

# Engineering Drawing (E 122) Engineering Graphics (E 125) LECTURE NOTES

## 1 INTRODUCTION

## 2 DRAFTING BASICS --- GEOMETRY & SHAPE DESCRIPTION

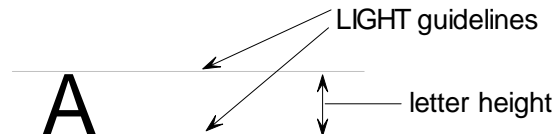
### I. Preliminaries

- A. (CT brings – camera, drafting stuff, sign-in sheet, triangle, scale, foam)
- B. Adds – get notes NOW, & SEE ME AFTER CLASS!
- C. Last time – engineering definition, design (must think spatially, geometrically, must know how things are built), drafting (communication of design, properly done when following standard conventions, importance of hand sketching), CAD programs (AutoCAD, Solidworks, ProEngineer, CATIA)

### II. Hand sketching practice

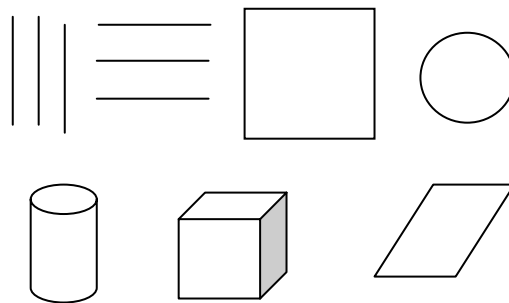
#### A. Lettering

- 1. Mechanical drafting – block style, all \_\_\_\_\_ letters, & \_\_\_\_\_ serif.
- 2. 2 types – vertical, slanted
- 3. Standard heights - .250" (1/4"), .3125 (5/16), .188 (3/16), .125 (1/8")
- 4. Use \_\_\_\_\_.



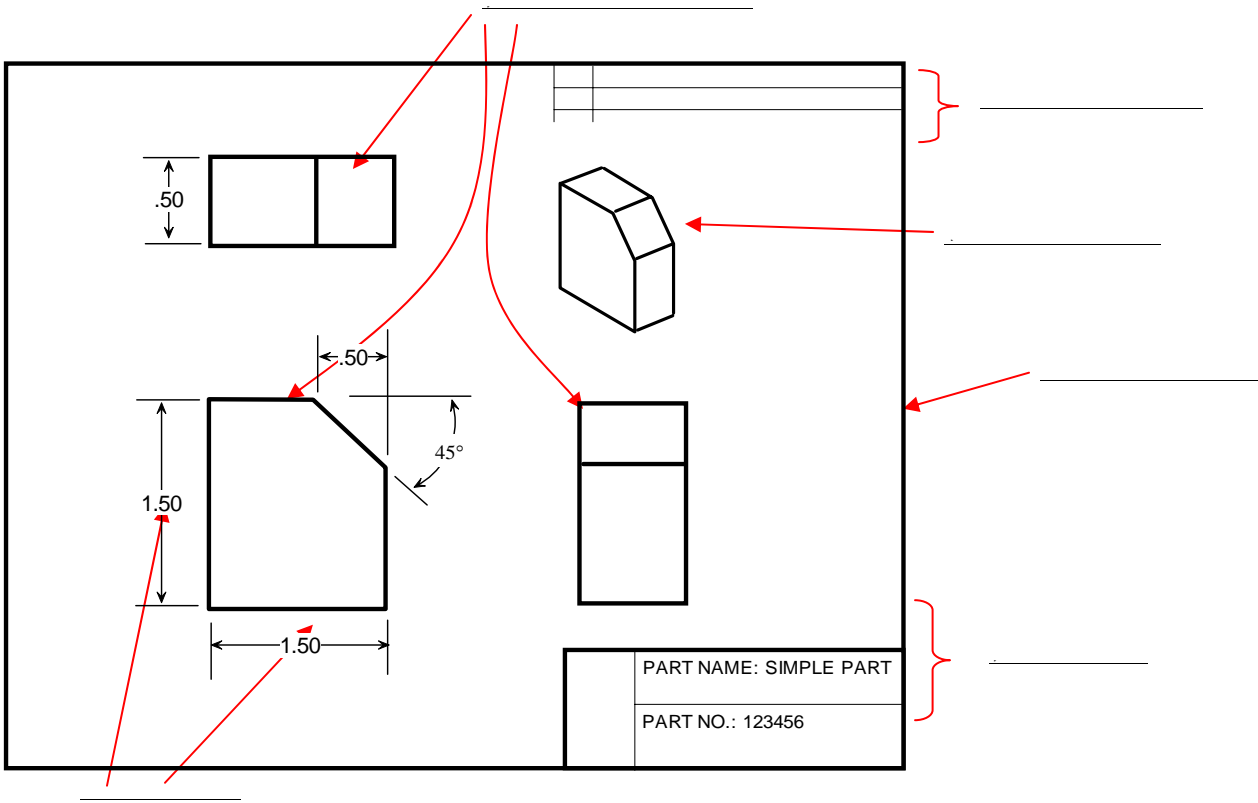
#### B. Practice sketching (loosen up!)

