The University of Jordan

School of Engineering

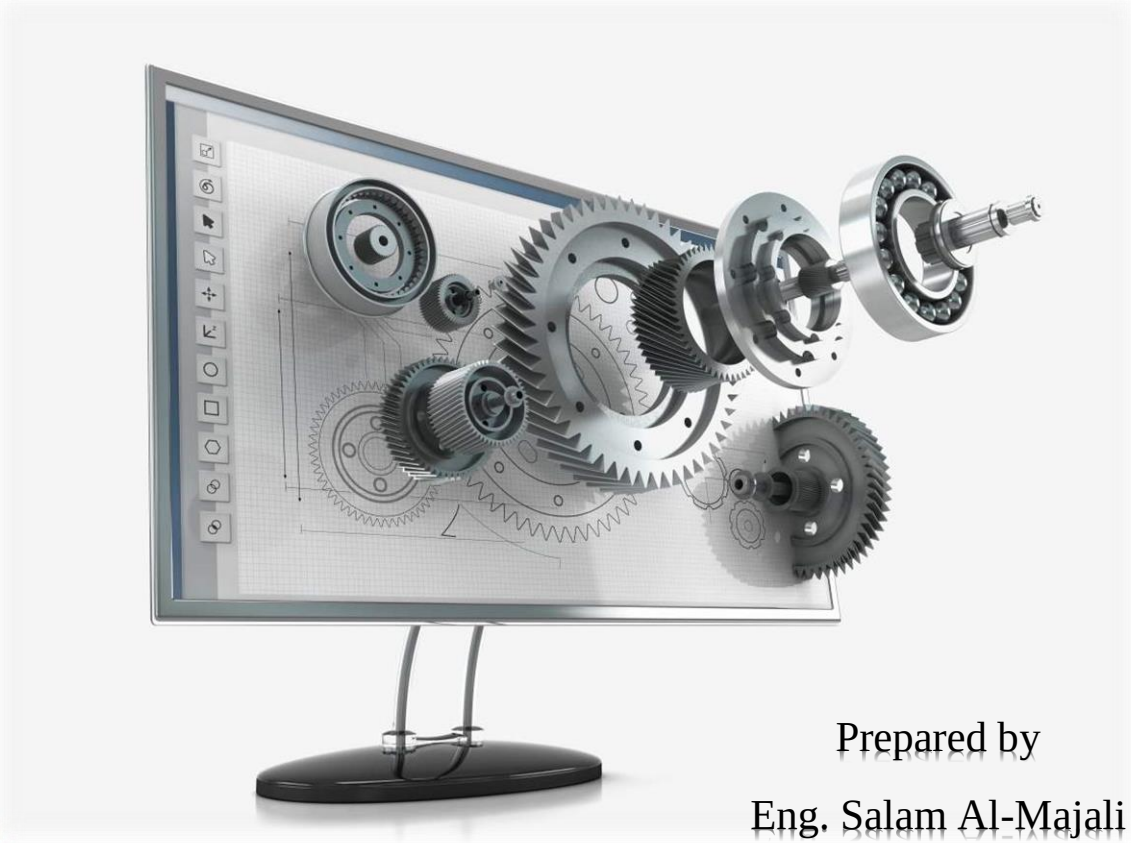
Mechanical Engineering Department

Engineering Drawing & Descriptive Geometry (0904131)

Spring 2020/2021

Practice to AutoCAD

2D Drawing, 3D Modeling



AUTODESK AUTOCAD

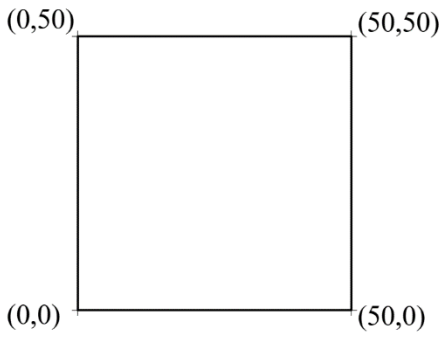
Prepared by

Eng. Salam Al-Majali

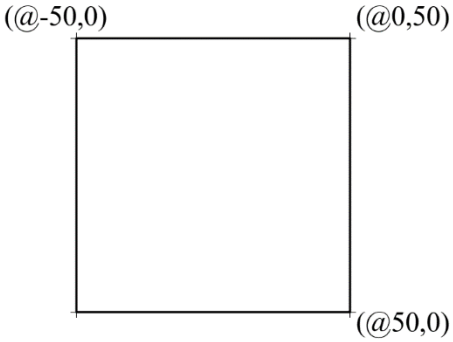
Eng. Reem Al-Daraien

Introduction to 2D Drawing in AutoCAD

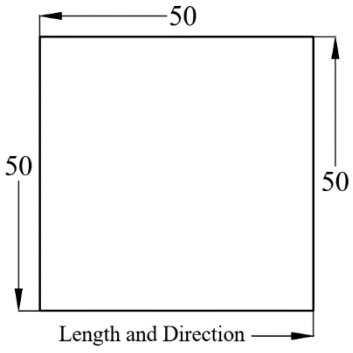
1. Introduction to the software worksheet.
2. Drawing Limits: Metric and Imperial.
3. Zoom and Pan.
4. Snap (F9) and Grid (F7).
5. Line , Polyline and Spline Commands: Ortho. (F8), Absolute, Relative, and Polar Coordinates.
6. Erase and Move Commands.



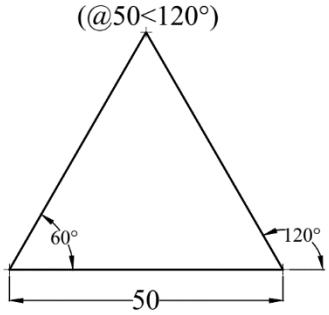
Absolute Coordinates



Relative Coordinates



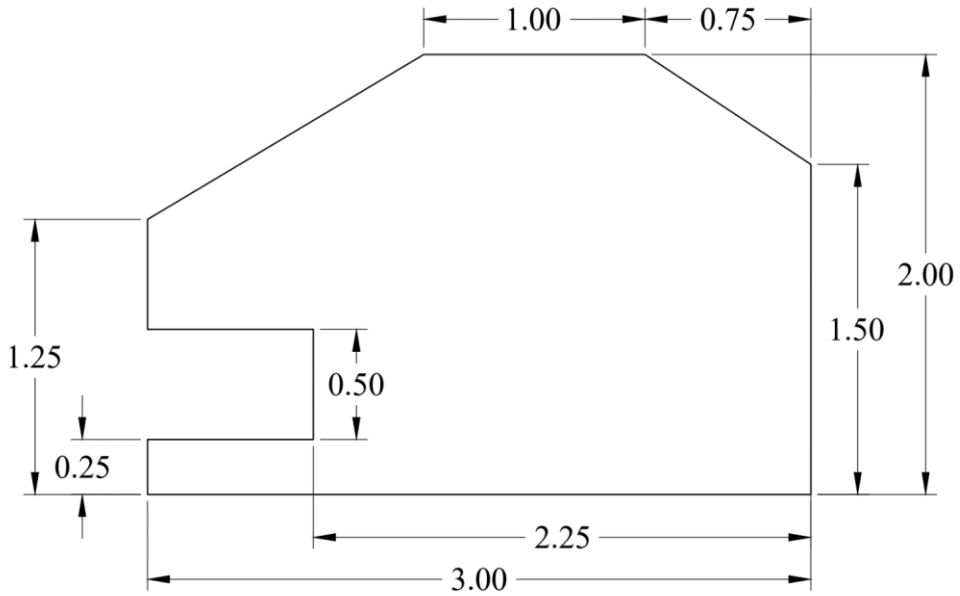
Ortho. Mode



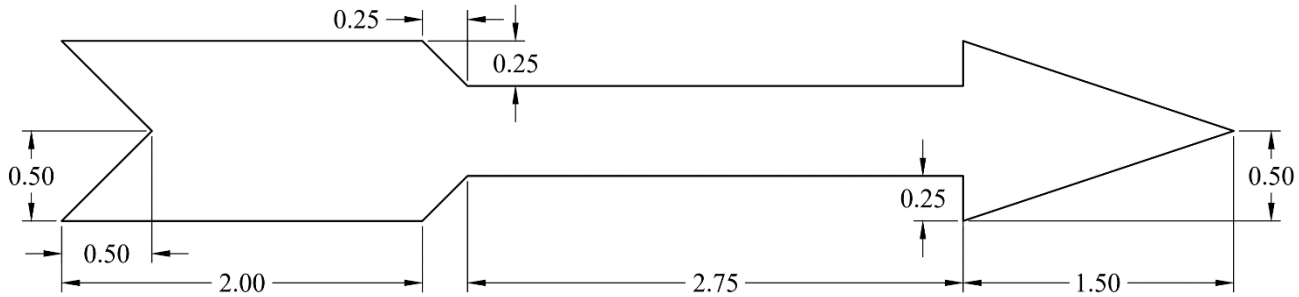
Polar Coordinates

Draw the following exercises. Dimensions are in inches.

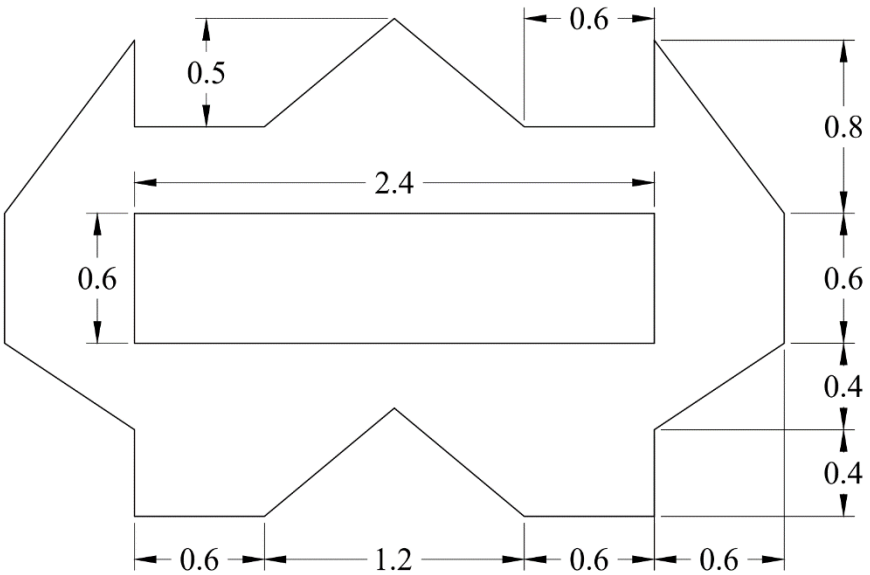
Ex. 1



Ex. 2

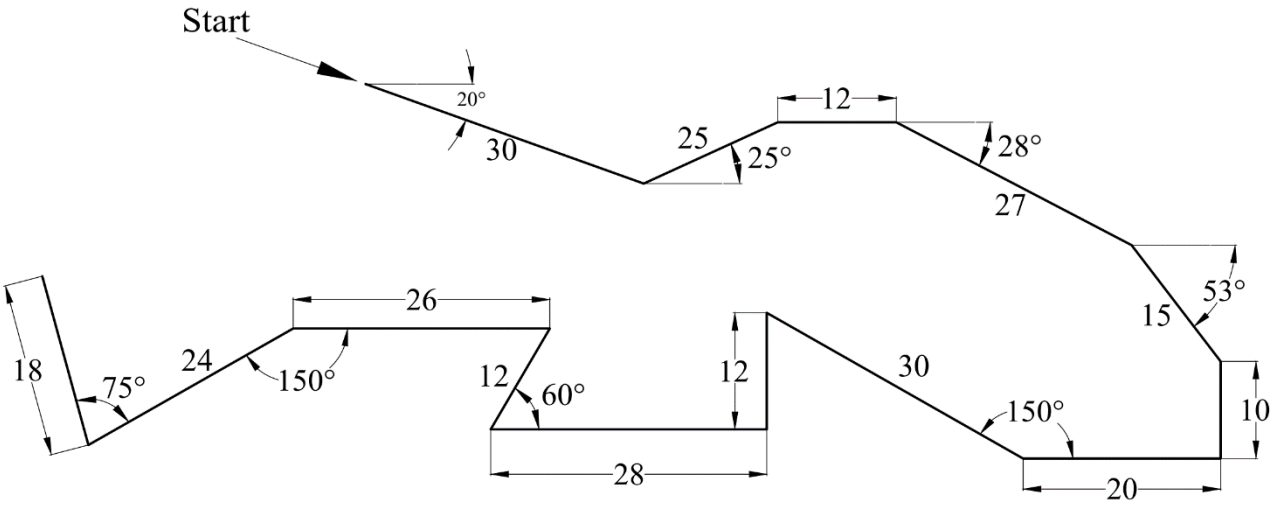


Ex. 3

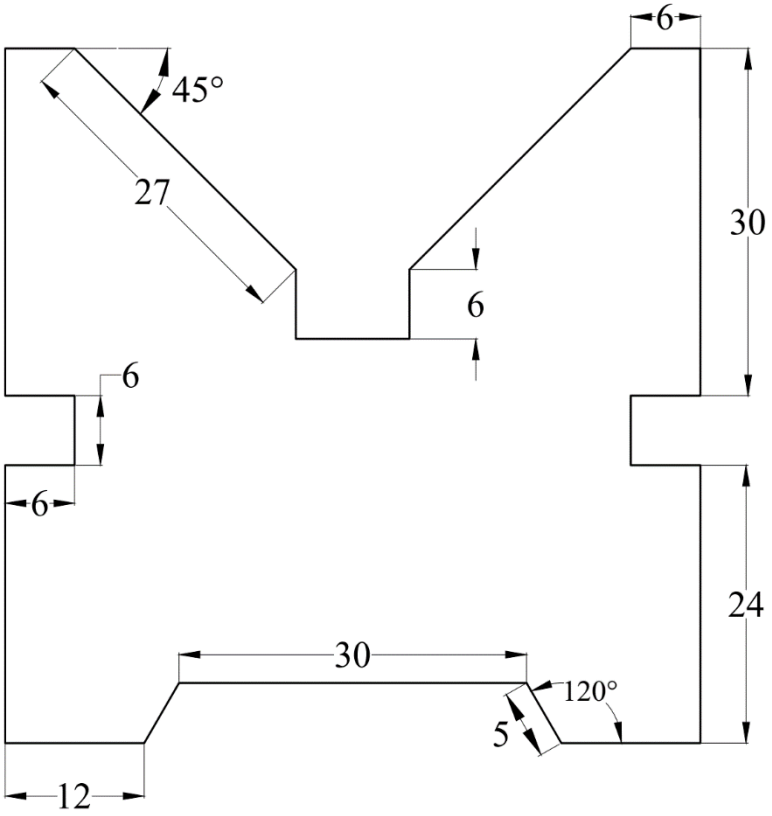


Draw the following exercises. Dimensions are in millimeters.

