

**AUTOMATION LAB**  
**B.E (Mechanical) VI semester**

**2021**

Name: \_\_\_\_\_

Roll No: \_\_\_\_\_ Batch. \_\_\_\_\_

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## DEPARTMENT OF MECHANICAL ENGINEERING

### VISION

The Mechanical Engineering Department endeavors to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to cater the ever changing industrial demands and social needs.

### MISSION

The Mechanical Engineering program makes available a high quality, relevant engineering education. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare the graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
- Extend a vital, state-of-the-art infrastructure to the students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- Develop the student community with wider knowledge in the emerging fields of Mechanical Engineering.
- Provide set of skills, knowledge and attitude that will permit the graduates to succeed and thrive as engineers and leaders.
- Create a conducive and supportive environment for all round growth of the students, faculty & staff

### PROGRAM EDUCATIONAL OBJECTIVES

1.	Prepare the graduates with a solid foundation in Engineering, Science and Technology for a successful career in Mechanical Engineering.
2.	Train the students to solve problems in Mechanical Engineering and related areas by engineering analysis, computation and experimentation, including understanding basic mathematical and scientific principles.
3.	Inculcate students with professional and ethical attitude, effective communication skills, team work skills and multidisciplinary approach
4.	Provide opportunity to the students to expand their horizon beyond mechanical engineering
5.	Develop the students to adapt to the rapidly changing environment in the areas of mechanical engineering and scale new heights in their profession through lifelong learning

## NOTES TO REMEMBER WHEN WORKING IN AutoCAD

1. When using an AutoCAD command, you **MUST** read the prompt line and respond as needed
2. In a prompt, the **CAPITALIZED** letter(s) of an option are typed short-cuts for that option. Information typed on the prompt line is not case-sensitive.
3. To exit a command and return to a Command: prompt, press the Esc (Escape) key.
4. In command prompts, AutoCAD's default selection for the prompt appears between the less than and more than symbols (< >). If you press the Enter key without typing a different option on the prompt line, the default option is selected.

**EXAMPLE:** In a prompt for the Circle command, which reads:  
3P/2P/TTR/ <point>:

If no other option is selected, AutoCAD assumes that you will give it a location for the center of the circle. If you want to use any other option (2P, 3P, or TTR), you must type the option on the prompt line.

5. When AutoCAD asks you to indicate a location for an object, the default method of selection is a mouse pick. If you accidentally click your left mouse button while the cursor is in the drawing area, the object will be placed where the cursor was located when you clicked the mouse button.
6. Help files of AutoCAD are the best resource for reference. To open it from AutoCAD use Help Menu.
7. **Save often to avoid losing your work or you WILL regret it.**

## A quick summary of the basic AutoCAD commands used.

Tool bars are also used. Right click in an empty toolbar area to configure.

<b>Command line:</b>	<b>Key shortcut:</b>	<b>Pull down menu:</b>
CLOSE		File > Close
UNITS		Format > Drawing Setup...
LIMITS		Format > Drawing Limits
GRID	F7	Format > Drafting Settings...
SNAP	F9	Format > Drafting Settings...
ZOOM	Z	
	Esc	
SAVEAS		File > Save as...
LINE		Draw > Line
COORDS		
SPLINE		Draw > Spline
ERASE		Modify > Erase
TRIM		Modify > Trim
OFFSET		Modify > Offset
EXTEND		Modify > Extend
OSNAP	F3	
LA		
XLINE		Draw > Construction Line
LTSCALE		
PROPERTIES		Modify > Properties
MOVE		Modify > Move
BHATCH		Draw > Hatch
BLOCK		Draw > Block > Make
INSERT		Insert > Block...
DIMSTYLE		Format > Dimension Style...
MTEXT		Draw > Text
VPORTS		View > Viewports

**Ex. No: 1**

**Date:**

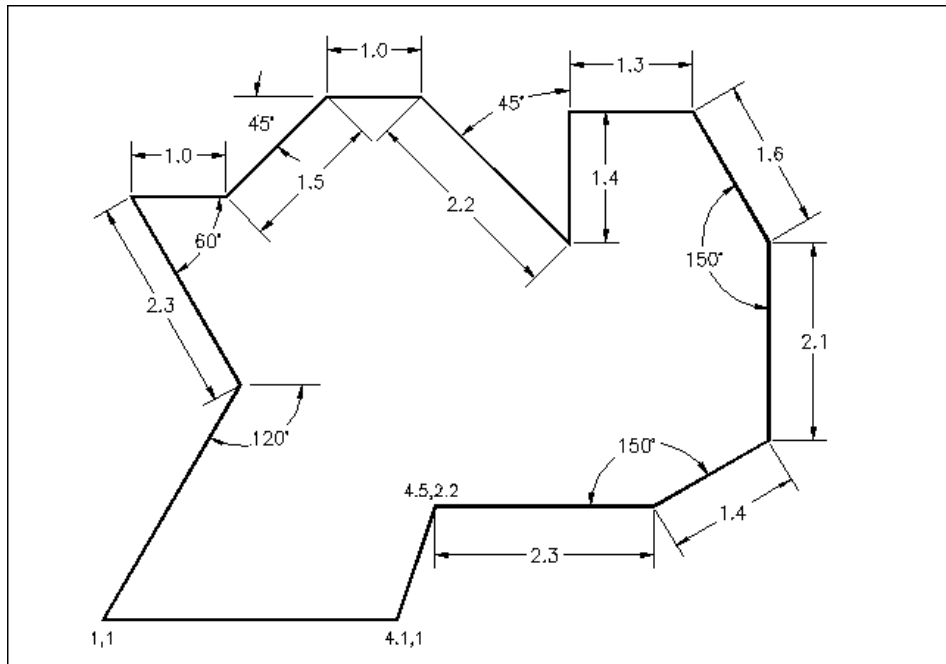


Fig - 1

The following is a list of all the commands required to complete Ex.No.1. Press the F2 key to see your input. (Press F2 to close the text screen).

Remember to press **ENTER** after entering each co-ordinate point.

**Command: 1 LINE**

**From point: 1,1**

**Specify next point or [Undo]: 4.1,1**

**Specify next point or [Undo]: 4.5,2.2**

**Specify next point or [Close/Undo]: @2.3,0**

**Specify next point or [Close/Undo]: @1.4<30**

**Specify next point or [Close/Undo]: @0,2.1**

**Specify next point or [Close/Undo]: @1.6<120**

**Specify next point or [Close/Undo]: @-1.3,0**

**Specify next point or [Close/Undo]: @0,-1.4**

**Specify next point or [Close/Undo]: @2.2<135**

**Specify next point or [Close/Undo]: @-1,0**

**Specify next point or [Close/Undo]: @1.5<225**

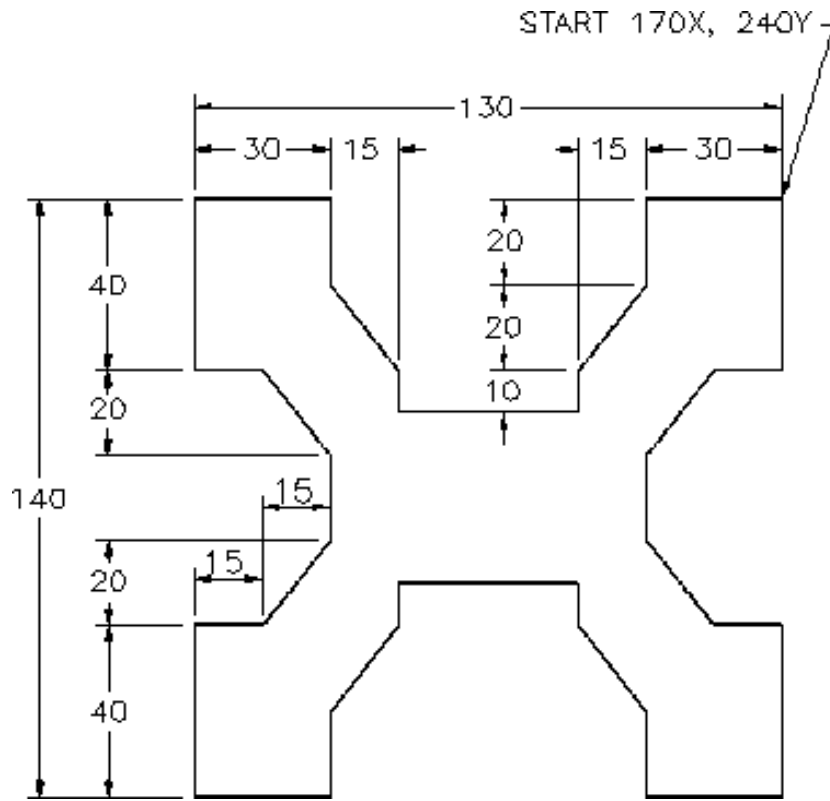
**Specify next point or [Close/Undo]: @-1,0**

**Specify next point or [Close/Undo]: @2.3<-60**

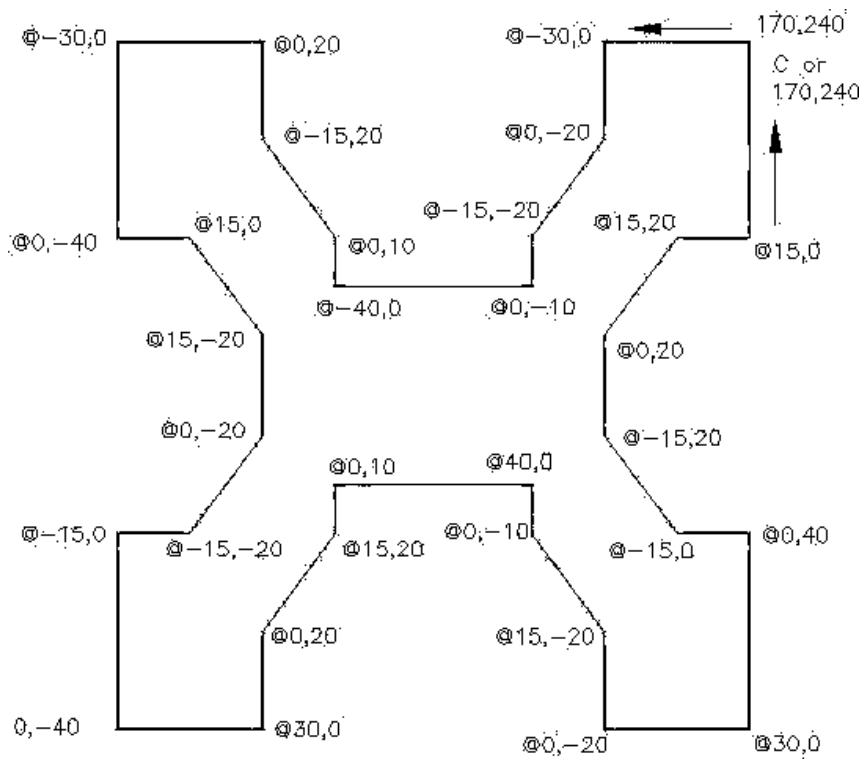
**Specify next point or [Close/Undo]: 1,1**

