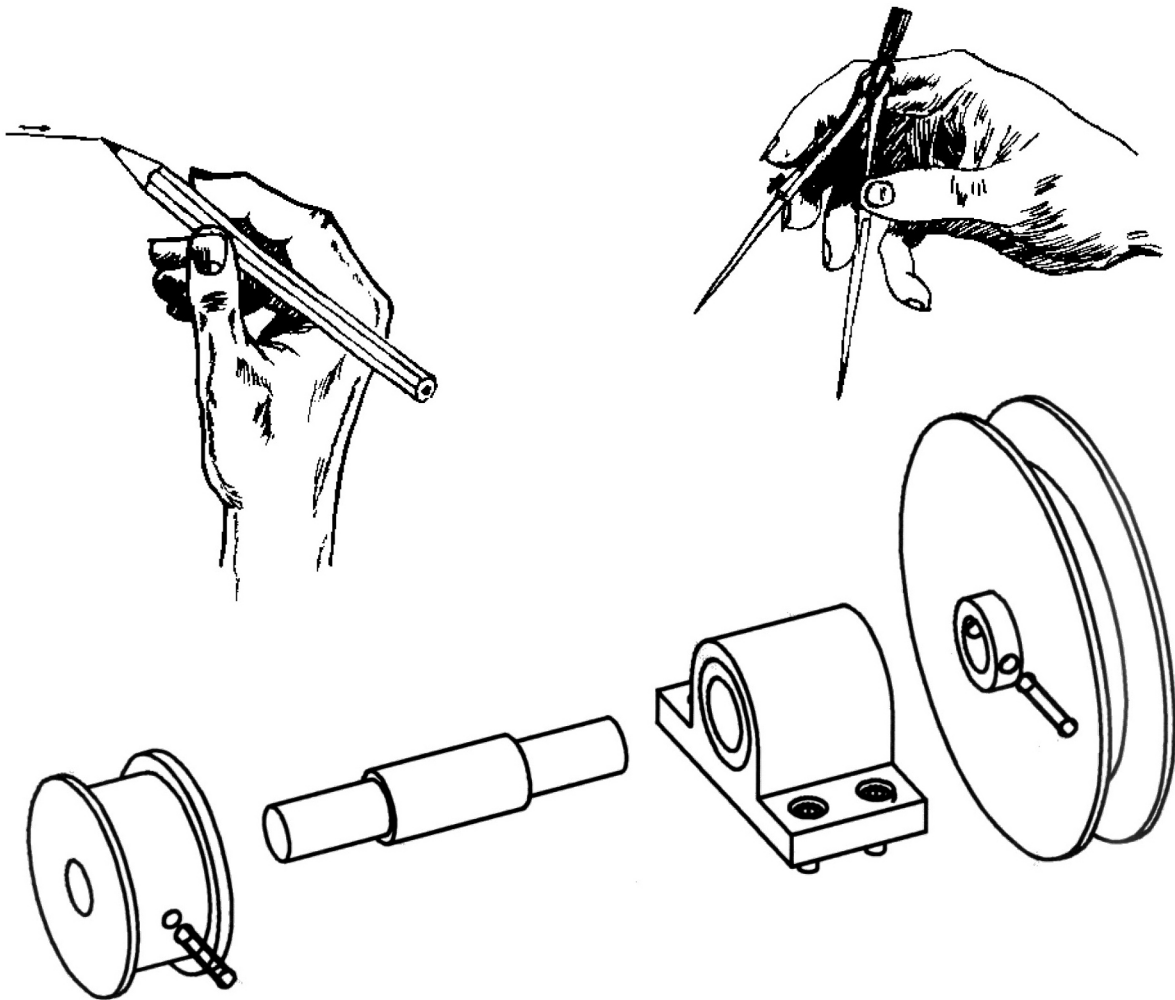


Engineering Graphics

Text and Workbook

Series 2

by
Jerry W. Craig and Orval B. Craig



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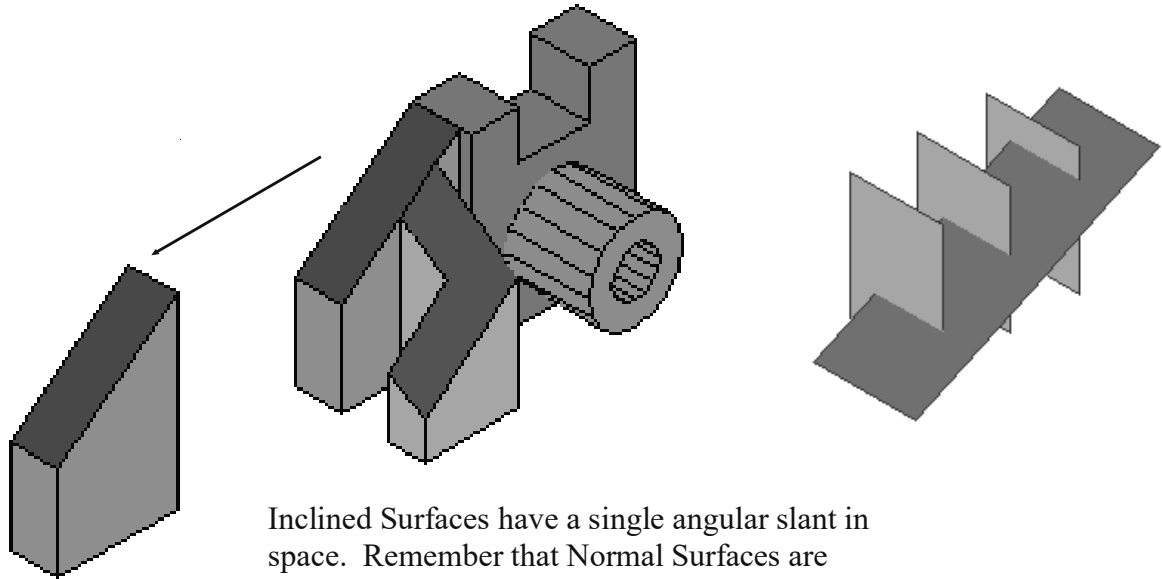
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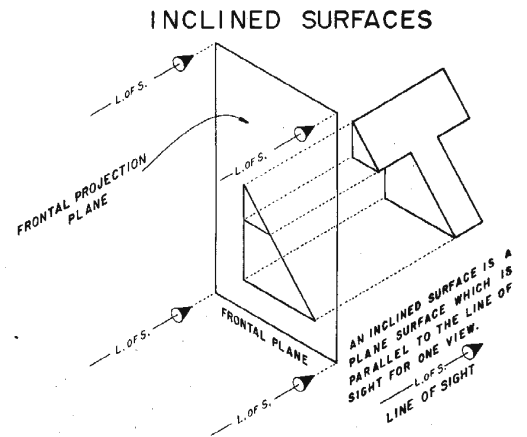
[BARNES & NOBLE](https://www.barnesandnoble.com)

Introduction to Inclined Surfaces

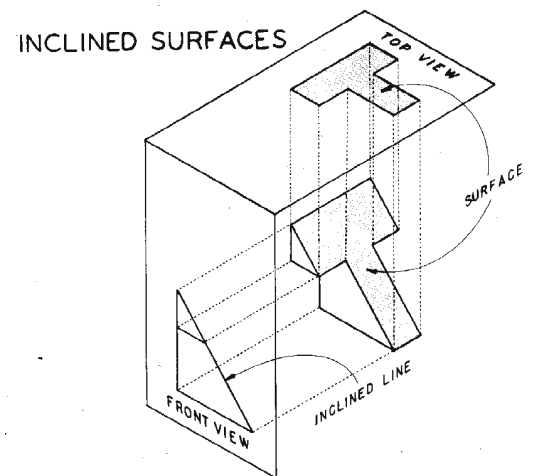


Inclined Surfaces have a single angular slant in space. Remember that Normal Surfaces are either vertical or horizontal in space.

Inclined Surfaces appear as an inclined edge-of-surface in one view. In this example, the "T" shaped surface is set parallel to the lines of sight for the front view.



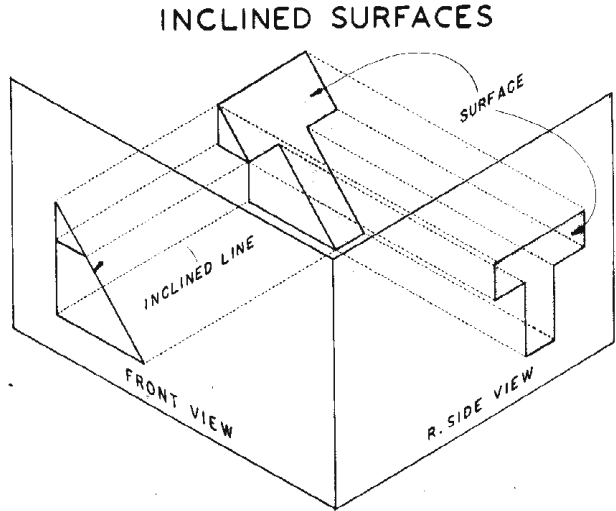
Projecting surface "T" to the top view will show the surface, but it will appear shorter than its actual extent. Surface "T" is classified as foreshortened in the top view.



Looking at the side view, surface "T" appears as a foreshortened surface.

Analyzing Inclined surfaces starts by picking an inclined line in one view.

An Inclined line in one view may be the edge-of-surface view of an Inclined surface on an object.



Three possible Inclined surface views.

1. Inclined edge-of-surface in the front view.

Surface "T" appears as an inclined edge-of-surface in the front view. It will appear as a foreshortened surface in the top view and as a foreshortened surface in the side view.

An Inclined surface will always have the same general shape whenever it appears as a surface.

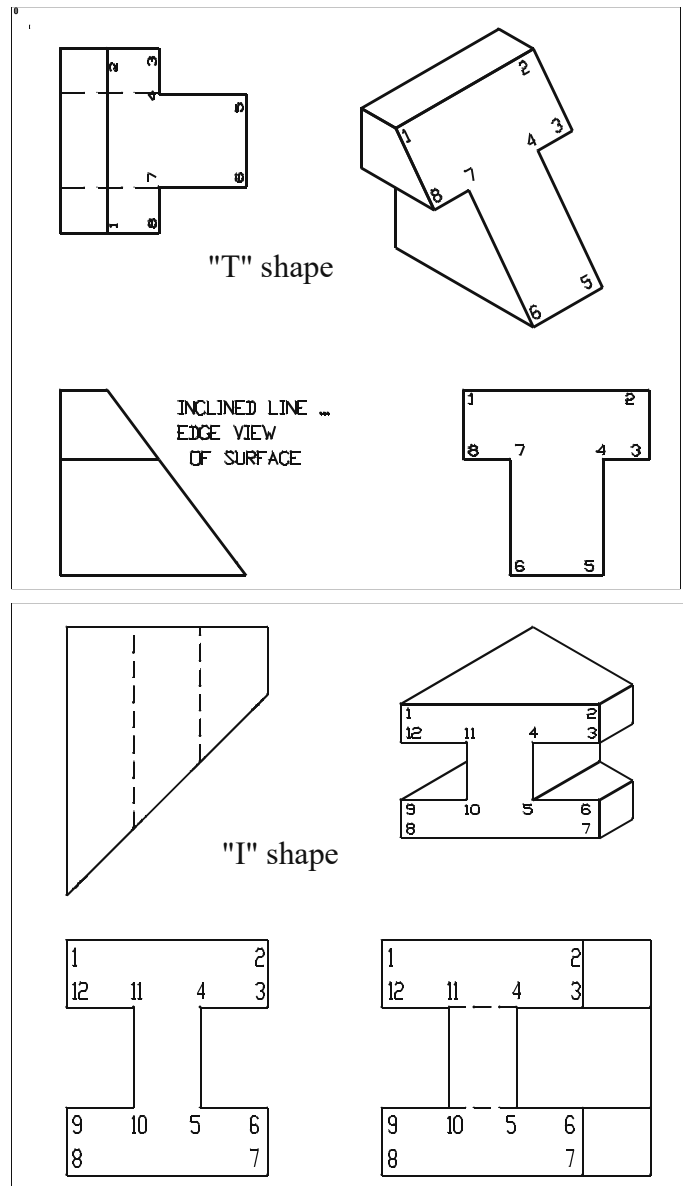
2. Inclined edge-of-surface in the top view.

