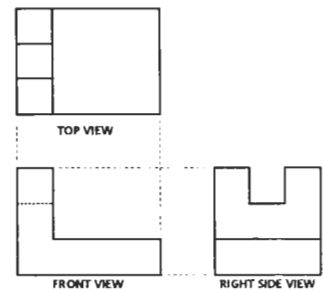


Drafting: An Introduction



Introduction

Drafting is a graphic language that is part of what is called **graphic communications**. It is a very exact language that allows engineers and designers to tell others what they are to construct or manufacture. A **draftsperson** is the communicator for the engineering or design team. He or she receives the sketches and specifications from the designer, architect, or engineer, and using the knowledge and skills of drafting, transforms these ideas into plans that can be used to create products or complete construction projects.

There are two major fields or areas of drafting; architectural and mechanical. **Architectural drafting** is a field of technical knowledge that provides the techniques for describing buildings. **Mechanical drafting** describes mechanical or manufactured products.

To become a draftsperson, you must have a knowledge of basic drafting techniques. Being a draftsperson often requires that you can solve visual puzzles as well. You will need to learn how to use different line symbols and methods to represent an object so that there is no doubt about what is wanted. Information on a drawing is provided in a specific form, and you will need to learn how to letter in this way. Drafting is work that requires care and patience, and you must be able to pay attention to detail.

There is a variety of different types of drawings that engineers use. Each has a specific purpose. The two basic types of mechanical drawings are **multiview** and **pictorial**.

Multiview drawings are used when accurate details and dimensions need to be communicated. This type of drawing is usually prepared as a plan to follow when objects are to be manufactured. These drawings are called **working drawings**.

Multiview drawings are prepared in a certain arrangement with separate views which describe the front, top, and sides of an object. (See Figure 1.) Usually only three views are required to show or explain the detail of a part fully. Sometimes, however, a great deal of detail is needed and drawings will be prepared to show bottom and rear views as well.

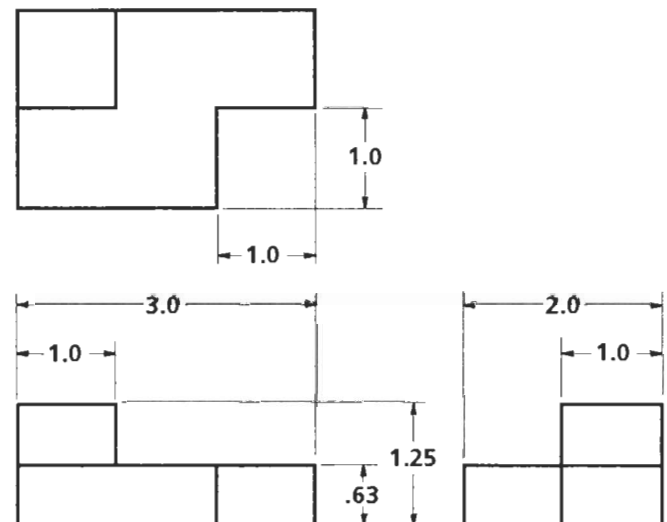


Figure 1 - Sample Multiview Drawing

Pictorial drawings generally show the front, top, and sides of an object in one view. The term "pictorial" tells you that the drawing resembles a picture of the object. Pictorial drawings are used to show what an object will look like, and how it is assembled. Pictorial drawings are often included in assembly instructions and repair and maintenance manuals. There are three basic types of pictorials. They are (1) isometric, (2) perspective, and (3) oblique.

Isometric drawings are prepared on lines drawn at 30 degree angles to the horizontal plane. The front, top, and side are drawn to their true length, which produces an approximate view of the object. (See Figure 2.)

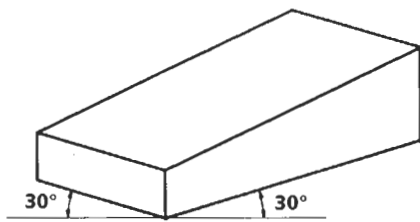


Figure 2 - Sample Isometric Drawing

Perspective drawings describe an object as it appears to the eye. The most distant points appear smaller than those closest to the observer even if they are actually the same size. The most common types of perspective drawings are the one-point and two-point perspective. (See Figure 3.)

