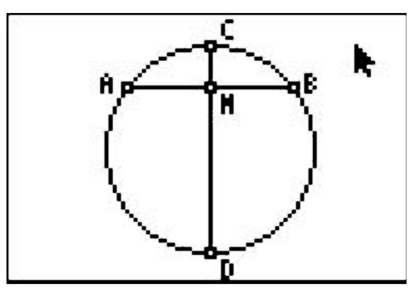
4. Construct a line perpendicular to segment AB through M, to represent the rescuer walking away from the path at a 90° angle until the signal disappears.

5. Find one intersection point of the perpendicular line and the circle. Label it C.

6. The rescuer turns around and walks in the opposite direction until the signal disappears again. Find the other intersection point of the perpendicular line and the circle. Label it D.

7. Hide the perpendicular line. Construct a segment connecting points C and D. A sample figure is shown.

8. The rescuer walks back to the midpoint of this new path.



Find the midpoint of segment CD and label it X. This will be the center of the circle formed by the beacon signals. The rescuer finds the missing person here!

9. To confirm that you have located the center of the circle, measure the distances from X to A, B, C, and D.

Problem 2 –Extension

10. Write a proof of the relationship used in the activity. Given a chord of a circle and its perpendicular bisector, prove that the perpendicular bisector passes through the center of the circle.

11. Use a compass and straightedge to construct a circle and a chord. Construct the perpendicular bisector of the chord and see that it passes through the center of the circle.

10.2 Inscribed Angle Theorem

This activity is intended to supplement Geometry, Chapter 9, Lesson 4.

Problem 1 –Inscribed Angle Theorem

Start the *Cabri Jr*. application by pressing the **APPS** key and selecting **Cabri Jr**. Open the file *INSCRIB1* by pressing $Y =$, selecting **Open...**, and selecting the file. In *INSCRIB1*, you are given circle D with radius AD. Angle ADB is a central angle and $\angle ACB$ is an inscribed angle.

1. Move point A to 2 different positions and point C to 2 different positions and collect the data in the table below. Calculate the ratios of $m\angle ACB$ to $m\angle ADB$ for each position and record the calculation in the table below.

TABLE 10.1:

Position	Measure of $\angle ACB$	Measure of $\angle ADB$	$\frac{m\angle ACB}{m\angle ADB}$
1			
2			
3			
4			

2. Angles ACB and ADB are said to intercept the same arc, AB, because they go through the same points A and B on the circle. An inscribed angle in a circle is __________ the measure of the central angle that intercepts the same arc on the circle.

Open the file *INSCRIB2*. You are given circle D. Angles ACB and AEB are inscribed angles and intercept the same arc.

3. Move point A to 2 different positions and move point E to 2 different positions and collect the data in the table below.

TABLE 10.2:

Position	Measure of $\angle ACB$	Measure of $\angle AEB$
1		
2		
3		
4		

4. Make a conjecture about two inscribed angles who intercept the same arc in a circle.

Open the file *INSCRIB3*. You are given circle D. Use this file to answer the following questions.

5. In circle D, what kind of segment is AB?

6. In circle D, what is $m\angle ACB$? (Hint: Use your answer to Exercise 4 to help you.).

Problem 2 –Extension of the Inscribed Angle Theorem

Open the file *INSCRIB4*. You are given circle D, AB, and $\angle ACB$. Point G is a point on AB, $\angle ACB$ is an inscribed angle, and AG and BG are lines.

7. Move point A to 2 different positions and move point G to 2 different positions and collect the data in the table below.

TABLE 10.3:

Position	Measure of $\angle ACB$	Measure of $\angle ADB$	Measure of $\angle AGE$
1			
2			
3			
4			

8. Make a conjecture: The angle formed by the intersection of $\overrightarrow{AG}$ and $\overrightarrow{BG}$ is _______ the measure of the central angle ADB.

Open the file *INSCRIB5*. You are given circle D, arc AB, and $\angle ACB$. Point G is a point on arc AB and $\angle ACB$ is an inscribed angle. Also, you are given chord AB and a tangent line BE.

9. Move point A to 2 different positions and move point B to 2 different positions and collect the data in the table below.

TABLE 10.4:

Position	Measure of $\angle ACB$	Measure of $\angle ADB$	Measure of $\angle ABE$
1			
2			
3			
4			

10. Make a conjecture: The angle between a chord and the tangent line at one of its intersection points equals _______________ of the central angle intercepted by the chord.

10.3 Circle Product Theorems

This activity is intended to supplement Geometry, Chapter 9, Lesson 6.