- 1. Straight lines – horiz and vertical
- 2. Squares, rectangles, triangles
- 3. Circles, ellipses
- 4. Solids – blocks, cylinders, cones,



### III. A Basic Engineering Drawing

- A. Views – orthographic, isometric
- B. Dimensions – tell us the size/location of features
- C. Annotations – centerlines (much more later)
- D. Sheet format – border, title block, revision block



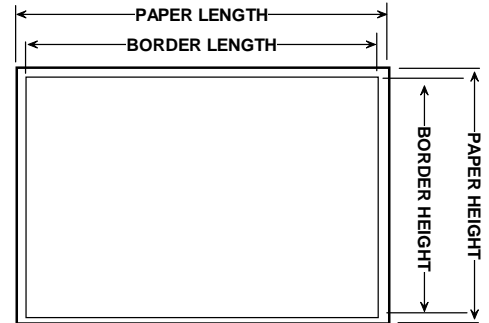
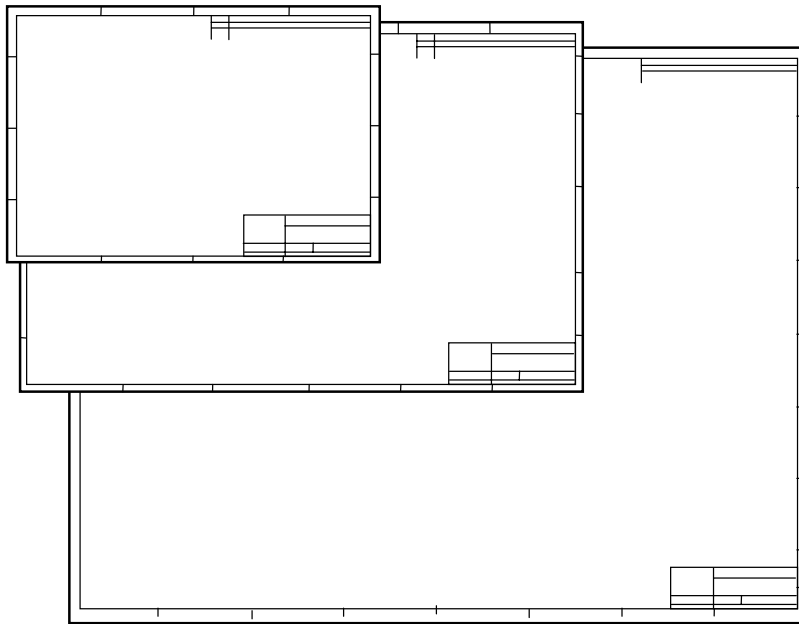
### IV. Sheet formats

