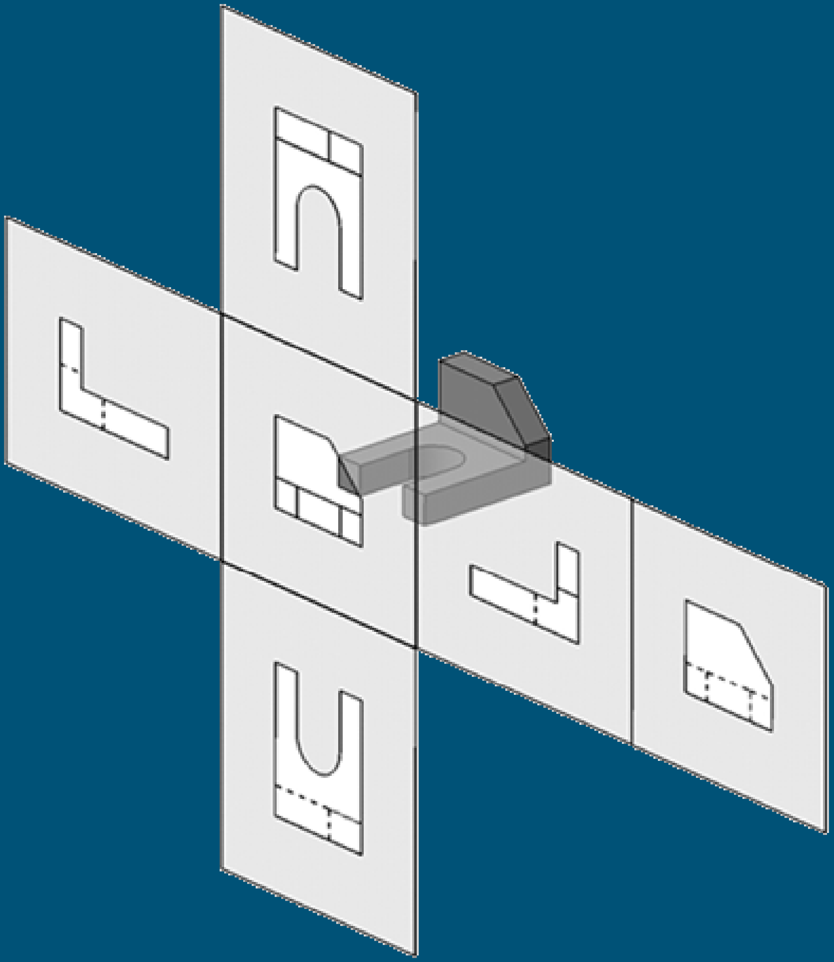
ENGINEERING GRAPHICS ESSENTIALS

Text and Video Instruction

Third Edition



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DIMENSIONING

In Chapter 2 you will learn how to dimension an orthographic projection using proper dimensioning techniques. This may seem like a simple task; however, dimensioning a part is not as easy as inserting the sizes used to draw the part. Dimensions affect how a part is manufactured. A small change in how an object is dimensioned may produce a part that will not pass inspection. The type and placement of the dimensions and the dimension text is highly controlled by ASME standards (American Society of Mechanical Engineers). By the end of this chapter, you will be able to dimension a moderately complex part using proper dimensioning techniques. CAUTION! Dimensioning complex/production parts require the knowledge of GD&T (Geometric Dimensioning & Tolerancing).

2.1) DETAILED DRAWINGS

In addition to the shape description of an object given by an orthographic projection, engineering drawings must also give a complete size description using dimensions. This enables the object to be manufactured. **An orthographic projection, complete with all the dimensions and specifications needed to manufacture the object is called a *detailed drawing*.** Figure 2-1 shows an example of a detailed drawing.

Dimensioning a part correctly entails conformance to many rules. It is very tempting to dimension an object using the measurements needed to draw the part. But, these are not necessarily the dimensions required to manufacture it. Generally accepted dimensioning standards should be used when dimensioning any object. Basically, the dimensions should be given in a clear and concise manner and should include all the information needed to produce and inspect the part exactly as intended by the designer. There should be no need to measure the size of a feature directly from the drawing.

The dimensioning standards presented in this chapter are in accordance with the ASME Y14.5M-1994 standard. Other common sense practices will also be presented.

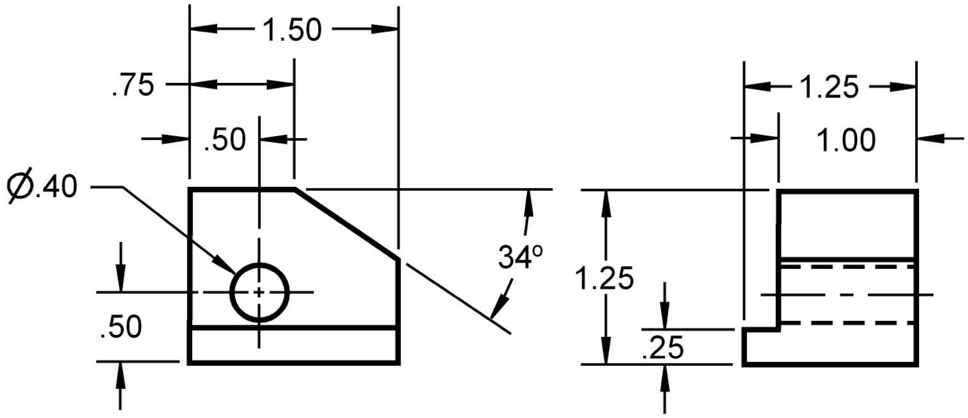


Figure 2-1: Detailed drawing

2.2) LEARNING TO DIMENSION

Proper dimensioning techniques require the knowledge of the following three areas.

1) Dimension Appearance and Techniques: Dimensions use special lines, arrows, symbols and text. In Section 2.3 (Dimension Appearance and Techniques) we will learn:

    a) The lines used in dimensioning.
    b) Types of dimensions.
    c) Dimension symbols.
    d) Dimension spacing and readability.
    e) Dimension placement.

2) Dimensioning and Locating Features: Different types of features require unique methods of dimensioning.

3) Dimension Choice: Your choice of dimensions will directly influence the method used to manufacture a part. Learning the following topics will guide you when choosing your dimension units, decimal places and the dimension's starting point:

    a) Units and decimal places.
    b) Locating features using datums.
    c) Dimension accuracy and error build up.

2.3) DIMENSION APPEARANCE AND TECHNIQUES

2.3.1) Lines Used in Dimensioning

Dimensioning requires the use of *dimension*, *extension* and *leader lines*. **All lines used in dimensioning are drawn thin so that they will not be confused with visible lines.** Thin lines should be drawn at approximately 0.3 mm or 0.016 inch.

- Dimension line: A dimension line is a thin solid line terminated by arrowheads, which indicates the direction and extent of a dimension. A number is placed near the mid point to specify the feature's size. Ideally, dimension lines should be broken to allow for the insertion of the feature's size.

- Extension line: An extension line is a thin solid line that extends from a point on the drawing to which the dimension refers. The dimension line meets the extension lines at right angles, except in special cases. **There should be a visible gap between the extension line and the object**. Long extension lines should be avoided.

Figure 2-2 illustrates the different features of a dimension.

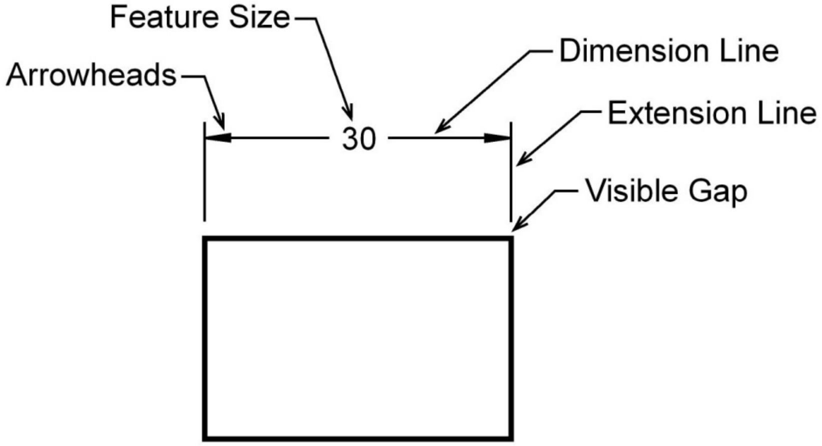


Figure 2-2: Features of a dimension.

- Leader line: A leader line is a straight inclined thin solid line that is usually terminated by an arrowhead. It is used to direct a dimension, note, symbol, item number, or part number to the intended feature on a drawing. The leader is not vertical or horizontal, except for a short horizontal portion extending to the first or last letter of the note. The horizontal part should not underline the note and may be omitted entirely.

The leader may be terminated:

a) with an arrow, if it ends on the outline of an object.
b) with a dot (∅1.5 mm, minimum), if it ends within the outline of an object.
c) without an arrowhead or dot, if it ends within the outline of an object.

When creating leader lines, the following should be avoided:

a) Crossing leaders.
b) Long leaders.
c) Leaders that are parallel to adjacent dimension, extension or section lines.
d) Small angles between the leader and the terminating surface.

Figure 2-3 illustrates different leader line configurations.

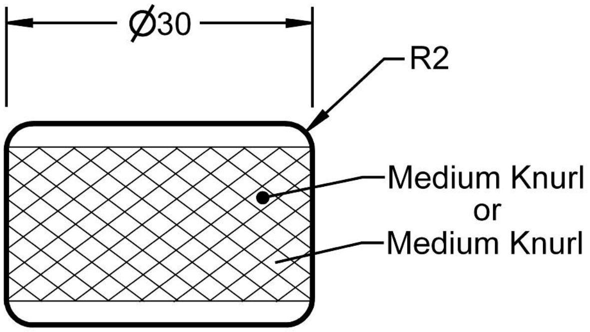


Figure 2-3: Leader line configurations.

- Arrowheads: The length and width ratio of an arrowhead should be 3 to 1 and the width should be proportional to the line thickness. A single style of arrowhead should be used throughout the drawing. Arrowheads are drawn between the extension lines if possible. If space is limited, they may be drawn on the outside. Figure 2-4 shows the most common arrowhead configurations.

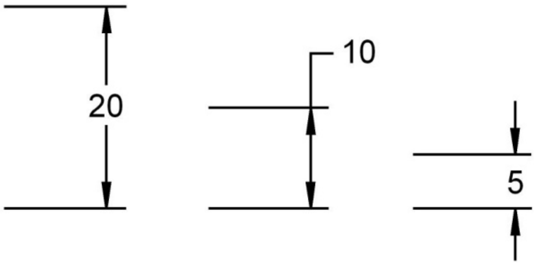


Figure 2-4: Arrowhead and feature size placement.

2.3.2) Types of Dimensions

Dimensions are given in the form of *linear distances*, *angles*, and *notes*.

- Linear distances: A linear dimension is used to give the distance between two points. They are usually arranged horizontally or vertically, but may also be aligned with a particular feature of the part.
- Angles: An angular dimension is used to give the angle between two surfaces or features of a part.
- Notes: Notes are used to dimension diameters, radii, chamfers, threads, and other features that can not be dimensioned by the other two methods.

Instructor Led Exercise 2-1: Dimension types

In Figure 2-1, count the different types of dimensions.

- How many linear horizontal dimensions are there?
- How many linear vertical dimensions are there?
- How many angular dimensions are there?
- How many leader line notes are there?

2.3.3) Lettering

Lettering should be legible, easy to read, and uniform throughout the drawing. **Upper case** letters should be used for all lettering unless a lower case is required. **The minimum lettering height is 0.12 in (3 mm).**

2.3.4) Dimensioning Symbols

Dimensioning symbols replace text and are used to minimize language barriers. Many companies produce parts all over the world. A print made in the U.S.A. may have to be read in several different countries. The goal of using dimensioning symbols it to eliminate the need for language translation. Table 2-1 shows some commonly used dimensioning symbols. These symbols will be used and explained throughout the chapter.

Term	Symbol
Diameter	∅
Spherical diameter	S∅
Radius	R
Spherical radius	SR
Reference dimension	(8)
Counterbore / Spotface	⌴
Countersink	⌵
Number of places	4X

Term	Symbol
Depth / Deep	↧
Dimension not to scale	$\underline{10}$
Square (Shape)	□
Arc length	$\overset{\frown}{5}$
Conical Taper	⌲
Slope	⌳
Symmetry	⌯

Table 2-1: Dimensioning symbols.

2.3.5) Dimension Spacing and Readability

Dimensions should be easy to read and minimize the possibility for conflicting interpretations. Dimensions should be given clearly and in an organized fashion. They should not be crowded or hard to read. The following is a list of rules that control dimension spacing and readability:

a) The spacing between dimension lines should be uniform throughout the drawing. The space between the first dimension line and the part should be at least 10 mm; the space between subsequent dimension should be at least 6 mm. However, the above spacing is only intended as a guide.

b) Do not dimension inside an object or have the dimension line touch the object unless clearness is gained.

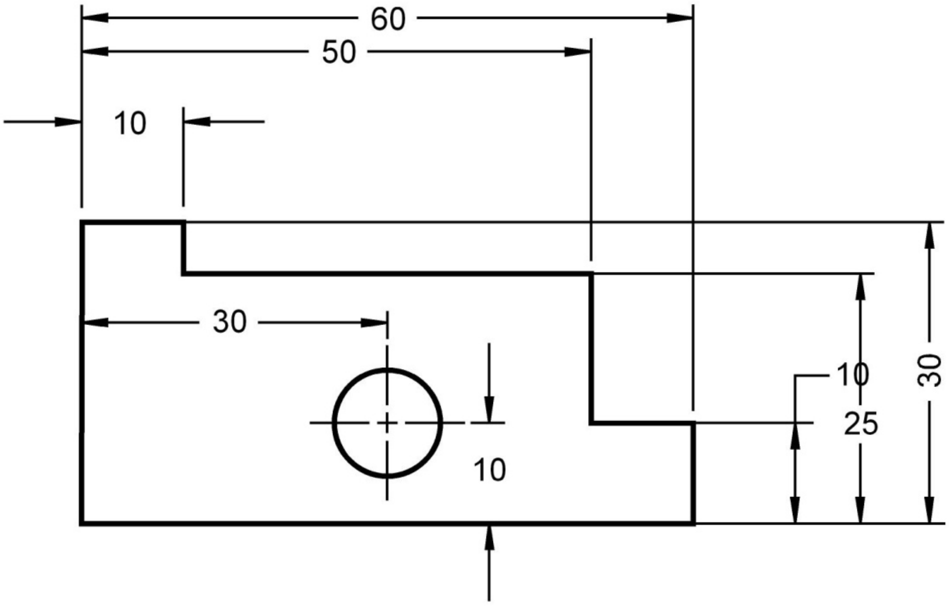
c) Dimension text should be horizontal which means that it is read from the bottom of the drawing.

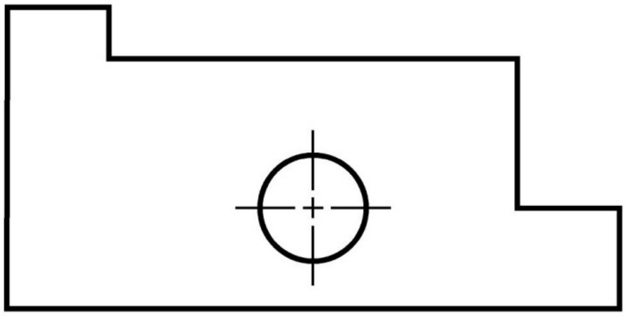
d) Dimension text should not cross dimension, extension or visible lines.

Instructor Led Exercise 2-2: Spacing and readability 1

Consider the incorrectly dimensioned object shown. There are 5 types of dimensioning mistakes. List them and then dimension the object correctly.

1)
2)
3)
4)
5)





e) Dimension lines should not cross extension lines or other dimension lines. To avoid this, shorter dimensions should be placed before longer ones. Extension lines can cross other extension lines or visible lines. However, this should be minimized. Where extension lines cross other lines, the extension lines are not broken. If an extension line crosses an arrowhead or is near an arrowhead, a break in the extension line is permitted.

f) Extension lines and centerlines should not connect between views.

g) Leader lines should be straight, not curved, and point to the center of the arc or circle at an angle between 30^{o}-60^{o}. The leaders should *float* or, in other words, lead from the arrow up to the text.

Try Exercise 2-3.

h) Dimensions should not be duplicated or the same information given in two different ways. The use of reference (duplicated) dimensions should be minimized. Duplicate dimensions may cause needless trouble. If a change is made to one dimension, the reference dimension may be overlooked causing confusion. If a reference dimension is used, the size value is placed within parentheses (e.g. (10)).

Try Exercise 2-4.

2.3.6) Dimension Placement

Dimensions should be placed in such a way as to enhance the communication of your design. The following are rules that govern the logical and practical arrangement of dimensions to insure maximum legibility:

a) Dimensions should be grouped whenever possible.

b) Dimensions should be placed between views, unless clearness is promoted by placing some outside.

c) Dimensions should be attached to the view where the shape is shown best.

d) Do not dimension hidden lines.

Try Exercise 2-5.

Instructor Led Exercise 2-3: Spacing and readability 2

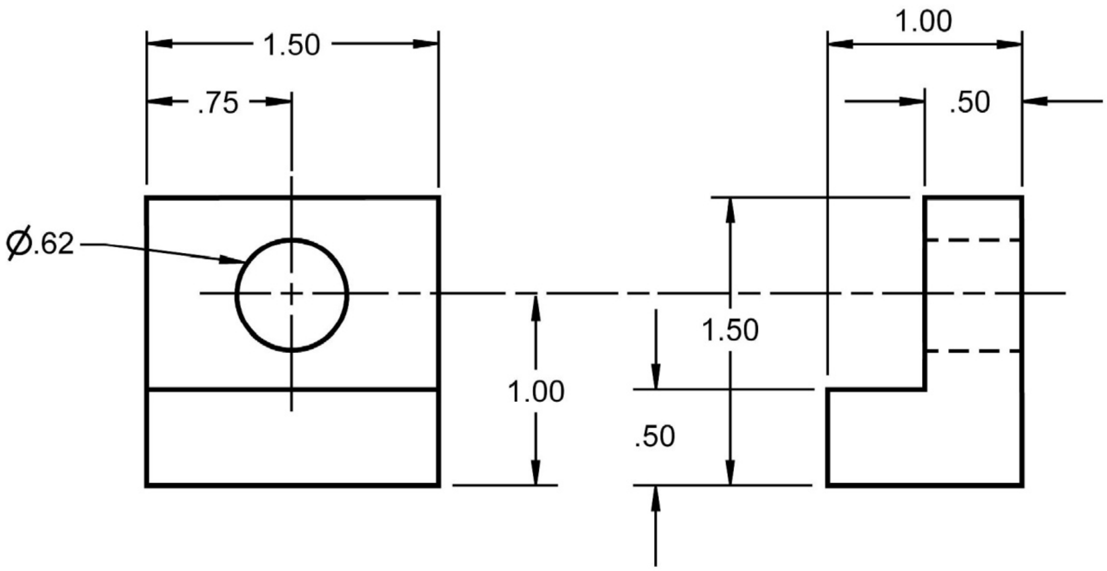
Consider the incorrectly dimensioned object shown. There are 4 types of dimensioning mistakes. List them and then dimension the object correctly.

1)

2)

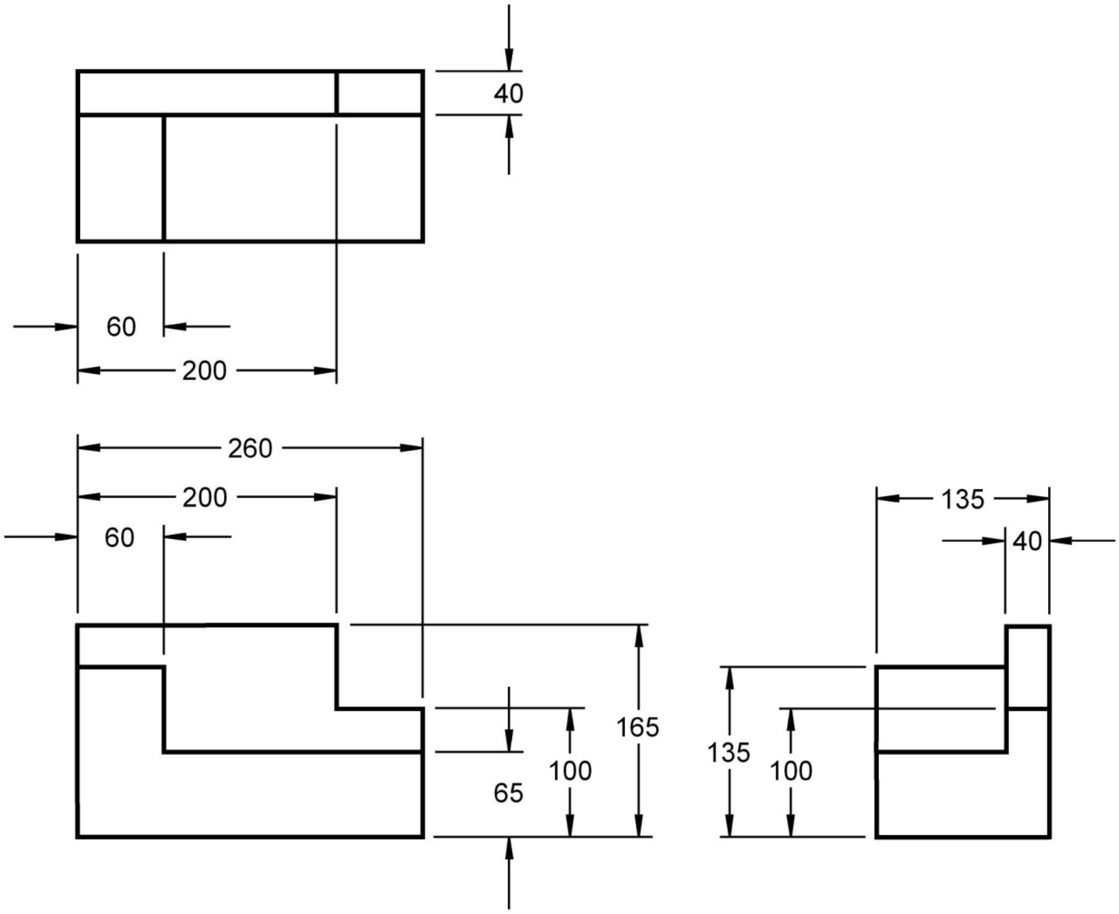
3)

4)



Instructor Led Exercise 2-4: Duplicate dimensions

Find the duplicate dimensions and cross out the ones that you feel should be omitted.



Instructor Led Exercise 2-5: Dimension placement

Consider the incorrectly dimensioned object shown. There are 6 types of dimensioning mistakes. List them and then dimension the object correctly.

