

Properties of Parallelograms

ID: 11933

Time Required
45 minutes



Activity Overview

Students will explore the various properties of parallelograms. They will also explore necessary and sufficient conditions that guarantee that a quadrilateral is a parallelogram.

Topic: Quadrilaterals & General Polygons

- *Inductive Reasoning*
- *Parallelograms*

Teacher Preparation and Notes

- *To complete this activity, students will need to know how to change between pages, grab and move points.*
- *The multiple choice items are self-check and students can check them by pressing  + .*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter “11933” in the quick search box.***

Associated Materials

- *PropsParallelograms_Student.doc*
- *PropsParallelograms.tns*
- *PropsParallelograms_Soln.tns*

Suggested Related Activities

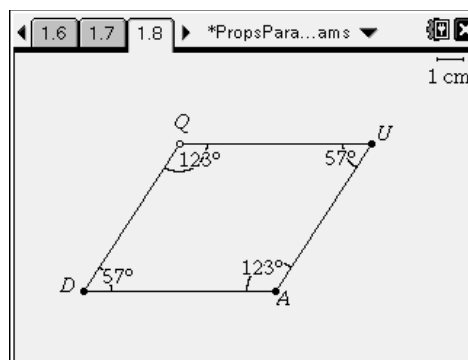
To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Properties of Parallelograms (TI-84 Plus family) — 7273*
- *Properties of Parallelograms (TI-Nspire technology) — 9285*
- *Investigating Parallelograms (TI-Nspire technology) — 8489*

Problem 1 – Properties of Parallelograms

Students will begin this activity by looking at properties of parallelograms. They will discover that opposite sides are congruent, opposite angles are congruent, and that consecutive angles are supplementary.

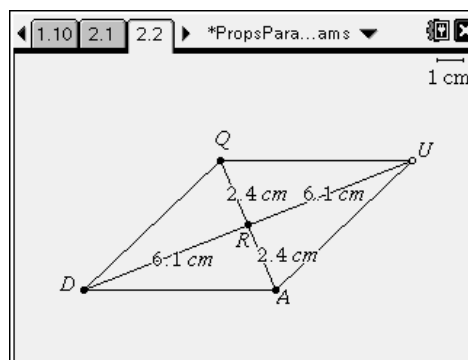
As an extension, students can prove each of these using parallel lines and transversals. Students will need to know the properties of alternate interior, same-side interior, and corresponding angles.



TI-Nspire Navigator Opportunity: Quick Poll (Open Response)
See Note 1 at the end of this lesson.

Problem 2 – Diagonals of Parallelograms

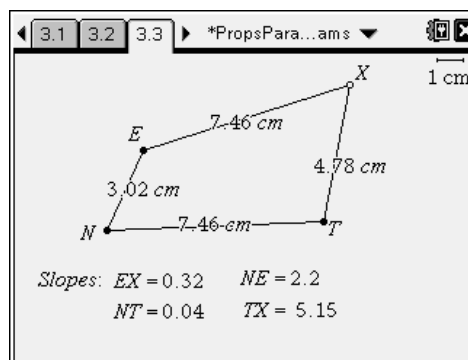
In Problem 2, students are asked to investigate the diagonals of a parallelogram. Students should discover that the diagonals of a parallelogram bisect each other. This particular wording may be hard for students discover independently.



Problem 3 – Proving Parallelograms

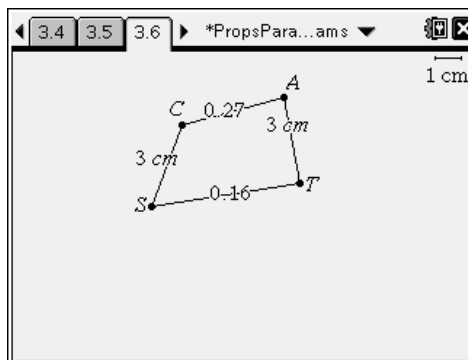
In this problem, students explore various properties and see if they guarantee that a quadrilateral is a parallelogram.

First, students are given a pair of opposite sides congruent and try to form a quadrilateral that is not a parallelogram with both pairs of opposite sides congruent by moving point X. Students should find that having both pairs of opposite sides congruent does guarantee that a quadrilateral is a parallelogram.

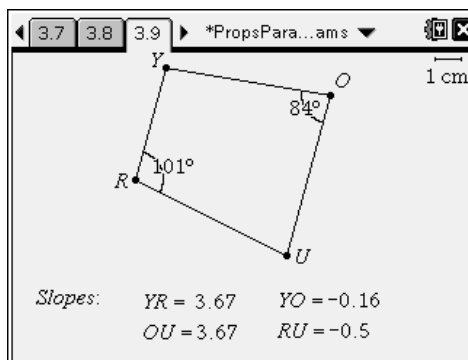


TI-Nspire Navigator Opportunity: Live Presenter
See Note 2 at the end of this lesson.