- A. Drawing border
- B. Title block
  - 1. \_\_\_\_\_ name
  - 2. \_\_\_\_\_ name
  - 3. Part or drawing \_\_\_\_\_.
  - 4. Drawing \_\_\_\_\_.
  - 5. Convention (1st or 3rd angle; units of measure)
  - 6. Default tolerances (or “box tolerances”)
  - 7. \_\_\_\_\_.
  - 8. Draftsperson
  - 9. etc.
- C. Revision block
  - 1. Shows \_\_\_\_\_ of the part
  - 2. Often done with letters (A, B, C, ...)
- D. Scale
  - 1. \_\_\_\_\_ world: \_\_\_\_\_ world

2. 1:1 = full scale
3. 2:1 = appears in drawing 2x as big as it does in real world
4. 10:1 = appears in drawing \_\_\_\_\_ as big as it does in real world
5. 1:10 = appears in drawing \_\_\_\_\_ as big as it does in real world

E. Sheet sizes

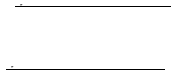
1. Selected based on \_\_\_\_\_ and \_\_\_\_\_.



INCH DRAWING SIZES		
DRAWING SIZE	BORDER SIZE*	OVERALL PAPER SIZE
A	8.00 X 10.50	8.50 X 11.00
B	10.60 X 16.50	11.00 X 17.00
C	16.25 X 21.25	17.00 X 22.00
D	21.00 X 33.00	22.00 X 34.00
E	33.00 X 43.00	34.00 X 44.00

METRIC DRAWING SIZES		
DRAWING SIZE	BORDER SIZE*	OVERALL PAPER SIZE
A4	190 X 267	210 X 297
A3	277 X 390	297 X 420
A2	400 X 564	420 X 594
A1	574 X 811	594 X 841
A0	821 X 1159	841 X 1189

V. Line types (there are different kinds, see p. ~ 49 - 50)



A. Visible lines

1. Represent – visible \_\_\_\_\_, object contours (or \_\_\_\_\_)
2. How to draw – medium-thickness, solid (\_\_\_\_\_ ) lines

B. Hidden lines

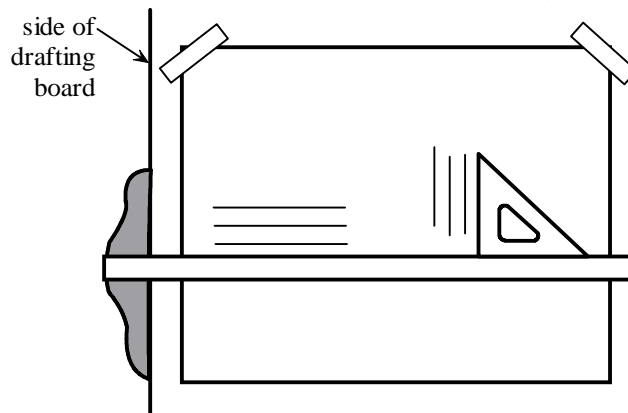
1. Represent – same thing as visible lines, but for features that are \_\_\_\_\_ by the part
2. How to draw – \_\_\_\_\_ lines

C. Centerlines

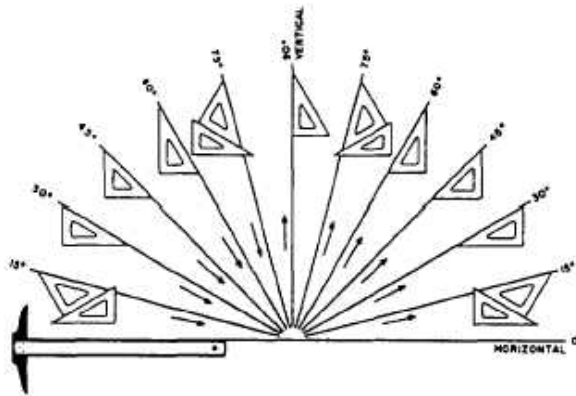
1. Represent – center of a hole, or symmetric features (more later)
2. How to draw – thin, alternating line & short dashes

