WORKBOOK EDITION

Short Version

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2000
2006

LINES & VIEWS

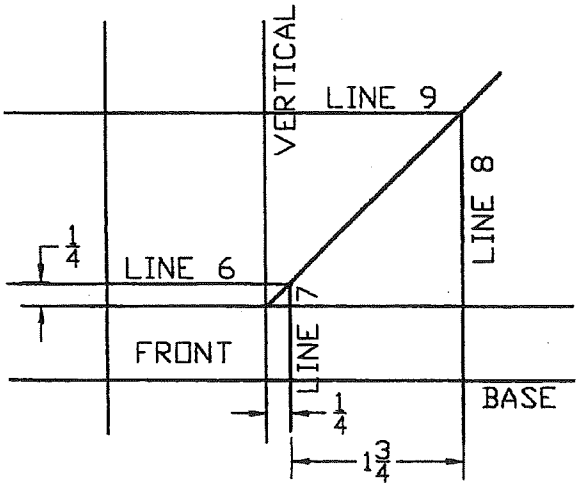
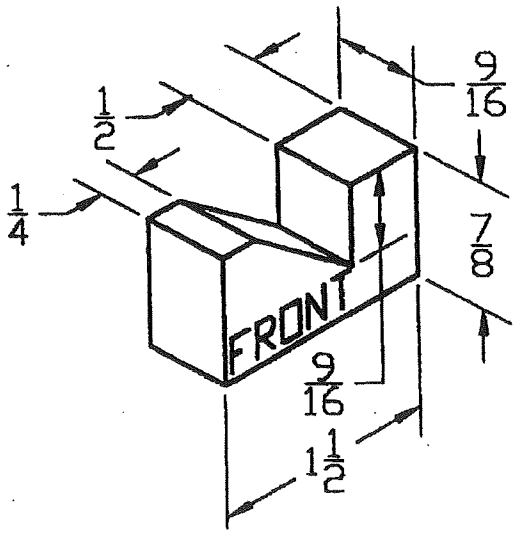
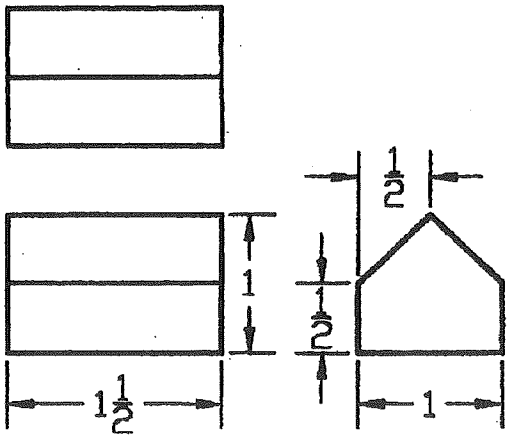


FIGURE 14



PROBLEM 58



PROBLEM 58

The PARKE System

INTRODUCTION:

Drafting is basically LINES, the meaning of those lines in VIEWS and the relationship between those views. This workbook has a carefully planned sequence of problems designed to teach you those lines and views. Each concept is broken down into simple steps which you need to learn before going on to the next problem. The sequence is very important. Years of watching students to see how much trouble they had with each problem and many revisions of the problems has resulted in a sequence which is effective and challenging, yet not too difficult. It is very important you complete and understand each problem before going on to the next problem.

Problems 1-23 are designed to teach you how to use graph paper to measure. Using squares to measure will save you a lot of time. It will also teach you the concept of measurement which will also prepare you for learning to read a rule.

It is very important you understand how to use the "9 lines" to locate the position of the three views. Those are shown and explained on pages 10, 11 and 12. Understanding how to use those "9 lines" will avoid a lot of problems.

Some students have difficulty understanding the "three views" concept. Do not get too discouraged. When you begin drawing isometrics the relationship between the three views and isometrics often begins to make more sense.

TO THE TEACHER:

LINES & VIEWS was not written to be used as a self-directed activity but several teachers have used that approach and were pleased with the results.

A word of caution: When I developed this program I had a solid model of each problem for the student to see. The object was placed in a clear plastic box and a marker was used to draw the object on each side of the box. This seemed like a good idea, but it backfired. Students began to rely on seeing the actual object, and the more they did, the harder it was for them to visualize. Since each problem teaches a certain concept they had trouble later on. I hid the models and they did better.

RECOMMENDED EQUIPMENT AND MATERIALS FOR USING THIS WORKBOOK:

1. Drafting board, about 12 X 17 inches, or larger
2. "T" square- 12 inches or larger
3. Small 45 and 30/60 degree triangles
4. Ruler marked in 1/16 inches
5. No. 2 pencil with eraser
6. 6H drafting pencil for construction lines.
   Option: a colored pencil
7. Transparent tape, 1/2 inch wide
8. Drafting tape
9. Compass
10. Ball point pen of any color.

MEASUREMENTS

The dotted lines in this book are parallel, horizontal or vertical lines. Parallel lines are lines which are the same distance apart the length of the lines. Horizontal lines go left and right. Vertical lines go up and down. Those parallel horizontal lines in this this book form a "grid." All of the lines on that grid are 1/4 of an inch apart.

When a vertical line crosses a horizontal line, there is an intersection. One set of vertical lines 1/4 inch apart and one set of horizontal lines 1/4 inch apart forms a grid with intersections all 1/4 inch apart.

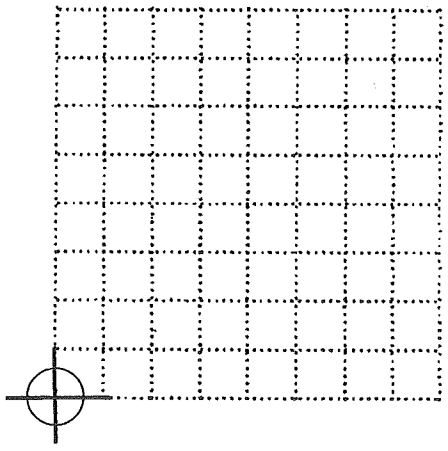
Each problem has a grid area for you to do your work. That area has 1/4 inch grid lines.

Notice the circle drawn around the intersection in the lower left hand corner of the grid for problem 1. The lines extend through the circle. This is the symbol for what is called the "*datum point.*"

Problem 1 has 6 points for you to locate. Each point will come at an intersection. When you locate a point make a small dot and number that intersection.

PROBLEM 1

Point 1. Start at the *datum point* in the lower left hand corner of the grid area and go up 1 square and to the right 2 squares.
Point 2. From point 1 go to the right 4 squares.
Point 3. From point 2 go up one square.
Point 4. From point 3 go to the left 3 squares.
Point 5. From point 4 go up 4 squares.
Point 6. From point 5 go to the left 1 square.
Point 7. From point 6 go down 5 squares
Now draw a straight line from points 1-2, 2-3, 3-4, 4-5, 5-6, and 6-1.



PROBLEM 1

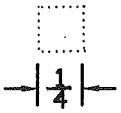
You should have drawn the letter "L".

There is a simpler way to write the directions than right-left or up-down. In this system *all horizontal lines are called "X" lines. All vertical lines are called "Y" lines.* They are said to be on the X-axis and the Y-axis. *When "+" is given the direction is either up or to the right. When "-" is given the direction is either down, or to the left.* Combining X and Y with + and minus gives the following possibilities:

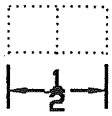
X + to the right horizontally
Y + up vertically
X - to the left horizontally
Y - down vertically

The grid lines form squares which are 1/4 of an inch on each side. This means distance can be given in inches rather than squares as follows:

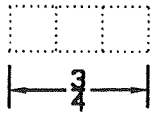
one square equals 1/4 inch



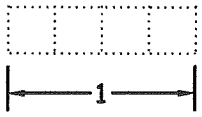
two squares equals 2/4 inch, which is 1/2 inch



three squares equals 3/4 inch



four squares equals 4/4 inch, which is 1 inch



Both X and Y will always be given even though it may be "0" inch. When "0" is given there will be no movement on that axis.

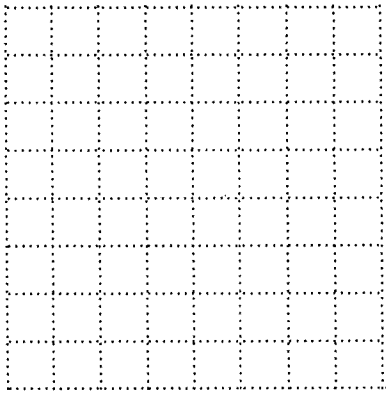
IMPORTANT

On all of the drawings in this book draw the *"datum point"* symbol in the lower left hand corner of the grid area before you start.

The first measurement starts at that datum point.

PROBLEM 2

Point				
1	X +	1/2	Y +	1/4
2	X +	1	Y	0
3	X	0	Y +	1/4
4	X -	3/4	Y	0
5	X	0	Y +	1
6	X -	1/4	Y	0
7	X	0	Y -	1 1/4



PROBLEM 2

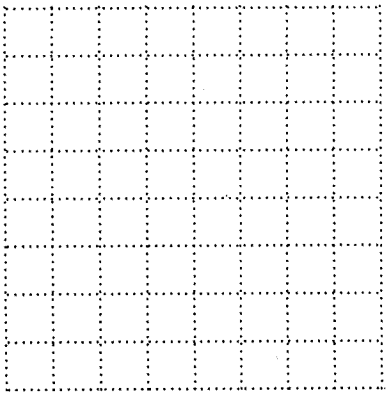
Notice Problem 2 is the same as Problem 1. The instructions are just written differently.

Using + and - on the X and Y axis is part of what is called the "*Cartesian coordinate system.*'

For Problems 3-5 locate each point on your grid then draw a line between the two points before locating the next point.

PROBLEM 3

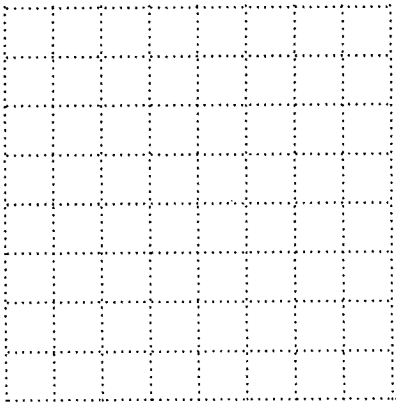
Point				
1	X +	3/4	Y +	1/4
2	X +	1/4	Y	0
3	X	0	Y +	1
4	X +	1/2	Y	0
5	X	0	Y +	1/4
6	X -	1 1/4	Y	0
7	X	0	Y -	1/4
8	X +	1/2	Y	0
9	X	0	Y -	1



PROBLEM 3

PROBLEM 4

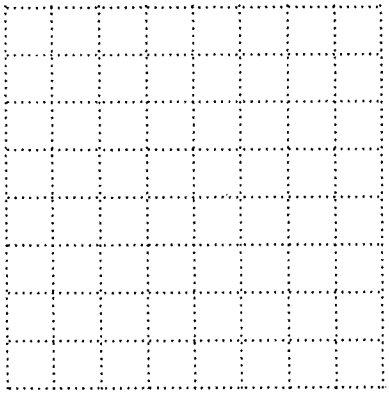
Point				
1	X +	1/2	Y +	1/4
2	X +	3/4	Y	0
3	X	0	Y +	1/4
4	X -	1/2	Y	0
5	X	0	Y +	1/4
6	X +	1/4	Y	0
7	X	0	Y +	1/4
8	X -	1/4	Y	0
9	X	0	Y +	1/4
10	X +	1/2	Y	0
11	X	0	Y +	1/4
12	X -	3/4	Y	0
13	X	0	Y -	1 1/4



PROBLEM 4

PROBLEM 5

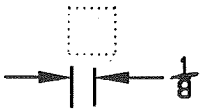
Point				
1	X +	3/4	Y +	1/4
2	X +	3/4	Y	0
3	X	0	Y +	1/4
4	X -	1/2	Y	0
5	X	0	Y +	1/4
6	X +	1/2	Y	0
7	X	0	Y +	1/4
8	X -	1/2	Y	0
9	X	0	Y +	1/2
10	X -	3/4	Y	0
11	X	0	Y -	1/4
12	X +	1/2	Y	0
13	X	0	Y-	1/4
14	X-	1/2	Y	0
15	X	0	Y -	1/4
16	X +	1/2	Y	0
17	X	0	Y -	1/2



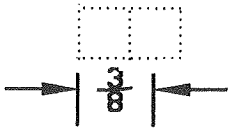
PROBLEM 5

One square on the grid is equal to 1/4 inch. A point halfway between the intersections is 1/8 inch. In Problems 6 - 9 there are measurements given in eighths. When measurements are given in eighths count by eighths. For example:

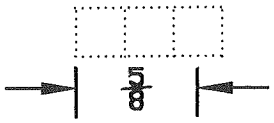
One half of a square equals 1/8 inch



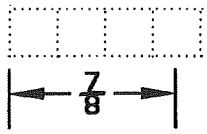
one square plus one half of a square equals 2/8 inch plus 1/8 which is 3/8 inch



two squares plus one half of a square equals 4/8 inch plus 1/8 which is 5/8 inch



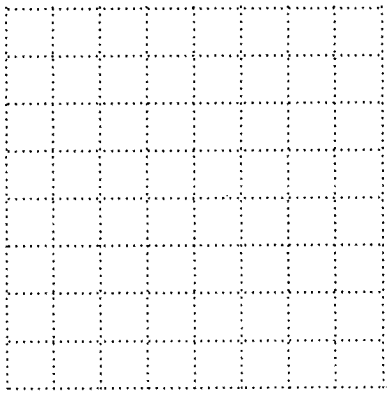
three squares plus one half of a square equals 6/8 inch plus 1/8 which is 7/8 inch



In the following problems estimate the halfway point between lines. You do not have to measure.