Surface "I" appears as an inclined edge-of-surface in the top view. It will appear as a foreshortened surface in the front view and a foreshortened surface in the side view.

An Inclined surface will always have the same number of corners and edges whenever it appears as a surface.

Surface "I" has 12 corners and edges in each surface view.

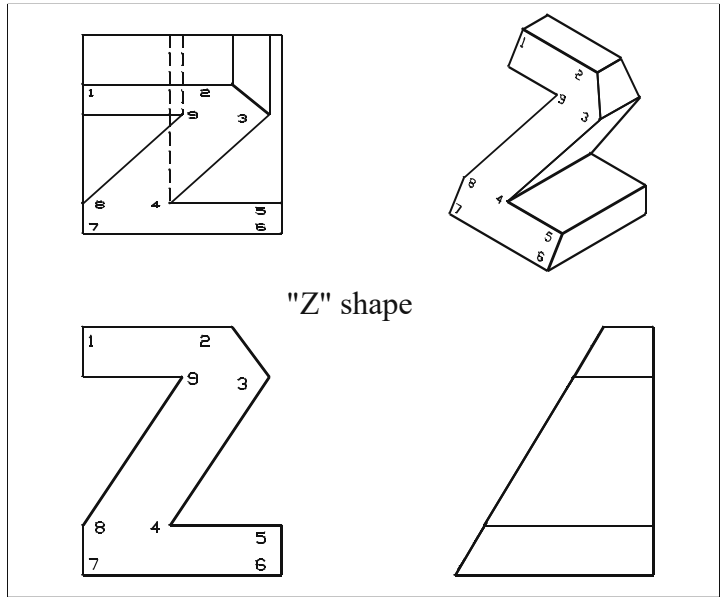
Numbering the corners of an Inclined surface will help assure that all corners are correctly drawn.



3. Inclined surface appearing as an inclined edge-of-surface in the side view.

Surface "Z" appears as an inclined line in the side view. It is a surface in the front and top views.

Inclined surfaces must have the same parallel and non-parallel edges whenever they appear as surfaces.



This is the complete Inclined Surface Chart. It is easier to remember than the Normal Surface Chart. Usually, if there is an inclined line in one view, it will be the edge of an inclined surface appearing in the other views.

PROVING INCLINED SURFACES

1. INCLINED LINE IN ONE VIEW — SURFACE IN THE OTHER TWO VIEWS.
2. SURFACE MUST HAVE SAME GENERAL SHAPE.
3. SURFACES MUST HAVE SAME NUMBER OF CORNERS AND EDGES.
4. SURFACES MUST HAVE THE SAME PARALLELISM AND NON PARALLELISM OF EDGES.

INCLINED SURFACES

FRONT	TOP	SIDE
INCLINED LINE	SURFACE	SURFACE
SURFACE	INCLINED LINE	SURFACE
SURFACE	SURFACE	INCLINED LINE

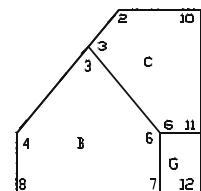
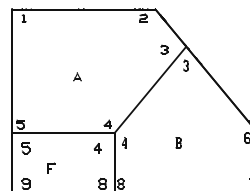
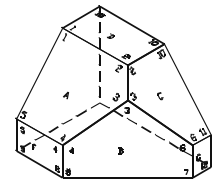
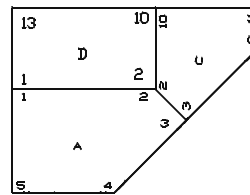
INCLINED LINES ARE TRUE LENGTH LINES
SURFACES ARE FORESHORTENED

Analyze the surfaces on this part:

"A" (1,2,3,4,5) is an inclined line in the side view. It is a surface in the front and top views.

"B" (3,6,7,8,4) is an inclined line in the top view. It is a surface in the front and side views.

"C" (2,10,11,6,3) is an inclined line in the front view. It is a surface in the top and side views.



Analyzing Inclined Edges

An Inclined edge will appear as an inclined line in one view and will be either vertical or horizontal in the other views.

Line 1,2 is parallel to the front projection plane in this example. It is horizontal in the top view and vertical in the side view.

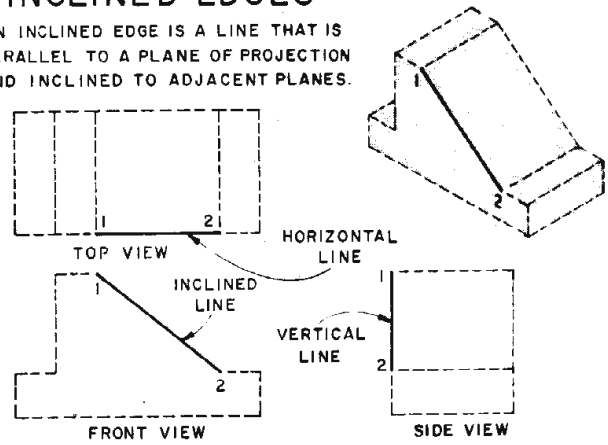
Line 1,2 is true length in the front view.

Inclined line 1,2 is parallel to the top projection plane. It is true length in the top view.

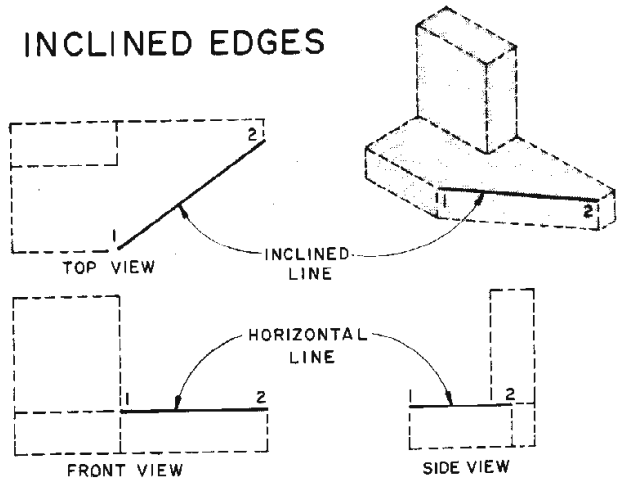
Line 1,2 is horizontal in the front and side views and is foreshortened in those views.

INCLINED EDGES

AN INCLINED EDGE IS A LINE THAT IS PARALLEL TO A PLANE OF PROJECTION AND INCLINED TO ADJACENT PLANES.



INCLINED EDGES

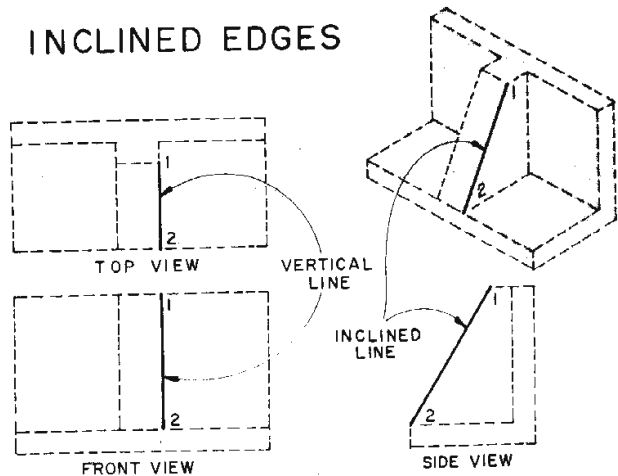


INCLINED EDGES

FRONT	TOP	SIDE
INCLINED LINE	HORIZONTAL LINE	VERTICAL LINE
HORIZONTAL LINE	INCLINED LINE	HORIZONTAL LINE
VERTICAL LINE	VERTICAL LINE	INCLINED LINE

INCLINED LINES ARE TRUE LENGTH LINES
HORIZONTAL AND VERTICAL LINES ARE FORESHORTENED

INCLINED EDGES



Inclined edge chart. It is important to know when a line appears true length in a view.

Inclined line 1,2 in this example is parallel to the side projection plane. It is a vertical foreshortened line in the front and top views.

Projecting Inclined Surfaces

Given: Front and Side views are complete.

Draw: Top view.

1. Locate reference for measurements. Sketch a vertical line in the side view. Sketch a horizontal line in the top view. DEPTH is the common dimension from side to top views.

2. Identify an inclined line in the front view. It is surface "F" in the side view.

3. Number the corners of the surface in the side view. Be sure to place a number at each corner. Do not duplicate numbers.

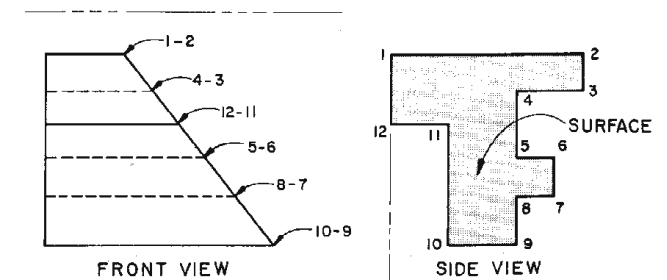
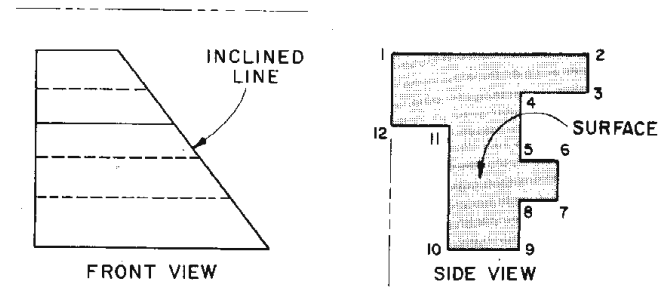
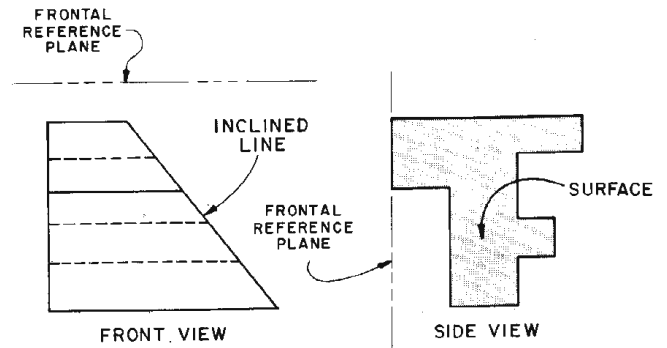
Surface "F" has 12 corners and edges.

4. Locate the numbers on the inclined line in the front view.

The inclined line in the front view is the surface in the side view. All the numbers on the surface in the side view must be on the inclined line in the front view and no place else.

Drawing surface "F" in the top view becomes an automatic process.

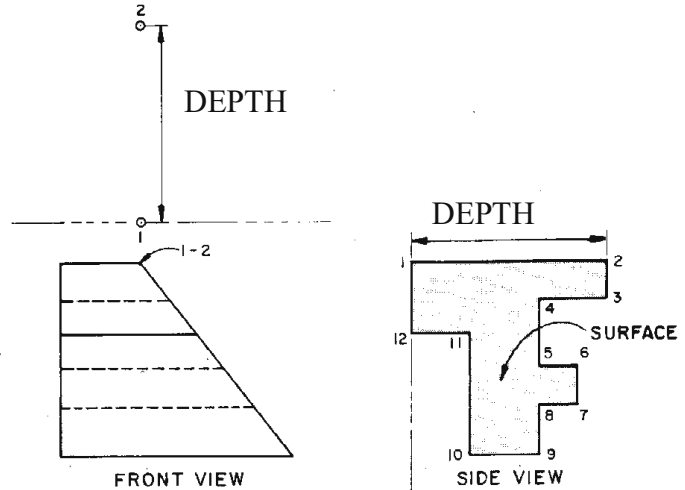
- ___ Project the points from the front view.
- ___ Measure the points from the side view.



- Transfer point 1 to the top view.
- 1 projects up from the front view.
- 1 is on the reference in the side view.
- 1 is on the reference in the top view.

- Transfer point 2 to the top view.
- 2 projects from the front view.
- 2 is the full depth (horizontal) in the side view.
- 2 is the full depth (vertical) in the top view.