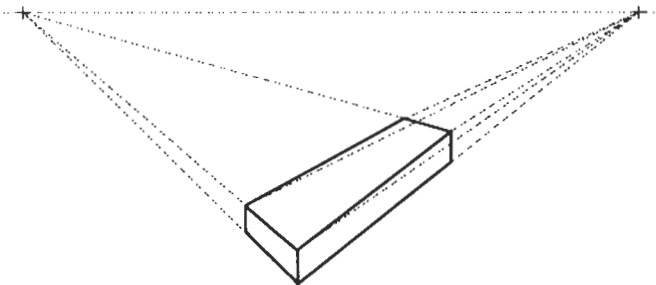


Figure 3 - Sample Two-point Perspective

Oblique drawings are prepared in a similar manner to isometric; the difference, however, is that the oblique drawing is prepared with one side of the object on the horizontal plane. The view that represents the side of the object is drawn at any angle between 0 and 90 degrees. (See Figure 4.)

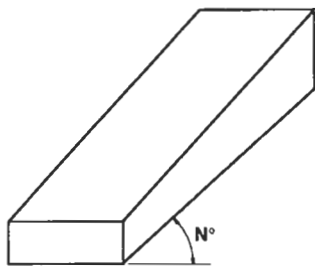


Figure 4 - Sample Oblique Drawing

Job Description

Drafting technology requires a knowledge of basic drafting skills. In this activity package, you are going to practice the skills of a draftsman. You will need to know the uses of drafting tools, materials, and media. You will need to learn the drafting alphabet of lines, and learn to letter the Gothic single stroke alphabet. You will then learn the methods of describing shape and size using orthographic projection and dimensioning. Lastly,

you will be developing some skills in pictorial drawing, using isometric, oblique, and perspective drawing techniques.

Materials and Supplies

To complete this activity, you will need the following materials:

drawing paper, 9" x 12"
 tracing vellum, 9" x 12"
 HB, 2H, & 4H drawing pencils
 eraser
 T-square
 45 degree triangle
 30-60 degree triangle
 architect scale
 ruler
 compass
 drafting dots or drafting tape

How to Use Drafting Tools

1. Before you begin, you need to make sure that your drafting board and all your tools are clean.
2. Place your drawing paper on the drafting board approximately in the middle.
3. Press the head of the T-square firmly against the left edge of the drawing board. Note: If you are left-handed, reverse the T-square and press the head against the right edge.
4. Slide the paper in line with the T-square until the blade is lined up with the bottom edge of the paper. When you have the paper **perpendicular** to the edge of the drawing board, tape the top corners. Slide the T-square up and tape the bottom corners.
5. Using the 4H pencil and the T-square, draw several **horizontal** lines.
6. Place the 45° triangle against the edge of the T-square and draw several **vertical** lines.
7. Draw a few lines using the angled side of the triangle. Check to see that these lines are straight and **parallel**.
8. Draw a number of circles using your compass. Set your compass to the desired radius, which is one half the **diameter** of the circle.
9. After you have completed this activity, remove the tape and save your drawing for later use.

Drawing the Alphabet of Lines

1. Place Exercise Sheet #1 on your drawing board.
2. Slide the paper in line with the T-square until

the blade is in line with the bottom edge of the paper. When you have the paper **perpendicular** to the edge of the drawing board, tape the top corners. Slide the T-square up and tape the bottom corners.

- Use your set of drafting pencils to construct six examples of the alphabet of lines.

The Single Stroke Gothic Alphabet

- Place Exercise Sheet #2 on your drawing board.
- Slide the paper in line with the T-square until the blade is in line with the bottom edge of the paper. When you have the paper **perpendicular** to the edge of the drawing board, tape the top corners. Slide the T-square up and tape the bottom corners.
- Use your HB pencil to produce three copies of each Gothic letter.

Measuring Accurately

The ruler or scale is the instrument the drafter uses for measurement. Since not all objects are in full inches, you will need to be able to use the **subdivisions** of the ruler. Look at the enlargement of the inch shown in Figure 5. Note that the inch is divided into 16 equal parts. Each part is 1/16 of an inch.

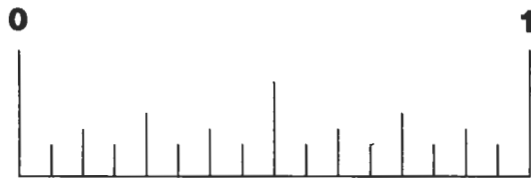


Figure 5 - Subdivisions of an Inch

- Place Exercise Sheet #3 on your drawing board.
- Use your ruler or architect scale to measure each line segment; place your answers in the blanks. If you are using the scale, be sure to use the 16 scale to measure.

