



Lesson 7: Drawing Parallelograms

Student Outcomes

- Students use a protractor, ruler, and setsquare to draw parallelograms based on given conditions.

Lesson Notes

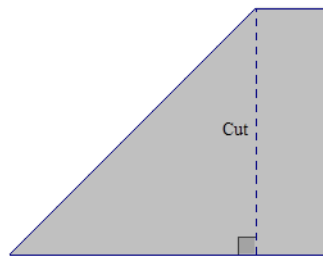
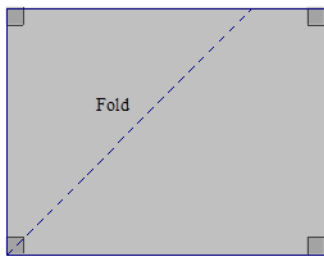
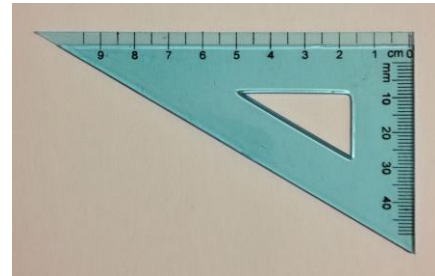
In Lesson 6, students drew a series of figures (e.g., complementary angles, vertical angles, circles of different radii, and isosceles triangles). Lesson 7 familiarizes students with a geometry tool known as the setsquare, and they use it to draw parallelograms under a variety of conditions.

Similar to the previous lesson, students should have experience with using tools and making comparisons between drawings done with tools and drawings done freehand. Work in this lesson embodies Mathematical Practice 5.

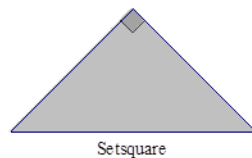
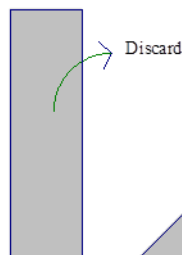
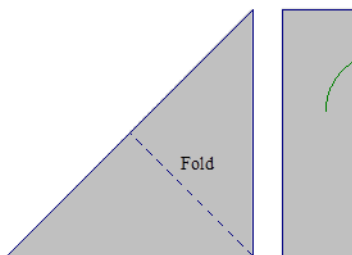
Classwork

Opening (5 minutes)

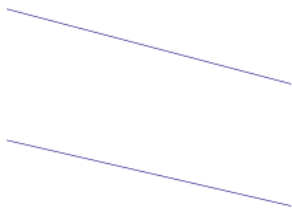
A setsquare is a triangle with a right angle. It can be made out of plastic or out of paper. Have students create their own setsquares out of paper or cardstock.



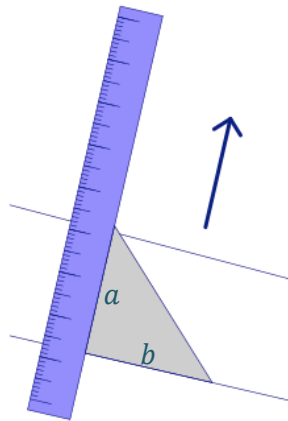
Place tape on the edges of the setsquare.



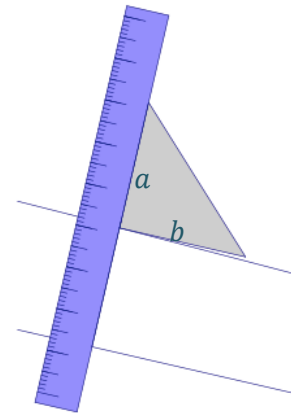
Have students use a setsquare and a ruler to check if lines are parallel.



We want to determine whether these lines are parallel.

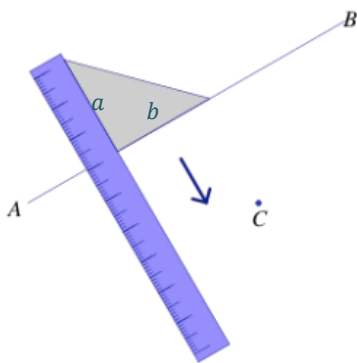


Identify the two sides of the setsquare that meet at the right angle as shown, a and b (a and b are legs of the setsquare). Place the ruler against a , and align b with one of the two lines. Notice that the ruler must be perpendicular to the line.