**Ex. No: 2**

**Date:**



**Hint for Fig.2**



**Ex. No: 3**

**Date:**

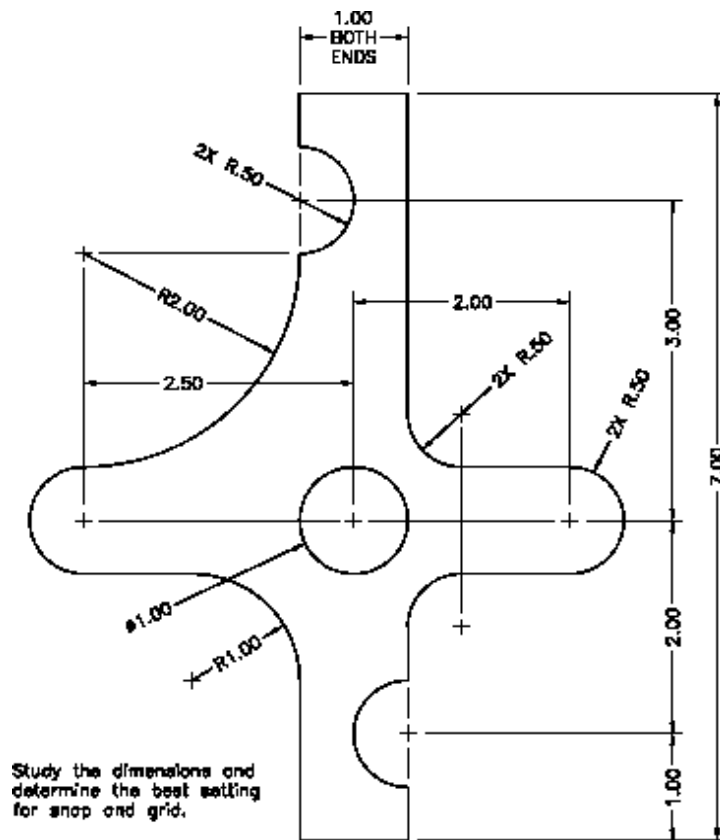


Fig - 3



**Ex. No: 4**

**Date:**

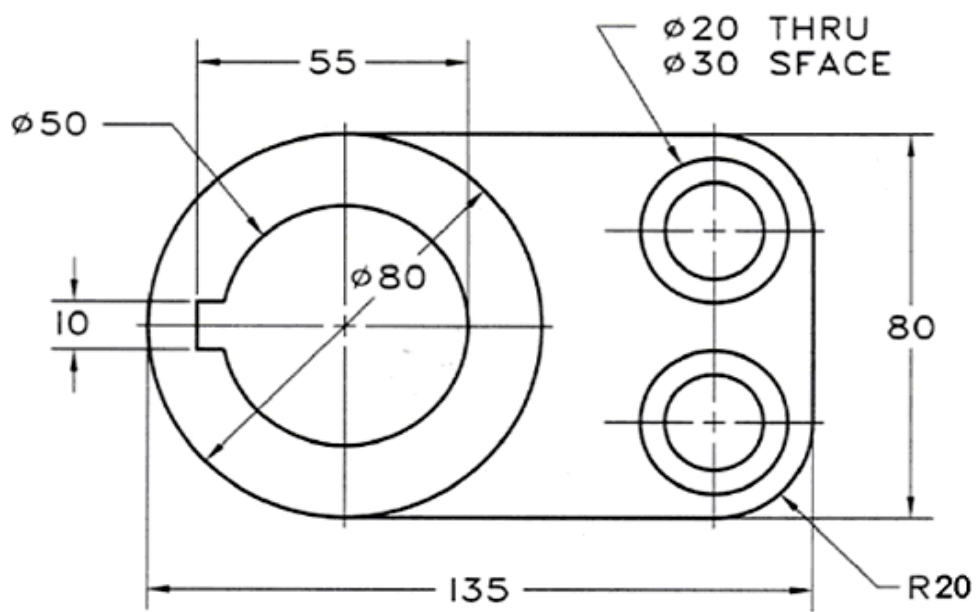


Fig - 4

**Ex. No: 5**  
**Date:**

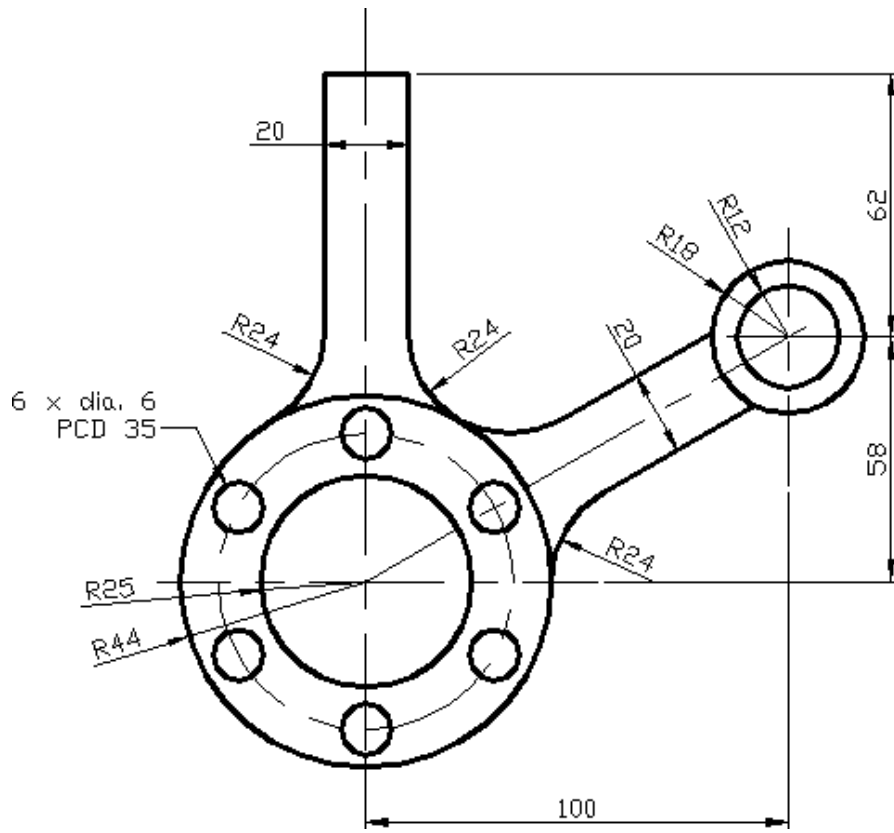


Fig - 5

# MACHINE DRAWING

**Ex. No: 6**

**KNUCKLE JOINT**

**Date:**

Draw Full sectional front view (Fig 6) of the knuckle Joint

**PROCEDURE:**

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command) .From the dialog box, select end point, mid point etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box select required view.
6. Draw the different parts of Knuckle joint by using draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of drawing is hatched.

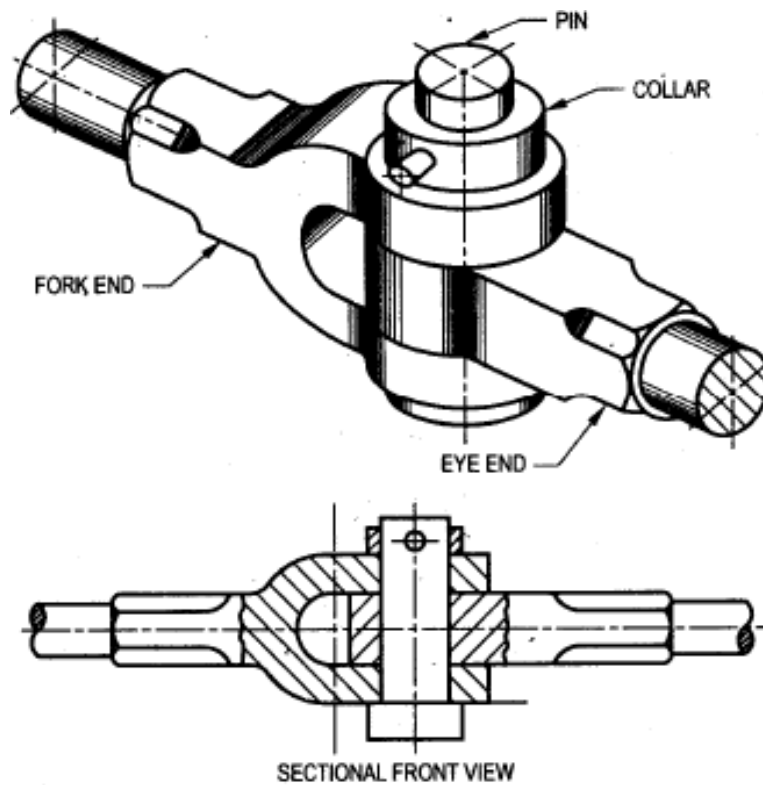
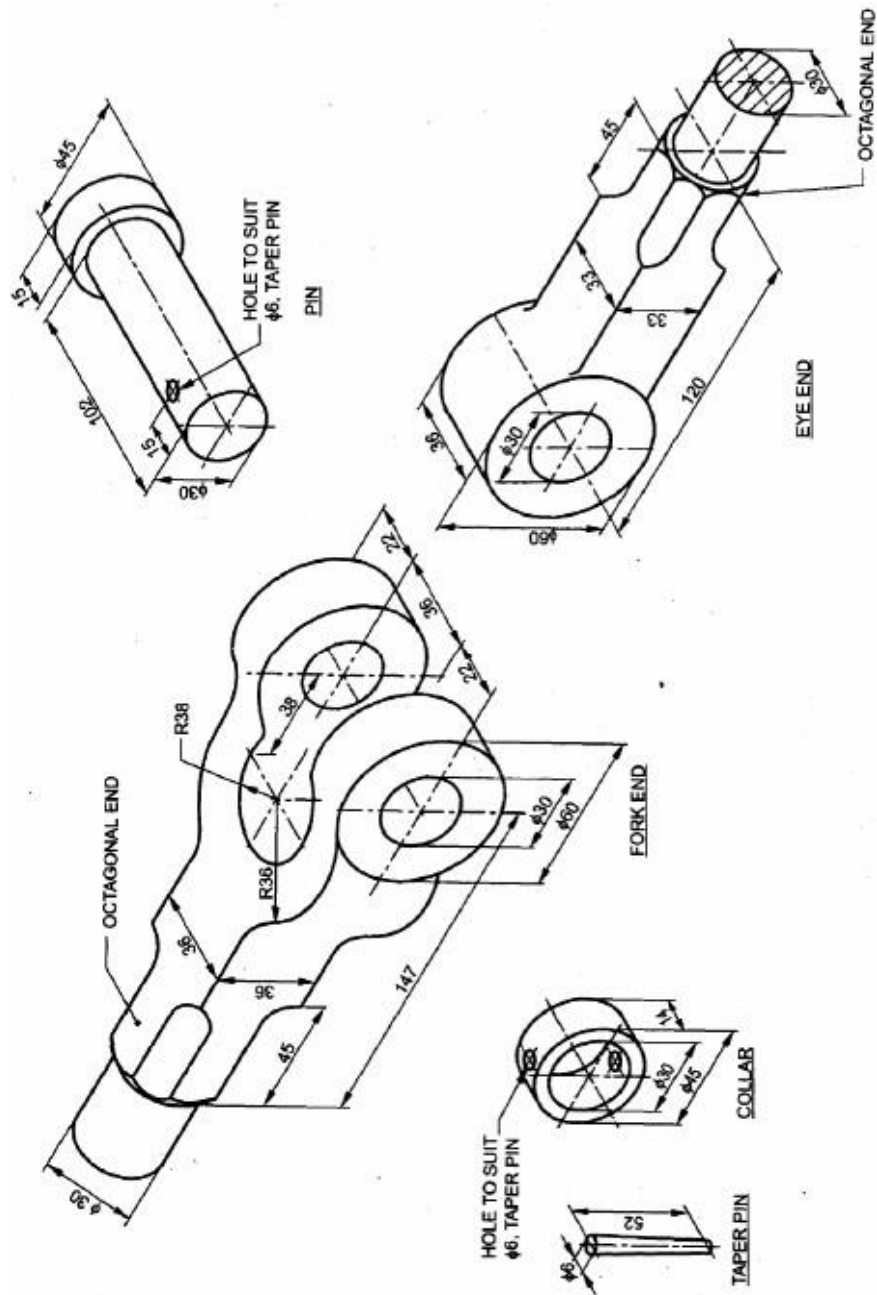


Fig 6



**DETAILS OF KNUCKLE JOINT**

ALL DIMENSIONS IN MM.