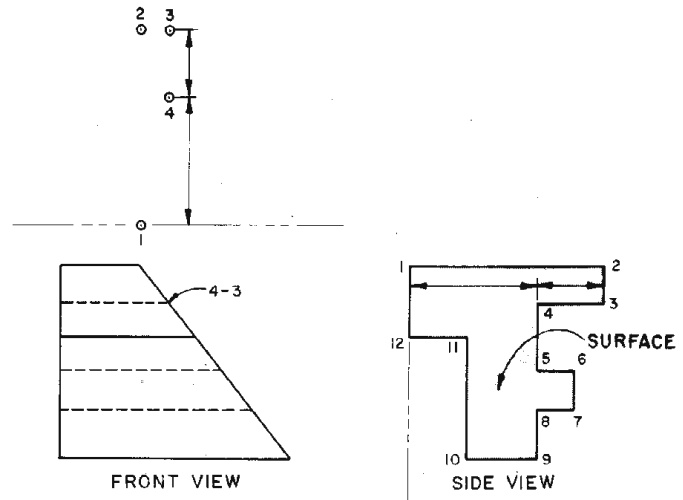
Put a dot and label each point in the top view.



Project points 3 and 4 to the top view.

Measure the depth distances (horizontal) in the side view. Transfer the same distances (vertical) to the top view.

Place a dot and carefully label the points in the top view.



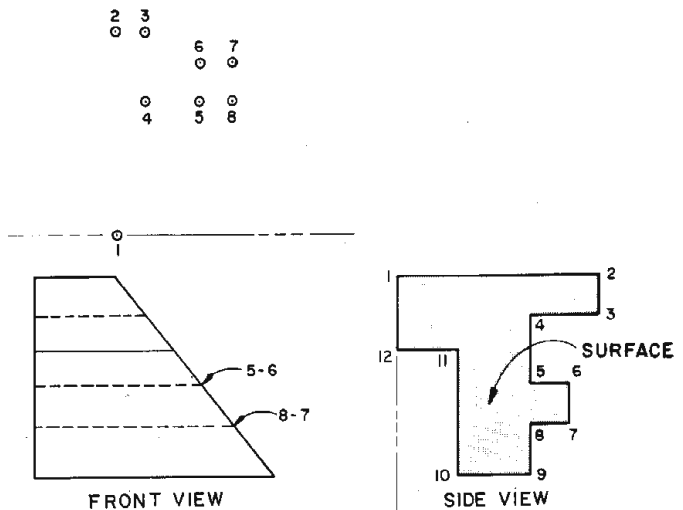
Transfer 5,6,7,8 to the top view.

Project the points from the front view.

Measure the distances from the side view.

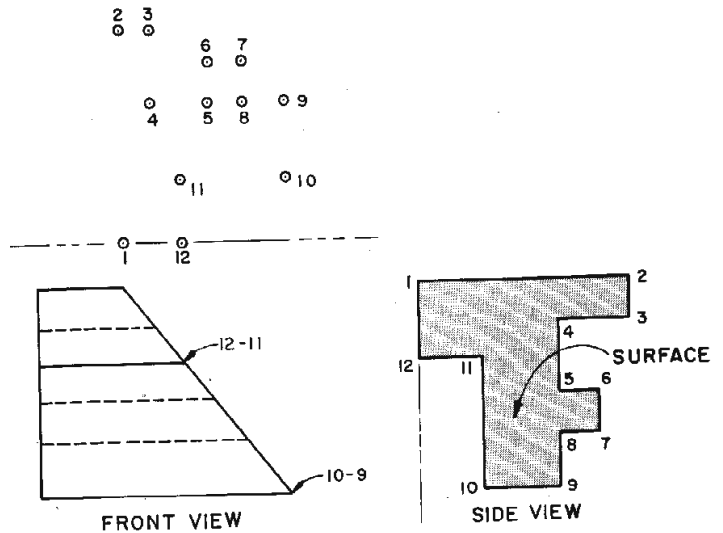
Transfer the measurements to the top view.

Locate each point with a dot and carefully label each point in the top view.



All the points have been transferred to the top view and labeled.

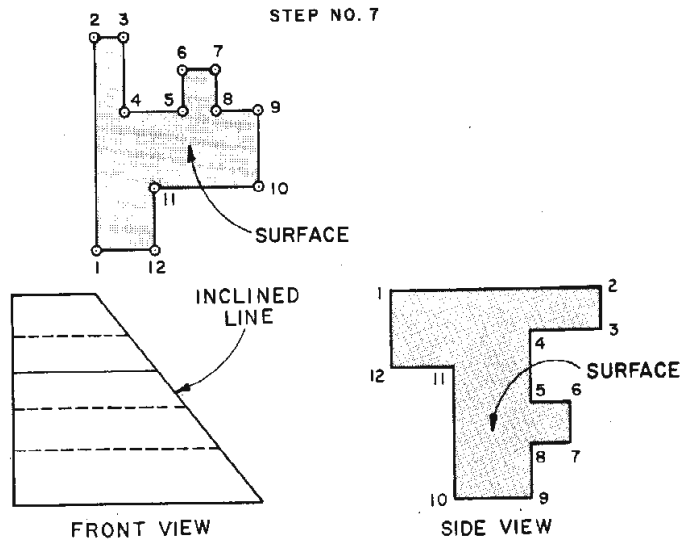
This process makes it possible to create portions of a missing view before the shape can be visualized. This is an excellent means of developing the ability to visualize complex shapes.



Connect the points in the same order they were connected in the side view.

Inclined surface "F" has been transferred to the top view. It must have:

- ___ The same number of corners and edges.
- ___ The same parallel edges.
- ___ The same general shape in each surface view.

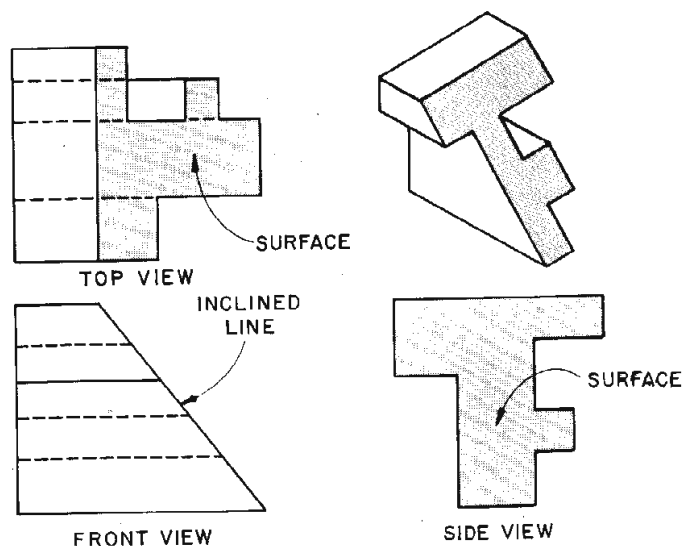


Thirteen surfaces must still be analyzed and drawn to complete the top view. These are all Normal Surfaces.

___ Six horizontal lines in the side view must be horizontal lines in the front view and surfaces in the top view.

___ Six Vertical lines in the side view must be surfaces in the front view and horizontal lines in the top view.

___ A vertical line in the front view must be a surface in the side view and a vertical line in the top view.

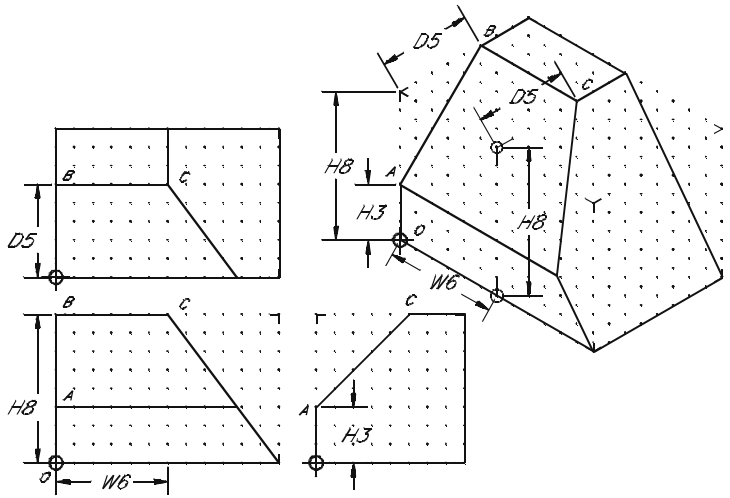


Inclined Surfaces in Pictorial Views

Points on pictorial views may require 1, 2, or 3 measurements to locate.

Working from the lower left corner (0,0) of the object, points are measured using HEIGHT, WIDTH and DEPTH:

- __ point A is 3 units above O (H3).
- __ point B is 8 units up and 5 units back (H8,D5).
- __ point C is 6 units to the right, 8 units up and 5 units back. (W6, H8, D5).



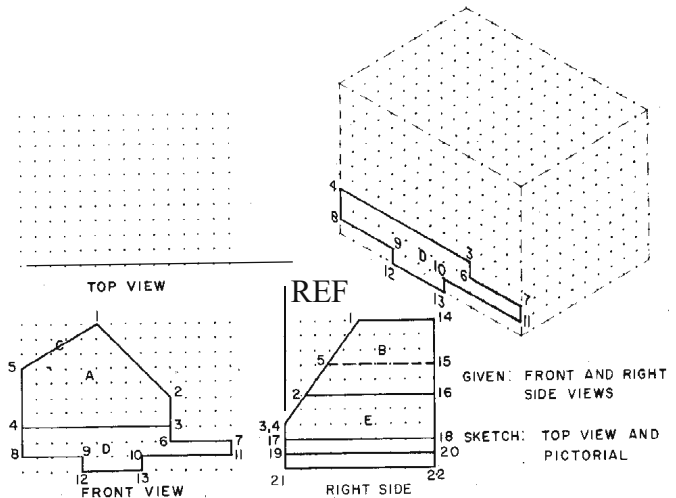
Problem Solution:

Sketch a horizontal line in the top view and a vertical line in the side view for measurements.

Inclined line 1,4 in the side view is surface 1,2,3,4,5 in the front view.

- __ Number the corners in the front view.
- __ Transfer the numbers back to the side view.

You must know exactly where each corner of the surface is .. in BOTH given views.

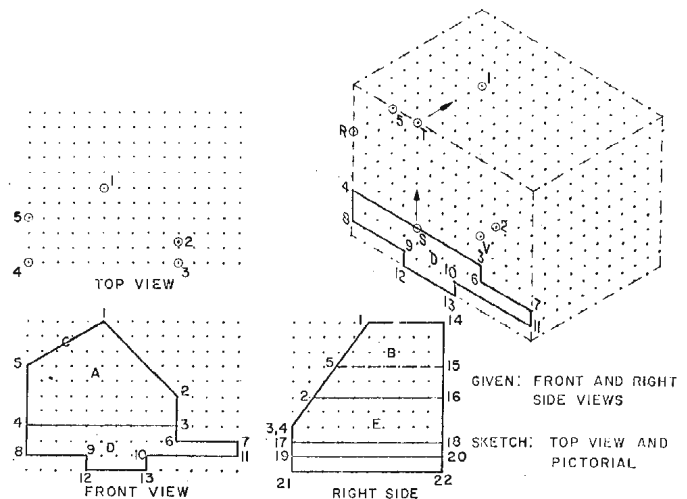


Transfer the points to the top view:

- __ 3 and 4 project up. Both are on the front face, zero distance measurement.
- __ 5 projects from the front. 5 is 3 units depth.
- __ 1 projects from the front. 1 is 5 units depth,
- __ 2 projects from the front, 2 is 1 1/2 units depth.

Transfer the points to the pictorial:

- __ 3 and 4 are already shown.
- __ 5 is 4 units above 4 and 3 units back. (4H and 3D relative to 4).
- __ 1 is 5 units width, 10 units height and 5 units depth from the lower left corner of the grid. (5W, 10H and 5D)
- __ 2 is 2 units up and 1 1/2 units back from 3. (2H and 1 1/2D relative to 3).



Connect the points 1,2,3,4,5,1 in order. This locates surface "A".

Inclined line "B" in the front view is surface 1,14,16,2 in the side view.