Problem 1 –Chord-Chord Product Theorem

Start the *Cabri Jr.* application by pressing the **APPS** key and selecting **Cabri Jr**. Open the file *INSCRIB1* by pressing $Y =$, selecting **Open...**, and selecting the file. In *PRODUC1*, you are given circle O and two chords AB and CD that intersect at point X. You are also given the lengths AX, BX, CX, and DX.

1. Move point A to four different points and collect the data in the table below and calculate the products $AX \cdot BX$ and $CX \cdot DX$.

TABLE 10.5:

Position	AX	BX	CX	DX	$AX \cdot BX$	$CX \cdot DX$
1						
2						
3						
4						

2. What do you notice about the products $AX \cdot BX$ and $CX \cdot DX$?

3. If two chords intersect in the interior of a circle, then the product of the lengths of the segments of one chord is ____________ to the product of the lengths of the segments of the other chord.

Problem 2 –Secant-Secant Product Theorem

Open the file *PRODUC2*. You are given circle O and two chords AB and CD that intersect at point X. You are also given the lengths AX, BX, CX, and DX.

4. Move point A to four different points and collect the data in the table below and calculate the products $AX \cdot BX$ and $CX \cdot DX$.

TABLE 10.6:

Position	AX	BX	CX	DX	$AX \cdot BX$	$CX \cdot DX$
1						
2						
3						
4						

5. What do you notice about the products $AX \cdot BX$ and $CX \cdot DX$?

6. If two secant segments share the same endpoint outside of a circle, then the product of the lengths of one secant segment and its external segment ___________ the product of the lengths of the other secant segment and its external

segment.

Problem 3 –Secant-Tangent Product Theorem

Open the file *PRODUC3*. You are given circle O and two chords AB and CD that intersect at point X. You are also given the lengths AX, CX, and DX.

7. Move point A to four different points and collect the data in the table below and calculate AX^2 and $CX \cdot DX$.

TABLE 10.7:

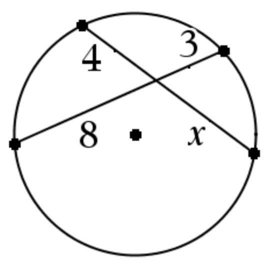
Position	AX	CX	DX	AX^2	$CX \cdot DX$
1					
2					
3					
4					

8. What do you notice about the products AX^2 and $CX \cdot DX$?

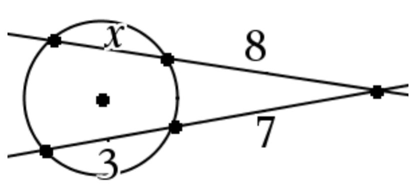
9. If a secant segment and a tangent segment share an endpoint outside of a circle, then the product of the lengths of the secant segment and its external segment _________ the square of the length of the tangent segment.

Problem 4 –Application of Product Theorems

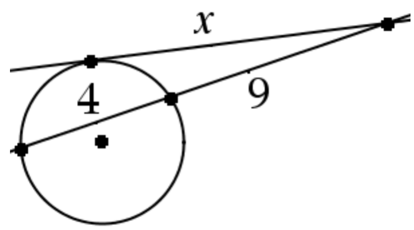
10. Find the value of x.



11. Find the value of x.



12. Find the value of x.


x
4
9

CHAPTER 11 SE Perimeter and Area - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

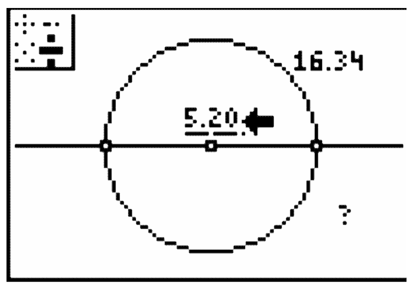
- CK-12 Geometry - Second Edition: Chapter 10
- CK-12 Geometry - Basic: Chapter 10

11.1 Diameter and Circumference of a Circle

This activity is intended to supplement Geometry, Chapter 10, Lesson 4.