VI. Board Drafting

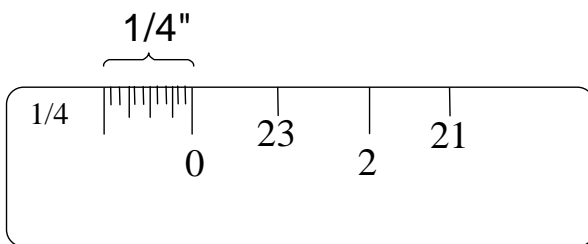
A. Using the equipment – pencils, drafting board, t-square, triangles



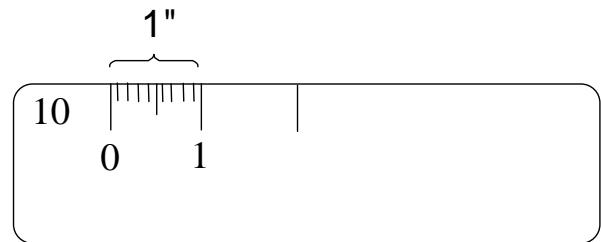
1. Use 2 triangles to make lines at 15 degree angle increments.



2. Other pencil techniques
  - a. Making // lines
  - b. Making lines  $\perp$  to each other
  - c. Bisecting an angle
  
3. Using the scale (not called a \_\_\_\_\_)
  - a. Architect's scale – feet and inches (inches are on other side of 0)
    - i. 1/4 – means 1/4" = 1'
  - b. Engineer's scale – 1 inch on paper is divided into XX number of units
    - i. 10 – means 10 units/inch
    - ii. If drawing scale is 1" = 20', then use the "20" scale (each little division represents 1 foot).