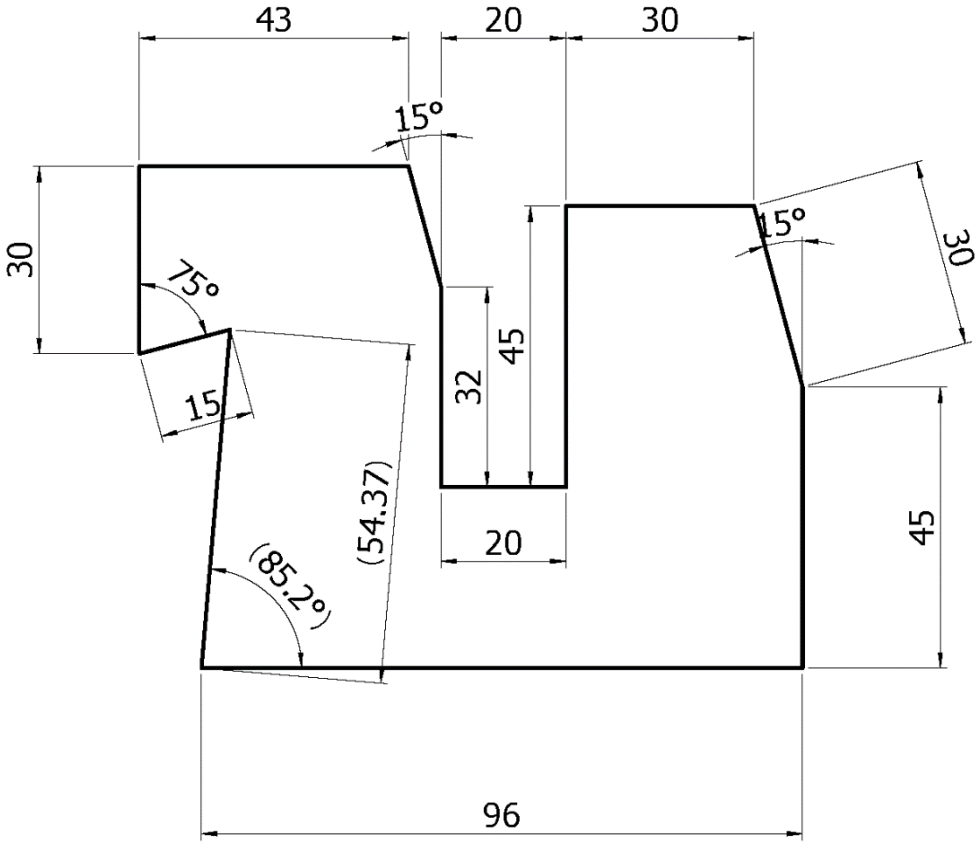
Ex. 4



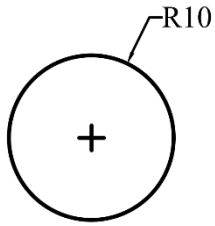
Ex. 5


6
45°
27
30
6
6
6
24
30
120°
5
12

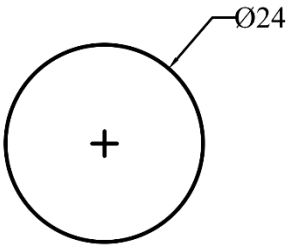
Ex. 6


43
20
30
15°
30
15°
15°
30
45
32
15
(54.37)
(85.2°)
20
45
96

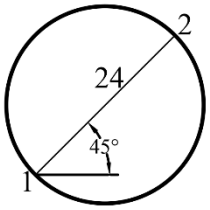
Circles



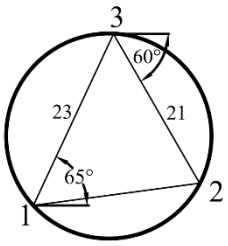
Circle, Radius



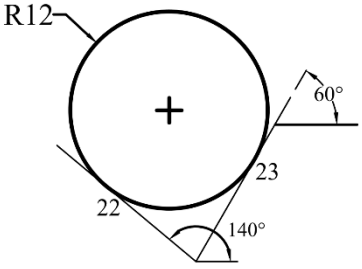
Circle, Diameter



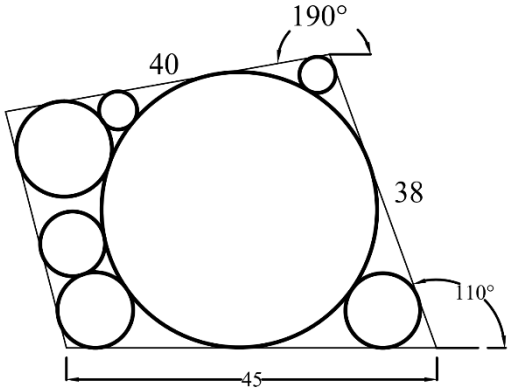
2-Point



3-Point



Tan,Tan, Radius



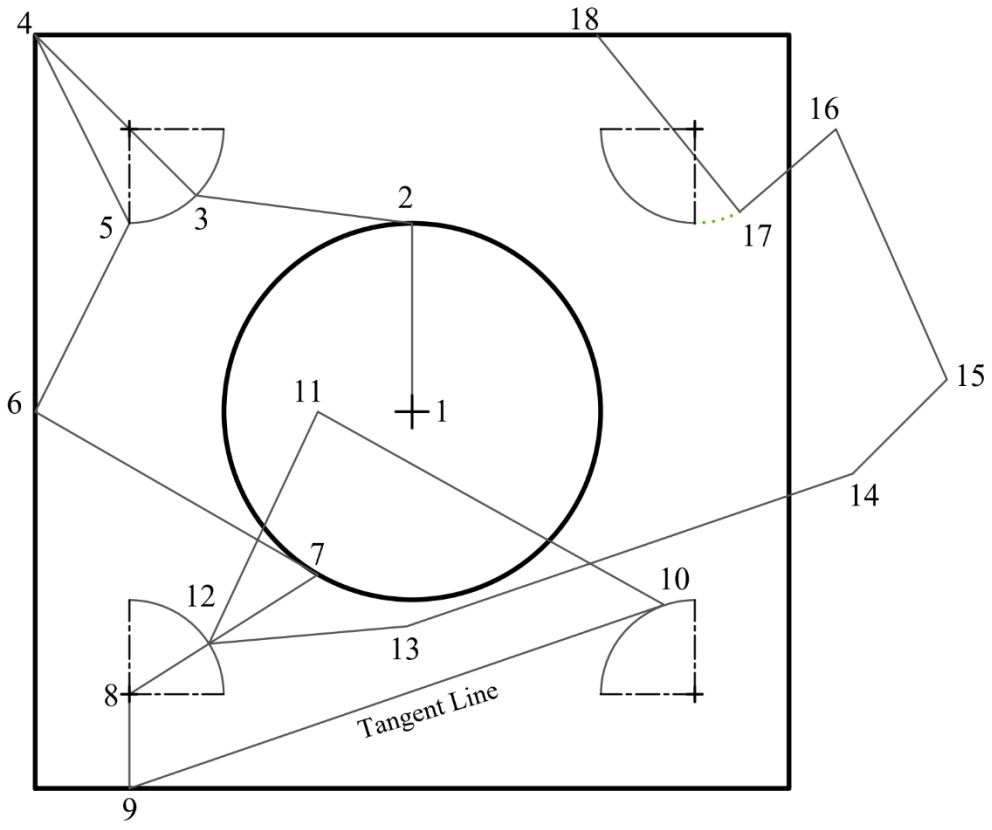
Tan,Tan, Tan

Object Snap

F(3),

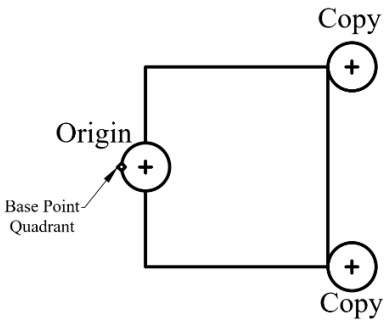
1. Using the **absolute coordinates**, draw a 4" **square** with lower left corner at (1.5, 2.5).
2. Draw a 1" radius **circle** with a center at (3.5, 4.5).
3. Draw four **circles** centered at (2,3), (5,3), (5,6) and (2,6) with 0.5 radius.
4. Draw a **point** at (@6,4.5).
5. Use **Object Snap** to draw line segments through 18 Points using the following modes:

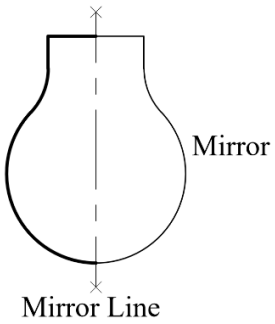
1	Center	10	Tangent
2	Quadrant	11	Midpoint between Quadrant and Center
3	Midpoint	12	Intersection
4	End	13	Apparent Intersection of Lines (1-2) and (6-7)
5	End	14	Parallel to line (9-10), distance = 2.5
6	Midpoint	15	Node (0.5,0.5)
7	Tangent	16	**From** the upper right corner at (0.25,-0.5)
8	Center	17	Extension of arc by (0.25)
9	Perpendicular	18	Near any point on top line

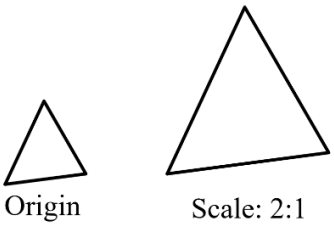


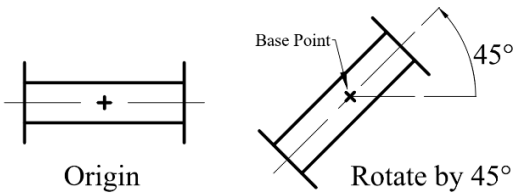
Modify Commands

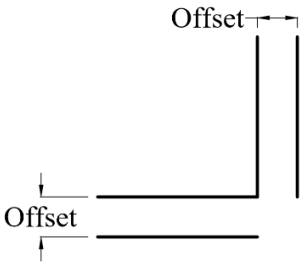
Basic Modify Commands: Copy, Mirror, Scale, Rotate, Offset, Trim, Fillet, Chamfer, Extend, Stretch, Explode, Break, Join, Divide, Properties, and Match Properties.

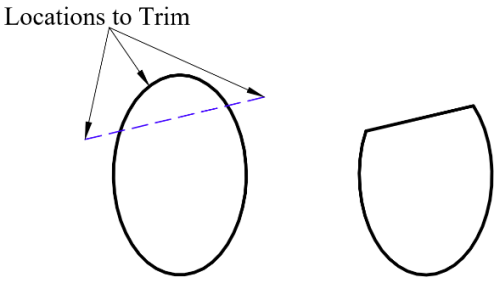


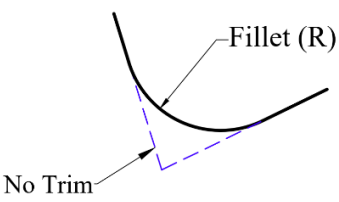


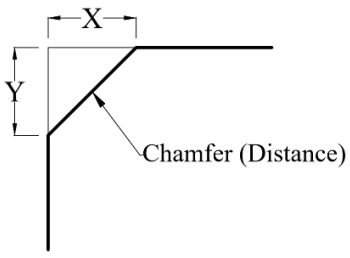




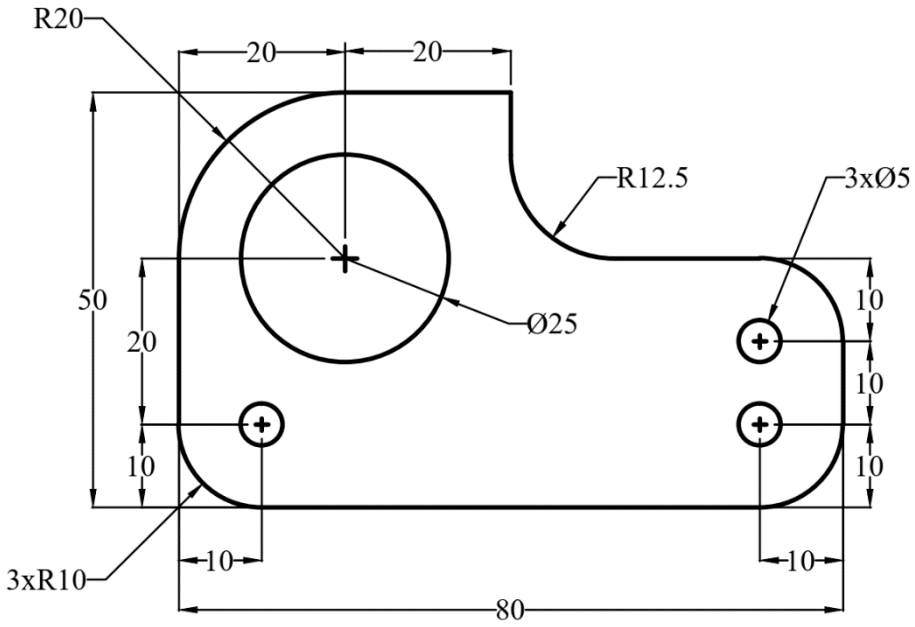




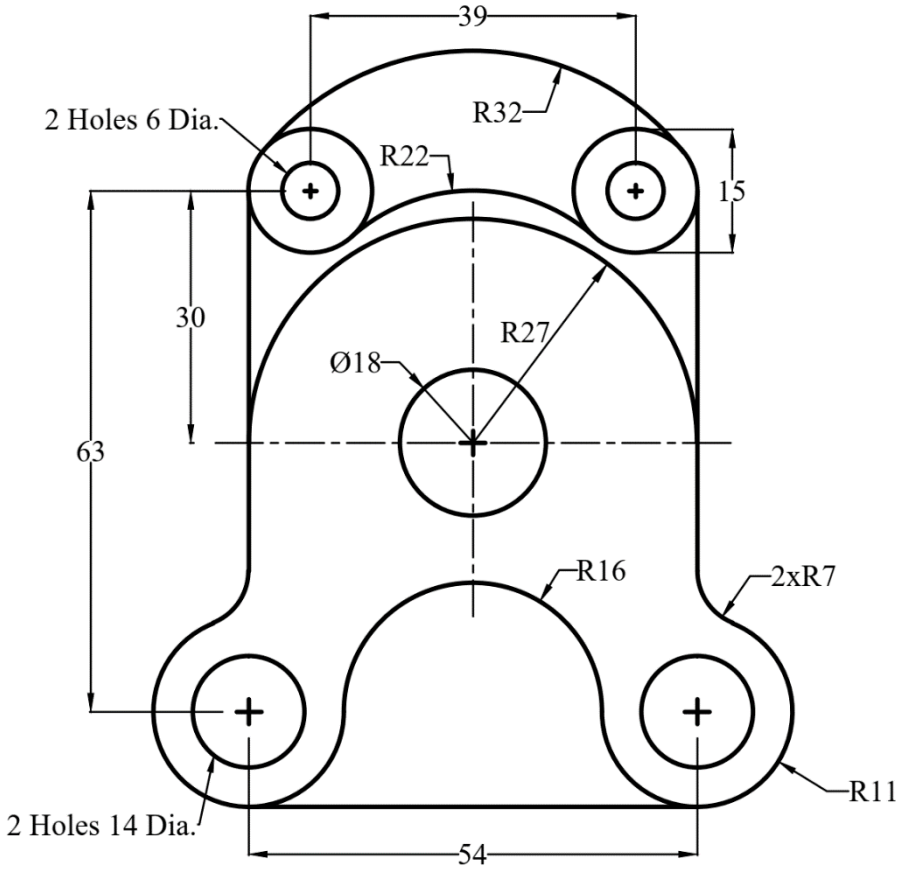




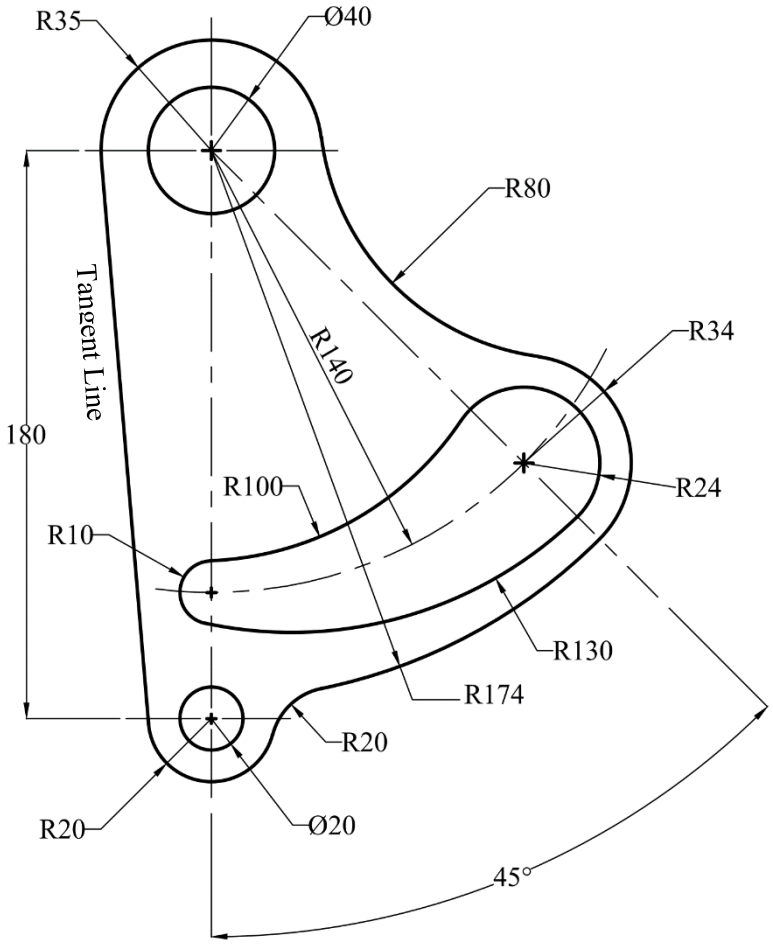
Ex. 1


R20
20
20
R12.5
3xØ5
50
20
Ø25
10
10
10
10
10
3xR10
10
10
80

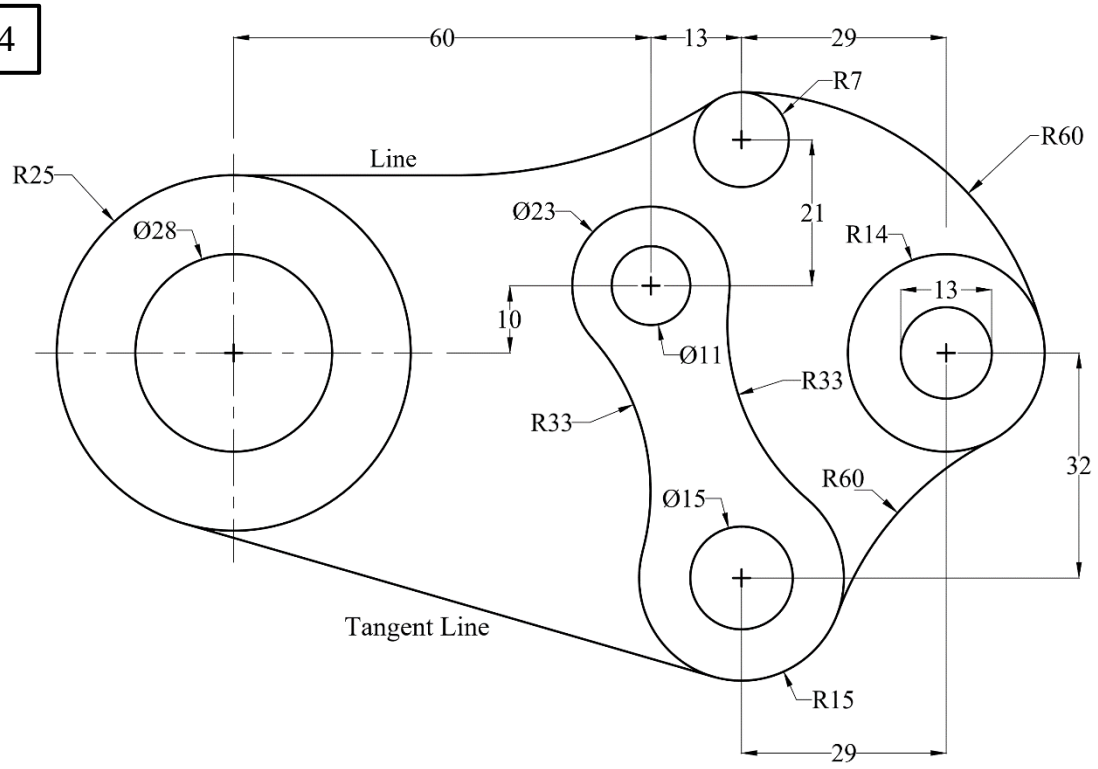
Ex. 2


39
2 Holes 6 Dia.
R32
R22
15
30
R27
Ø18
63
R16
2xR7
R11
2 Holes 14 Dia.
54

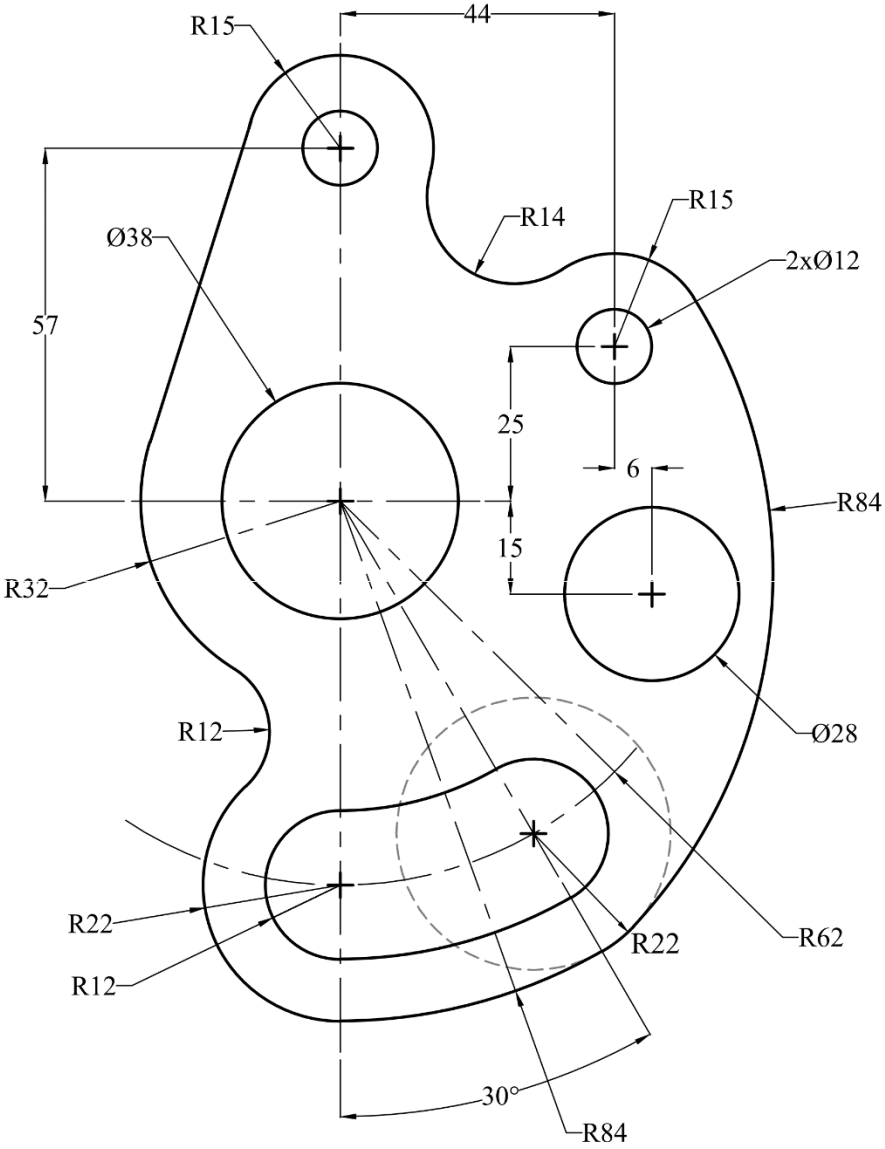
Ex. 3


R35
Ø40
R80
Tangent Line
R140
R34
180
R100
R24
R10
R130
R174
R20
R20
Ø20
45°

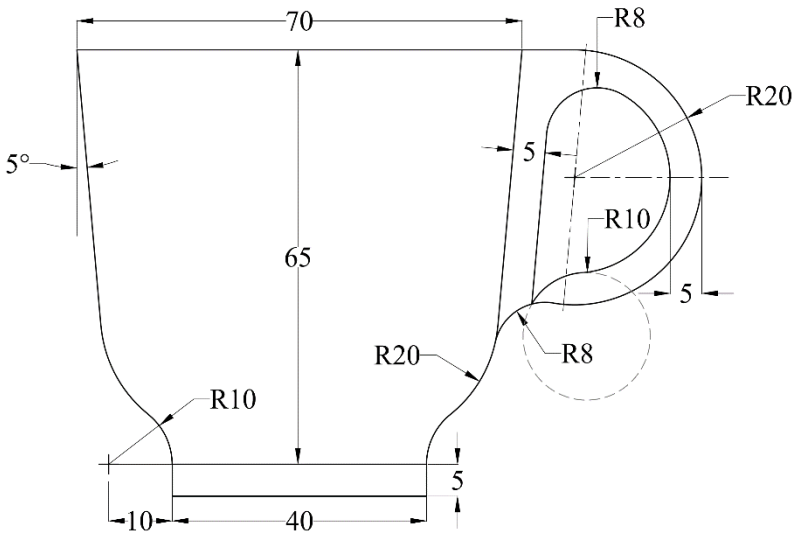
Ex. 4


60
13
29
R7
R60
Line
R25
Ø23
21
Ø28
R14
13
10
Ø11
R33
R33
32
R60
Ø15
Tangent Line
R15
29