1)

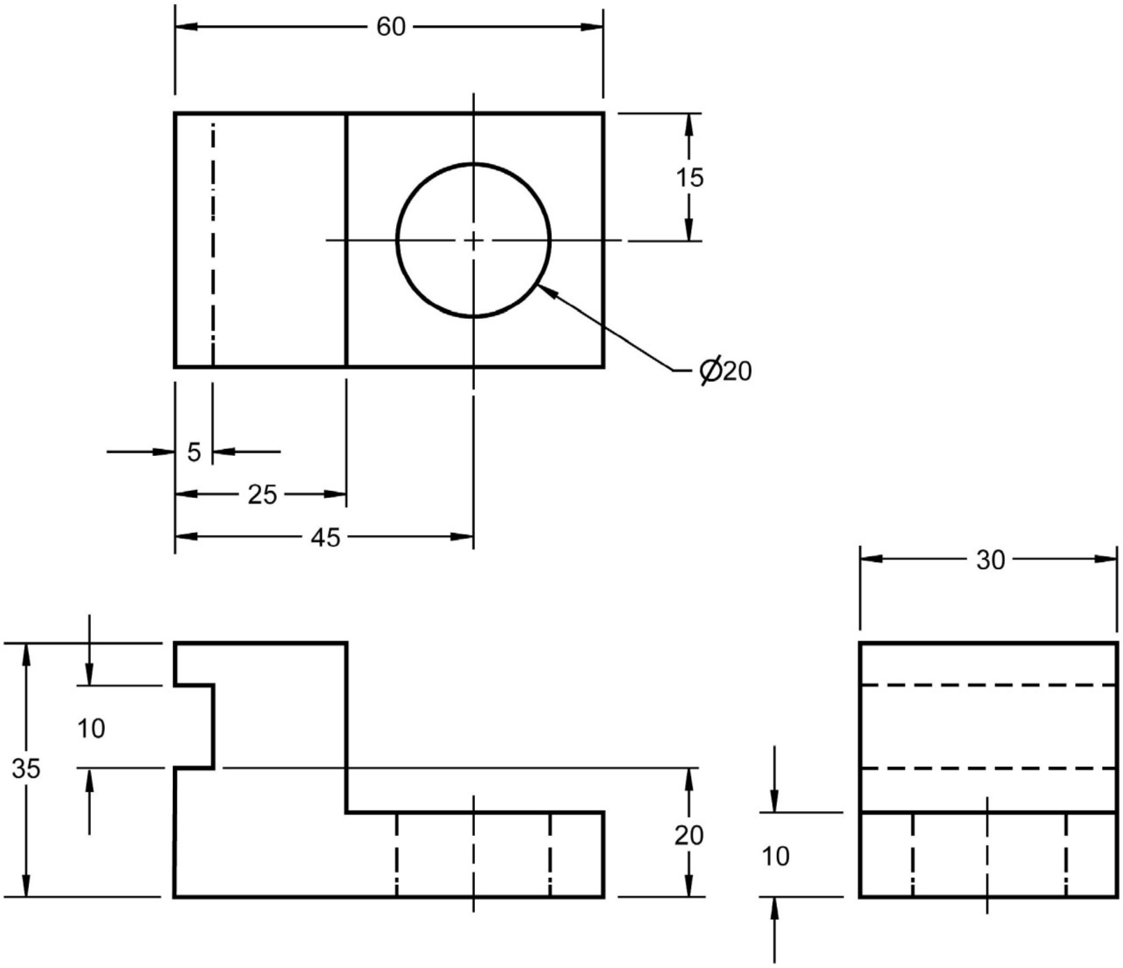
2)

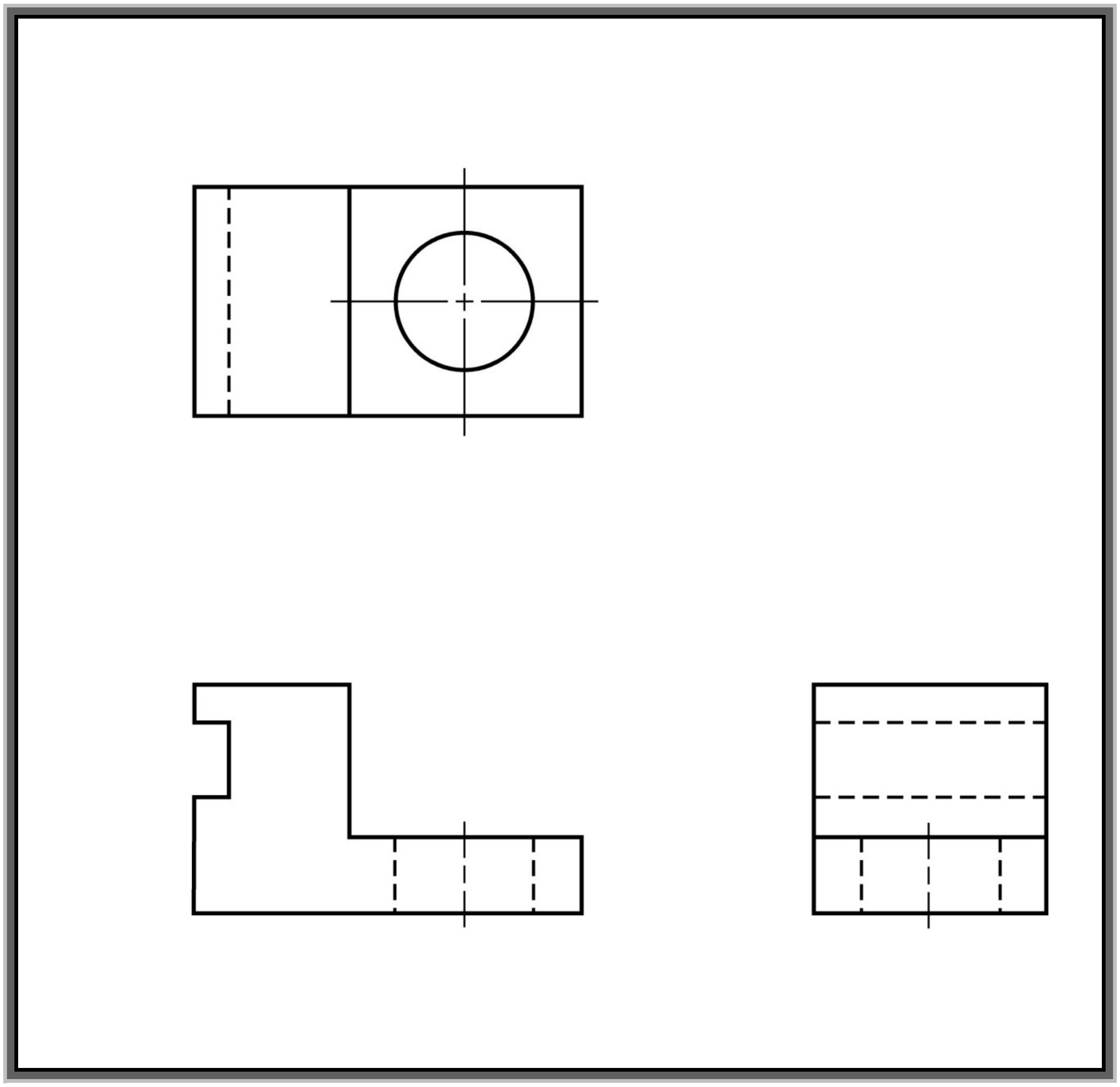
3)

4)

5)

6)





2.4) DIMENSIONING AND LOCATING SIMPLE FEATURES

The following section illustrates the standard ways of dimensioning different basics features that occur often on a part.

a) A circle is dimensioned by its diameter and an arc by its radius using a leader line and a note. A diameter dimension is preceded by the symbol "∅", and a radial dimension is preceded by the symbol "R". On older drawings you may see the abbreviation "DIA" placed after a diameter dimension and the abbreviation "R" following a radial dimension. Figure 2-5 illustrates the diameter and radius dimensions.

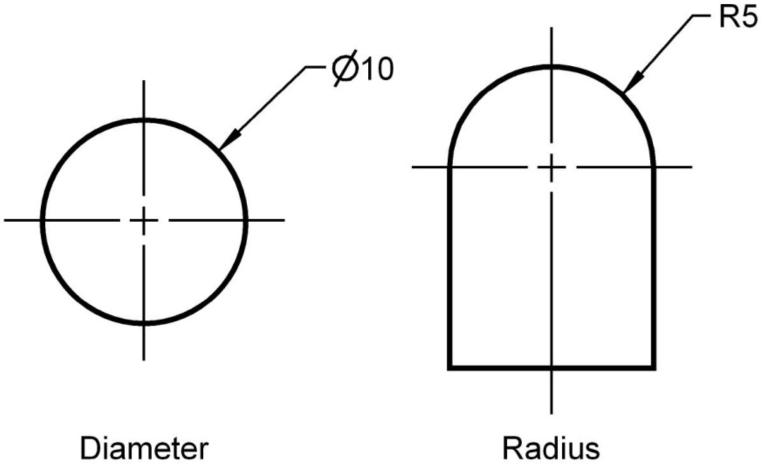


Figure 2-5: Diameter and radius dimensions

Try Exercise 2-6

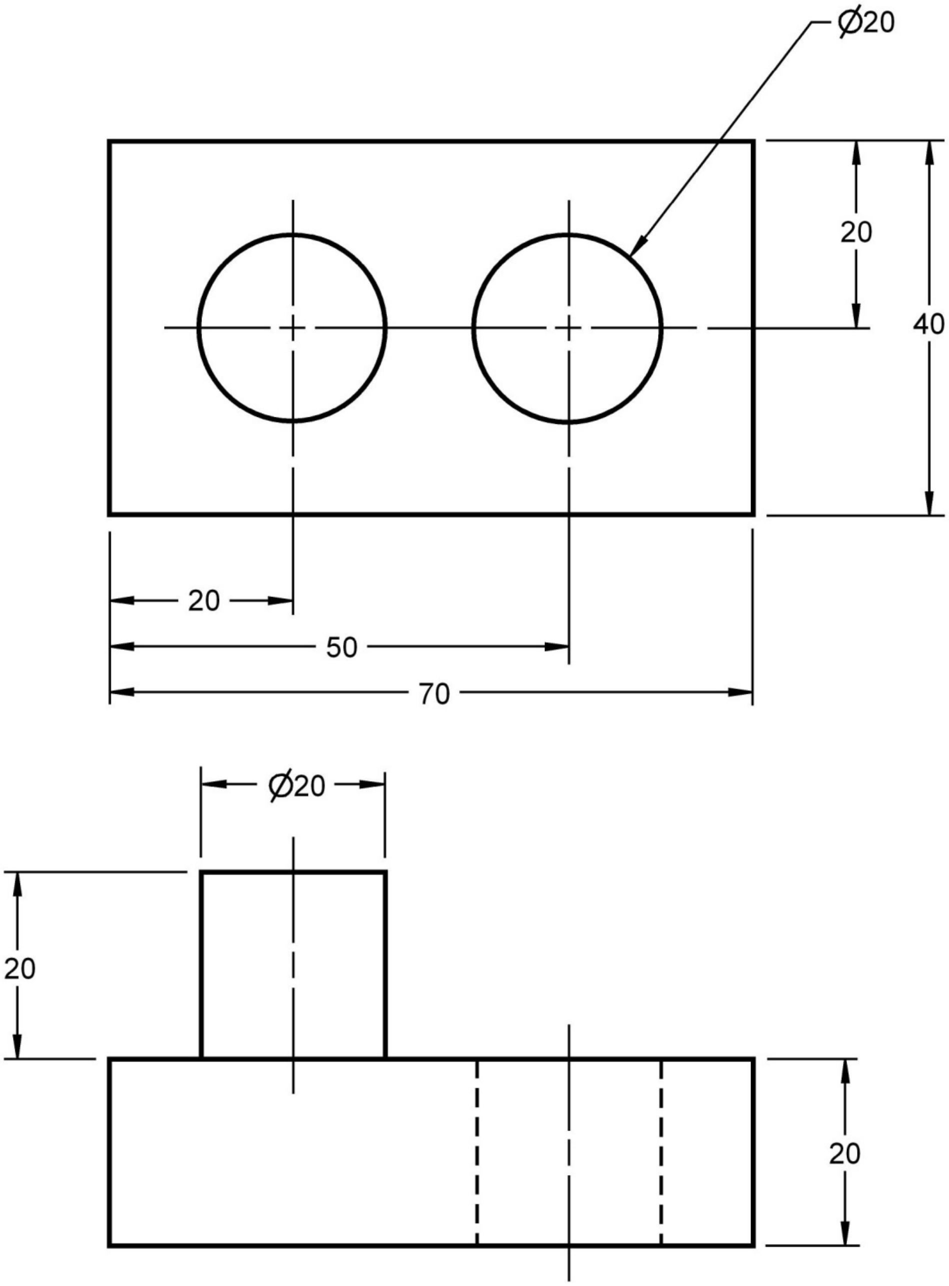
b) Holes are dimensioned by giving their diameter and location in the circular view (see Exercise 2-6).

c) A cylinder is dimensioned by giving its diameter and length in the rectangular view, and is located in the circular view. By giving the diameter of a cylinder in the rectangular view, it is less likely to be confused with a hole (see Exercise 2-6).

Instructor Led Exercise 2-6: Circular and rectangular views

Below is shown the front and top view of a part. Consider the hole and cylinder features of the part when answering the following questions.

- Which view is considered the circular view and which is considered the rectangular view?
- Looking at just the top view, can you tell the difference between the hole and the cylinder?



d) The depth of a blind hole may be specified in a note and is the depth of the full diameter from the surface of the object. Figure 2-6 illustrates how to dimension a blind hole (i.e. a hole that does not pass completely through the object).

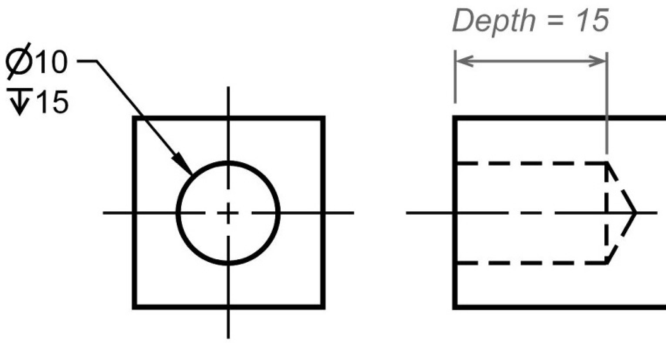


Figure 2-6: Dimensioning a blind hole.

e) If a hole goes completely through the feature and it is not clearly shown on the drawing, the abbreviation “THRU” follows the dimension.

f) If a dimension is given to the center of a radius, a small cross is drawn at the center. Where the center location of the radius is unimportant, the drawing must clearly show that the arc location is controlled by other dimensioned features such as tangent surfaces. Figure 2-7 shows several different types of radius dimensions.

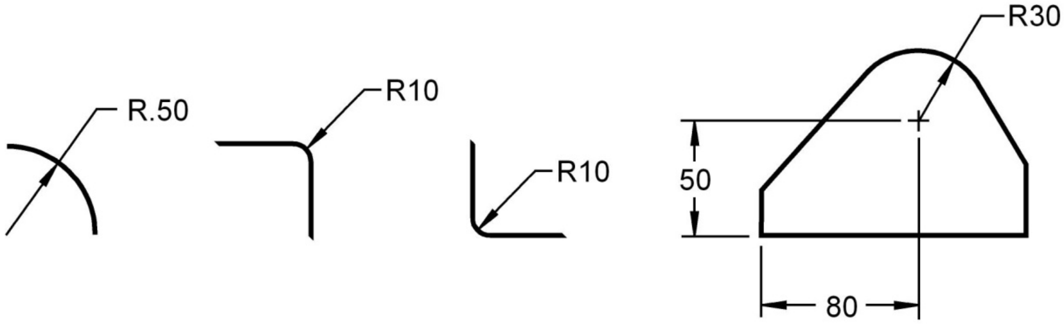


Figure 2-7: Dimensioning radial features.

g) A complete sphere is dimensioned by its diameter and an incomplete sphere by its radius. A spherical diameter is indicated by using the symbol "S∅" and a spherical radius by the symbol "SR". Figure 2-8 illustrates the spherical diameter and spherical radius dimensions.

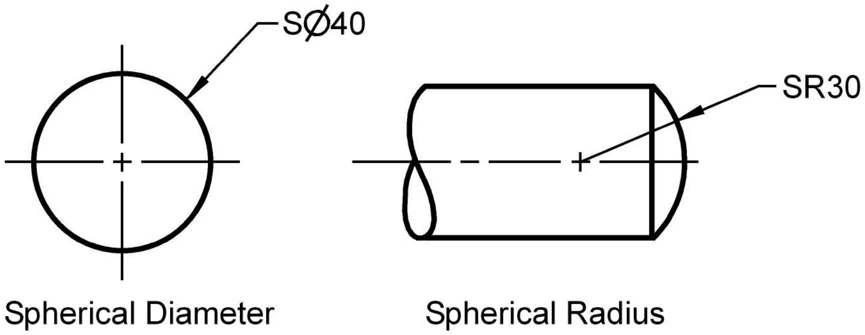


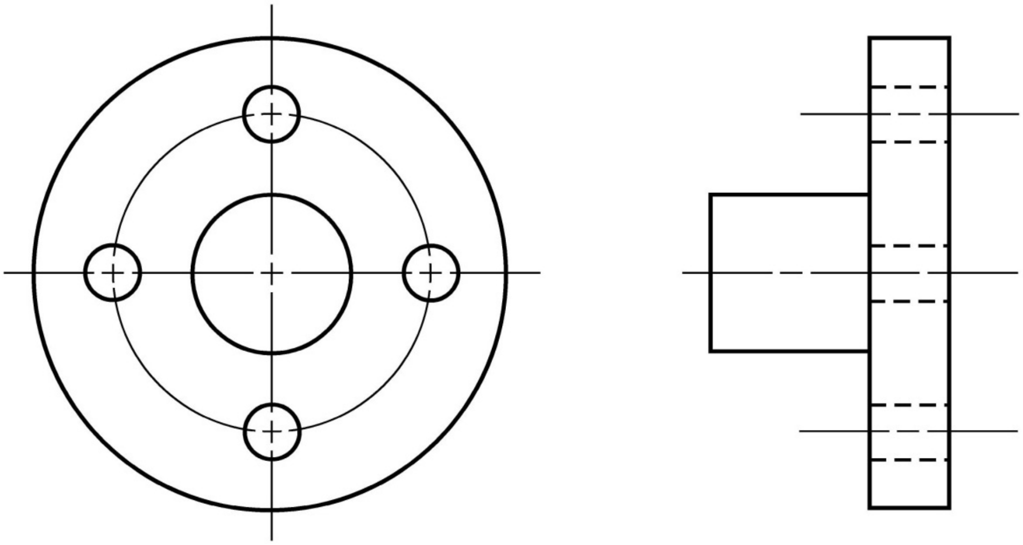
Figure 2-8: Dimensioning spherical features.

h) Repetitive features or dimensions may be specified by using the symbol "X" along with the number of times the feature is repeated. There is no space between the number of times the feature is repeated and the "X" symbol, however, there is a space between the symbol "X" and the dimension (i.e. 8X ∅10).

Try Exercise 2-7

Instructor Led Exercise 2-7: Dimensioning and locating features

Dimension the following object.



2.5) DIMENSIONING AND LOCATING ADVANCED FEATURES

The following section will illustrate the standard ways of dimensioning different features that occur often on a part.

a) If the center of a radius is outside the drawing or interferes with another view, the dimension lines may be foreshortened. In this case, a false center and jogged dimensions are used to give the size and location from the false center as shown in Figure 2-9. The false center is indicated by a small cross.

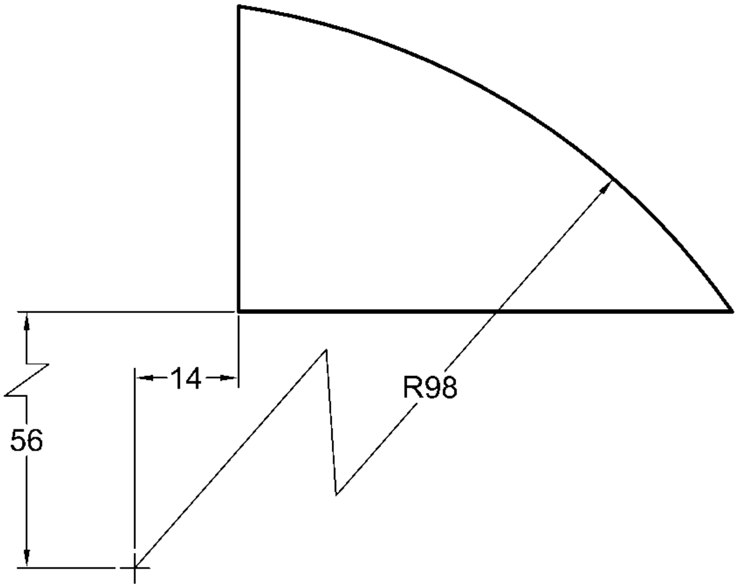
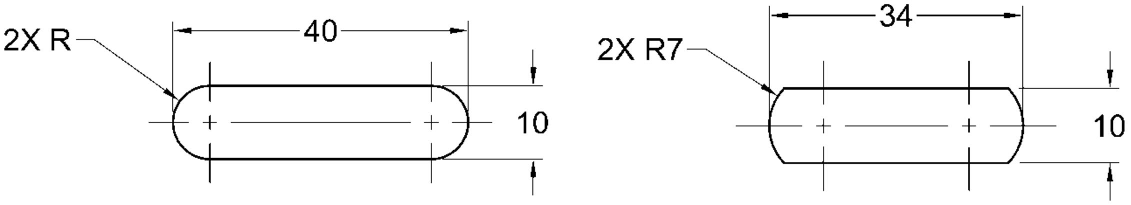


Figure 2-9: Jogged radius

b) Solid parts that have rounded ends are dimensioned by giving their overall dimensions (see Figure 2-10). If the ends are partially rounded, the radii are also given. For fully rounded ends, the radii are indicated but the value is not given.



Fully rounded ends

Partially rounded ends

Figure 2-10: Rounded ends

c) Slots are dimensioned by giving their overall dimensions or by giving the overall width and the distance between centers as shown in Figure 2-11. The radii are indicated but the value is not given.

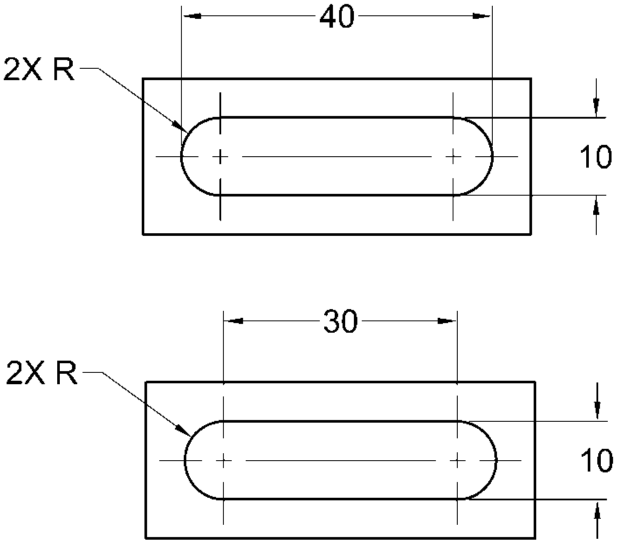


Figure 2-11: Slots

d) The length of an arc is dimensioned using the arc length symbol as shown in Figure 2-12.

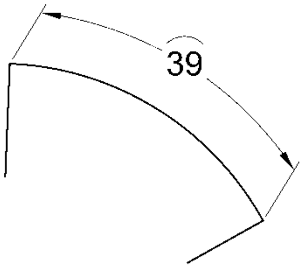


Figure 2-12: Arc length

e) Equally spaced features are specified by giving the number of spaces followed by the repeated feature symbol “X”, a space, and then the dimension value of the space as shown in Figure 2-13. One space may be dimensioned and given as a reference value.

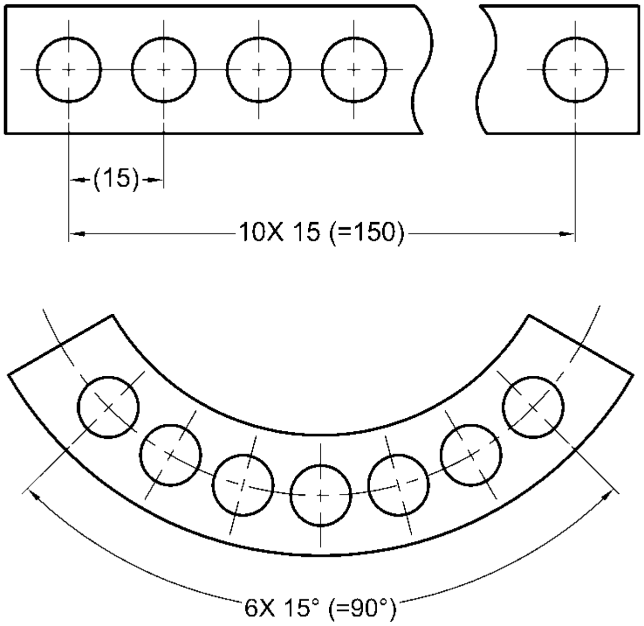


Figure 2-13: Equally spaced features

f) If a part is symmetric, it is only necessary to dimension to one side of the center line of symmetry. The center line of symmetry is indicated by using the symbol “⌯”. On older drawings you might see the symbol “℄” used instead. Figure 2-14 illustrates the use of the symmetry symbol.