PROBLEM 6

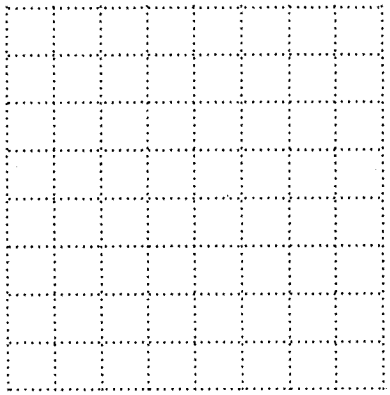
Point				
1	X +	1/2	Y +	1/4
2	X +	1/4	Y	0
3	X +	1/4	Y +	3/8
4	X +	1/4	Y -	3/8
5	X +	1/4	Y	0
6	X -	3/8	Y +	5/8
7	X +	3/8	Y +	5/8
8	X -	1/4	Y	0
9	X -	1/4	Y -	3/8
10	X -	1/4	Y +	3/8
11	X -	1/4	Y	0
12	X +	3/8	Y -	5/8
13	X -	3/8	Y -	5/8



PROBLEM 6

PROBLEM 7

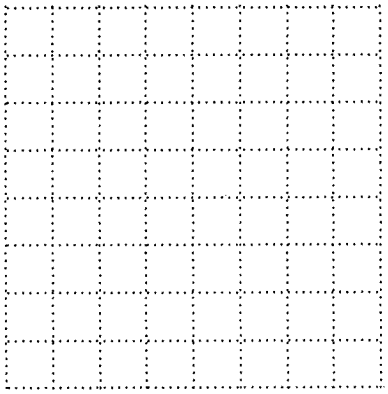
Point				
1	X +	1/2	Y +	1/2
2	X +	1/4	Y	0
3	X	0	Y +	7/8
4	X +	5/8	Y -	7/8
5	X +	1/4	Y	0
6	X	0	Y +	1 1/4
7	X -	1/4	Y	0
8	X	0	Y -	7/8
9	X -	5/8	Y +	7/8
10	X -	1/4	Y -	0
11	X	0	Y -	1 1/4



PROBLEM 7

PROBLEM 8

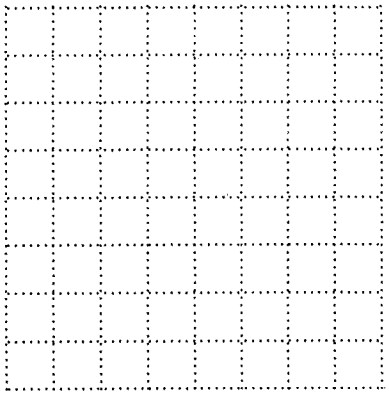
Point				
1	X +	1/2	Y +	1/4
2	X +	1 1/8	Y	0
3	X	0	Y +	1/4
4	X -	3/4	Y	0
5	X +	3/4	Y +	3/4
6	X	0	Y +	1/4
7	X -	1 1/8	Y	0
8	X	0	Y -	1/4
9	X +	3/4	Y	0
10	X -	3/4	Y -	3/4
11	X	0	Y -	1/4



PROBLEM 8

PROBLEM 9

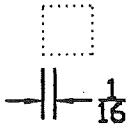
Point				
1	X +	3/4	Y +	1/4
2	X +	1/4	Y	0
3	X	0	Y +	1/4
4	X -	1/4	Y	0
5	X +	1/8	Y +	1/8
6	X +	1/8	Y +	7/8
7	X -	1/4	Y	0
8	X +	1/8	Y -	7/8
9	X -	1/8	Y -	1/8
10	X	0	Y -	1/4



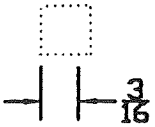
PROBLEM 9

Problems 10 through 22 have measurements In 1/16 ths. There are four 1/16 ths in each Square. When a measurement is given in 1/16 ths count in 1/16 ths as follows:

one fourth of one square equals 1/16 inch,

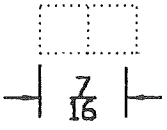


three fourths of a square equals 3/16 inch,

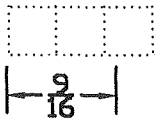


one square, plus one fourth of a square equals 4/16 inch, plus 1/16 which is 5/16 inch,

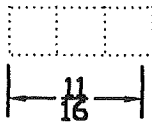
One square, plus three fourth's of a square equals 4/16 inch plus 3/16 inch which is 7/16 inch



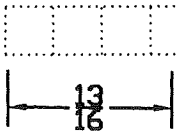
two squares, plus one fourth of a square equals 8/16 inch, plus 1/16 which is 9/16 inch



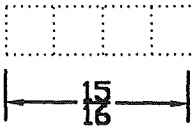
two squares, plus three fourth's of a square equals 8/16 inch, plus 3/16 which is 11/16 inch



three squares, plus one fourth of a square equals 12/16 inch, plus 1/16 which is 13/16 inch



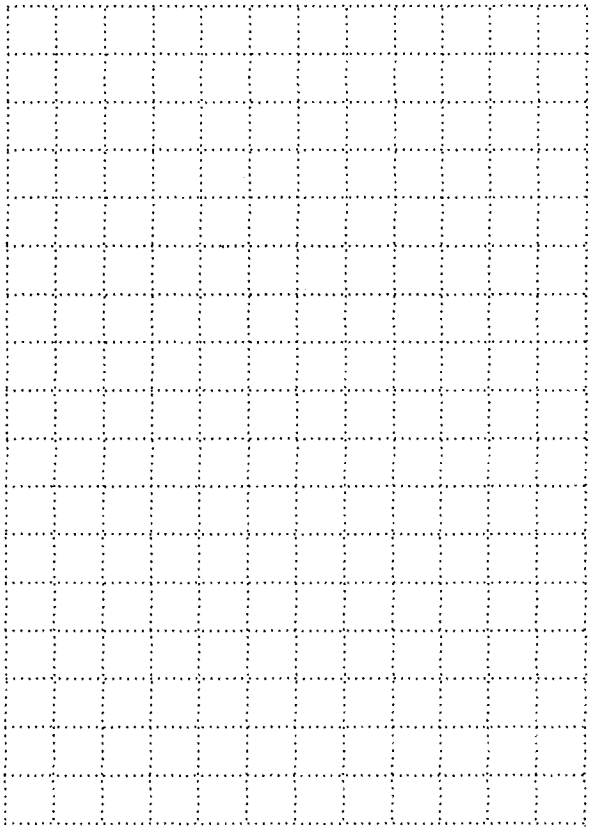
three squares, plus three fourths of a square equals 12/16 inch, plus 3/16 which is 15/16 inch



PROBLEM 10

Point				
1	X +	1/2	Y +	1/4
2	X +	2	Y -	0
3	X +	0	Y +	7/16
4	X -	1/2	Y +	5/16
5	X -	1/2	Y +	1 1/4
6	X +	9/16	Y +	1 13/16
7	X -	1 1/2	Y -	1 1/8
8	X +	1 7/8	Y -	0
9	X -	1 1/2	Y +	1 1/8
10	X +	9/16	Y -	1 13/16
11	X -	1/2	Y -	1 1/4
12	X -	1/2	Y -	5/16

Back to point 1



PROBLEM 10

Problems 11 - 19 will all be worked on one grid area. They all use the same reference point. Connect the dots from each problem before moving on to the next problem.

PROBLEM 11

Point				
1	X +	3/4	Y +	1/4
2	X +	1 1/2	Y +	1/2
3	X	0	Y -	1/2
4	X -	1 1/2	Y +	1/2
5	X	0	Y -	1/2

PROBLEM 12

Point				
1	X +	1	Y +	1 1/8
2	X +	1/4	Y -	5/16
3	X +	9/16	Y +	1/16
4	X +	1/4	Y +	5/16

PROBLEM 13

Point				
1	X +	3/4	Y +	1 1/8
2	X +	1/4	Y -	3/8
3	X +	1/4	Y -	1/8
4	X +	1/2	Y	0
5	X +	1/4	Y +	1/8
6	X +	1/4	Y +	3/8
7	X	0	Y +	2
8	X -	1 1/2	Y	0
9	X -	0	Y -	2

PROBLEM 14

Point				
1	X +	1	Y +	1 3/4
2	X +	5/16	Y	0
3	X	0	Y +	3/8
4	X -	5/16	Y	0
5	X	0	Y -	3/8

PROBLEM 15

Point				
1	X +	1/4	Y +	2 7/16
2	X +	2 1/2	Y	0
3	X	0	Y +	1/16
4	X -	2 1/2	Y	0
5	X	0	Y -	1/16

PROBLEM 16

Point				
1	X +	2 1/4	Y +	1 11/16
2	X +	5/16	Y +	1/8
3	X -	0	Y +	3/8
4	X -	5/16	Y	0

PROBLEM 17

Point				
1	X +	1 11/16	Y +	1 3/4
2	X +	5/16	Y	0
3	X	0	Y +	3/8
4	X -	5/16	Y	0
5	X	0	Y -	3/8

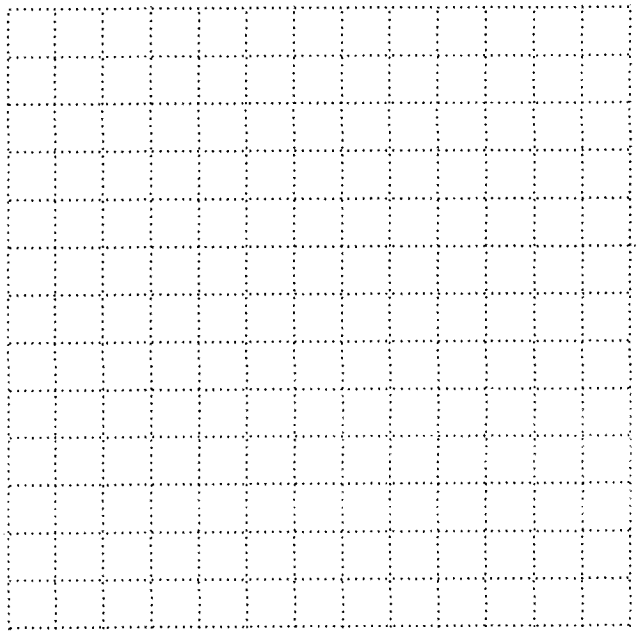
PROBLEM 18

Point				
1	X +	3/4	Y +	1 11/16
2	X -	5/16	Y +	1/8
3	X	0	Y +	3/8
4	X +	5/16	Y	0

PROBLEM 19

Point				
1	X +	1 1/2	Y +	1 3/4
2	X -	3/16	Y -	3/16
3	X +	1/4	Y +	1/16

PROBLEMS 11-19



Problems 20 - 22 use the same reference point. Connect the dots from each problem before moving on to the next problem.

PROBLEM 20

Point				
1	X +	3/8	Y +	1/4
2	X +	5/8	Y	0
3	X	0	Y +	1/2
4	X	0	Y +	1/2
5	X -	5/8	Y	0
6	X	0	Y -	1/2
7	X	0	Y -	1/2

Connect points 3 and 6

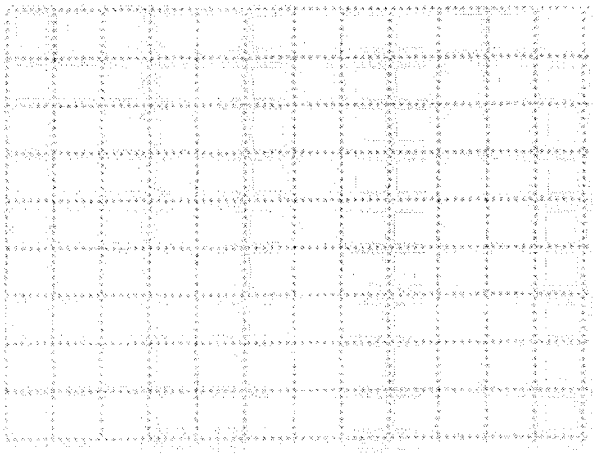
PROBLEM 21

Point				
1	X +	1 1/4	Y +	1/4
2	X +	1 1/2	Y	0
3	X	0	Y +	1
4	X -	3/4	Y	0
5	X	0	Y -	1/2
6	X -	3/4	Y	0
7	X	0	Y -	1/2

PROBLEM 22

Point				
1	X +	1 1/4	Y +	1 1/2
2	X +	3/4	Y	0
3	X +	3/4	Y	0
4	X	0	Y +	5/8
5	X -	3/4	Y	0
6	X -	3/4	Y	0
7	X	0	Y -	5/8

Connect points 2 and 5



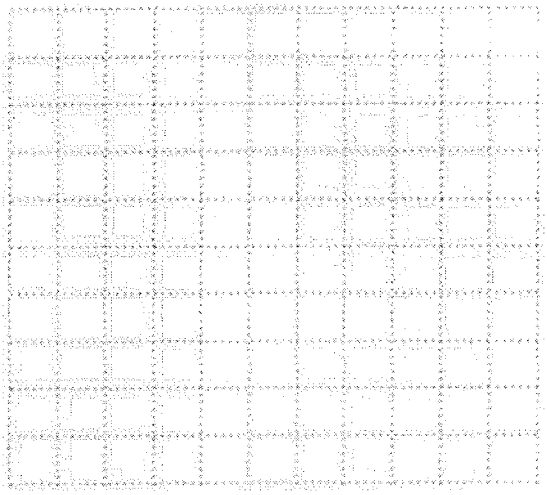
PROBLEMS 20 - 22

PROBLEM 23

Point				
1	X +	1/8	Y +	9/16
2	X +	5/8	Y -	5/16
3	X +	1 3/4	Y +	3/4
4	X	0	Y +	1
5	X -	3/4	Y -	5/16
6	X	0	Y -	3/8
7	X -	1	Y -	3/8
8	X -	5/8	Y +	5/16
9	X +	1	Y +	3/8
10	X	0	Y +	3/8
11	X +	3/4	Y +	5/16

Connect points:

6 to 9
5 to 10
4 to 11
1 to 8
7 to 2



PROBLEM 23

PROJECTION

One of the most common methods used to draw an object is orthographic projection. Do not let the strange words scare you. The principle is rather simple. Figures 1, 2, and 3 illustrate the principle.