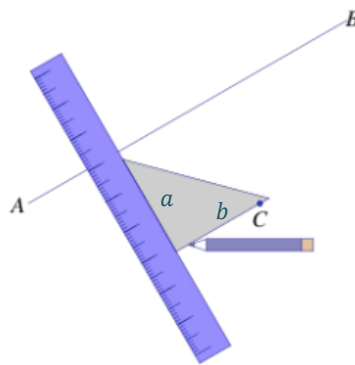


Slide the setsquare along the ruler. Try to line b up with the other line. If the edge of the setsquare aligns with the line, the two lines are parallel. If the edge of the setsquare does not align with the line, then the two lines are not parallel.

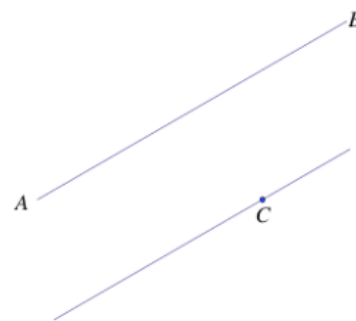
Have students use a setsquare and a ruler to draw a line parallel to \overline{AB} through the point C .



We want to draw a line through C parallel to \overline{AB} . Align b with \overline{AB} .



Slide the setsquare along the ruler until it is possible to draw a segment through C along b .



Use your ruler to extend the segment through C . The two lines are parallel.

Example 1 (5 minutes)**Example 1**

Use what you know about drawing parallel lines with a setsquare to draw rectangle $ABCD$ with dimensions of your choice. State the steps you used to draw your rectangle, and compare those steps to those of a partner.

Possible steps: Draw \overline{AB} first. Align the setsquare so that one leg aligns with \overline{AB} , and place the ruler against the other leg of the setsquare; mark a point X , $\underline{\hspace{1cm}}$ cm away from \overline{AB} . Draw a line parallel to \overline{AB} through X . Realign the setsquare with \overline{AB} , situate the ruler so that it passes through A , and draw a segment with a length of $\underline{\hspace{1cm}}$ cm. Mark the intersection of the line through A and the parallel line to \overline{AB} as D . \overline{AD} is now drawn perpendicular to \overline{AB} . Repeat the steps to determine C .

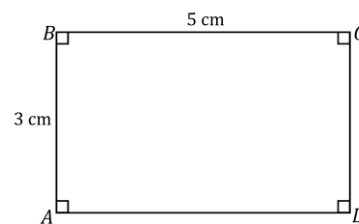
Scaffolding:

Consider providing a visual reminder (e.g., a chart handout or poster) naming the quadrilaterals and their key properties.

Example 2 (7 minutes)**Example 2**

Use what you know about drawing parallel lines with a setsquare to draw rectangle $ABCD$ with $AB = 3$ cm and $BC = 5$ cm. Write a plan for the steps you will take to draw $ABCD$.

Draw \overline{AB} first. Align the setsquare so that one leg aligns with \overline{AB} , and place the ruler against the other leg of the setsquare; mark a point X 5 cm away from \overline{AB} . Slide the setsquare along the ruler until it aligns with X . Draw a line parallel to \overline{AB} through X . To create the right angle at A , align the setsquare so that the leg of the setsquare aligns with \overline{AB} , situate the ruler so that the outer edge of the ruler passes through A , and draw a line through A . Mark the intersection of the line through A and the parallel line to \overline{AB} as D . Repeat the steps to determine C .



Make sure that students label all vertices, right angles, and measurements. This example also provides an opportunity to review the definition of diagonal:

- In a quadrilateral $ABCD$, \overline{AC} and \overline{BD} would be called the diagonals of the quadrilateral.