**Ex. No: 7**

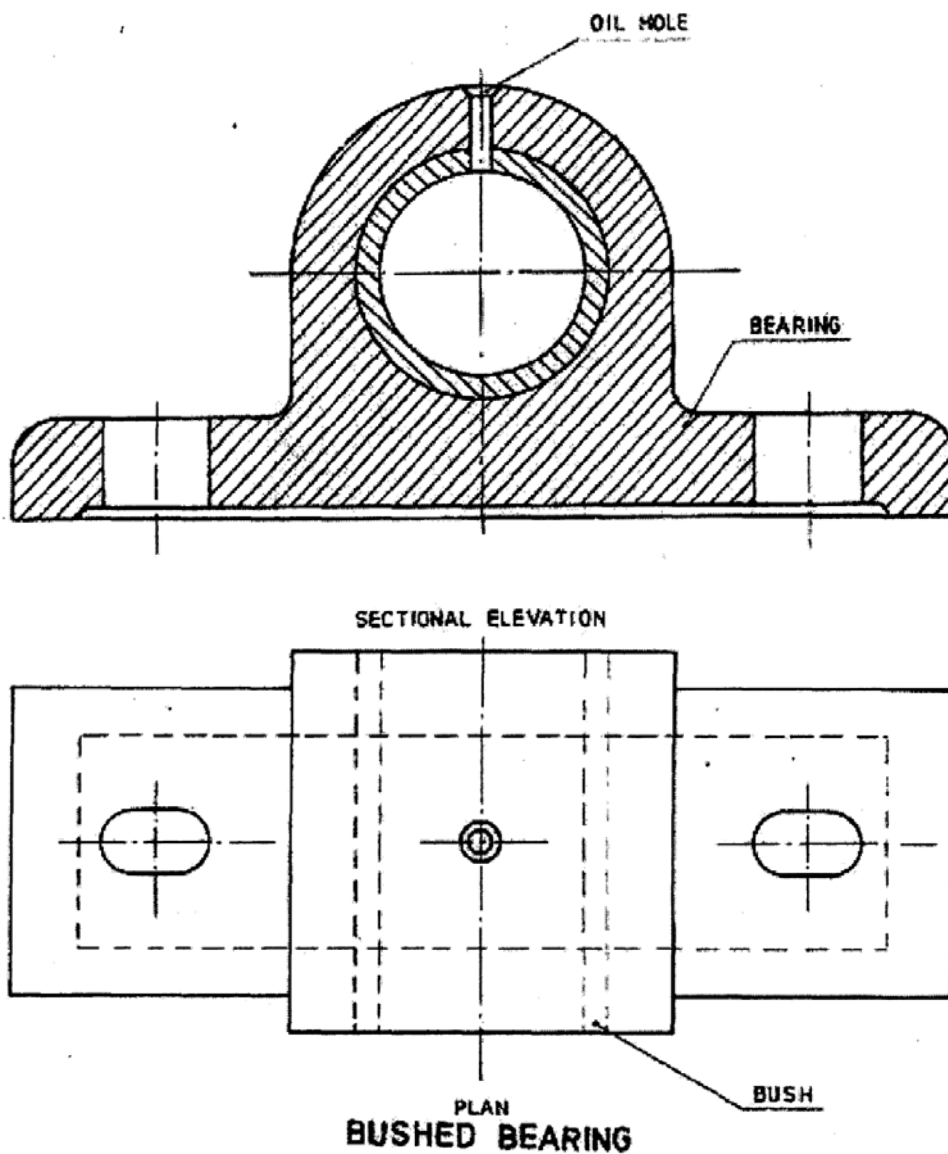
**BUSHED BEARING**

**Date:**

Draw the Full Sectional Front View (Fig 7) of the BUSHED BEARING

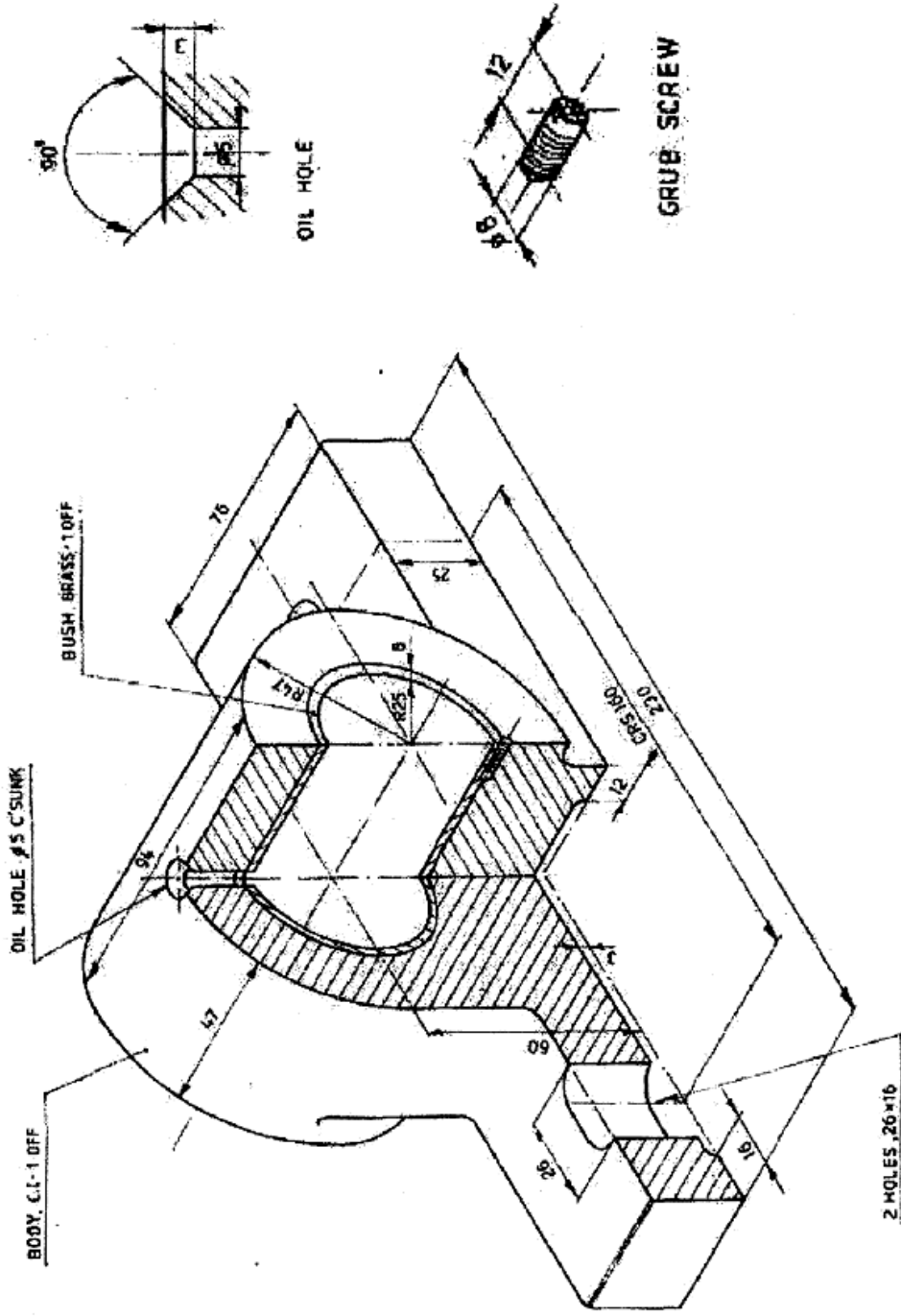
**PROCEDURE:**

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command) .From the dialog box, select end point, midpoint etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box select required view.
6. Draw the different parts of bushed bearing by using draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of drawing is hatched.



**Fig 7**

# BUSHED BEARING



## C++ PROGRAM: -

### OTTO CYCLE EFFICIENCY

**Ex. No: 8**

**Date:**

**Program:**

```
#include<iostream.h>
#include<conio.h>
#include<math.h>
#include<iomanip.h>

void main()
{

clrscr();
float cr,p1,p2,p3,p4,t1,t2,t3,t4,q1,eff;

cout<<"\nEnter the Compression ratio (cr) ";
cin>>cr;

cout<<"\nEnter the initial pressure(p1) in bar";
cin>>p1;

cout<<"\nEnter the initial Temperature (t1) in
Kelvin";
cin>>t1;

cout<<"\nEnter the Heat Supplied (q1) kJ/kg ";
cin>>q1;

cout<<"\n*****OTTO CYCLE*****\n";

p2=pow(cr,1.4)*p1;

t2=pow(cr,1.4-1)*t1;

t3=q1/0.718+t2;
```

## C++ PROGRAM: –

### OTTO CYCLE EFFICIENCY

**Ex. No: 8**

**Date:**

**Aim:**

An engine working on the Otto cycle is supplied with air at 0.1MPa, 35°C. The compression ratio is 8. Heat supplied is 2100KJ/Kg. K. To write a program in C++ to calculate the maximum temperature, maximum pressure and efficiency of the cycle. (For air,  $C_v = 0.718$  kJ/kg.K,  $C_p = 1.005$  kJ/kg.K and  $R = 0.287$ kJ/kg.K.

**Given Data:**

$P_1 = 0.1\text{MPa} = 1\text{bar}$ ,  $T_1 = 35^\circ\text{C} = 308$  K,  $\text{CR} = 8$ ,  
 $Q_1 = 2100\text{kJ/kg K}$ ,  $C_v = 0.718$  kJ/kg K,  $C_p = 1.005$  kJ/kg K  
and  $R = 0.287$  kJ/kg K.

**Usage of Formula:**

$$P_2 = rk^\gamma * P_1, \quad T_2 = rk^{\gamma-1} * T_1, \quad T_3 = \frac{Q_1}{C_v} + T_2,$$

$$P_3 = \frac{T_3}{T_2} * P_2, \quad P_4 = \left(\frac{1}{rk}\right)^\gamma * P_3, \quad T_4 = \left(\frac{1}{rk}\right)^{\gamma-1} * T_3,$$

$$\eta = 1 - \frac{1}{rk^{\gamma-1}}$$

where,

$rk$  = Compression ratio,  $\gamma$  = Specific heat ratio = 1.4

**Display:**



```

p3=(t3/t2)*p2;

p4=pow(1/cr,1.4)*p3;

t4=pow(1/cr,1.4-1)*t3;

eff=1-1/pow(cr,1.4-1);

cout<<"\nPressure: \n";
cout<<"\n\t P1="<<setprecision(2)<<p1<<"bar";

cout<<"\n\t P2="<<setprecision(2)<<p2<<"bar";

cout<<"\n\t P3="<<setprecision(2)<<p3<<"bar";

cout<<"\n\t P4="<<setprecision(2)<<p4<<"bar";

cout<<"\nTemperature:\n";
cout<<"\n\t t1="<<setprecision(2)<<t1<<"Kelvin";

cout<<"\n\t t2="<<setprecision(2)<<t2<<"Kelvin";

cout<<"\n\t t3="<<setprecision(2)<<t3<<"Kelvin";

cout<<"\n\t t4="<<setprecision(2)<<t4<<"Kelvin";

cout<<"\nThe efficiency of the cycle =
"<<setprecision(2)<<eff*100<<"%";

getch();
}

```

# C++ PROGRAM: -

## COMPRESSOR DIMENSIONS

**Ex. No: 9**

**Date:**

**Program:**

```
#include<iostream.h>
#include<conio.h>
#include<math.h>

void main()
{

clrscr();

float fad,p1,p2,n,N,vc,vs,y,eff,
volume,vol,dia,stroke;

cout<<"\n**** COMPRESSOR DIMENSIONS ****\n";

cout<<"\nEnter the value of air delivered:";
cin>>fad;

cout<<"\nEnter Initial pressure and Compressed
pressure in bar:";
cin>>p1>>p2;

cout<<"\nEnter the speed in rpm:";
cin>>N;

cout<<"\nEnter Vc and Vs value :";
cin>>vc>>vs;

cout<<"\nEnter L/D ratio:";
cin>>y;

cout<<"\nEnter the n value:";
cin>>n;
```

# C++ PROGRAM: -

## COMPRESSOR DIMENSIONS

**Ex. No: 9**

**Date:**

**Aim:**

To write a program in C++ to determine the diameter and stroke length of the compressor.

The parameters are

- 1) The Free Air Delivered (FAD) is 150 m<sup>3</sup>/min.
- 2) Initial pressure is 1 bar
- 3) Compressed pressure is 8 bar
- 4) The speed of compressor is 300 rpm
- 5) Clearance volume is 1 m<sup>3</sup>
- 6) Swept volume is 16 m<sup>3</sup>
- 7) L/D ratio is 1.5
- 8) n = 1.3

**Given Data:**

FAD = 150 m<sup>3</sup>/min., P1 = 1bar, P2 = 8bar, N = 300 rpm, Vc = 1m<sup>3</sup>, Vs = 16m<sup>3</sup>, n(specific heat ratio) = 1.3 and L/D = 1.5.

