

2.4 Use Postulates and Diagrams



Before

You used postulates involving angle and segment measures.

Now

You will use postulates involving points, lines, and planes.

Why?

So you can draw the layout of a neighborhood, as in Ex. 39.

Key Vocabulary

- **line perpendicular to a plane**
- **postulate**, p. 8

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 learned four postulates in Chapter 1.

POSTULATE 1	Ruler Postulate	page 9
POSTULATE 2	Segment Addition Postulate	page 10
POSTULATE 3	Protractor Postulate	page 24
POSTULATE 4	Angle Addition Postulate	page 25

Here are seven new postulates involving points, lines, and planes.

POSTULATES

For Your Notebook

Point, Line, and Plane Postulates

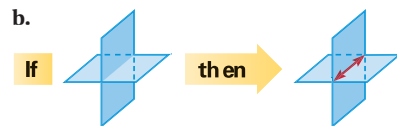
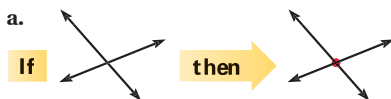
- POSTULATE 5** Through any two points there exists exactly one line.
- POSTULATE 6** A line contains at least two points.
- POSTULATE 7** If two lines intersect, then their intersection is exactly one point.
- POSTULATE 8** Through any three noncollinear points there exists exactly one plane.
- POSTULATE 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.

EXAMPLE 1 Identify a postulate illustrated by a diagram

State the postulate illustrated by the diagram.



Solution

- a. **Postulate 7** If two lines intersect, then their intersection is exactly one point.
- b. **Postulate 11** If two planes intersect, then their intersection is a line.

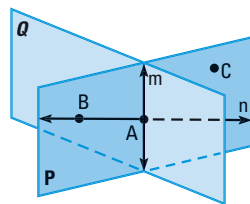
EXAMPLE 2 Identify postulates from a diagram

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 .

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GUIDED PRACTICE for Examples 1 and 2

- 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**
- Use the diagram in Example 2 to write examples of Postulates 5, 6, and 7. **Line n passes through points A and B , line n contains points A and B , line m and n intersect at point A .**

CONCEPT SUMMARY

For Your Notebook

Interpreting a Diagram

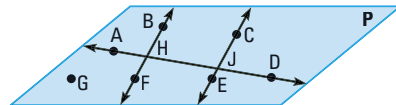
When you interpret a diagram, you can only assume information about size or measure if it is marked.

YOU CAN ASSUME

- All points shown are coplanar.
- $\angle AHB$ and $\angle BHD$ are a linear pair.
- $\angle AHF$ and $\angle BHD$ are vertical angles.
- A , H , J , and D are collinear.
- \vec{AD} and \vec{BF} intersect at H .

YOU CANNOT ASSUME

- G , F , and E are collinear.
- \vec{BF} and \vec{CE} intersect.
- \vec{BF} and \vec{CE} do not intersect.
- $\angle BHA \cong \angle CJA$
- $\vec{AD} \perp \vec{BF}$ or $m\angle AHB = 90^\circ$



EXAMPLE 3 Use given information to sketch a diagram

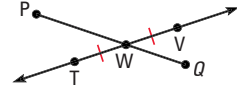
Sketch a diagram showing \overleftrightarrow{TV} intersecting \overline{PQ} at point W , so that $\overline{TW} \cong \overline{WV}$.

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 .

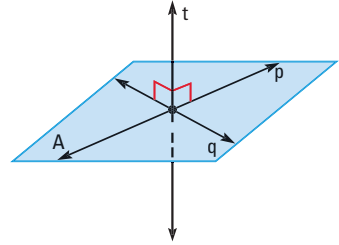


AVOID ERRORS

Notice that the picture was drawn so that W does not look like a midpoint of \overline{PQ} . Also, it was drawn so that \overline{PQ} is not perpendicular to \overline{TV} .

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.

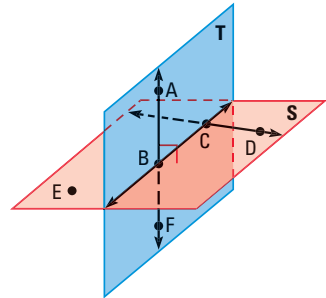
In a diagram, a line perpendicular to a plane must be marked with a right angle symbol.



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

No drawn line connects $E, B,$ and D , so you cannot assume they are collinear. With no right angle marked, you cannot assume $\overline{CD} \perp$ plane T .



GUIDED PRACTICE for Examples 3 and 4

In Exercises 3 and 4, refer back to Example 3.

3. If the given information stated \overline{PW} and \overline{QW} are congruent, how would you indicate that in the diagram? **See margin.**
4. Name a pair of supplementary angles in the diagram. *Explain.*
Sample answer: $\angle TWP, \angle WVP$; they form a linear pair.
5. In the diagram for Example 4, can you assume plane S intersects plane T at \overleftrightarrow{BC} ? **yes**
6. *Explain* how you know that $\overleftrightarrow{AB} \perp \overleftrightarrow{BC}$ in Example 4.

6. It is given that line \overline{AB} is perpendicular to plane S , therefore line \overline{AB} is perpendicular to every line in the plane that intersects it at point B .