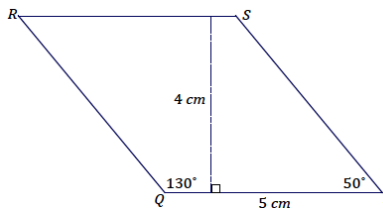
With respect to the solution, students will not respond (and are not expected to respond) with the level of detail found in the solution. The goal is to get them thinking about how they will use their newly acquired skills to draw a rectangle with the setsquare. Share the solution so they have exposure to the precision needed for clear instructions. Eventually, in Geometry, students will write instructions so precise that a person who doesn't know what a rectangle is would still be able to draw one by using the instructions.

Example 3 (7 minutes)

Example 3

Use a setsquare, ruler, and protractor to draw parallelogram $PQRS$ so that the measurement of $\angle P$ is 50° , $PQ = 5$ cm, the measurement of $\angle Q$ is 130° , and the length of the altitude to \overline{PQ} is 4 cm.

Steps to draw the figure: Draw \overline{PQ} first. Align the setsquare and ruler so one leg of the setsquare aligns with \overline{PQ} , and mark a point X 4 cm from \overline{PQ} . Slide the setsquare along the ruler so that one side of the setsquare passes through X , and draw a line through X ; this line is parallel to \overline{PQ} . Using \overline{PQ} as one ray of $\angle P$, draw $\angle P$ so that the measurement of $\angle P$ is 50° and that the ray PS intersects with the line parallel to \overline{PQ} (the intersection is S). Draw $\angle Q$ so that the measurement of $\angle Q$ is 130° ; the ray QR should be drawn to intersect with the line parallel to \overline{PQ} (the intersection is R).

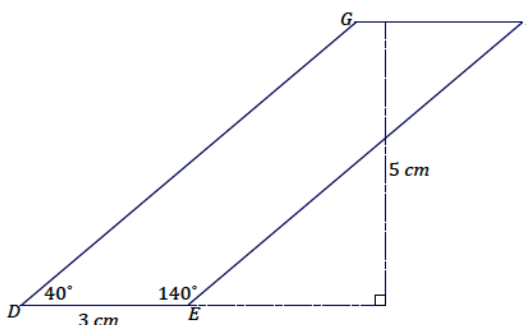


Exercise 1 (6 minutes)

Exercise 1

Use a setsquare, ruler, and protractor to draw parallelogram $DEFG$ so that the measurement of $\angle D$ is 40° , $DE = 3$ cm, the measurement of $\angle E$ is 140° , and the length of the altitude to \overline{DE} is 5 cm.

Steps to draw the figure: Draw \overline{DE} first. Align the setsquare and ruler so one leg of the setsquare aligns with \overline{DE} , and mark a point X 5 cm from \overline{DE} . Slide the setsquare along the ruler so that one side of the setsquare passes through X , and draw a line through X ; this line is parallel to \overline{DE} . Using \overline{DE} as one ray of $\angle D$, draw $\angle D$ so that the measurement of $\angle D$ is 40° and that the ray DG intersects with the line parallel to \overline{DE} (the intersection is G). Draw $\angle E$ so that the measurement of $\angle E$ is 140° ; the ray EF should be drawn to intersect with the line parallel to \overline{DE} (the intersection is F).

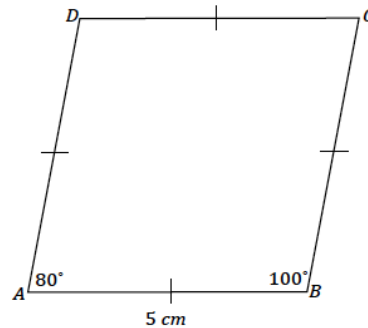


Example 4 (7 minutes)

Example 4

Use a setsquare, ruler, and protractor to draw rhombus $ABCD$ so that the measurement of $\angle A$ is 80° , the measurement of $\angle B$ is 100° , and each side of the rhombus measures 5 cm.