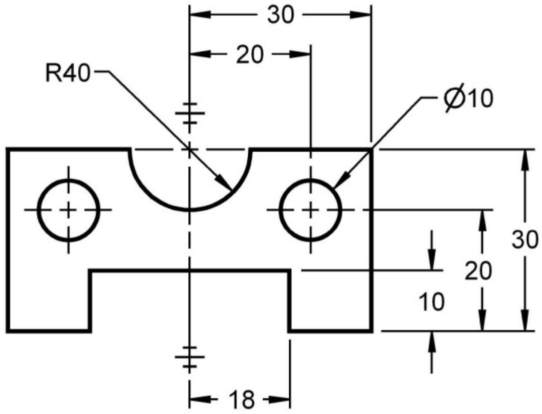


Figure 2-14: Center line of symmetry.

g) Counterbored holes are specified by giving the diameter (∅) of the drill (and depth if appropriate), the diameter (∅) of the counterbore (⌴), and the depth (↧) of the counterbore in a note as shown in Figure 2-15. If the thickness of the material below the counterbore is significant, this thickness rather than the counterbore depth is given.

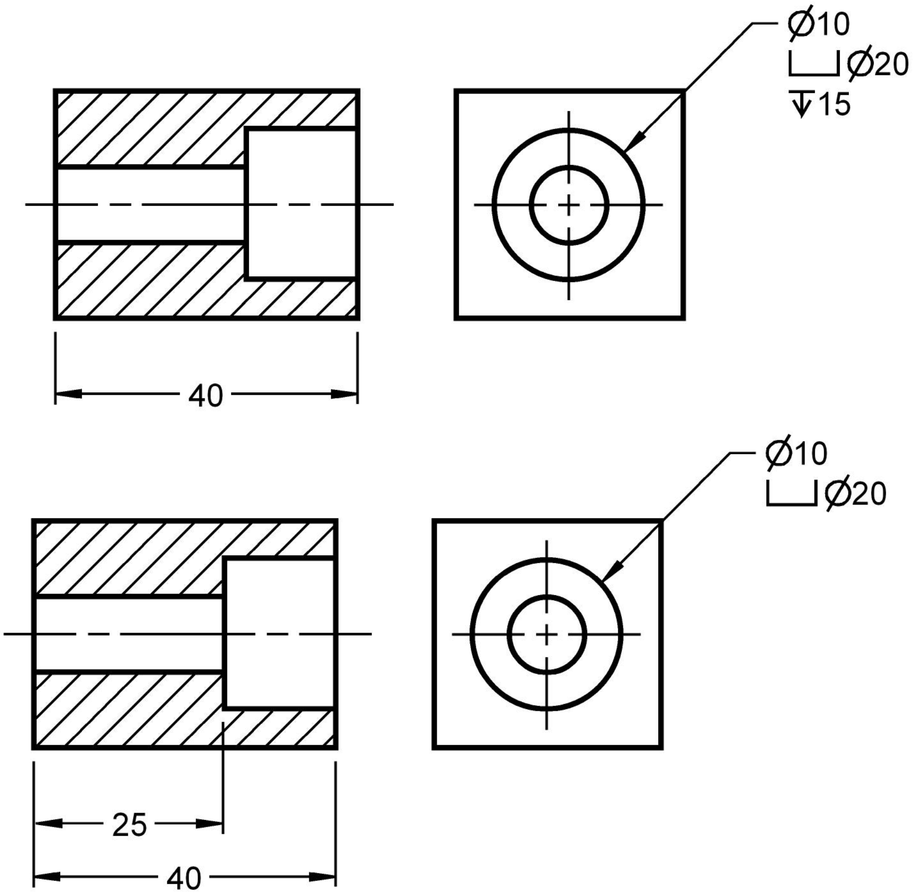


Figure 2-15: Counterbored holes.

Application Question 2-1

What is the purpose of a counterbored hole?

h) Spotfaced holes are similar to counterbored holes. The difference is that the machining operation occurs on a curved surface. Therefore, the depth of the counterbore drill can not be given in the note. It must be specified in the rectangular view as shown in Figure 2-16.

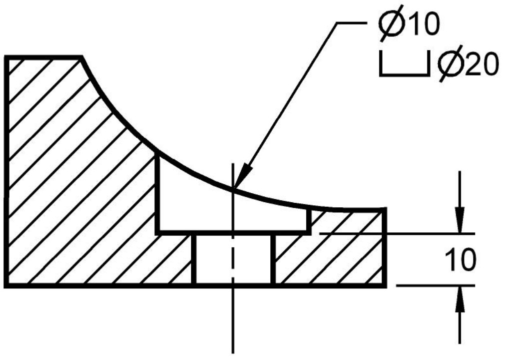


Figure 2-16: Spotfaced holes.

i) Countersunk holes are specified by giving the diameter (∅) of the drill (and depth if appropriate), the diameter (∅) of the countersink (⌵), and the angle of the countersink in a note as shown in Figure 2-17.

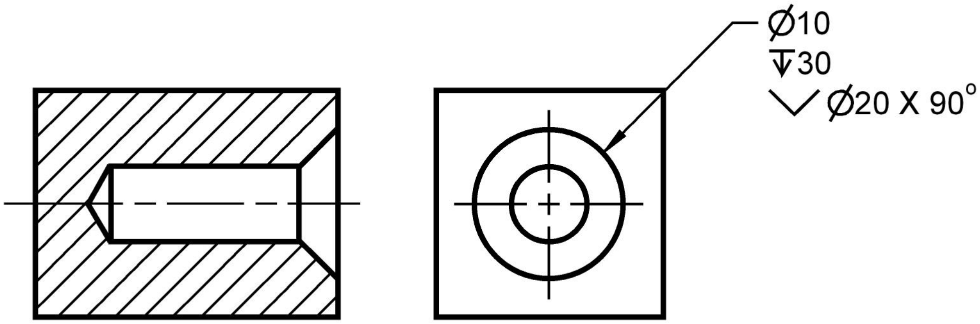


Figure 2-17: Countersunk holes.

Application Question 2-2

What is the purpose of a countersunk hole?

j) Chamfers are dimensioned by a linear dimension and an angle, or by two linear dimensions. A note may be used to specify 45 degree chamfers because the linear value applies in either direction (see Figure 2-18). Notice that there is a space between the 'X' symbol and the linear dimension. The space is inserted so that it is not confused with a repeated feature.

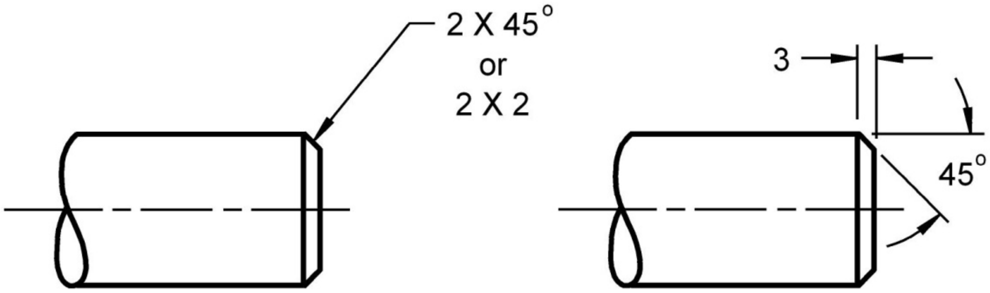


Figure 2-18: Chamfers.

Application Question 2-3

What is the purpose of a chamfer?

2.5.1) Drawing Notes

Drawing notes give additional information that is used to complement conventional dimension. Drawing notes provide information that clarify the manufacturing requirements for the part. They cover information such as treatments and finishes among other manufacturing processes. A note may also be used to give blanket dimensions, such as the size of all rounds and fillets on a casting or a blanket tolerance. Notes may apply to the entire drawing or to a specific area. A general note applies to the entire drawing. A local note is positioned near and points to the specified area to which it applies. The note area is identified with the heading "NOTE:".

Instructor Led Exercise 2-8: Advanced features

Consider the incorrectly dimensioned object shown. There are 7 types of dimensioning mistakes. List them and then dimension the object correctly.

1)

2)

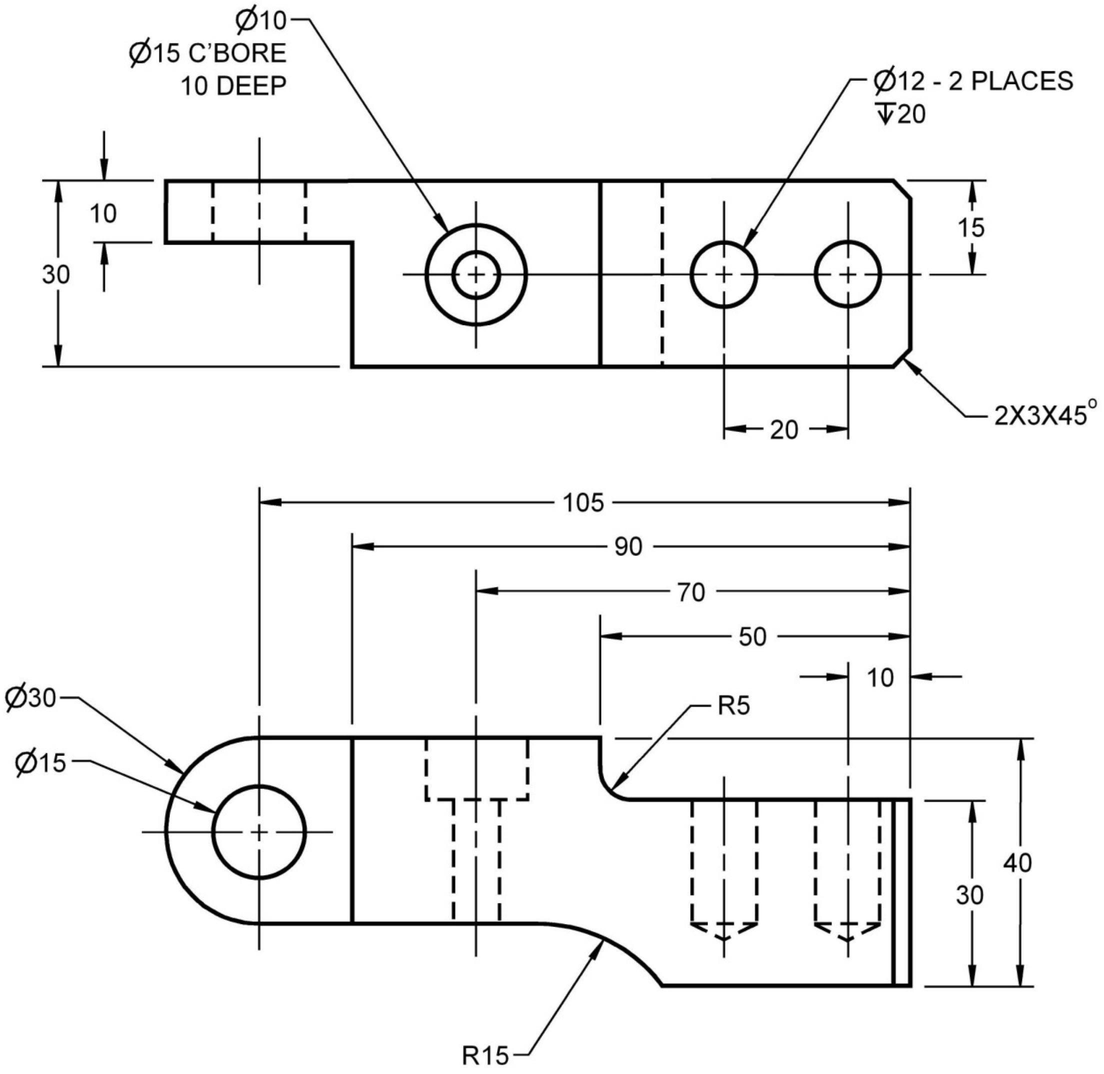
3)

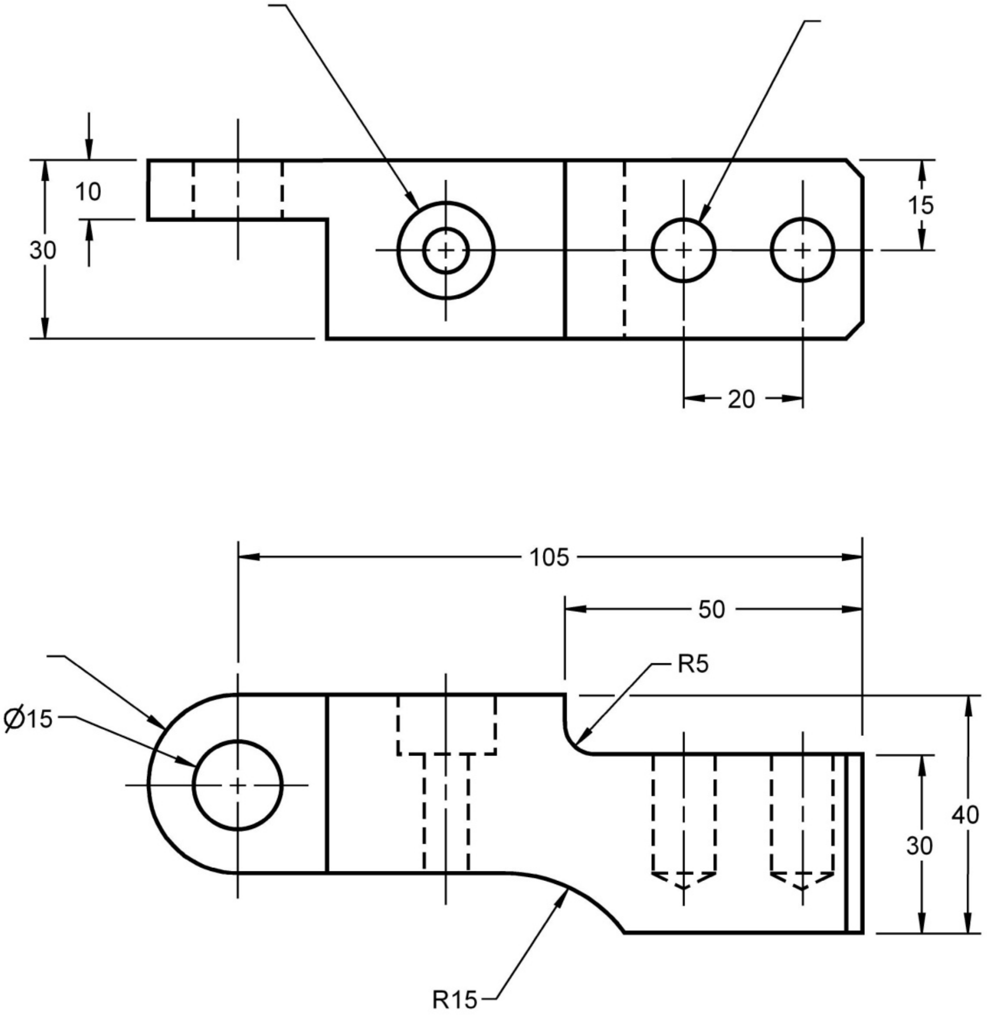
4)

5)

6)

7)




10
30
15
20
105
50
R5
Ø15
40
30
R15

2.6) DIMENSION CHOICE

Dimension placement and dimension text influences the manufacturing process used to make the part. However, your **choice of dimensions should depend on the function and the mating relationship of the part**, and then on manufacturing. Even though dimensions influence how the part is made, the manufacturing process should not be specifically stated on the drawing.

2.6.1) Units and Decimal Places

a) Decimal dimensions should be used for all machining dimensions. Sometimes you may encounter a drawing that specifies standard drills, broaches, and the like by size. For drill sizes that are given by number or letter, a decimal size should also be given.

b) On drawing where all the dimensions are given either in millimeters or inches, individual identification of the units is not necessary. However, the drawing should contain a note stating UNLESS OTHERWISE SPECIFIED, ALL DIMENSION ARE IN MILLIMETERS (or INCHES). If some inch dimensions are used on a millimeter drawing or visa versa, the abbreviations **IN** or **mm** shall follow the dimension value.

c) Metric dimensions are given in ‘mm’ and to 0 or 1 decimal place (e.g. 10, 10.2). When the dimension is less than a millimeter, a zero should proceed the decimal point (e.g. 0.5).

d) English dimensions are given in ‘inches’ and to 2 decimal places (e.g. 1.25). A zero is not shown before the decimal point for values less than one inch (e.g. .75).

e) Metric 3rd angle drawings should be designated by the SI projection symbol shown in Figure 2-19.

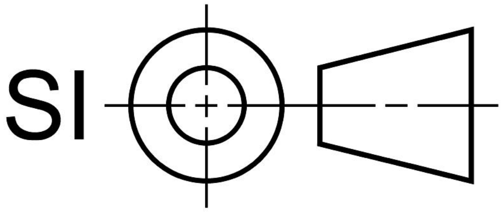


Figure 2-19: SI projection symbol.

2.6.2) Locating Features Using Datums

Consider three mutually perpendicular datum planes as shown in Figure 2-20. These planes are imaginary and theoretically exact. Now, consider a part that touches all three datum planes. The surfaces of the part that touch the datum planes are called datum features. **Most of the time, features on a part are located with respect to a datum feature.** In some cases, it is necessary to locate a feature with respect to another feature that is not the datum feature.

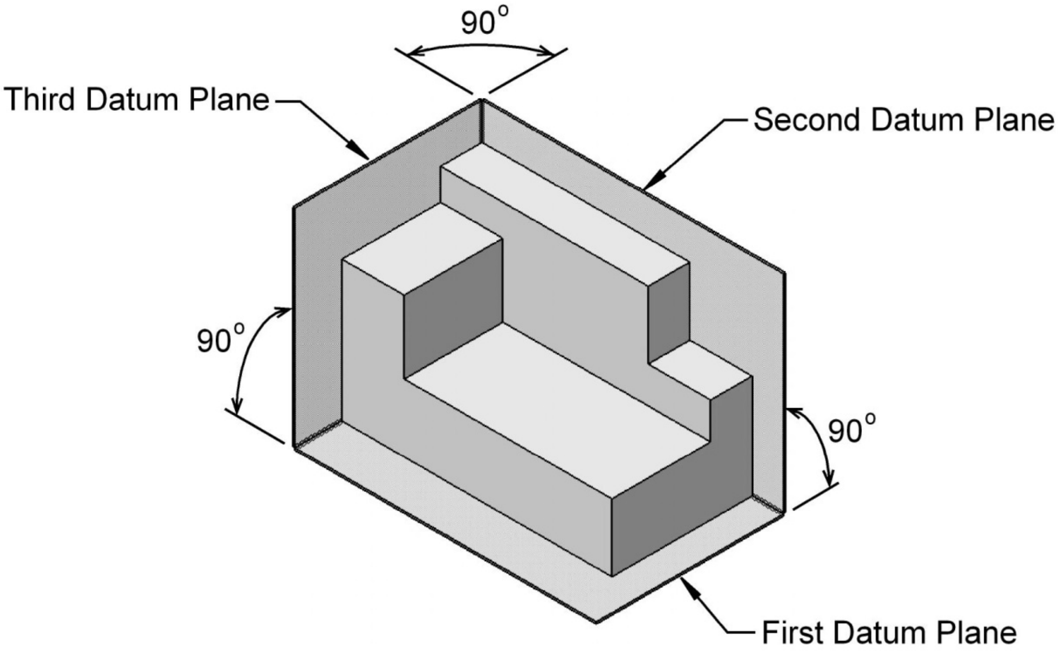


Figure 2-20: Datums and datum features.

Datum feature selection is based on the function of the part. When selecting datum features, think of the part as a component of an assembly. Functionally important surfaces and features should be selected as datum features. For example, to ensure proper assembly, mating surfaces should be used as datum features. A datum feature should be big enough to permit its use in manufacturing the part. If the function of the part is not known, take all possible measures to determine its function before dimensioning the part. In the process of learning proper dimensioning techniques, it may be necessary to make an educated guess as to the function of the part. Figure 2-21 shows a dimensioned part. Notice how all the dimensions originate from the datum features.

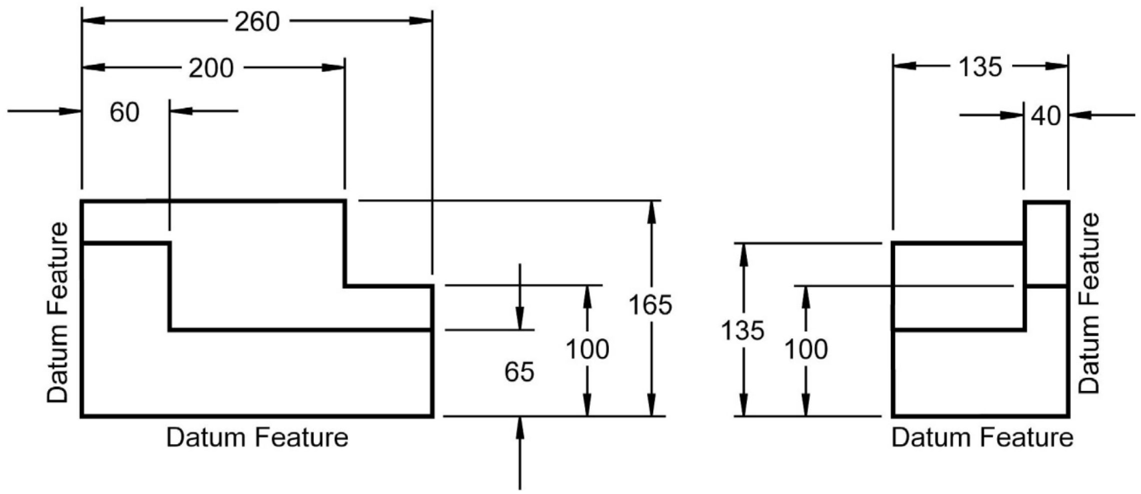


Figure 2-21: Dimensioning using datum features.

a) Datum dimensioning is preferred over continuous dimensioning (see Figure 2-22). Features should be located with respect to datum features.

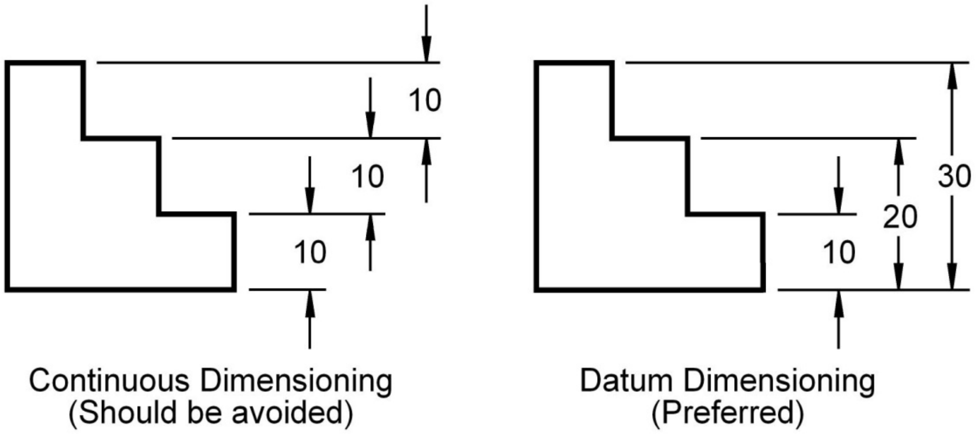


Figure 2-22: Continuous versus datum dimensioning.

b) Dimensions should be given between points or surfaces that have a functional relation to each other (slots, mating hole patterns, etc...). Figure 2-23 shows a part that has two holes that are designed to mate up with two pins on another part. Therefore, the distance between the holes is more important than the distance of the second hole from the datum feature. There would be a similar dimension on the other part specifying the distance between the pins to ensure proper mating.

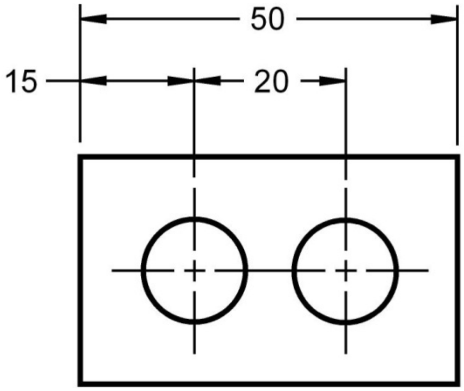


Figure 2-23: Dimensioning functionally important features.

2.6.3) Dimension Accuracy

There is no such thing as an "exact" measurement. Every dimension has an implied or stated tolerance associated with it. A tolerance is the amount a dimension is allowed to vary.