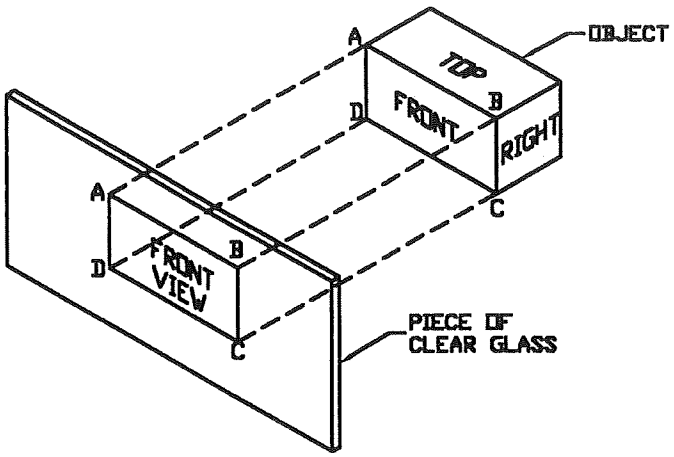


FIGURE 1

An imaginary plane is placed in front of the object, and the object is viewed through that plane. The plane is parallel to the surface of the object. To make it easier to understand the illustrations, we will use a clear piece of glass to represent the imaginary plane. Points A, B, C, and D are projected, or moved out, to the plane. They are then marked on the piece of glass. These points are the corners of the object. The distances between the points will always be the same distance on the glass AS LONG AS THEY ARE PARALLEL TO THE PLANE. If they are not parallel, they will not be the same lengths. Those will be explained later. Whenever there is an edge on the object, there will be a line on the glass (plane). The lines in Figure 1 are between A-B, B-C, C-D, and D-A. All the edges can be seen and are called VISIBLE LINES. After the lines are drawn, we have what is called the front view.

Figure 2 is similar to Figure 1. In Figure 1, the imaginary plane was drawn to the front. In Figure 2 the object is viewed from the right side. Only lines B-E, E-F, F-C, and C-B are drawn, because they are the only lines that can be seen when viewed through the imaginary plane. This gives the RIGHT SIDE VIEW.

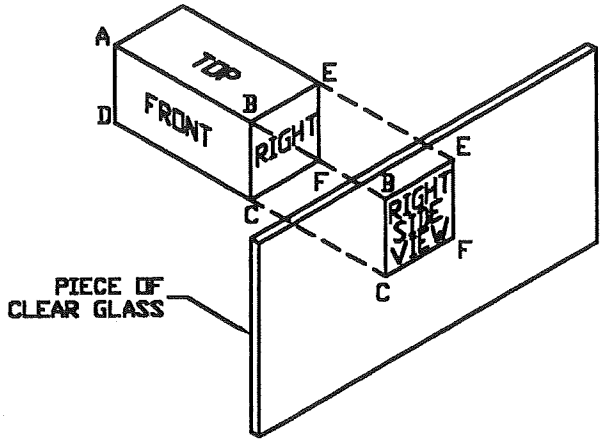


FIGURE 2

In Figure 3 the imaginary plane is parallel to the top of the object. Points are projected, and visible lines A-B, B-E, E-G and G-A are connected. This gives the TOP VIEW of the object.

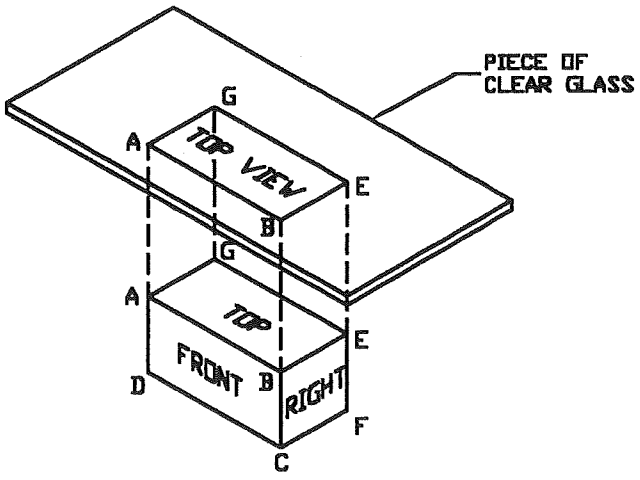


FIGURE 3

In Figures 1, 2, and 3 we have three projected views. Each view has been seen at right angles, 90 degrees, to the other two views. Orthographic projection means to draw the views at right angles to the other views.

The next step is to position these three views so they will give an accurate description of the object. The front view is shown in Figure 4.

FIGURE 4

Figure 5 shows the front and right side views. Notice that points B and C in the front view are the same as points B and C in the right side view. Look at Figure 5 and you will see they have to be the same. The right side view is located to the right of the front view because it is that way on the object. Point B will always be on the same level in both the front and side views because they are the same point.

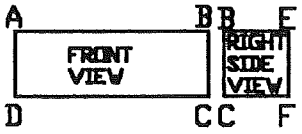


FIGURE 5

Notice in Figure 6 that the top view is directly above, not a little bit to either side of, the front view. Notice line A-B is shared by the front and top views. Also notice line B-E are shared by the top and side views.

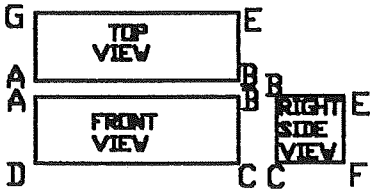


FIGURE 6

Figure 7 is an object with the right side view shown in the orthographic views.

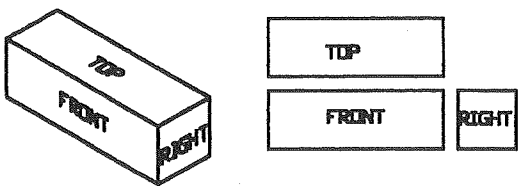


FIGURE 7

The object in Figure 8 is the same object shown in Figure 7. The only difference is the object is turned and the left side view is shown in the orthographic views.

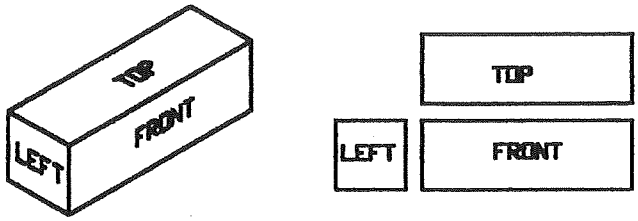


FIGURE 8

The object shown in Figures 9 and 10 is different than the object shown in Figures 7 and 8. The area bounded by lines A, G, E, and F on Figure 9 is not on the same level as the area bounded by lines B, H, A, and D of the same figure. If you will look at the top view of Figure 10, you will see that these areas appear to be on the same level.

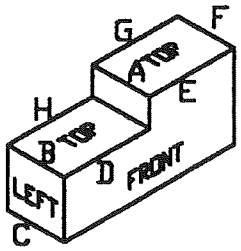


FIGURE 9

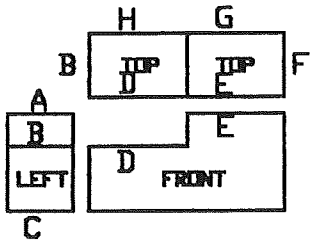


FIGURE 10

If you have a problem understanding how they can both appear to be on the same level, try the following experiment. Extend both of your arms in front of you with your fingers pointing upward. Position your hands so one hand is about four inches closer to your face than the other hand. Close one eye and look at your hands. They should appear to be the same distance from your face. When viewed with only one eye, you cannot distinguish distance from your face, except by size comparison.

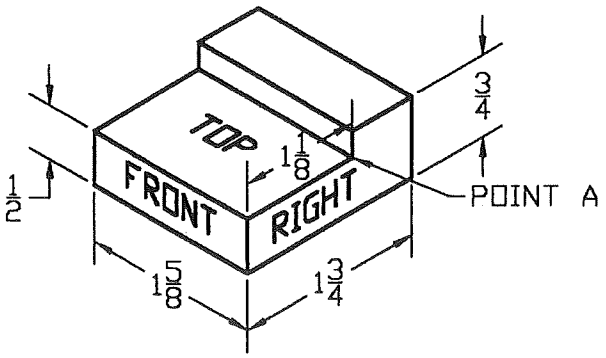
In orthographic projection all points are projected onto a viewing plane and will appear to be the same distance in the experiment.

SIX THINGS TO REMEMBER:

1. The front and top views share points and lines.
2. The top and side views share points and lines.
3. The side and front views share points and lines.
4. Each view is drawn as if you were looking at it from an angle of 90 degrees to the other two views.
5. The top view is always placed exactly above the front view.
6. The side view is always placed exactly to the side of the front view. Right sides are placed to the right of the front and left sides to the left of the front.

POSITIONING THREE VIEW ORTHOGRAPHIC DRAWINGS

The way you start drawing the three views is very important. There are nine lines that should be drawn at the first of each problem. These lines determine the proper placement of the views. They are called "construction lines." Construction lines must be very thin and light. Use a sharp 6H pencil for construction lines. The procedure for drawing these lines is given after Problem 24. Page 14 has a dotted line grid space for you to draw on. Remove the page and draw in that space.



PROBLEM 24

LINE 1: BASE LINE

A horizontal line for the bottom of the front and side views. For Problem 24, draw the line on a grid line 1/4 inch above the bottom line. See Figure 11. A grid line is any of the grid lines.

LINE 2: VERTICAL LINE

For Problem 24, draw this line on a grid line 1 3/4 inches from the left side of the blue grid space. See Figure 11.

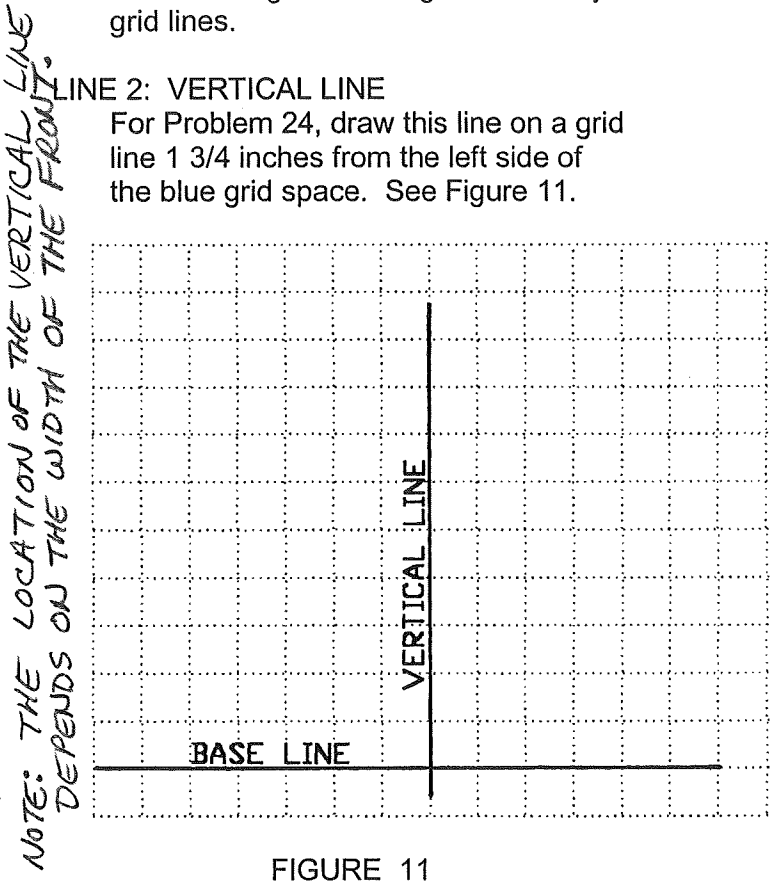


FIGURE 11

LINE 3: MAXIMUM HEIGHT LINE

The maximum height of the object is 3/4 inch. See side view of Problem 24. This line is 3/4 inch above and parallel to the base line. See Figure 12.

LINE 4: MAXIMUM WIDTH LINE

The maximum width of the object is 1 5/8 inches. See front view of Problem 24. This line is 1 5/8 inches to the left and parallel to the vertical line. See Figure 12. Lines 1, 2, 3, and 4 complete the box for the front view.

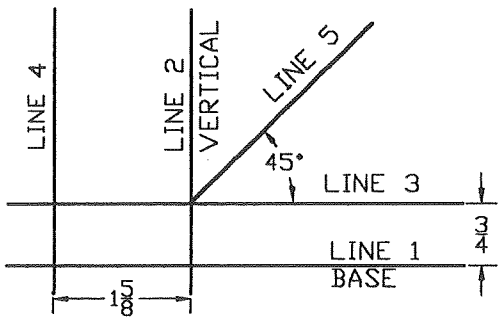


FIGURE 12

LINE 5: 45° LINE

This line is used to transfer measurements from the side to the top view. The line starts at the upper right-hand corner of the box for the front view as shown in Figure 12. To draw a 45° line on graph paper, go from intersection to intersection of the grid lines as shown in Figure 13.