__ transfer 1,14 to 1 in the front view.

__ transfer 2,16 to 2 in the front view.

__ project 14 to the top view. 14 measures 10 units depth (back of the object).

__ project 16 to the top view. 16 also measures 10 units depth.

Plot 14 and 16 on the pictorial:

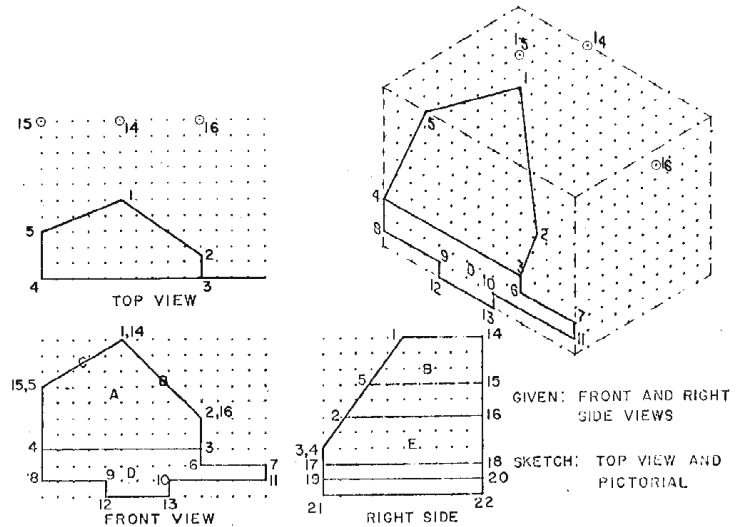
__ 14 is 5 units in back of 1.

(5D relative to 1).

__ 16 is 8 1/2 units deep relative to 2.

(8 1/2D relative to 2).

Connect 1,14,16,2,1 to complete the surface.



Finish the drawing.

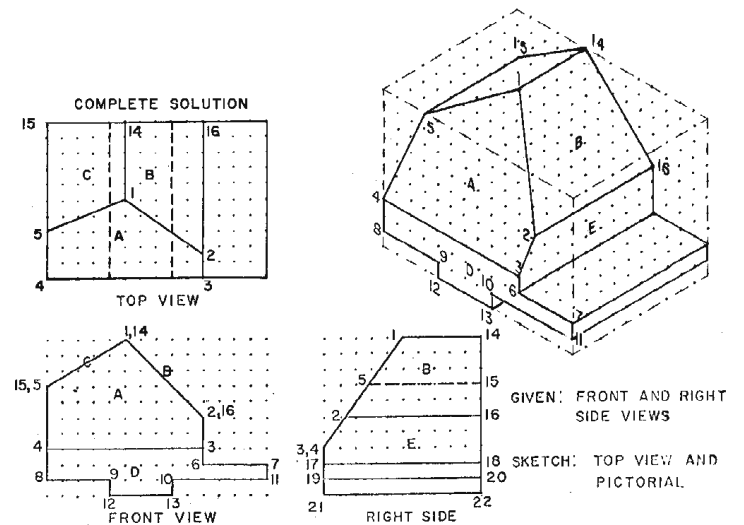
Inclined line "C" in the front view is surface 1,14,15,5 in the side view. Project point 15 to the front view. Locate point 15 in the top view. 15 projects from the front and measures 10 units depth from the side view. Draw surface 1,14,15,5,1 in the top view.

Locate point 15 in the pictorial view. 15 is 7 units depth relative to 5. Draw surface 1,14,15,5,1 in the isometric.

Horizontal edge-of-surface 6,7 in the front view is horizontal edge-of-surface 17,18 in the side view.

__ Sketch a surface in the top view 4 units wide and 10 units deep.

__ Sketch the surface on the pictorial view.



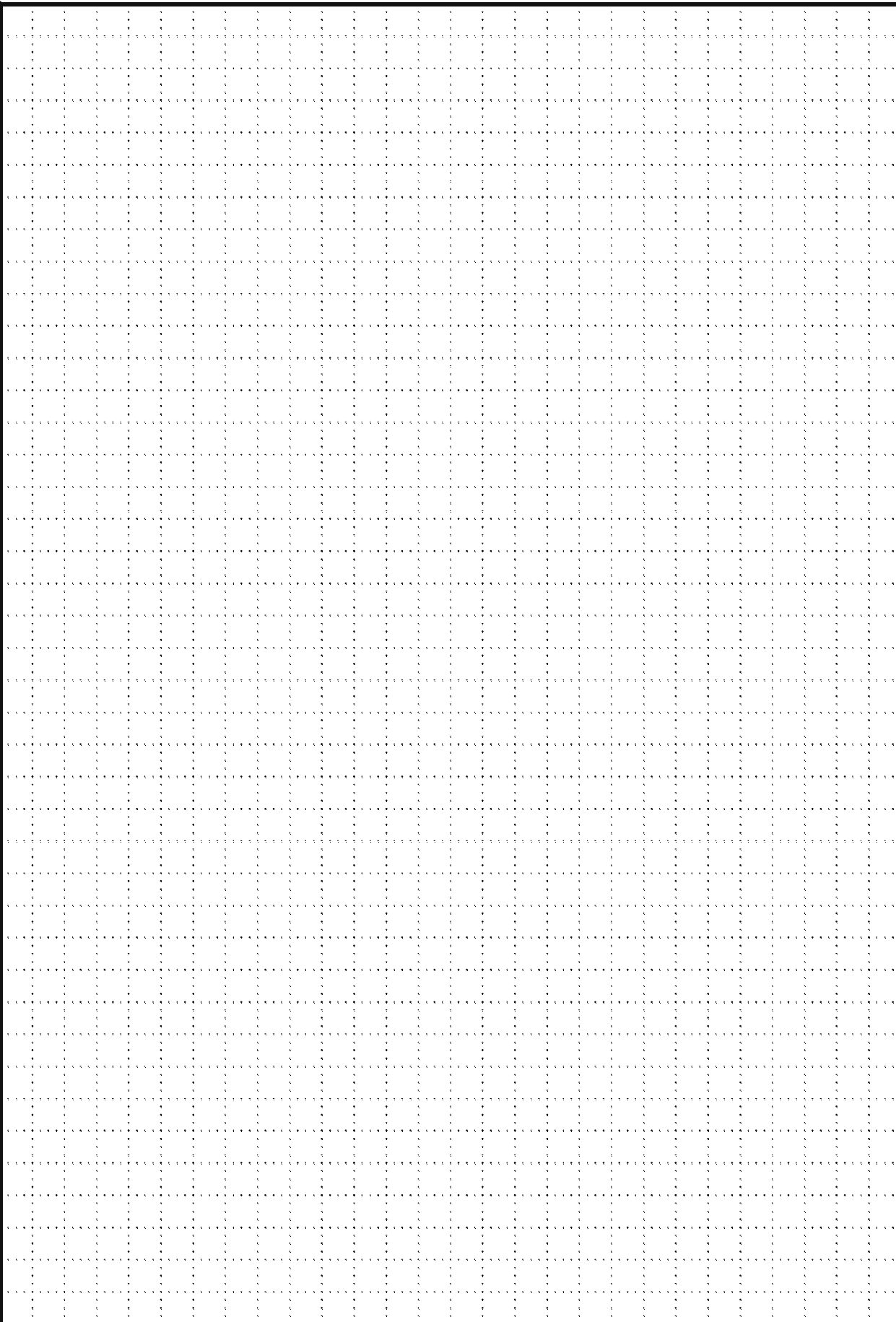
Vertical edge-of-surface 10,13 in the front view is normal surface 19,20,22,21 in the side view. Sketch a vertical hidden line in the top view directly above 10,13 and extending from front to back (10 units).

Vertical edge-of-surface 9,12 in the front view is a hidden surface behind 19,20,22,21 in the side view. Sketch a vertical hidden line in the top view directly above 9,12 and 10 units deep.

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FILE NUMBER

GRADE

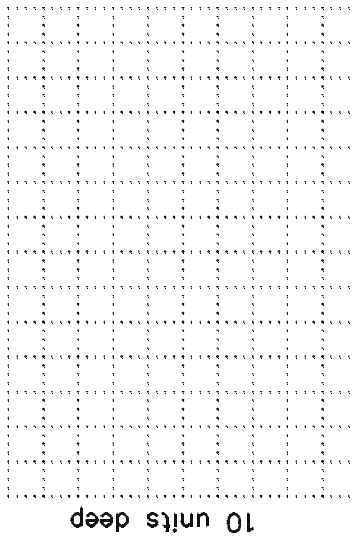
.....	
NAME
DATE

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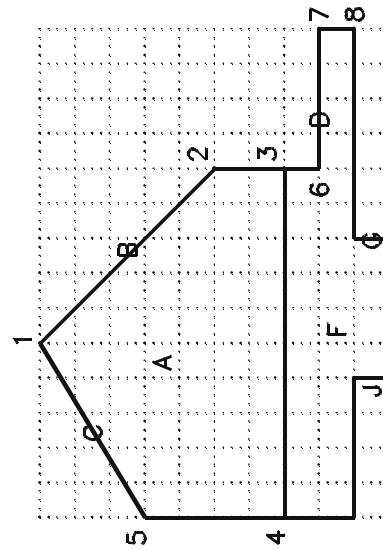
INCLINED SURFACE LECTURE SHEET

Please sketch the answer as the instructor talks. Follow the reasoning used to prove every line and point on the drawing.

(back face of the object)

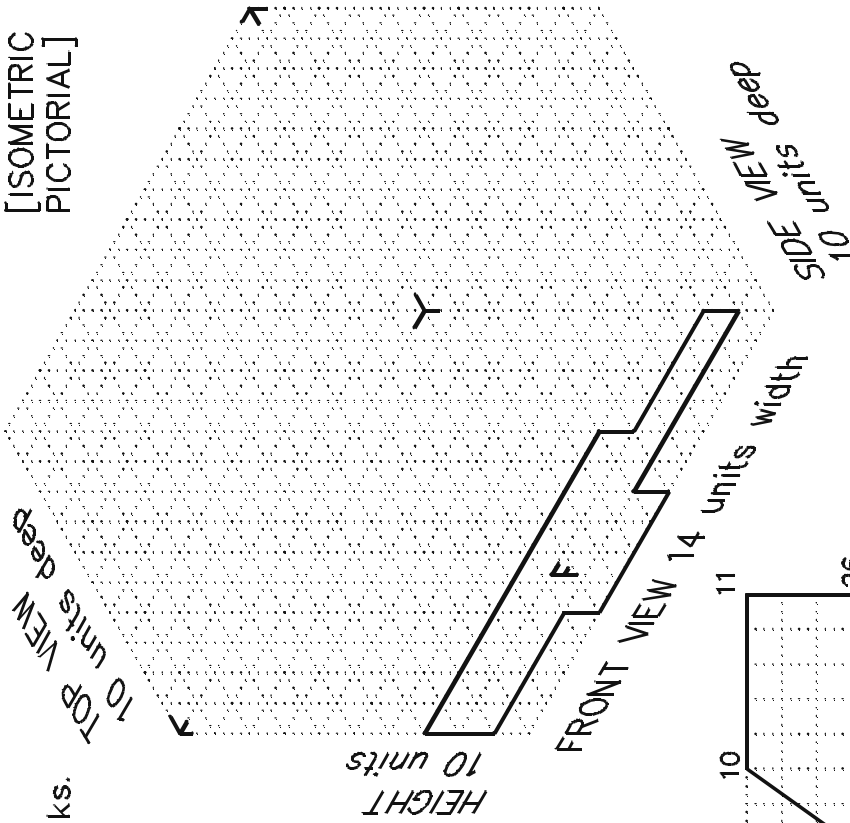


(front face of object)



[FRONT VIEW]

[TOP VIEW]



[ISOMETRIC PICTORIAL]

NOTE:
 Show hidden lines in orthographic views.
 Do not show hidden lines in pictorial views.