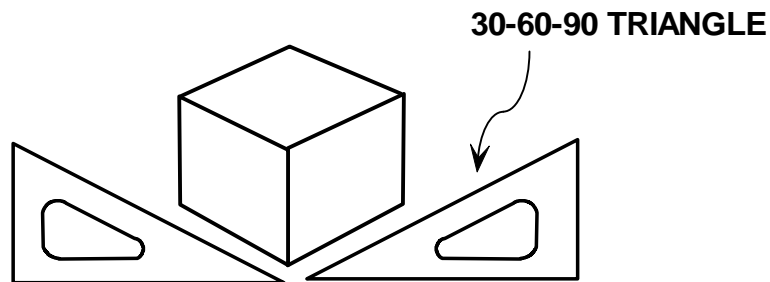


**Architect's Scale**

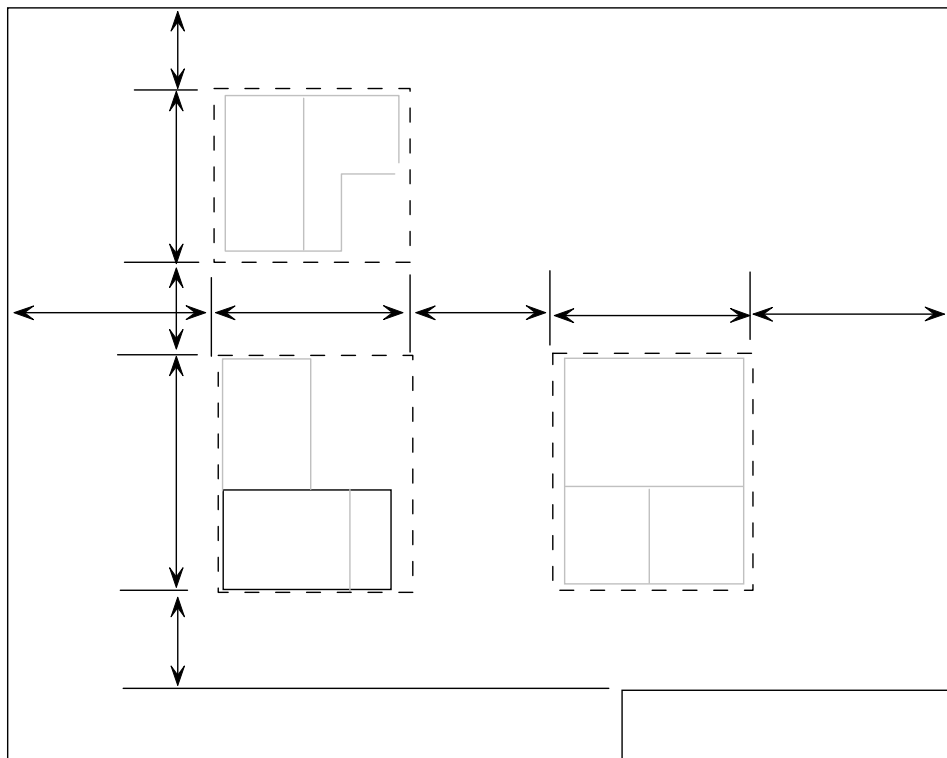
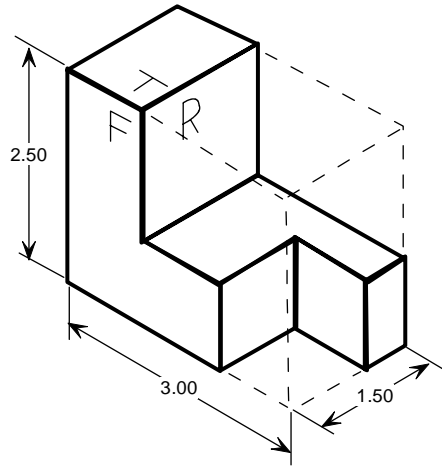


**Engineer's Scale**

4. For this class...
  - a. Use graph paper, triangle to draw horiz & vert lines
  - b. Use \_\_\_\_\_ triangle for isometric views



- A. Lightly sketch the border (1/4"), then title block (5" x 1")
- B. Decide on scale
- C. Spacing views on page
  - 1. Figure out dimensions of \_\_\_\_\_ of each view
  - 2. Work out horizontal & vertical spacing for the orthographic & isometric views
- D. Fill in detail \_\_\_\_\_, keeping features aligned
- E. Use the \_\_\_\_\_ triangle for the isometric
- F. Fill in dimension detail (lightly)
- G. When done, \_\_\_\_\_ lines.



VIII. Geometry & Shape Description

A. Geometry

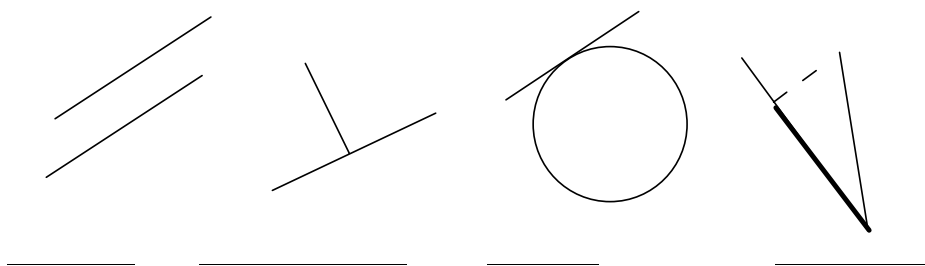
1. Field of knowledge related to \_\_\_\_\_, \_\_\_\_\_, & size of entities like points, lines, angles, & solids.