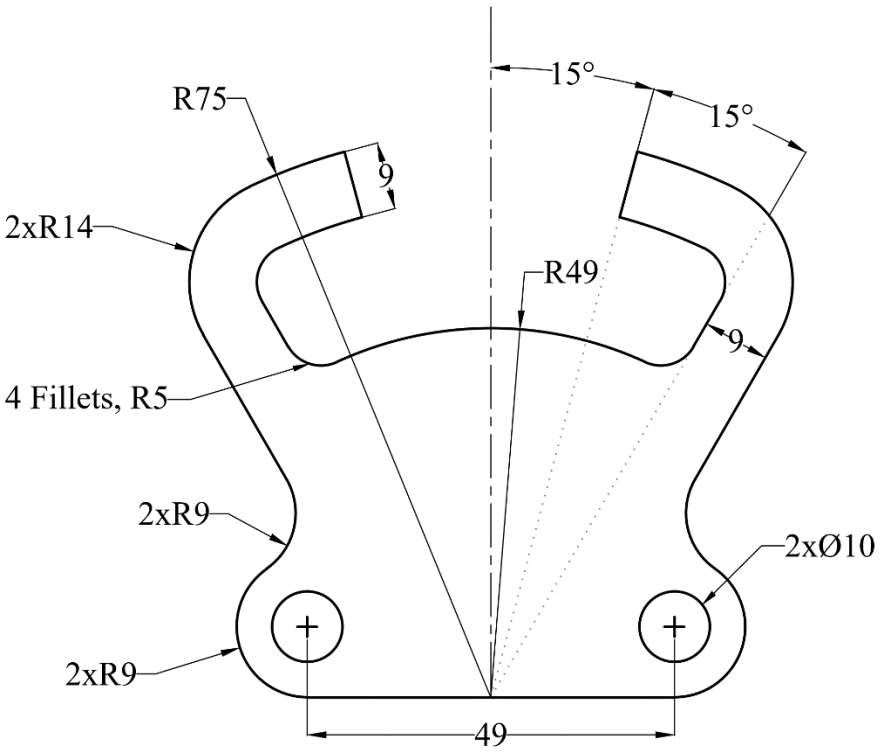
Ex. 5


R15
44
R14
R15
2xØ12
Ø38
57
25
6
R84
15
R32
R12
Ø28
R22
R62
R22
R12
30°
R84

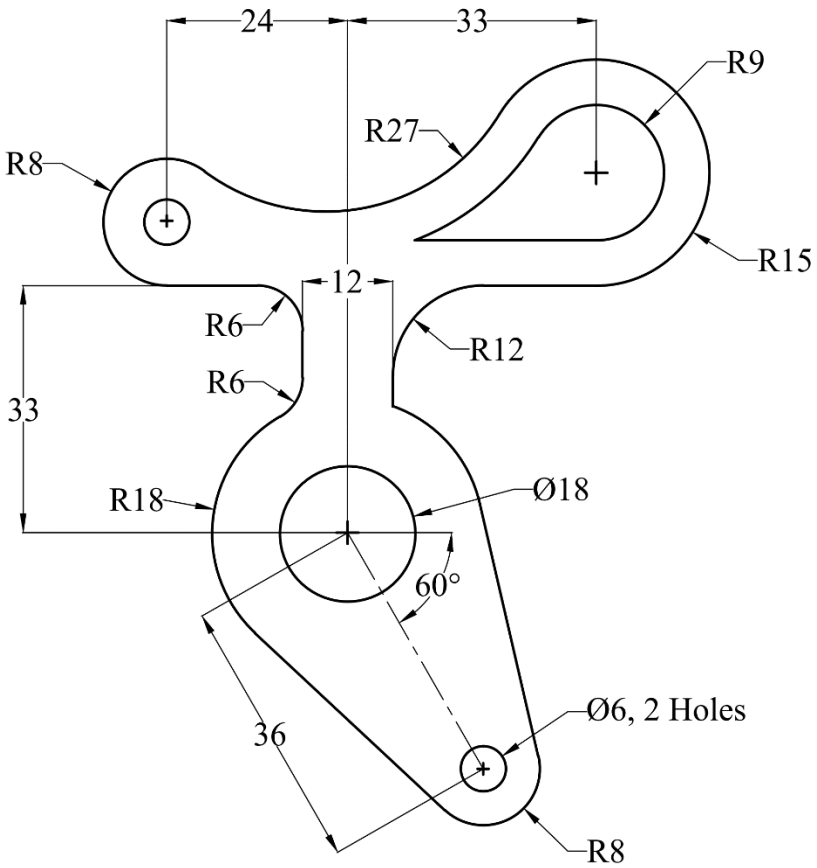
Ex. 6


70
R8
R20
5°
5
R10
65
5
R20
R8
R10
5
10
40

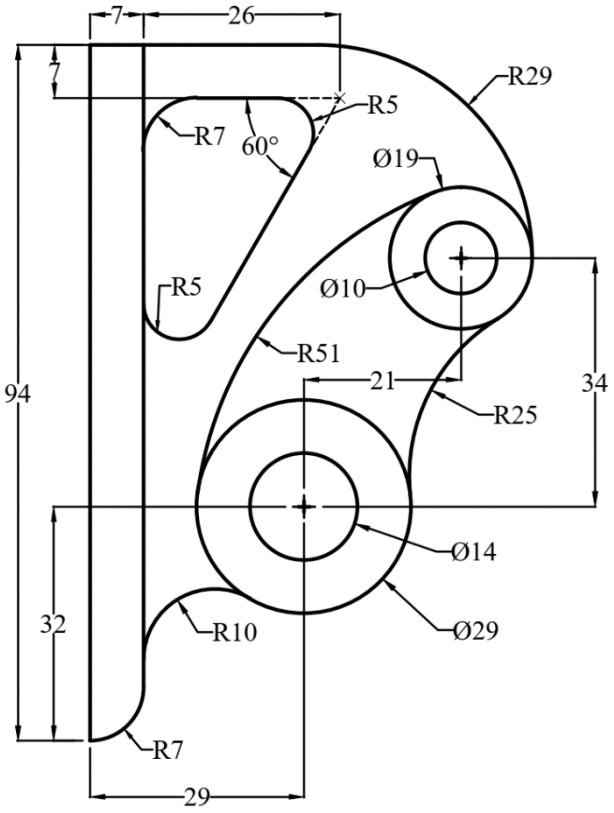
Ex. 7


15°
15°
R75
9
2xR14
R49
9
4 Fillets, R5
2xR9
2xØ10
2xR9
49

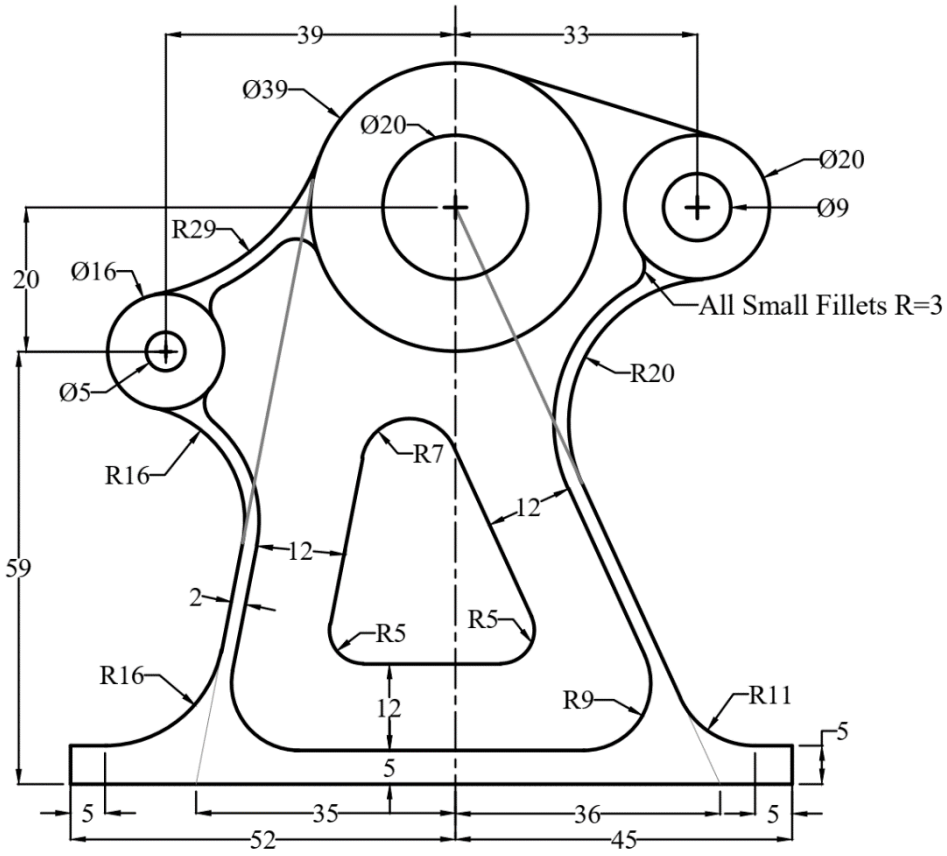
Ex. 8


24
33
R9
R27
R8
R15
12
R6
R12
R6
33
R18
Ø18
60°
Ø6, 2 Holes
36
R8

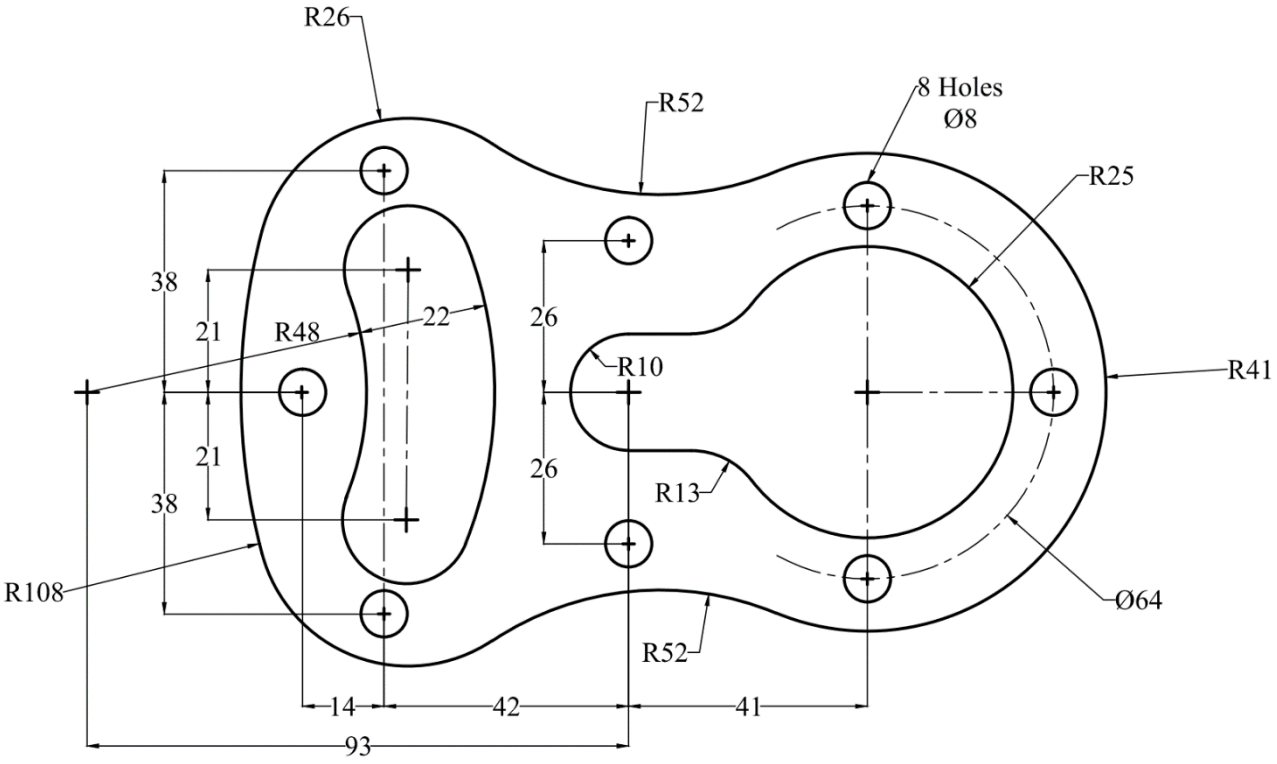
Ex. 9


7
26
7
R29
R5
R7
60°
Ø19
R5
Ø10
R51
21
34
94
R25
Ø14
32
R10
Ø29
R7
29

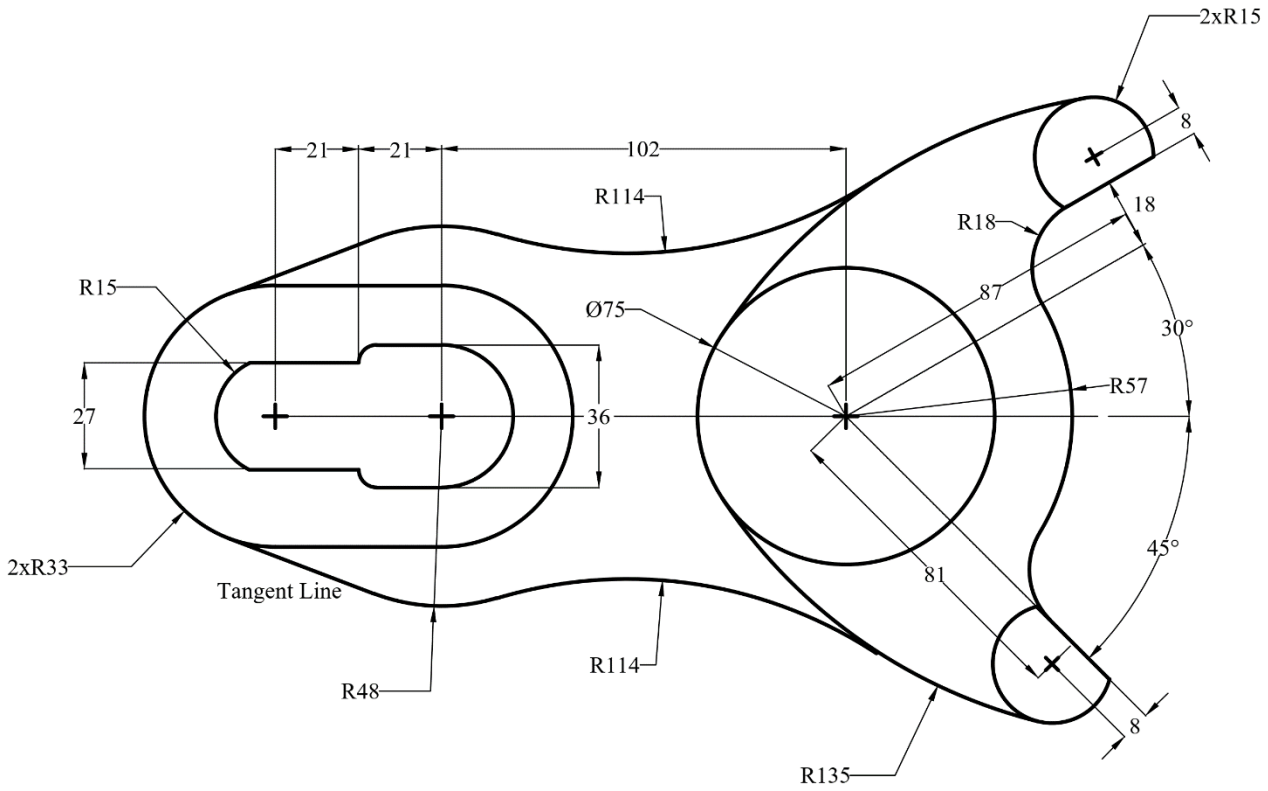
Ex. 10


39
33
Ø39
Ø20
Ø20
Ø9
R29
20
Ø16
All Small Fillets R=3
R20
Ø5
R16
R7
12
12
59
2
R5
R5
R16
12
R9
R11
5
5
5
35
36
5
52
45

