

Properties of Parallelograms – ID: 9285

By Michele Patrick

Time required

40 minutes

Activity Overview

In this activity, students find angle measures and lengths of sides and diagonals of parallelograms, rectangles, rhombi, and squares. They change the size and shape of each type of parallelogram to see which properties hold true for each. Last, they complete a Venn diagram illustrating the relationships among the parallelograms and answer some always-sometimes-never questions regarding parallelograms.

Concepts

- *Parallelograms*
- *Rectangles*
- *Rhombi*
- *Squares*

Teacher Preparation

This activity is designed to be used in a middle-school or high-school geometry classroom.

- *For this activity, students will need to be familiar with the following terms: diagonals, opposite sides, opposite angles, and consecutive angles.*
- *You can use this activity to introduce the types of parallelograms and their properties, or just investigate the properties of parallelograms.*
- *The screenshots on pages 2–5 demonstrate expected student results. Refer to the screenshots on page 6 for a preview of the student TI-Nspire document (.tns file).*
- ***To download the student .tns file and student worksheet, go to education.ti.com/exchange and enter “9285” in the quick search box.***

Classroom Management

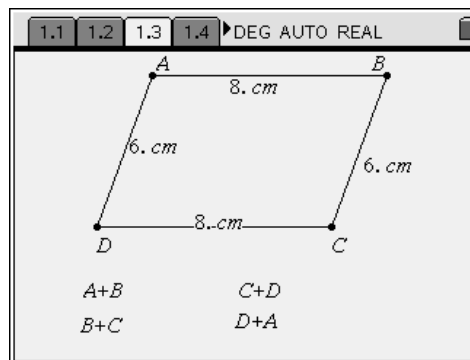
- *This activity is intended to be mainly **teacher-led**, with breaks for individual student work. Use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds.*
- *The student worksheet [GeoAct16_PropParallelograms_worksheet_EN](#) helps guide students through the activity and provides a place for students to record their answers.*
- *The TI-Nspire solution document [GeoAct16_PropParallelograms_Soln_EN](#) shows the expected results of working through the activity.*

TI-Nspire[™] Applications*Graphs & Geometry, Notes*

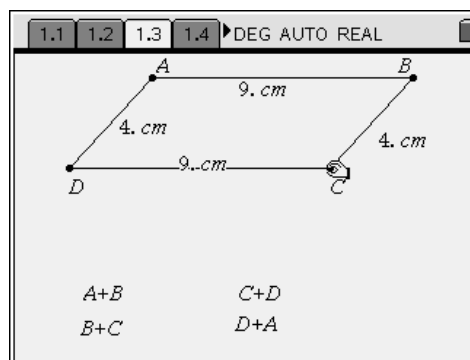
Problem 1 – Investigating parallelograms

On page 1.3, quadrilateral $ABCD$ is a parallelogram. Remind students that both pairs of opposite sides are parallel.

Students are to find the length of each side of the parallelogram by using the **Length tool (MENU > Measurement > Length)**. With the **Length tool** activated, they can find the distance of a side by clicking on each endpoint of the segment.

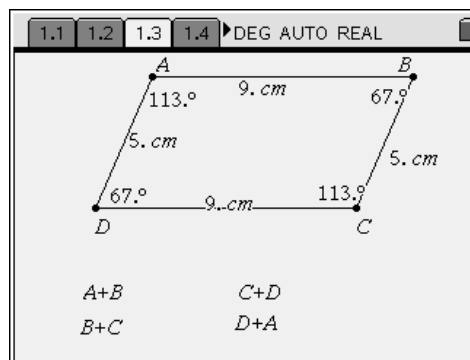


Students can now drag vertices and watch the measures of the sides as the shape of the parallelogram changes. They need to make a conjecture about the lengths of opposite sides of a parallelogram.



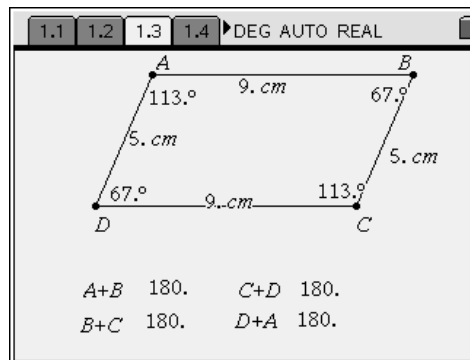
Students are to then measure each angle of the parallelogram (**MENU > Measurement > Angle**). To measure an angle, select three points on the angle, one on one side of the angle, then the vertex, and then a point on the other side.

Again, students can drag vertices and make a conjecture about the measures of the opposite angles of a parallelogram.