Instructor Led Exercise 2-9: Dimension accuracy

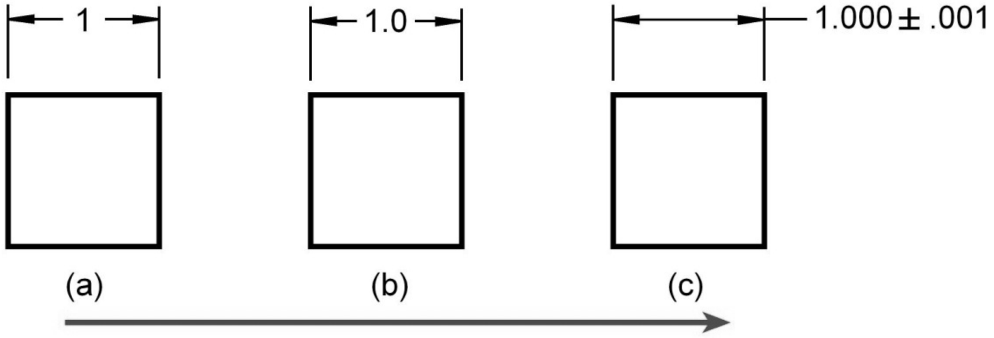
Consider the figure shown below.

- Which dimensions have implied tolerances and which have stated tolerances?
- Does the arrow indicate an increasing or decreasing accuracy?
- Write down the range in which the dimension values are allowed to vary.

  (a)

  (b)

  (c)



2.6.4) Rounding off

The more accurate the dimension the more expensive it is to manufacture. To cut costs it is necessary to round off fractional dimensions. If, for example, we are rounding off to the second decimal place and the third decimal place number is less than 5, we truncate after the second decimal place. If the number in the third decimal place is greater than 5, we round up and increase the second decimal place number by 1. If the number is exactly 5, whether or not we round up depends on if the second decimal place number is odd or even. If it is odd, we round up and if it is even, it is kept the same.

Instructor Led Exercise 2-10: Rounding off

Round off the following fractions to two decimal places according to the rules stated above.

(5/16) .3125 →

(5/32) .1562 →

(1/8) .125 →

(3/8) .375 →

2.6.5) Cumulative Tolerances (Error Buildup)

Figure 2-24 shows two different styles of dimensioning. One is called *Continuous Dimensioning,* the other *Datum Dimensioning*. Continuous dimensioning has the disadvantage of accumulating error. **It is preferable to use datum dimensioning to reduce error buildup.**

Consider the part shown in Figure 2-24. It is dimensioned using both continuous and datum dimensioning. The implied tolerance of all the dimensions is on the first decimal place. If we look at the continuous dimensioning case, the actual dimensions are x.*e*, where 0.*e* is the error associated with each dimension. Adding up the individual dimensions, we get an overall dimension of 3x + 3*(0.*e*). The overall dimension for the datum dimensioning case is 3x + 0.*e.* As this example shows, continuous dimensioning accumulates error.

Another advantage of using datum dimensioning is the fact that many manufacturing machines are programmed using a datum or origin. Therefore, it makes it easier for the machinist to program the machine if datum dimensioning is used.

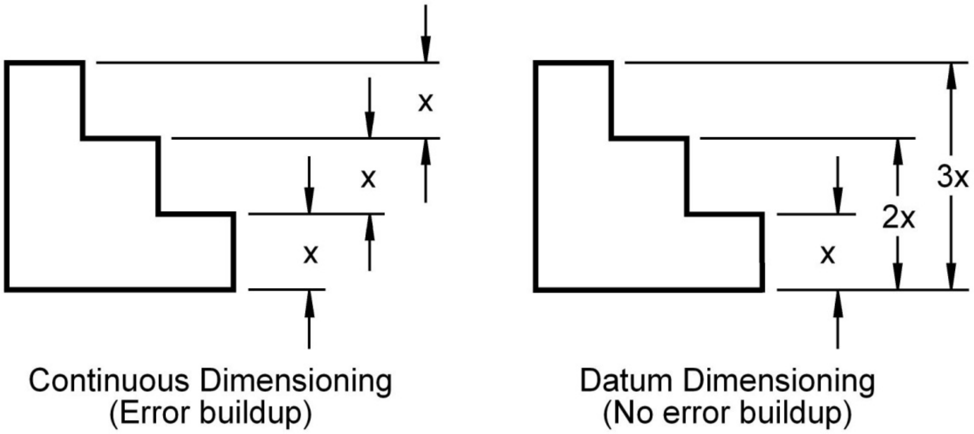


Figure 2-24: Error buildup.

Instructor Led Exercise 2-11: Dimension choice

Consider the incorrectly dimensioned object shown. There are 6 types of dimensioning mistakes. List them and then dimension the object correctly.

1)

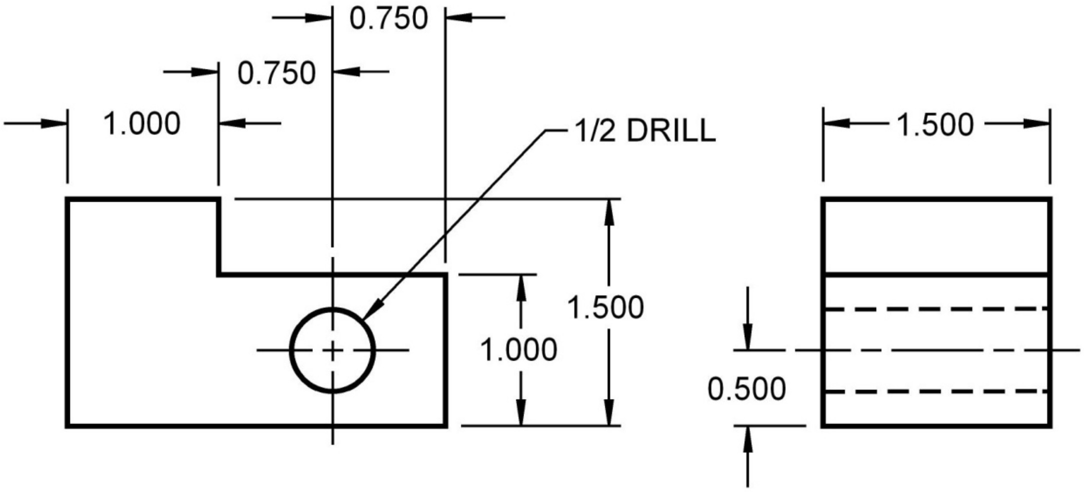
2)

3)

4)

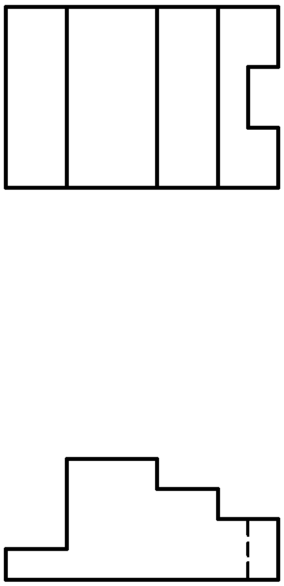
5)

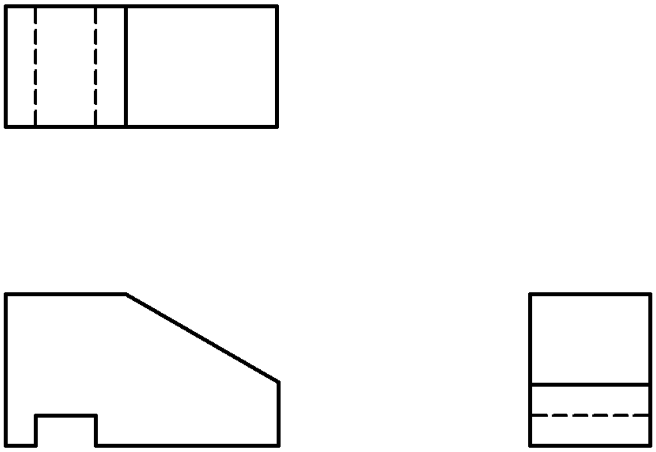
6)



Video Exercise 2-12: Beginning Dimensioning

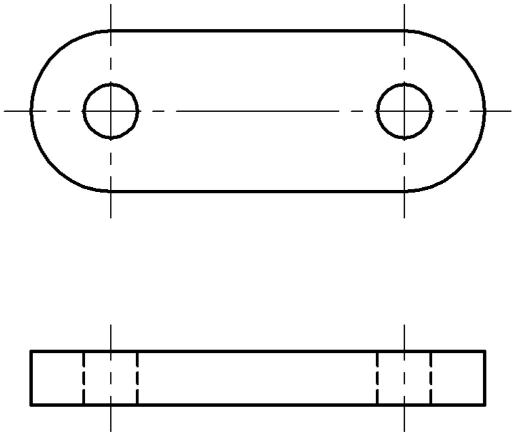
This video exercise will take you through dimensioning the following objects using proper dimensioning techniques.

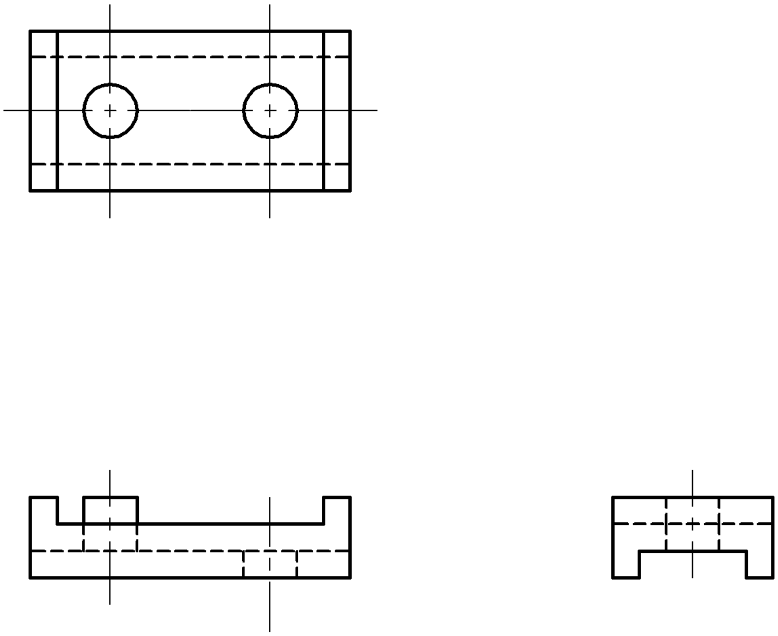




Video Exercise 2-13: Intermediate Dimensioning

This video exercise will take you through dimensioning the following objects using proper dimensioning techniques.



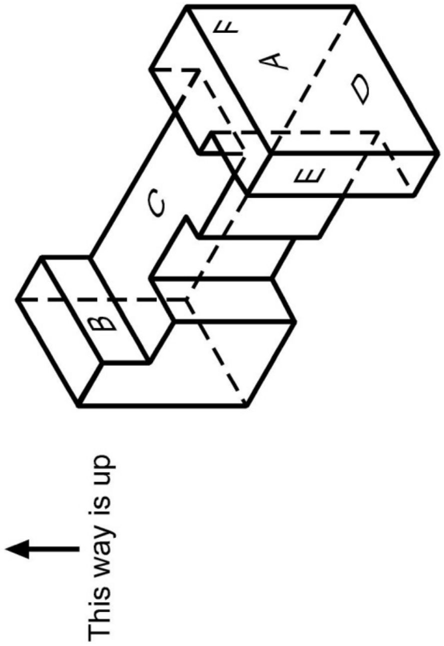


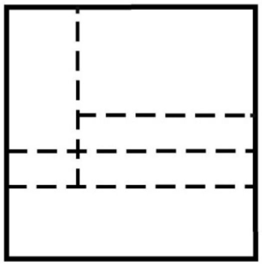
NOTES:

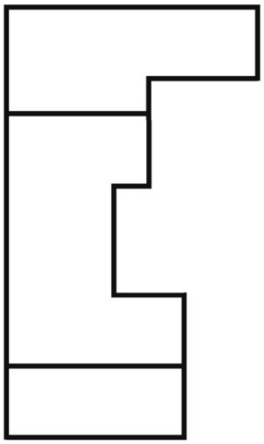
In Class Student Exercise 2-14: Dimensioning 1

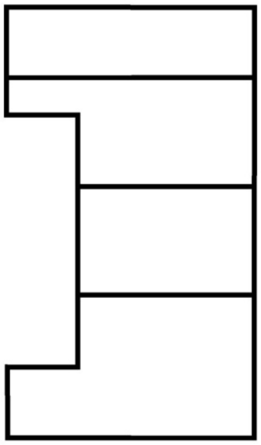
Name: ______________________________ Date: ______________

Dimension the following object using proper dimensioning techniques. Did we need to draw the right side view?







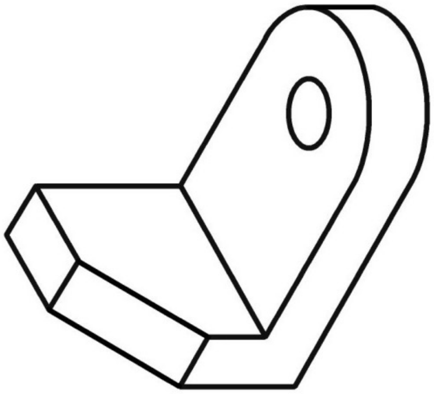


NOTES:

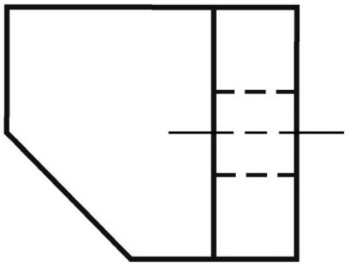
In Class Student Exercise 2-15: Dimensioning 2

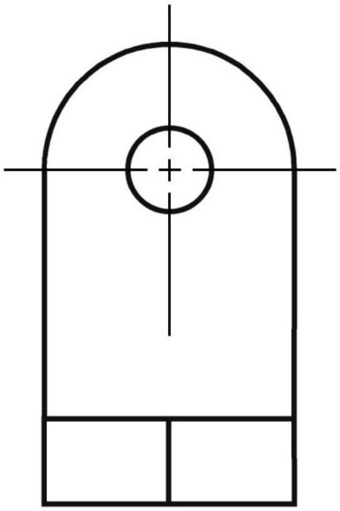
Name: ______________________________ Date: ______________

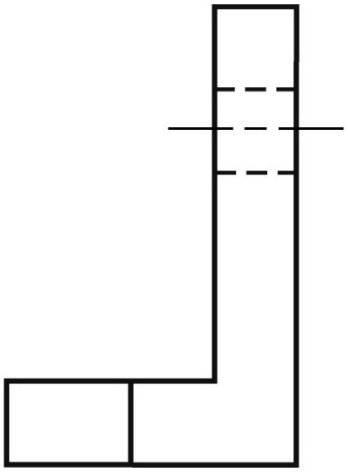
Dimension the following object using proper dimensioning techniques.



This way is up





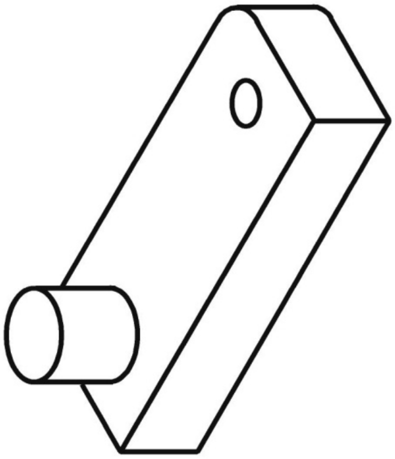


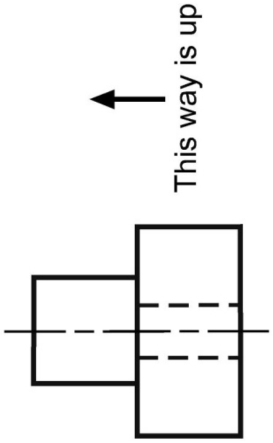
NOTES:

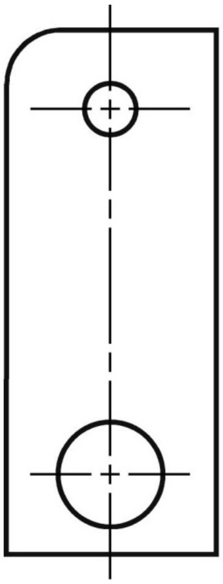
In Class Student Exercise 2-16: Dimensioning 3

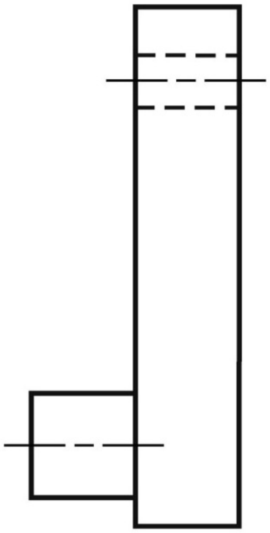
Name: ______________________________ Date: ______________

Dimension the following object using proper dimensioning techniques.







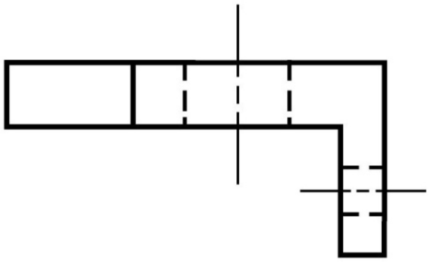


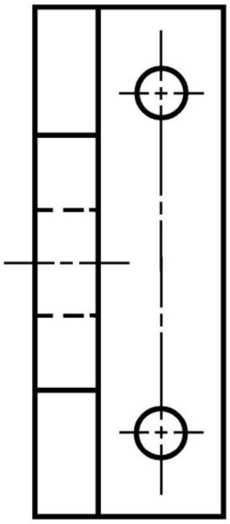
NOTES:

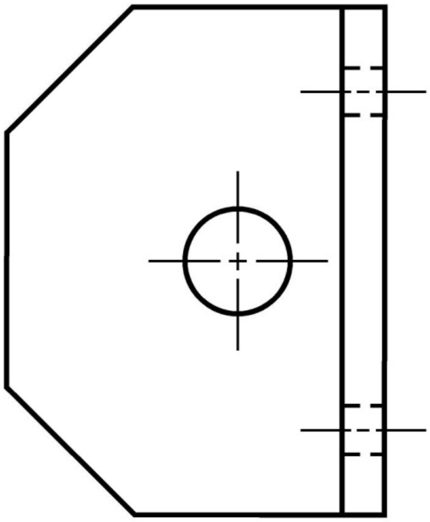
In Class Student Exercise 2-17: Dimensioning 4

Name: ____________________________________ Date: ________________

Dimension the following object using proper dimensioning techniques.



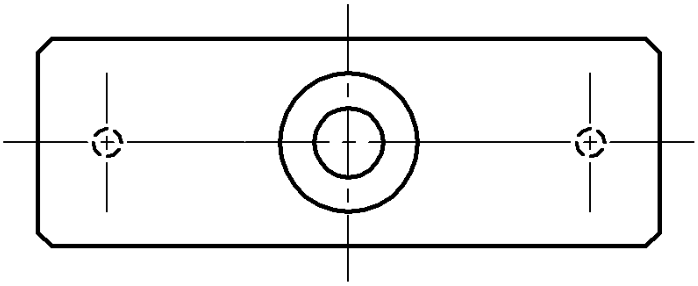


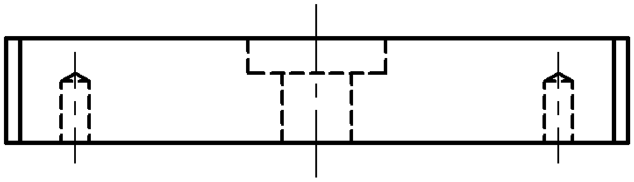


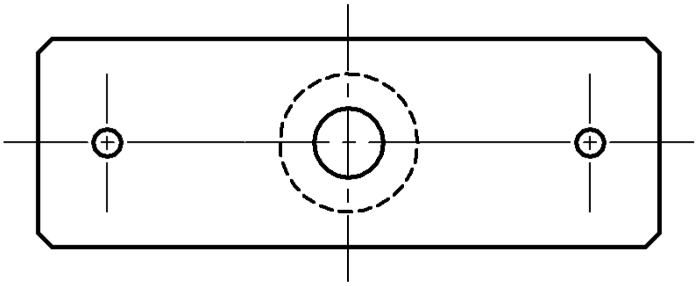
NOTES:

Video Exercise 2-18: Advanced Dimensioning 1

This video exercise will take you through dimensioning the following objects using proper dimensioning techniques.

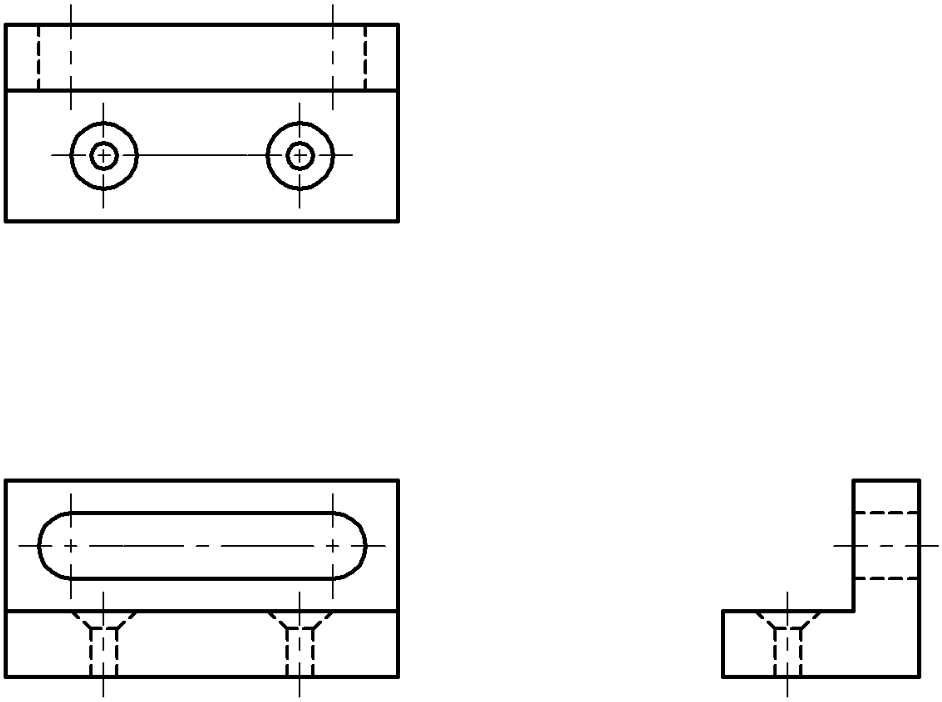






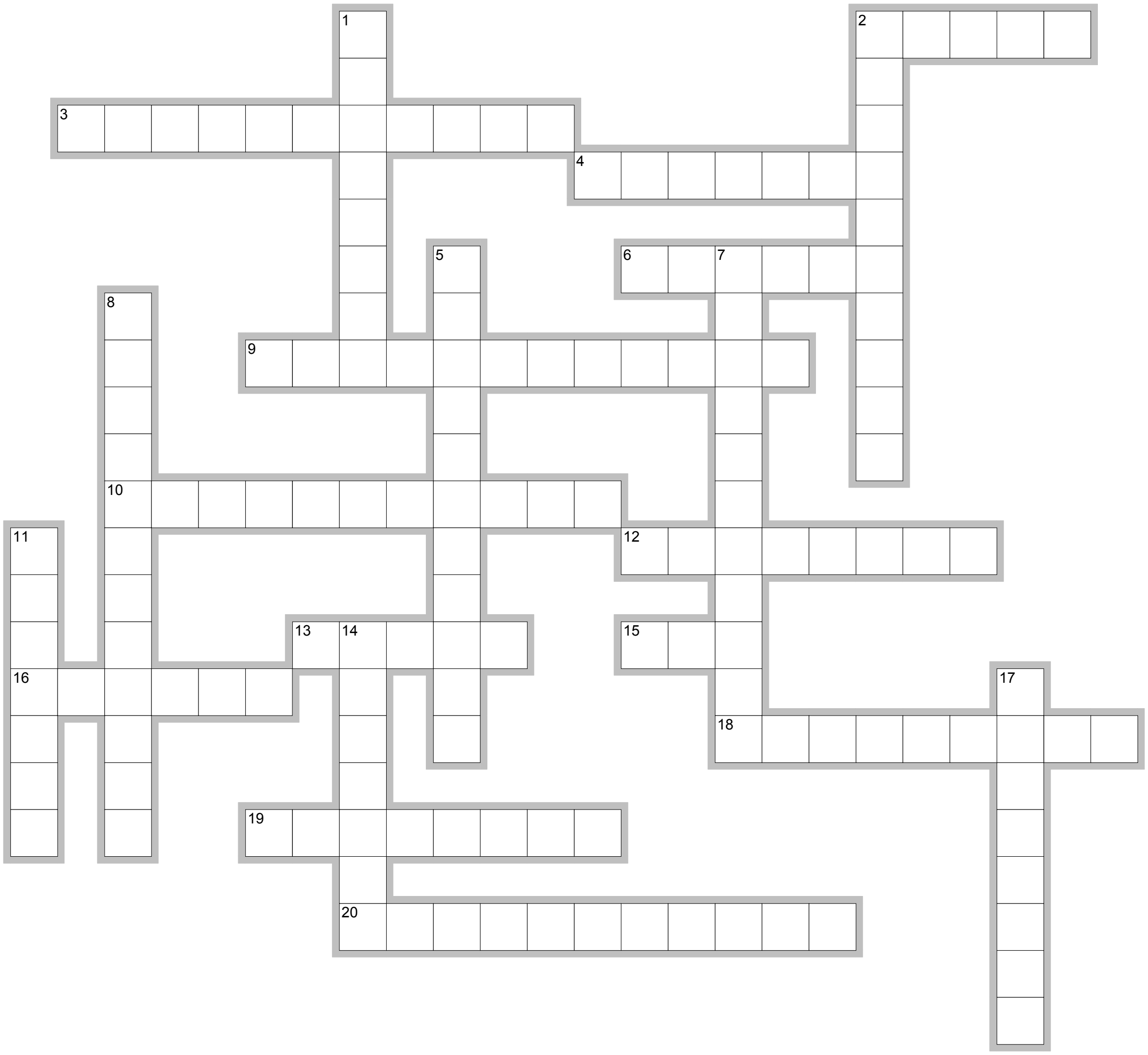
Video Exercise 2-19: Advanced Dimensioning 2

This video exercise will take you through dimensioning the following objects using proper dimensioning techniques.