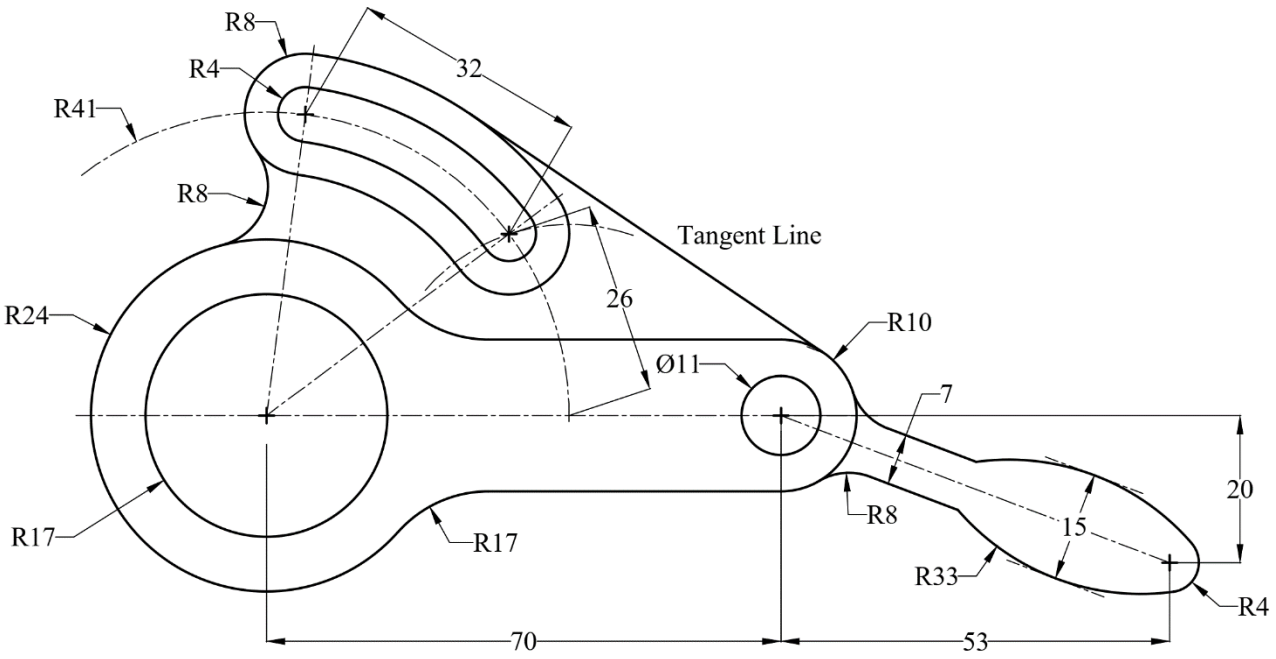
Ex. 11


R26
R52
8 Holes
Ø8
R25
R41
38
21
R48
22
26
R10
21
38
26
R13
R108
Ø64
R52
14
42
41
93

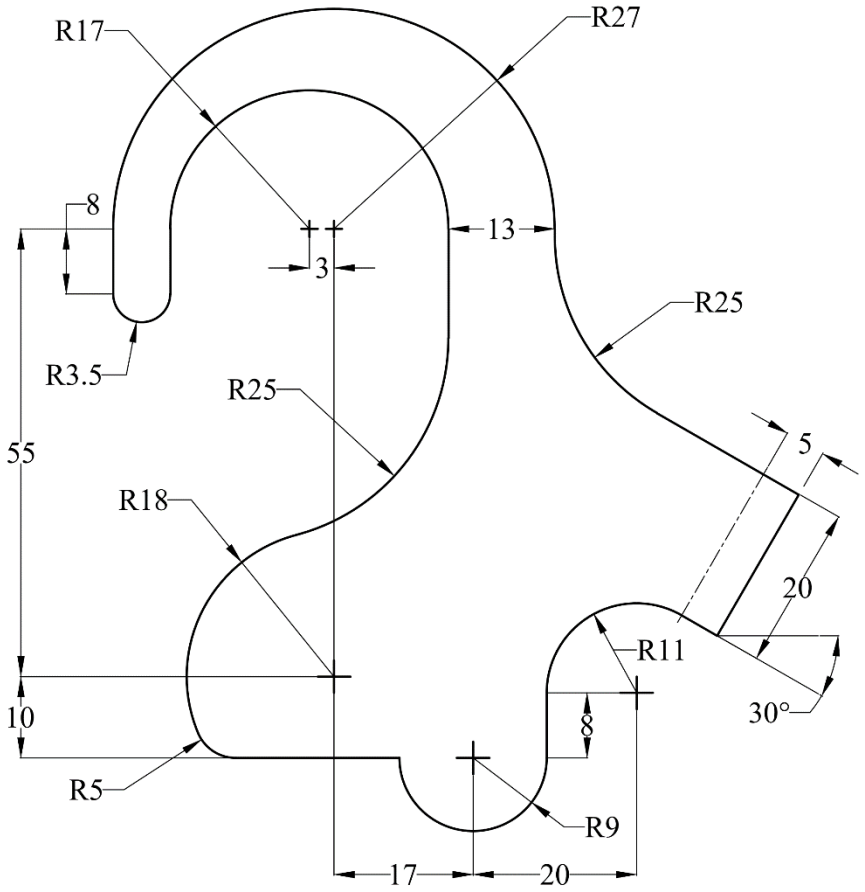
Ex. 12


2xR15
8
21
21
102
R114
18
R18
R15
87
Ø75
30°
R57
27
36
2xR33
Tangent Line
81
45°
R114
R48
8
R135

Ex. 13

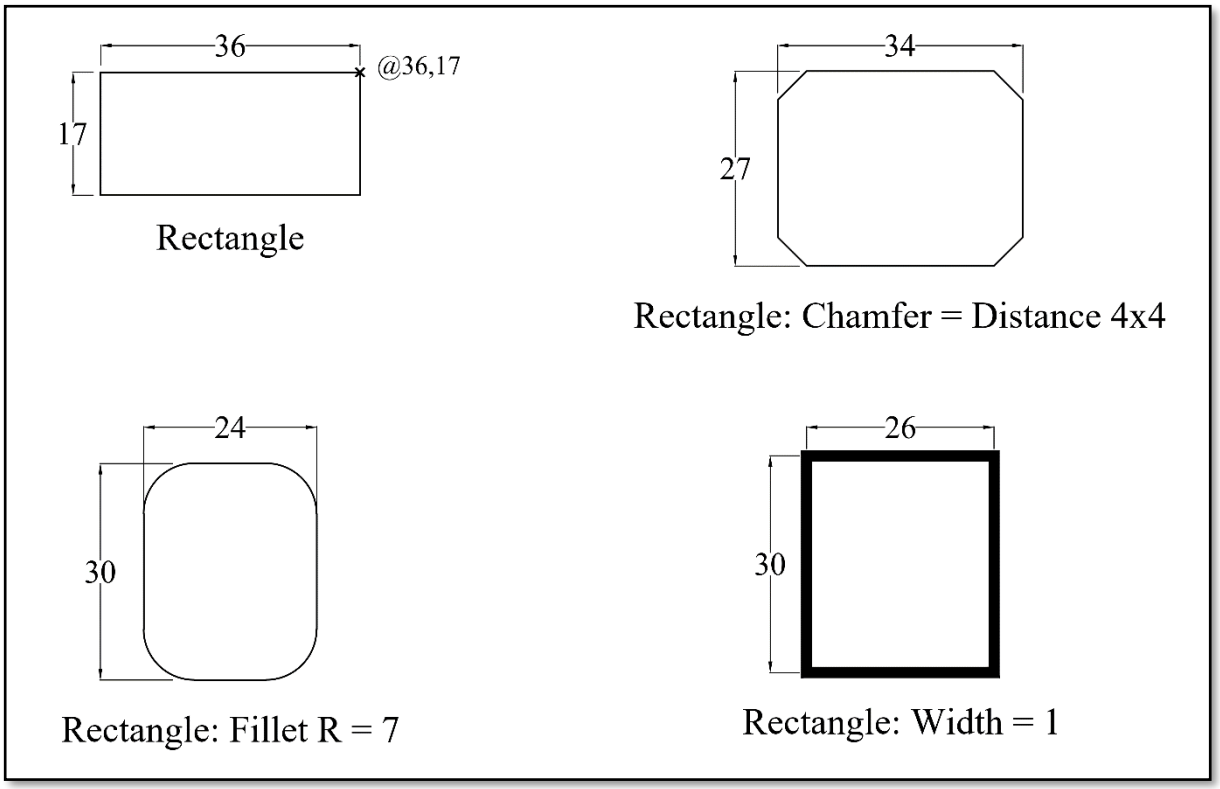

R8
R4
32
R41
R8
Tangent Line
26
R24
R10
Ø11
7
20
R8
15
R17
R17
R33
R4
70
53

Ex. 14


R17
R27
8
13
3
R25
R3.5
R25
5
55
R18
20
R11
10
8
30°
R5
R9
17
20

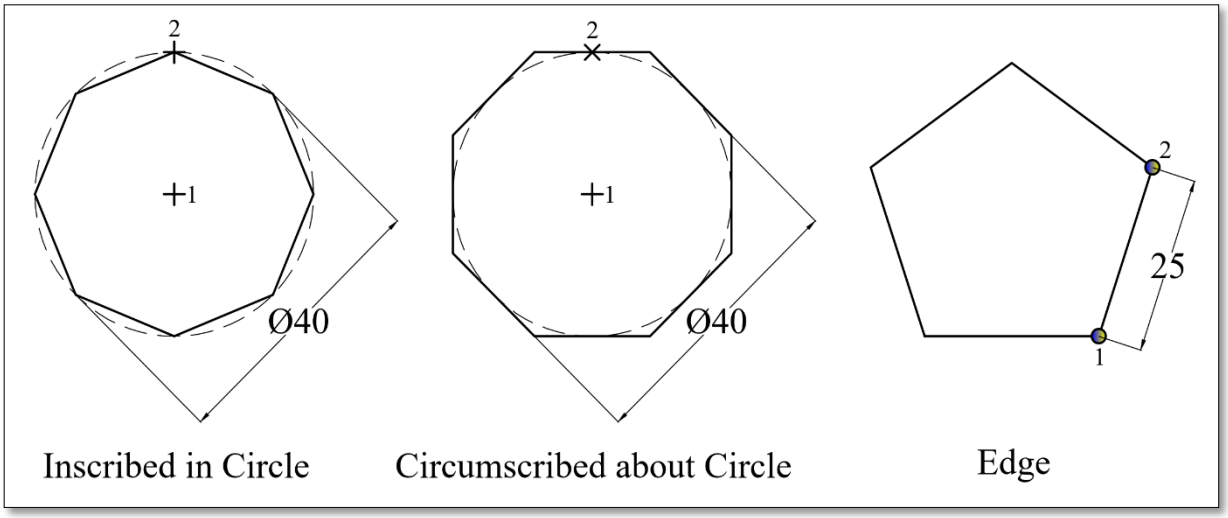
Rectangle and Polygon Commands

1. Rectangle

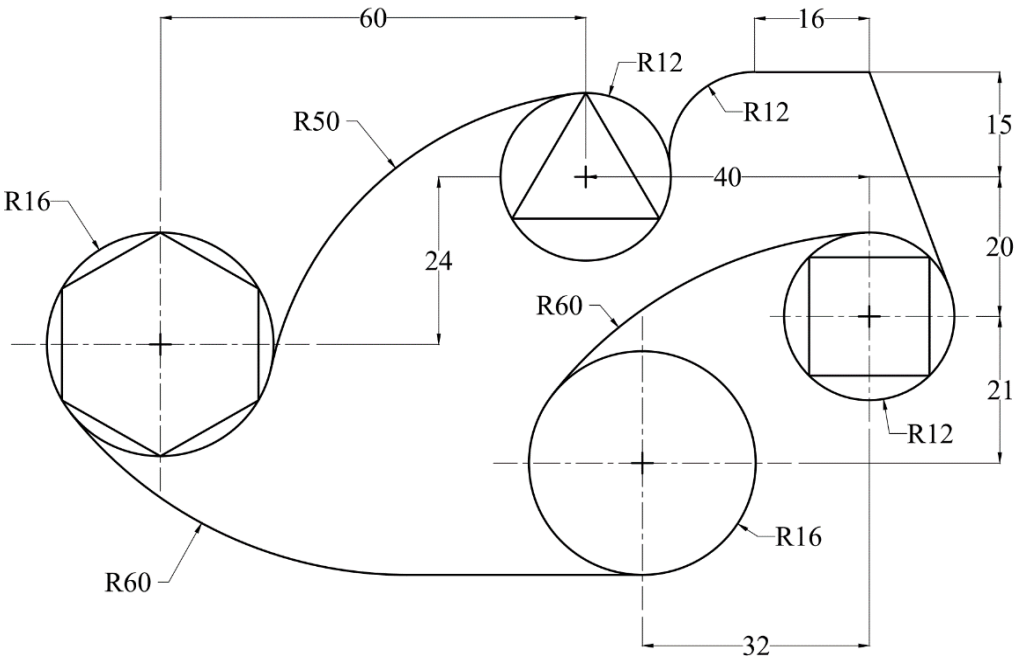


2. Polygons:

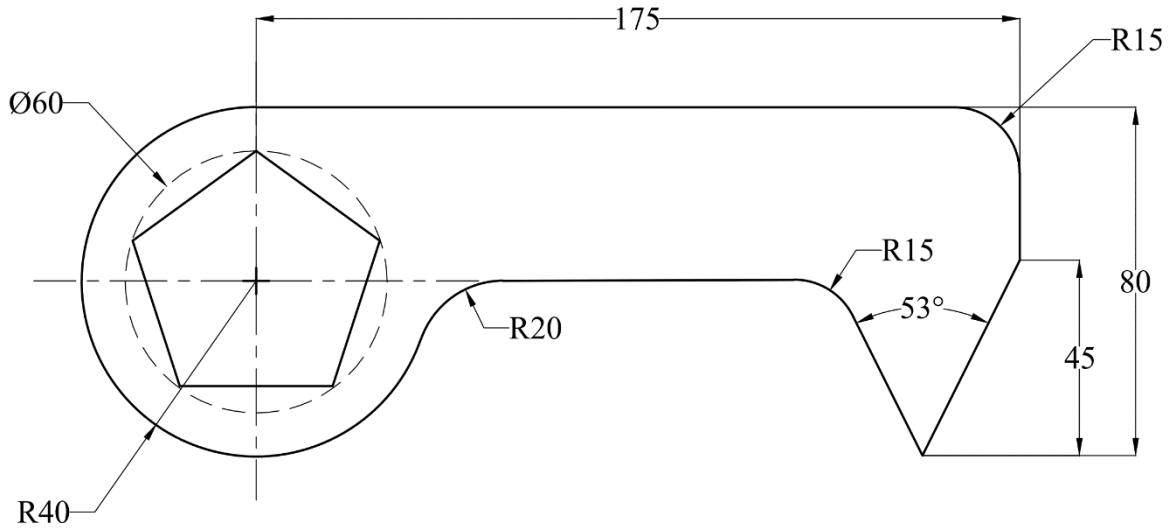
a. Center, Radius: Inscribed and circumscribed about the circle.
b. Edge.



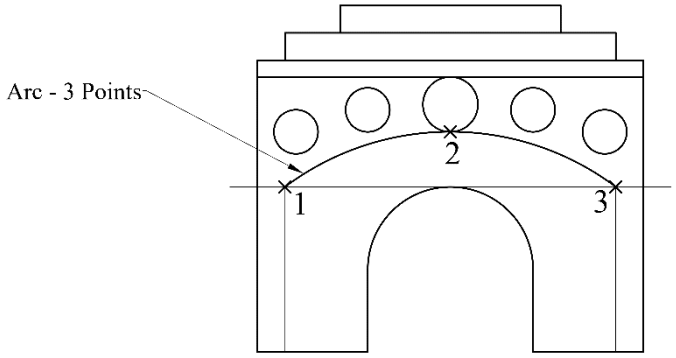
Ex. 1


60
16
R12
R12
R50
15
40
R16
24
20
R60
21
R12
R16
R60
32

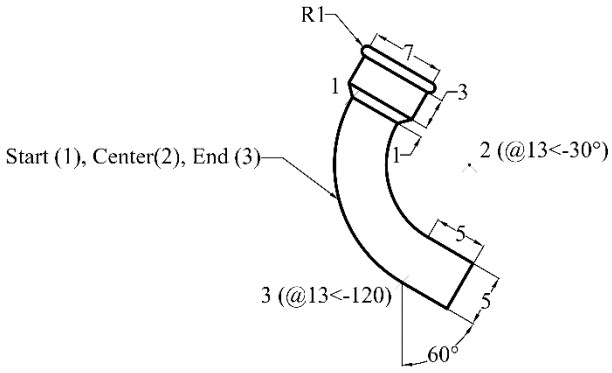
Ex. 2


175
R15
Ø60
R15
80
53°
R20
45
R40

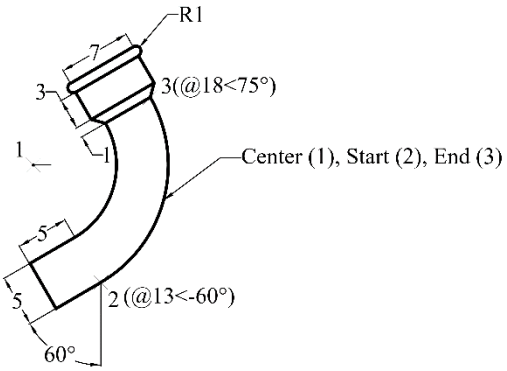
Arc Commands



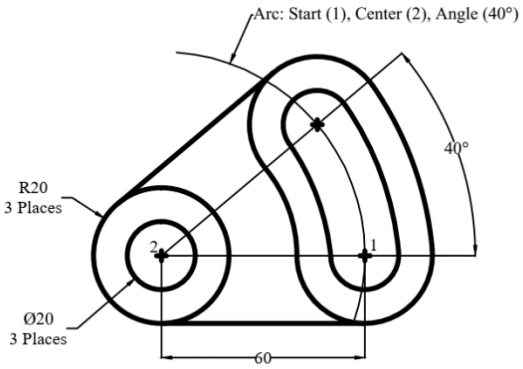
(a)



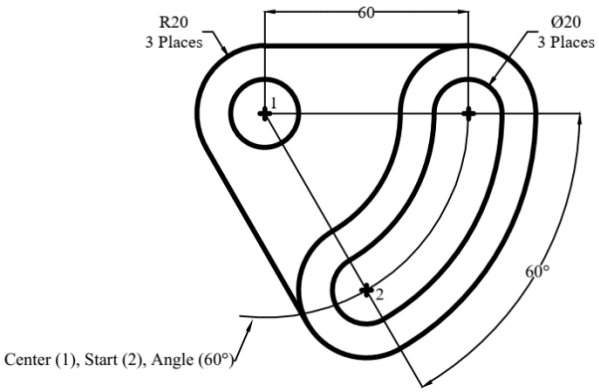
(b)



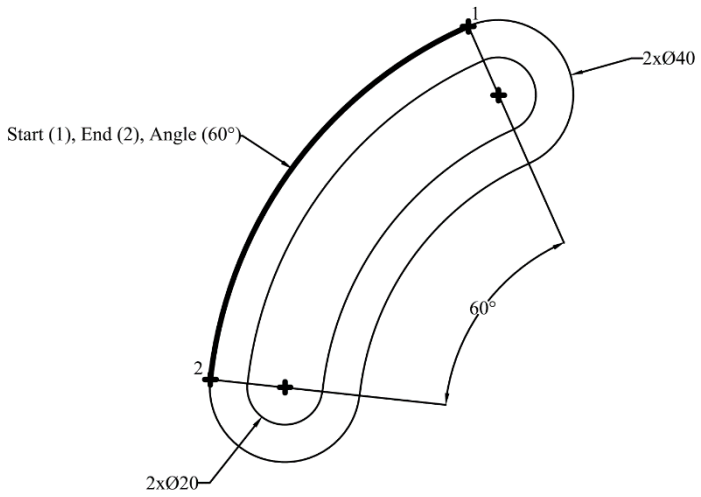
(c)