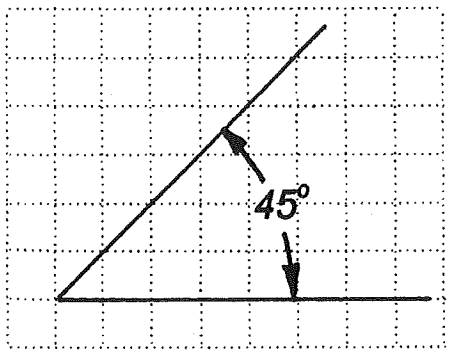


FIGURE 13

LINES 6 AND 7: SPACING LINES

These lines determine the distance between the views. The problems in this book are to be spaced 1/4 inch apart. One line is to be 1/4 inch above the top of the front view. Since the right side of Problem 24 is to be drawn, the line will be to the right of the front view. See Figure 14.

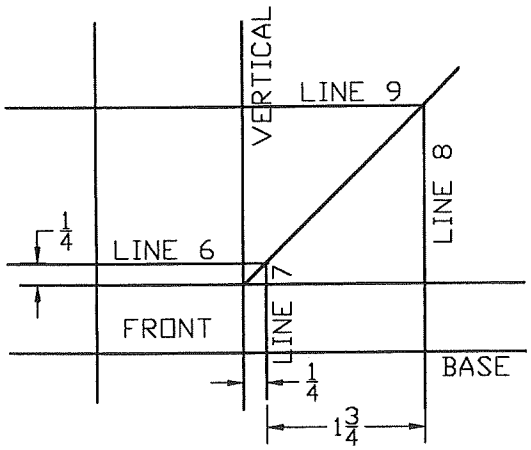


FIGURE 14

LINE 8: MAXIMUM DEPTH LINE (SIDE VIEW)

The maximum depth of the object is 1 3/4 inches. See side view of Problem 24. Draw a parallel line 1 3/4 inches to the right of line 7. See Figure 14. This line must extend up until it crosses the 45 line.

LINE 9: MAXIMUM DEPTH LINE (TOP VIEW)

Draw a horizontal line from where line 8 crosses the 45° line. See Figure 14. Notice that the distance between lines 6 and 9 is the same as between 7 and 8. If they are not, you have made an error.

NOTE: You have now drawn three views of a box for Problem 24. Figure 15 shows the position of the three views of the box. The top view of Problem 24 will go in the shaded area labeled TOP in Figure 15. DO NOT SHADE IN THE AREAS ON YOUR DRAWING. The front view goes in the shaded area marked front, and the right side view goes in the shaded area marked RIGHT SIDE. Lines 1 through 9 are to be used for all three view orthographic drawings. Dimensions for all lines will change with the problems except the distance between views. If you need a left side view, lines will be drawn to the left of the front view instead of the right. Show the right side view in the problems that follow.

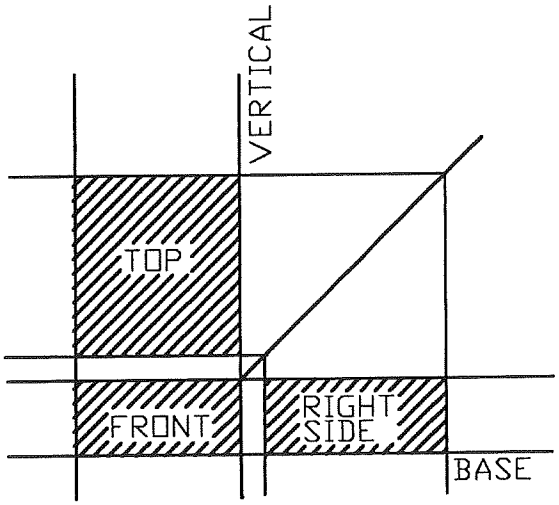


FIGURE 15

NOTE:
WE WILL ALWAYS DRAW THE RIGHT SIDE VIEW IN THE EXERCISES THAT FOLLOW.

LOCATING A POINT ON AN OBJECT (Point "A" of Problem 24)

STEP 1: Point A is 1/2 inch above the bottom of the object. See side view of Problem 24. Draw a horizontal line 1/2 inch above the base line as shown in Figure 16.

STEP 2: Point A is 1 1/8 inches back from the front of the object. See side view of Problem 24. Draw a vertical line 1 1/8 inches back as shown in Figure 16. The line should extend up until it crosses the 45° line. Point A is where the lines drawn in Step 1 and 2 cross.

STEP 3: Draw a horizontal line from where the line drawn in Step 2 crosses the 45° line. See Figure 16. This line locates the line in the top view.

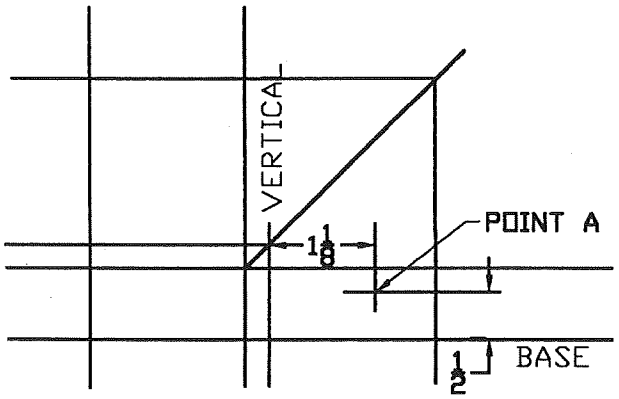


FIGURE 16

COMPLETING THE VIEWS

STEP 1: Use a 2H pencil and straight edge to draw object lines of the right side view. Object lines are heavy dark lines. The object lines of the right side view are A-B, B-C, C-D, D-E, E-F, and F-A of Figure 17.

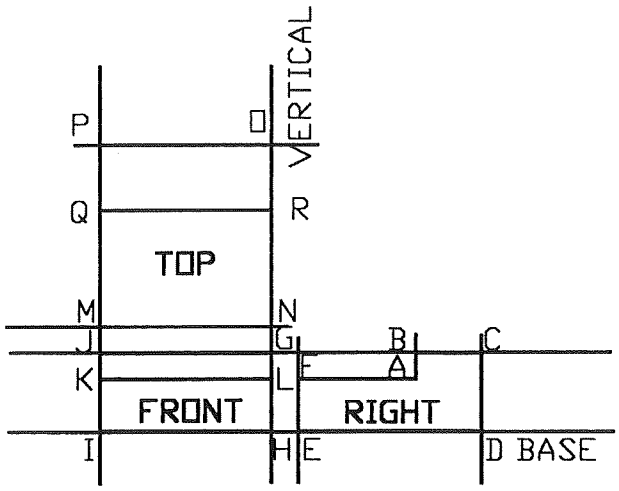


FIGURE 17

STEP 2: Draw object lines for the front view. Object lines are G-H, H-I, I-J, J-G and K-L of Figure 17. If you study problem 24, you should see that there will be an edge along line K-L.

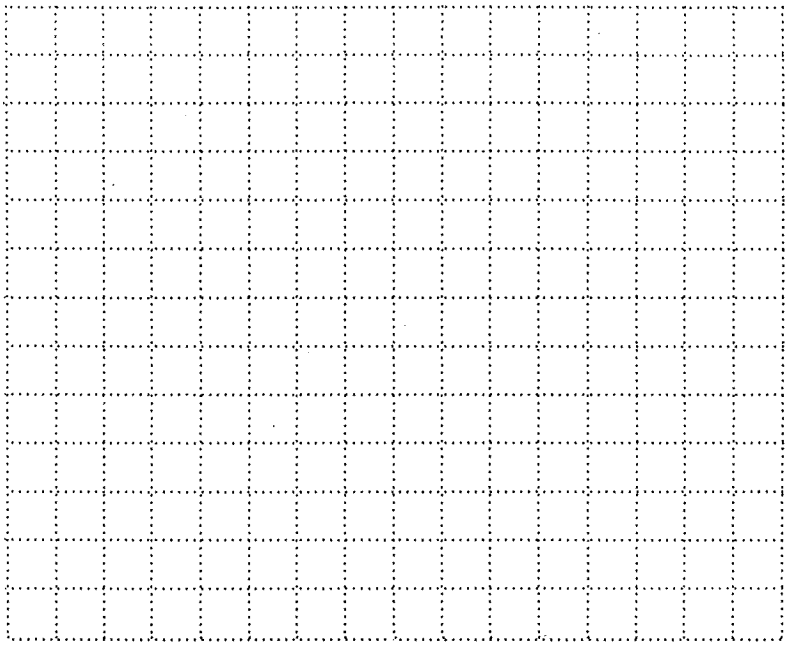
STEP 3: Draw object lines for the top view. Object lines are M-N, N-O, O-P, P-M, and Q-R of Figure 17. If you study problem 24, you should see that there will be an edge along line Q-R.

STEP 4: Use a 2H pencil to label the three views.

STEP 5: Carefully ~~erase~~ LOOK AT construction lines.

THEY SHOULD BE VERY LIGHT MAKE THEM THIN AND DIM.

THE LINES THAT SHOW THE EDGE OF THE OBJECT SHOULD BE DARK.



PROBLEM 24

INSTRUCTIONS FOR PLACING THE 9 LINES
For problems 25 through 57

Grid lines are provided for each problem. Placing the lines as explained below will make it easier to for you to draw the 45 degree.

BASE LINE

Make this line 1/4 above the bottom of the grid space provided for you to solve the problem.

VERTICAL LINE (UP & DOWN LINE)

1. Measure from the left side of the grid space, then make the vertical line at the next grid line.

Example; if the width of the drawing, in the front view, is 5/8, measure 5/8 inch and make the vertical line at the next line, which is 3/4.

Example; if the width is 1 15/16 the vertical line would be on the 2 inch grid line.

THIS IS FOR SELECTING THE LOCATION OF THE VERTICAL LINE

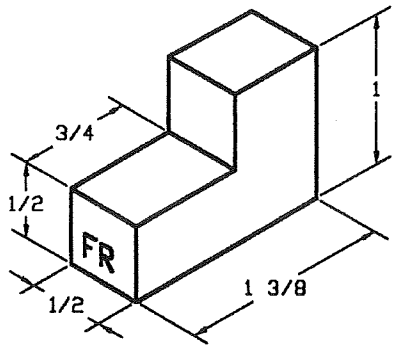
2. If the measurement comes on a grid line go to the next grid line.

Example; if the width is 1 inch go to the 1 1/4 inch grid line.

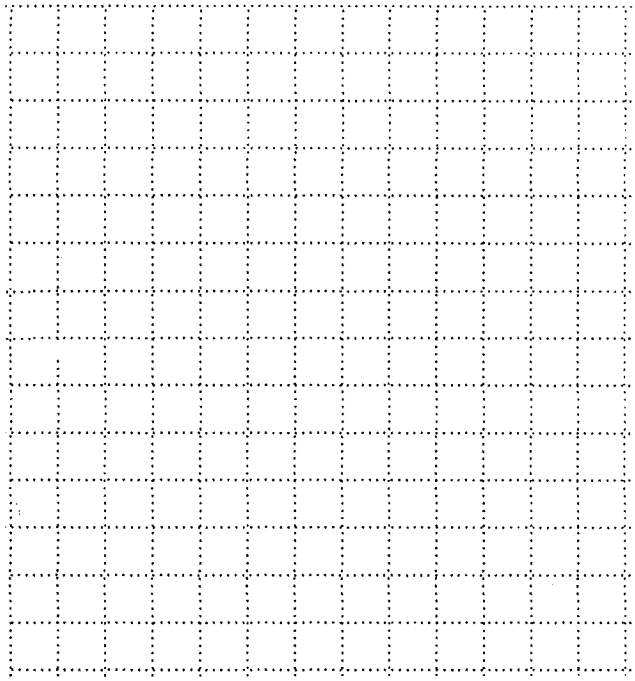
OBJECT LINES

THESE SHOULD BE VERY LIGHT (NOT DARK) LINES.

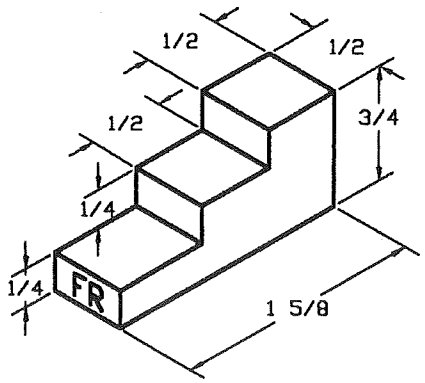
Draw three views each of problems 25-29 on the 1/4 inch grid provided. Use a 6H pencil to make construction lines. Use a No. 2 pencil for object lines. ~~Erase~~ construction lines. Remember to position the top view directly above the front view and the side view directly to the side of the front. Make drawings full size.



