3.4 Parallel Lines and Transversals

Focus Question When two parallel lines are cut by a transversal, what can be said about the eight angles that are formed?

Launch

Suggest that the goal is to discover the ways that angles connect to parallel lines. Show a parallelogram made from polystrips.

Suggested Questions

- *If I push on one of the sides, how do the angles and sides change?*
- *What is the sum of the angles?*
- *What is the measure of each angle?*
- *What relationships do you see among the angles?*

Students might notice that opposite angles are congruent, but unless they measure, they may not be able to say that adjacent pairs of angles are supplements to each other. Use Teaching Aid 3.4A to talk about parallel and nonparallel lines.

Key Vocabulary

- parallel lines
- rectangle
- transversal
- vertical angles

Materials

Accessibility Labsheet

- 3.4A: Parallelograms

Labsheet

- 3.4B: Questions A–E

Teaching Aid

- 3.4A: Parallel and Non-Parallel Lines

Explore

In our development of the angle properties from parallel lines cut by a transversal, we start with an observation about angles in a parallelogram. So, it is probably wise to have a mid-problem, mini-summary discussion when all groups have completed work on Question A.

Suggested Questions

- *How did you get your answers to Question A?*

Question D introduces the term vertical angles. Be sure to push them to give logical reasoning for the congruence of vertical angle pairs.

Summarize

Discuss parallel lines and parallelograms. Ask the class to examine some of the shapes in the Shapes Set. Help them see the connection between parallel lines and parallelograms.

Suggested Questions

- *Are rectangles parallelograms? Why?*
- *How can you draw a parallelogram?*

ACE

Assignment Guide for Problem 3.4

Applications: 17 | Connections: None
Extensions: 39

Answers to Problem 3.4

A. **1.** Opposite angles of any parallelogram are congruent.

2. Consecutive angles of any parallelogram are supplementary (add to 180°).

3. In $ABCD$, $\angle A = 45°$, $\angle C = 45°$, and $\angle D = 135°$; in $JKLM$, $\angle J = 120°$, $\angle K = 60°$, and $\angle L = 120°$.

B. In the given figure, angles b, d, f, h, j, l, and n all measure 150°; angles a, c, e, g, i, k, m, and o all measure 30°. These conclusions can be justified as follows: First, a and c are supplements of the 150° angle, so they must be 30°. Angle b is the supplement of both a and c, so it must be 150°. Then angle g is a consecutive angle to the 150° angle in a parallelogram, so it must be 30° and so on. **Note:** At this opportunity, you might choose to point out the vertical angle property when two lines intersect.

C. **1.** This figure is half of the diagram in Question B, so it suggests that angles a, c, e, and h are congruent and angles b, d, f, and g.

2. Angles a, c, e, and h are 100°, and angles b, d, f, and g are 80°.

D. **1.** Vertical angles are a and c, b and d, e and h, and f and g.

2. Supplementary angles are any adjacent pair like a and b, b and c, c and d, a and d, e and f, f and h, g and h, and e and g.

3. Vertical angles are always congruent. The standard proof of this fact (supposedly the first proof ever in geometry) argues that if angles a and c are vertical, they have a common supplement b. Thus $a + b = 180 = b + c$. Subtracting b from both sides of the equation gives $a = c$.

E. $x + (6x + 5) = 180$ implies that $x = 25$ and $6x + 5 = 155$. So $\angle EAB = \angle DAC = 25°$, $\angle BAD = 155°$, $\angle EAF = 65°$, and $\angle FAD = 90°$.