INCLINED SURFACE LECTURE SHEET

DRAWN BY:

DATE

COURSE

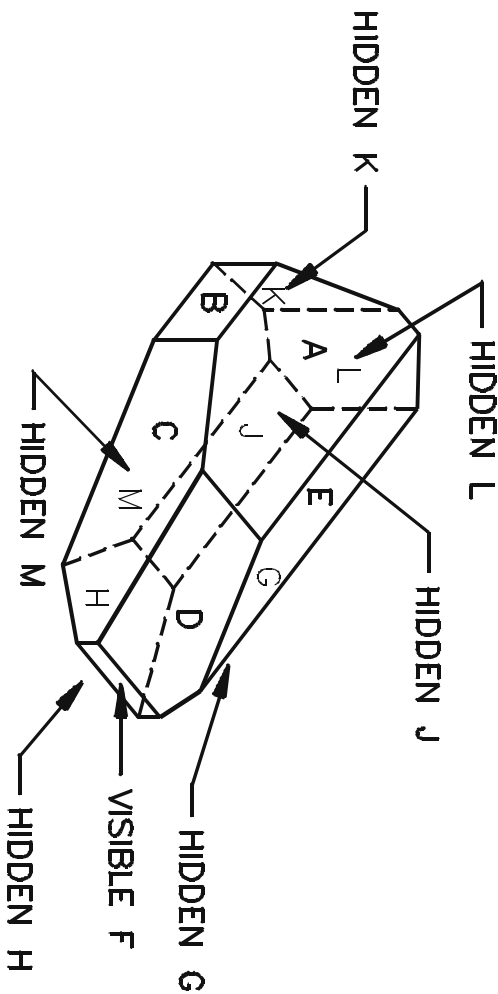
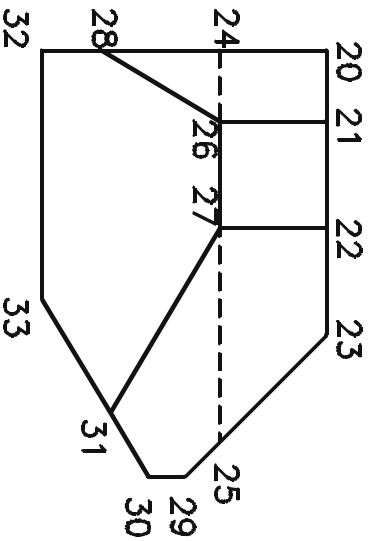
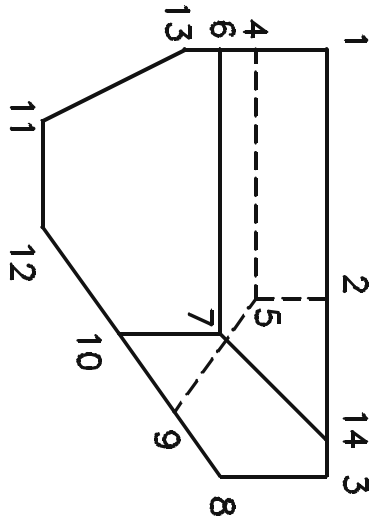
GRADE

DRAWING

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GRADE



SURFACE STUDY:

- SURFACE "F" IS, 46,47,49,48 IN THE RIGHT VIEW.
- "F" IS 29,30 IN THE FRONT VIEW.
- "F" IS 3,8 IN THE TOP VIEW.
- "F" IS A NORMAL SURFACE.

USE THIS DRAWING WITH PAGE I-2

I-1 INCLINED SURFACES

NAME

DATE

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FILE NUMBER

GRADE

USE THIS PAGE WITH I-1. NEATLY LETTER THE ANSWERS IN THE TABLE.

SURFACE	TOP VIEW	FRONT VIEW	RIGHT SIDE VIEW	SURFACE TYPE
A				
B				
C				
D				
E				
F	3,8	29,30	46,47,49,48	NORMAL
G				
H				
J				
K				
L				
M				

SURFACE TABLES – REVIEW – FILL IN THE MISSING BLOCKS
NORMAL SURFACES

FRONT	TOP	SIDE
SURFACE		
SURFACE		
SURFACE		

FRONT	TOP	SIDE
INCLINED LINE		
INCLINED LINE	INCLINED LINE	
INCLINED LINE		INCLINED LINE

I-2 INCLINED SURFACES

NAME

DATE

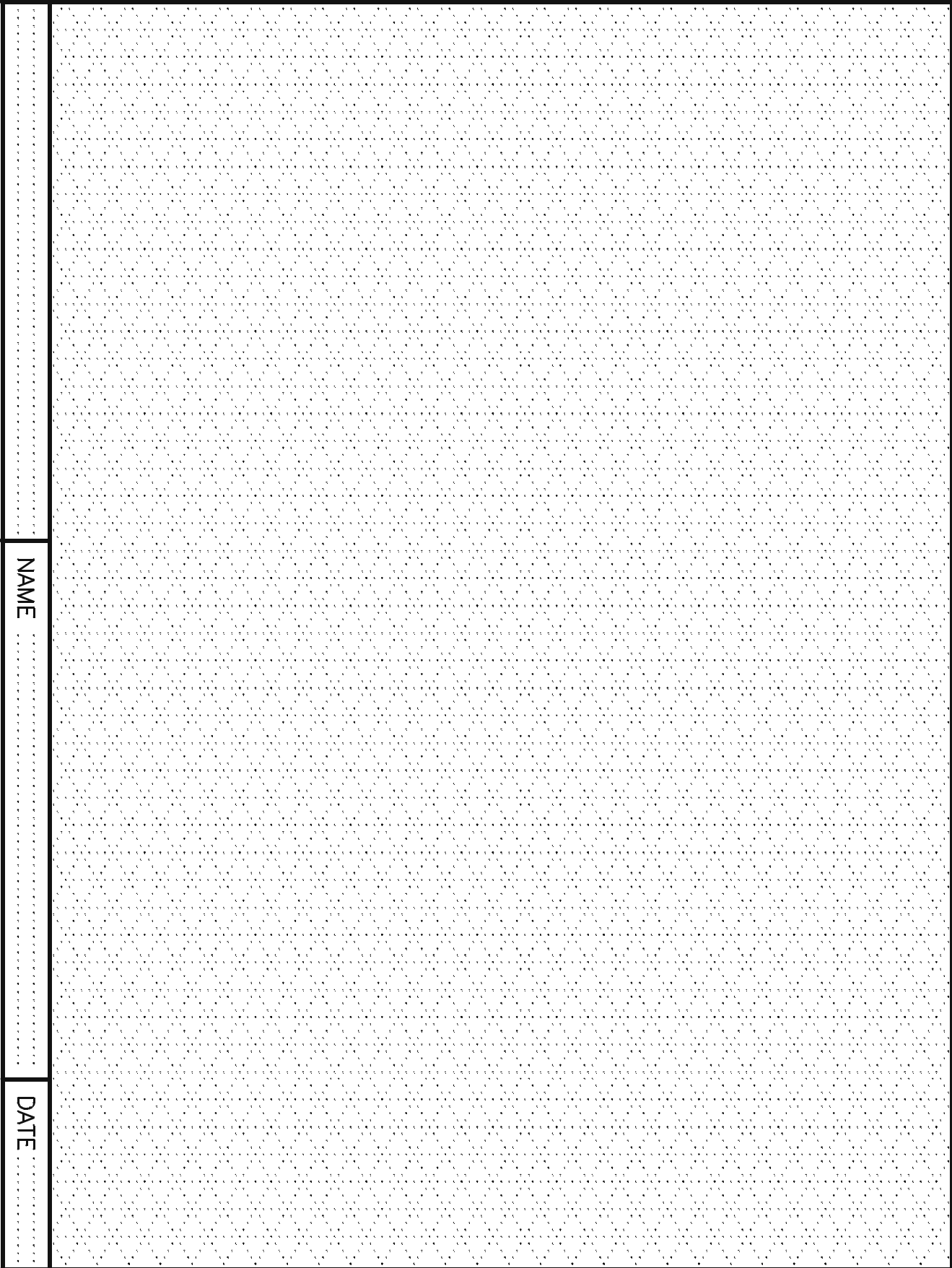
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NOTE: Use this grid format
in horizontal direction.

FILE NUMBER

GRADE

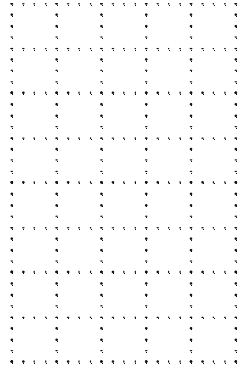
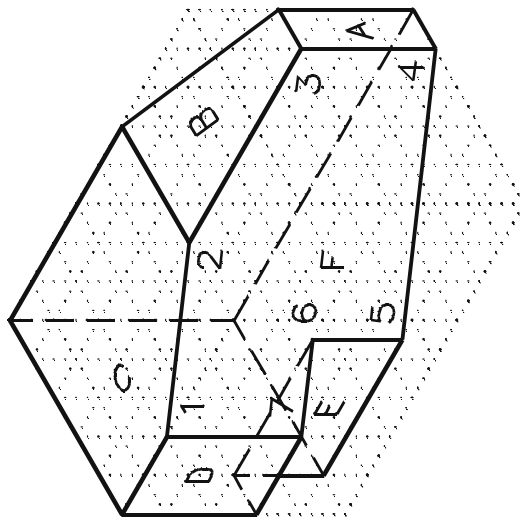
		NAME	
		DATE	



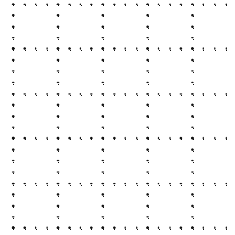
GRADE

FILE NUMBER

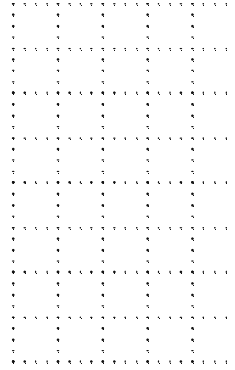
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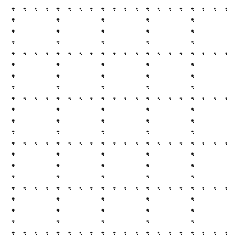
TOP VIEW



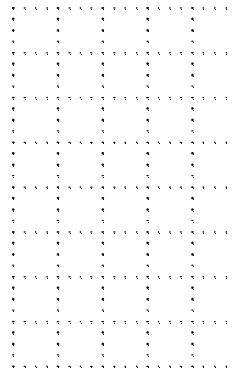
RIGHT SIDE VIEW



FRONT VIEW



LEFT SIDE VIEW

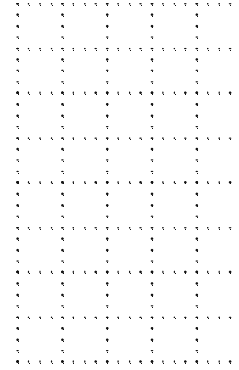


REAR (BACK) VIEW

GIVEN: ISOMETRIC PICTORIAL VIEW.
SKETCH THE SIX REGULAR
ORTHOGRAPHIC VIEWS.

Be sure to show hidden lines
in the orthographic views.

LABEL SURFACES IN ALL VIEWS.



BOTTOM VIEW

I-3 INCLINED SURFACES

NAME

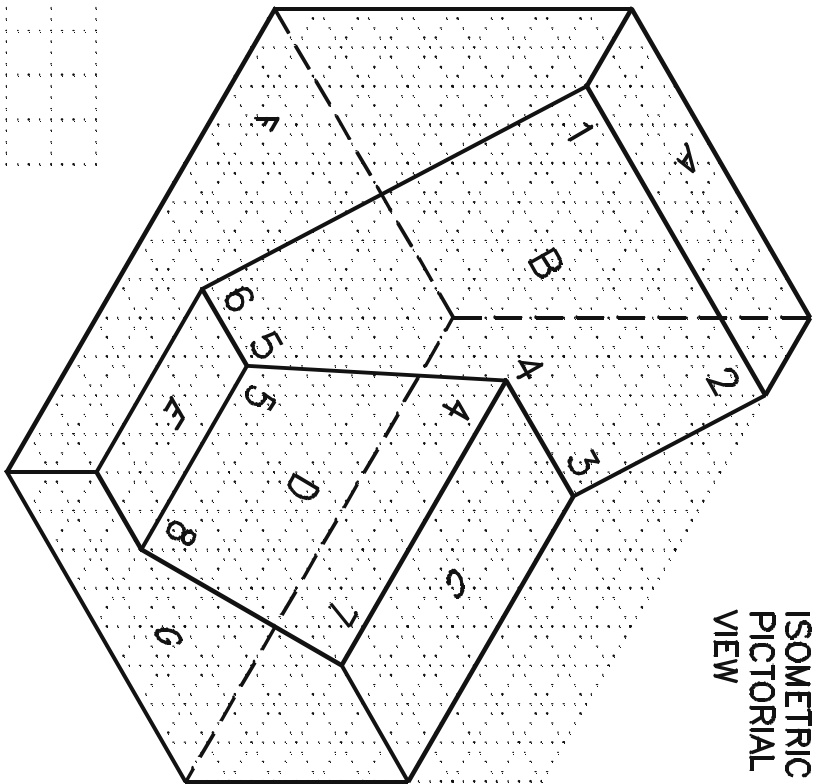
DATE

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FILE NUMBER

GRADE

IF SURFACES OR CORNERS ARE LABELED
IN THE GIVEN VIEWS, SHOW THE LABELS
IN ALL VIEWS. PROVE YOUR ANSWER.