B. Geometry of shapes

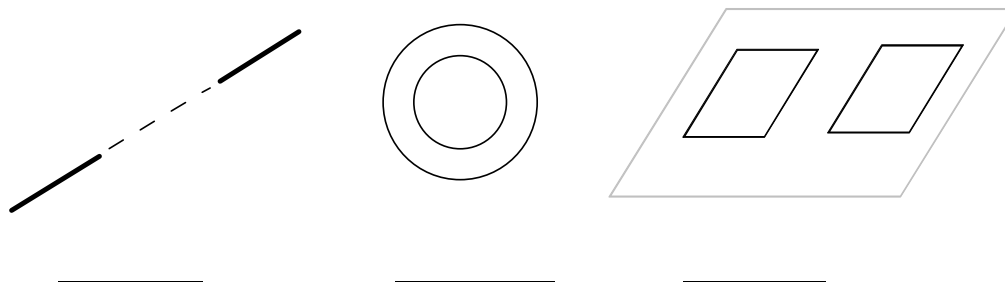
1. Lines, edges (1-dimensional, straight or curved) – have length.
2. Surfaces (2-dimensional, flat or wavy) – have area
3. Solids (3-dimensional, cubes or blobs) – have volume.

C. Geometric relationships

1. Parallel – 2 lines never \_\_\_\_\_ each other.
2. Perpendicular – having \_\_\_\_\_ angle.
3. Tangent – touching at just \_\_\_\_\_ (they just “kiss”).
4. Projection – (more on this later)



5. Co-linear – lie along the same line
6. Concentric – sharing the same \_\_\_\_\_ point
7. Co-planar – lie on the \_\_\_\_\_ plane.



D. Drawing views

1. Objects in the physical world – are \_\_\_\_\_!
2. Paper (which we’re going to draw on) is \_\_\_\_\_!
3. How do we depict 3D objects on 2D pieces of paper? \_\_\_\_\_ drawings

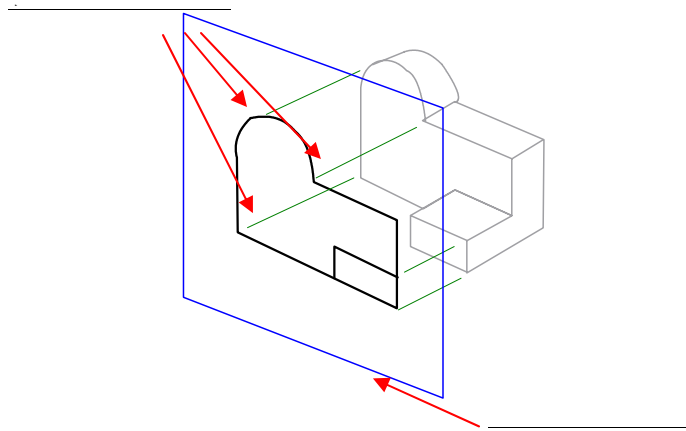
E. How do we “\_\_\_\_\_” our 3D part into a 2D view? ... Projection!

IX. Theory of projection

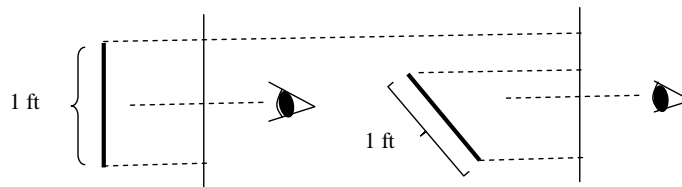
A. Geometry of projection

1. The viewer sees \_\_\_\_\_ being \_\_\_\_\_ off the surface of a part.
2. Light travels in \_\_\_\_\_ lines.
3. Line of \_\_\_\_\_ – a straight line drawn from the viewer’s eye to the object
  - a. Parallel or non-parallel

- 4. \_\_\_\_\_ plane – a plane that is perpendicular to the line of sight.
- 5. View – is image the \_\_\_\_\_ where lines of sight \_\_\_\_\_ the viewing plane.