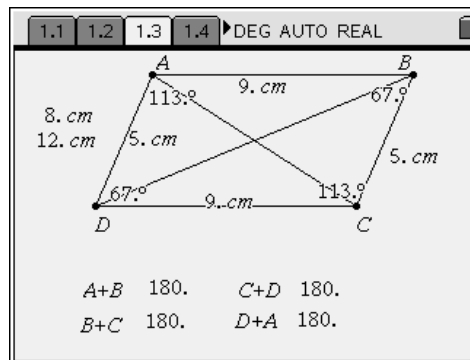


Students will not have difficulty seeing that the opposite angles are congruent, but they may have difficulty recognizing that the consecutive angles are supplementary. Students need to use the **Calculate tool (MENU > Tools > Calculate)** to find the sum of two consecutive angles. To use the **Calculate** tool, select the expression ($A + B$ in this case), then the measure of A , and then the measure of B .

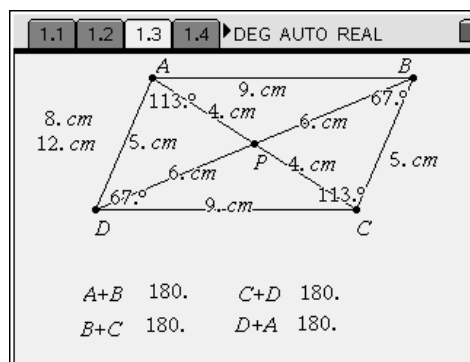
Students will see that even as vertices are dragged around, that the consecutive angles always have a sum of 180° .



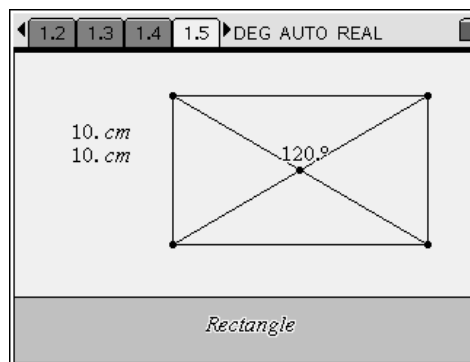
Next, students are to construct the diagonals of the parallelogram (**MENU > Points & Lines > Segment**). They can then find the lengths of the diagonals. Ask if the diagonals of a parallelogram are always congruent (no).



Lastly, students will need to construct the intersection of the diagonals (**MENU > Points & Lines > Intersection Point(s)**) and label it point *P*. They should find *AP*, *BP*, *CP*, *DP*, change the shape of the parallelogram, and make a conjecture about the diagonals (they bisect each other).

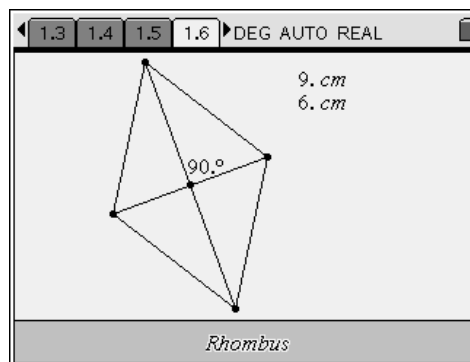


A rectangle is shown on page 1.5. Remind students that a rectangle is a parallelogram with four right angles. Since it is a parallelogram, it has all of the characteristics of a parallelogram as found on page 1.3. However, it may have characteristics that don't hold true for all parallelograms.



Students will construct the diagonals of the rectangle and determine if a) the diagonals are always congruent and b) if the diagonals are always perpendicular. They will see that the diagonals are always congruent, but not always perpendicular.

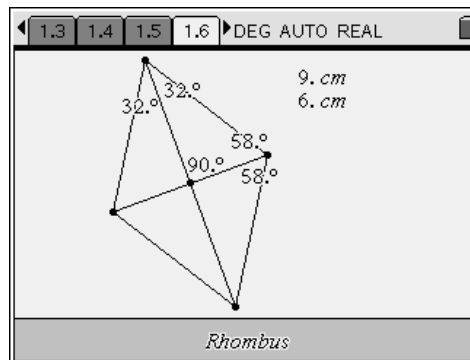
A rhombus is shown on page 1.6. Remind students that a rhombus is a parallelogram with four congruent sides. Like a rectangle, it holds all of the characteristics of a parallelogram, but may have more.



Students will construct the diagonals of the rhombus and determine if a) the diagonals are always congruent and b) if the diagonals are always perpendicular. They will see that the diagonals are always perpendicular, but are not always congruent.

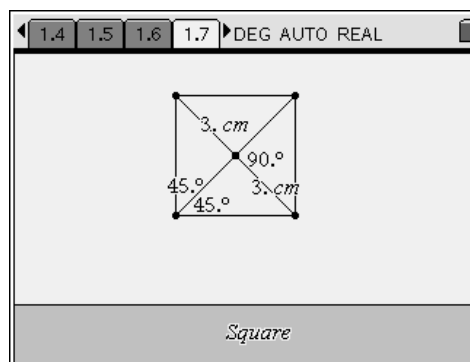
Now, students are to measure angles to determine if the diagonals bisect the angles of the rhombus.

The diagonals of a rhombus always bisect the angles of the rhombus. This is not necessarily true for other parallelograms. Students can return to pages 1.3 and 1.5 to verify this.