**Usage of Formula:**

$$\eta = 1 - \frac{v_c \left[ \left( \frac{p_2}{p_1} \right)^{\frac{1}{n}} - 1 \right]}{v_s} \quad \eta = \frac{\text{output}}{\text{Input}} = \frac{FAD}{V * N}, \therefore V(\text{volume}) = \frac{FAD}{\eta * N},$$

$$V(\text{volume}) = \frac{\pi}{4} D^2 L, \therefore D = \frac{4 * V}{\pi}, D(\text{diameter}) = \sqrt[3]{\frac{4 * V}{\pi}} = \left( \frac{4 * V}{\pi} \right)^{1/3}$$

$$V = \pi/4 D^2 L, L=1.5D$$

$$D^3 = \frac{4 * V}{1.5 * \pi}$$

$$D = \left( \frac{4 * V}{1.5 * \pi} \right)^{1/3}$$

```

eff=1-((vc/vs)*(pow(p2/p1,1/n)-1));
Volume=fad/(eff*N);
vol=(volume*4)/(y*3.141);
dia=pow(vol,0.333);
stroke=y*dia;
cout<<"\nCOMPRESSOR DIMENSIONS:\n";
cout<<"\nDiameter of the compressor is "<<dia<<"m";
cout<<"\nStroke of the compressor is "<<stroke<<"m";
getch();
}

```

**Display:**

## MATLAB

*MATLAB*, developed by Math works Inc., is a software package for high performance numerical computation and visualization. *MATLAB* provides an interactive environment with hundreds of reliable and accurate built-in mathematical functions. These functions provide solutions to a broad range of mathematical problems including matrix algebra, complex arithmetic, linear systems, differential equations, and many other types of scientific computations.

### RUNNING MATLAB

*MATLAB* supports almost every computational platform. *MATLAB* for *WINDOWS* is started by clicking on the *MATLAB* icon. The **command window** is launched, and after some messages such as intro, demo, help, info, and others, the prompt “>>” is displayed. The program is in an interactive command mode. If an expression with correct syntax is entered at the prompt in the command window, it is processed immediately and the result is displayed on the screen. If an expression requires more than one line, the last character of the previous line must contain three dots “...”. Characters following the percent sign are ignored. The command **clear** erases all variables in the command window.

In *MATLAB*, elements enclosed by brackets and separated by semicolons generate a column vector.

For example, the statement

```
X = [ 2; -4; 8] results in
```

```
X =
    2
   -4
    8
```

If elements are separated by blanks or commas, a row vector is produced.

### ELEMENTARY MATRIX OPERATIONS

*MATLAB* has two different types of arithmetic operations. Matrix arithmetic operations are defined by the rules of linear algebra. Array arithmetic operations are carried out element-by-element.

In *MATLAB*, a matrix is created with a rectangular array of numbers surrounded by brackets. The elements in each row are separated by blanks or commas. A semicolon must be used to indicate the end of a row. Matrix elements can be any *MATLAB* expression. The statement

```
A = [6 1 2; -1 8 3; 2 4 9]
```

results in the output

```
A=
    6    1    2
   -1    8    3
    2    4    9
```

If a semicolon is not used, each row must be entered in a separate line as shown below.

$$A = \begin{bmatrix} 6 & 1 & 2 \\ -1 & 8 & 3 \\ 2 & 4 & 9 \end{bmatrix}$$

Matrices of the same dimension can be added or subtracted. Two matrices, A and B, can be multiplied together to form the product AB if they are conformable. Two symbols are used for nonsingular matrix division.

$A \setminus B$  is equivalent to  $A^{-1}B$  and  $A/B$  is equivalent to  $AB^{-1}$

## 1.7 ELEMENTARY MATRIX OPERATIONS 11

### Example 1.1

For the matrix equation below,  $AX = B$ , determine the vector X.

$$\begin{bmatrix} 4 & -2 & -10 \\ 2 & 10 & -12 \\ -4 & -6 & 16 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix} = \begin{bmatrix} -10 \\ 32 \\ -16 \end{bmatrix}$$

The following statements

$$\begin{aligned} A &= [4 \ -2 \ -10; \ 2 \ 10 \ -12; \ -4 \ -6 \ 16]; \\ B &= [-10; \ 32; \ -16]; \\ X &= A \setminus B \end{aligned}$$

result in the output

$$\begin{aligned} X &= \\ & \mathbf{2.0000} \\ & \mathbf{4.0000} \\ & \mathbf{1.0000} \end{aligned}$$

In addition to the built-in functions, numerous mathematical functions are available in the form of M-files.

### Example 1.2

Use the **inv** function to determine the inverse of matrix A in Example 1.1 and then determine X. The following statements

$$\begin{aligned} A &= [4 \ -2 \ -10; \ 2 \ 10 \ -12; \ -4 \ -6 \ 16]; \\ B &= [-10; \ 32; \ -16]; \\ C &= \text{inv}(A) \end{aligned}$$

$$X = C*B$$

result in the output

```

C=
    2.2000    2.3000    3.1000
    0.4000    0.6000    0.7000
    0.7000    0.8000    1.1000

X=
    2.0000
    4.0000
    1.0000

```

### Example1.3

#### EIGEN VALUES

If A is an n x n matrix the 'n' numbers  $\lambda$  that satisfy  $Ax = \lambda x$  are the eigenvalues of 'A'. They are found using `eig(A)`, which returns the eigenvalues as a column vector. Eigenvalues and eigenvectors can be obtained with a double assignment statement `[X,D]=eig(A)`. The diagonal elements of D are the eigenvalues and the columns of X are the corresponding eigenvectors such that  $AX = XD$ .

Find the eigenvalues and the eigenvectors of the matrix A given by

$$A = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$$

```
A = [0 1 -1; -6 -11 6; -6 -11 5];
```

```
[X, D] = eig(A)
```

The eigenvalues and the eigenvectors are obtained as follows

```

X=
   -0.7071    0.2182   -0.0921
    0.0000    0.4364   -0.5523
    0.7071    0.8729   -0.8285

```

D=

$$\begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix}$$

### **Exercise: 1**

Find the solution to

$$2x_1 + x_2 - 4x_3 + 6x_4 + 3x_5 - 2x_6 = 16$$

$$x_1 + 2x_2 + 3x_3 + 5x_4 - 2x_5 = -7$$

$$x_1 - 2x_2 - 5x_3 + 3x_4 + 2x_5 + x_6 = 1$$

$$4x_1 + 3x_2 - 2x_3 + 2x_4 + x_6 = -1$$

$$3x_1 + x_2 - x_3 + 4x_4 + 3x_5 + 6x_6 = -11$$

$$5x_1 + 2x_2 - 2x_3 + 3x_4 + x_5 + x_6 = 5$$

using the matrix inverse and left and right division

### **Exercise: 2**

Given the matrix  $A = \begin{bmatrix} 7 & -6 & -4 & 1 \\ -5 & 1 & 0 & -2 \\ 10 & 11 & 7 & -3 \\ 19 & 9 & 7 & 1 \end{bmatrix}$ , compute the inverse of A.

Use the resulting matrix to obtain the solution of the matrix equation  $A\mathbf{x} = \mathbf{b}$  for the different choices of  $\mathbf{b}$  given below

(a)  $[-32; -18; 120; 153]$

(b)  $[11; -11; -1; 20]$

(c)  $[-5; -1; 8; 10]$

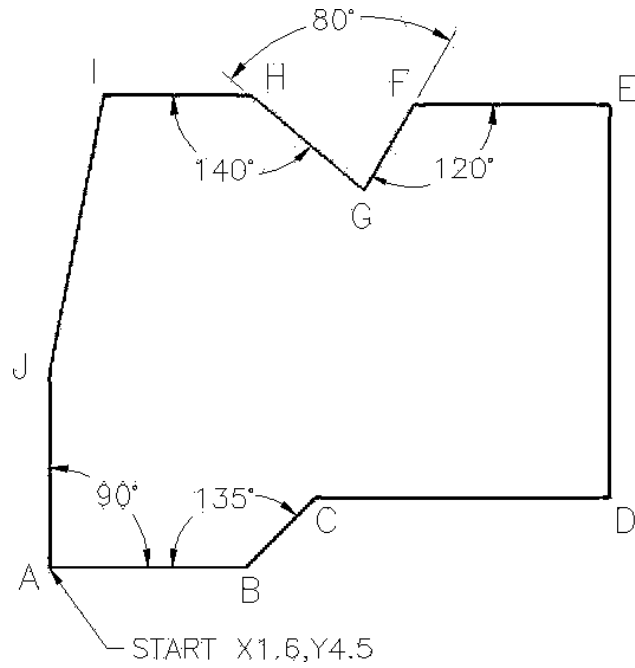
(d)  $[26; -21; 43; 81]$

Employ MatLab for the necessary computations



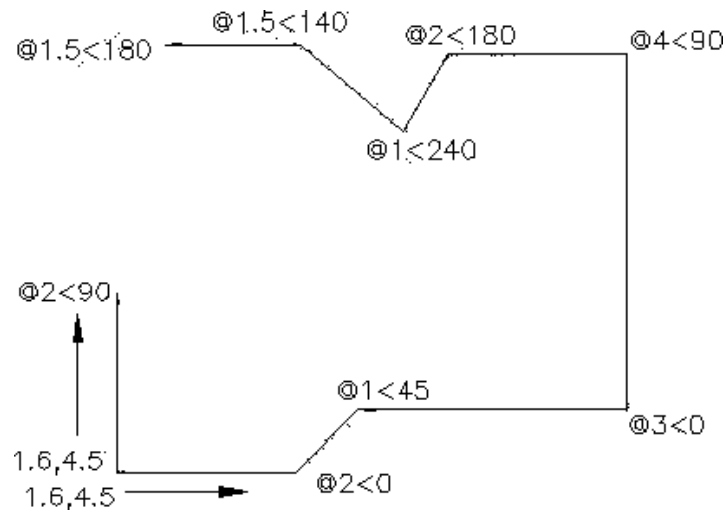
**AutoCAD DRAWINGS FOR PRACTICE**  
**(RECORD WORK NOT REQUIRED)**