In this activity you will

- *Draw a circle*
- *Measure the diameter of the circle*
- *Measure the circumference of the circle*
- *Calculate the ratio of the circumference to the diameter.*



1. Open Cabri Jr. and select **New**. Construct a circle.
2. Draw a line through the two points which determined the circle.
3. The line intersects the circle twice, but only one of these intersection points is marked. Mark the other intersection point by choosing **Point**, and then **Intersection**, from the $F2$ menu. The point is ready to be marked when both the circle and the line are flashing. Now we have two points on the circle which are the endpoints of a diameter.
4. Choose **Measure** and then **D. Length** from the $F5$ menu. Find the length of the diameter by selecting each of its endpoints. Show the measurement rounded to the hundredths and move it to a convenient location.
5. With the **Measurement** tool still active, find the circumference of the circle. Show the measurement rounded to the hundredths and move it to a convenient location.
6. Choose **Calculate** from the $F5$ menu. Select the circumference measurement, press the division key, and then select the diameter measurement. The number displayed is the ratio of the circle's circumference to its diameter.
7. Turn off the **Calculate** tool and grab the center of the circle. Move it to change the size of the circle.
8. To confirm that the ratio remains 3.14, repeat the **Calculate** procedure. (It is actually recalculated each time the size of the circle changes, but it is impossible to tell since this number is unchanging.)

11.2 From the Center of the Polygon

This activity is intended to supplement Geometry, Chapter 10, Lesson 6.

Problem 1 –Area of a Regular Pentagon

A regular polygon is a polygon that is equiangular and equilateral. The apothem of a regular polygon is a line segment from the center of the polygon to the midpoint of one of its sides.

Start the *Cabri Jr.* application by pressing **APPS** and selecting **Cabri Jr**. Open the file *PENTAGON* by pressing $Y =$, selecting **Open...**, and selecting the file. You are given regular pentagon $ABCDE$ with center R. You are given the length of $\overline{CD}$ (side of the polygon), $\overline{RM}$ (apothem), and the area of the polygon.

1. Drag point D to 4 different positions and record the data in the table below. The perimeter and apothem multiplied by perimeter will need to be calculated. The perimeter is the number of sides multiplied the length of $\overline{CD}$.

TABLE 11.1:

Position	Apothem (a)	Perimeter (p)	$a \cdot p$ (apothem times perimeter)	Area
1				
2				
3				
4				

2. Using the table discuss how the **area** and $a \cdot p$ are related?

Problem 2 –Area of a Regular Hexagon

In the problem, you will repeat the process from Problem 1 for a regular hexagon. Open the file *HEXAGON* showing a regular hexagon with center R. You are given the length of $\overline{CD}$ (side of the polygon), $\overline{RM}$ (apothem), and the area of the polygon.

3. Drag point D to 4 different positions and record the data in the table. The perimeter and apothem multiplied by perimeter will need to be calculated. The perimeter is the number of sides multiplied by the length of $\overline{CD}$.

TABLE 11.2:

Position	Apothem (a)	Perimeter (p)	$a \cdot p$ (apothem times perimeter)	Area
1				
2				
3				
4				

4. Using the data you found in both problems, give formula for the area of a regular polygon.

Problem 3 –Area of a Regular Polygon

Now you will look at the proof of the formula for the area of a regular polygon. $Area = \frac{1}{2}a \cdot p$ Open the file *OCTAGON*. Construct segments connecting the vertices of the regular octagon to the center R using the **Segment** tool. Each of these segments is a radius of the octagon.

5. How many triangles are created by the radii of the octagon?

6. Are all of the triangles congruent?

7. Use the **D.Length** measurement tool to measure the sides and the **Angle** measurement tool to measure the angles of one of the triangles. Are the triangles equilateral?

8. What is the area of $\triangle CDR$ in terms of the apothem a and the side of the triangle s?

9. Given the area of one triangle, what is the area of the regular polygon in terms of the length of the apothem a and of one side s for the octagon?

10. What is the area of an n-sided polygon in terms of the length of the apothem a and the length of one side s?

Problem 4 –Area of Regular Polygons

Find the area of the polygon with the given measurements.

11. regular heptagon of apothem 12 in. and sides with length 11.56 in.

12. regular dodecagon of apothem 2.8 cm and sides with length 1.5 cm

13. regular octagon of apothem 12.3 ft and sides with length 10.2 ft

14. regular hexagon of apothem 17.32 mm and perimeter 120 mm

CHAPTER 12 SE Surface Area and Volume - TI

Chapter Outline

This activity is intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 11
- CK-12 Geometry - Basic: Chapter 11

12.1 Surface Area of Cylinders

This activity is intended to supplement Geometry, Chapter 11, Lesson 2.

Problem 1 –Nets

Start the *Cabri Jr.* application by pressing the **APPS** key and selecting **Cabri Jr**. Open the file *CYLINDER* by pressing $Y =$, selecting **Open...**, and selecting the file. You should see a partial net of a right cylinder.