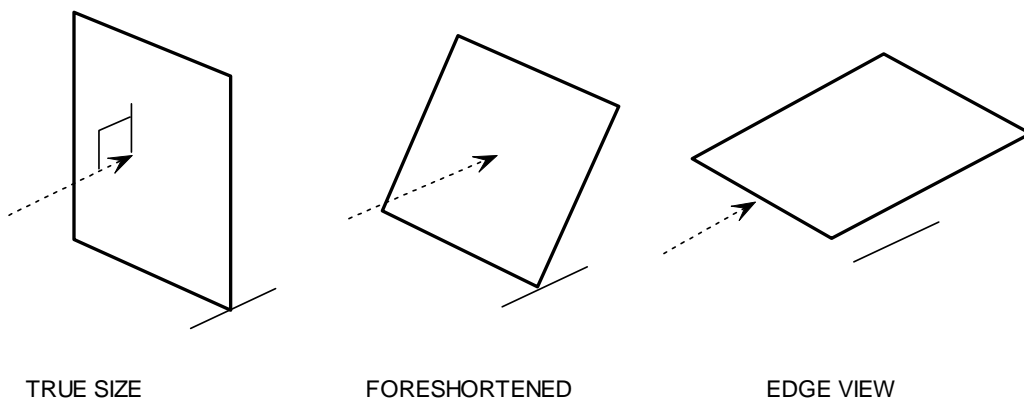


- B. Foreshortening – if lines of the object that are not \_\_\_\_\_ with viewing plane, but instead \_\_\_\_\_ in direction away from viewer, they appear shorter than they really are (think of lines in the road)



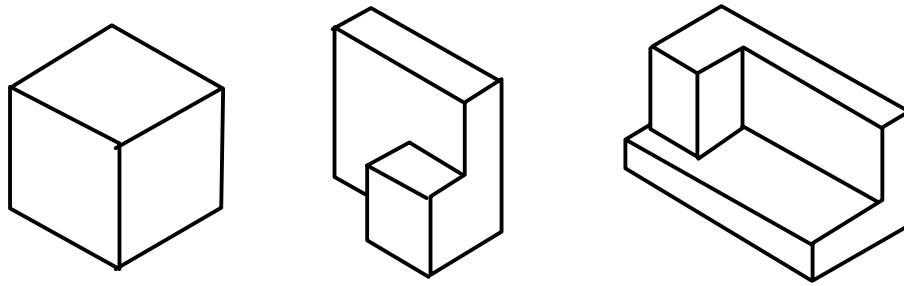
X. Views of a flat surface

- A. \_\_\_\_\_ size – the surface faces the viewer \_\_\_\_\_.
- B. Foreshortened – you can see the surface but it \_\_\_\_\_ the viewer directly.
- C. Edge view – the surface looks like a \_\_\_\_\_.

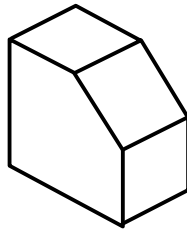


XI. Types of flat surfaces (planes)

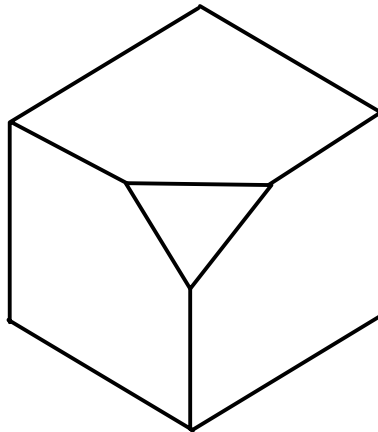
- A. \_\_\_\_\_ planes – surfaces that are \_\_\_\_\_ to (i.e., \_\_\_\_\_) sides of a cube.
  1. F – sides parallel to front face of cube
  2. R – sides parallel to right face of cube
  3. T – sides parallel to top face of cube



- B. Inclined planes – appear as a line in one of the \_\_\_\_\_ views.
1. RT – surface can be seen in Right and Top views. EV in Front view.
  2. FT – surface can be seen in F & T. Is EV in Right view.