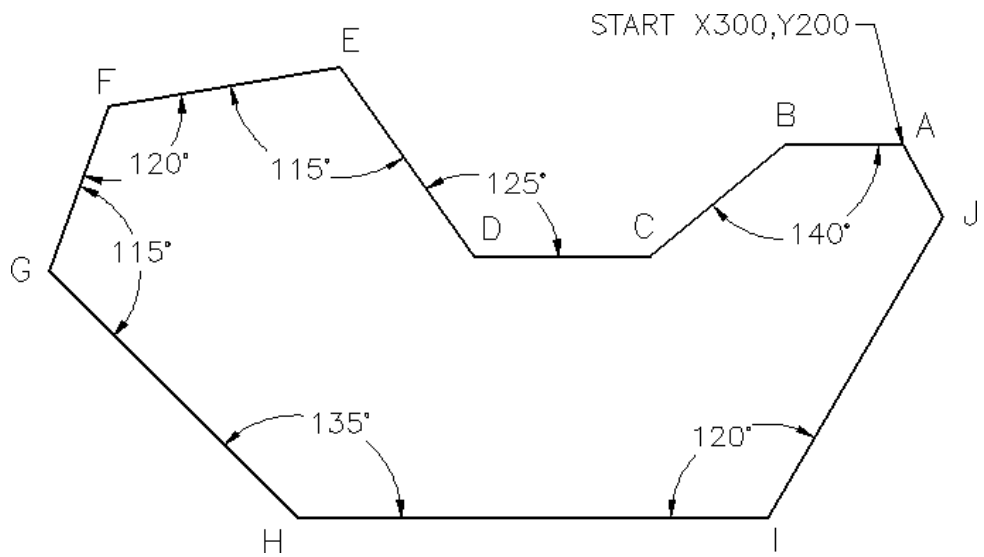
**Ex. No: 1**



**Fig 1.1**

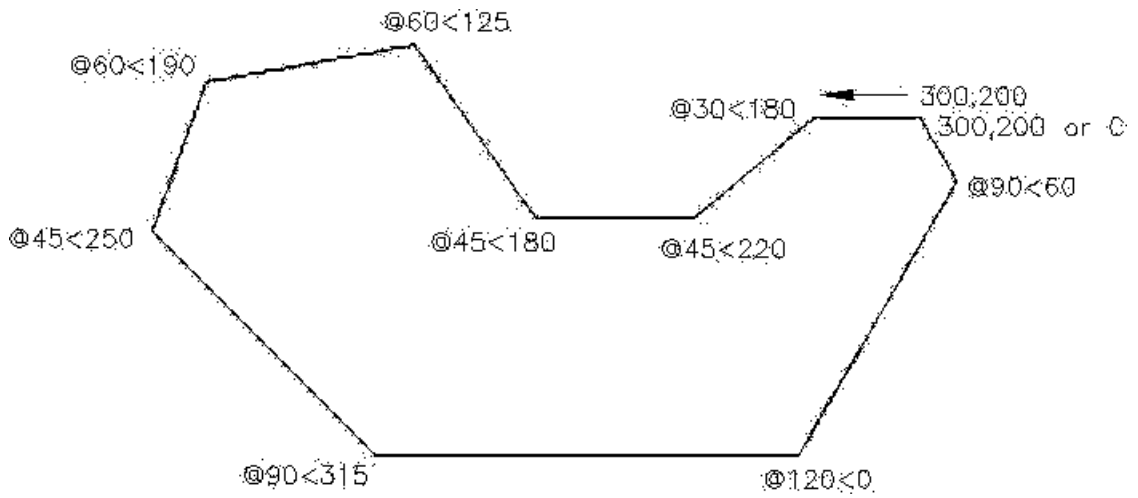
**Hints for Practice Fig 1.1**

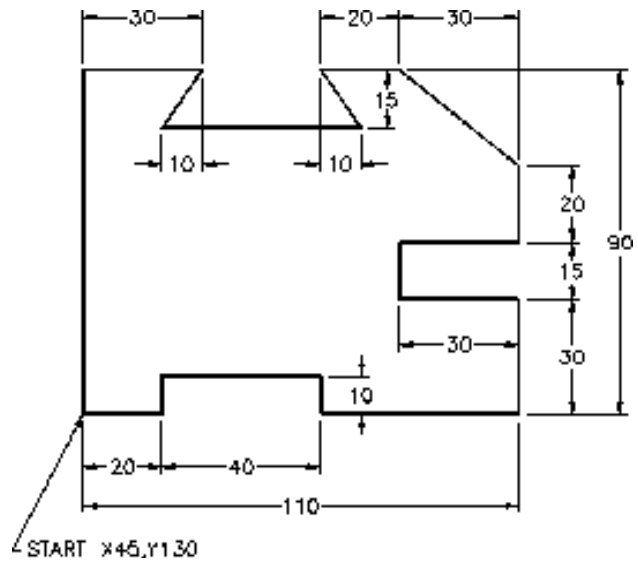




**Fig 1.2**

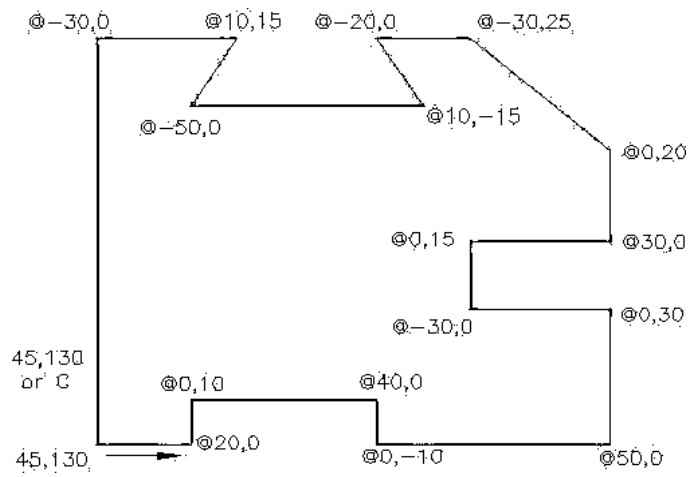
**Hints for Practice Fig 1.2**



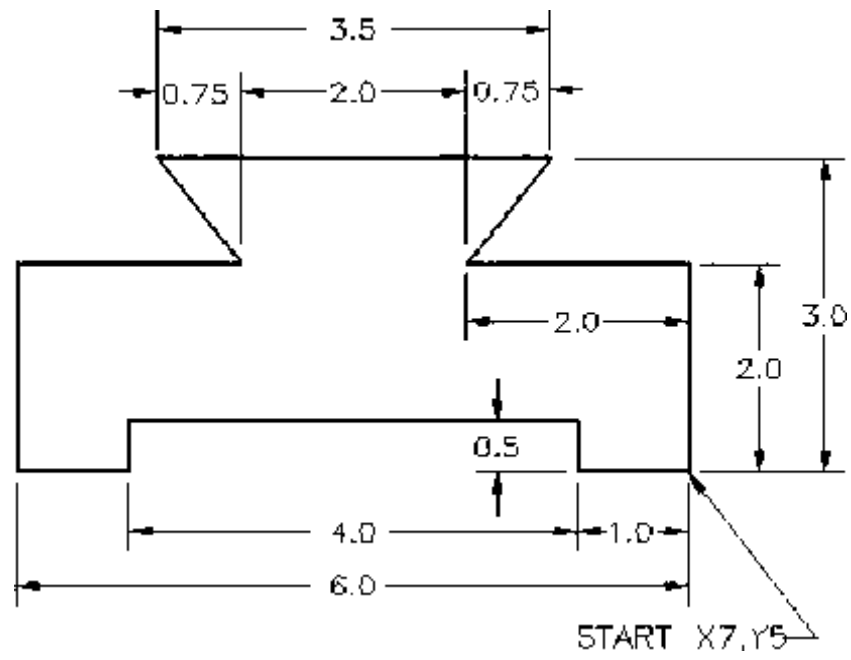


**Fig 1.3**

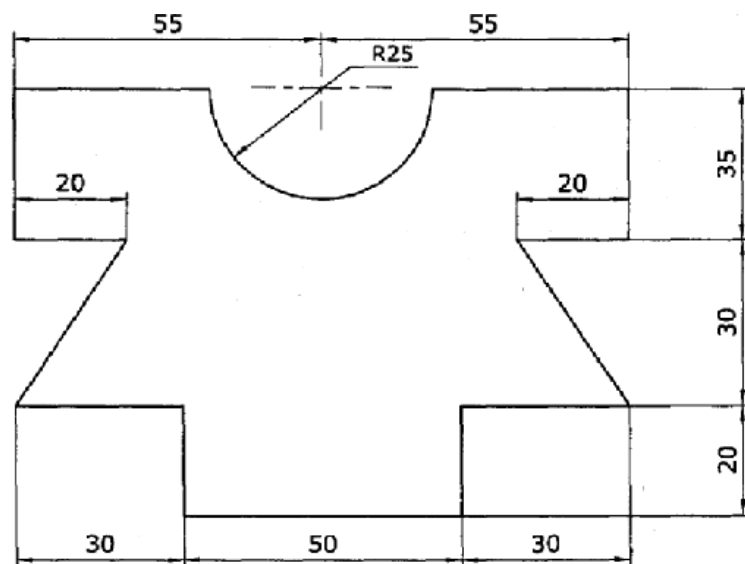
**Hints for Practice Fig 1.3**



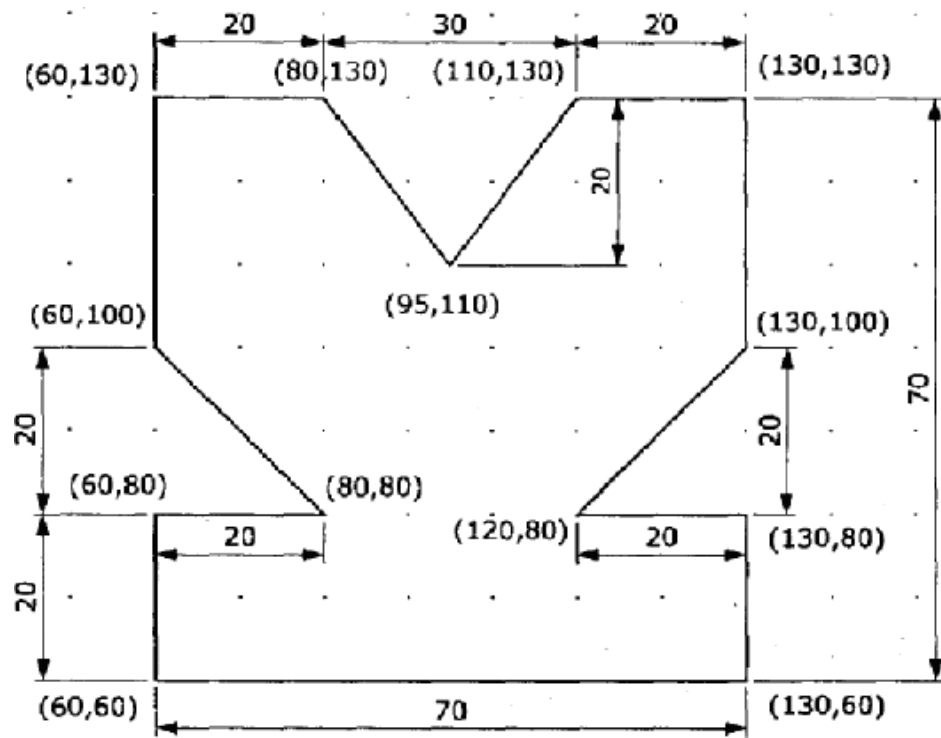
**Ex. No: 2**



**Fig 2.1**

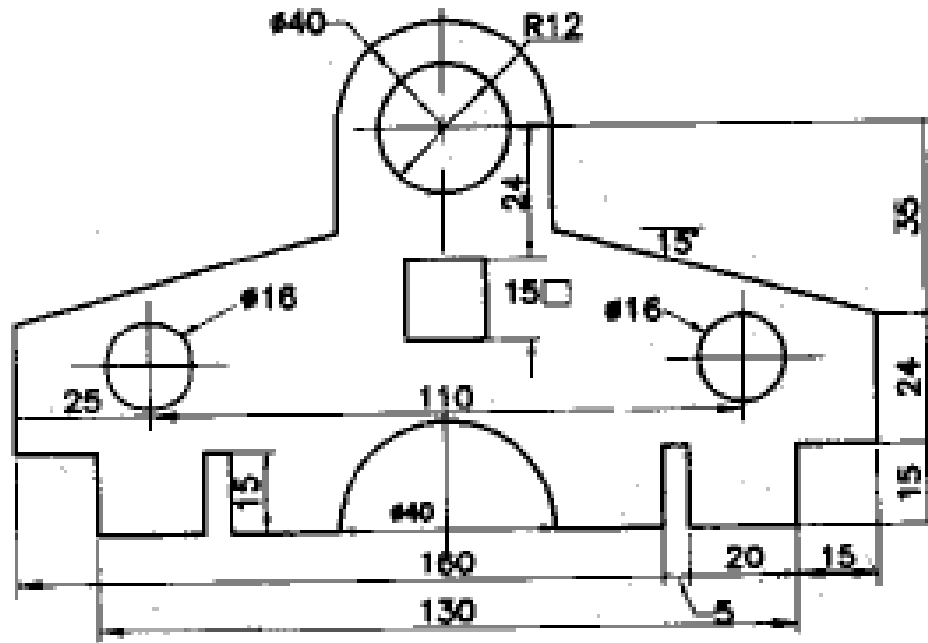


**Fig 2.2**

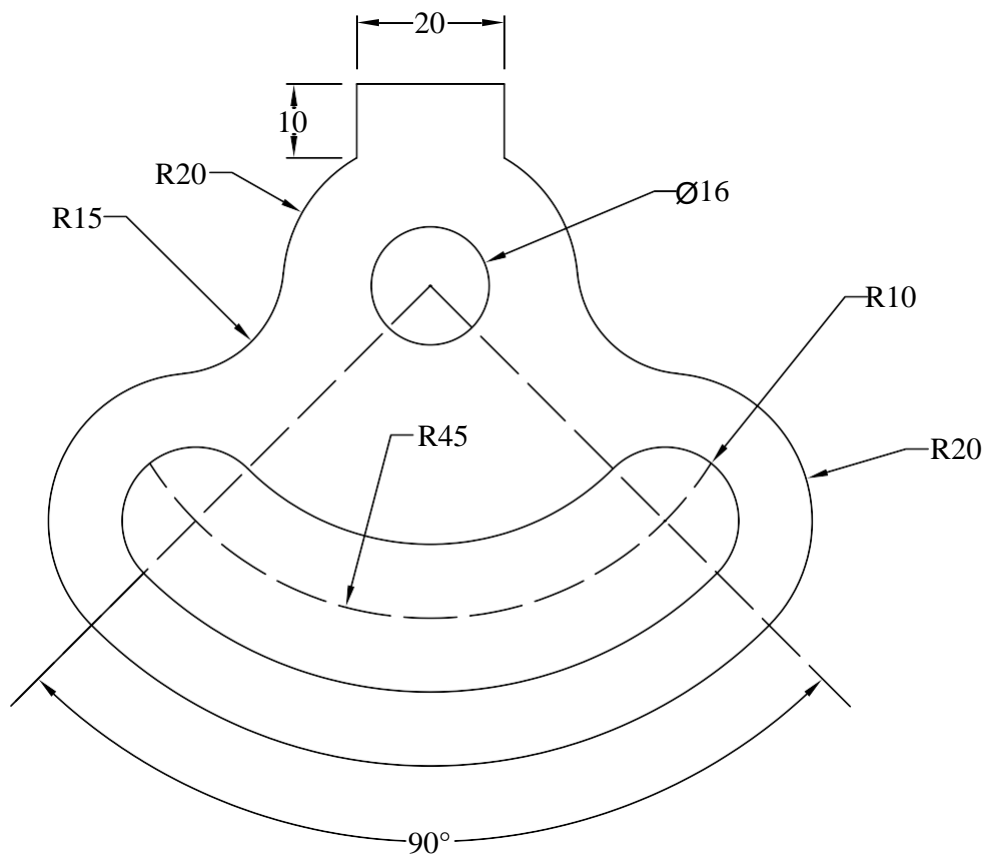


**Fig 2.3**

**Ex. No: 3**

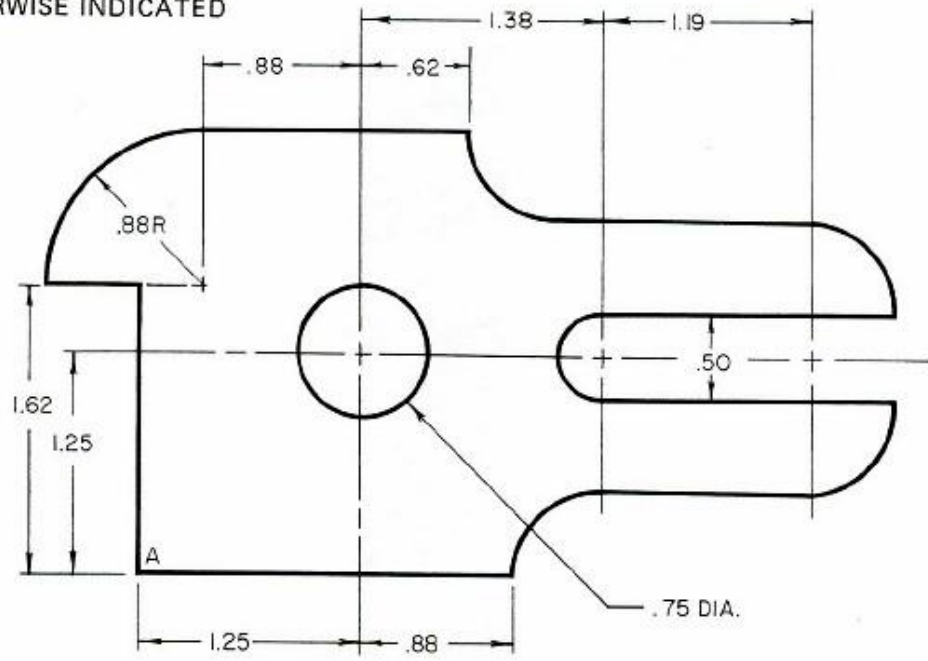


**Fig 3.1**



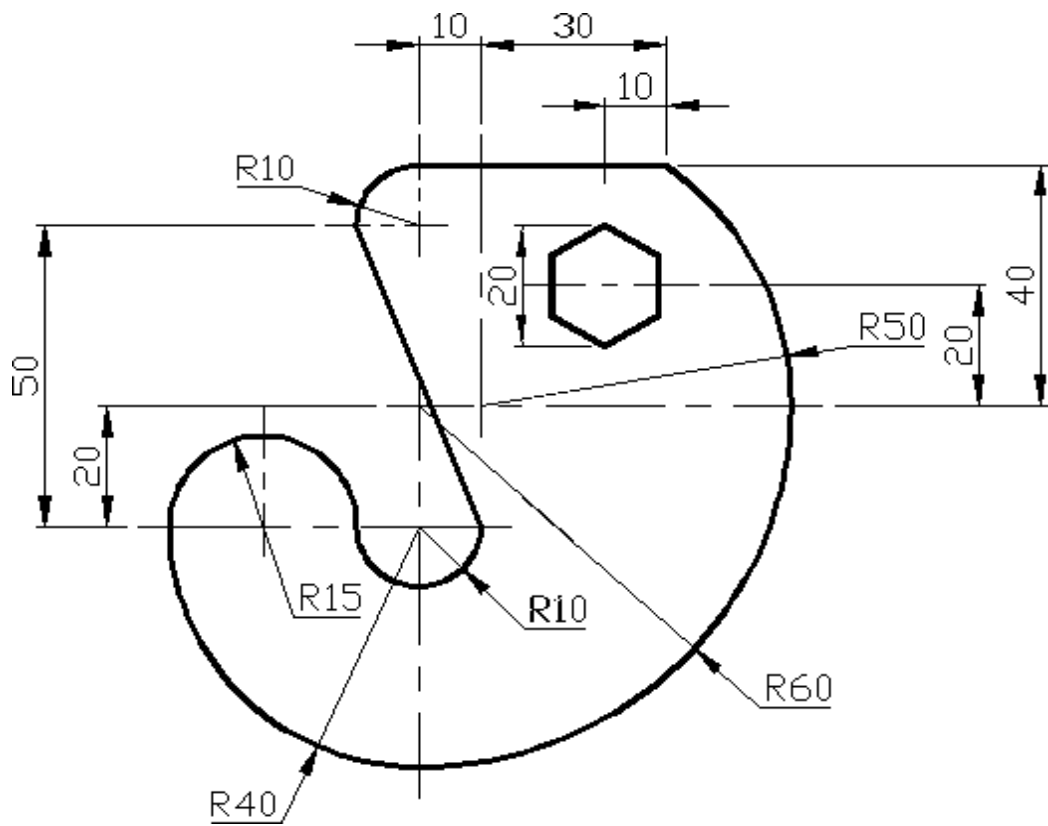
**Fig 3.2**

ALL RADII ARE .50 UNLESS  
OTHERWISE INDICATED

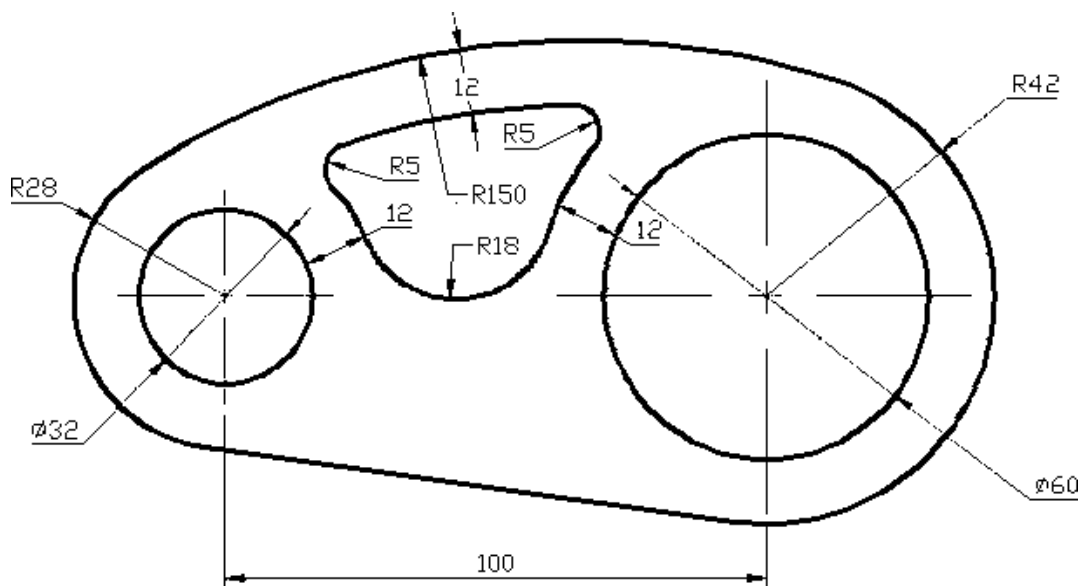


**Fig 3.3**

**Ex. No: 4**

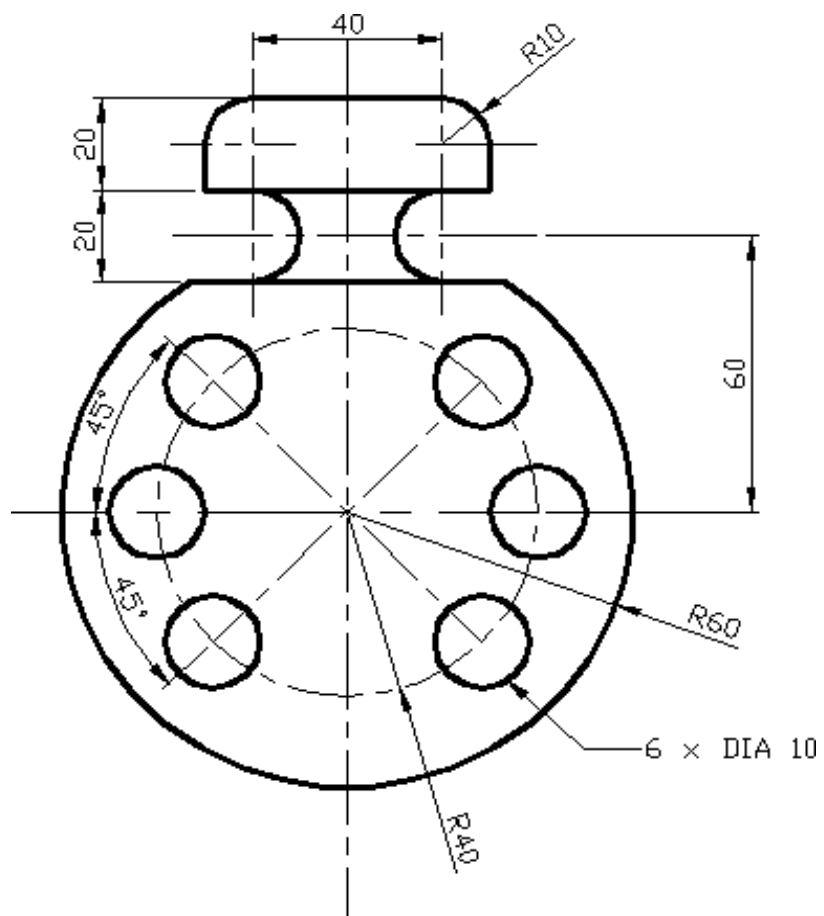


**Fig 4.1**



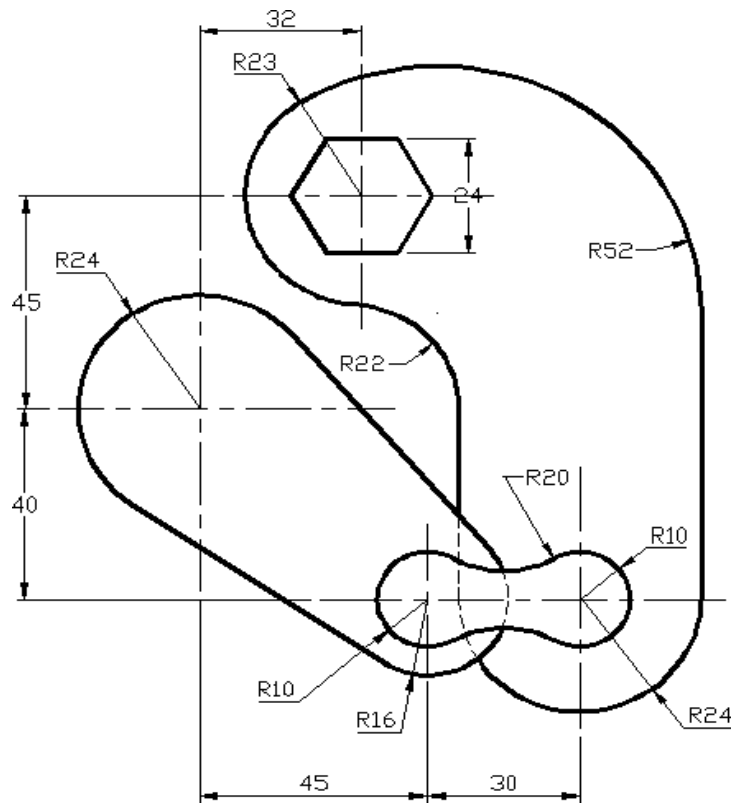