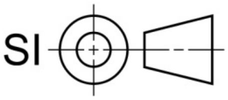
DIMENSIONING CROSSWORD PUZZLE

Name: ________________________________ Date: _______________



Across

2. What is this symbol? ↧
3. What is this symbol? ⌵
4. Dimension and extension lines are thin so that they will not be mistaken for .... lines.
6. What unit of measure is most commonly used on English drawing?
9. Datum dimensioning is preferred over continuous dimensions because it reduces ....
10. What unit of measure is most commonly used on a metric drawing?
12. Leader lines should not be horizontal or ....
13. Dimensioning hidden lines under some circumstances is allowed. (true, false)
15. How many zeros to the right of the decimal does two thousandths of an inch have?
16. The following symbol indicates that the drawing uses this unit of measure?



18. Which line type does not have arrowheads? (dimension, extension, leader)
19. A .... is located in the circular view.
20. A cylinder's diameter is given in the .... view.

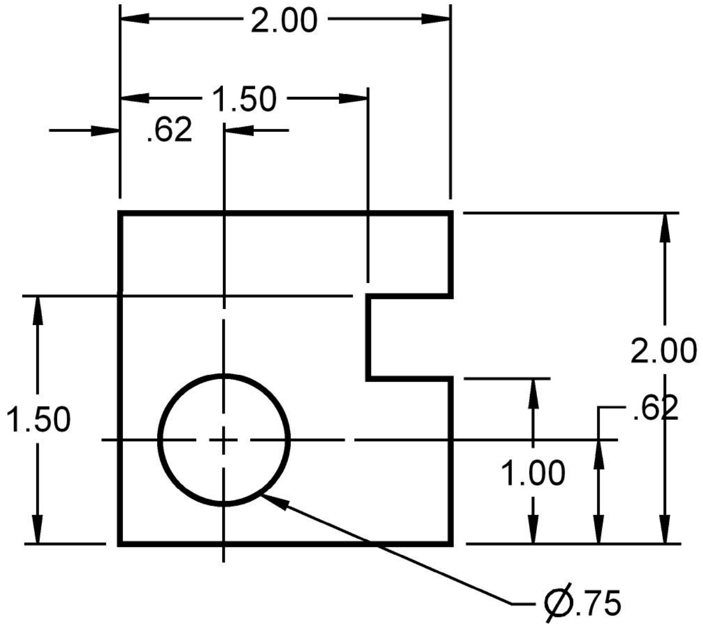
Down

1. A circular hole's diameter is placed in the .... view.
2. A detailed drawing is an orthographic projection with ....
5. A reference dimension is given within ....
7. What is this symbol? ⌴
8. A surface of the part that touches the datum plane.
11. X is the symbol used for repeated features. What else is this symbol used for?
14. Dimensions generally take the form of linear dimensions, notes and leaders and .... dimensions.
17. A complete circle such as a hole is dimensioned by its ....

DIMENSIONING PROBLEMS

Name: ______________________________ Date: ______________

P2-1) The following object is dimensioned incorrectly. Identify the incorrect dimensions and list all mistakes associated with them. Then, dimension the object correctly using proper dimensioning techniques. There are five mistakes.



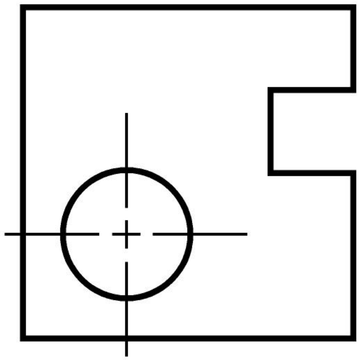
1)

2)

3)

4)

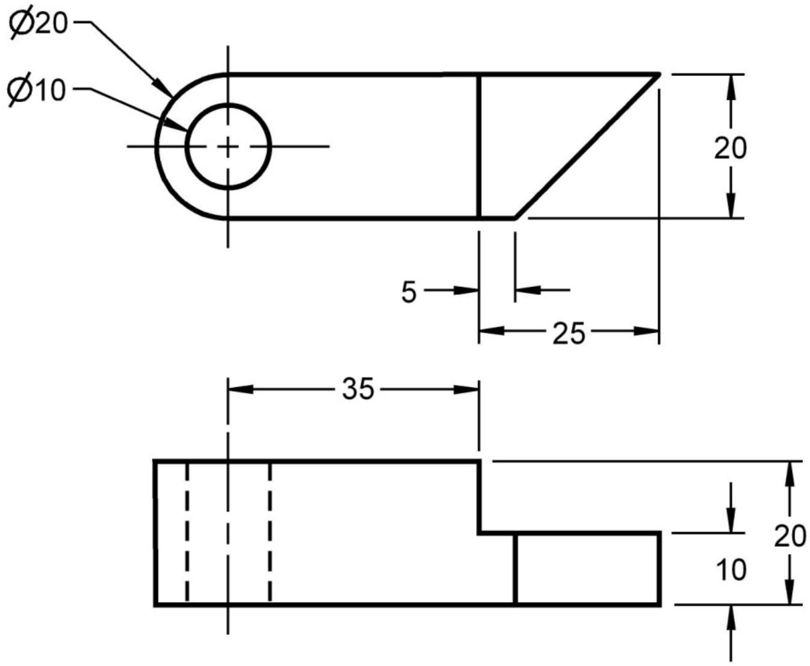
5)



NOTES:

Name: ________________________________ Date: _______________

P2-2) The following object is dimensioned incorrectly. Identify the incorrect dimensions and list all mistakes associated with them. Then, dimension the object correctly using proper dimensioning techniques. There are four mistakes.

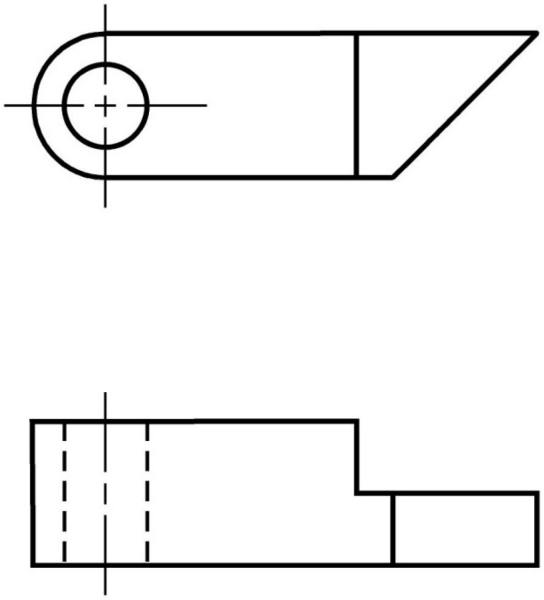


1)

2)

3)

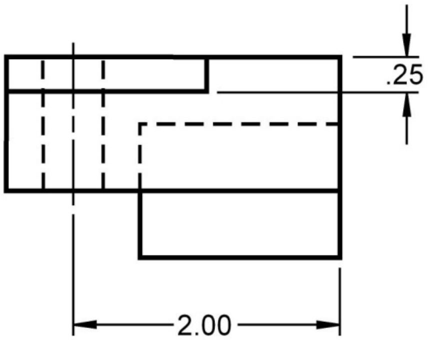
4)



NOTES:

Name: ______________________________ Date: ______________

P2-3) The following object is dimensioned incorrectly. Identify the incorrect dimensions and list all mistakes associated with them. Then, dimension the object correctly using proper dimensioning techniques. There are six mistakes.



1)

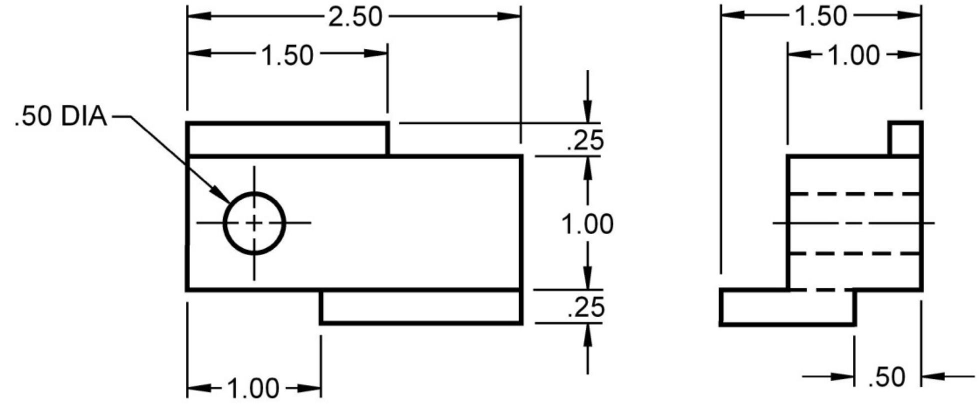
2)

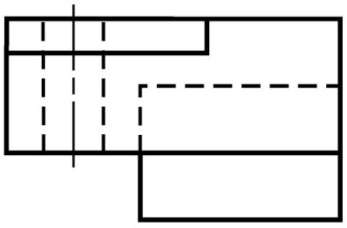
3)

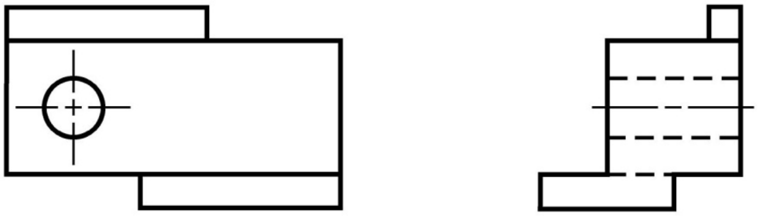
4)

5)

6)



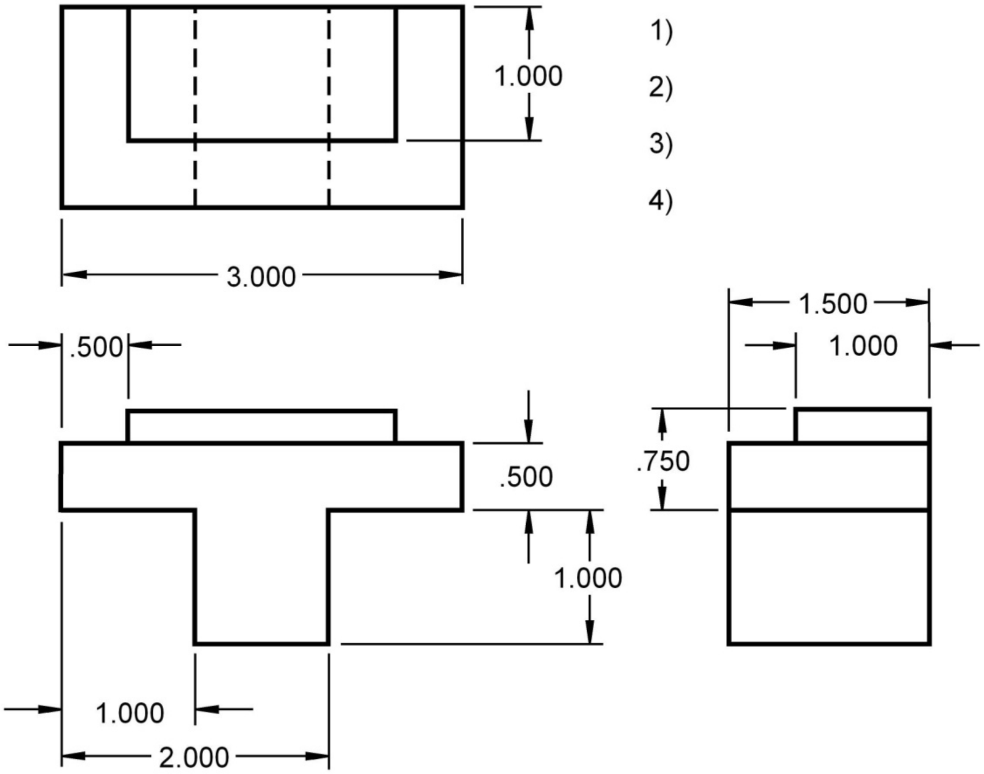




NOTES:

Name: ______________________________ Date: ______________

P2-4) The following object is dimensioned incorrectly. Identify the incorrect dimensions and list all mistakes associated with them. Then, dimension the object correctly using proper dimensioning techniques. There are four mistakes.

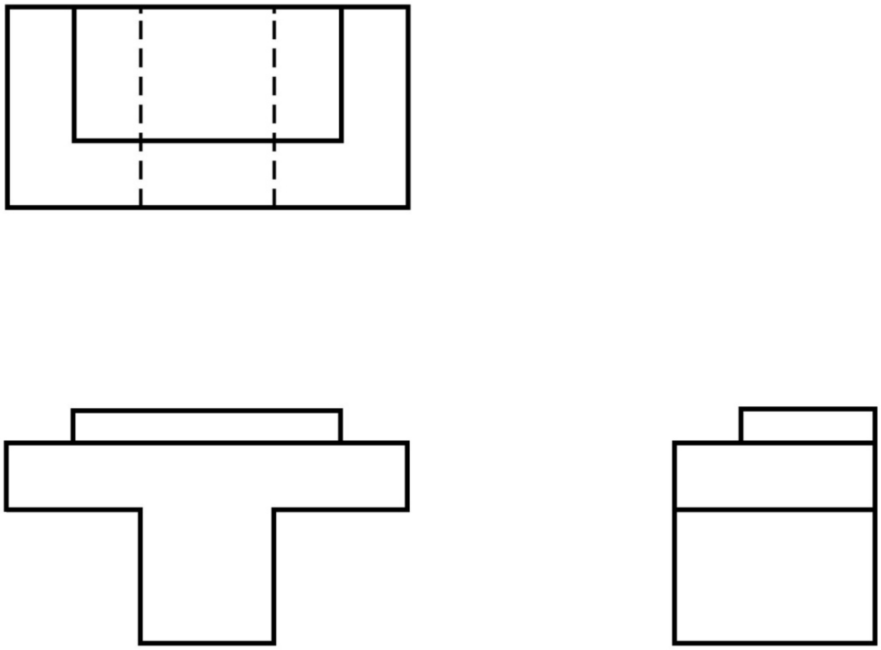


1)

2)

3)

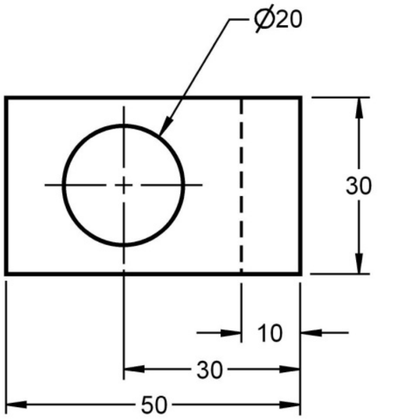
4)



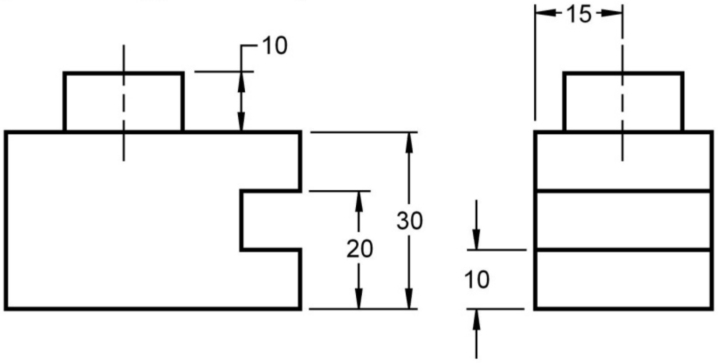
NOTES:

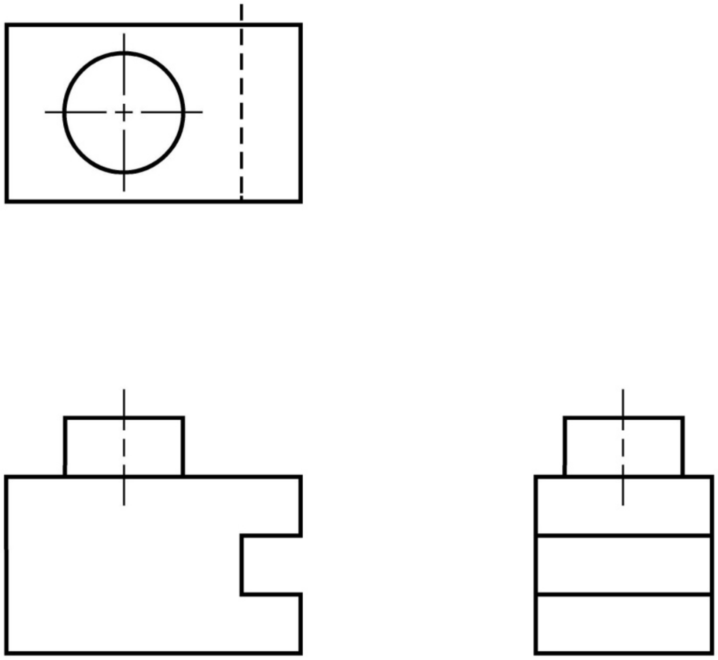
Name: ________________________________ Date: _______________

P2-5) The following object is dimensioned incorrectly. Identify the incorrect dimensions and list all mistakes associated with them. Then, dimension the object correctly using proper dimensioning techniques. There are five mistakes.



1)
2)
3)
4)
5)

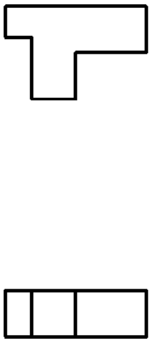


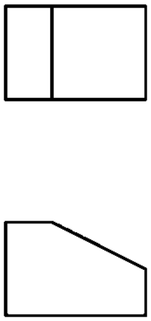


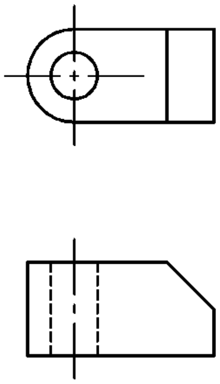
NOTES:

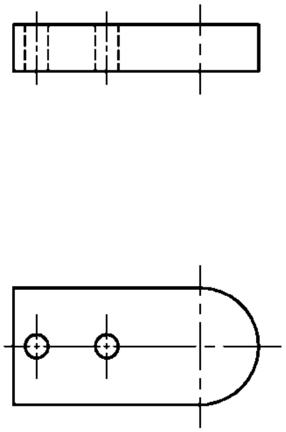
Name: ________________________________ Date: _______________

P2-6) Completely dimension the objects shown (by hand) using proper dimensioning techniques. Wherever a numerical dimension value is required, place an 'x'. Use dimensioning symbols where necessary.





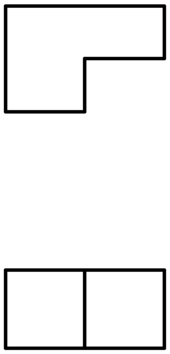


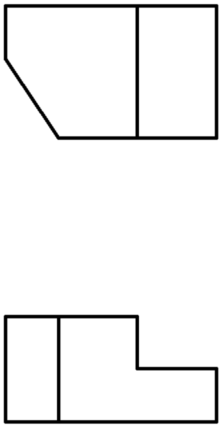


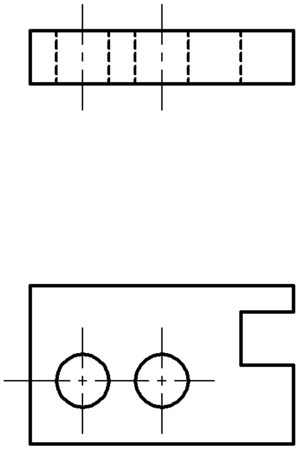
NOTES:

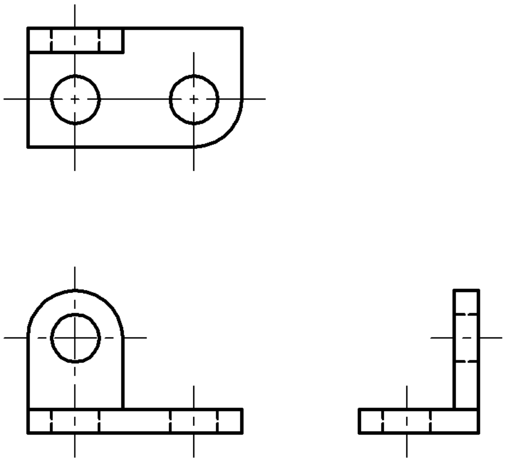
Name: ______________________________ Date: ______________

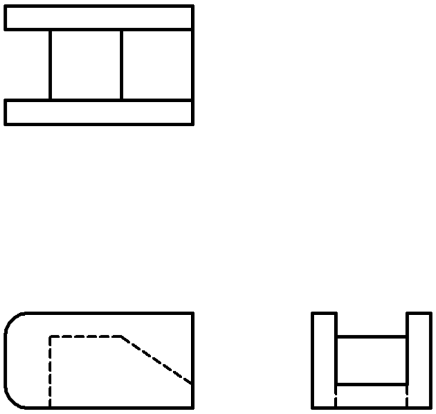
P2-7) Completely dimension the objects shown (by hand) using proper dimensioning techniques. Wherever a numerical dimension value is required, place an ‘x’. Use dimensioning symbols where necessary.

