2.4 Use Postulates and Diagrams

In geometry, rules that are accepted without proof are called *postulates* or *axioms*. Rules that are proved are called *theorems*. Postulates and theorems are often written in conditional form. Unlike the converse of a definition, the converse of a postulate or theorem cannot be assumed to be true.
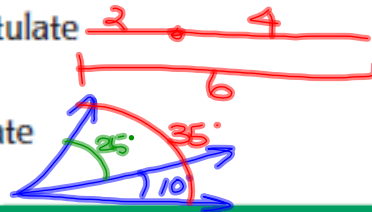
You have already learned four postulates.

POSTULATE 1 Ruler Postulate

POSTULATE 2 Segment Addition Postulate

POSTULATE 3 Protractor Postulate

POSTULATE 4 Angle Addition Postulate

POSTULATES   *For Your Notebook*

Point, Line, and Plane Postulates

POSTULATE 5 Through any two points there exists exactly one line.

POSTULATE 6 A line contains at least two points.

POSTULATE 7 If two lines intersect, then their intersection is exactly one point.

POSTULATE 8 Through any three noncollinear points there exists exactly one plane.

POSTULATE 9 A plane contains at least three noncollinear points.

POSTULATE 10 If two points lie in a plane, then the line containing them lies in the plane.

POSTULATE 11 If two planes intersect, then their intersection is a line.

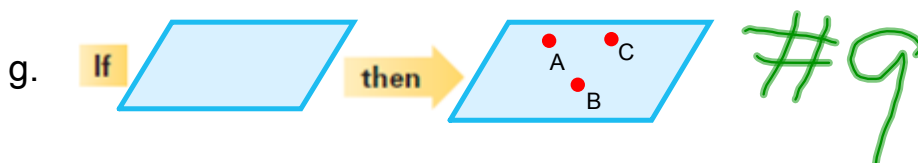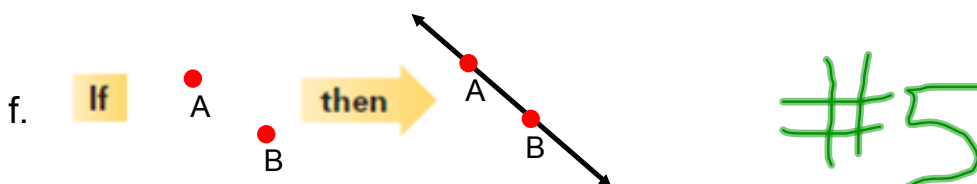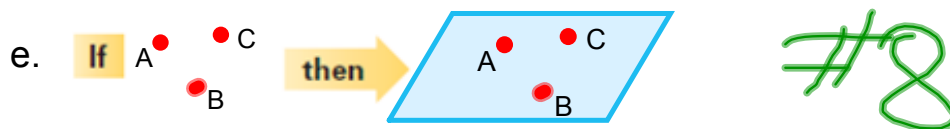**ALGEBRA CONNECTION** You have been using many of Postulates 5–11 in previous courses.
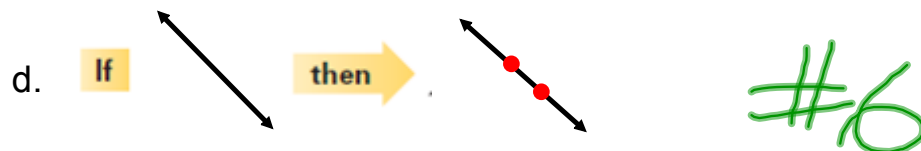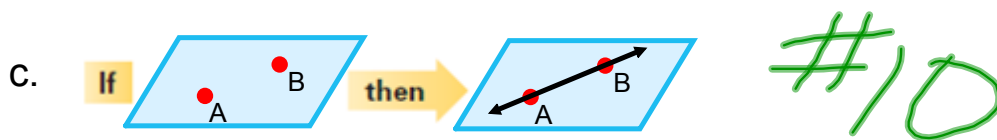
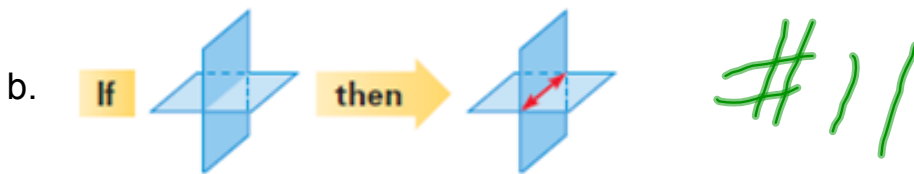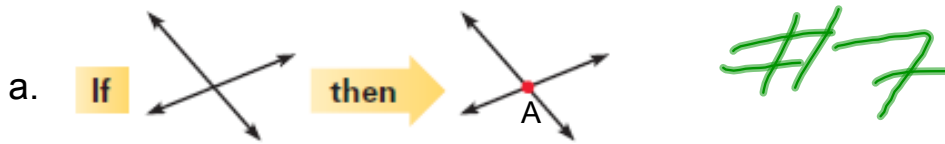One way to graph a linear equation is to plot two points whose coordinates satisfy the equation and then connect them with a line. Postulate 5 guarantees that there is exactly one such line. A familiar way to find a common solution of two linear equations is to graph the lines and find the coordinates of their intersection. This process is guaranteed to work by Postulate 7.