Steps to draw the figure: Draw \overline{AB} first. Using \overline{AB} as one ray of $\angle A$, draw $\angle A$ so that the measurement of $\angle A$ is 80° . The other ray, or the to-be side of the rhombus, AD , should be 5 cm in length; label the endpoint of the segment as D . Align the setsquare and ruler so one leg of the setsquare aligns with \overline{AB} and the edge of the ruler passes through D . Slide the setsquare along the ruler so that the edge of the setsquare passes through D , and draw a line along the edge of the setsquare. This line is parallel to \overline{AB} . Now align the setsquare and ruler so one leg of the setsquare aligns with \overline{AD} and the edge of the ruler passes through B . Slide the setsquare along the ruler so that the edge of the setsquare passes through B , and draw a line along the edge of the setsquare. This line is parallel to \overline{AD} . Along this line, measure a segment 5 cm with B as one endpoint, and label the other endpoint C . Join C to D .



Closing (1 minute)

- Why are setsquares useful in drawing parallelograms?
 - They give us a means to draw parallel lines for the sides of parallelograms.

Lesson Summary

A protractor, ruler, and setsquare are necessary tools to construct a parallelogram. A setsquare is the tool that gives a means to draw parallel lines for the sides of a parallelogram.

Exit Ticket (7 minutes)



Name _____

Date _____

Lesson 7: Drawing Parallelograms

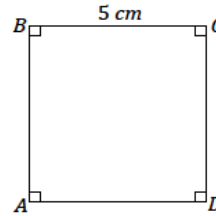
Exit Ticket

Use what you know about drawing parallel lines with a setsquare to draw square $ABCD$ with $AB = 5$ cm. Explain how you created your drawing.

Exit Ticket Sample Solutions

Use what you know about drawing parallel lines with a setsquare to draw square $ABCD$ with $AB = 5$ cm. Explain how you created your drawing.

Draw \overline{AB} (any side will do here) first. Align the setsquare and ruler so that one leg of the setsquare aligns with \overline{AB} ; mark a point X 5 cm away from \overline{AB} . Draw a line parallel to \overline{AB} through X . To create the right angle at A , align the setsquare so that the leg of the setsquare aligns with \overline{AB} , situate the ruler so that the outer edge of the ruler passes through A , and draw a line through A . Mark the intersection of the line through A and the parallel line to \overline{AB} as D ; join A and D . Repeat the steps to determine C , and join B and C .



Problem Set Sample Solutions

1. Draw rectangle $ABCD$ with $AB = 5$ cm and $BC = 7$ cm.

Steps to draw the figure: Draw \overline{AB} first. Align the setsquare so that one leg aligns with \overline{AB} , and place the ruler against the other leg of the setsquare; mark a point X 7 cm away from \overline{AB} . Draw a line parallel to \overline{AB} through X . To create the right angle at A , align the setsquare so that its leg aligns with \overline{AB} , situate the ruler so that the outer edge of the ruler passes through A , and draw a line through A . Mark the intersection of the line through A and the parallel line to \overline{AB} as D . Repeat the steps to determine C .

2. Use a setsquare, ruler, and protractor to draw parallelogram $PQRS$ so that the measurement of $\angle P$ is 65° , $PQ = 8$ cm, the measurement of $\angle Q$ is 115° , and the length of the altitude to \overline{PQ} is 3 cm.

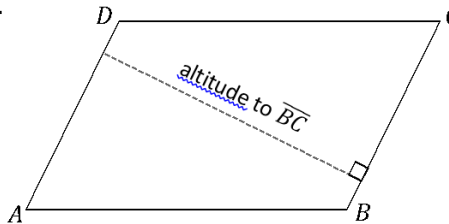
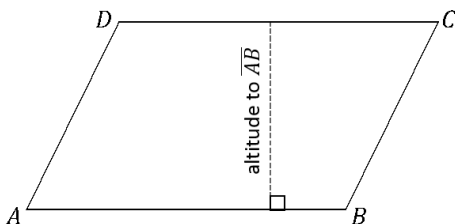
Steps to draw the figure: Draw \overline{PQ} first. Align the setsquare and ruler so one leg of the setsquare aligns with \overline{PQ} , and mark a point X 3 cm from \overline{PQ} . Slide the setsquare along the ruler so that one side of the setsquare passes through X , and draw a line through X ; this line is parallel to \overline{PQ} . Using \overline{PQ} as one ray of $\angle P$, draw $\angle P$ so that the measurement of $\angle P$ is 65° and that the ray PS intersects with the line parallel to \overline{PQ} (the intersection is S). Draw $\angle Q$ so that the measurement of $\angle Q$ is 115° ; the ray QR should be drawn to intersect with the line parallel to \overline{PQ} (the intersection is R).