1. What changes occur to the net when the point H is dragged?

2. What changes occur to the net when the point R is dragged?

3. Record 2 sets of measurements of the net:

TABLE 12.1:

Circle Radius	Rectangle Height	Rectangle Length

4. What is the result when you divide the Rectangle Length by the Circle Radius?

5. Explain this result. Drag point R to confirm your conjecture.

Problem 2 –Surface Area

6. Record these measurements:

Circle Radius: __________

Circle Area: __________

Rectangle L: __________

Rectangle Area: __________

Rectangle H: __________

7. Record the steps you performed to find the surface area of the cylinder:

1. ______________________________
2. ______________________________

8. What is the surface area of your cylinder?

9. How is the method used in #7 above related to the formula $SA = 2\pi R^2 + 2\pi RH$?

CHAPTER 13 SE Transformations - TI

Chapter Outline

The activities below are intended to supplement our Geometry FlexBook® resources.

- CK-12 Geometry - Second Edition: Chapter 12
- CK-12 Geometry - Basic: Chapter 12

13.1 Translations with Lists

This activity is intended to supplement Geometry, Chapter 12, Lessons 2 and 3.

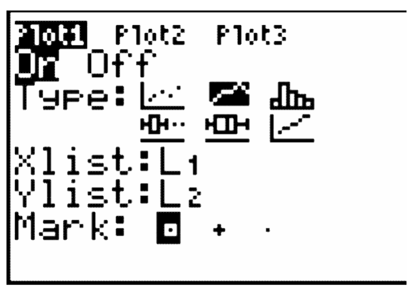
Problem 1 –Creating a Scatter Plot

Open the list editor by pressing **STAT ENTER**. Enter the $x-$values into list L_1 and the $y-$values into list L_2.

x	2	8	8	12	8	8	2	2
y	3	3	1	5	9	7	7	3

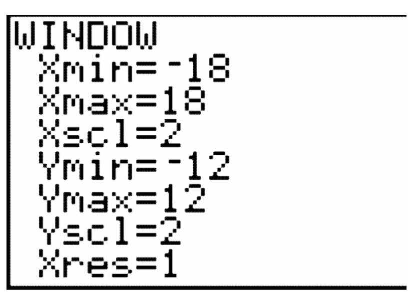
Create a connected scatter plot of L_1 vs. L_2.

Press 2^{nd} $[Y =]$ and select **Plot1**. Change the settings to match those shown at the right.

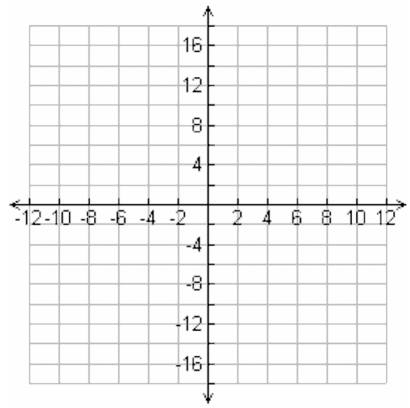


Press **WINDOW** and adjust the window settings to those shown at the right.

Press **GRAPH** to view the scatter plot.



Sketch the scatter plot.



Problem 2 –Reflections and Rotations

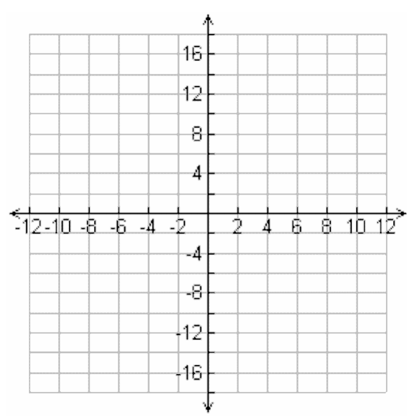
Go back to the list editor. Enter the formula $= -L_1$ at the top of list L_3 to create the opposite of each of the $x-$values in L_1.

Then, enter the formula $= -L_2$ at the top of list L_4 to create the opposite of each of the $y-$values in L_2.

Graph the following scatter plots using **Plot2**, one at a time. For each combination of lists, determine what type of *reflection* occurred.

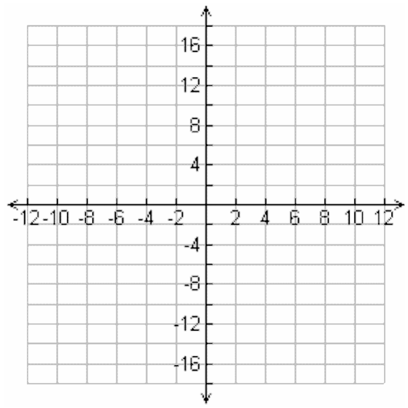
Press **GRAPH** to view **Plot1** and **Plot2** together.