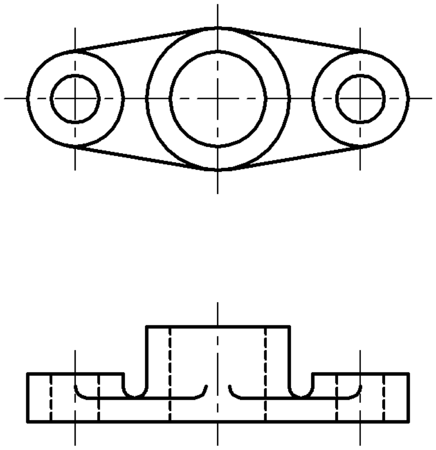








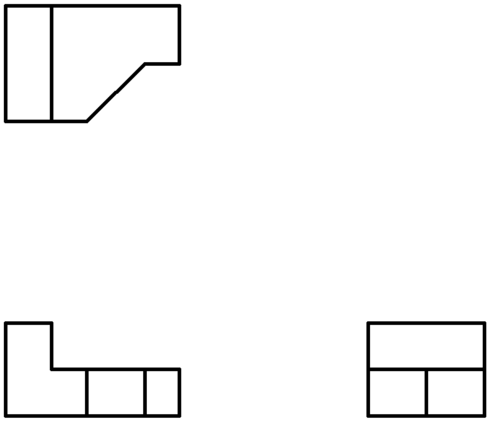


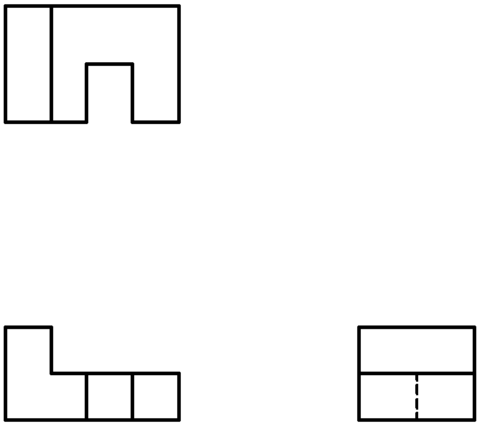


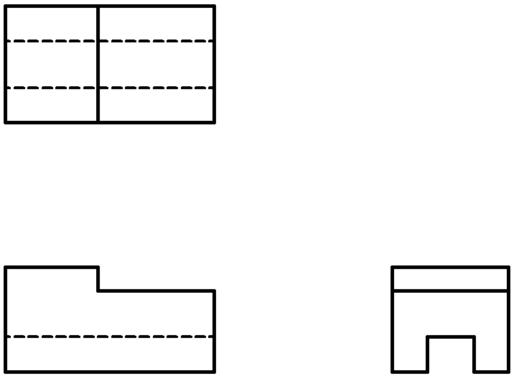
NOTES:

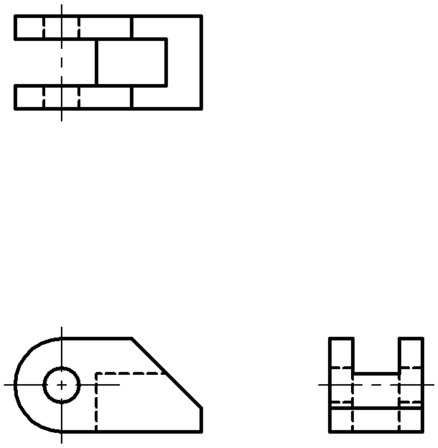
Name: ______________________________ Date: ______________

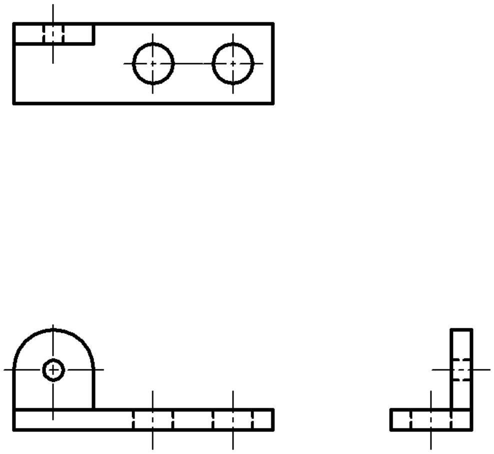
P2-8) Completely dimension the objects shown (by hand) using proper dimensioning techniques. Wherever a numerical dimension value is required, place an ‘x’. Use dimensioning symbols where necessary.

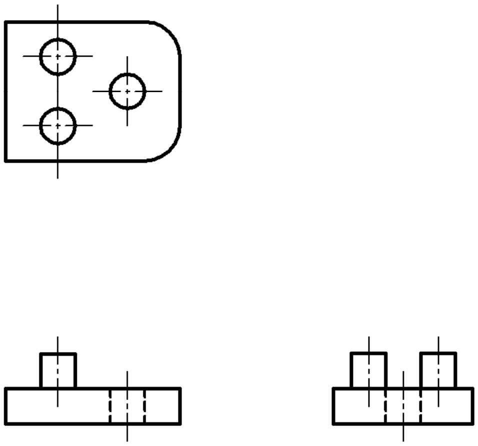








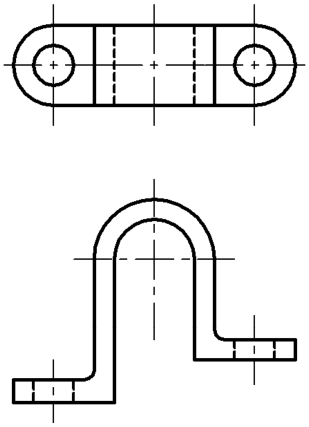


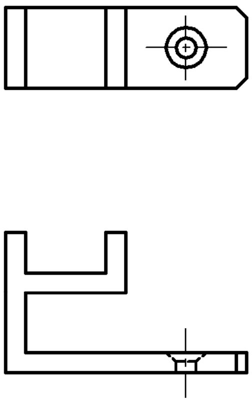


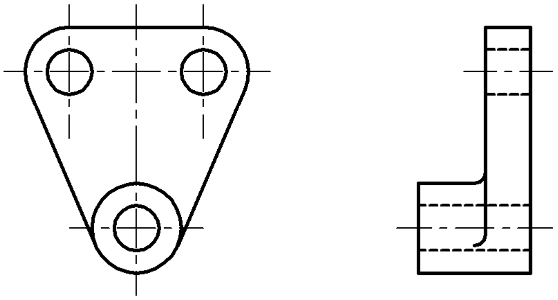
NOTES:

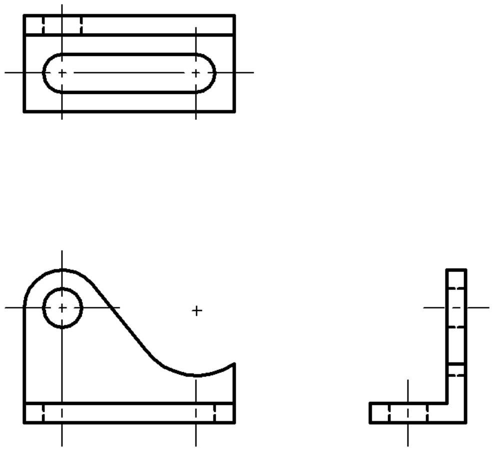
Name: ________________________________ Date: _______________

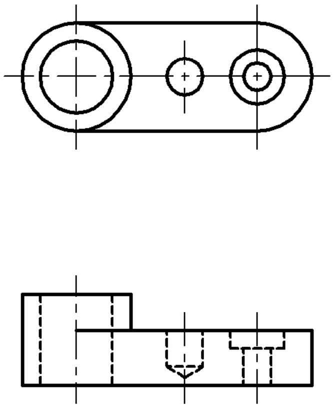
P2-9) Completely dimension the objects shown (by hand) using proper dimensioning techniques. Wherever a numerical dimension value is required, place an 'x'. Use dimensioning symbols where necessary.

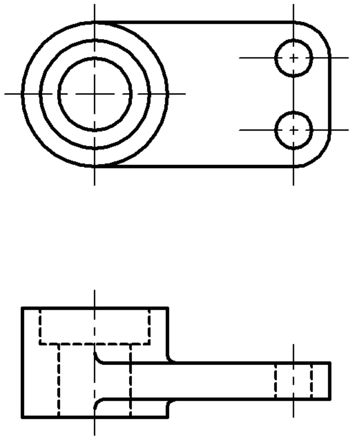






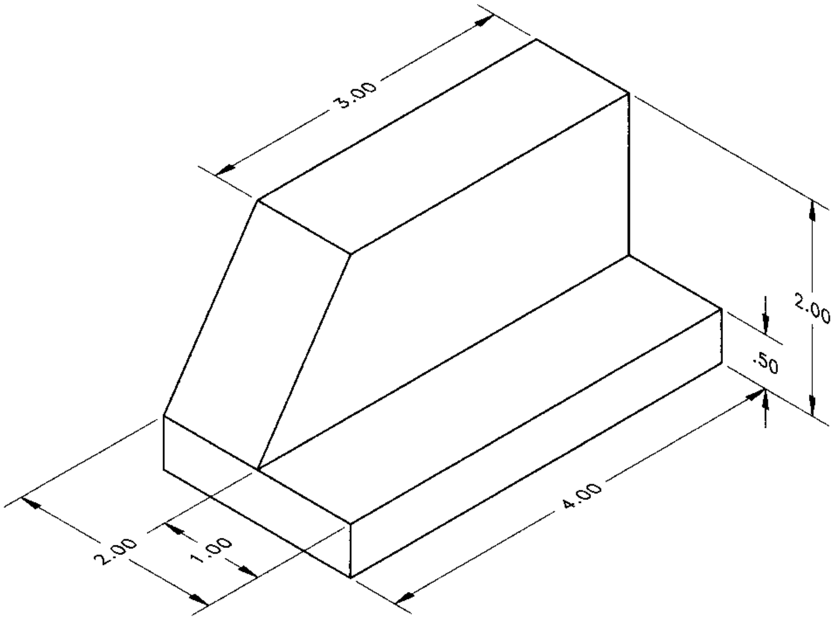




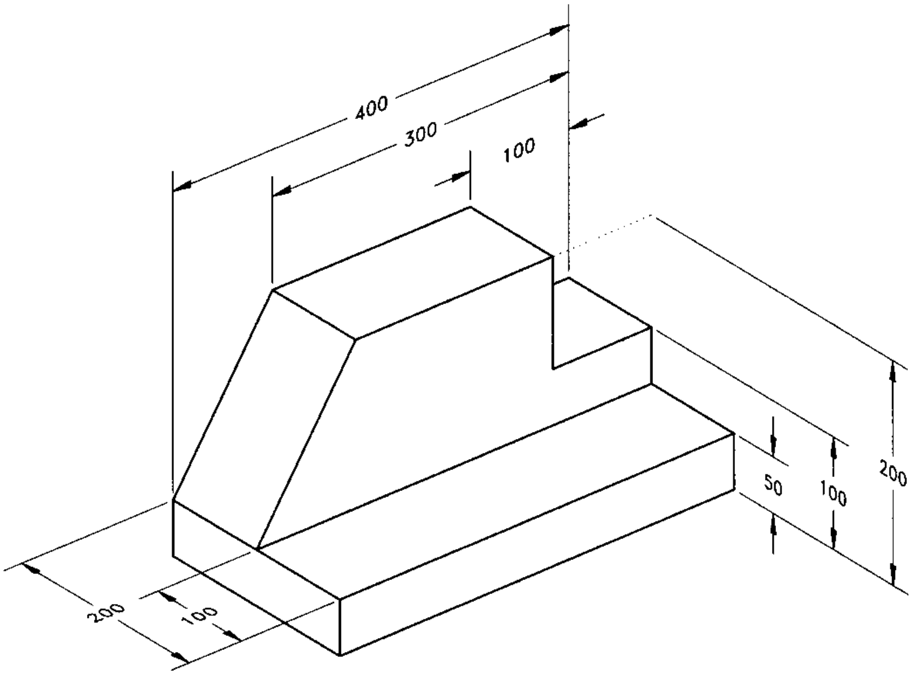


NOTES:

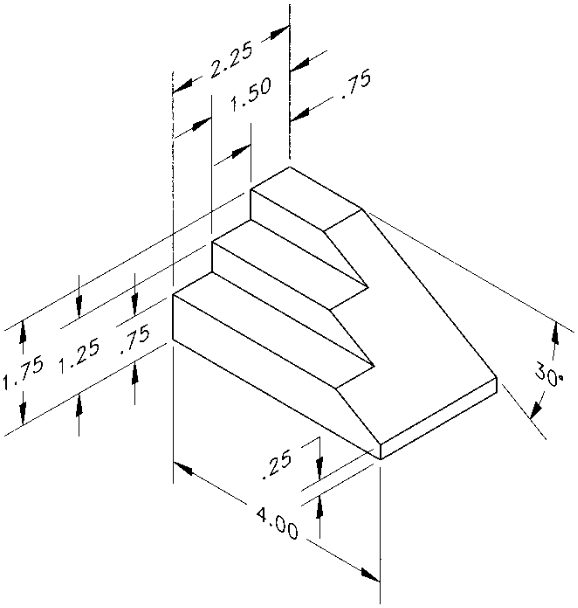
P2-10) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



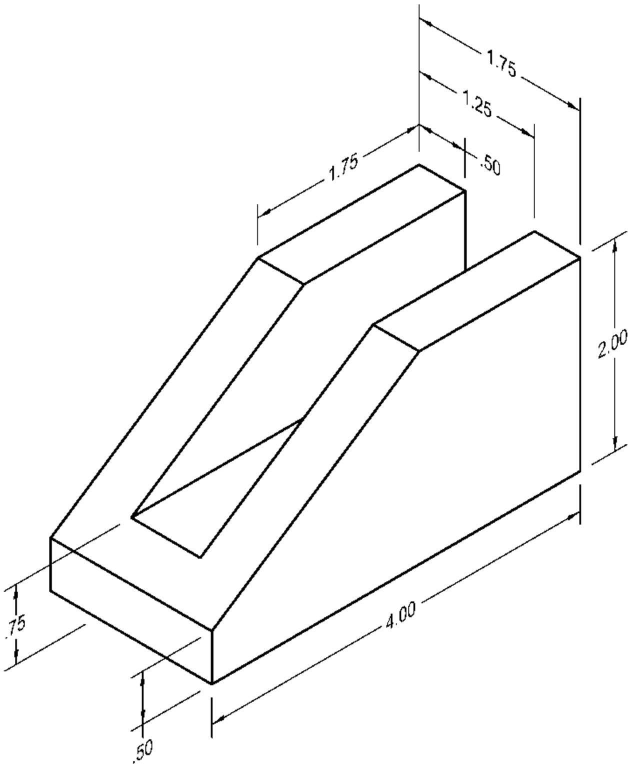
P2-11) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



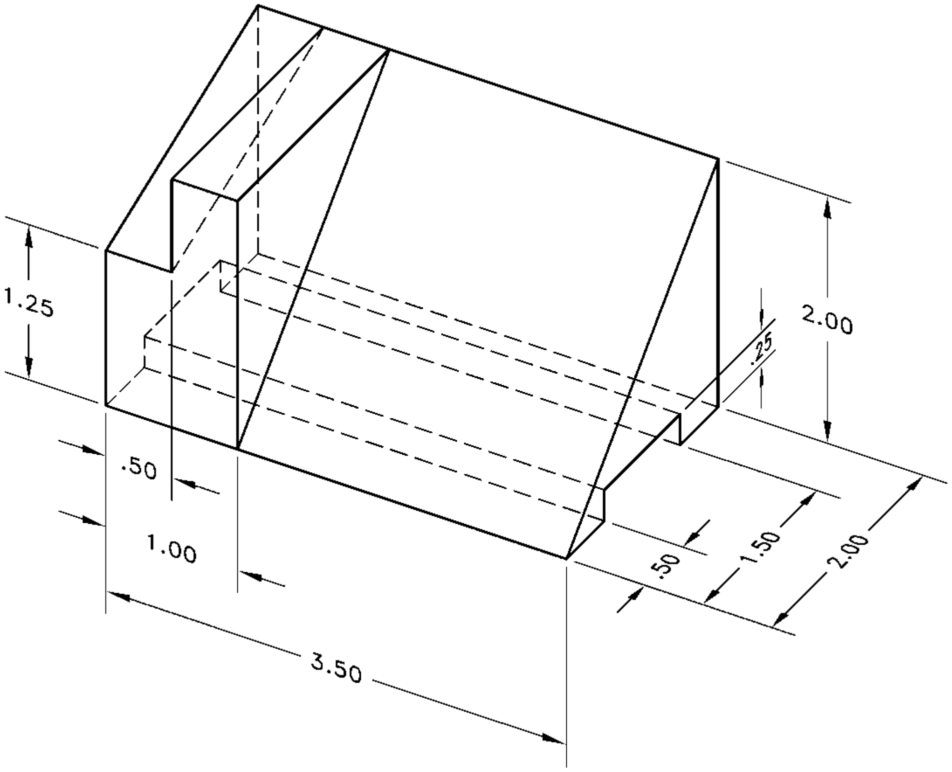
P2-12) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



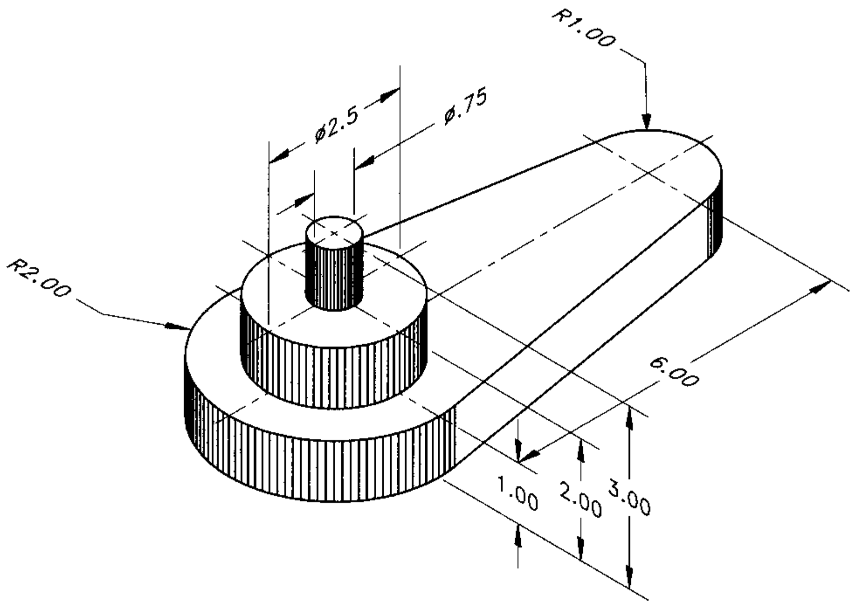
P2-13) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



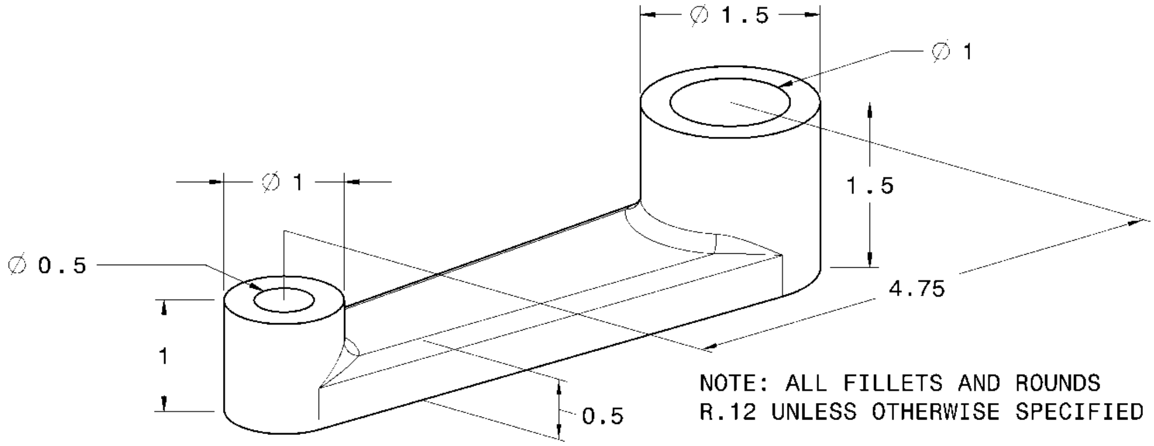
P2-14) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



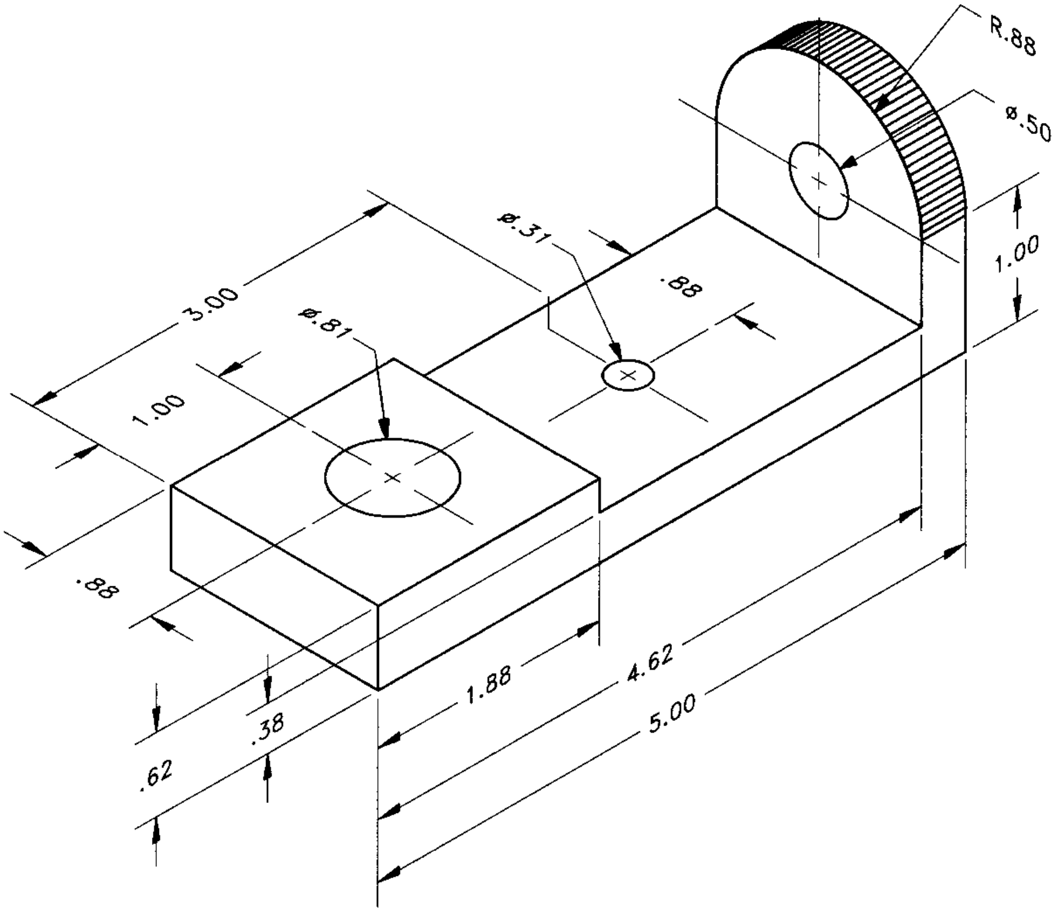
P2-15) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



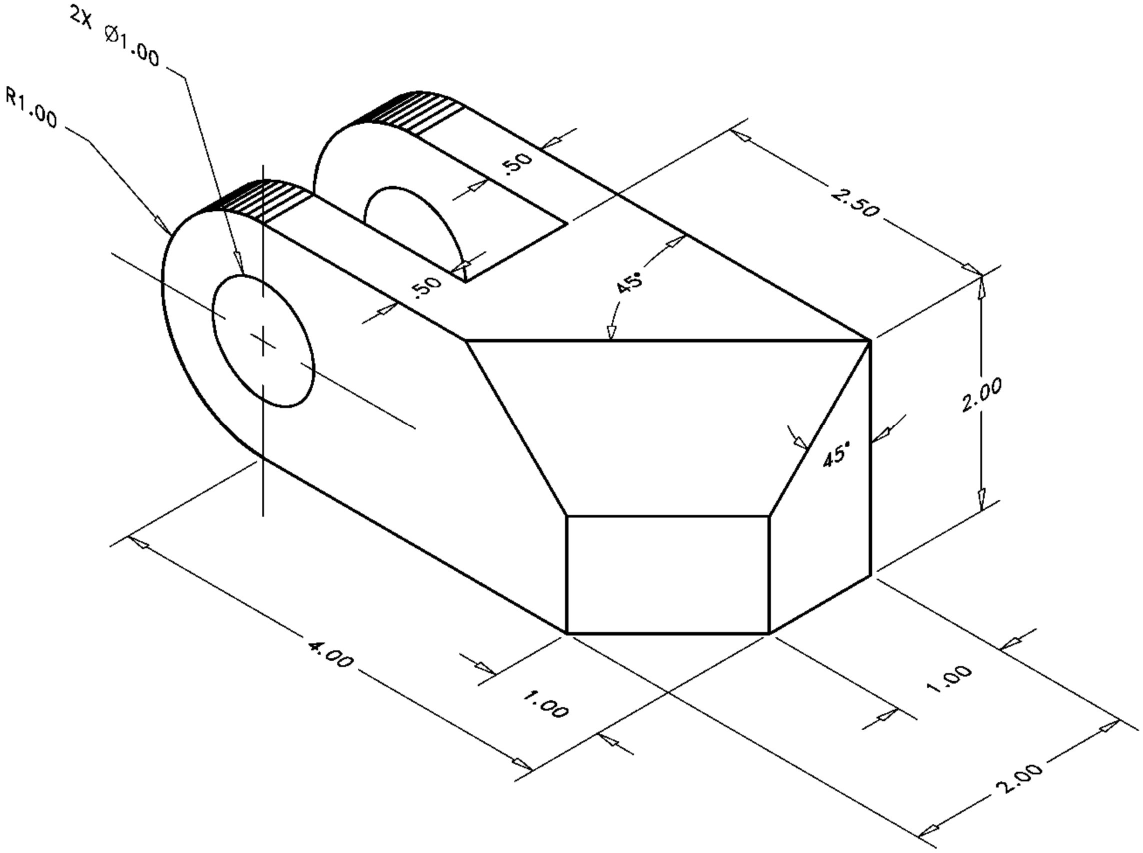
P2-16) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