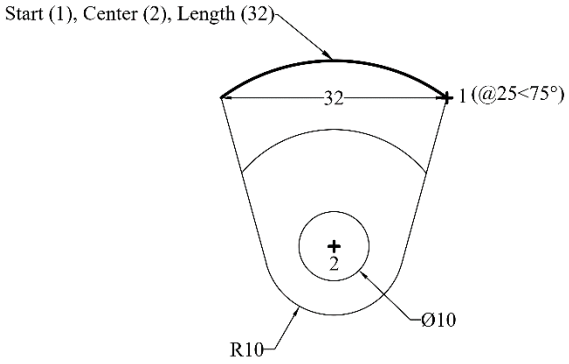
(d)



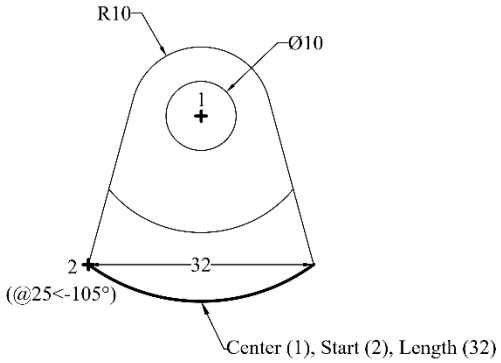
(e)


1
2xØ40
Start (1), End (2), Angle (60°)
60°
2
2xØ20

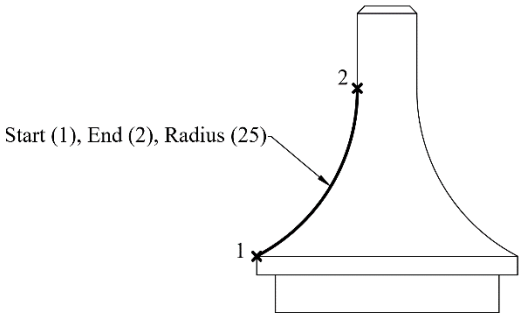
(f)


Start (1), Center (2), Length (32)
32
1 (@25<75°)
2
Ø10
R10

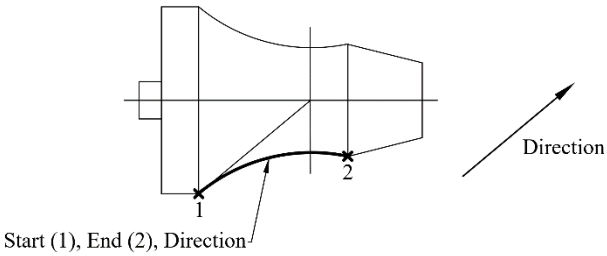
(g)


R10
Ø10
1
2
32
(@25<-105°)
Center (1), Start (2), Length (32)

(h)

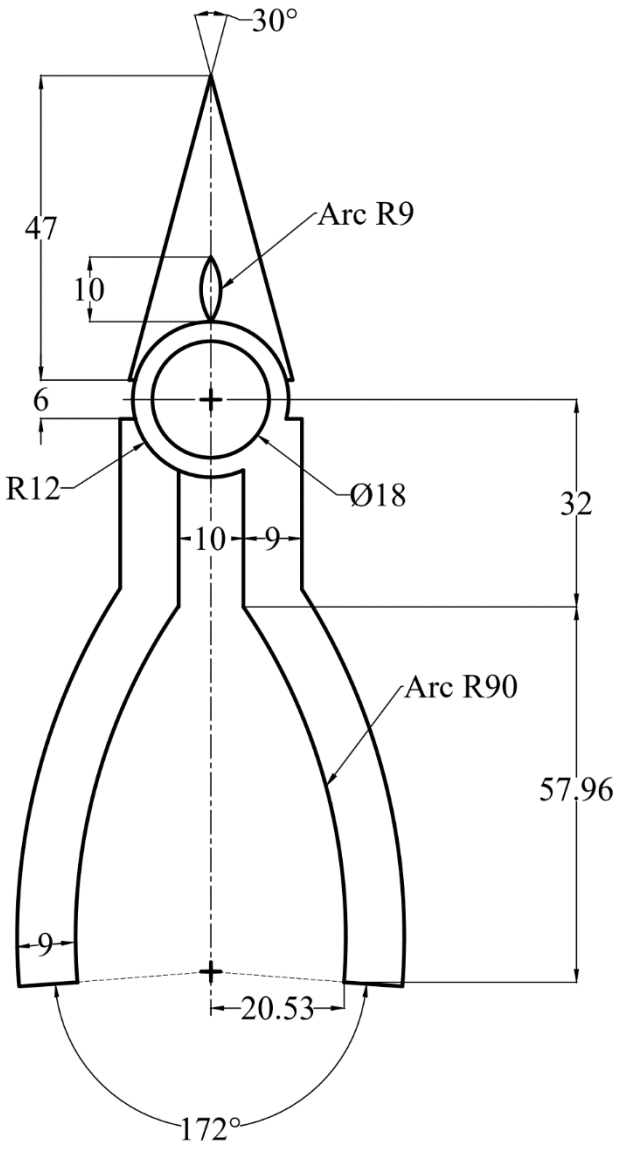

2
Start (1), End (2), Radius (25)
1

(i)

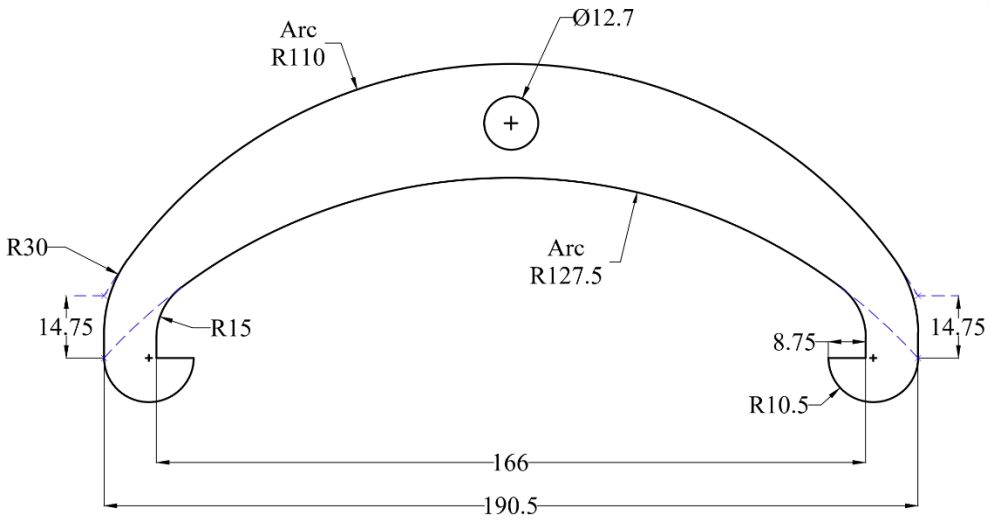

Direction
2
1
Start (1), End (2), Direction

(j)

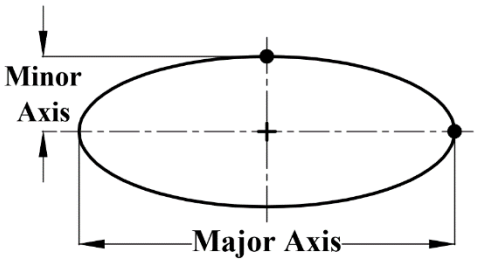
Ex. 1



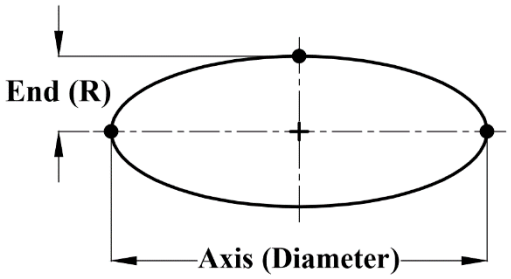
Ex. 2: Clamp of Laundry Machine



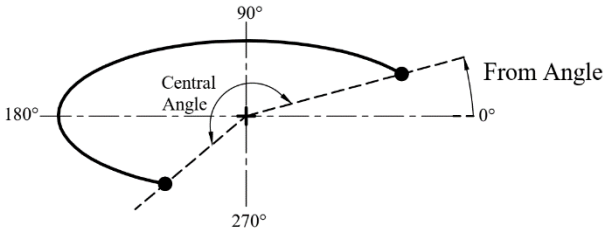
Ellipse Commands



Ellipse (Center, Radius)

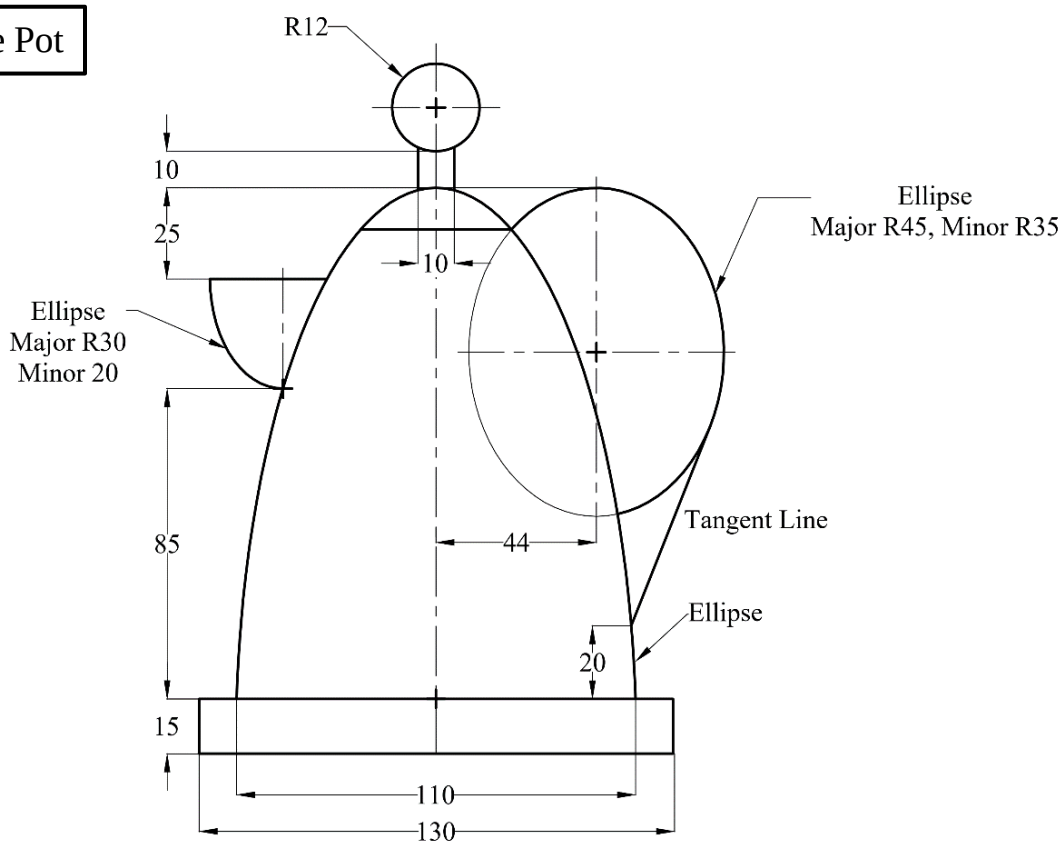


Ellipse (Axis, End)

