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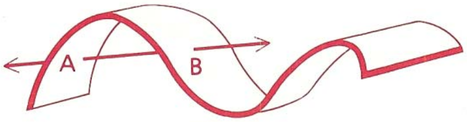
NAME **_6: Lines and Planes in Space_** Ms. Kresovic
Adv Geo period _6.1: Relating Lines to Planes_ Monday, December 08, 2014

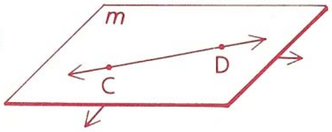
Objectives

After studying this chapter, you will be able to

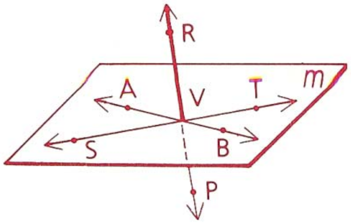
- Understand basic concepts relating to planes
- Identify four methods of determining a plane
- Apply two postulates concerning lines and planes



A surface that is not a plane



Plane surface



A, B, S, T, and V are *coplanar* points.
$\overleftrightarrow{AB}$ and $\overleftrightarrow{ST}$ are *coplanar* lines.
$\overline{AB}$ and $\overline{ST}$ are *coplanar* segments.
A, B, S, T, and R are *noncoplanar* points.
$\overleftrightarrow{AB}$, $\overleftrightarrow{ST}$, and $\overleftrightarrow{RP}$ are *noncoplanar* lines.
$\overline{AB}$, $\overline{ST}$, and $\overline{RP}$ are *noncoplanar* segments.

Definition The point of intersection of a line and a plane is called the ***foot*** of the line.

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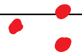
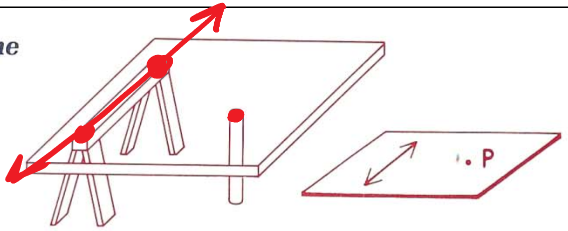
Four Ways to Determine a Plane

Prior knowledge: Any two points determine a line.

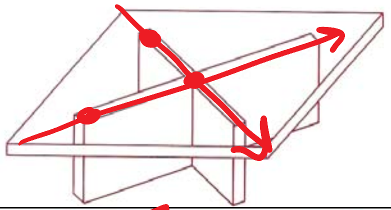
1. **Postulate** ***Three noncollinear points determine a plane.***



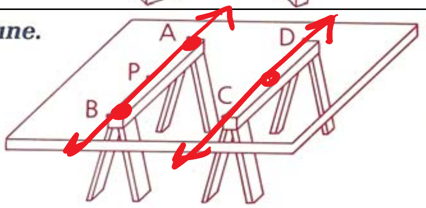
2. **Theorem 45** ***A line and a point not on the line determine a plane.***



3. **Theorem 46** ***Two intersecting lines determine a plane.***



4. **Theorem 47** ***Two parallel lines determine a plane.***



Proof: If $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ are parallel, then according to the definition of *parallel lines*, they lie in a plane. We need to show that they lie in *only one* plane. If P is any point on $\overleftrightarrow{AB}$, then according to Theorem 45, there is only one plane containing P and $\overleftrightarrow{CD}$. Thus, there is only one plane that contains $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$, because every plane containing $\overleftrightarrow{AB}$ contains P.

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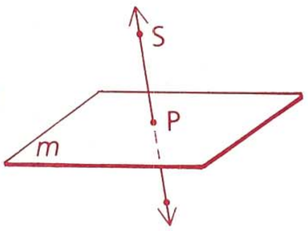
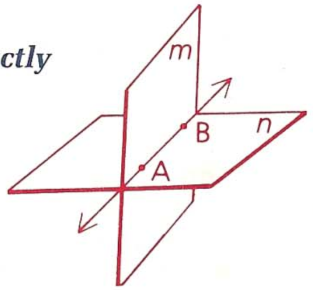
Two Postulates Concerning Lines and Planes

We shall assume the following two statements.