Second, students are given one pair of opposite sides congruent (\overline{AT} and \overline{CS}) and one pair of opposite sides parallel (\overline{CA} and \overline{ST}). Students will try to form a quadrilateral that is not a parallelogram by moving point A. They will find that having one pair of opposite sides congruent and one pair of opposite sides parallel does not guarantee that the quadrilateral is a parallelogram.



Lastly, students are given one pair of opposite sides parallel (\overline{YR} and \overline{OU}). Students will try to form a quadrilateral that is not a parallelogram by moving point O, given that the opposite angles must be congruent. Students should find that having one pair of opposite sides parallel and one pair of opposite angles congruent does guarantee that the quadrilateral is a parallelogram.



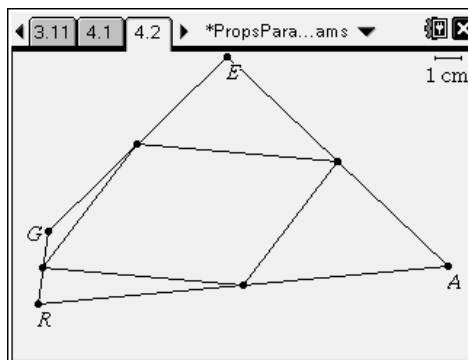
An extension of this problem would be to prove each of these or find a counterexample.

Students should know that the following prove that a quadrilateral is a parallelogram:

- 1) both pairs of opposite sides are congruent
- 2) both pairs of opposite angles are congruent
- 3) both pairs of opposite sides are parallel
- 4) one pair of opposite sides is both parallel and congruent
- 5) the diagonals bisect each other

Problem 4 – Extending the Properties

For this problem, students will create any quadrilateral on page 4.2 and name it **GEAR**. Next, students will find the midpoint of each side and connect the midpoints to form a quadrilateral. Students will use the properties of a parallelogram to see that a parallelogram is always created.



Students will need to use the **Polygon** tool (**MENU > Shapes > Polygon**) to create their quadrilateral. Students should then use the **Midpoint** tool (**MENU > Construction > Midpoint**) to find the midpoint of each side of their quadrilateral. Finally, students will use the **Segment** tool (**MENU > Points & Lines > Segments**) to connect each midpoint.

To decide that the quadrilateral formed by connecting the midpoints of **GEAR** is a parallelogram students may need to use the **Slope Measurement** tool (**MENU > Measurement > Slope**) and/or **Length Measurement** tool (**MENU > Measurement > Length**).

TI-Nspire Navigator Opportunity: Screen Capture

See Note 3 at the end of this lesson.

Student Solutions

1. A quadrilateral with both pairs of opposite sides parallel.
2. Sample answers:

Position	\overline{QU}	\overline{UA}	\overline{AD}	\overline{DQ}
1	6.35	4.05	6.35	4.05
2	6.35	5.9	6.35	5.9
3	7.95	5.08	7.95	5.08
4	5.15	5.08	5.15	5.08

3. The opposite sides are congruent.
4. Sample answers:

Position	$\angle Q$	$\angle U$	$\angle A$	$\angle D$
1	123	57	123	57
2	138	42	138	42
3	86	94	86	94
4	73	107	73	107

5. The consecutive angles are supplementary.
6. The opposite angles are congruent.

7. Sample answers:

Position	\overline{QR}	\overline{AR}	\overline{DR}	\overline{RU}
1	2.4	2.4	6.1	6.1
2	3.8	3.8	5	5
3	4.3	4.3	5.7	5.7
4	4.9	4.9	6.4	6.4

8. The diagonals bisect each other.
9. Yes
10. No
11. Yes
12. Parallelogram
13. Sample: Both pairs of opposite sides are parallel.

TI-Nspire Navigator Opportunities

Note 1

Problem 1, Question 2, Quick Poll (Open Response)

Ask students to submit the four coordinates for one of the positions they have. See if they recognize a pattern among all the quadrilaterals of the class.

Note 2

Problem 3, Live Presenter

Have a volunteer try to construct a quadrilateral as described. Take additional volunteers that think they can construct the quadrilateral as described that is not a parallelogram.

Note 3

Problem 4, Screen Capture

Use Screen Capture to look at all the quadrilaterals formed by students. Make sure that they followed the direction as given.