**Fig 4.2**



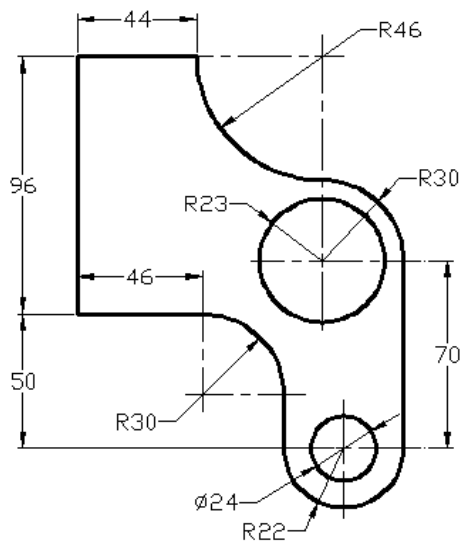


**Fig 4.3**

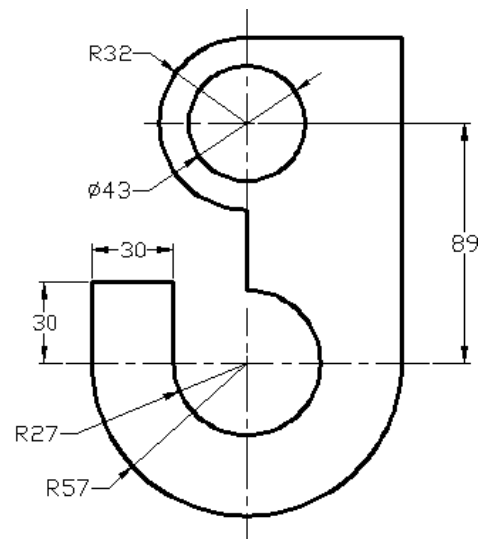
**Ex. No: 5**



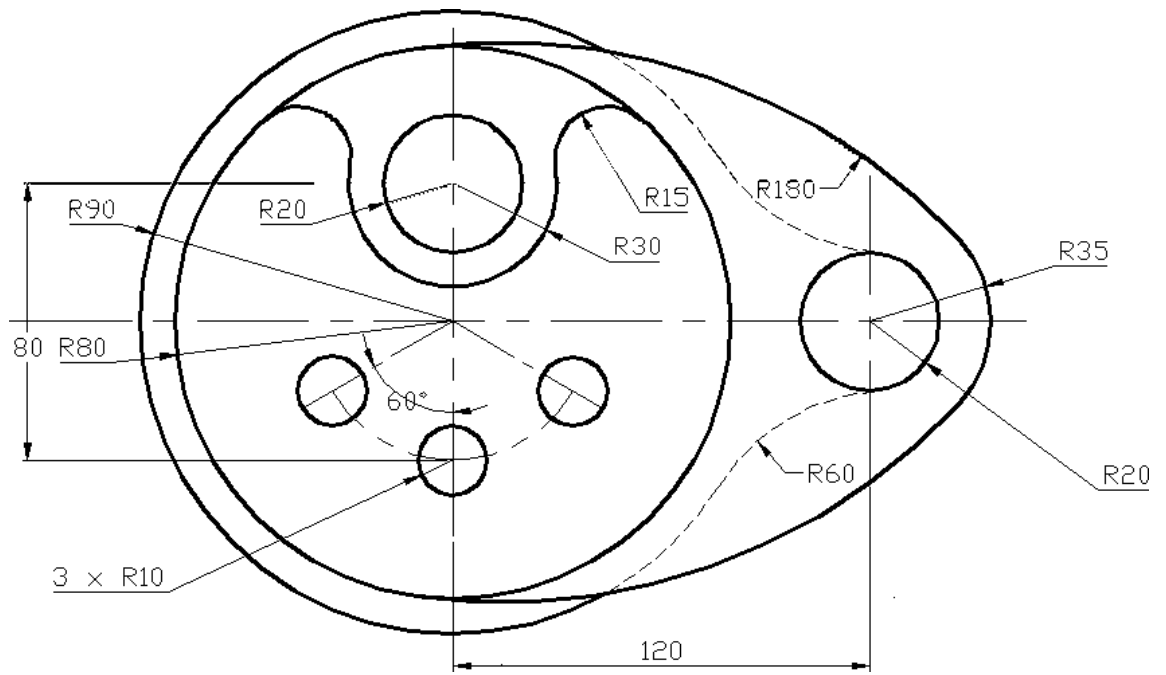
**Fig 5.1**



**Fig 5.2**



**Fig 5.3**



**Fig 5.4**

## Ex. No: 6.1

## FLANGED COUPLING

Draw the Half sectional view (Fig 6.1) of the given FLANGED COUPLING

### PROCEDURE:

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command). From the dialog box select end point, midpoint etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box select required view.
6. Draw the different parts of flange coupling by using draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of drawing is hatched.

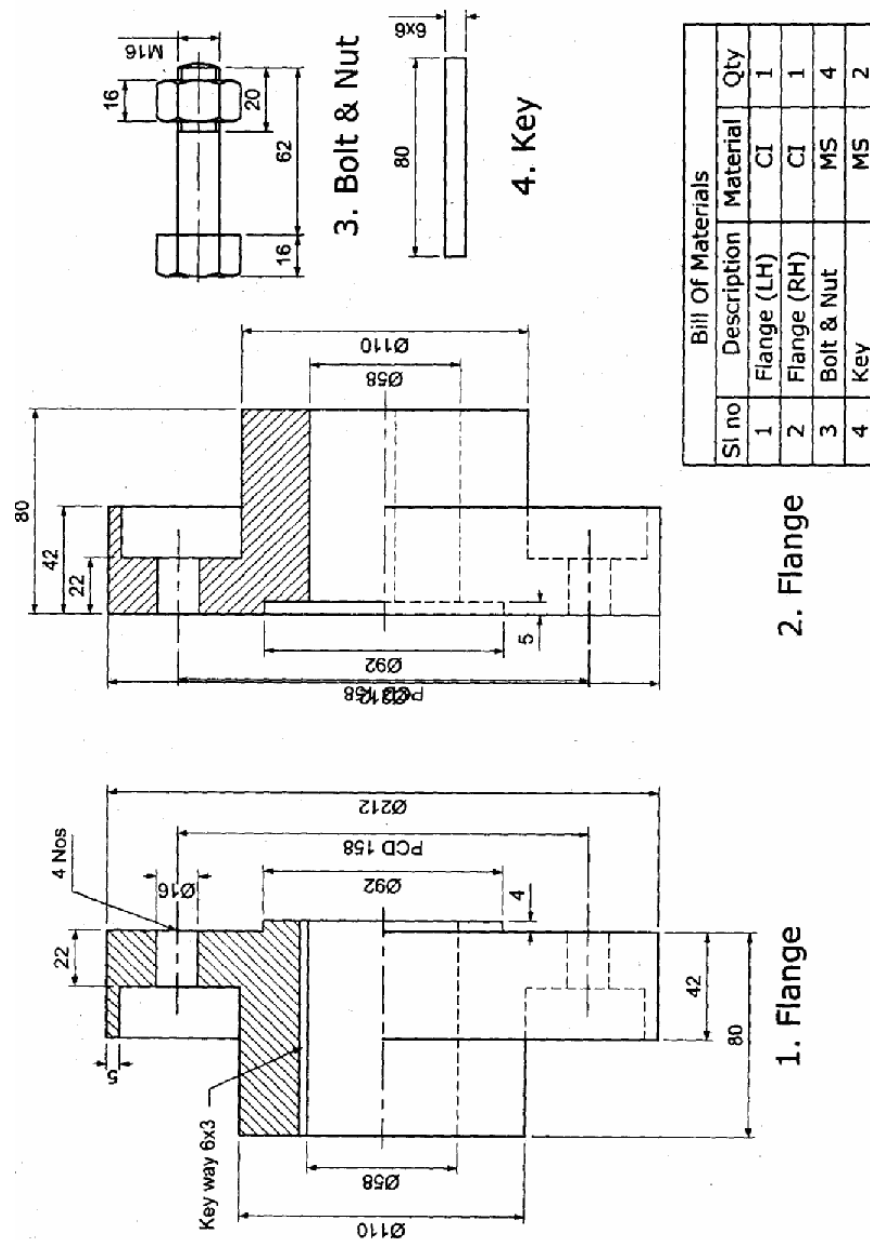


Fig 6.1

## Ex. No: 6.1

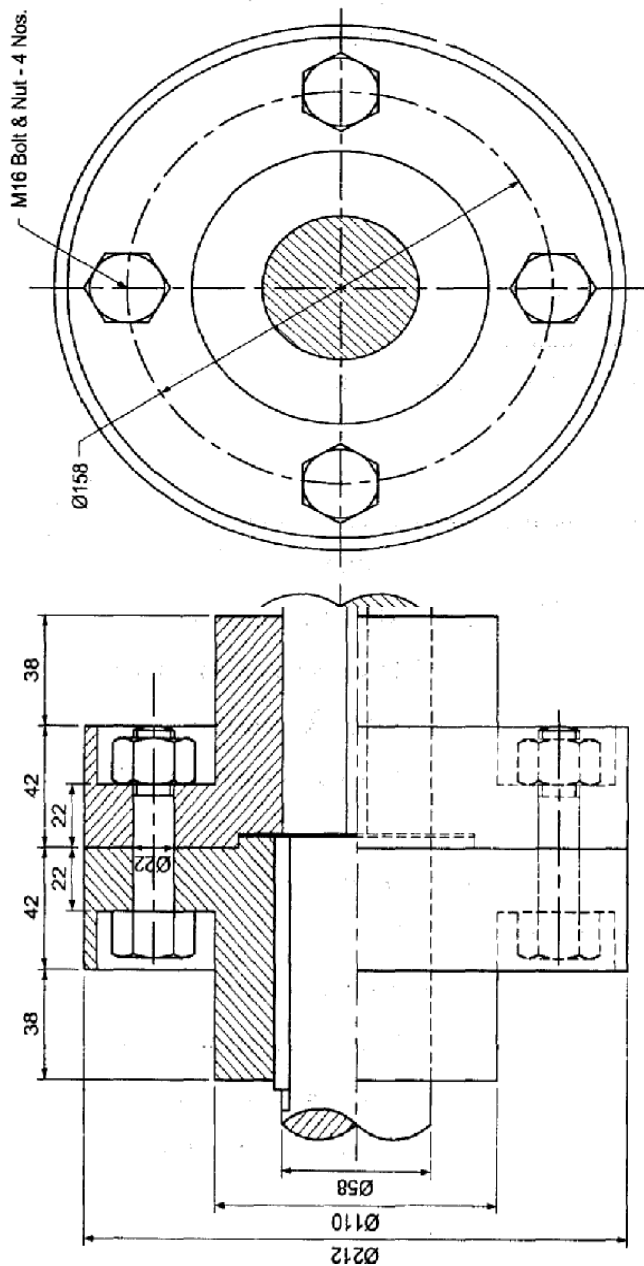
## FLANGED COUPLING

Draw the Half sectional view (Fig 6.1) of the given FLANGED COUPLING

### PROCEDURE:

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command). From the dialog box select end point, midpoint etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box select required view.
6. Draw the different parts of flange coupling by using draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of drawing is hatched.

Fig 6.1



Left Side View

Bill Of Materials			
Sl no	Description	Material	Qty
1	Flange (LH)	CI	1
2	Flange (RH)	CI	1
3	Bolt & Nut	MS	4
4	Key	MS	2

## Ex. No: 7.1

## SCREW JACK

Draw the Half Sectional Front view (Fig 7.1) of the SCREW JACK

### PROCEDURE:

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command). From the dialog box select end point, midpoint etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box select required view.
6. Draw the different parts of Screw Jack by using draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of drawing is hatched.