Postulate *If a line intersects a plane not containing it, then the intersection is exactly one point.*



Postulate *If two planes intersect, their intersection is exactly one line.*



In Class Examples

Problem 1

a $m \cap n = \underline{\ ?\ }$

b A, B, and V *determine plane* $\underline{\ ?\ }$.

c *Name the foot of* $\overleftrightarrow{RS}$ *in* m.

d $\overleftrightarrow{AB}$ *and* $\overleftrightarrow{RS}$ *determine plane* $\underline{\ ?\ }$.

e $\overleftrightarrow{AB}$ *and point* $\underline{\ ?\ }$ *determine plane* n.

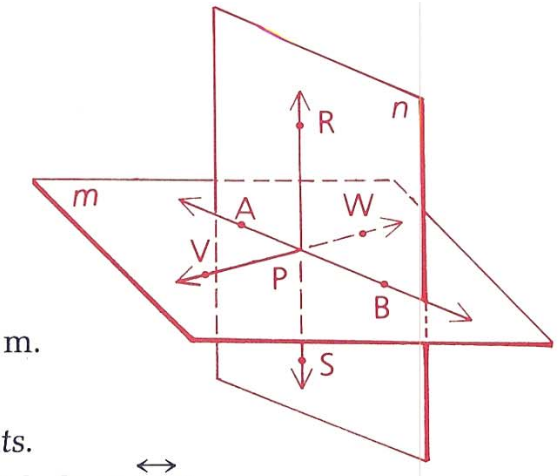
f *Does* W *lie in plane* n?

g *Line* AB *and line* $\underline{\ ?\ }$ *determine plane* m.

h A, B, V, *and* $\underline{\ ?\ }$ *are coplanar points.*

i A, B, V, *and* $\underline{\ ?\ }$ *are noncoplanar points.*

j *If* R *and* S *lie in plane* n, *what can be said about* $\overleftrightarrow{RS}$?

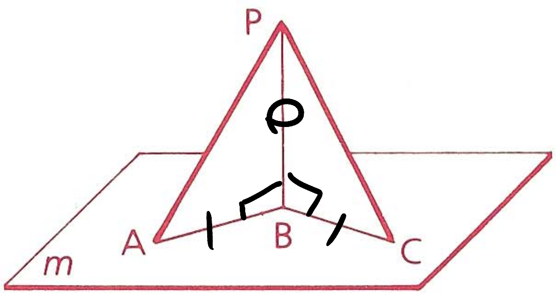


A $\overleftrightarrow{AB}$	C P	E R or S	G $\overleftrightarrow{VW}$	I R or S
B m	D n	F No	H W or P	J $\overleftrightarrow{RS}$ lies in n

Problem 2

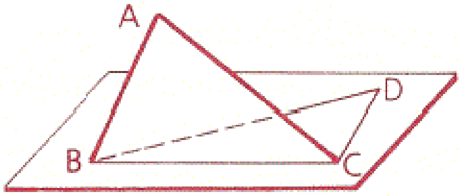
Given: A, B, *and* C *lie in plane* m.
$\overline{PB} \perp \overline{AB}$,
$\overline{PB} \perp \overline{BC}$,
$\overline{AB} \cong \overline{BC}$

Prove: $\angle APB \cong \angle CPB$



1 $\overline{PB} \perp \overline{AB}$, $\overline{PB} \perp \overline{BC}$	1 Given
2 $\angle PBA$ and $\angle PBC$ are right $\angle$s.	2 $\perp \Rightarrow$ RT $\angle$s
3 $\angle PBA \cong \angle PBC$	3 RT $\angle$s $\Rightarrow \cong \angle$s
4 $\overline{AB} \cong \overline{BC}$	4 Given
5 $\overline{PB} \cong \overline{PB}$	5 Ref
6 $\triangle PBA \cong \triangle PBC$	6 SAS
7 $\angle APB \cong \angle CPB$	7 CPCTC

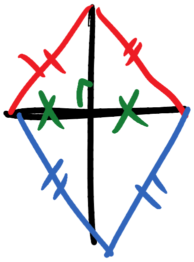
12 Cut a quadrilateral out of paper and fold it along a diagonal as shown in the figure. Is every four-sided figure a plane figure? No



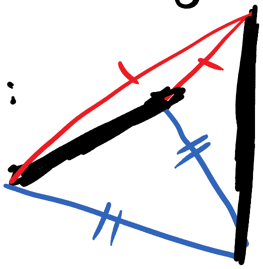
13 If two points in space are equidistant from the endpoints of a segment, will the line joining them be the perpendicular bisector of the segment? Explain.