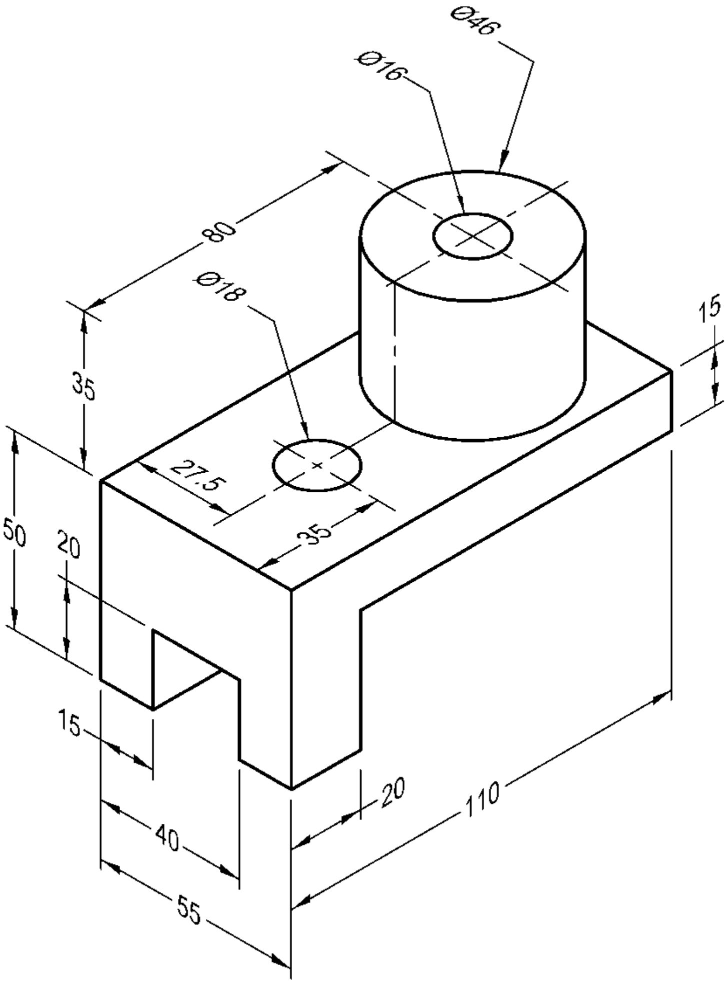
P2-17) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



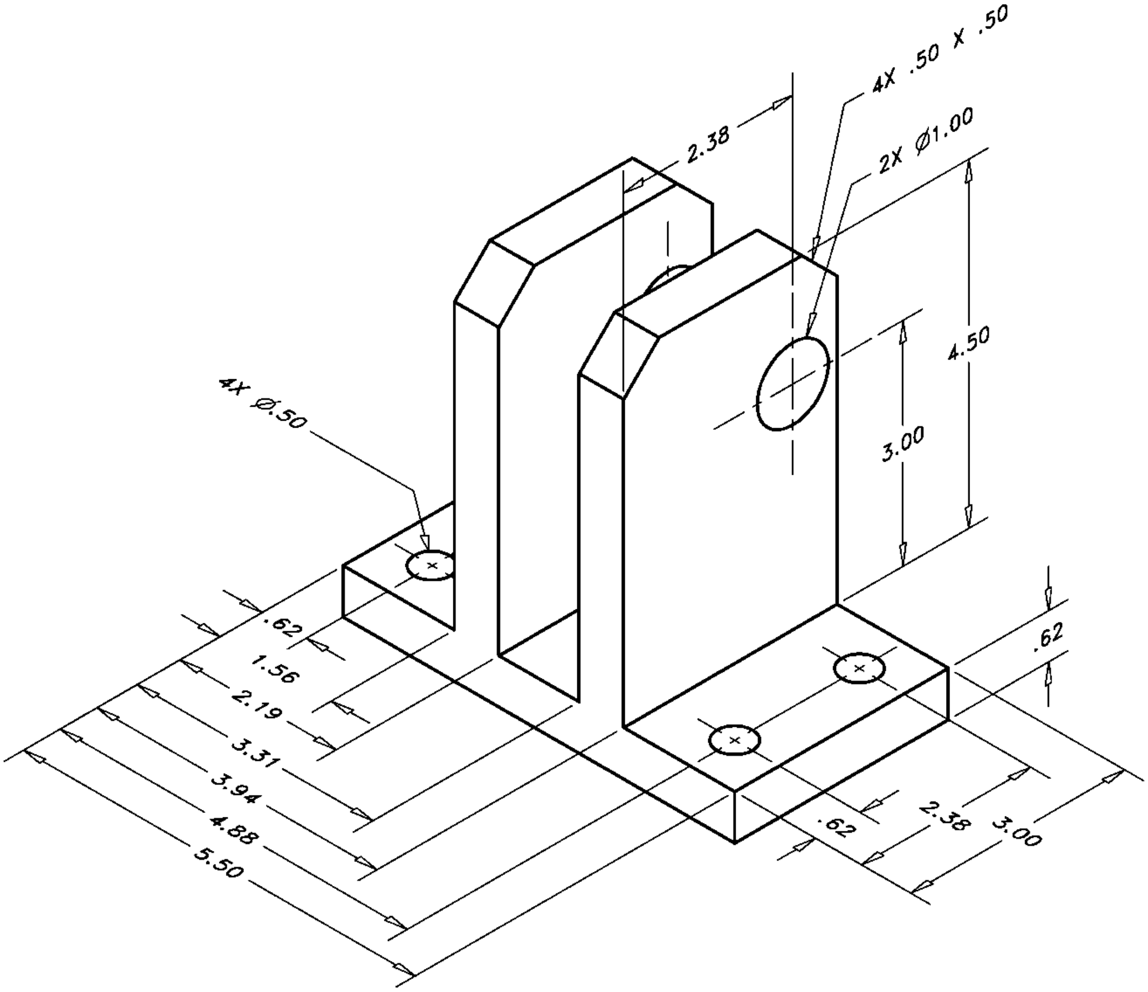
P2-18) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



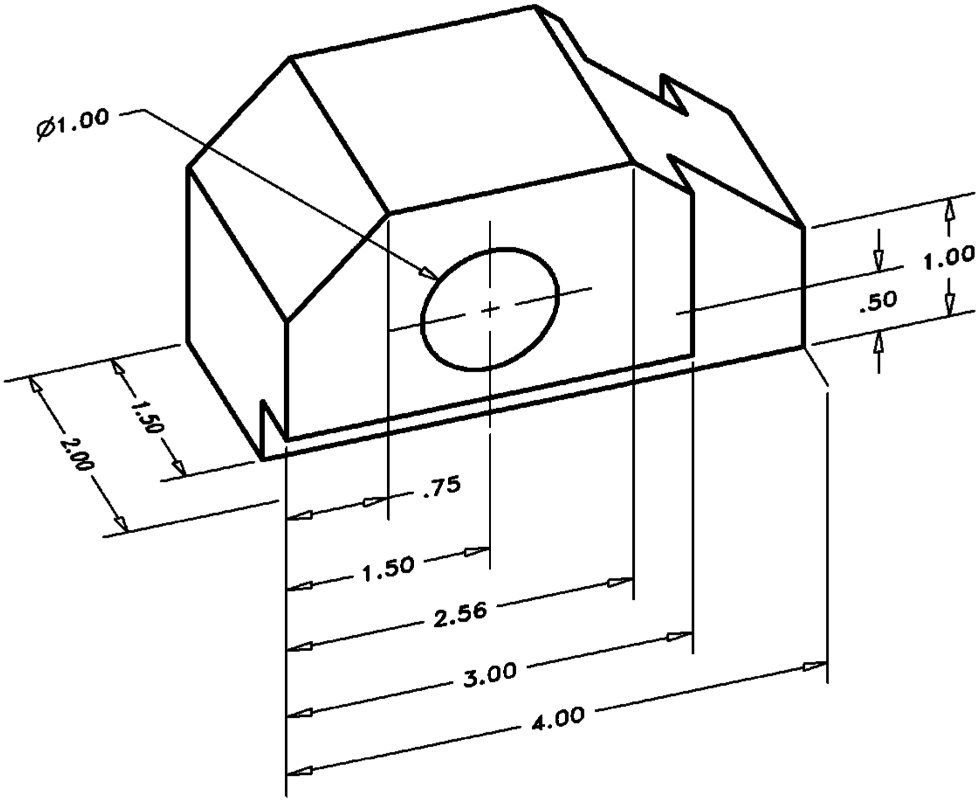
P2-19) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

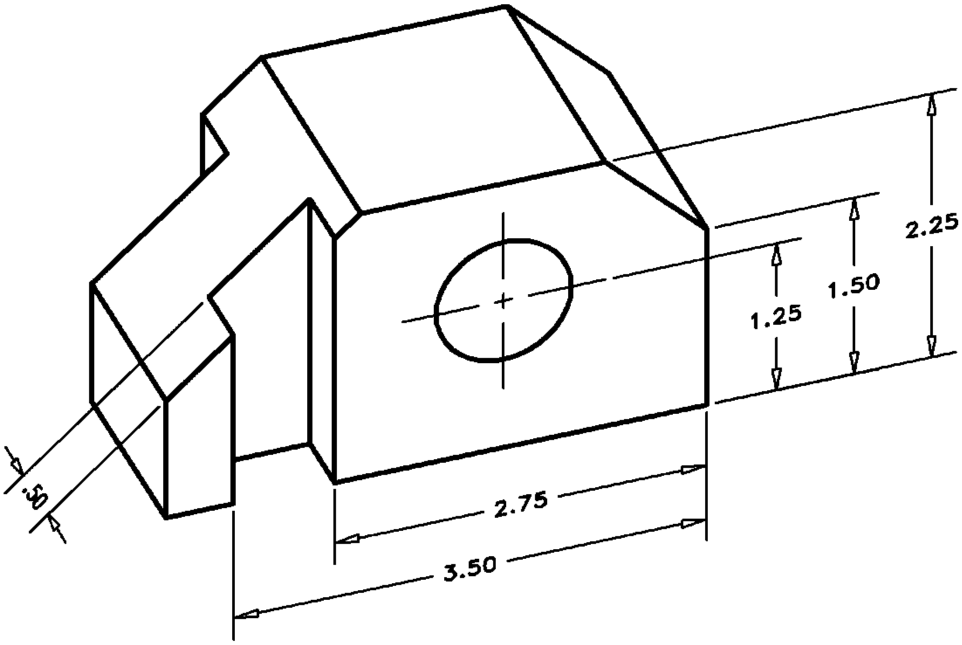


P2-20) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

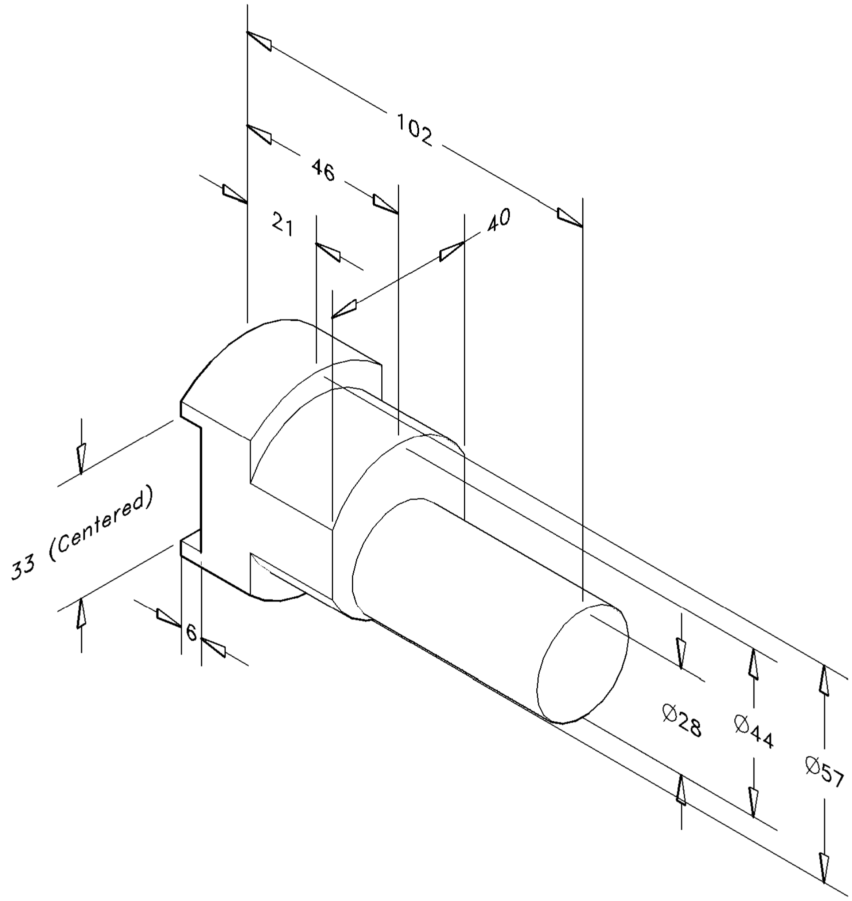


P2-21) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

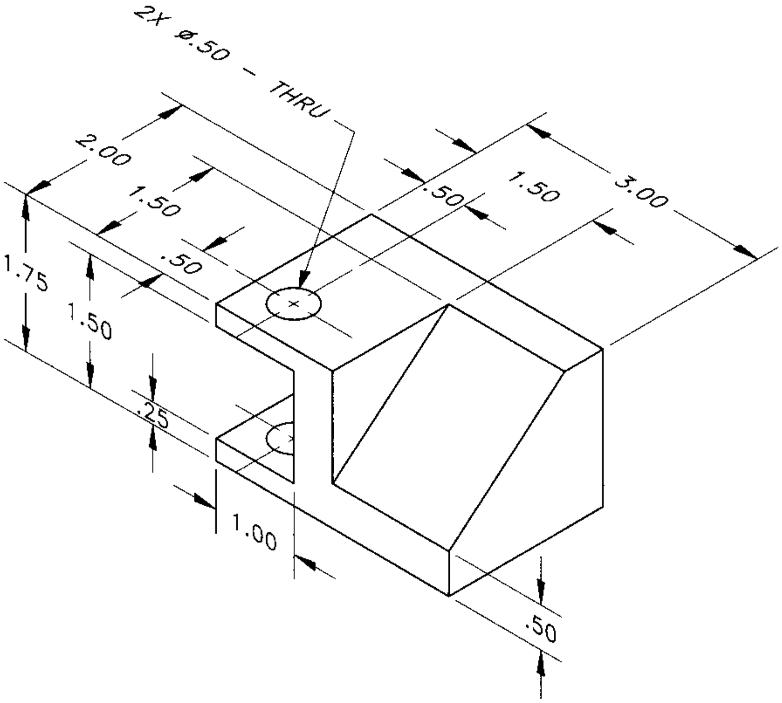




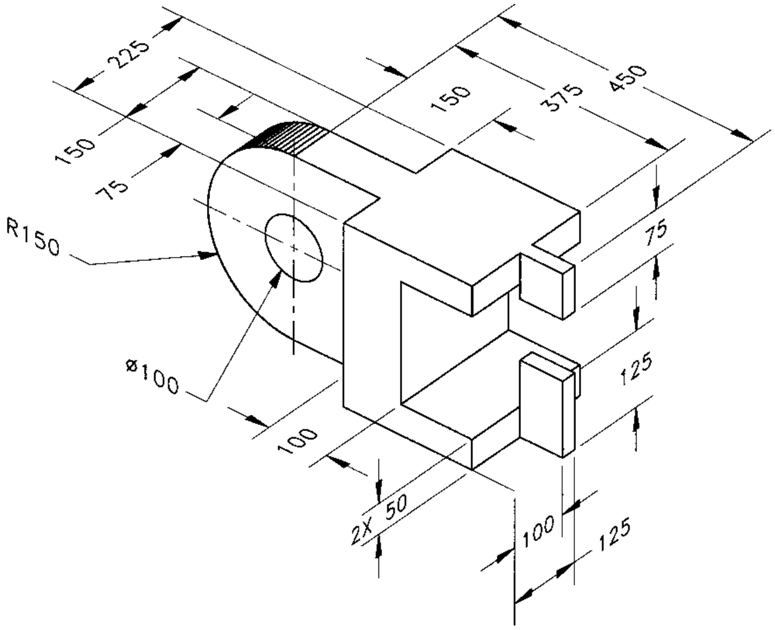
P2-22) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



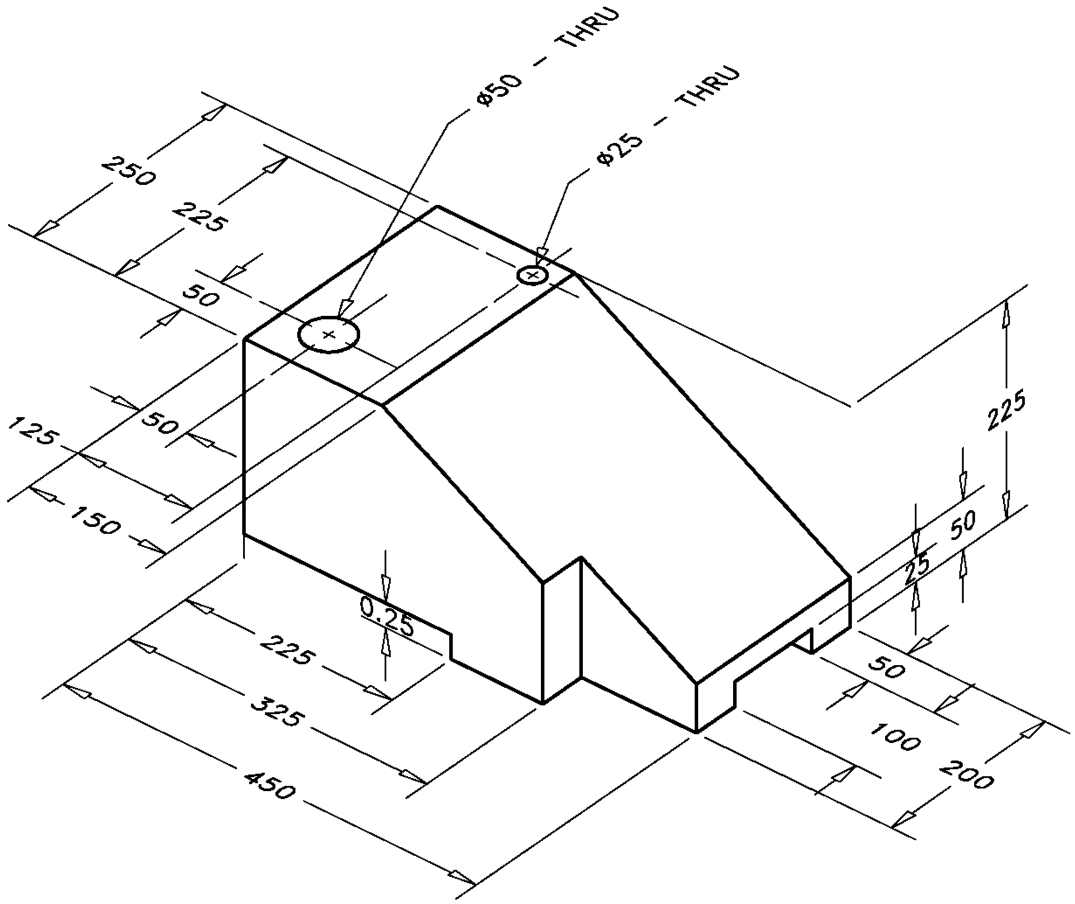
P2-23) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



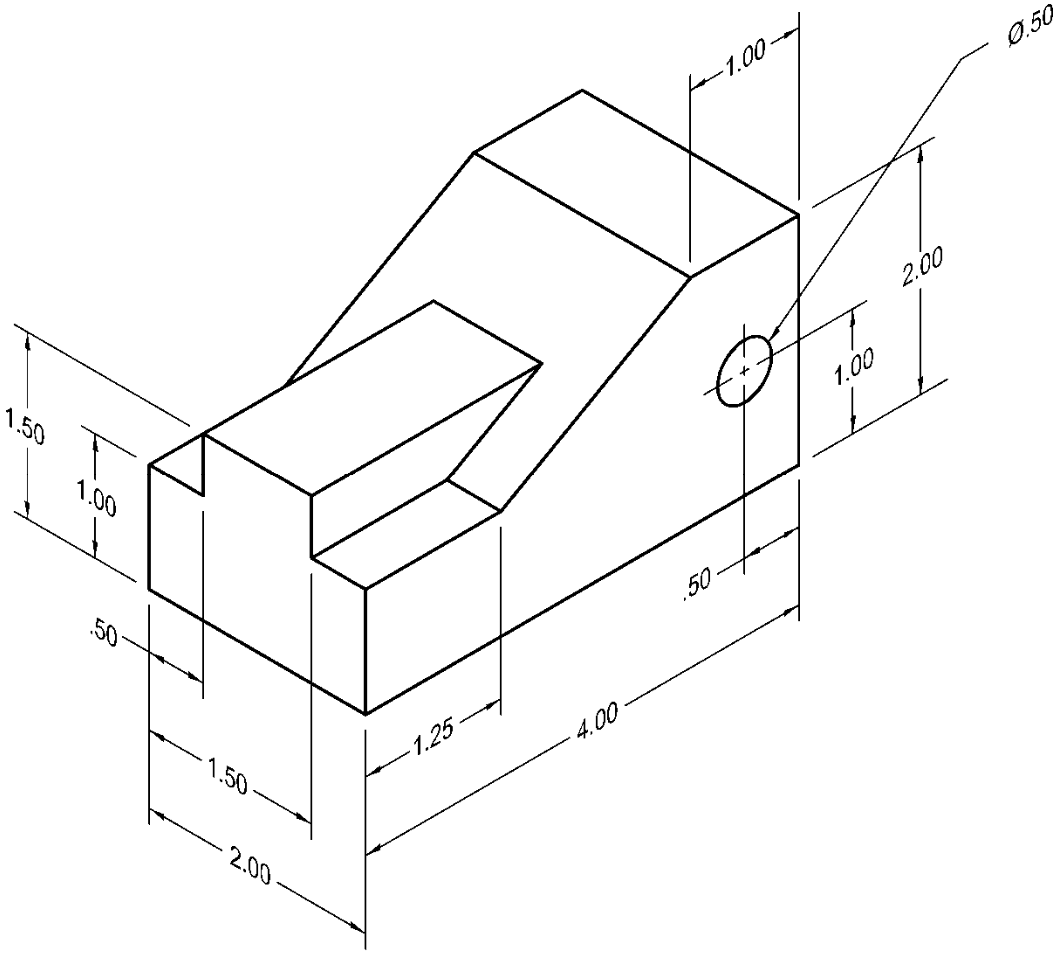
P2-24) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