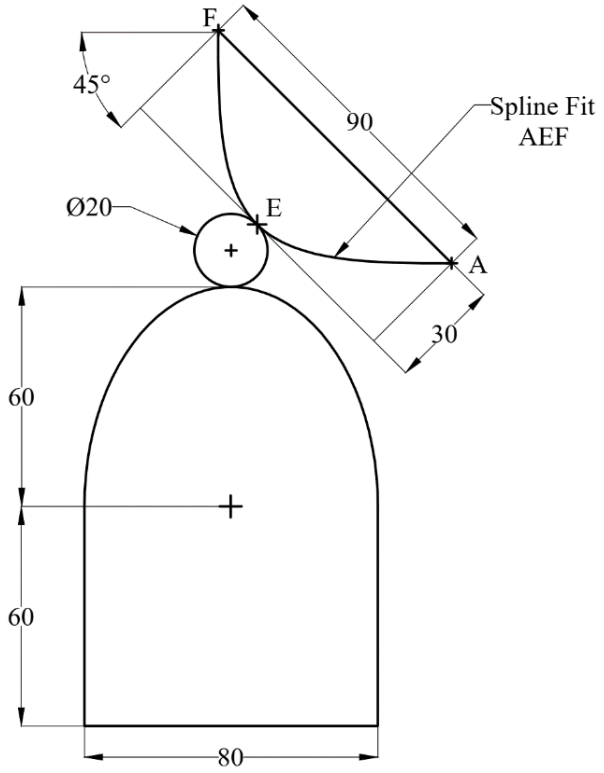


Elliptical Arc

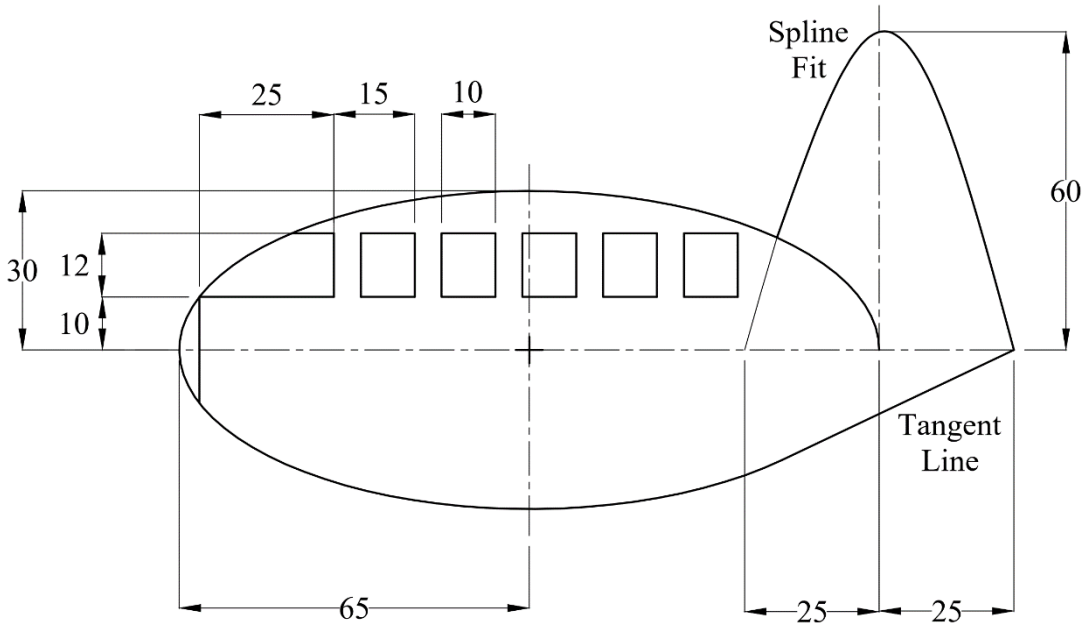
Ex. 1: Coffee Pot



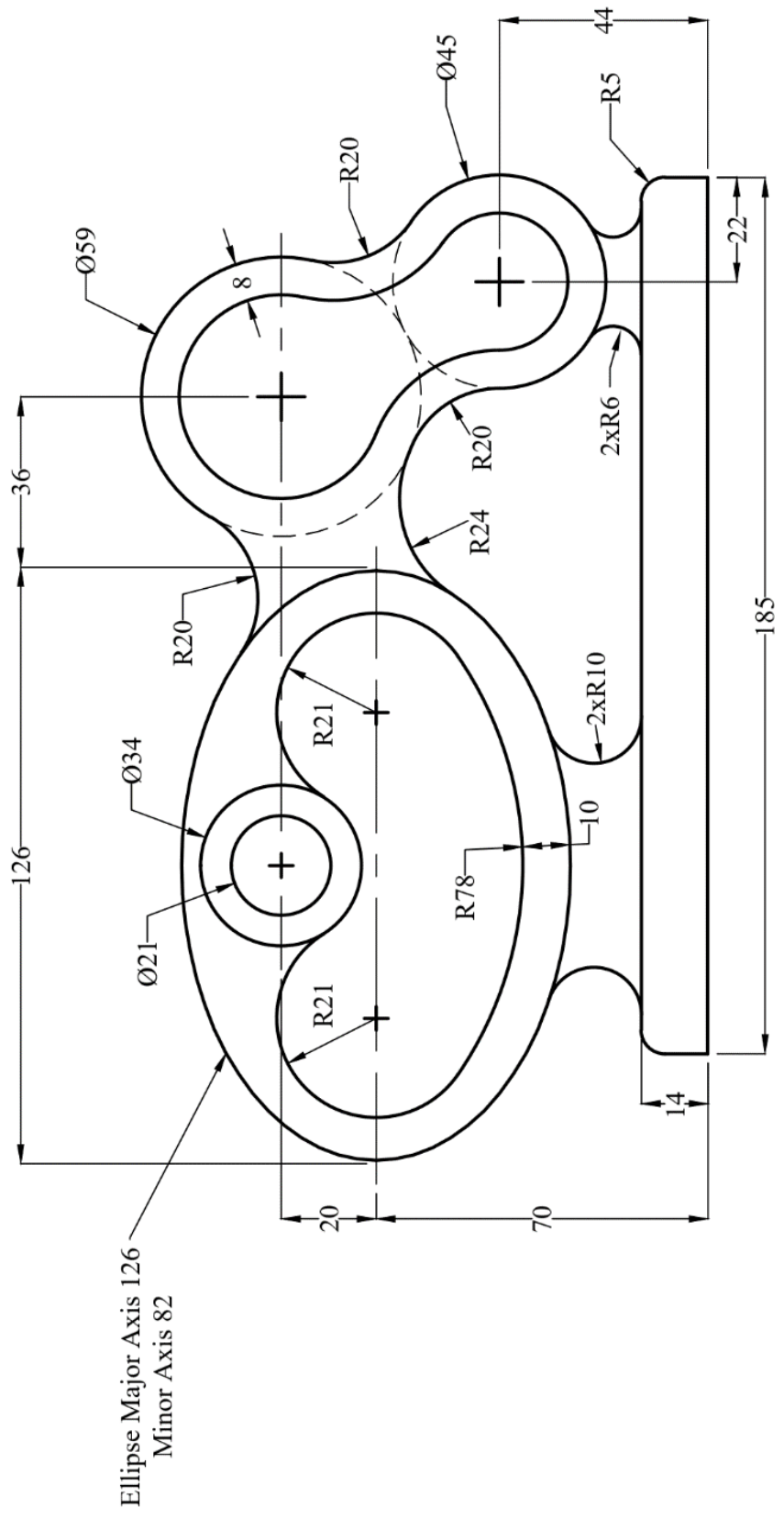
Ex. 2: Radar Station



Ex. 3: Toy Aeroplane

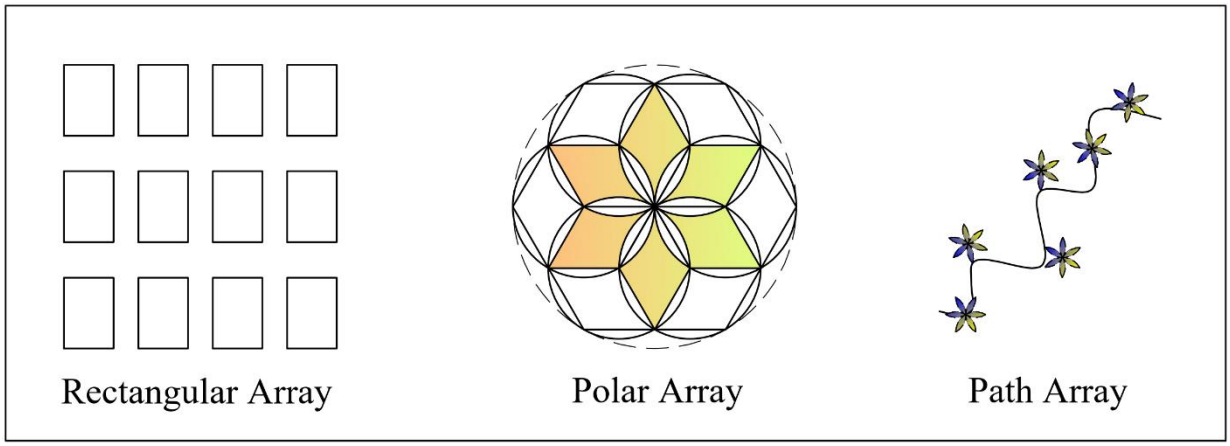


Ex. 5

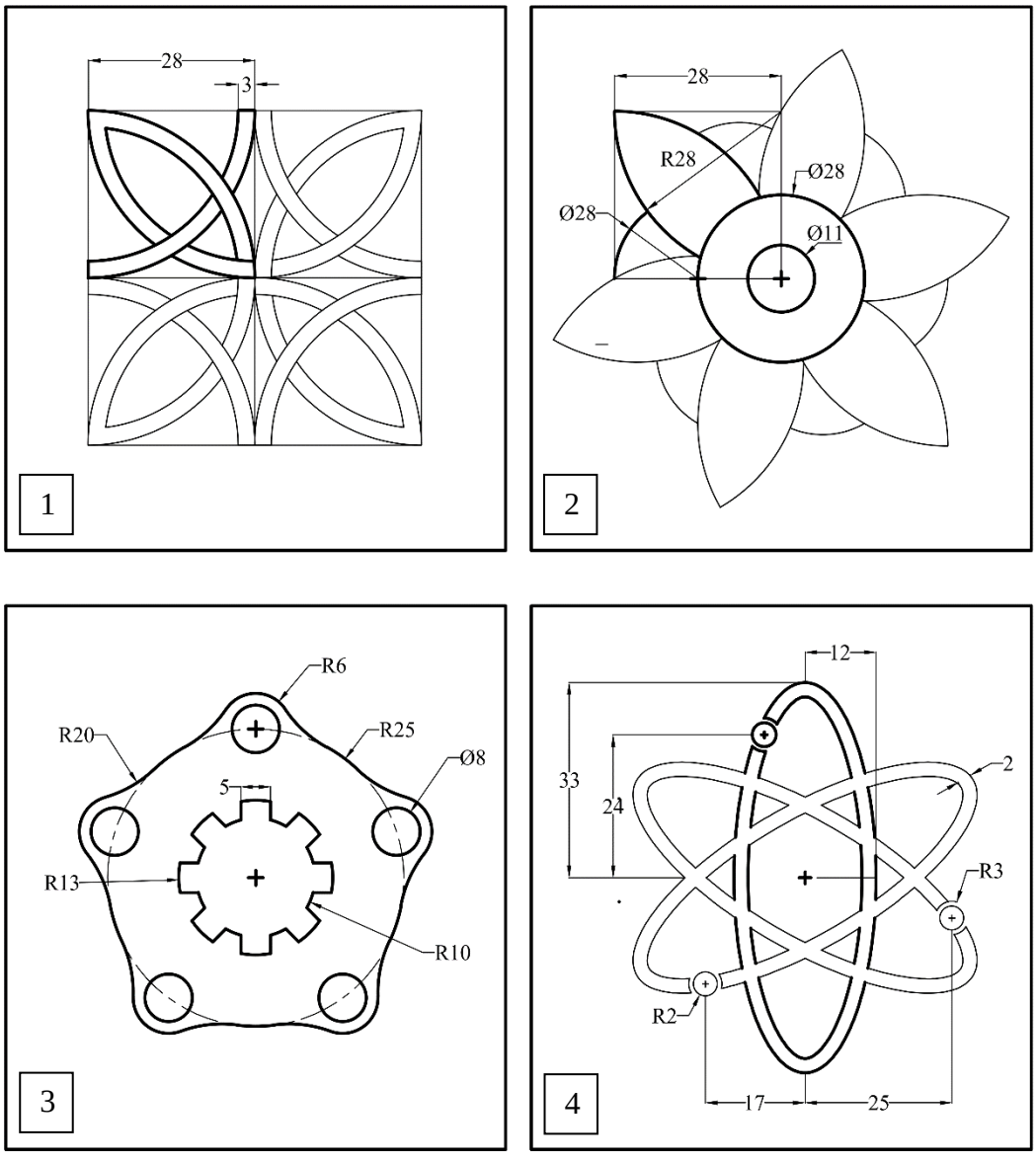

44
Ø45
R5
R20
Ø59
8
22
185
2xR6
R20
36
R24
R20
2xR10
R21
Ø34
10
126
R78
Ø21
R21
14
20
70
Ellipse Major Axis 126
Minor Axis 82

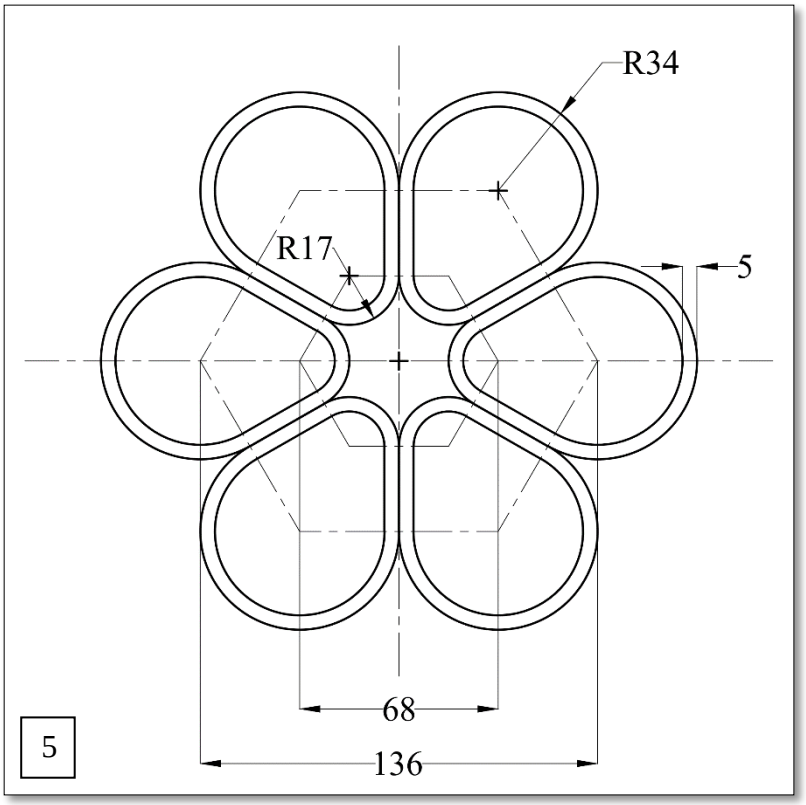
Array

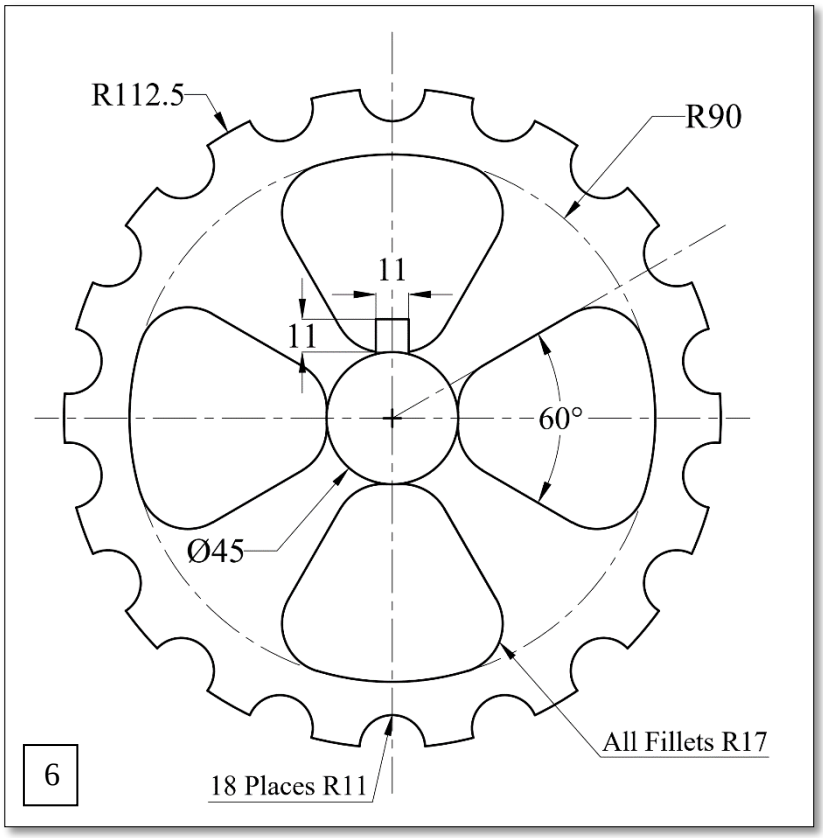
Associative and Explode

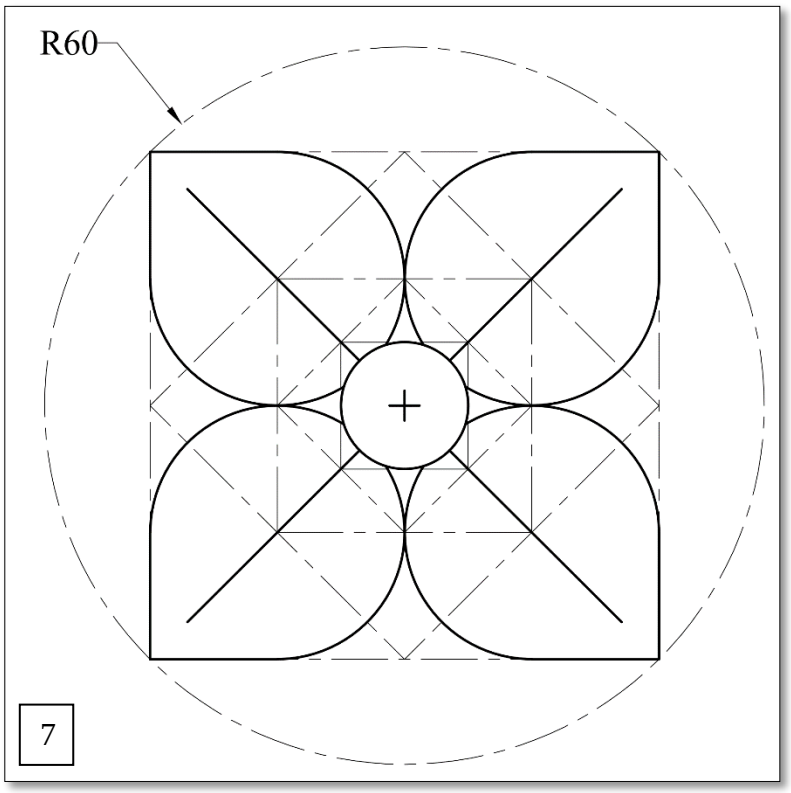


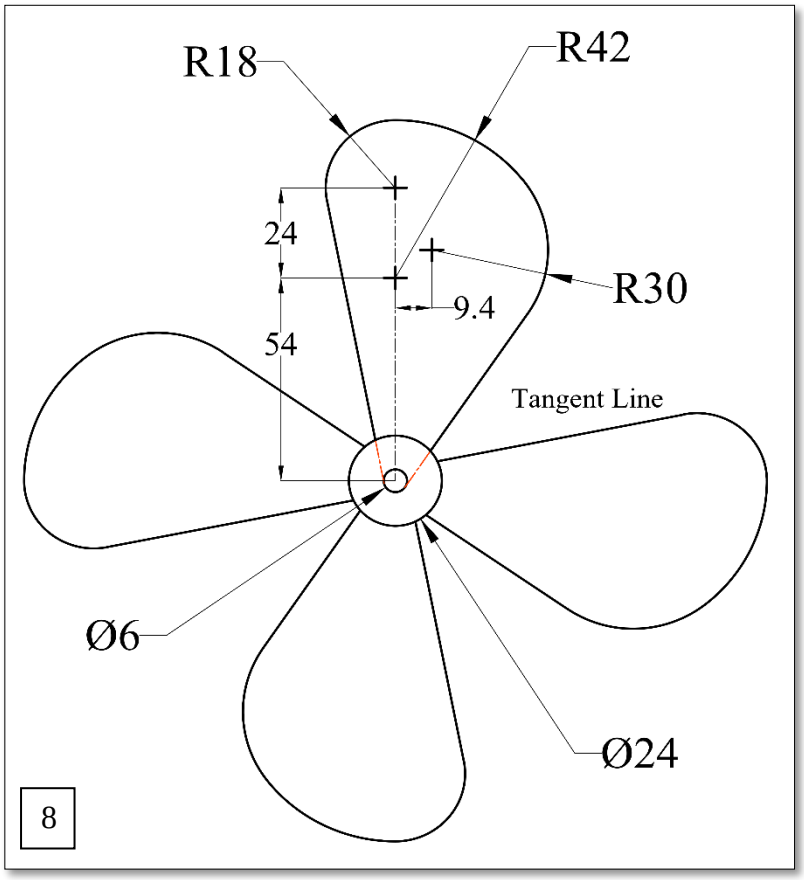
Draw the following patterns in exercise from (1) to (8) using Polar Array Command.