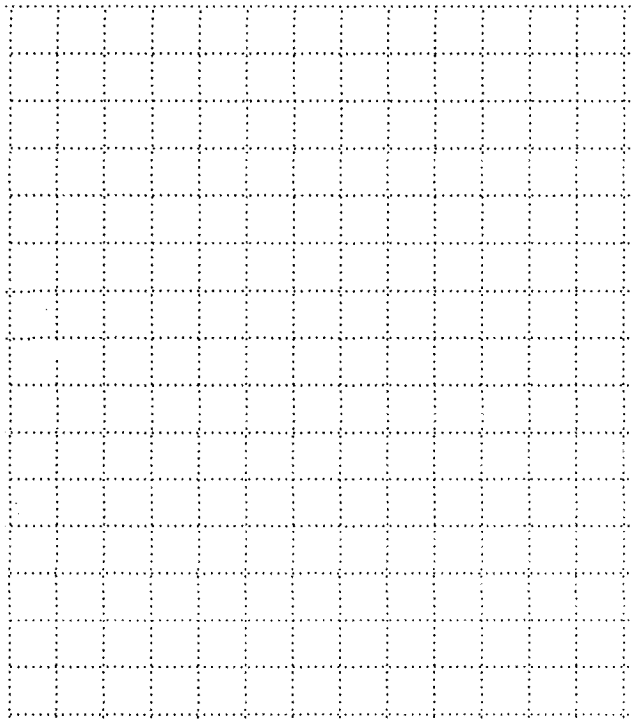
PROBLEM 25



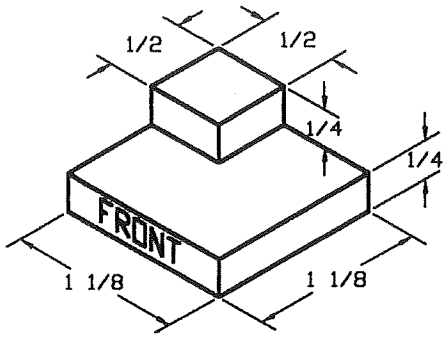
PROBLEM 25



PROBLEM 26

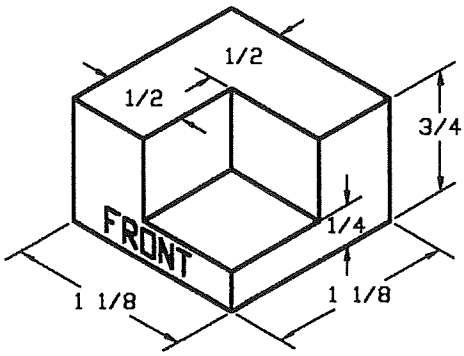


PROBLEM 26



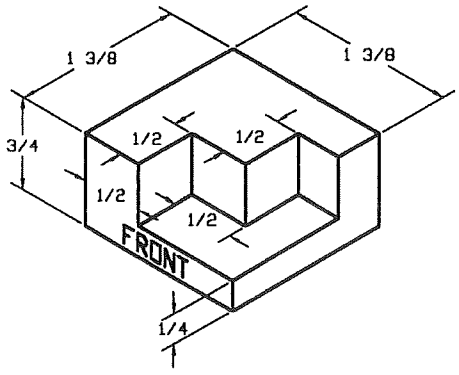
PROBLEM 27

PROBLEM 27



PROBLEM 28

PROBLEM 28



PROBLEM 29

PROBLEM 29

HIDDEN LINES

Notice the dashed line in the three view drawings of Figure 18. A dashed line represents a line that is not visible in that view. Lines that are not visible are called hidden lines. The dashes of the line are about 1/8 inch long. The spaces are about 1/32 of an inch. The dashes touch a visible line where the line starts and ends. When both a hidden and visible line occur at the same place, ONLY the visible line is shown.

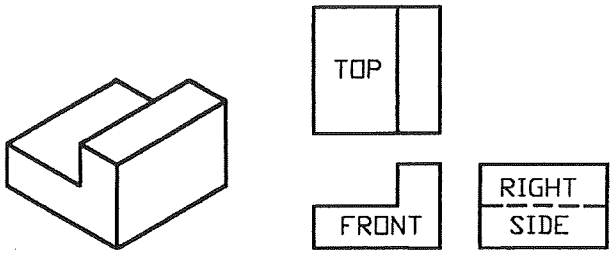
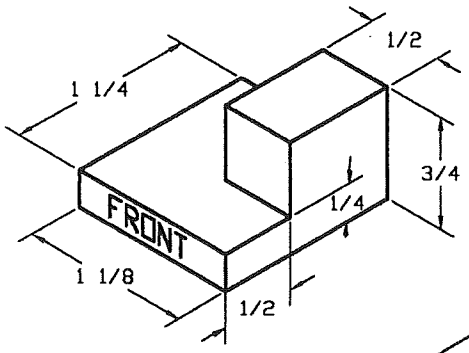
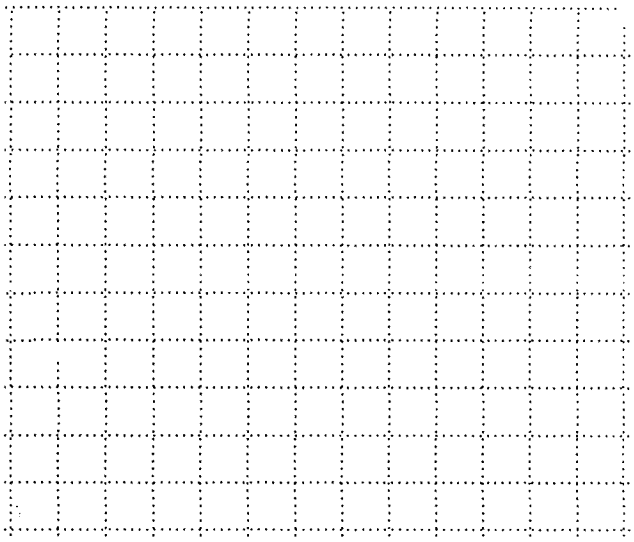


FIGURE 18

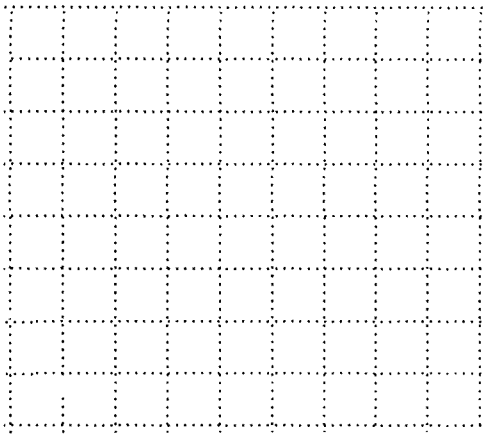
Draw three views of problems 30 through 39. Be sure to draw any hidden lines.



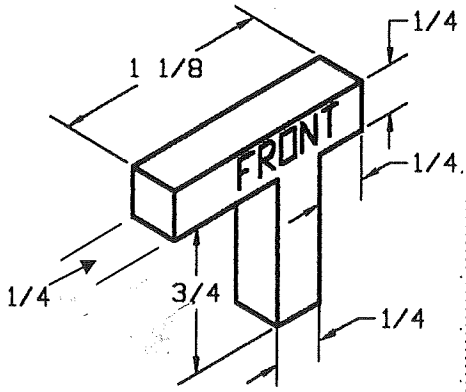
PROBLEM 30



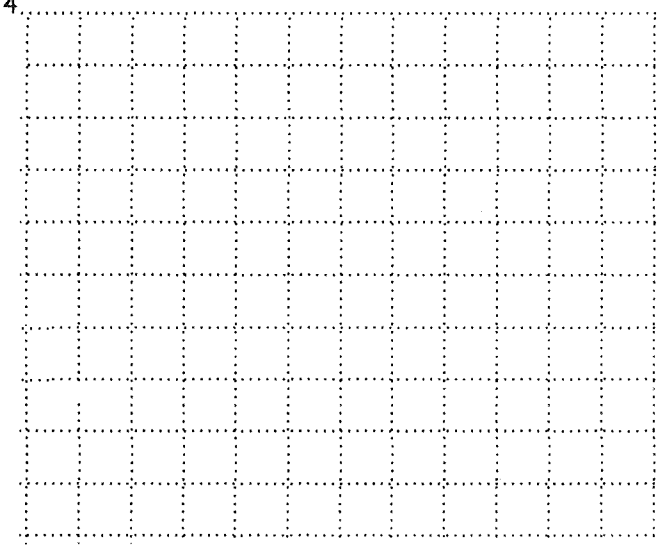
PROBLEM 30



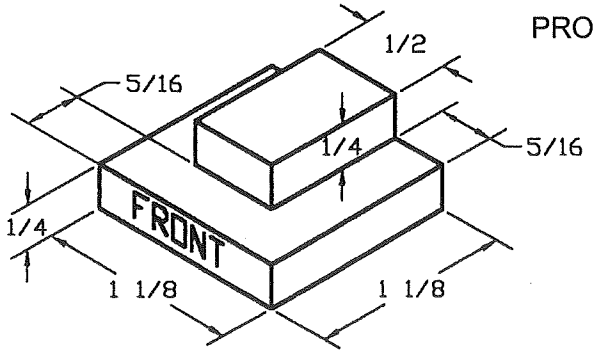
PROBLEM 31



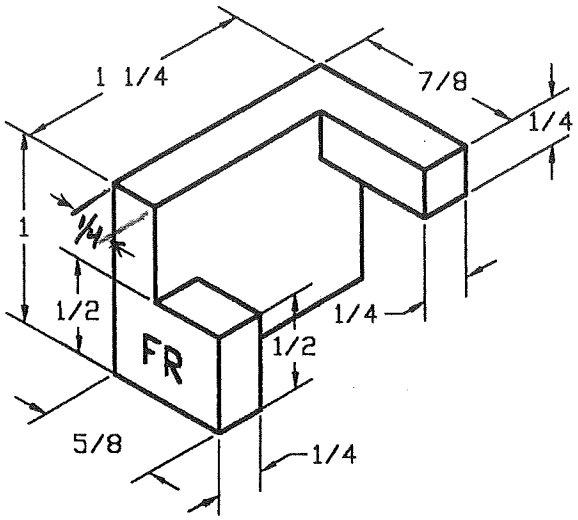
PROBLEM 31



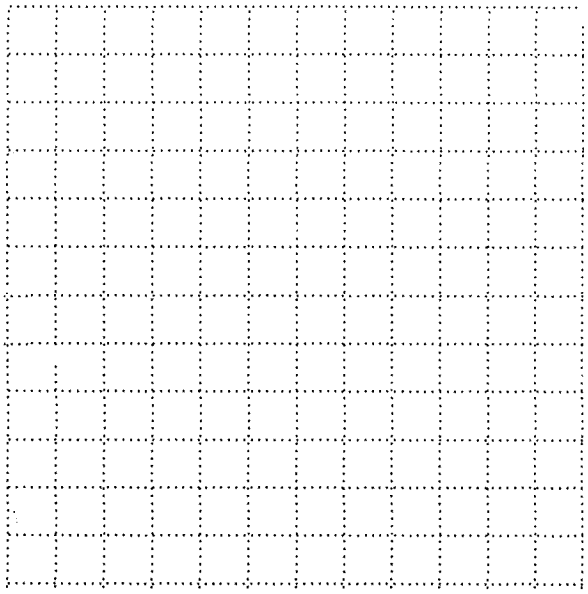
PROBLEM 32



PROBLEM 32

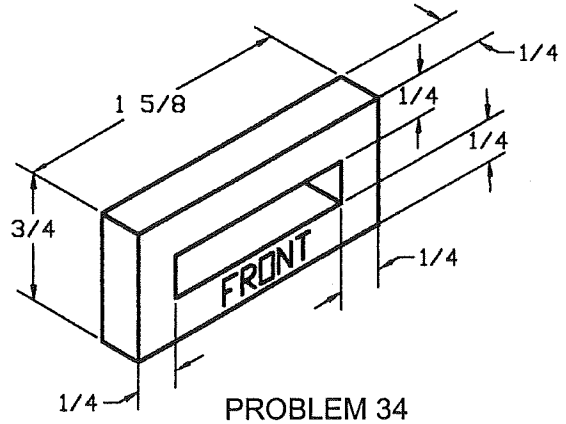


PROBLEM 33

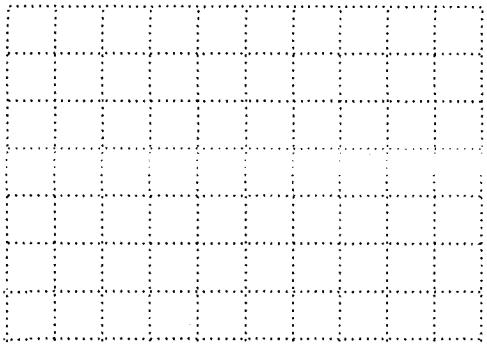


PROBLEM 33

NOTE: The slot only partially shown in problem 34 goes all the way through the object.



PROBLEM 34



PROBLEM 34

ANGLES

Many objects have angles other than right angles. These can be drawn by locating the ends of the lines and then connecting the points. Figure 19 is an example. Points A and B are located and then connected by a line. Notice that it appears as an angle in only one view.

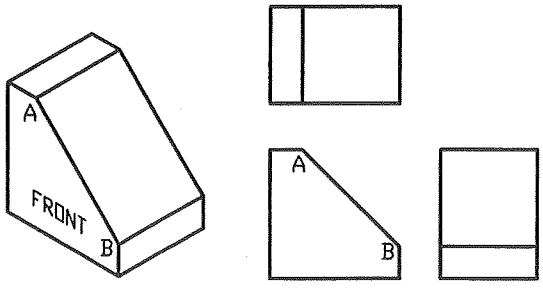


FIGURE 19

In Figure 20, point B is located by making a vertical line pass through the point and then measuring the distance from the base of the view. This gives the distance above the base. A line parallel to the base is then drawn through the point and measurement is taken from one edge to locate the point.