A: $x \leftarrow L_3$ and $y \leftarrow L_2$



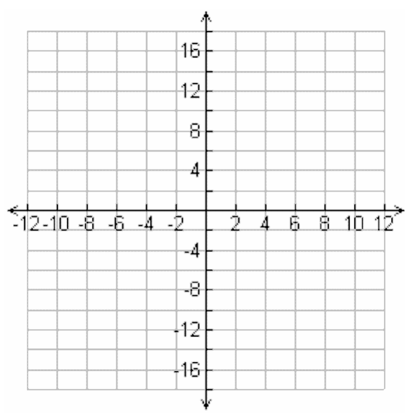
$(-x, y)$ ________

B: $x \leftarrow L_1$ and $y \leftarrow L_4$



$(x, -y)$ ________

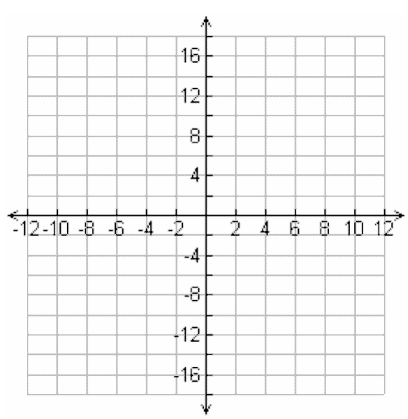
C: $x \leftarrow L_2$ and $y \leftarrow L_1$



(y, x) ________

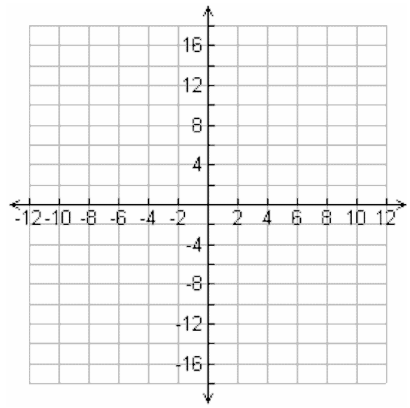
Use **Plot2** to create the following scatter plots. For each combination, determine what type of *rotation* occurred.

D: $x \leftarrow L_4$ and $y \leftarrow L_1$



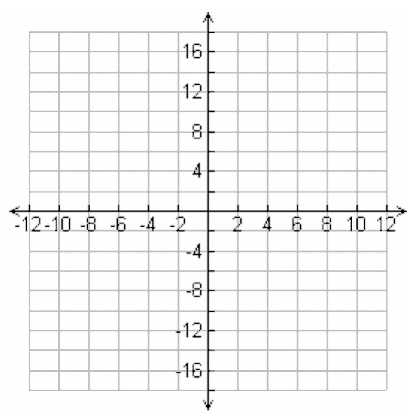
$(-y, x)$ ________

E: $x \leftarrow L_2$ and $y \leftarrow L_3$



$(-x,-y)$ ________

F: $x \leftarrow L_3$ and $y \leftarrow L_4$



$(y,-x)$ ________

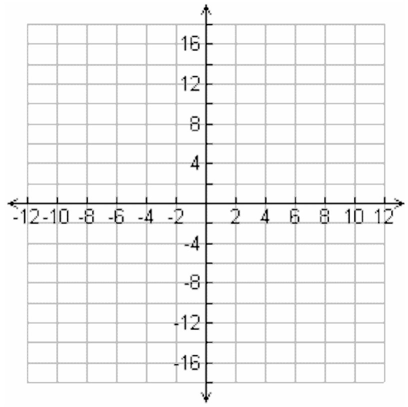
Problem 3 –Translations

Press **STAT ENTER** to go back to the list editor.

In the formula bar for L_3, enter $= L_1 - 5$ to translate the $x-$values. In the formula bar for L_4, enter $= L_2 + 3$ to translate the $y-$values.

Change **Plot2** so that the **Xlist** is L_3 and the **Ylist** is L_4. Press **GRAPH** to view the scatter plots.

Where did the image shift? How many units left/right and how many units up/down?