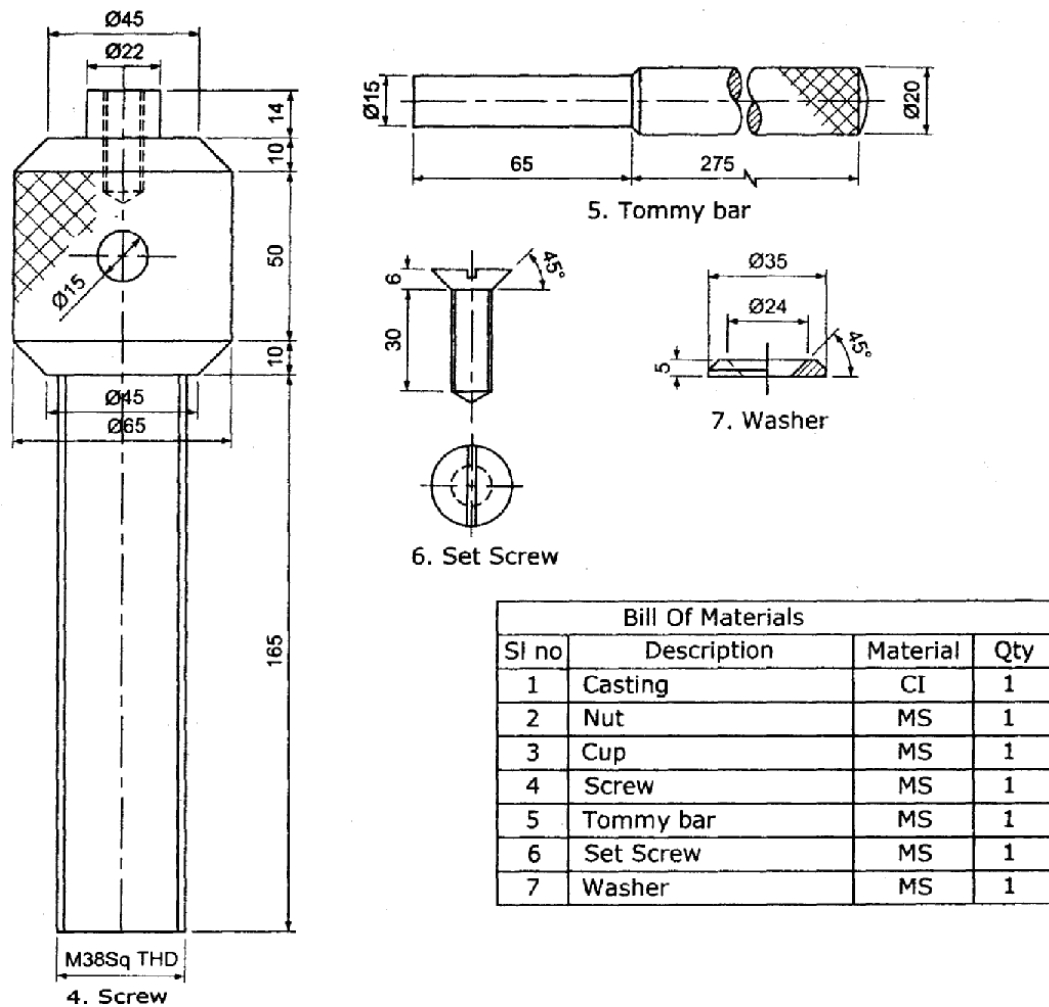
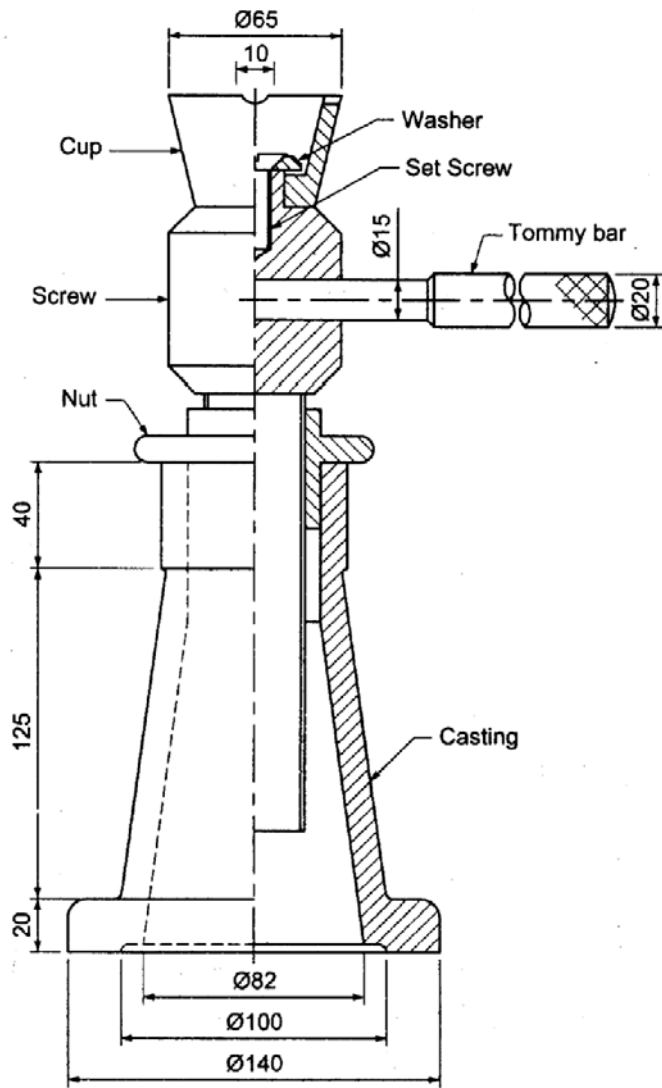


Fig 7.1



**Half sectional elevation**

Bill Of Materials			
Sl no	Description	Material	Qty
1	Casting	CI	1
2	Nut	MS	1
3	Cup	MS	1
4	Screw	MS	1
5	Tommy bar	MS	1
6	Set Screw	MS	1
7	Washer	MS	1

**Fig 7.1**

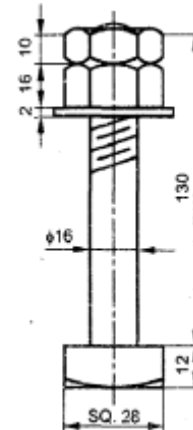
## Ex. No: 7.2

## PLUMMER BLOCK

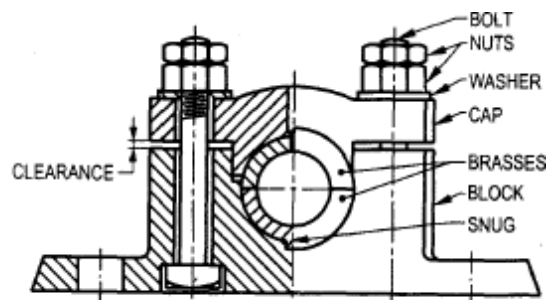
Draw the Half Sectional Front view (Fig 7.2) of the PLUMMER BLOCK

### PROCEDURE:

1. Open the AutoCAD window.
2. Set the required limits and grids.
3. Use F3 key (OSNAP command), from the dialog box Select end point, midpoint etc.
4. By using F8 key, the ortho is ON.
5. From the UCS (User Co-ordinate System) dialog box Select required view.
6. Draw the different parts of Plummer block by using Draw and edit commands.
7. By using move command, assemble all parts.
8. By using hatch command, the required portion of Drawing is hatched.

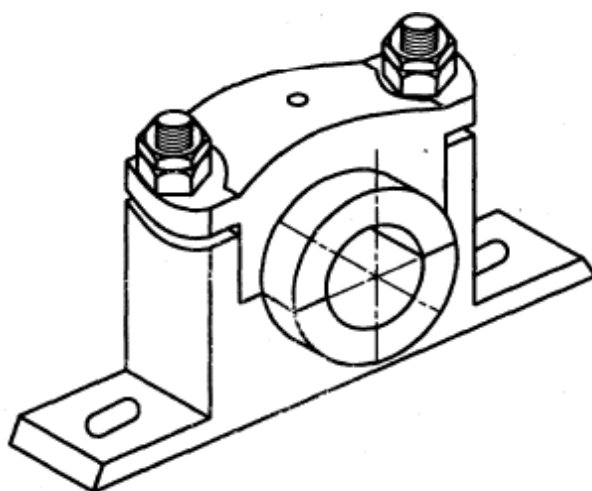


BOLT NUTS AND WASHER - 2 OFF



LEFT HALF SECTIONAL FRONT VIEW

Fig 7.2



ISOMETRIC VIEW



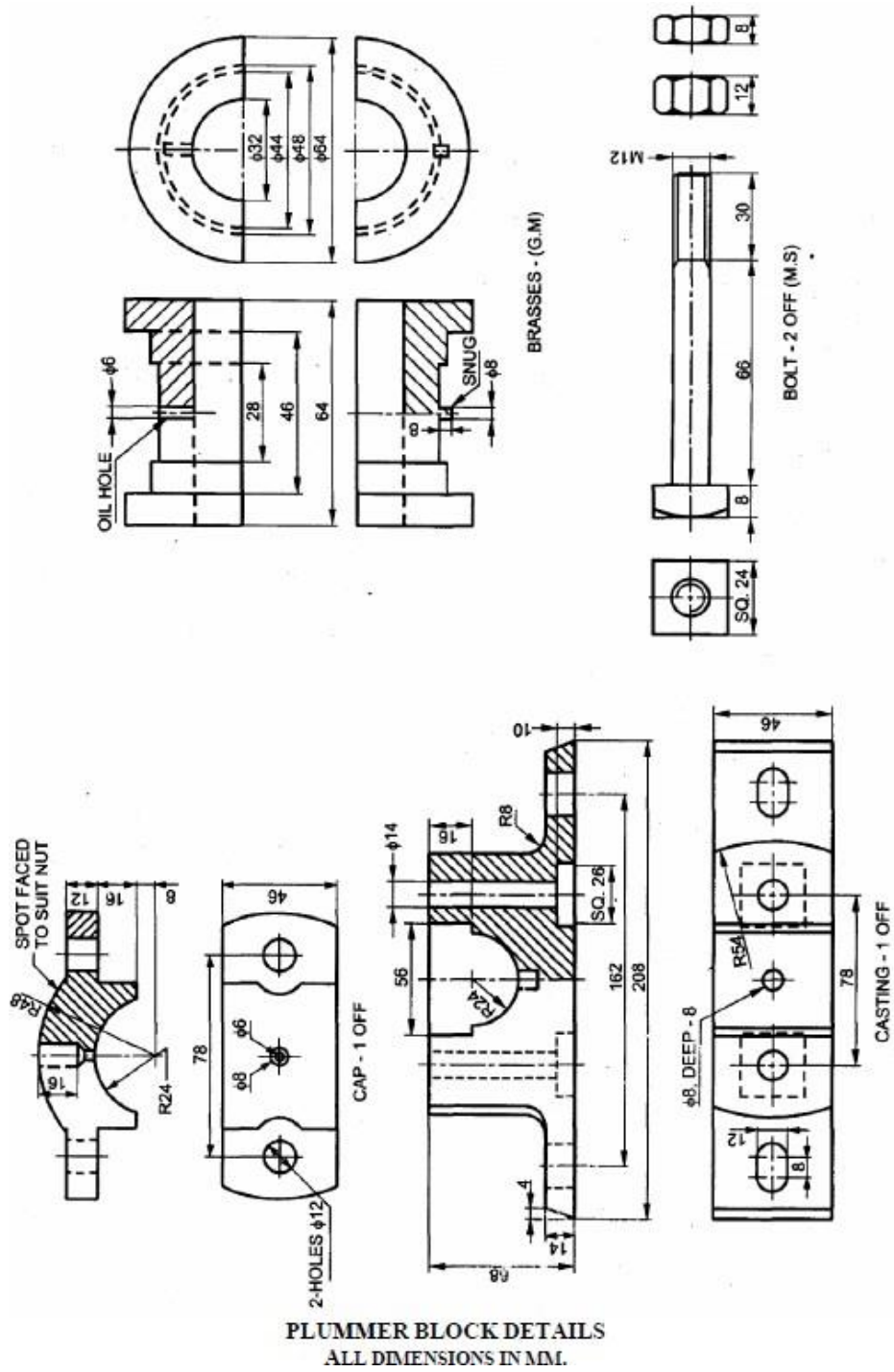


Fig 7.2