Describing the Shape of an Object

Three dimensional objects can be represented in a two dimensional drawing by using more than one view. In the drawing of the object in Figure 6, the "dimensions" are described as **length**, **width**, and **height**. A multiview drawing shows an object in multiple views. Each view contains two of the three dimensions. In Figure 7 the same object is shown as an **orthographic** drawing. Notice that the **front** view shows the length and height of the object; the

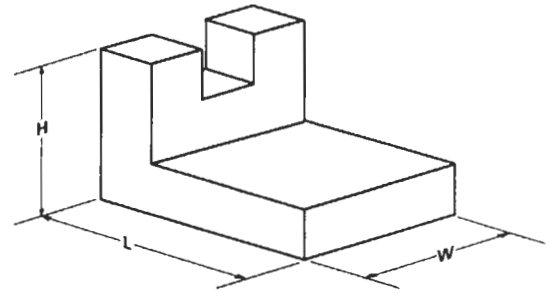


Figure 6 - Sample Pictorial Drawing

top view shows the length and width; and the **side** view shows the width and height.

- Place Exercise Sheet #4 on your drawing board.
- Slide the paper in line with the T-square until the blade is in line with the bottom edge of the paper. When you have the paper perpendicular to the edge of the drawing board, tape the top corners. Slide the T-square up and tape the bottom corners.
- Use your 4H pencil to complete each of the orthographic views. When the views are complete and you are sure each one is correct, use your HB pencil to darken in the **object lines** only. You may leave light **construction lines**.

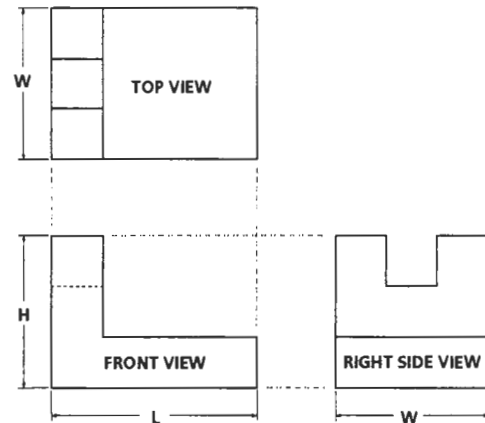


Figure 7 - Sample Orthographic Drawing

Using Dimensions

Just as there are standards for line weights, lettering, and other areas of drafting, there are standards for **dimensioning** a drawing. Dimensioning standards are rules that drafters use so that anyone who knows the rules will be able to understand and read a drawing. A group of professional engineers called the American Society of Mechanical Engineers (ASME) are the ones who have set these standards which are published by the American National Standards Institute (ANSI). You will see the ANSI notation on many drawings, this indicates the standards used in that set of drawings.

A drawing must have complete and accurate dimensions. A good rule for the drafter to follow when dimensioning is to think of "how many dimensions are needed to make the part." The *Rules for Dimensioning* handout contains simple guidelines you should follow as you complete the following exercise.

Place Exercise Sheet #5 on your drawing board. Use the "rules for dimensioning" to place the dimensions on the object. Use the 16 scale, and make all dimensions full size.

Using Pictorial Drawings

Pictorial drawings show an object as it would look to a person viewing it. They show the three dimensions (length, width, and height) of the object in a single view. In this exercise you will draw an object in each of the pictorial methods.

1. Place Exercise Sheet #6 on your drawing board.
2. Use a 4H pencil to draw construction lines.
3. Follow the instructions and complete a view of the object in **isometric**.
4. When you have completed the drawing, use your HB pencil to darken object lines.
5. Place Exercise Sheet #7 on your drawing board.
6. Use a 4H pencil to draw construction lines.
7. Follow the instructions and complete a view of the object in **oblique**.
8. Use your HB pencil to darken object lines when you have completed the drawing.
9. Place Exercise Sheet #8 on your drawing board.
10. Use a 4H pencil to draw construction lines.
11. Follow the instructions and complete a view of the object in **perspective**.
12. Use your HB pencil to darken object lines when you have completed the drawing.

Drawing a Border & Title Block

1. Make sure all your tools and materials are clean before you begin.
2. Using the T-square, align your drafting paper and tape down.
3. Duplicate the sample border and title block layout. Refer to the dimensions written on the layout. Use a very light dash to mark the correct measurement for the lines. Draw your border first using construction lines.
4. Check the lines for accurate measurements. Use your HB pencil to darken your lines.
5. Letter your title block as directed by your teacher.
6. After you have completed the exercise, put

your border and title block in a safe place so that you may refer to it at a later time.

Basic Drafting Exercises

Being able to use your drafting tools and applying the knowledge you have gained is an important skill. In the following exercises, you will use the standard border and title block layout for each of the drawing problems included in the Exercise Sheets. You will prepare a drawing as specified:

- Problem 1 - Draw the border and title block.
- Problem 2 - Draw the multiview drawing.
- Problem 3 - Draw the multiview drawing.
- Problem 4 - Draw the multiview and pictorial.