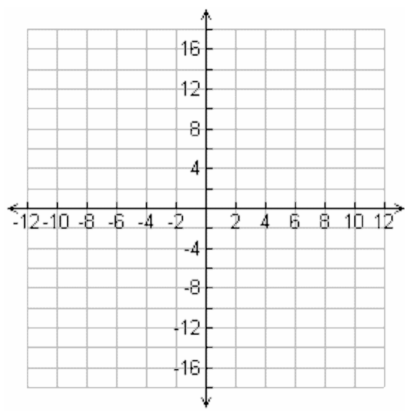


Translate the scatter plot into Quadrant 3 by editing the formula bars for L_3 and L_4.

L_3 formula: ______________

L_4 formula: ______________

Explain how the image shifted.

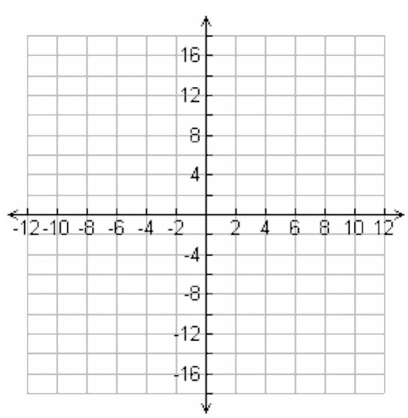


Problem 4 –Dilations

In the list editor, change the formula for L_3 to $= 0.5^*L_1$ and the formula for L_4 to $= 0.5^*L_2$.

Press **GRAPH** to view the scatter plots.

Explain what happened to the image.

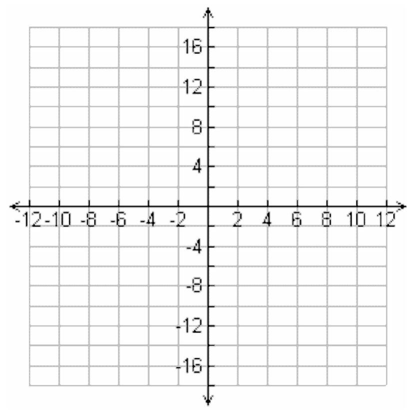


Dilate the scatter plot into Quadrant 3 by editing the formula bars for L_3 and L_4.

L_3 formula: _____________

L_4 formula: _____________

Explain what happened to the image.



13.2 Reflections & Rotations

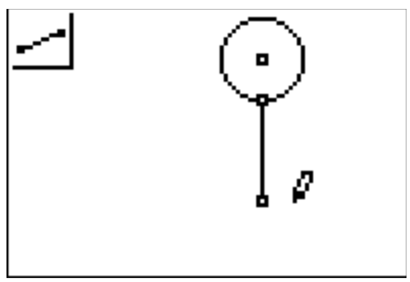
This activity is intended to supplement Geometry, Chapter 12, Lesson 5.

Problem 1–Constructing the puppet

Open a new document in *Cabri Jr*.

To construct the head of your puppet, use the **Circle** tool to place a circle near the **top right** of the screen.

Now use the **Segment** tool to construct a segment to serve as the body of your stick figure puppet.

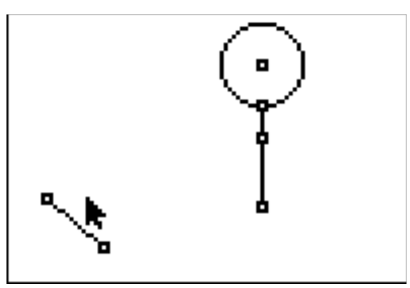


Place a point on the body to serve as the shoulder of the puppet. Be sure to use the **Point On** tool.

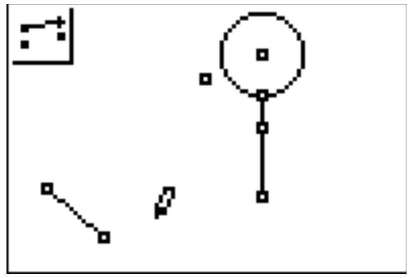
Construct a segment in the **bottom left** corner of the screen. This will serve as the translation vector that will be used to create an image point (the left hand) from the pre-image point (the shoulder).

It is important to start your segment at the bottom right since the order of creation of the segment will dictate the direction of the translation.

Move your pointer to the location you predict the hand (image point) will be located after the translation.



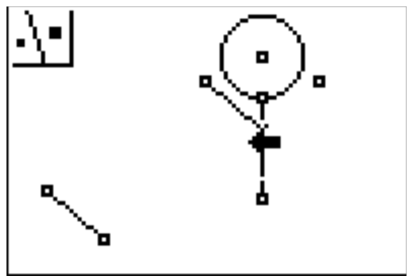
Translate the shoulder point, by choosing **Translation**, clicking on the shoulder and then clicking on the translation segment.