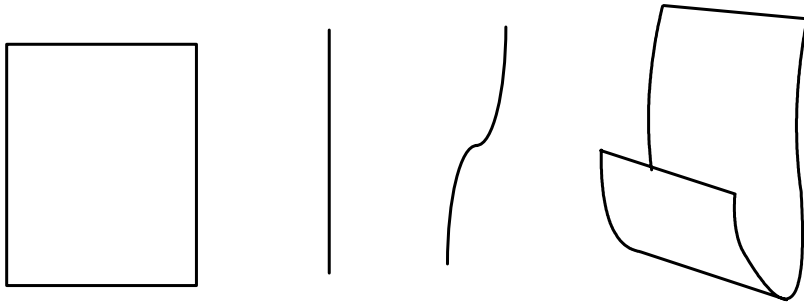


- C. Oblique planes – do not appear as a \_\_\_\_\_ in \_\_\_\_\_ of the principle views.
1. RTF – surface can be seen in right, top, & front views



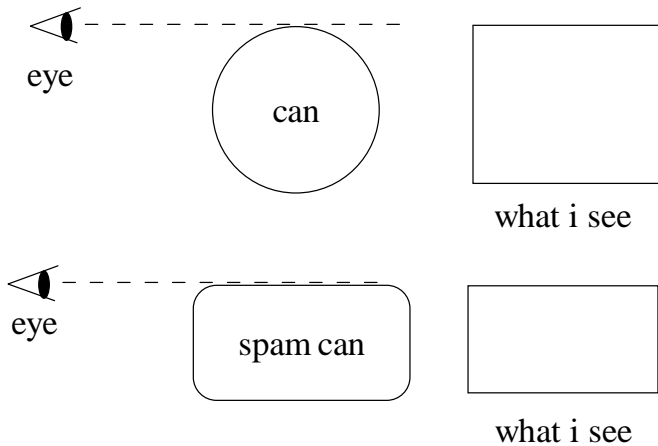
XII. “Line Rules” (what lines may indicate when to draw them)

- A. Imagine
1. Drawing a piece of paper from the front
  2. Draw the paper from the edge
  3. Bend the paper as an S and look from edge
  4. Bend paper as a U and look from edge

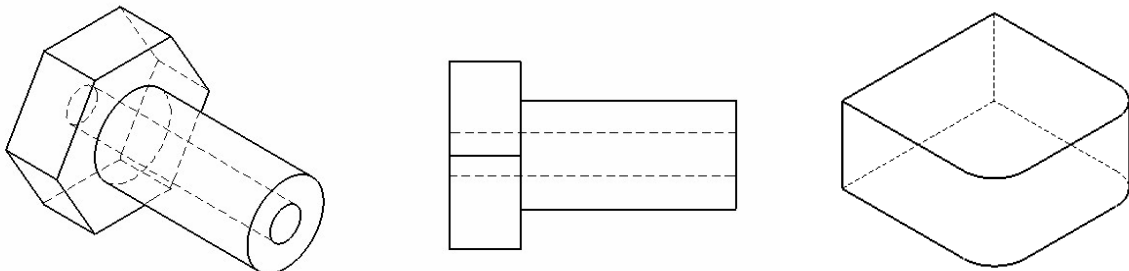


B. The Rules

1. Edges – “sharp” \_\_\_\_\_ of 2 \_\_\_\_\_.
2. Edge view of a surface – surface is  $\perp$  to plane of view.
3. Contour/profile/ or limit of curved surface –



C. Try it with these parts



XIII. Line precedence

- A. What if 2 lines (say, visible and hidden) lie on top of each other?
- B. Which do you draw?
  1. Cutting plane, Visible line, Hidden line, Centerline