$$y = \frac{2}{1}x + 1$$
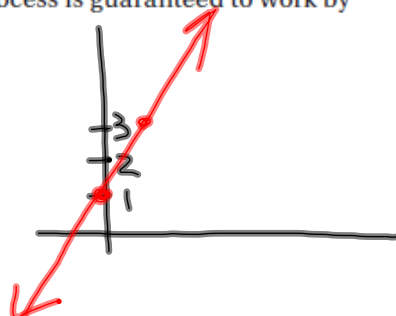
EXAMPLE 1 **Identify a postulate illustrated by a diagram**

State the postulate illustrated by the diagram.

a. **If** [diagram] **then** [diagram with point A]   #7

b. **If** [diagram] **then** [diagram]   #11

c. **If** [diagram with points A, B] **then** [diagram with line through A, B]   #10

d. **If** [diagram with line] **then** [diagram with line and two points]   #6

e. **If** [diagram with points A, B, C] **then** [diagram with plane and points A, B, C]   #8

f. **If** [diagram with points A, B] **then** [diagram with line through A, B]   #5

g. **If** [diagram with empty plane] **then** [diagram with plane and points A, B, C]   #9

EXAMPLE 2 Identify postulates from a diagram

Use the diagram to write examples of Postulates 9 and 10.

Postulate 9 Plane *P* contains at least three noncollinear points, *A*, *B*, and *C*.

Postulate 10 Point *A* and point *B* lie in plane *P*, so line *n* containing *A* and *B* also lies in plane *P*.

Animated Geometry at my.hrw.com
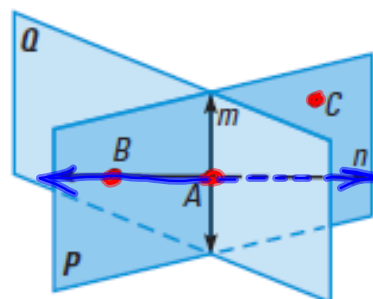
✓ **GUIDED PRACTICE** for Examples 1 and 2

1. Use the diagram in Example 2. Which postulate allows you to say that the intersection of plane *P* and plane *Q* is a line? **Postulate 11**

2. Use the diagram in Example 2 to write examples of Postulates 5, 6, and 7.

**CONCEPT SUMMARY** *For Your Notebook*

Interpreting a Diagram

When you interpret a diagram, you can assume information about size or measure only if it is marked.

YOU CAN ASSUME

All points shown are coplanar.

∠AHB and ∠BHD are a linear pair.

∠AHF and ∠BHD are vertical angles.

A, *H*, *J*, and *D* are collinear.

$\overleftrightarrow{AD}$ and $\overleftrightarrow{BF}$ intersect at *H*.

YOU CANNOT ASSUME

G, *F*, and *E* are collinear.

$\overleftrightarrow{BF}$ and $\overleftrightarrow{CE}$ intersect.

$\overleftrightarrow{BF}$ and $\overleftrightarrow{CE}$ do not intersect.

∠BHA ≅ ∠CJA

$\overleftrightarrow{AD} \perp \overleftrightarrow{BF}$ or m∠AHB = 90°
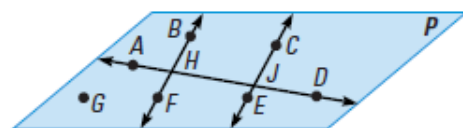
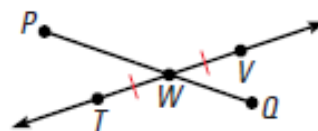## EXAMPLE 3   Use given information to sketch a diagram

Sketch a diagram showing $\overleftrightarrow{TV}$ intersecting $\overline{PQ}$ at point W, so that $\overline{TW} \cong \overline{WV}$.

Solution

**STEP 1** Draw $\overleftrightarrow{TV}$ and label points T and V.

STEP 2 Draw point W at the midpoint of $\overline{TV}$.
Mark the congruent segments.

STEP 3 Draw $\overline{PQ}$ through W.

PERPENDICULAR FIGURES A line is a **line perpendicular to a plane** if and only if the line intersects the plane in a point and is perpendicular to every line in the plane that intersects it at that point.

In a diagram, a line perpendicular to a plane must be marked with a right angle symbol.
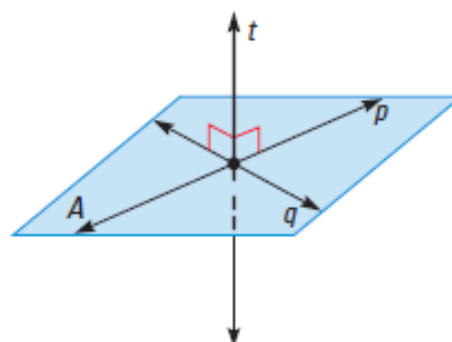
EXAMPLE 4   Interpret a diagram in three dimensions

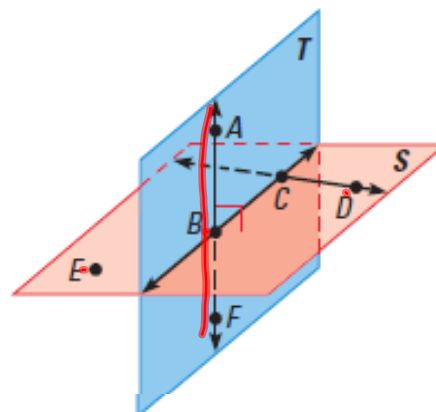Which of the following statements *cannot* be assumed from the diagram?

✓ A, B, and F are collinear.

✗ E, B, and D are collinear.

✓ $\overline{AB} \perp$ plane S

✗ $\overline{CD} \perp$ plane T

✓ $\overleftrightarrow{AF}$ intersects $\overleftrightarrow{BC}$ at point B.

Solution