ISOMETRIC
PICTORIAL
VIEW

Two large rectangular grids of dots for drawing orthographic views. The top grid is 10 units wide and 10 units high. The bottom grid is 10 units wide and 10 units high.

ORTHOGRAPHIC VIEWS

GIVEN: ISOMETRIC
PICTORIAL VIEW.
REQUIRED: SKETCH THE
TOP, FRONT AND RIGHT
SIDE VIEWS.

I-4 INCLINED SURFACES

NAME

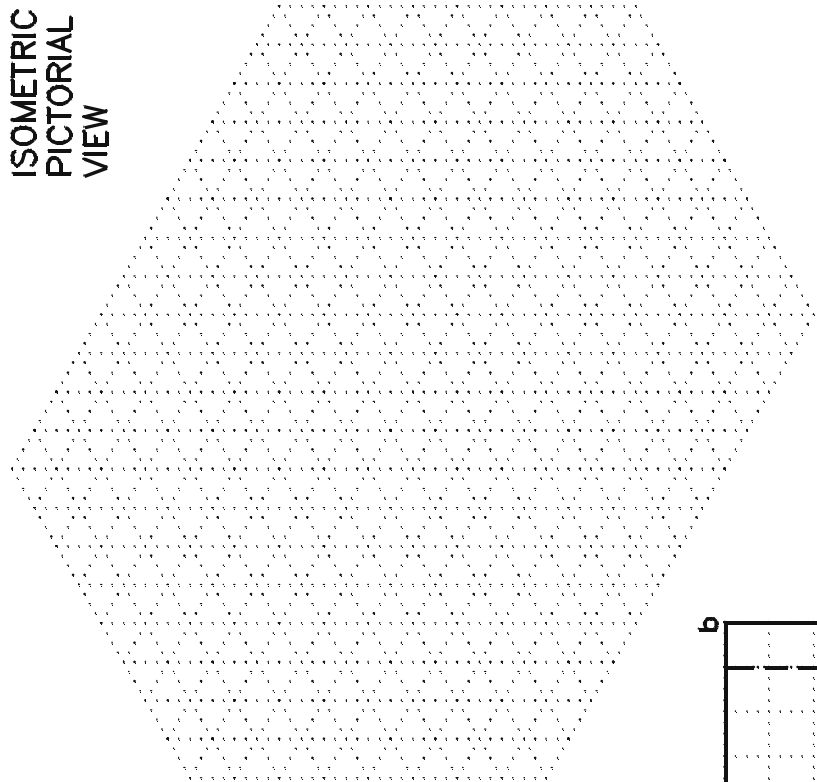
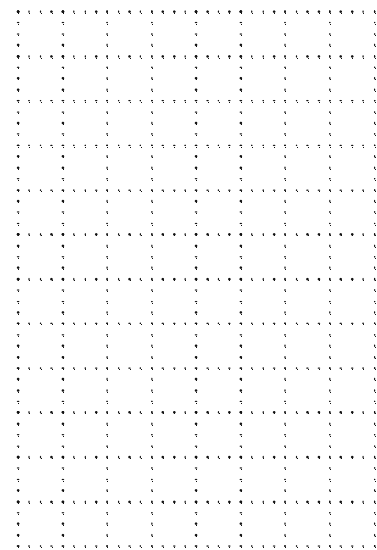
DATE

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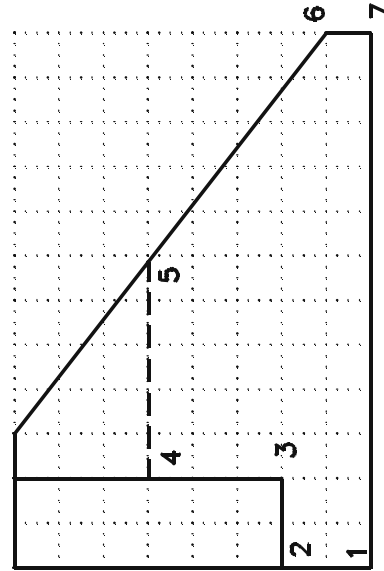
FILE NUMBER

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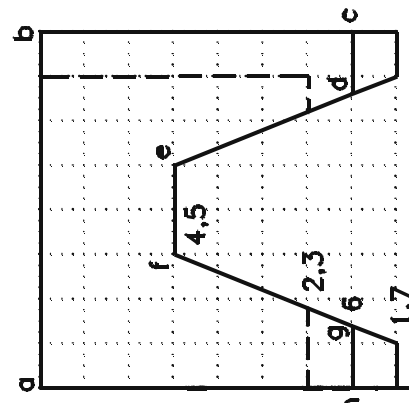
IF SURFACES OR CORNERS ARE LABELED IN THE GIVEN VIEWS, SHOW THE LABELS IN ALL VIEWS. PROVE YOUR ANSWER.



ISOMETRIC PICTORIAL VIEW



SURFACE 1,2,3,4,5,6,7 IS HIDDEN.



GIVEN: FRONT AND RIGHT SIDE VIEWS.
REQUIRED: SKETCH THE TOP AND ISOMETRIC PICTORIAL VIEWS.

ORTHOGRAPHIC VIEWS

I-5 INCLINED SURFACES

NAME

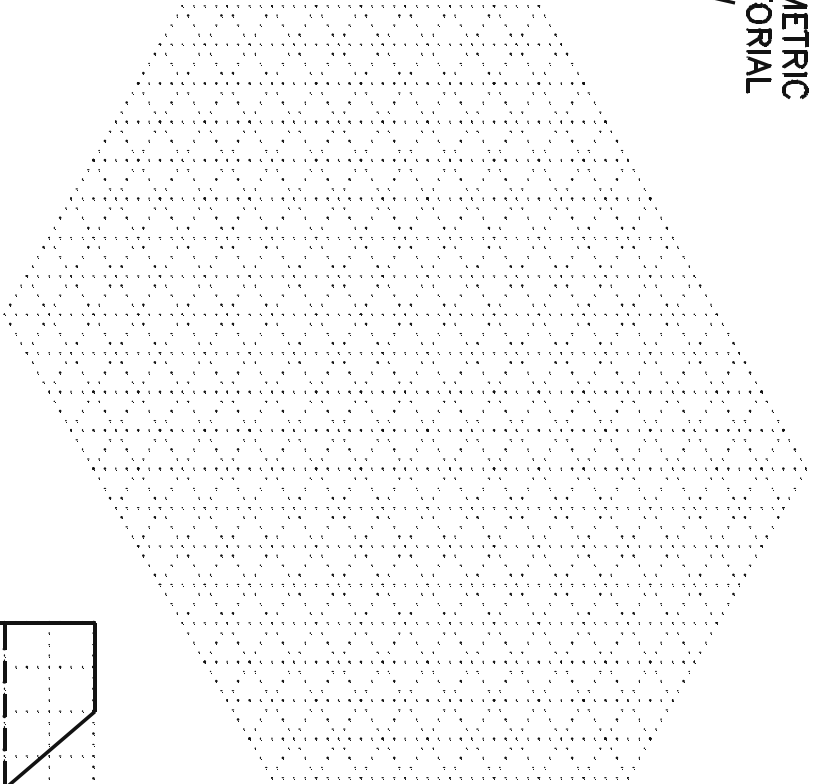
DATE

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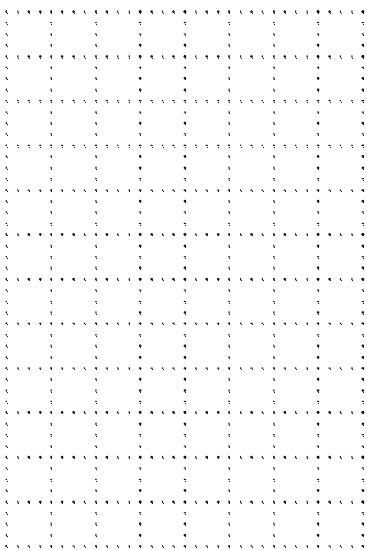
FILE NUMBER

GRADE

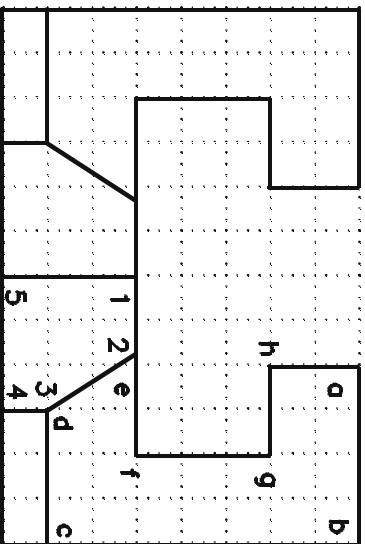
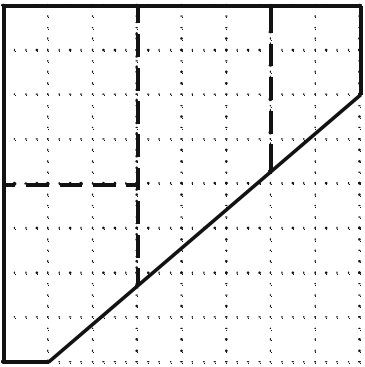
ISOMETRIC
PICTORIAL
VIEW



WHEN GIVEN SURFACES OR CORNERS
ARE LABELED, SHOW THE LABELS
IN ALL VIEWS. PROVE YOUR ANSWER.



GIVEN: FRONT AND LEFT SIDE
VIEWS.
REQUIRED: SKETCH THE TOP
VIEW AND ISOMETRIC
PICTORIAL VIEW.