If pts are in space & not in a plane, then the line joining them may not intersect the seg.

In a plane



In space:



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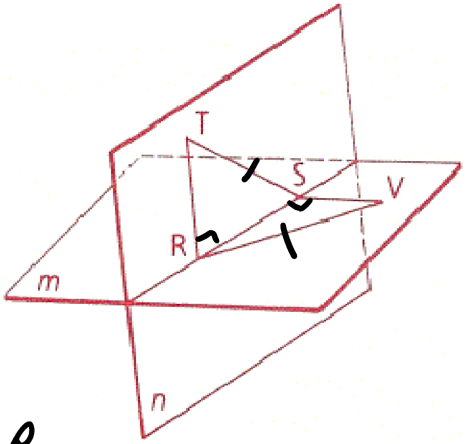
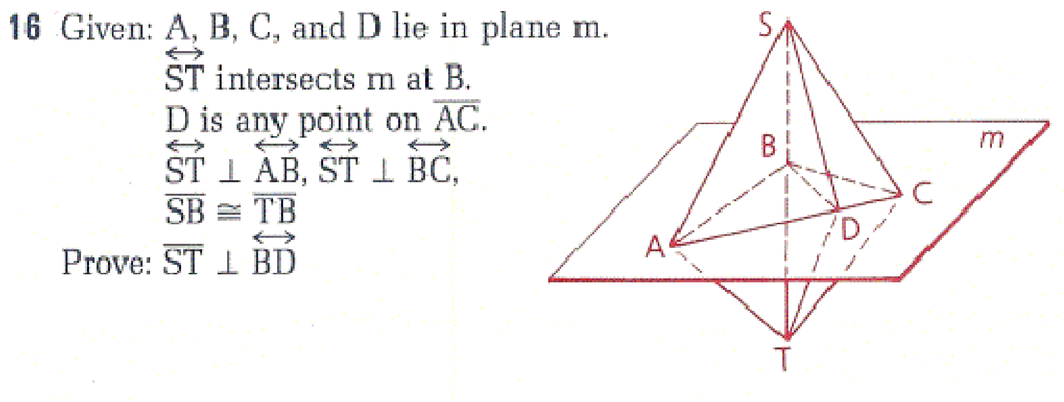
14 Given: Planes m and n intersect in $\overleftrightarrow{RS}$.
m contains R, S, and V.
n contains R, S, and T.
$\overline{TS} \cong \overline{VR}$,
$\overline{TR} \perp \overline{RS}$,
$\overline{VS} \perp \overline{RS}$
Prove: $\overline{TR} \cong \overline{VS}$



S	R
1. Planes m & n $\cap$ $\overleftrightarrow{RS}$ $\overline{TS} \cong \overline{VR}$ $\overline{TR} \perp \overline{RS}$, $\overline{VS} \perp \overline{RS}$	1. given
2 $\angle TRS$ & $\angle VSR$ rt $\angle$s	2 $\perp \Rightarrow$ rt $\angle$s
3 $\overline{RS} \cong \overline{SR}$	3 Ref
4. $\Delta RSV \cong \Delta SRT$	4. HL(2,1,3)
5. $\overline{TR} \cong \overline{VS}$	5. cpctc

$\cong \triangle$s

SSS
SAS
~~ASA~~
HL



16 Given: A, B, C, and D lie in plane m.
$\overleftrightarrow{ST}$ intersects m at B.
D is any point on $\overline{AC}$.
$\overleftrightarrow{ST} \perp \overleftrightarrow{AB}$, $\overleftrightarrow{ST} \perp \overleftrightarrow{BC}$,
$\overline{SB} \cong \overline{TB}$

Prove: $\overline{ST} \perp \overleftrightarrow{BD}$

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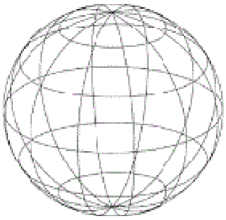
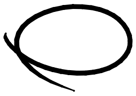
Homework

1 Consider a spherical object, such as an orange or a globe. If two points are marked on it and a straight line is drawn through the two points, does the line lie on the surface? Is it possible to draw a straight line that will lie entirely on the surface?