Vocabulary

engineer	architect
mechanical drafting	specifications
architectural drafting	orthographic projection
pictorial	multiview
diameter	parallel
vertical	horizontal
isometric	oblique
perspective	alphabet of lines
gothic single stroke alphabet	architect scale
drawing to scale	construction line
center line	hidden line
object line	dimension
dimension line	extension line
perpendicular	

On Your Own

1. Look for drawings around your house. Look for assembly drawings for appliances, toys, or models. Check out the instruction books for your TV, stereo, and VCR. Look in the glove compartment of your car for the owner's manual. Are there drawings? What kind are they? Bring these drawings to class and share what you have found.

2. Look in the Sunday newspaper and find the Home & Design Section. Look for drawings of houses. What kind of drawing can you find? Bring them to class to share what you have found.



Office of Vocational, Adult,
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Technology Education
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Miami, Florida

TEACHER GUIDE

DRAFTING: AN INTRODUCTION

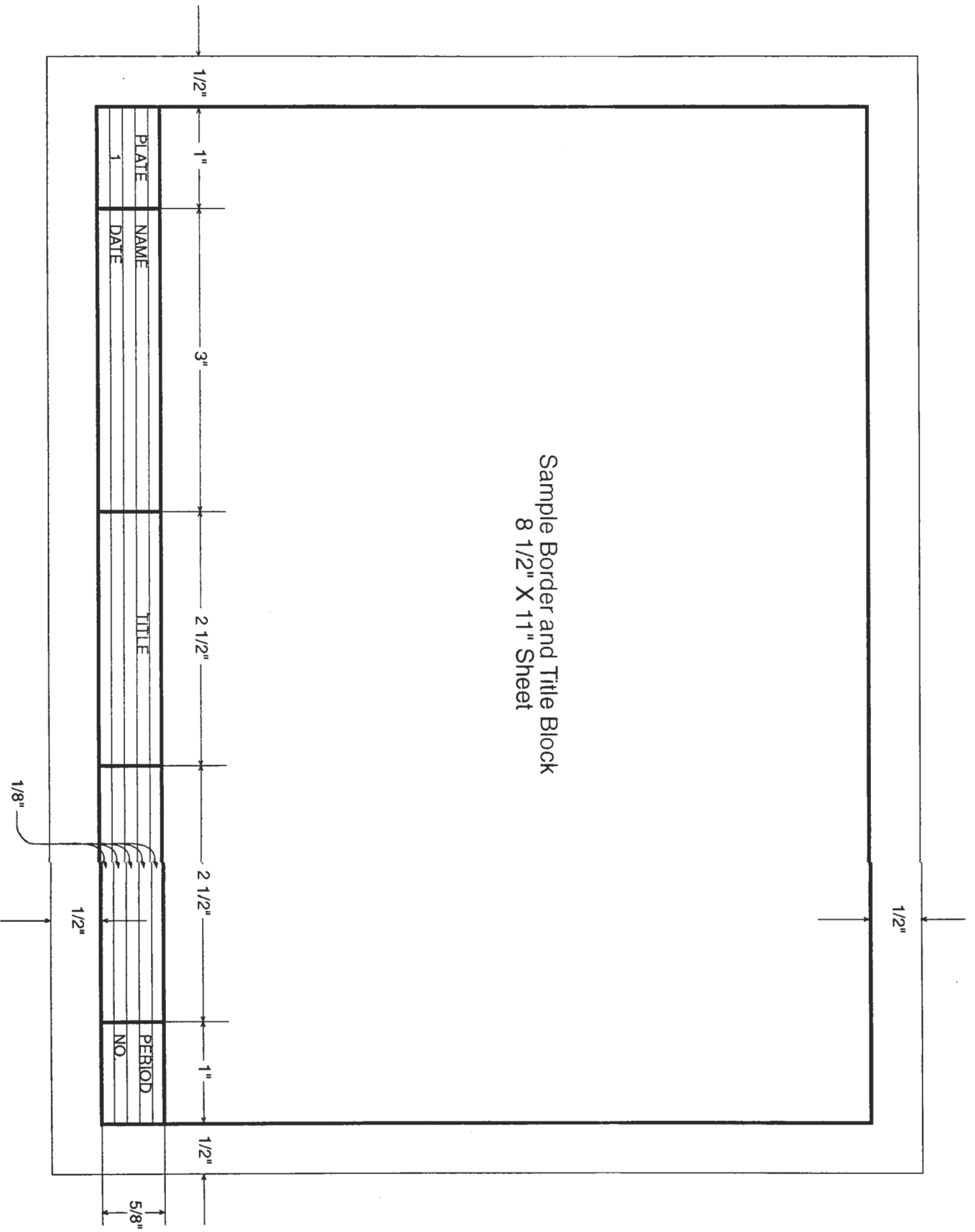
Objectives: Upon completion of this assignment, students will be able to:

- Describe the use of drafting to communicate technical information.
- Use basic drafting tools properly.
- Measure to the nearest 1/16".
- Draw an object to scale.
- Describe the alphabet of lines and its uses.
- Demonstrate proper lettering techniques using the single stroke Gothic alphabet.
- Draw an object using the orthographic projection technique.
- Draw an object in isometric, oblique, and perspective.
- Describe the function of dimensions and use them correctly to dimension an object.

Helpful Hints:

1. Collect a series of different types of drawings you can find around the home. Use these in your opening presentation of how drawings are used.
2. Get a set of blueprints for a rather complicated mechanical object and for a house. Show and compare the two different types of drawings.
3. There are many good drafting workbooks available that contain exercise sheets that can be used for additional practice and reinforcement of the concepts presented in this unit. Remember to adhere to copyright laws.
4. Use an overhead projector with "miniature" drafting tools (T-square & triangles) to demonstrate the procedures contained in this activity.
5. Make styrofoam models of the objects in the exercises so students can "visualize" the objects to be drawn.
6. A fun way to practice lettering is to get copies of popular song lyrics. Have students letter them out.

Sample Border and Title Block
8 1/2" X 11" Sheet



RULES FOR DIMENSIONING

Dimension Lines

Dimension lines are thin, black, solid lines that show where a dimension begins and ends. Draw them parallel to the surface or edge being described. Break the dimension line to allow room for the dimension on engineering drawings. On architectural drawings, draw a continuous dimension line and place the dimension above it. (See Figure 1.)

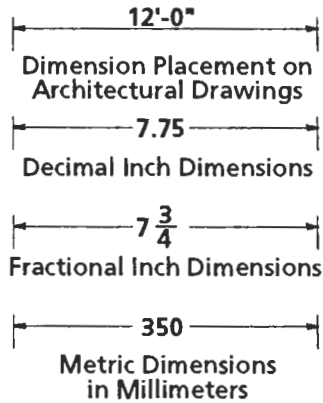


Figure 1

Draw the dimension line nearest to the view $\frac{3}{8}$ inch (10 mm) away from the object line. Space all other dimension lines $\frac{1}{4}$ inch (6 mm) away from the first dimension line and each other. (See Figure 2.) Do not

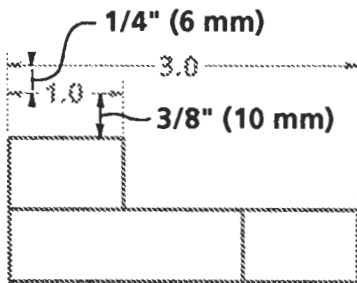


Figure 2

use object line, center lines, or extension lines as dimension lines. Whenever possible, line up dimension lines to give your drawing an orderly appearance and make it easier to read. (See Figure 3.)

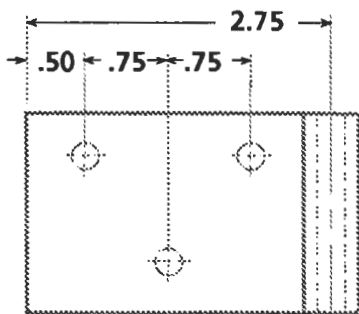
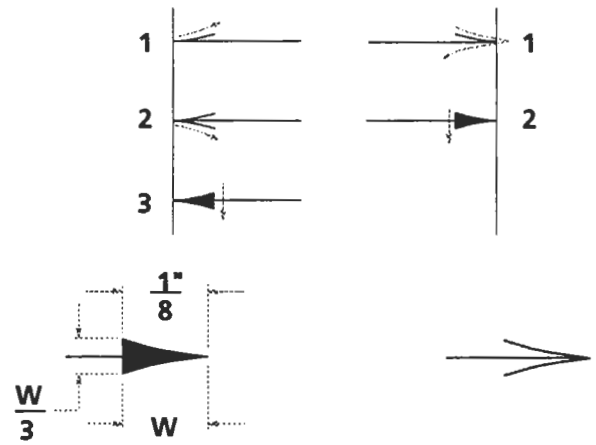


Figure 3

Arrowheads

Arrowheads show the beginning and the end of a dimension line. Draw arrowheads freehand using two or three strokes and make them one-third as high as they are long. They may be open or closed. (See Figure 4.) Draw all the arrowheads on a drawing the same size. Make the length of the arrowheads on a drawing the same size. Make the length of the arrowhead on a small drawing approximately $\frac{1}{8}$ inch (3 mm) and up to $\frac{3}{16}$ inch (5 mm) on a large drawing.