3. Use a setsquare, ruler, and protractor to draw rhombus $ABCD$ so that the measurement of $\angle A$ is 60° , and each side of the rhombus measures 5 cm.

Steps to draw the figure: Draw \overline{AB} first. Using \overline{AB} as one ray of $\angle A$, draw $\angle A$ so that the measurement of $\angle A$ is 60° . The other ray, or to-be side of the rhombus, AD , should be 5 cm in length; label the endpoint of the segment as D . Align the setsquare and ruler so one leg of the setsquare aligns with \overline{AB} and the edge of the ruler passes through D . Slide the setsquare along the ruler so that the edge of the setsquare passes through D , and draw a line along the edge of the setsquare. This line is parallel to \overline{AB} . Now, align the setsquare and ruler so one leg of the setsquare aligns with \overline{AD} and the edge of the ruler passes through B . Slide the setsquare along the ruler so that the edge of the setsquare passes through B , and draw a line along the edge of the setsquare. This line is parallel to \overline{AD} . Along this line, measure a segment 5 cm with B as one endpoint, and label the other endpoint C . Join C to D .

The following table contains partial information for parallelogram $ABCD$. Using no tools, make a sketch of the parallelogram. Then, use a ruler, protractor, and setsquare to draw an accurate picture. Finally, complete the table with the unknown lengths.

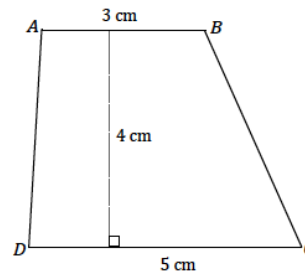
Two of the sketches are provided.



	$\angle A$	AB	Altitude to \overline{AB}	BC	Altitude to \overline{BC}
4.	45°	5 cm	2.8 cm	4 cm	3.5 cm
5.	50°	3 cm	2.3 cm	3 cm	2.3 cm
6.	60°	4 cm	4 cm	4.6 cm	3.5 cm

7. Use what you know about drawing parallel lines with a setsquare to draw trapezoid $ABCD$ with parallel sides \overline{AB} and \overline{CD} . The length of \overline{AB} is 3 cm, and the length of \overline{CD} is 5 cm; the height between the parallel sides is 4 cm. Write a plan for the steps you will take to draw $ABCD$.

Draw \overline{AB} (or \overline{CD}) first. Align the setsquare and ruler so that one leg of the setsquare aligns with \overline{AB} ; mark a point X 4 cm away from \overline{AB} . Draw a line parallel to \overline{AB} through X . Once a line parallel to \overline{AB} has been drawn through X , measure a portion of the line to be 3 cm, and label the endpoint on the right as C and the other endpoint D . Join D to A and C to B .



8. Use the appropriate tools to draw rectangle $FIND$ with $FI = 5$ cm and $IN = 10$ cm.

Draw \overline{FI} first. Align the setsquare so that one leg aligns with \overline{FI} , and place the ruler against the other leg of the setsquare; mark a point X 10 cm away from \overline{FI} . Draw a line parallel to \overline{FI} through X . To create the right angle at F , align the setsquare so that its leg aligns with \overline{FI} , and situate the ruler so that its outer edge passes through F , and then draw a line through F . Mark the intersection of the line through F and the parallel line to \overline{FI} as D . Repeat the steps to determine N .

9. Challenge: Determine the area of the largest rectangle that will fit inside an equilateral triangle with side length 5 cm.

Students will quickly discover that rectangles of different dimensions can be drawn; finding the largest rectangle may take multiple efforts. The maximum possible area is 5.4 cm^2 .

Supplement