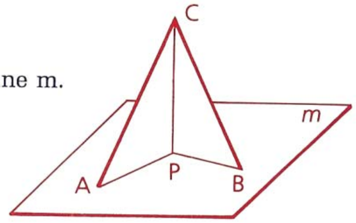


3 Consider two points on a cylindrical surface, such as the curved surface of a tin can. Does the line connecting two such points *always* lie on the surface? Does it *ever* lie on the surface?



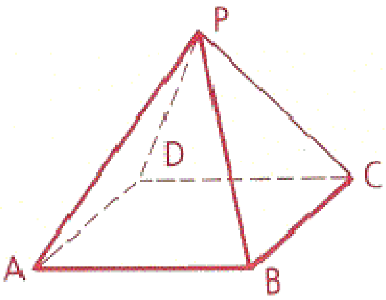
5 A three-legged stool will not rock, even if the legs are of different lengths. Many four-legged stools wobble. Explain.

7 Given: A, P, and B lie in plane m.
$\overleftrightarrow{CP} \perp \overleftrightarrow{AP}$, $\overleftrightarrow{CP} \perp \overleftrightarrow{PB}$,
$\overline{PA} \cong \overline{PB}$
Prove: $\overline{CA} \cong \overline{CB}$



Statements	Reasons
1. A, P, and B lie in plane as shown.	1. Given
2.	2. Given
3.	3. Given
4.	4. ⊥ ⇒ rt ∠s
5.	5. rt ∠s ⇒ cong. ∠s
6.	5. Reflexive
7.	6. SAS
8.	7. CPCTC

15 The figure at the right is a square pyramid. How many planes are determined by its vertices? (There are more than five.) Name them. Create a list.



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Class Work

This work is required, and due by the end of class. You are encouraged to work together.

2 **a** $r \cap s =$ ___?___

b $\overleftrightarrow{AB} \cap s =$ ___?___

c Name three collinear points.

d Name four noncoplanar points.

e What plane do points A, B, and E determine?

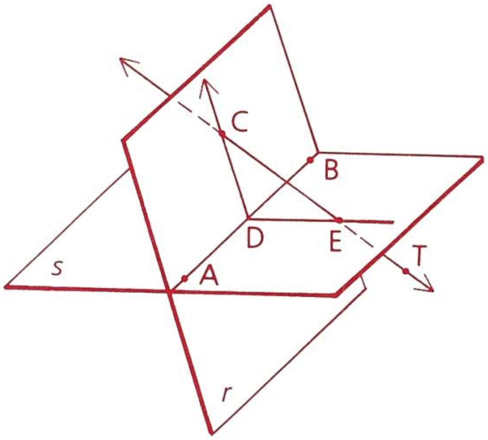
f What plane do $\overleftrightarrow{AB}$ and $\overleftrightarrow{ED}$ determine?

g Name the foot of $\overleftrightarrow{TC}$ in plane s.

h Name the foot of $\overleftrightarrow{TC}$ in plane r.

i Do $\overleftrightarrow{CD}$ and $\overleftrightarrow{ED}$ determine a plane?

j If $\overleftrightarrow{CD} \perp \overleftrightarrow{AB}$, name the right angles formed.

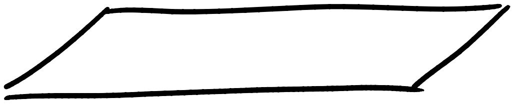


A	C	E	G	I
B	D	F	H	J

4. Make freehand sketches of

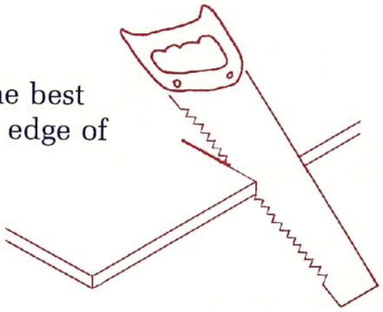
(a) a horizontal plane,

(b) a vertical plane, and



(c) two intersecting planes.

6 What theorem or assumption in this chapter provides the best explanation for the fact that when you saw a board, the edge of the cut is a straight line?



8 Given: $\odot O$ lies in plane p.
$\overleftrightarrow{VO} \perp \overleftrightarrow{OS}$,
$\overleftrightarrow{VO} \perp \overleftrightarrow{OT}$
Prove: $\angle VSO \cong \angle VTO$