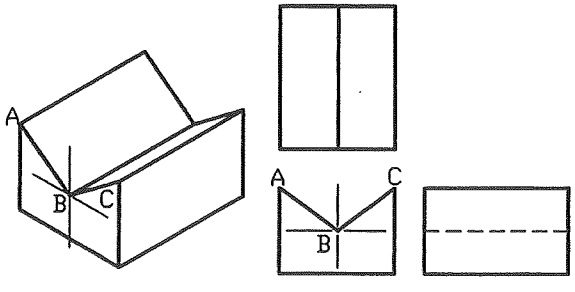
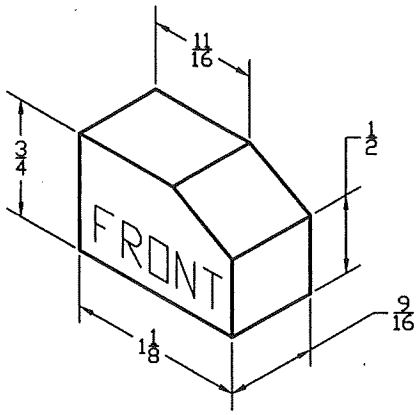
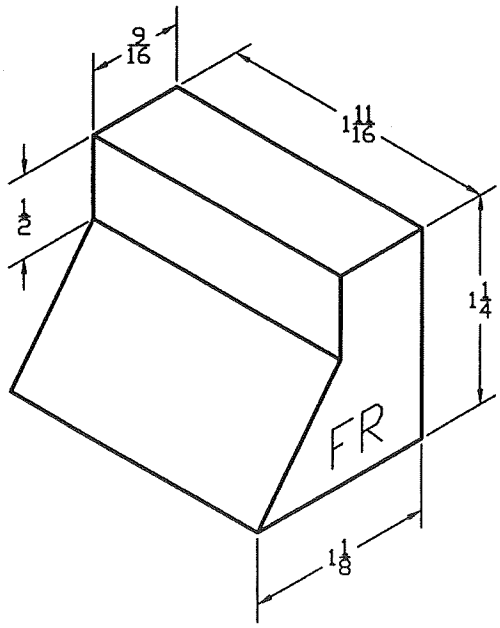


FIGURE 19



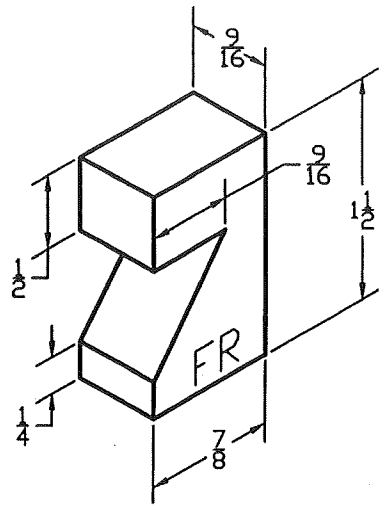
PROBLEM 35

PROBLEM 35



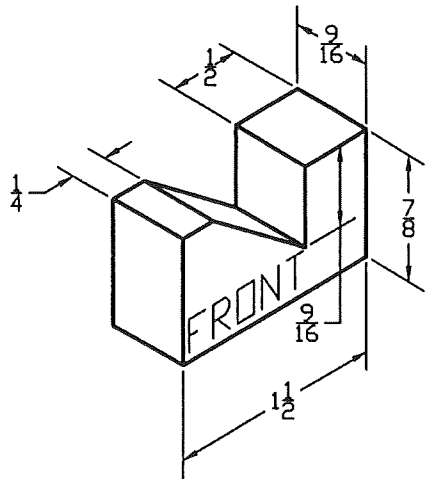
PROBLEM 36

PROBLEM 36



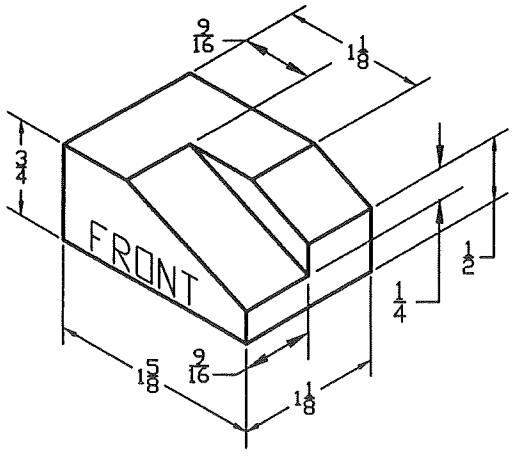
PROBLEM 37

PROBLEM 37



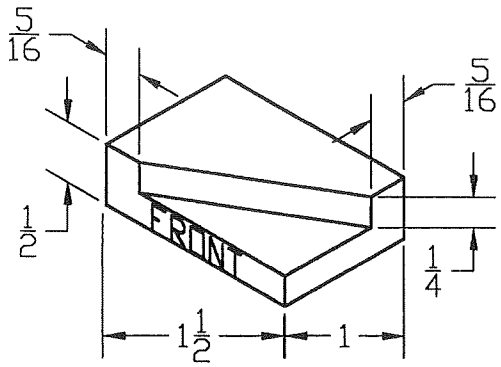
PROBLEM 38

PROBLEM 38

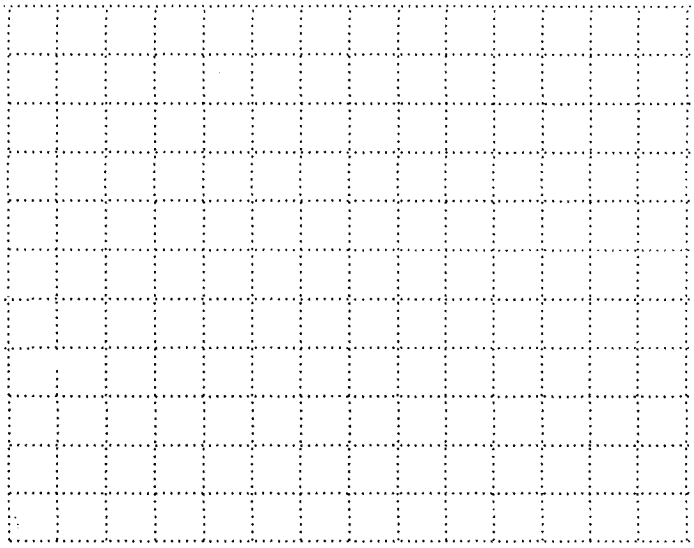


PROBLEM 39

PROBLEM 39



PROBLEM 40



PROBLEM 40

CIRCLES AND ARCS

Many objects have circles and parts of circles. If part of a circle is used, it is called an "arc." The center of a circle is called the "radius point." Since an arc is part of a circle, it will also have a radius point.

Centerlines are used to show the location of radius points. Centerlines are a combination of long and short dashes. The long dashes are 3/4 to 1 1/2 inches long, and the short dashes are about 1/16 to 1/8 inch long. Centerlines are thin lines, object lines are wide, and hidden lines are medium. Construction lines are thin and very light.

Figure 21 has an object with a hole all the way through. Notice that the short dashes of the centerline are at the center of the circle. Also notice the centerlines and hidden lines in the top and front views.

The diameter of the circle is also given. Another way of showing it is a circle will be explained later.

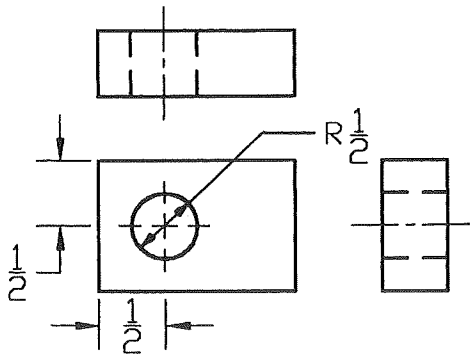


FIGURE 21

Figures 22 and 23 show an object with an arc. Centerlines are again used to locate the radius point. The radius is given for arcs as show

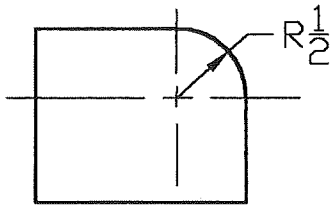


FIGURE 22

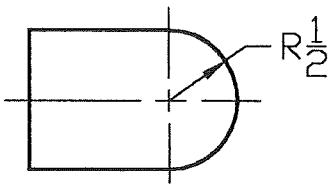


FIGURE 23

Figure 24 shows an object viewed from an angle. The object has a hole in it. Although the hole is a true circle, it appears out of round because it is viewed at an angle. The shape is called an "ellipse."

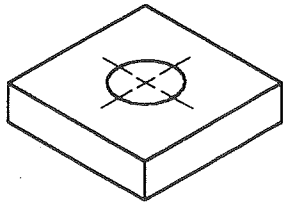


FIGURE 24

In problem 42 you will see the following:

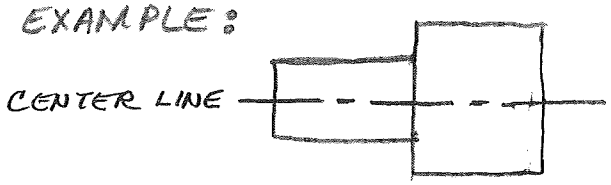
ø1

The symbol before the number means the diameter of a circle. The number 1 after the symbol means the diameter is 1.

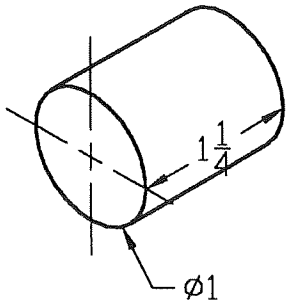
When an object is round, two of the views will be the same, so only one of the identical views is needed. Only two views are needed for problems 41, 42, and 43.

NOTE: YOU NEED TO SHOW CENTER LINES AND HIDDEN LINES.

EXAMPLE:

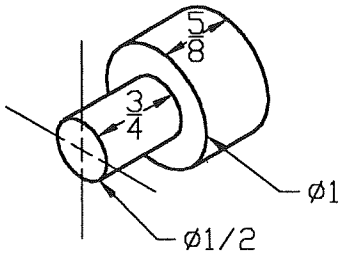


____ FIND THE CENTER LINE ON THE POSTER ABOVE THE SINK.
INITIAL



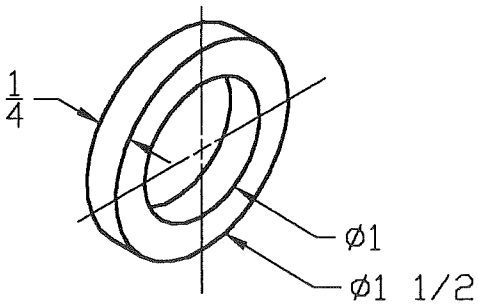
PROBLEM 41

PROBLEM 41



PROBLEM 42

PROBLEM 42



PROBLEM 43

PROBLEM 43

READING A RULE

It is very important for you to be able to read a rule. Rules are easy to read if you understand the marking system and practice a little. The longest marks on a rule are inch marks. See Figure 25.

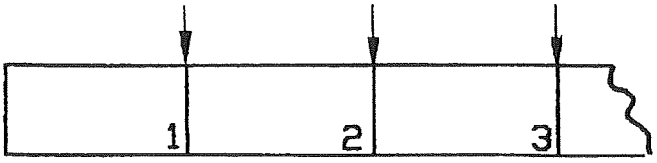


FIGURE 25

Next to the longest marks are the 1/2 inch marks. Notice that the marks are located halfway between the inch marks. See Figure 26.

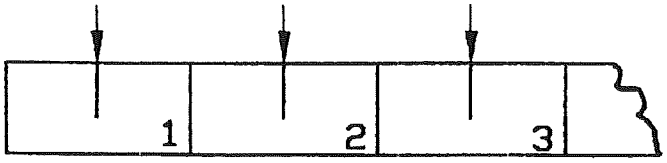


FIGURE 26

The half inch is divided by shorter marks. These marks are 1/4 inch marks. An inch has 4 quarters to the inch, but there are only two 1/4 inch marks. This is because the inch and half inch marks serve as quarter inch marks. Notice that the 1/4 inch marks are shorter than the 1/2 inch marks. See Figure 27.

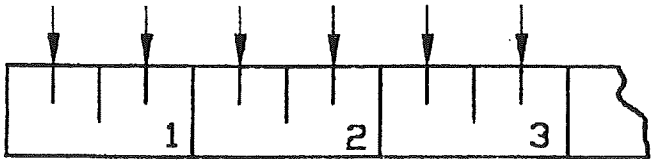


FIGURE 27

The marks located halfway between the 1/4 inch marks are 1/8 inch marks. Notice they are shorter than the 1/4 inch marks. The half and quarter inch marks also serve as 1/8 inch marks. See Figure 28.

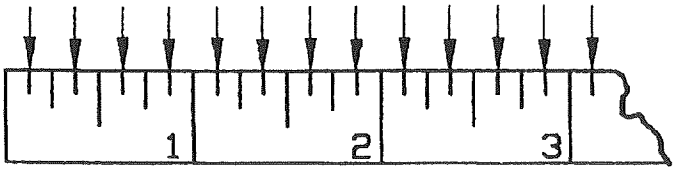


FIGURE 28

Most common rules are marked off in 1/16 inches. These marks are located halfway between the 1/8 inch marks. Notice that they are shorter than the other marks. See Figure 29.

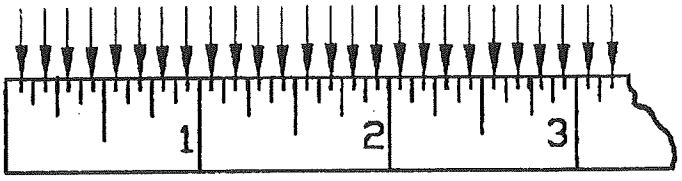


FIGURE 29

Give the distance between the following points of problem 44. Reduce fractions of the following distances: A-B _____

A-C _____

A-D _____

A-E _____

A-F _____

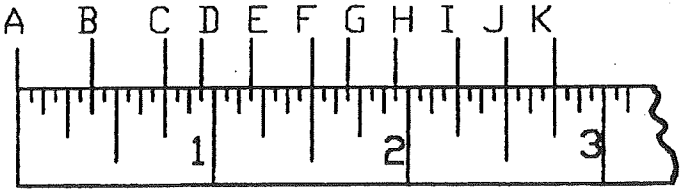
A-G _____

A-H _____

A-I _____

A-J _____

A-K _____



PROBLEM 44

NOTE:

There is a great website for practicing reading a ruler. If you open Google and then search for "Read a Ruler" you will probably find "The Ruler Game" Try the game and see how high of a score you can achieve!

http://rickyspears.com/rulergame

Use a ruler to measure the length of the lines in problems 45, 46 and 47. Measure to the nearest 1/16 of an inch. Write your answers in the spaces provided.