A CLOSED ARROWHEAD

AN OPEN ARROWHEAD

Figure 4

Extension Lines

Extension lines are used to extend the lines on a view to show where dimension lines start and end. Place them outside the view beginning about $\frac{1}{16}$ inch (1.5 mm) away from the view. Extend them about $\frac{1}{8}$ inch (3 mm) past the last dimension. (See Figure 5.) Make extension lines like dimension lines: thin, solid, and black.

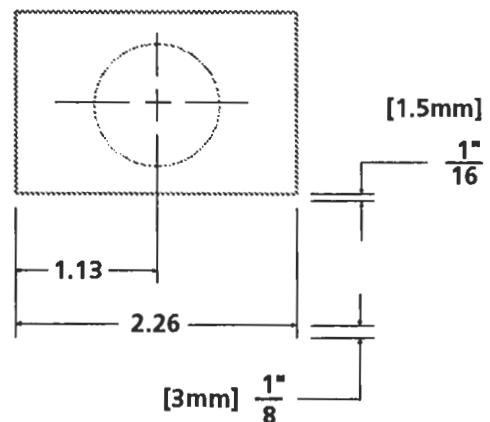


Figure 5

**LANGUAGE ARTS APPLICATION
DRAFTING: AN INTRODUCTION**

Student Name

In all types of jobs you will find that you need the ability to communicate your ideas effectively. Writing skills are necessary in all occupations. Here are a few examples of how writing skills are related to this activity.

The ability to conduct research is an important skill that any business person, professional, or student must possess. This assignment will require you to visit the library and do some research on a career in drafting.

Use the resources available in your school media center to do your research. Ask the media specialist for help. You might find information in the card catalog, career file, occupational catalogs, college catalogs, or other sources to answer the following questions:

1. What local colleges, community colleges, and universities offer courses or programs in Drafting?

2. What education is required for a career in Drafting?

3. What kinds of businesses hire draftspersons?

**LANGUAGE ARTS APPLICATION
DRAFTING: AN INTRODUCTION (Cont'd.)**

4. What kinds of skills do drafters need to possess?

5. What is the pay scale for drafters? How much can one expect to earn in this occupation?

6. For a career in drafting, what types of high school courses are recommended?

MATH APPLICATION DRAFTING: AN INTRODUCTION

Student Name _____

In all types of occupations you will need the ability to apply mathematics effectively. Here are a few examples of how math skills are used in relation to this activity.

Drafting is a precise language that involves working with measurements. Draftspersons work with specifications given to them by designers, architects, or engineers, and they must transform these specifications into plans that can be used to create products. The ability to work with measurements is one skill used often by the draftsperson. In the drafting activity package you will be using the ruler to measure and lay out line lengths. It is important that you are able to add and subtract measurements accurately to do this.

In this exercise you will be asked to add and subtract measurements that have like and unlike denominators. When the fractions have different denominators, you must change the fractions to equivalent fractions with common denominators. Whole numbers can simply be added or subtracted.

Example: $1 \frac{1''}{8} + 3 \frac{1''}{2} = ?''$

Find the least common denominator (LCD) of the fractions.

In this example, the LCD is 8.

Change to equivalent fractions.

Solution: $1 \frac{1''}{8} + 3 \frac{4''}{8} = ?''$

$$1 \frac{1''}{8} + 3 \frac{4''}{8} = 4 \frac{5''}{8}$$

Try these:

Addition:

1. $4 \frac{3''}{8} + 3 \frac{5''}{16} = \underline{\hspace{2cm}}$

2. $3 \frac{5''}{16} + 9 \frac{1''}{8} = \underline{\hspace{2cm}}$

3. $7 \frac{1''}{2} + 2 \frac{3''}{16} = \underline{\hspace{2cm}}$

Subtraction:

4. $7 \frac{11''}{16} - 3 \frac{1''}{4} = \underline{\hspace{2cm}}$

5. $9 \frac{7''}{8} - 4 \frac{5''}{16} = \underline{\hspace{2cm}}$

6. $11 \frac{3''}{4} - 2 \frac{3''}{8} = \underline{\hspace{2cm}}$

MATH APPLICATION
DRAFTING: AN INTRODUCTION (Cont'd.)