ORTHOGRAPHIC VIEWS

I-6 INCLINED SURFACES

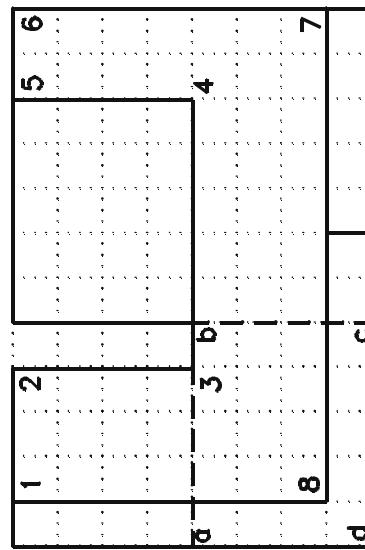
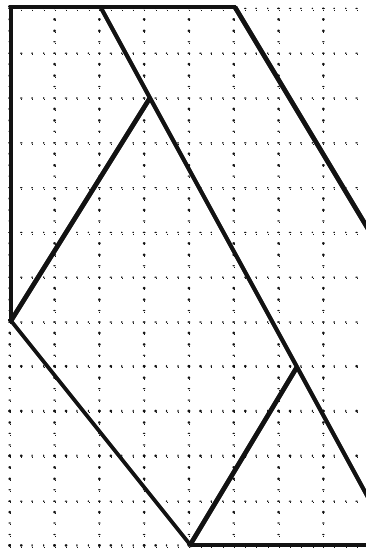
NAME

DATE

FILE NUMBER GRADE

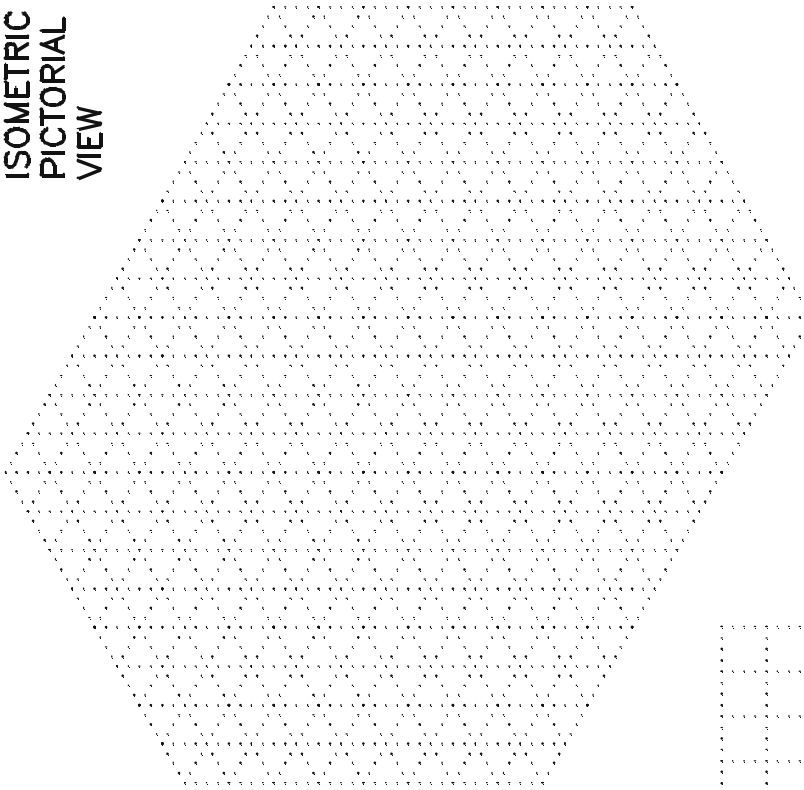
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IF SURFACES OR CORNERS ARE LABELED IN THE GIVEN VIEWS, SHOW THE LABELS IN ALL VIEWS. PROVE YOUR ANSWER.

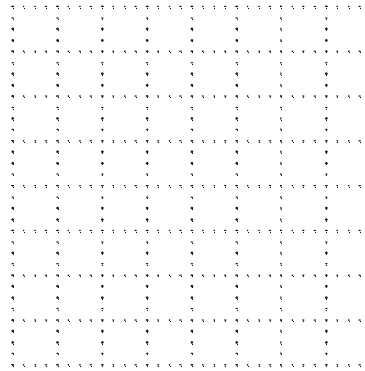


a, b, c, d is a hidden surface.

ISOMETRIC
PICTORIAL
VIEW



GIVEN: FRONT AND TOP VIEWS.
REQUIRED: SKETCH THE RIGHT SIDE VIEW AND ISOMETRIC PICTORIAL VIEW.



ORTHOGRAPHIC VIEWS

I-7 INCLINED SURFACES

NAME

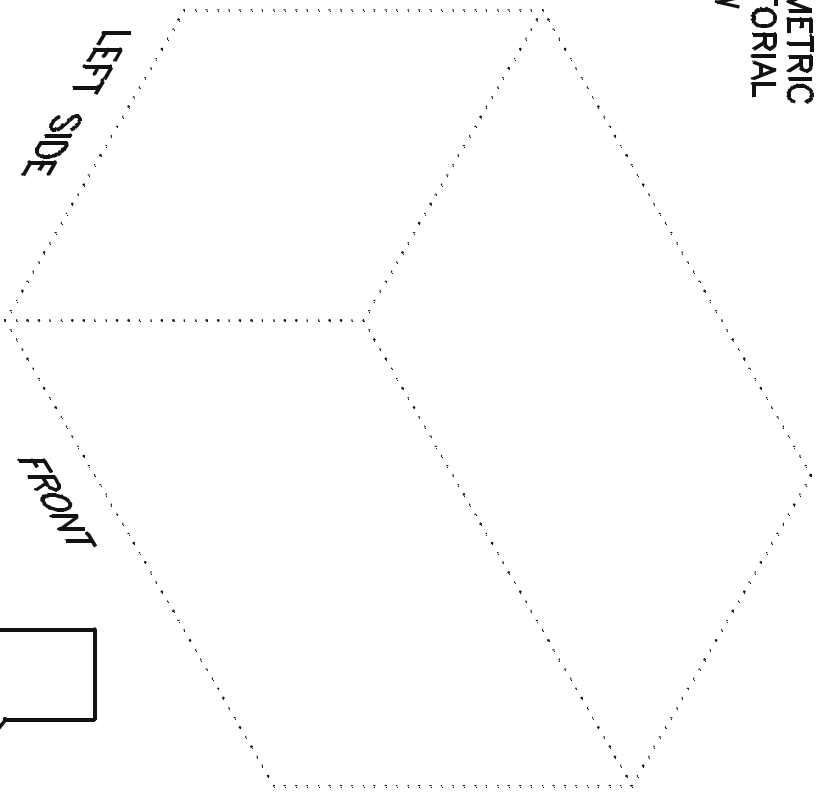
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FILE NUMBER

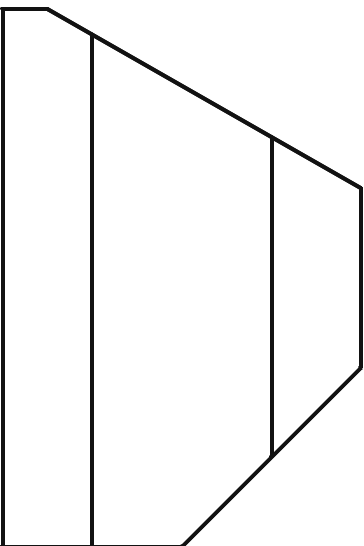
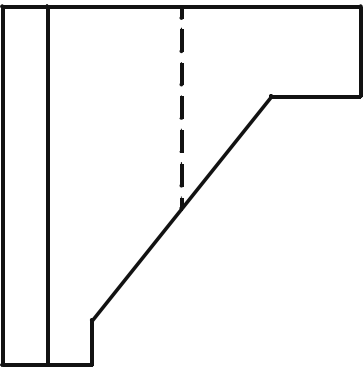
GRADE

ISOMETRIC
PICTORIAL
VIEW



LABEL THE CORNERS OF INCLINED SURFACES. SHOW LABELS IN ALL VIEWS.

GIVEN: LEFT SIDE AND FRONT VIEWS.
REQUIRED: SKETCH THE TOP VIEW AND THE ISOMETRIC PICTORIAL VIEW.



ORTHOGRAPHIC VIEWS

I-8 INCLINED SURFACES

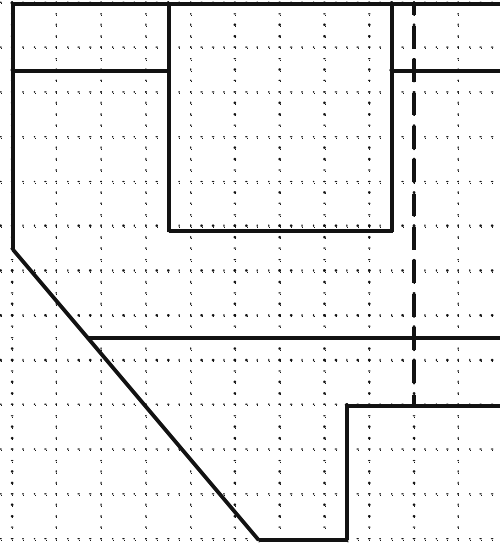
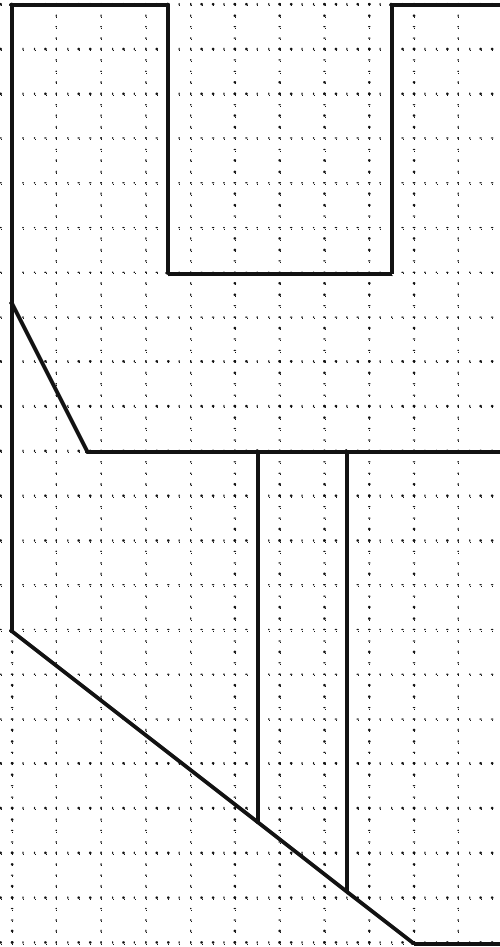
NAME

DATE

FILE NUMBER GRADE

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GIVEN: FRONT AND RIGHT SIDE VIEWS.
REQUIRED: SKETCH THE TOP VIEW. SKETCH THE ISOMETRIC PICTORIAL ON ANOTHER ISOMETRIC SHEET.
LABEL THE CORNERS OF THE INCLINED SURFACES.
SHOW LABELS IN ALL VIEWS.



I-9 INCLINED SURFACES

NAME

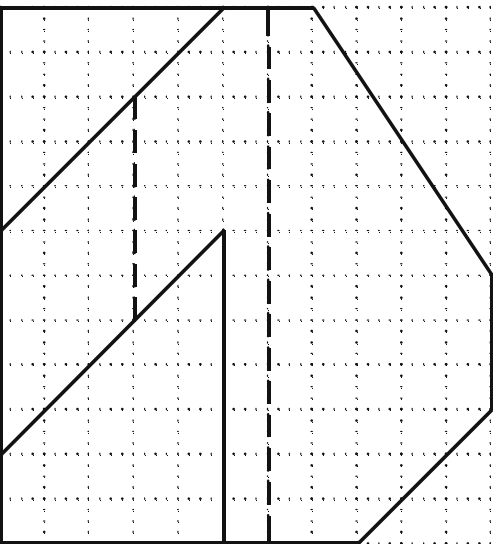
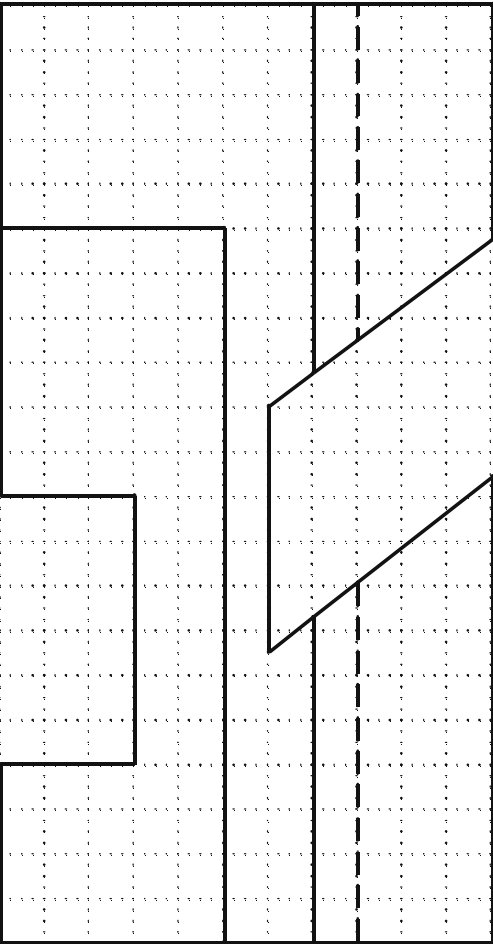
DATE

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FILE NUMBER

GRADE

GIVEN: FRONT AND RIGHT
SIDE VIEWS.
REQUIRED: SKETCH THE TOP
VIEW.
SKETCH THE PICTORIAL VIEW
ON ANOTHER ISOMETRIC SHEET.
LABEL THE CORNERS OF
THE INCLINED SURFACES.
SHOW LABELS IN ALL VIEWS.