Problem 45

Line A _____ Line G _____

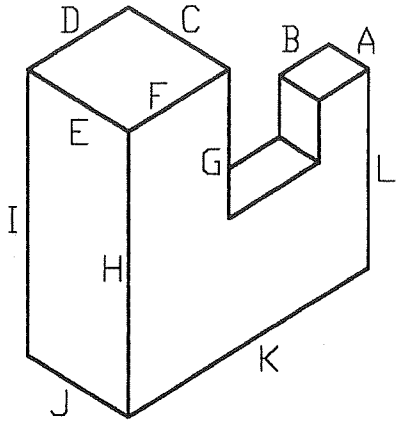
Line B _____ Line H _____

Line C _____ Line I _____

Line D _____ Line J _____

Line E _____ Line K _____

Line F _____ Line L _____



PROBLEM 45

Problem 46

Line A _____ Line I _____

Line B _____ Line J _____

Line C _____ Line K _____

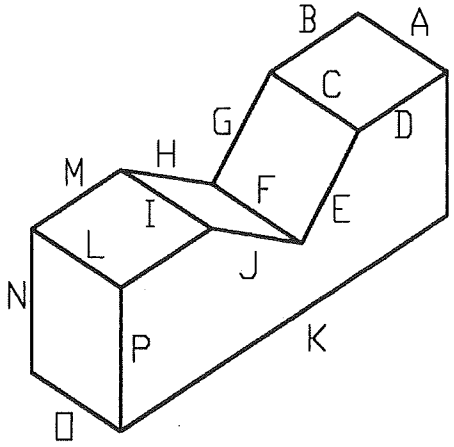
Line D _____ Line L _____

Line E _____ Line M _____

Line F _____ Line N _____

Line G _____ Line O _____

Line H _____ Line P _____



PROBLEM 46

Problem 47

Line A _____ Line H _____

Line B _____ Line I _____

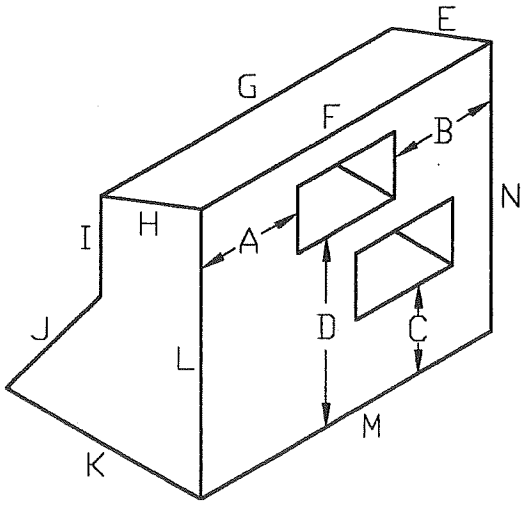
Line C _____ Line J _____

Line D _____ Line K _____

Line E _____ Line L _____

Line F _____ Line M _____

Line G _____ Line N _____



PROBLEM 47

U. OF DRAFTING BOARD
"T" SQUARE AND TRIANGLES

The teacher will have to show you how to use the drafting board, "T" square and triangles for Problem 48.

(1) Remove this sheet from the workbook. Use tape to fasten it to the drafting board. Have the bottom edge even with the "T" square. MAYLINE BAR

MAYLINE BAR

(2) Use pencil, "T" square and triangle to draw a vertical line 1/2 inch from the right edge of the sheet.

(3) Draw two more vertical lines 3 1/4 inches apart, as shown in Figure 30.

(4) Draw a horizontal line 4 1/4 inches above the bottom edge of the sheet from the right vertical line to the left vertical line. See figure 30.

(5) Draw very light parallel lines about 1/2 inch apart as shown below in Figure 31.
Section A: Horizontal lines.
Section B: Vertical lines.
Section C & D: Lines 30 degrees to

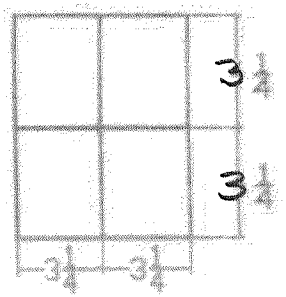


Figure 30

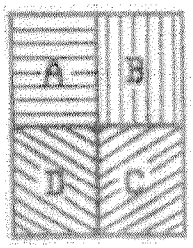


Figure 31

HAND SKETCH THE FIGURE 31 PATTERN ON 3 SHEETS OF WHITE PAPER. DO NOT USE A RULER OR STRAIGHT EDGE TOOL!

ISOMETRIC DRAWINGS

Isometric drawings combine the three views into a single drawing. Figure 32 is a three view orthographic drawing of a simple box. Figure 33 is an isometric drawing of the same box. Isometric drawings should look familiar to you. You have been making 3 views of isometric drawings in the first part of this book.

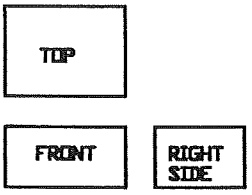


FIGURE 32

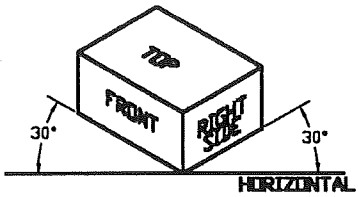


FIGURE 33

Hidden lines on an isometric drawing are confusing so they are normally not used.

Study the front view of Figure 32 and the front part of Figure 33. Notice how they are much alike. The only difference is the horizontal lines in the orthographic drawing are at 30° in the isometric. Also notice the front view is to the left of the vertical line. Now compare the right side of both drawings.

They are also the same except the horizontal lines in one are 30° lines in the isometric. Notice how the horizontal and vertical lines of the top view in the orthographic drawing both become 30° lines in the isometric.

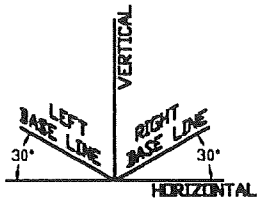
All lines used in Figure 32 are either vertical, or horizontal. Each vertical and horizontal line is the same length in the isometric. Lines which are not vertical, or horizontal in an orthographic are not the same length on the isometric. To determine the length you have to locate the end points of the line.

Orthographic drawings have three separate views. Each view is built on two basic lines. One line is vertical, the other is horizontal. The horizontal line is the base line.

The framework for an isometric uses three basic lines. One is vertical just like the vertical in orthographic. The other two lines are at a 30° angle to the horizontal. See Figure 33. Both 30° lines begin at the vertical line and move upward at a 30° angle. One goes to the right and the other to the left

Figure 34 shows the two 30 degree base lines and the vertical line. All isometric drawings are based on these lines.

FIGURE 34



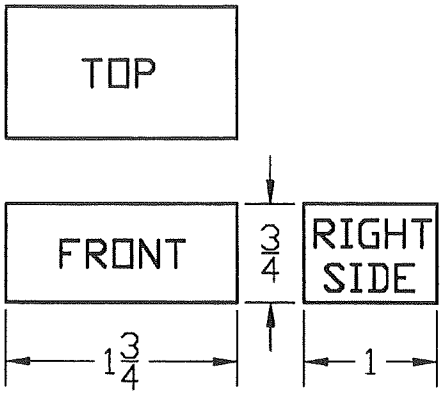
You are to do your work on the worksheets in this book. They have the base and vertical lines printed for you. Remove a page as needed, tape it to your drafting board with the punched holes across the top. Be sure to have the vertical line and 30 degrees lines aligned with your triangle and "T" square.

The first thing to do when you begin an isometric drawing is to construct a box for the view. Problems 49 and 50 are simple boxes. All lines should be light construction lines. Use 6H for construction lines. When the drawing is complete use 2H pencil to darken in the lines of the object.

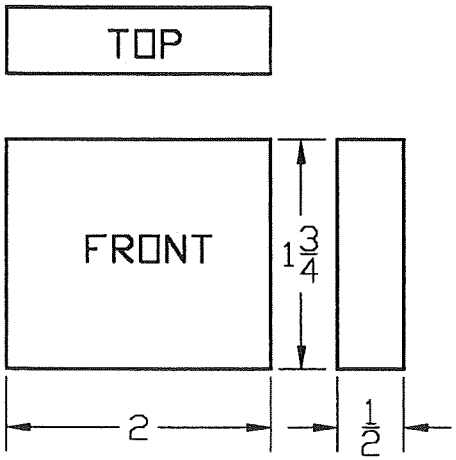
Page 28 is for problems 49 through 54.

The following chart should be helpful.

COMPARISONS		
ORTHOGRAPHIC		*ISOMETRIC*
vertical lines in side view	=	*vertical lines in side view*
vertical lines in front view	=	*vertical lines in front view*
horizontal lines in side view	=	*30 degree lines in side view*
horizontal lines in front view	=	*30 degree lines in front view*
vertical lines in top view	=	*30 degree lines in top view*
horizontal lines in top view	=	*30 degree lines in top view*
vertial and horizontal line lengths in top, front and side views	=	*same lengths in top, front, or side views*
lines **NOT** *vertical, or horizontal in top, front, side views*	=	**NOT** *the same length in top, front, or side views*
Uses hidden lines	=	*does not use hidden lines*



PROBLEM 49



PROBLEM 50

Figure 36 is an isometric drawing of the object shown in Figure 35. Notice that the right side view in one figure is similar to the right side view in the other figure. Study the front views in both figures. Notice that they are NOT alike. This is because of the step in the object. In the orthographic drawing the step appears to be on the same plane in the front view. It does not appear in the same plane in the isometric. The same is true of the top view.

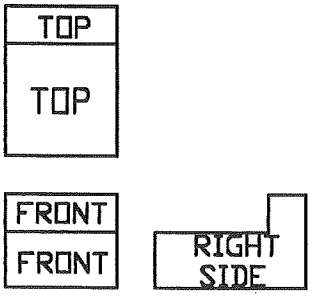


FIGURE 35

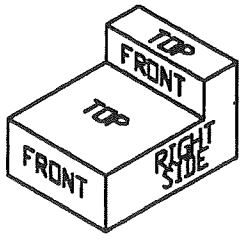
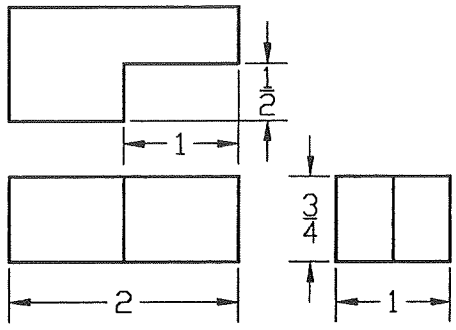
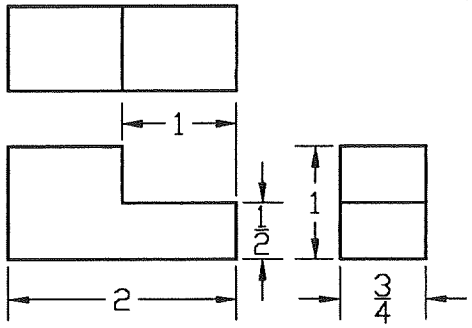


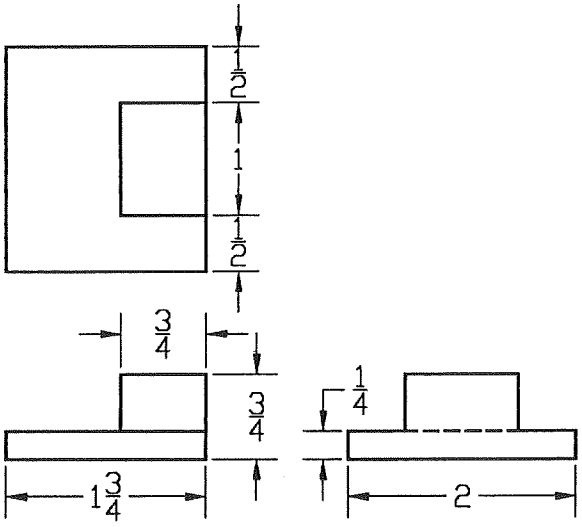
FIGURE 36



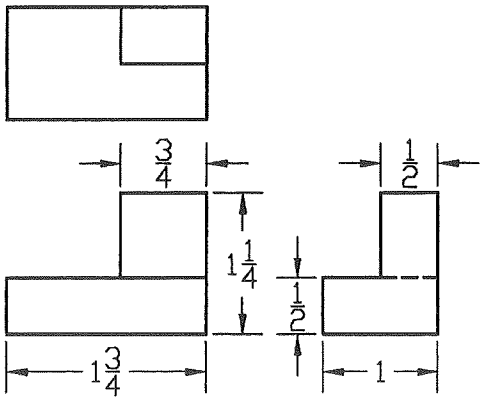
PROBLEM 51



PROBLEM 52

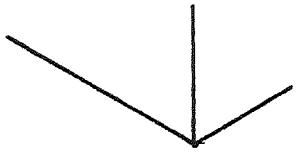


PROBLEM 53

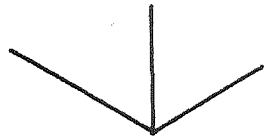


PROBLEM 54

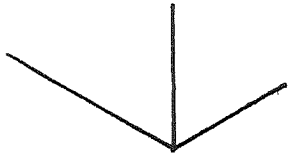
PROBLEM 49



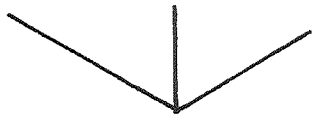
PROBLEM 50



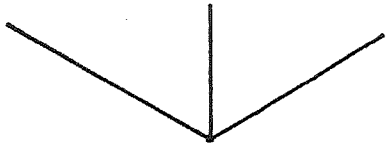
PROBLEM 51



PROBLEM 52



PROBLEM 54



PROBLEM 53

SURFACES NOT PARALLEL TO ONE VIEWING PLANE

Isometric drawings have three basic viewing planes. They are the front, top and side view. Some objects have surfaces that are not parallel to one of these planes. The object in figure 37 has such a plane. ONE EDGE OF THE SURACE IS PARALLEL TO THE FRONT VIEW. Steps 1 through 4 tell how to locate the surface on an isometric drawing.