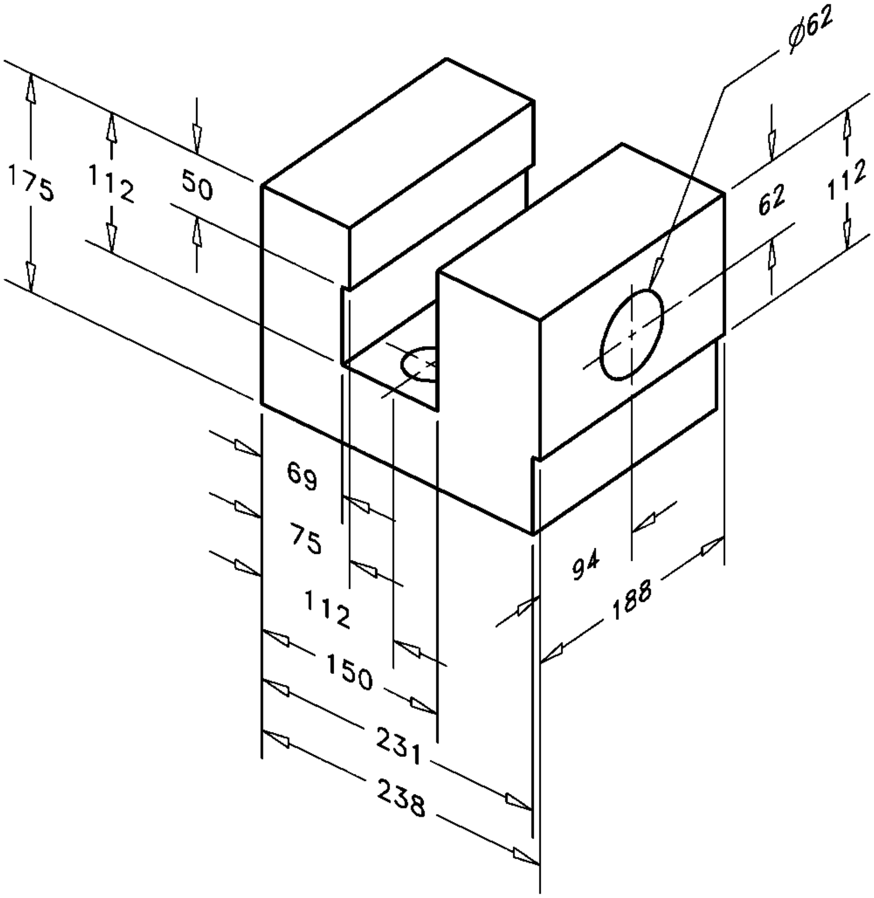
P2-25) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

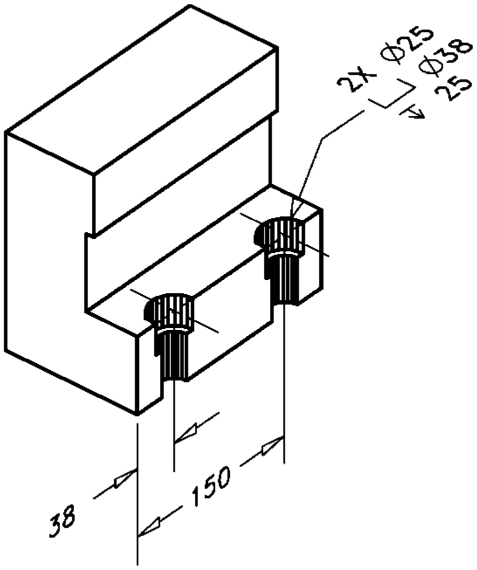


P2-26) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

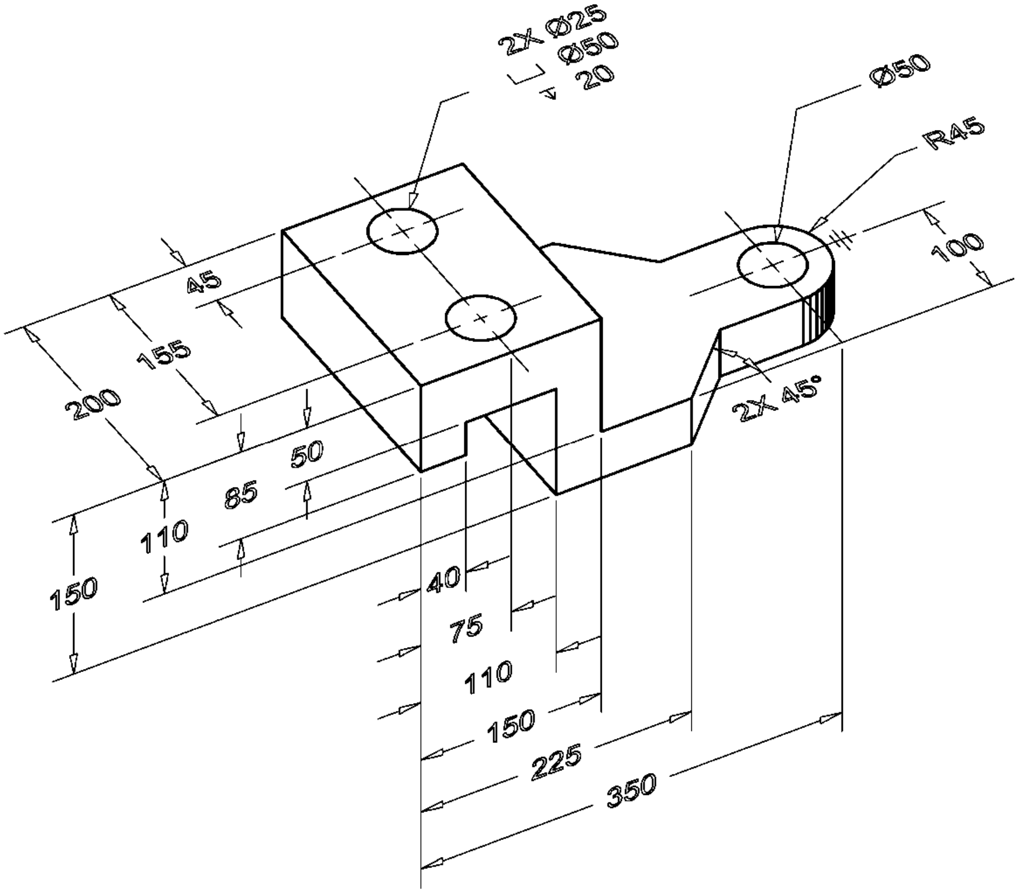


P2-27) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

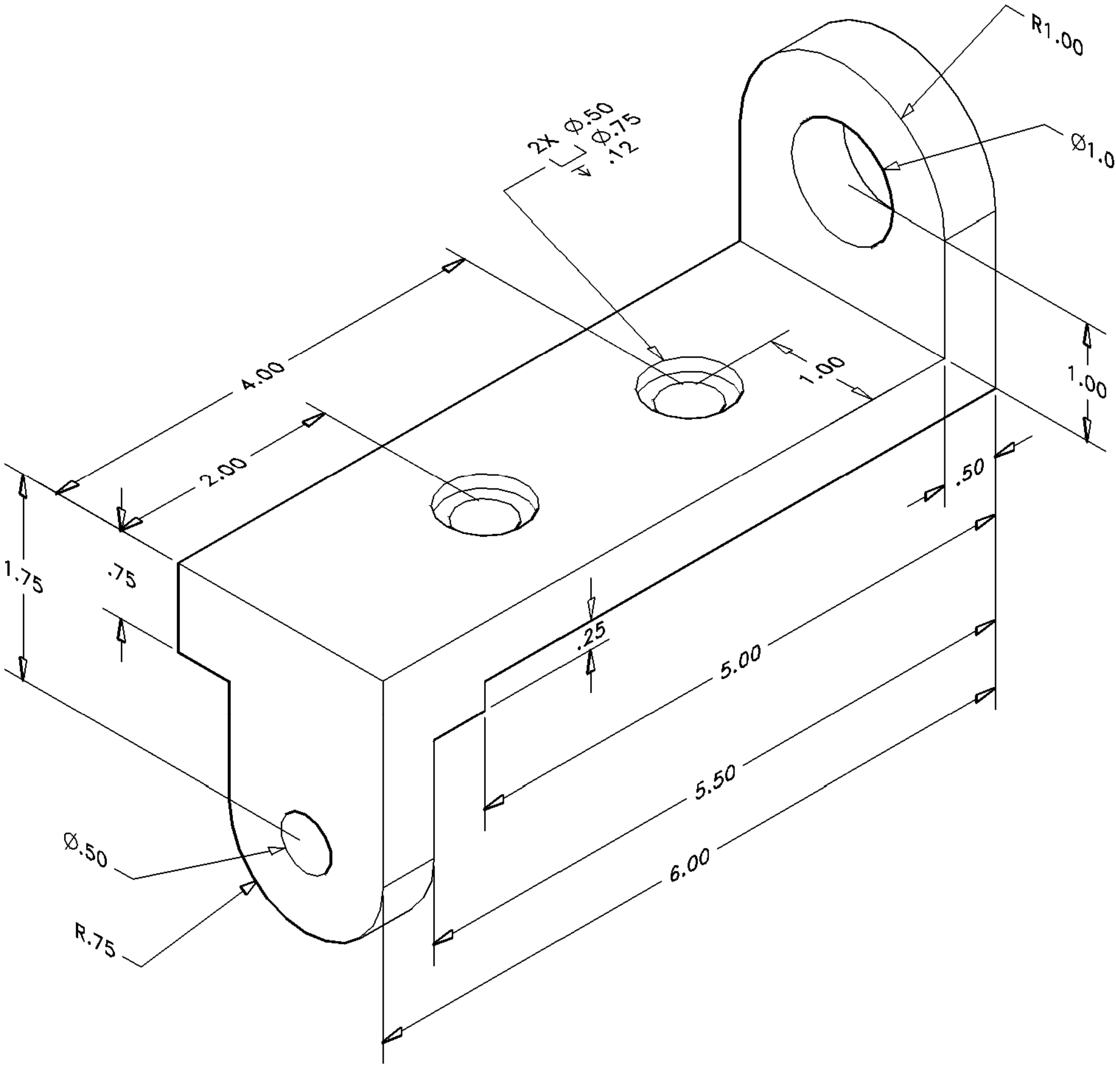




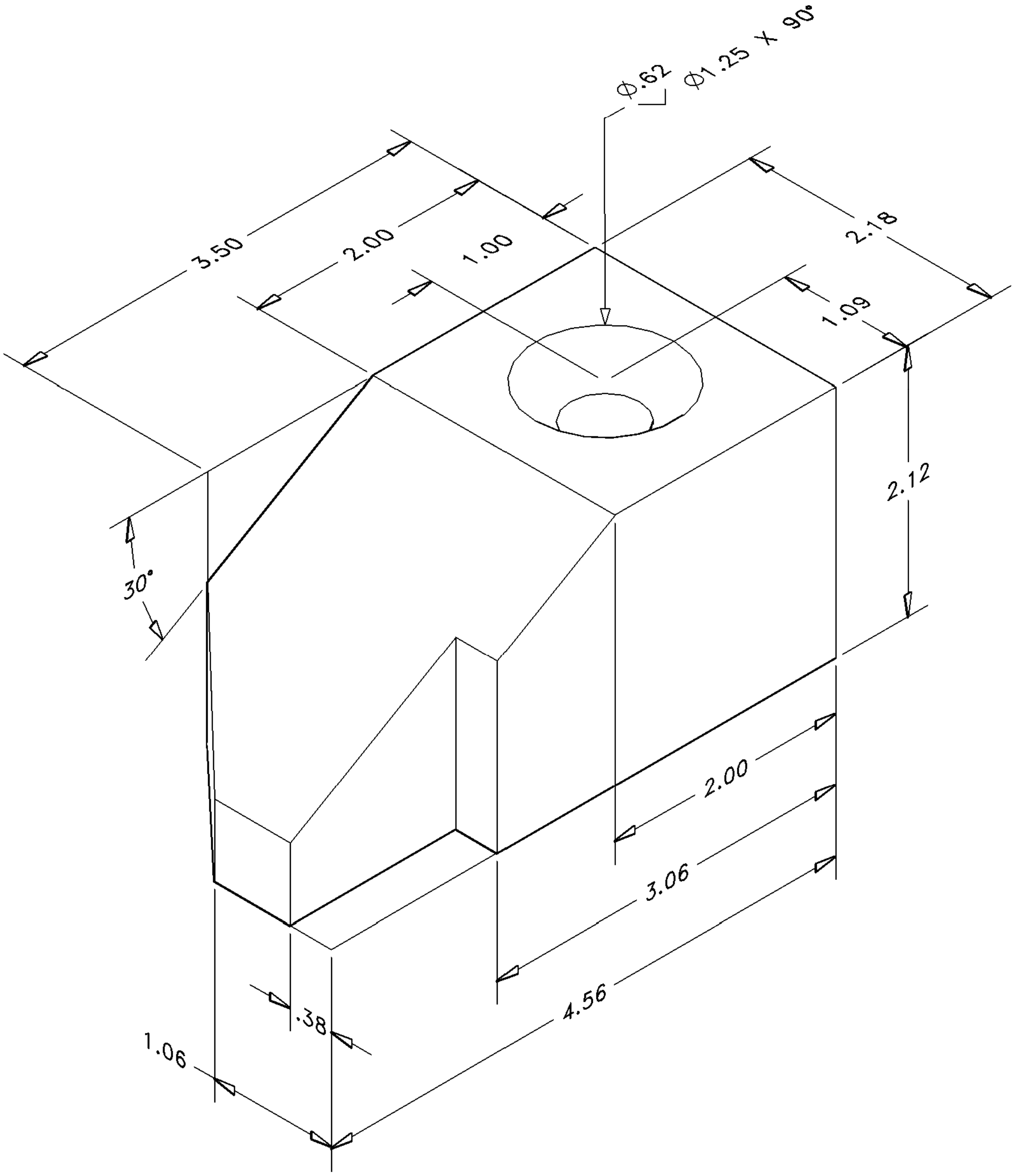
P2-28) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



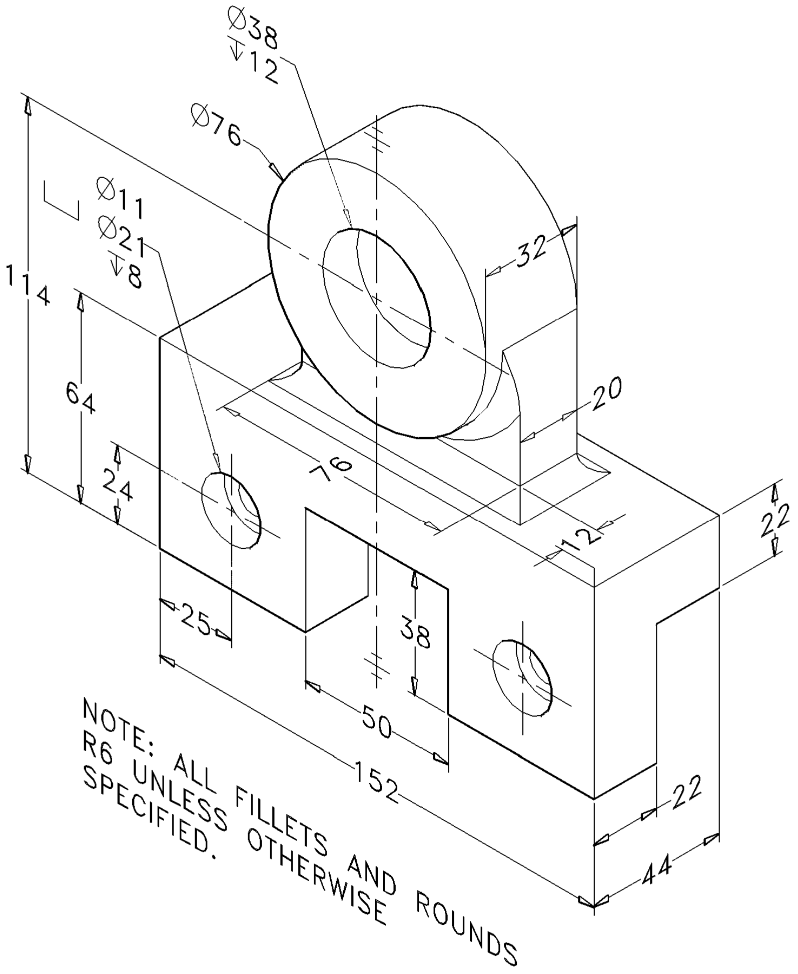
P2-29) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



P2-30) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

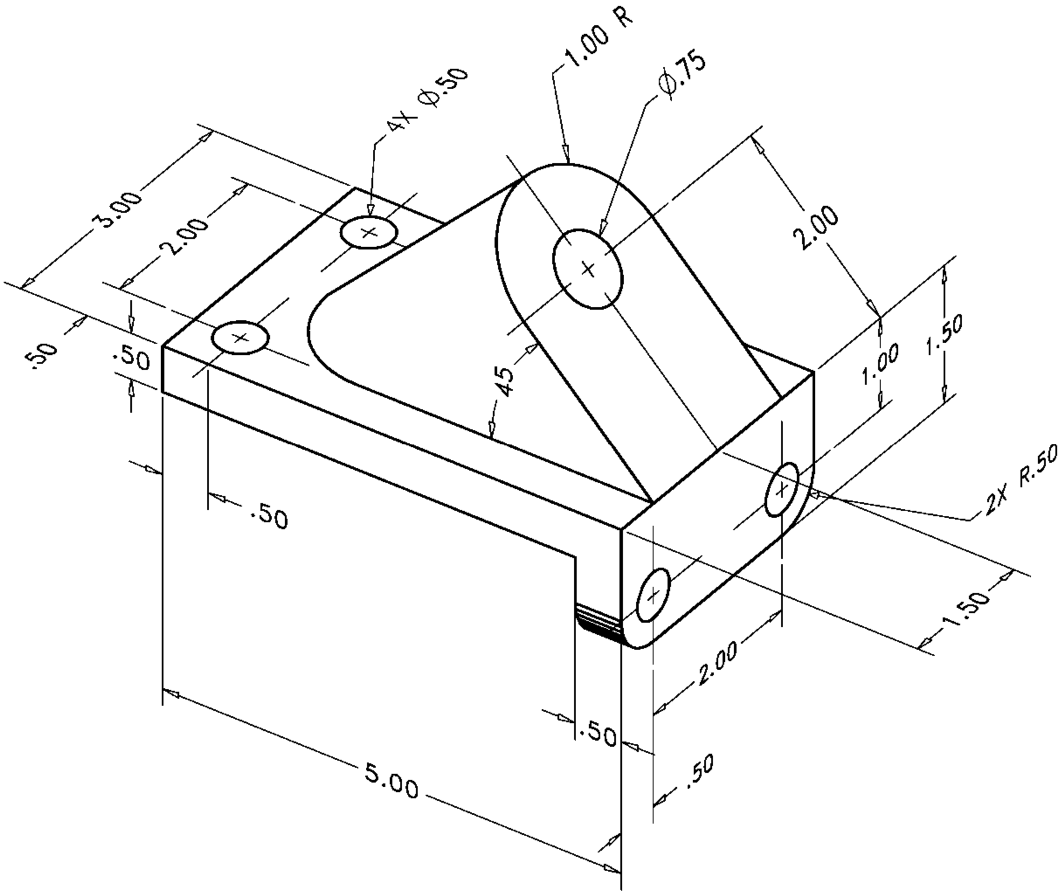


P2-31) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

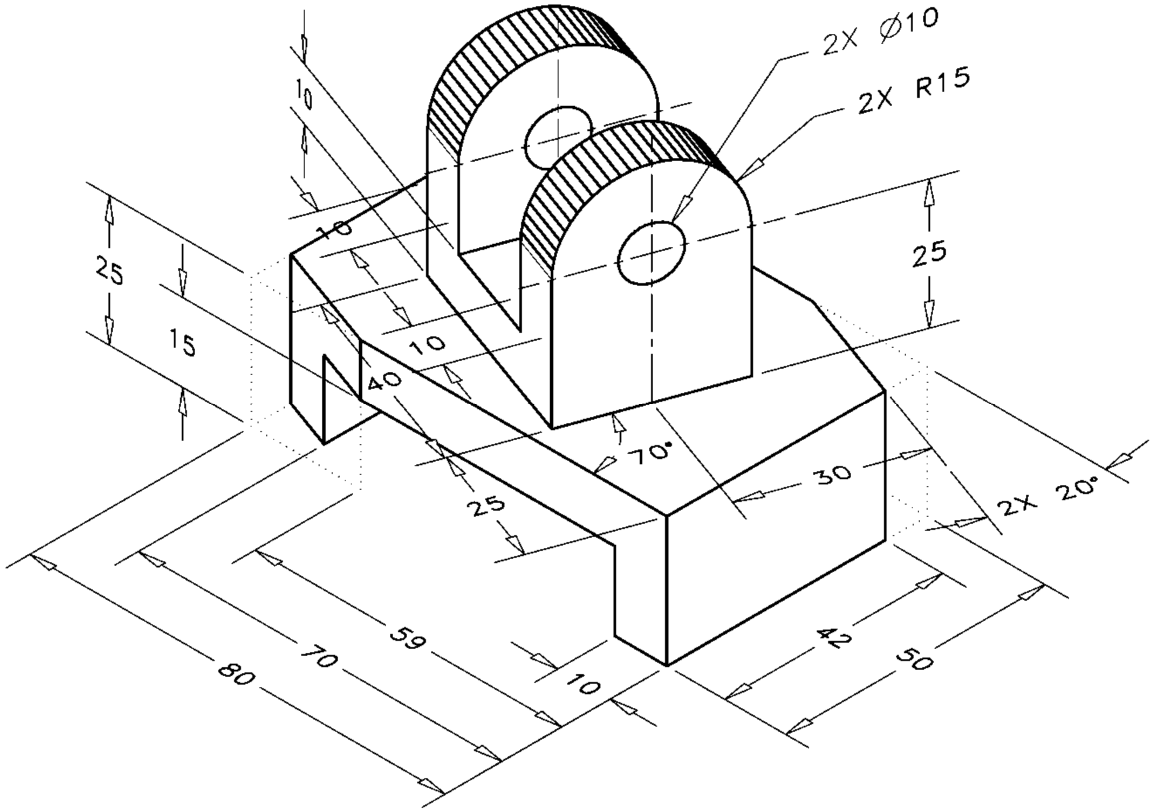


NOTE: ALL FILLETS AND ROUNDS R6 UNLESS OTHERWISE SPECIFIED.

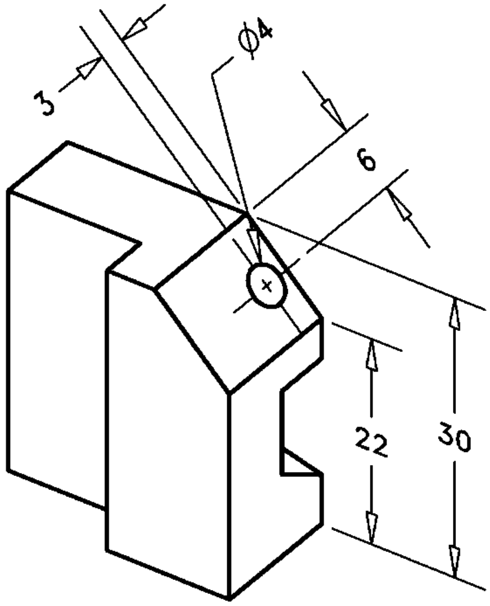
P2-32) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.

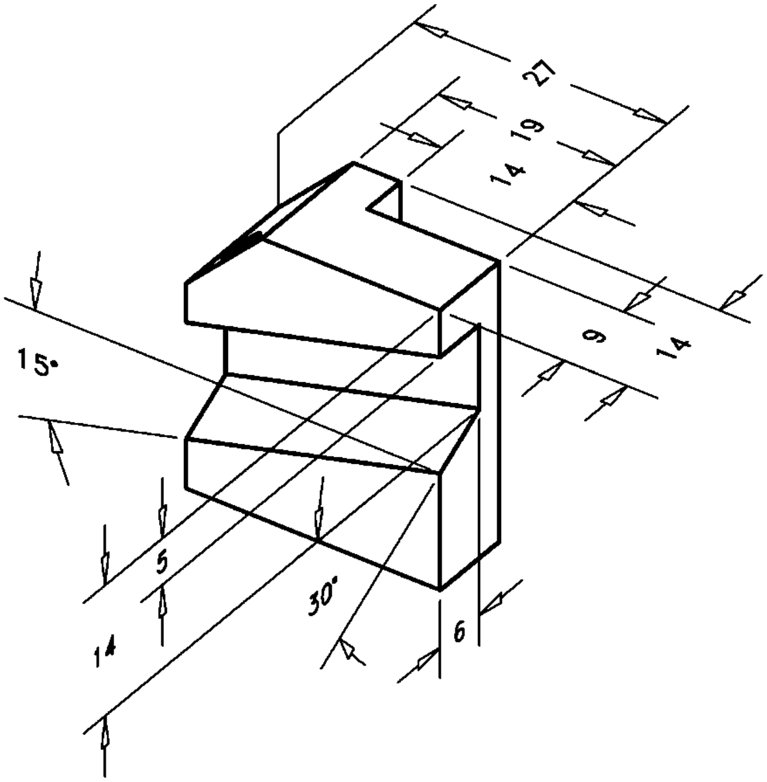


P2-33) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.



P2-34) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.





P2-35) Using a computer drawing package, draw the necessary views and completely dimension the part shown. Do not base your 2-D dimension placement on the 3-D dimensions shown. Use proper dimensioning techniques to dimension your object. Include a title block and print using appropriate pen widths.