A square is shown on page 1.7. Again, remind students that a square is a parallelogram with four congruent sides and four right angles. That means that it holds all the characteristics of parallelograms, rectangles, and rhombi. Students should measure diagonals and angles of the square to confirm this fact.

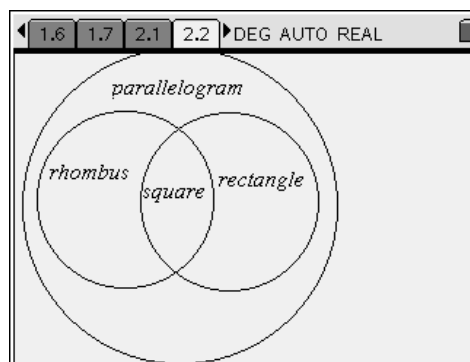
Discuss with students the relationships and properties of the parallelograms investigated before continuing.



Problem 2 – Assessment

On page 2.2, students will see a blank Venn diagram. They need to drag each of the words into an appropriate place on the diagram. Discuss the correct answer; including why the positions of rectangle and rhombus can be exchanged.

A series of questions appears on pages 2.3 through 2.7. Each is a fill-in-the blank statement which should be completed with *always*, *sometimes*, or *never*.



In addition to answering the questions on their handheld, you may wish for students to record the correct answers on their worksheet.

Ask students how the Venn diagram on page 2.2 can help them answer some of the questions. Encourage students to come up with their own always-sometimes-never questions.

- Page 2.3 – sometimes
- Page 2.4 – sometimes
- Page 2.5 – always
- Page 2.6 – never
- Page 2.7 – always

Solutions – Student Worksheet Exercises

Problem 1: The opposite sides of a parallelogram are both parallel and congruent.

The opposite angles of a parallelogram are congruent.

The consecutive angles are supplementary.

Are the diagonals of a parallelogram always congruent?

No

Do the diagonals of a parallelogram always bisect each other?

Yes

Are the diagonals of a rectangle always congruent?

Yes

Are the diagonals of a rectangle always perpendicular?

No

Are the diagonals of a rhombus always congruent?

Yes

Are the diagonals of a rhombus always perpendicular?

Yes

Are the diagonals of a rhombus always angle bisectors of the angles of the rhombus?

Yes

Describe the triangles formed by constructing the diagonals of a square.

The triangles are isosceles right triangles.

Problem 2: A rectangle is sometimes a square.

The diagonals of a parallelogram are sometimes congruent.

The diagonals of a rhombus are always perpendicular.

The consecutive angles of a parallelogram are never complementary.

A square is always a rhombus.

Properties of Parallelograms – ID: 9285

(Student)TI-Nspire File: *GeoAct16_PropParallelograms_EN.tns*

1.1 1.2 1.3 1.4 ▸ DEG AUTO REAL

PROPERTIES OF PARALLELOGRAMS

Geometry

Parallelograms, Rectangles,
Rhombi, and Squares

1.1 1.2 1.3 1.4 ▸ DEG AUTO REAL

In this activity, you will explore relationships among different types of parallelograms.

On the next page, find the lengths of the sides and the measures of the angles. Then construct the diagonals and find the length of each.

What conjectures can you make?

1.1 1.2 1.3 1.4 ▸ DEG AUTO REAL

$A+B$ $C+D$
 $B+C$ $D+A$

1.1 1.2 1.3 1.4 ▸ DEG AUTO REAL

For pages 1.5 through 1.7, construct and find the lengths of the diagonals.

Are the diagonals always congruent?

Are the diagonals always perpendicular?

1.2 1.3 1.4 1.5 ▸ DEG AUTO REAL

Rectangle

1.3 1.4 1.5 1.6 ▸ DEG AUTO REAL

Rhombus

1.4 1.5 1.6 1.7 ▸ DEG AUTO REAL

Square

1.5 1.6 1.7 2.1 ▸ DEG AUTO REAL

On the next page move the words, *parallelogram*, *rhombus*, *square*, and *rectangle*, to the appropriate place on the venn diagram.

On pages 2.3 through 2.7, fill in the blank with *always*, *sometimes*, or *never*.

1.6 1.7 2.1 2.2 ▸ DEG AUTO REAL

parallelogram
rhombus
square
rectangle

1.7 2.1 2.2 2.3 ▸ DEG AUTO REAL

Question

A rectangle is _____ a square.

Answer ▾

2.1 2.2 2.3 2.4 ▸ DEG AUTO REAL

Question

The diagonals of a parallelogram are _____ congruent.

Answer ▾

2.2 2.3 2.4 2.5 ▸ DEG AUTO REAL

Question

The diagonals of a rhombus are _____ perpendicular.

Answer ▾

2.3 2.4 2.5 2.6 ▸ DEG AUTO REAL

Question

The consecutive angles of a parallelogram are _____ complementary.

Answer ▾

2.4 2.5 2.6 2.7 ▸ DEG AUTO REAL

Question

A square is _____ a rhombus.

Answer ▾