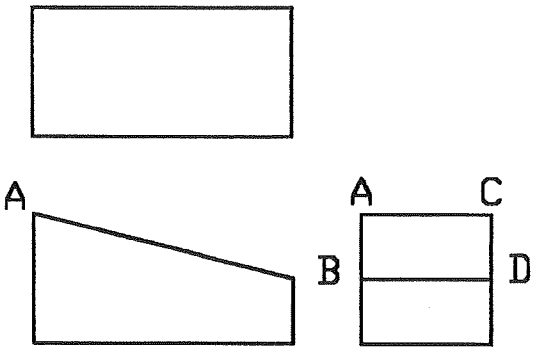


FIGURE 37

STEP 1: Draw an imaginary box just large enough to hold the object. Use construction lines. See Figure 38.

STEP 2: Locate points A, B,C and D as shown in Figure 39.

STEP 3: Connect points A-B, C-D, and B-D as shown in Figure 39.

SHOW VERY LIGHT

STEP 4: Darken lines and ~~erase~~ construction lines. See Figure 40..

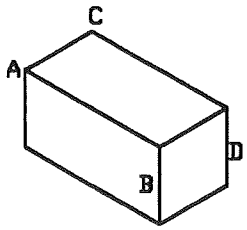


FIGURE 38

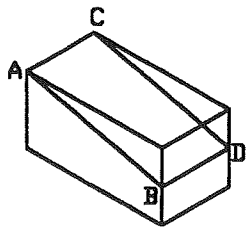


FIGURE 39

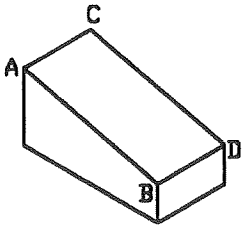
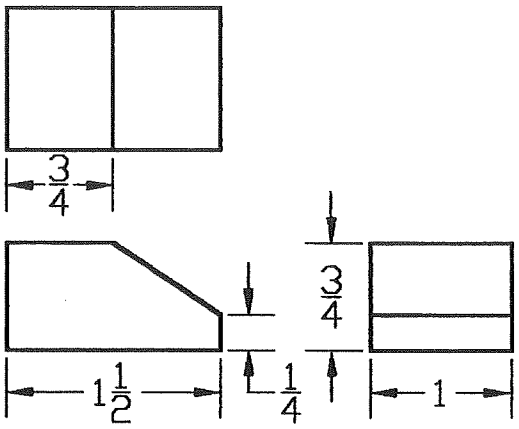
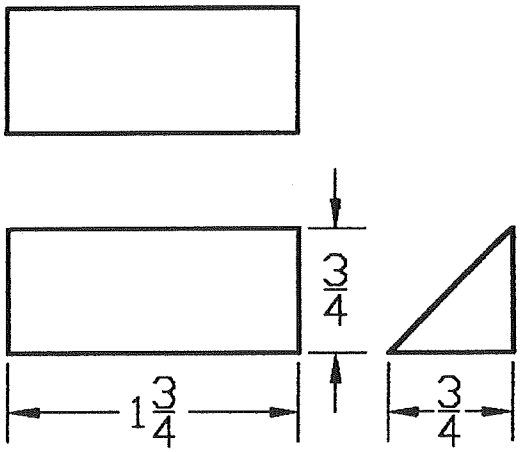


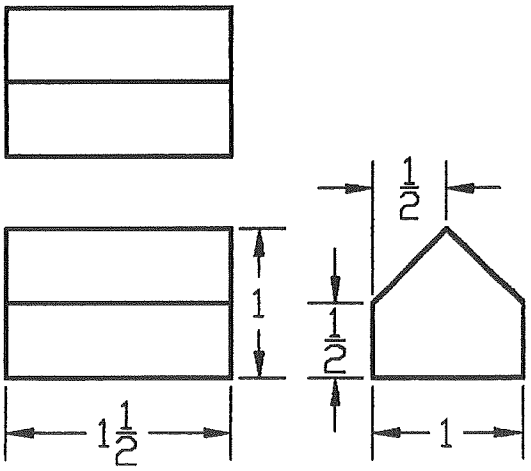
FIGURE 40



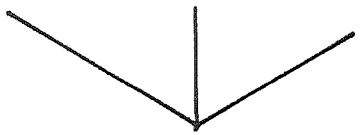
PROBLEM 55



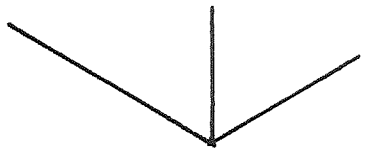
PROBLEM 56



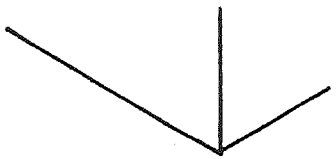
PROBLEM 57



PROBLEM 55



PROBLEM 57



PROBLEM 56

DEVELOPMENTS

Orthographic projections usually use only three views, but there are actually six regular views. Figure 42 shows all six regular views of the object shown in Figure 41. The back view could also be placed above the top view; to the right of the right side view; or to the left of the left side view; instead of the position shown.

Figure 43 shows the views moved together to form a single unit. The result is called a STRETCH OUT. Hidden lines are not shown in stretchouts.

The next step is to bend and fold the stretch out along the edges that are shared by two views. If the stretch out is drawn, cut, and folded properly,

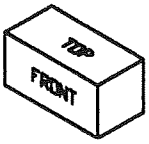


FIGURE 41

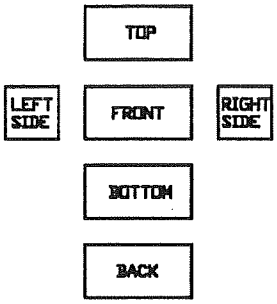


FIGURE 42

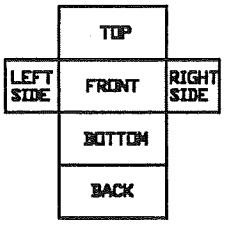


FIGURE 43

The object shown in Figure 44 differs from the object shown in Figure 41. Figure 44 has a notch cut out of one end. Making a stretch out of Figure 44 that can be folded properly will require dividing some of the views into separate parts. Notice in Figure 45 that some of the lines are cut. The stretch out cannot be folded if they are not cut Figure 46 shows the object after the stretch out has been folded.

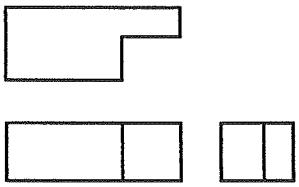


FIGURE 44

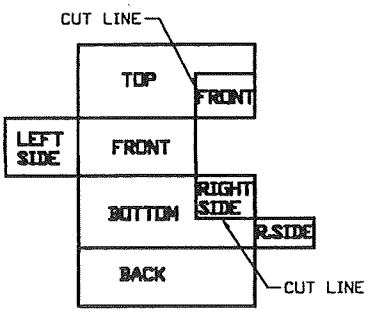


FIGURE 45

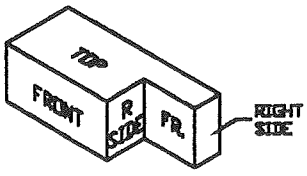
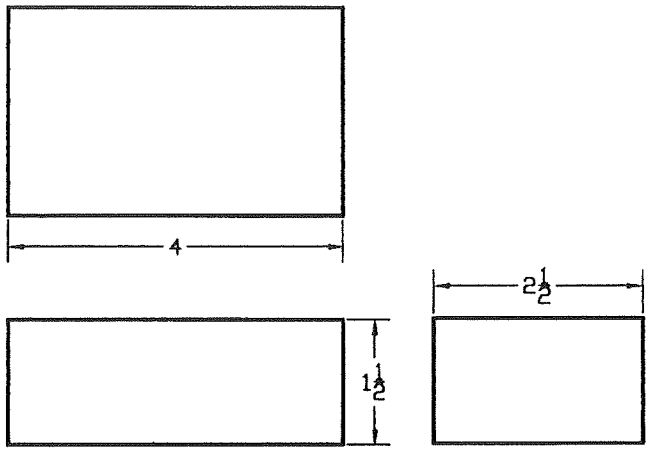


FIGURE 46

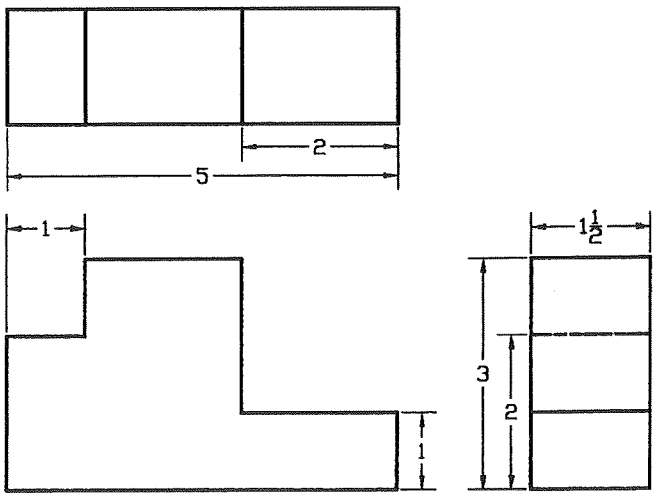
USE GRAPH PAPER

~~Remove pages at the end of this work book~~ as needed to make stretch outs of Problems 58, 59 and 60. After making a stretch out, use a ball-point pen to go over each line to be folded. Press down hard with the pen but be careful not to tear the paper. Next use scissors to cut out the stretchout. Fold the stretchout and fasten together with clear tape.

Write your name on each of the problems before folding.



PROBLEM 58

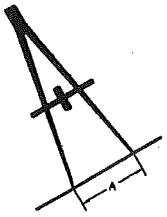


PROBLEM 59

USING A COMPASS TO TRANSFER MEASUREMENTS

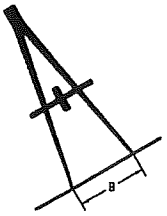
Dividers are used by most people who make drawings. Dividers are similar to a compass; a compass has a pencil point and a metal point; a divider has two metal points. When a compass is used, the pencil point must be kept sharp.

To transfer a measurement, adjust the dividers so one point is on one end of the measurement and the other point is on the other end of the measurement, see Figure 47. After the compass has been set, use it to mark the distance on the other line as shown in Figure 48.



A = distance to be transferred

FIGURE 47



B = distance transferred

FIGURE 48

To find the length of a curved line set the compass points about 1/8 inch apart. Draw a straight line. Use the compass to measure along the curved line in steps, see Figure 49. Measure the same number of steps on the straight line as shown in Figure 50. The length of the curved line will rarely come out with an even number of steps. Set the calipers to the remaining distance and transfer the measurement to a straight line. See Figures 49-50.

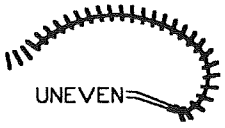


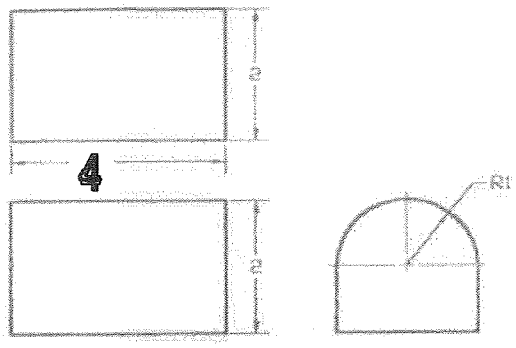
FIGURE 49

FIGURE 50

For Problem 60 use dividers to measure the curved line below. You can draw a straight line along the top of this page to do the measuring. Transfer the measurements and measure to the nearest 1/16 inch.

The line is _____ inches long.

PROBLEM 60



PROBLEM 61

From the top and front views of Problem 61 the object appears to be a simple rectangular box, but the end view shows the top is curved. Draw the end view, then use your dividers/compass to determine the length of the curve.

You can also use math to determine the length. The formulas are:

Circumference = ΠD(3.14) x diameter.
Diameter = R x 2

Use math to calculate the length. Notice this is only half of a circle. Math is an accurate way to determine the length. If the distance measured using the dividers/compass is not the same as the distance you determined using math, why do you think there is a difference?

Lay out the bottom and ends on your sheet, add the straight sides, then add the length needed for the curved portion. Using math you should come up with .14 as part of the answer. 1/8 inch is .125, which is close enough for your sketch. Your finished stretch-out should be similar to Figure 51 below. Cut and fold stretch-out.

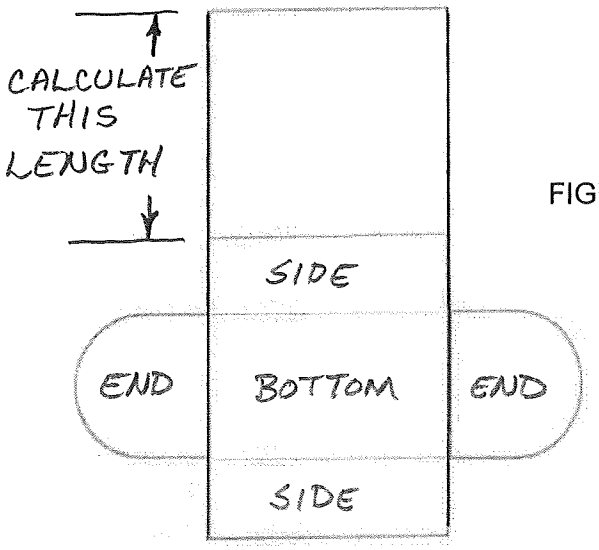


FIGURE 51

34 s

35 s