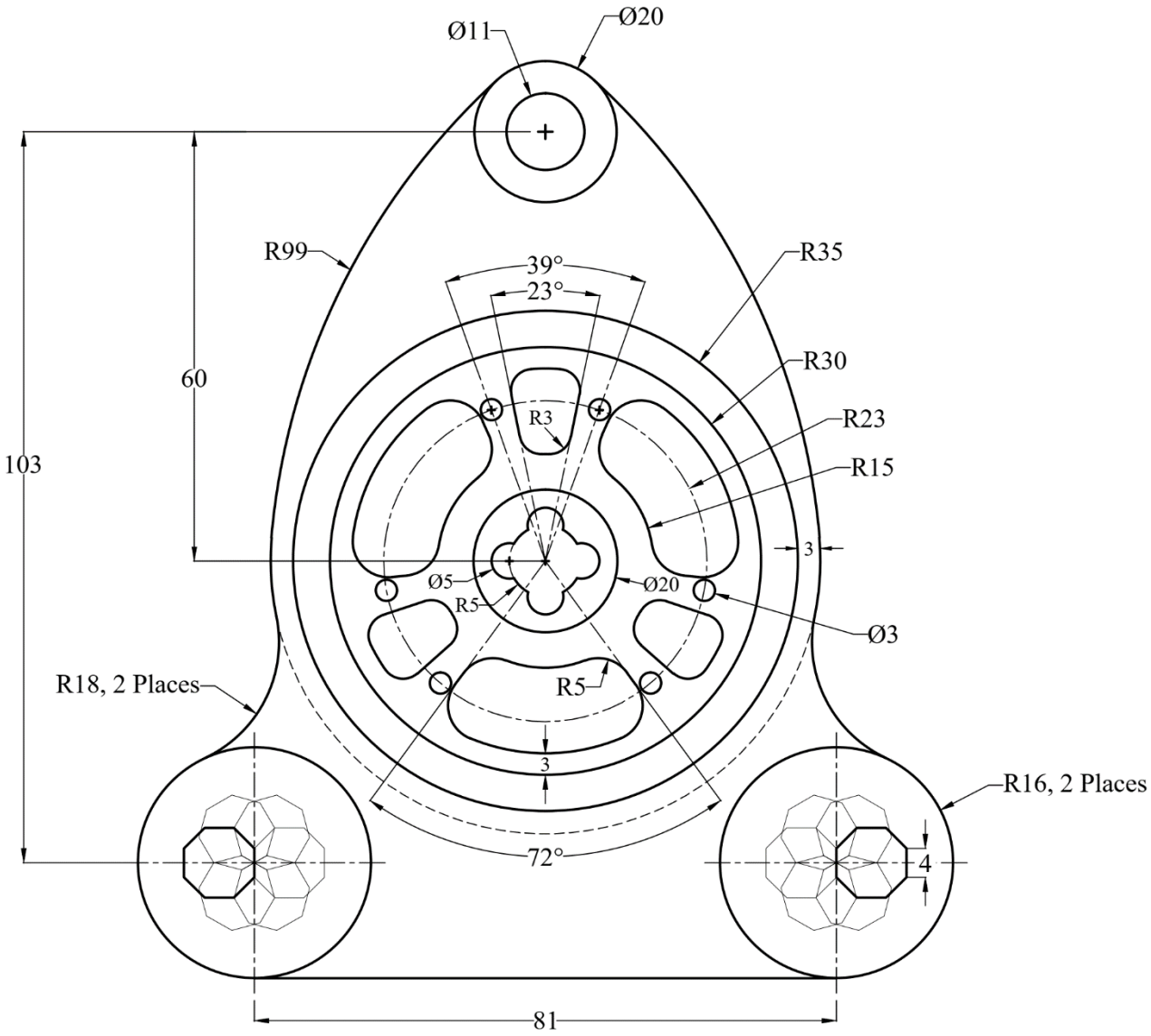

R34
R17
5
68
136
5


R112.5
R90
11
11
60°
Ø45
All Fillets R17
18 Places R11
6

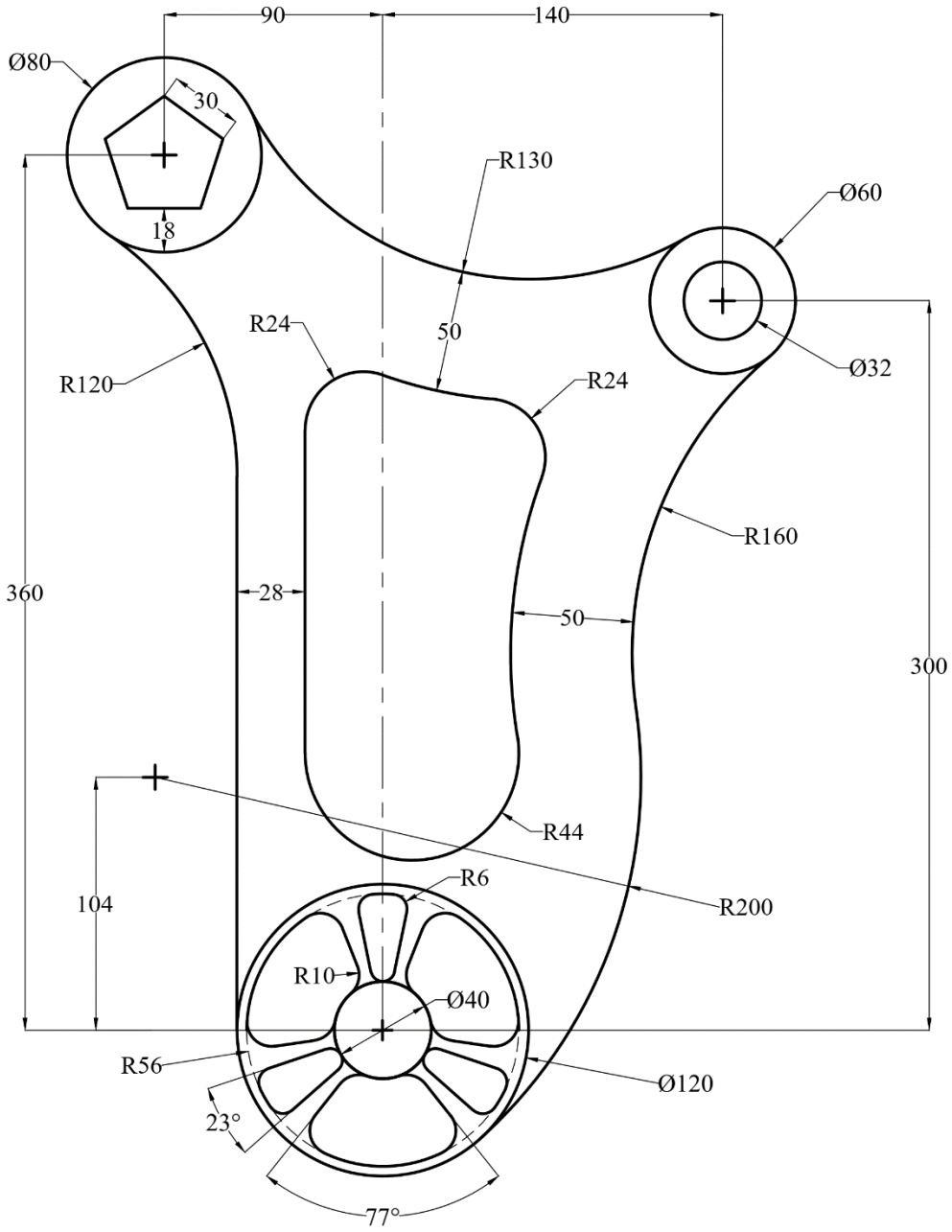

R60
7


R18
R42
24
R30
9.4
54
Tangent Line
Ø6
Ø24
8

Ex. 1


Ø11
Ø20
R99
39°
23°
R35
60
R30
R3
R23
103
R15
3
Ø5
R5
Ø20
Ø3
R18, 2 Places
R5
3
R16, 2 Places
72°
4
81

Ex. 2


90
140
Ø80
30
18
R130
Ø60
R24
50
R120
R24
Ø32
R160
360
28
50
300
R44
104
R6
R200
R10
Ø40
R56
Ø120
23°
77°

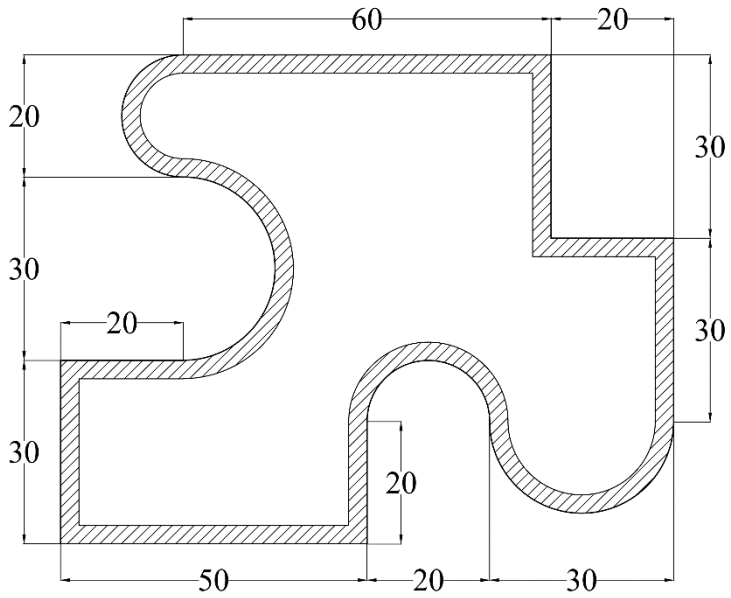
Join, Region, Boundary, Hatch, and Area

Case A:

1. Use the **Polyline** command to draw the outline of the given layout.
2. Use the **Offset** command to draw the inner wall. (Offset Distance = 3).
3. **Hatch** the area as shown in the Figure. (**Type**: ANSI31, **Scale**: 2).
4. Find the **Area** and the **Perimeter** of the hatched zone.

Area =   Perimeter =

5. Use the **Text** command to insert the **Area** and the **Perimeter** values on the screen.
6. Put all **Dimensions** on the Figure.



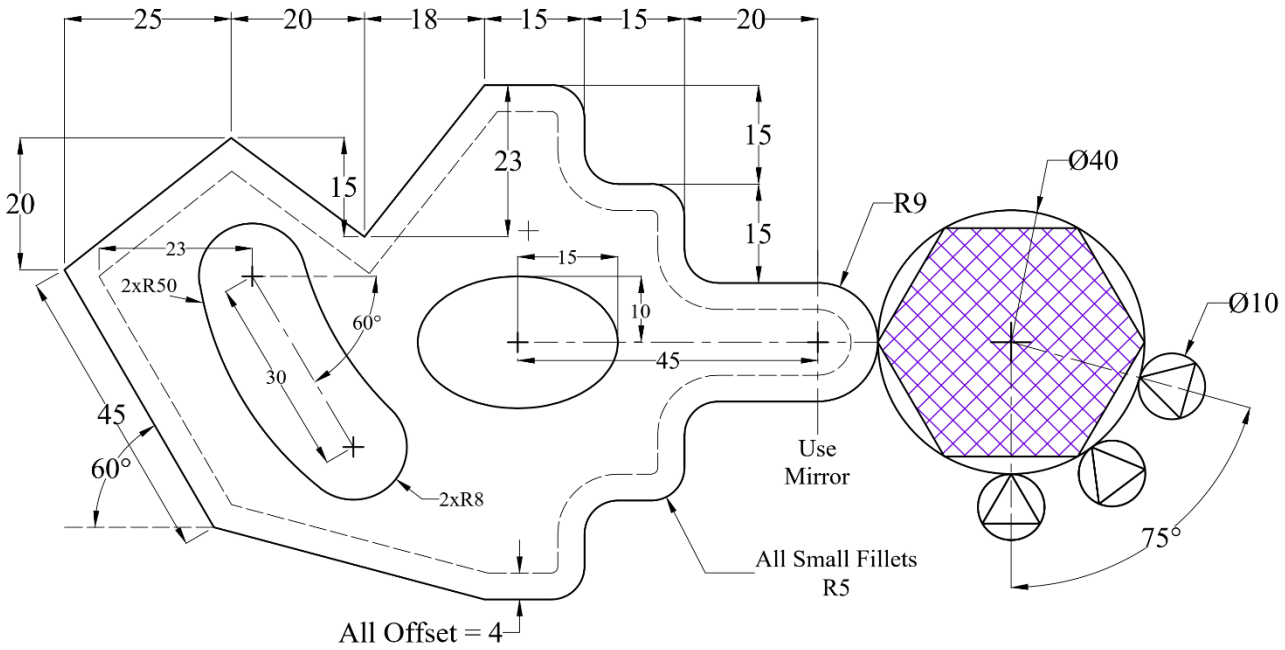
Case B:

1. Use the **Line** command to draw the outlines of the given layout.
2. Use **Join or Boundary** commands to turn the outlines into one.
3. Use the **Offset** command for the inner wall. (Offset Distance = 3).
4. Use (Add and Subtract Area) command to find the **Area** of the inner wall.

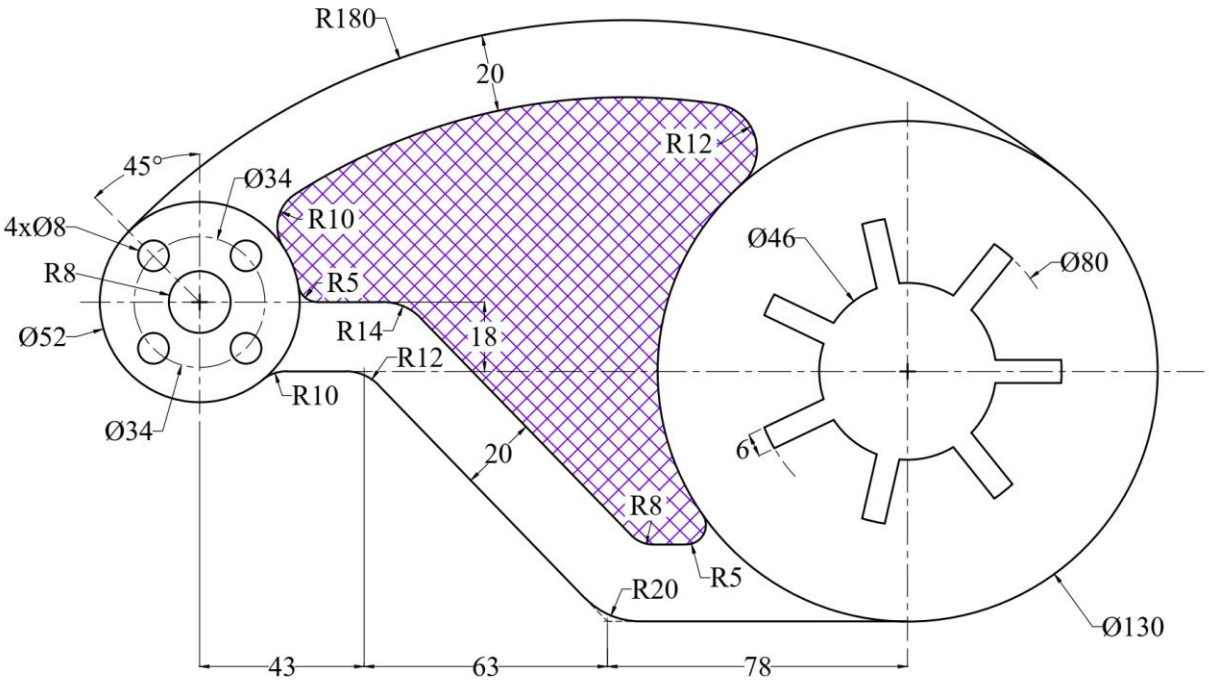
Add Area =   Subtract Area =

5. Use the **Text** command to insert the **Area** and the **Perimeter** values on the screen.
6. Put all **dimensions** on the Figure.

Ex. 1


25
20
18
15
15
20
15
23
15
20
15
23
2xR50
60°
30
15
10
45
45
60°
2xR8
R9
Ø40
Ø10
Use
Mirror
75°
All Small Fillets
R5
All Offset = 4

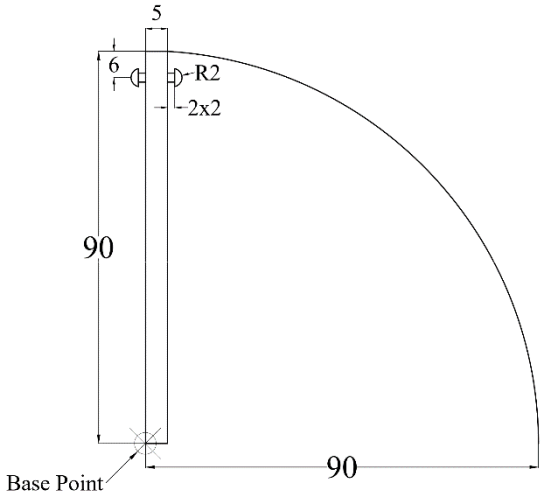
Ex. 2


R180
20
45°
Ø34
4xØ8
R8
Ø52
Ø34
R10
R5
R14
18
R12
R12
R10
20
R8
R5
R20
Ø46
Ø80
6
Ø130
43
63
78

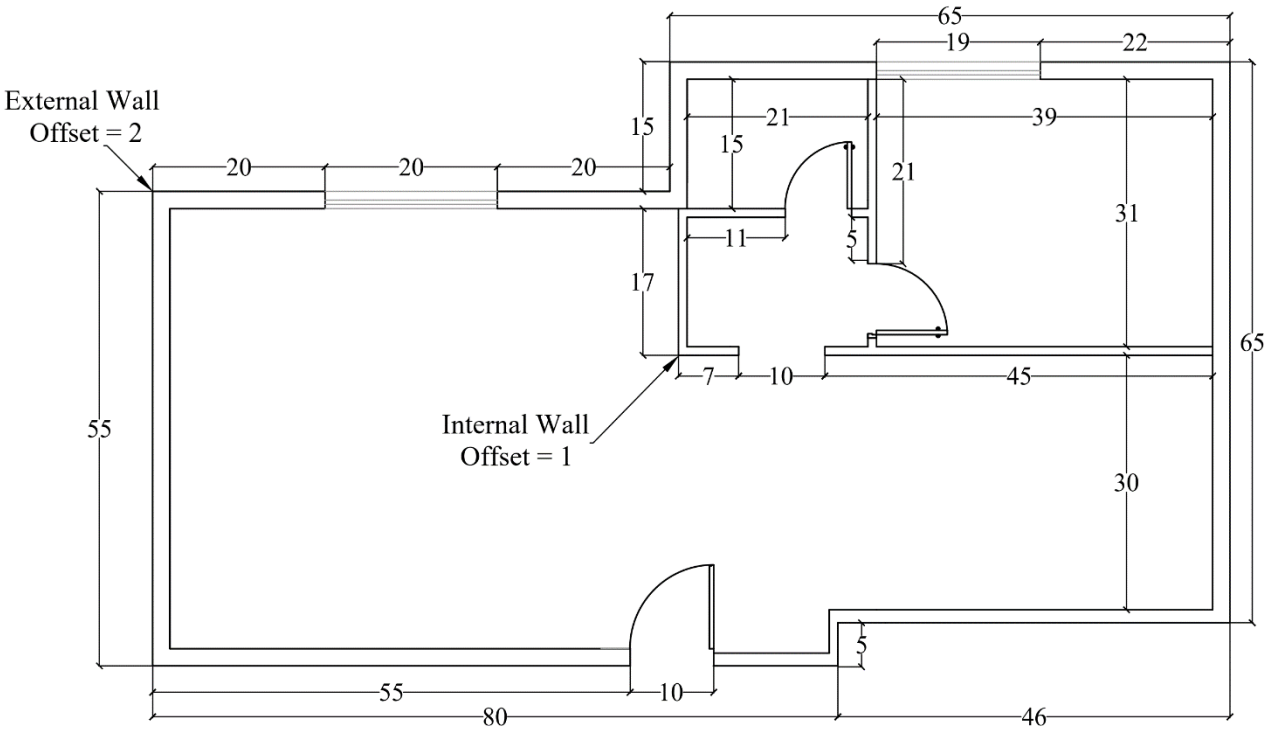
Block

Create, and Insert

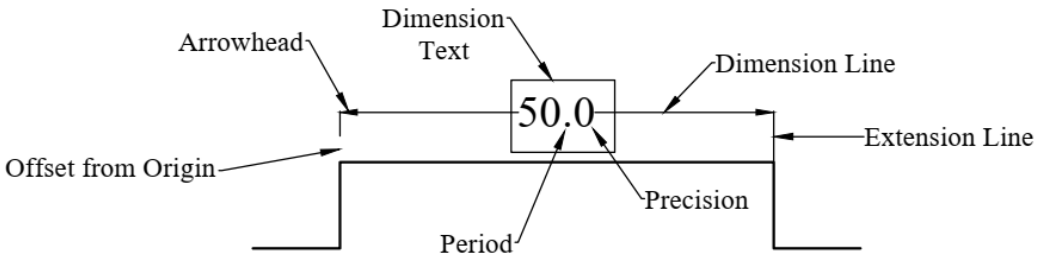
1. Draw the following **"Door"**, create a block, and name it **"Door"**.



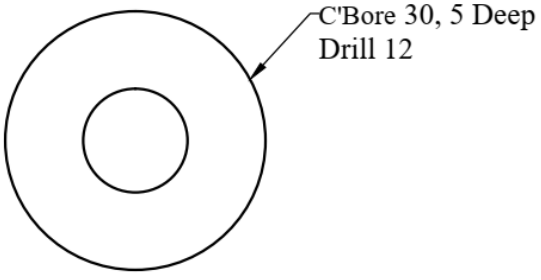
2. Insert the **"Door"** block in the proper places as shown in the given layout. Scale: 10:1

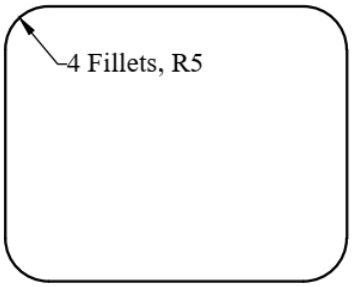


Dimensions



Leaders





Dimensioning Rules

A. Dimension Placement

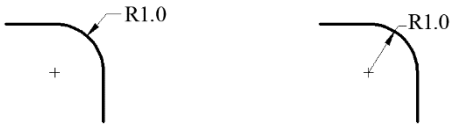
- Place dimensions on the most descriptive views.
- Take dimensions from visible lines not from hidden lines.
- Organize and align dimensions for ease of reading.
- The dimensions are normally positioned to maintain a minimum of 3/8" (9.52mm) open space around the object.
- Do not repeat dimensions.
- Dimensions should not cross other lines (unless necessary).
- Extension lines may cross other extension lines or object lines if necessary.
- Arrowheads are long and narrow (3 to 1 ratio).
- Do not place dimensions within views (unless necessary).
- Give an overall dimension and omit one of the chain dimensions.
- Shorter dimensions are placed inside longer ones.
- Angles may be dimensioned either by coordinates or angular measurements in degrees.
- Place angular dimensions outside the angle.
- Dimension cylinders in their rectangualr views with diameter.

B. Dimensioning for Holes

- Dimension holes in the circular view.

C. Dimensioning for Fillets, Rounds, and Arcs

- **Rounds** are dimensioned either by a leader pointing toward the center of the arc or the arrow may be placed inside (if space permits).