I-10 INCLINED SURFACES

NAME

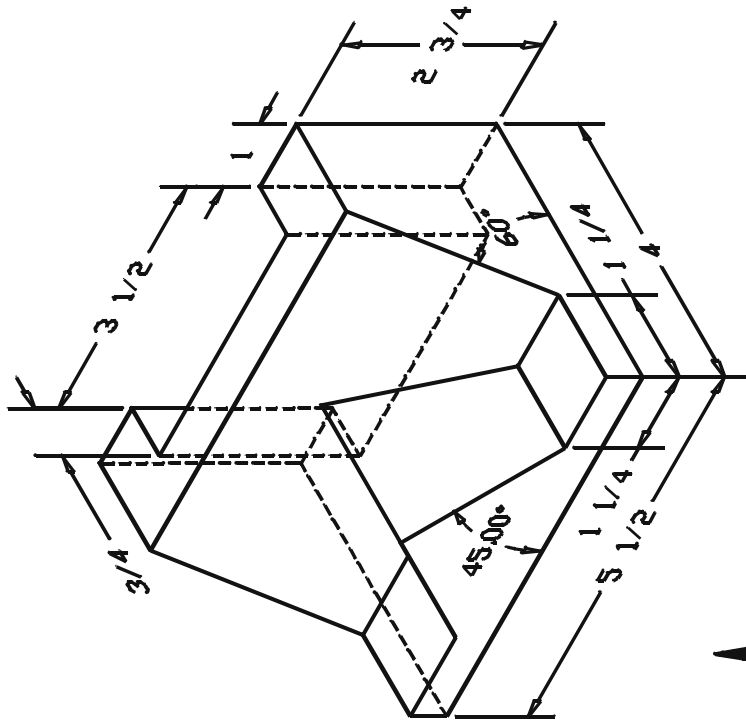
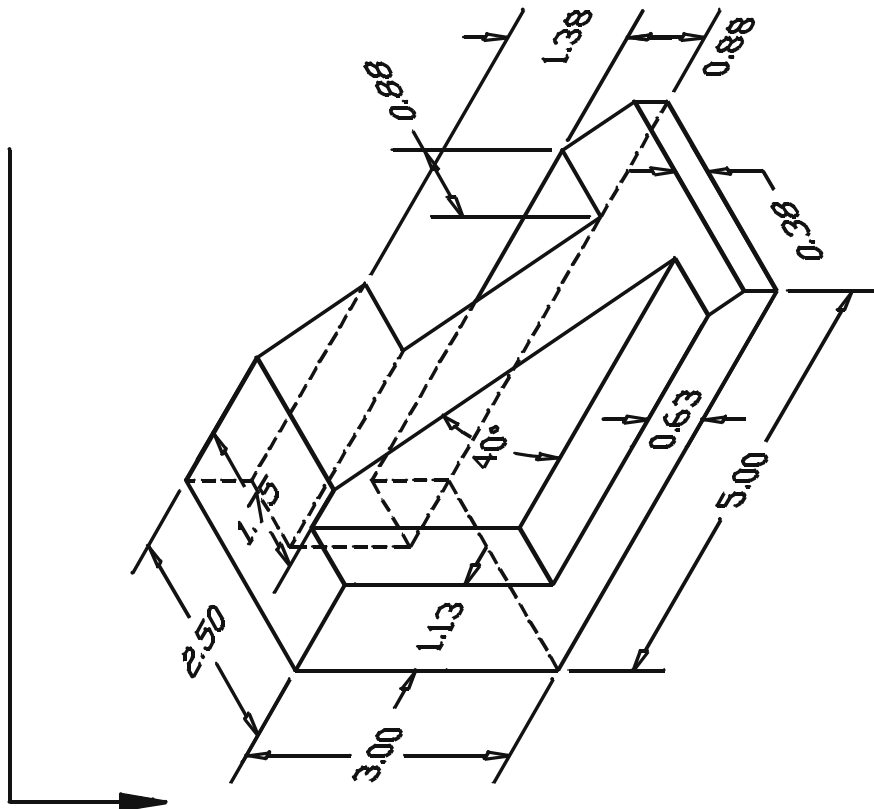
DATE

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GRADE

FILE NUMBER

1. GIVEN: ISOMETRIC PICTORIAL VIEW
REQUIRED: DRAW THE FRONT, TOP
AND RIGHT SIDE ORTHOGRAPHIC
VIEWS.



2. GIVEN: ISOMETRIC PICTORIAL VIEW
REQUIRED: DRAW THE FRONT, TOP
AND RIGHT SIDE ORTHOGRAPHIC
VIEWS.

I-11 INCLINED SURFACES

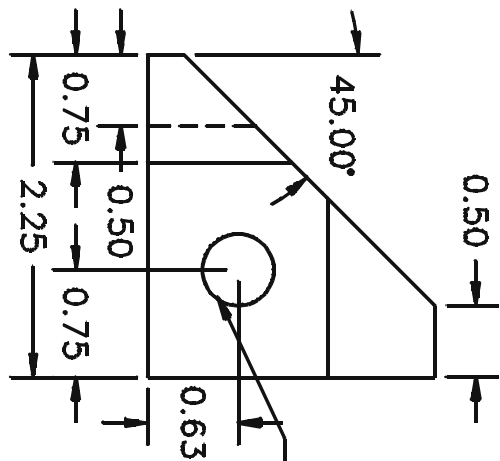
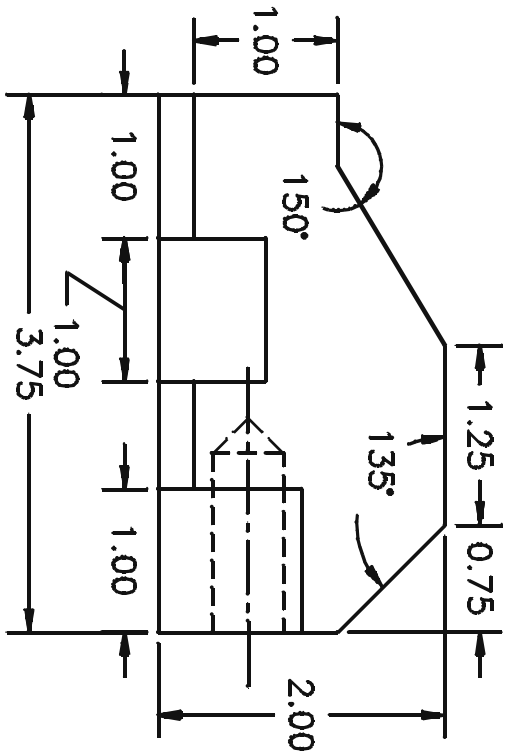
NAME

DATE

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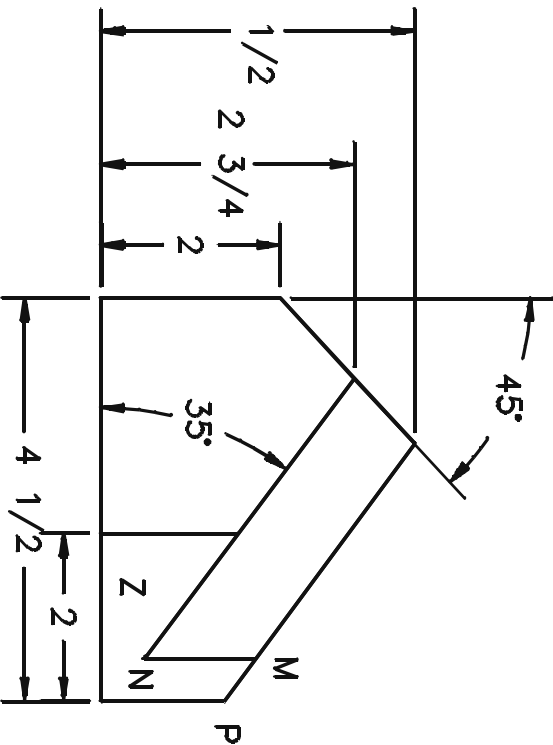
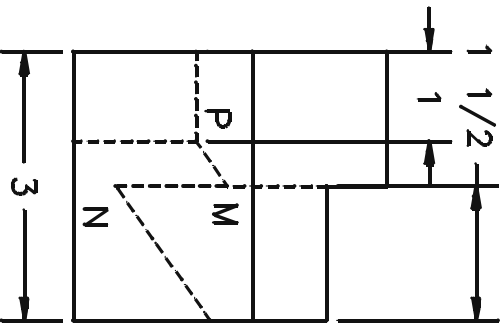
FILE NUMBER

GRADE



GIVEN: FRONT AND RIGHT SIDE VIEWS.
REQUIRED: DRAW THE FRONT, RIGHT SIDE AND TOP VIEWS.

PROBLEM A.



PROBLEM B.

GIVEN: LEFT SIDE AND FRONT VIEWS.
REQUIRED: DRAW FRONT TOP AND RIGHT SIDE VIEWS.
NOTE: TOP VIEW NEEDED TO LOCATE POINTS "M" AND "N" IN THE FRONT AND SIDE VIEWS.
SURFACE "Z" IS AN INCLINED SURFACE.

I-12 INCLINED SURFACES

NAME

DATE

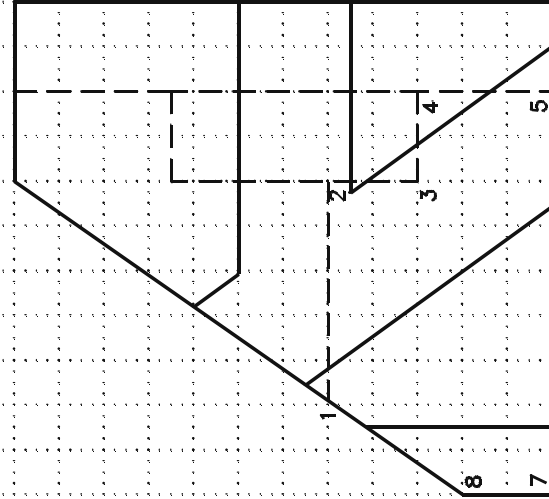
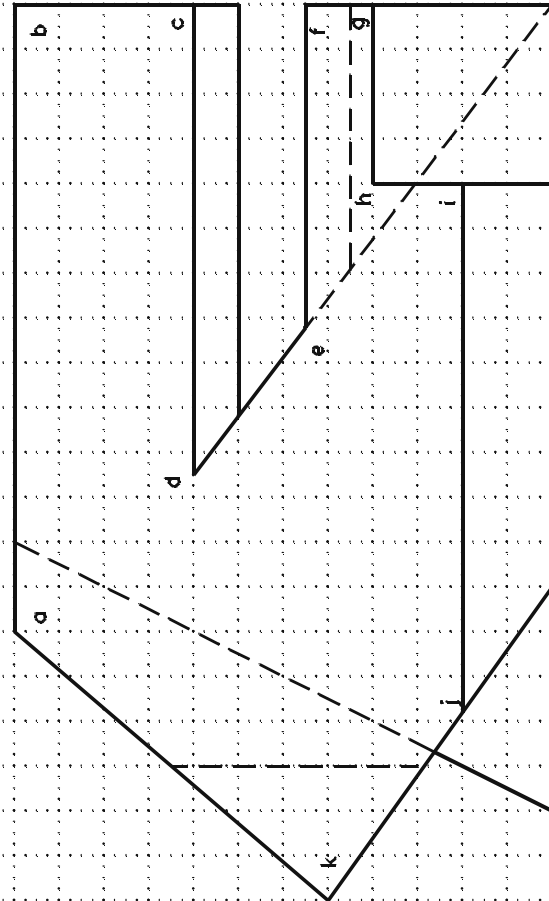
GRADE

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TYPICAL EXAM

GIVEN: COMPLETE FRONT AND
RIGHT SIDE VIEWS.
SKETCH TOP VIEW.
SHOW HIDDEN LINES.
LABEL CORNERS.



T-4 INCLINED SURFACE TYPICAL EXAM

NAME

DATE

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NOTE: TURN PAGE VERTICALLY
FOR USE.

FILE NUMBER

GRADE

		NAME	
		DATE	