Try the following word problems: (Show your work in the area provided.)

7. _____ Mr. Pierce wrote the following measurements on the chalk board:
 $4\frac{5''}{8}$, $6\frac{1''}{4}$, and $8\frac{3''}{16}$. What is the sum of the three measurements?
8. _____ A student in the manufacturing laboratory needs to cut four boards from a piece of pine. The lengths needed are $11\frac{3''}{16}$, $3\frac{5''}{8}$, $4\frac{7''}{16}$, and $9\frac{1''}{8}$. Each time the student cuts a length of wood, $\frac{1''}{8}$ will need to be added to the overall length to allow for the width of the saw kerf. What length piece of wood will the student need to use?
9. _____ It takes 5 pieces of metal measuring 2" wide by $3\frac{3''}{8}$ long to make a pencil box. How many inches of 2" wide material would you need to make 5 pencil boxes?
10. _____ A student wants to make plastic key chains $1\frac{1''}{4}$ wide by $4\frac{3''}{8}$ long. How many plastic key chains could the student make from a piece of plastic measuring $1\frac{1''}{4}$ inches wide by 48" long?

QUIZ
DRAFTING: AN INTRODUCTION

Student Name

True or False:

- _____ 1. Drafting pencils come in various grades of hardness. The HB pencil lead is harder than the 4H pencil lead.
- _____ 2. All of the following are pictorial drawings: isometric, oblique, orthographic, and perspective.
- _____ 3. Three dimensions that will describe the overall size of an object are length, width and height.
- _____ 4. Dimensions are placed on a drawing so that they are hard to find and read.
- _____ 5. The type of drafting used by architects to draw and describe buildings is called mechanical drawing.
- _____ 6. T-squares are used to draw horizontal lines, while triangles are used to draw vertical lines.
- _____ 7. The single stroke Gothic alphabet is often used in drafting because it is easy to read.
- _____ 8. A line that is used to indicate a part or surface that is not visible in a view is called a hidden line.
- _____ 9. The dimensions that describe the front view of an object in an orthographic drawing are width and height.
- _____ 10. In an orthographic drawing the front and right sides will have the same height.

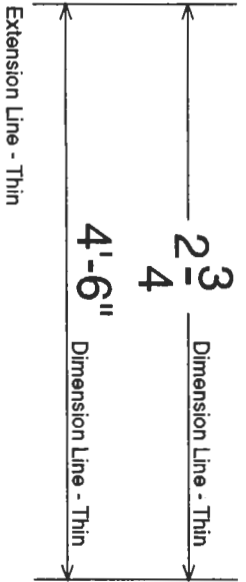
ANSWER KEY
QUIZ
DRAFTING: AN INTRODUCTION

1. false
2. false
3. true
4. false
5. false
6. true
7. true
8. true
9. false
10. true

Visible Line - Thick _____

Hidden Line - Thin - - - - -

Center Line - Thin _____



The Alphabet of Lines

NAME:

DATE:

PERIOD:

1

LETTERING

Using an F or HB pencil with a slightly rounded point, construct each letter in the spaces provided. Observe the form and proportion of each letter to assist you in improving your lettering in future assignments.

A				B				C			
D				E				F			
G				H				I			
J				K				L			
M				N				O			
P				Q				R			
S				T				U			
V				W				X			
Y				Z				&			
1				2				3			
4				5				6			
7				8				9			
0				$\frac{1}{2}$				$\frac{1}{4}$			

NAME:

DATE:

PERIOD:

2

Answer

Answer

1. _____

13. _____

2. _____

14. _____

3. _____

15. _____

4. _____

16. _____

5. _____

17. _____

6. _____

18. _____

7. _____

19. _____

8. _____

20. _____

9. _____

21. _____

10. _____

22. _____

11. _____

23. _____

12. _____

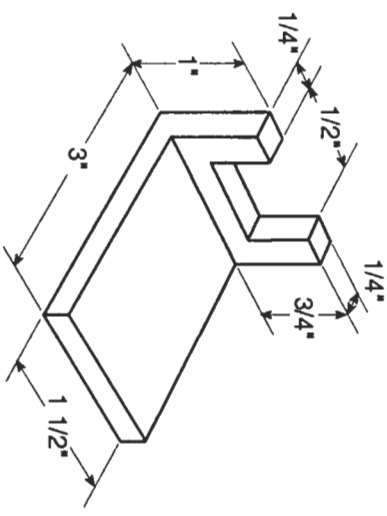
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NAME:

DATE:

PERIOD:

3



TOP VIEW

FRONT VIEW

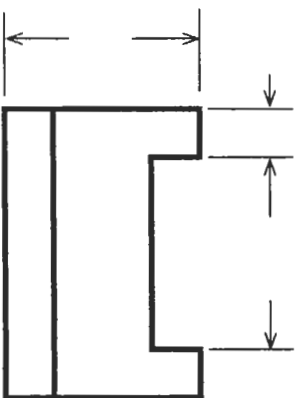
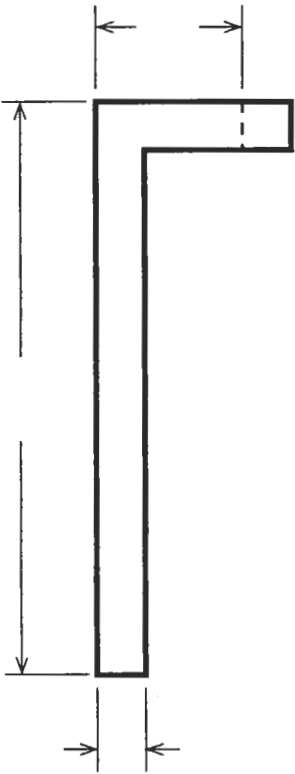
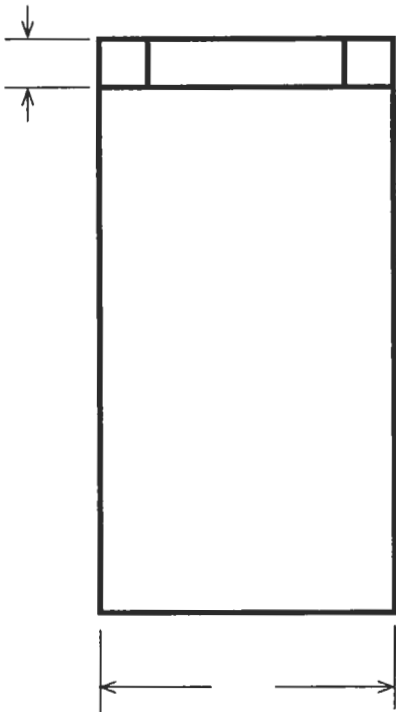
RIGHT SIDE VIEW

NAME:

DATE:

PERIOD:

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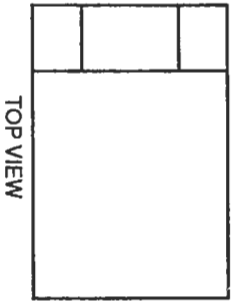


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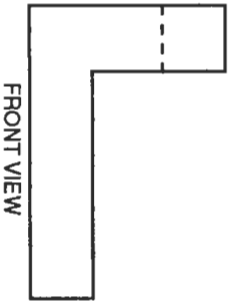
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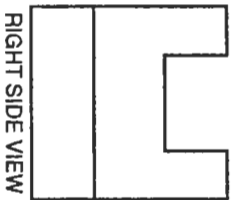
5



TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

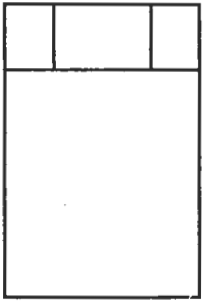
ISOMETRIC PICTORIAL

NAME:

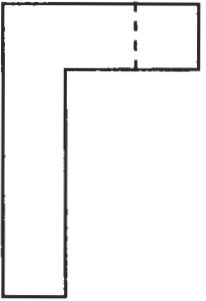
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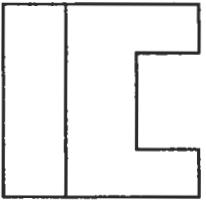
6



TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

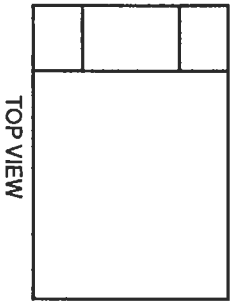
OBLIQUE

NAME:

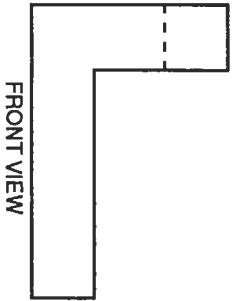
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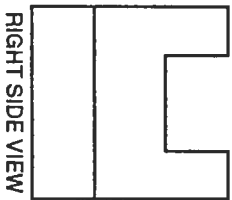
7



TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

PERSPECTIVE

NAME:

DATE:

PERIOD:

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