Connect the shoulder to the left hand using a segment.

Move your pointer to the place on the screen where you think the right hand will be if you were to reflect the left hand with respect to the body of the stick figure.

Choose the **Reflection** tool. Reflect the left hand by clicking on the left hand and then the body of the puppet.



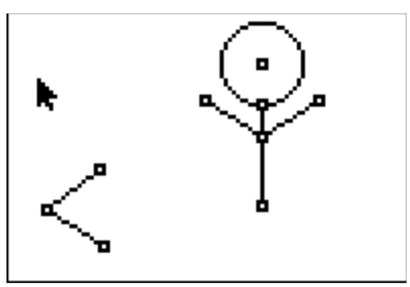
Connect the right hand and the shoulder using a line segment.

Click on the top point of your translation segment and press **ALPHA**. Drag the point up and down to watch the puppet's arms move.

- Why do the arms move when you are not dragging them?

Next, construct the legs of the puppet. To begin, you need to create a translation segment for the legs. This is crucial to the working of the puppet.

Draw a segment that **starts** above and to the right of where your arm segment ended. Have the leg segment **end** on the same point that your arm translation segment ended.



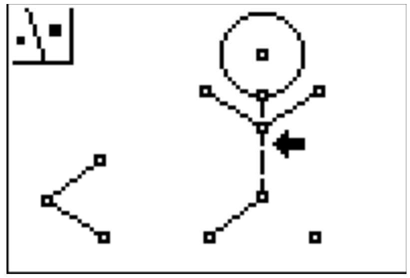
Move your pointer to the place on the screen where you think the left foot will be if you were to translate the hip using the leg translation segment you created in the previous step.

In the same way you translated the shoulder point to get the left hand, translate the hip point to create a left foot.

Connect the left foot and the hip using the **Segment** tool.

Move your pointer to the place on the screen where you think the right foot will be if you were to reflect the left foot with respect to the body of the stick figure.

Reflect the left foot with respect to the body to obtain the image point which will serve as the right foot. How good was your guess?



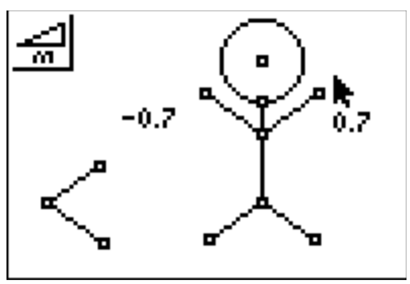
Connect the right foot to the hip using a segment and your puppet will be complete.

Problem 2–Moving the puppet

Move your cursor to the point where the arm and leg translation segments meet. Press **ALPHA** to grab the point. Move the point around and watch your puppet move on the screen.

- Why does moving one point results in the moving of two arms and two legs?
- Experiment with stretching out the translation segments and shrinking them, observing what happens.
- How do you think the slopes of the two arms compare?

Test your theory by finding the slopes of the arms using the **Slope** tool from the Measure menu.

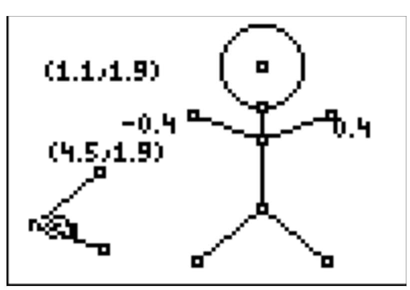


Now, grab the intersection point of the arm and leg translation segments again and move it around.

- What happens to the slope? Why?

Use **Coord. Eq.** tool to find the coordinates of the left and right hand. Grab the intersection point of the arm and leg translation segments and move the arms and legs.

- What happens to the coordinates? Why?

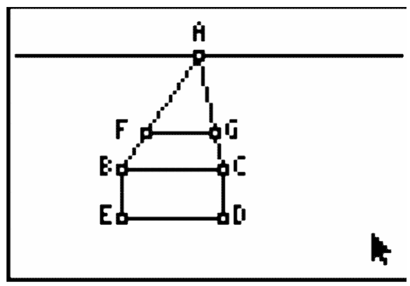


13.3 Perspective Drawing

This activity is intended to supplement Geometry as an end-of-the-year activity.

Problem 1–One-point perspective

Open the *Cabri Jr.* file *RECPRISM*. Follow these steps to complete the drawing of a rectangular prism in one-point perspective.



- Use the **Segment** tool to draw $\overline{AB}$ and $\overline{AC}$. These two segments are called *vanishing segments* because they connect a point on the figure to the vanishing point.
- Create $\overline{FG}$ such that F is between A and B, G is between A and C, and $\overline{FG} \| \overline{BC}$ as shown in the diagram to the right.

To do this, you will need to use the **Point On, Parallel, Intersection, Hide/Show**, and **Segment** tools. Ask your teacher if you need help.

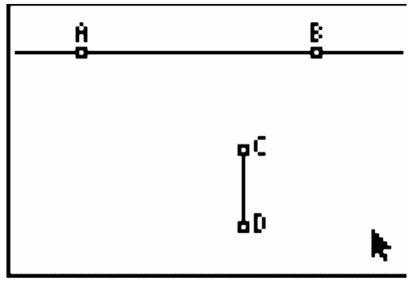
- Hide the vanishing segments, $\overline{AB}$ and $\overline{AC}$, and draw $\overline{BF}$ and $\overline{CG}$. Then drag the vanishing point to the far left or far right. What do you notice?
- Draw vanishing segments $\overline{AD}$ and $\overline{AE}$. Then use the **Perp**. tool construct two lines perpendicular to $\overline{FG}$—one through F and the other through G.
- Create $\overline{GH}$ and $\overline{FJ}$ using the **Intersection, Hide/Show**, and **Segment** tools.
- Hide the vanishing segments, and draw the three remaining edges of the rectangular prism.

Drag the vanishing point (A) and edges, *not* the vertices, of the rectangular prism. When you finish exploring, you may use the **Hide/Show** or **Display** tool to hide or dash the "hidden lines."

Then use similar steps to construct a triangular prism in one-point perspective using the *Cabri Jr.* file *TRIPRISM*.

Problem 2 –Two-point perspective

Open the *Cabri Jr.* file *TWOPERSP*. Follow these instructions to construct a rectangular prism in two-point perspective.



- Draw four vanishing segments: $\overline{AC}$, $\overline{AD}$, $\overline{BC}$, and $\overline{BD}$.
- Use the **Point On, Parallel, Intersection, Hide/Show**, and **Segment** tools as you did in

Problem 1 to construct two more vertical edges of the prism, $\overline{EF}$ and $\overline{GH}$. Label them such that $\overline{CD}$ is the "middle" edge, with $\overline{EF}$ on its left and $\overline{GH}$ on its right.

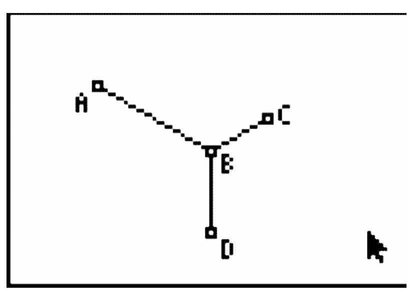
- The three vertical segments represent the "side" edges of the left and right faces of the rectangular prism. Draw the four segments that represent the "top" and "bottom" edges of these faces.
- Hide the four vanishing segments, and then draw four more: from E and F to B and from G and H to A. Mark the intersection of the upper two vanishing segments J and that of the lower two vanishing segments K, and draw $\overline{JK}$.
- Hide the vanishing segments, and then draw the remaining four edges of the prism.

Drag the vanishing points and edges or vertices of the rectangular prism. When you finish exploring, you may again use the **Hide/Show** or **Display** tool to hide or dash the "hidden lines."

In the space below, describe the similarities and differences between drawing in one-point perspective and drawing in two-point perspective. Then advance to Problem 3.

Problem 3 –An isometric drawing

Open the *Cabri Jr.* file *ISODRAW*. Construct an isometric drawing of a rectangular prism by following these steps.



- First, you will construct lines using the **Parallel** tool. Refer to the diagram to the right.

You should construct two lines though point D (one parallel to $\overline{AB}$, the other to $\overline{BC}$) and two lines that are parallel to $\overline{BD}$ (one through point A, the other through point C).

- Use the **Intersection** tool to mark the lower left intersection as point E and the lower right intersection as point F.
- Hide the parallel lines, and use the **Segment** tool to draw $\overline{AE}$, $\overline{CF}\overline{DE}$, and $\overline{DF}$.

- Using the same sequence of tools, construct the remaining edges: $\overline{AG}$, $\overline{CG}$, $\overline{EH}$, $\overline{FH}$, and $\overline{GH}$. (Can you figure out how?)

Grab and drag points A, C, or D to change the dimensions of the rectangular prism. Again, you may change the appearance of the "hidden lines."

In the space below, describe any similarities and differences between an isometric drawing and a perspective drawing.