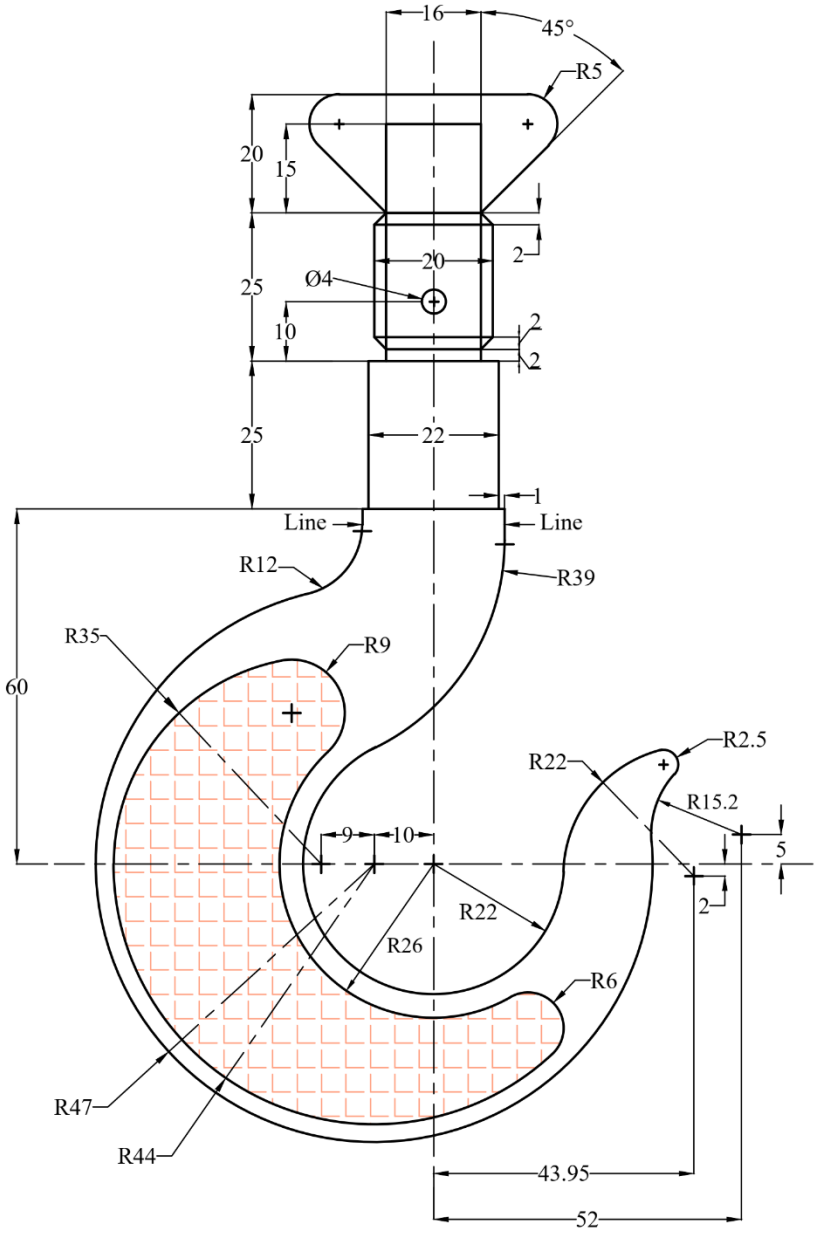
- A very slightly rounded corners may be denoted by: Break Corner.
- **Fillets** (inside rounded corners) are dimensioned by the same rules as rounds.
- If all fillets and rounds haveequal radii, the note "All Fillets and Rounds 1.0R" may be used instead of dimensioning each sperately.
- **Arcs** are dimensioned with a radius. Small arcs are dimensioned as they were fillets and rounds.

Layers

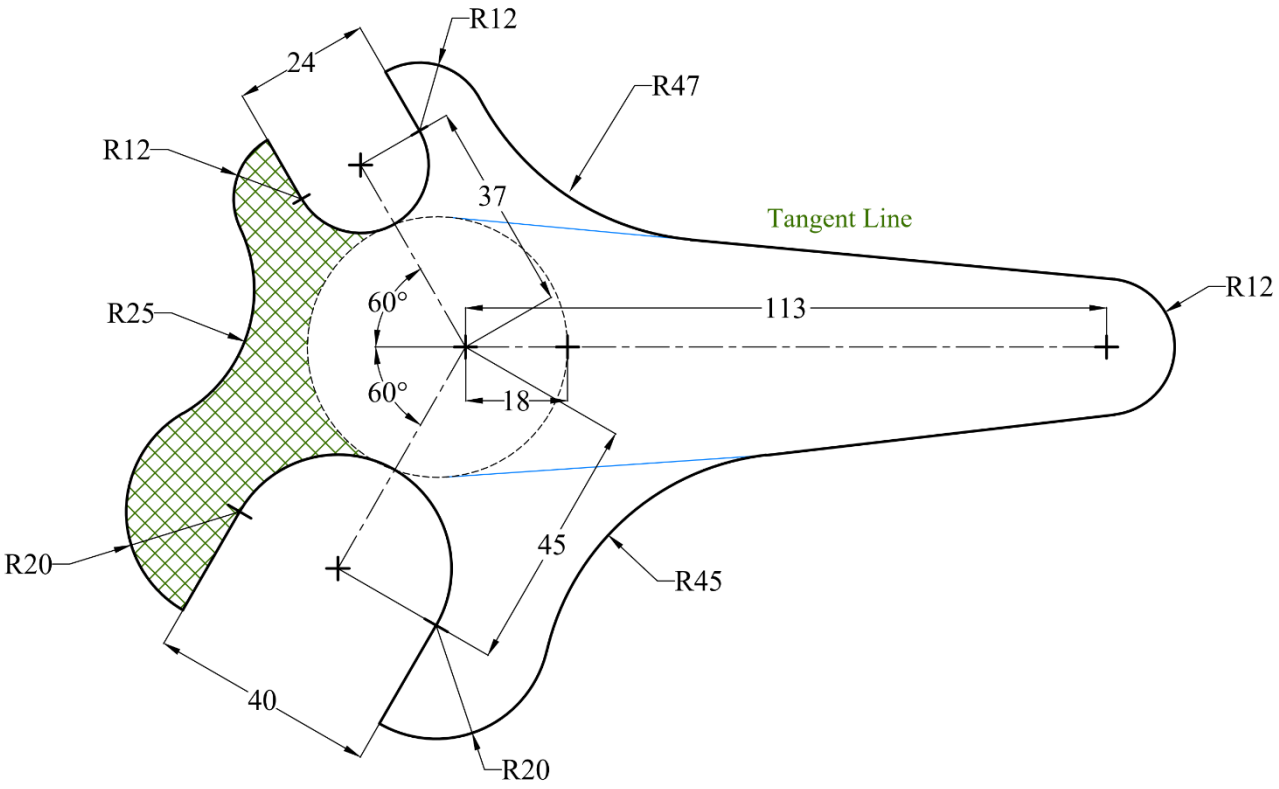
1. Create six layers as indicated in the table below with different colors.
2. Put all dimensions.
3. Find the area of the hatched zone and insert its value as a text on the screen.

Layer	Name	Line Type	Line Weight
1	Outlines	Continuous	0.50
2	Centerline	Center 2	0.35
3	Hatch Line	Continuous	0.30
4	Dimensions	Continuous	0.30
5	Text	Continuous	0.50
Note: You can give any name for the layers.			

Ex. 1: Hook



Ex. 2

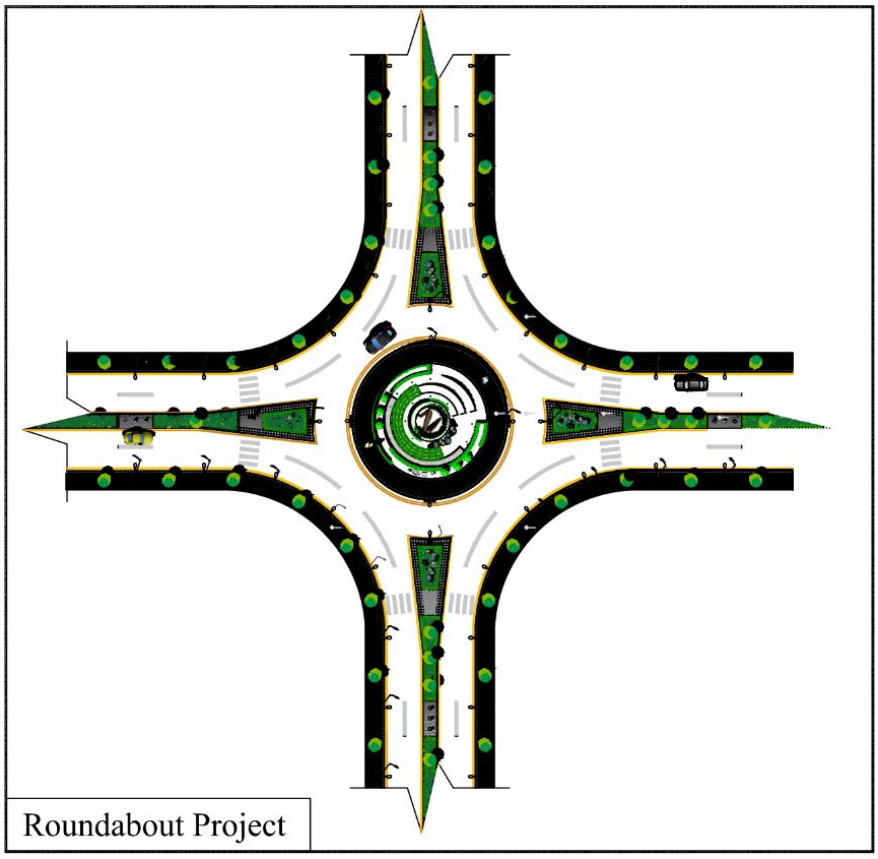

R12
24
R47
R12
37
Tangent Line
R12
R25
60°
113
60°
18
R20
45
R45
40
R20

Layout Plot and Publish

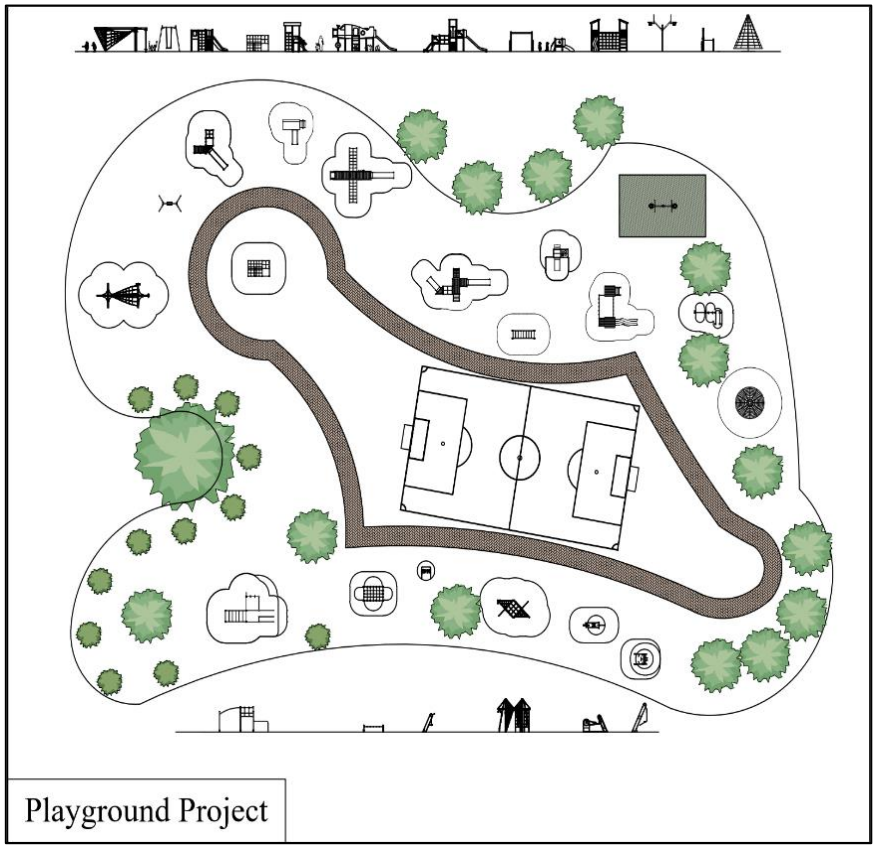
In reference to the previous exercise (Ex. 1); Hook,

1. Create a new **Page Setup** and name it “Hook”.
2. Change the following settings:
    a. **Printer**: Your current **Windows system printer** or choose **DWF to PDF.pc3**.
    b. **Paper Size**: ISO A3 (420 × 297 mm).
    c. **Plot area:** Window or Layout.
    d. **Plot scale** = 1:1.
    e. **Orientation**: Portrait.
3. Use the **Plot** command.
4. If the Plot command is not used, tab to **“Layout”** and repeat the above steps.
5. Use **Viewport** command and choose (**1 viewport**) to draw the required view.
6. Use **Publish** command to create the layout as a **Pdf** file.

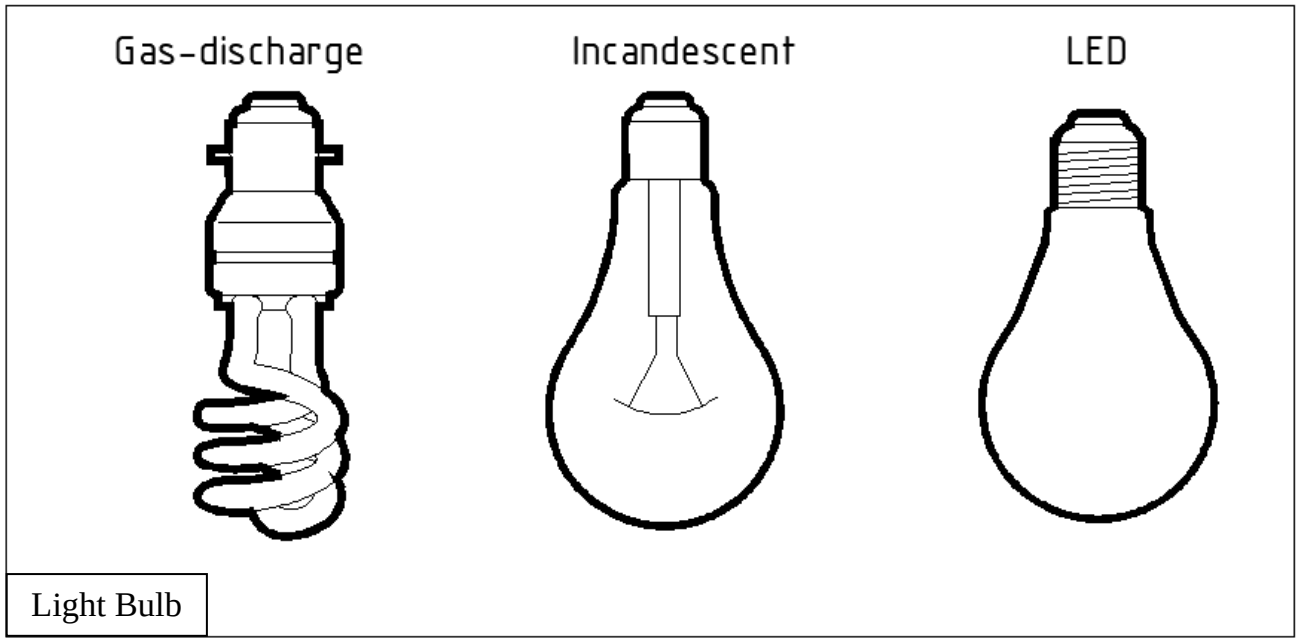
Engineering Applications



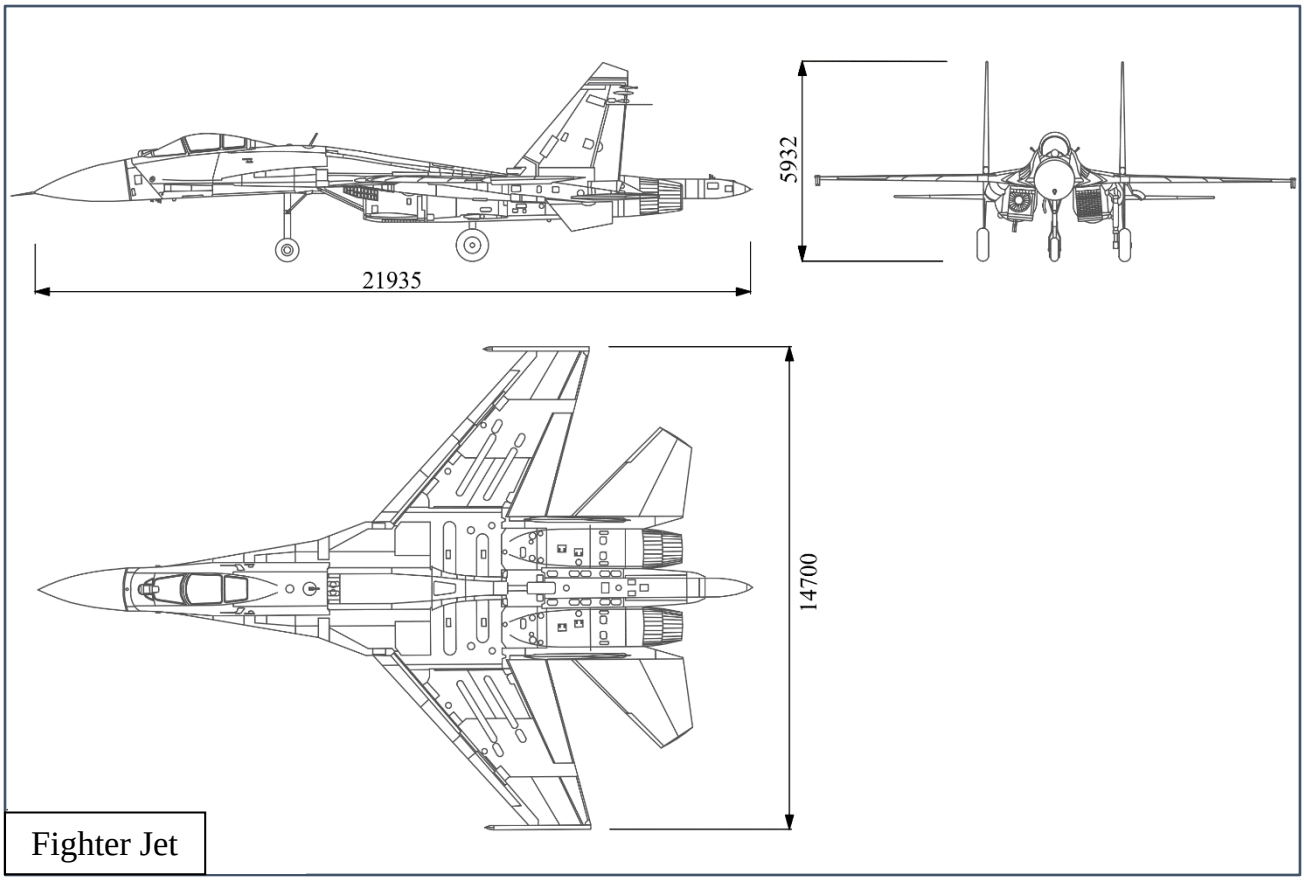
Roundabout Project



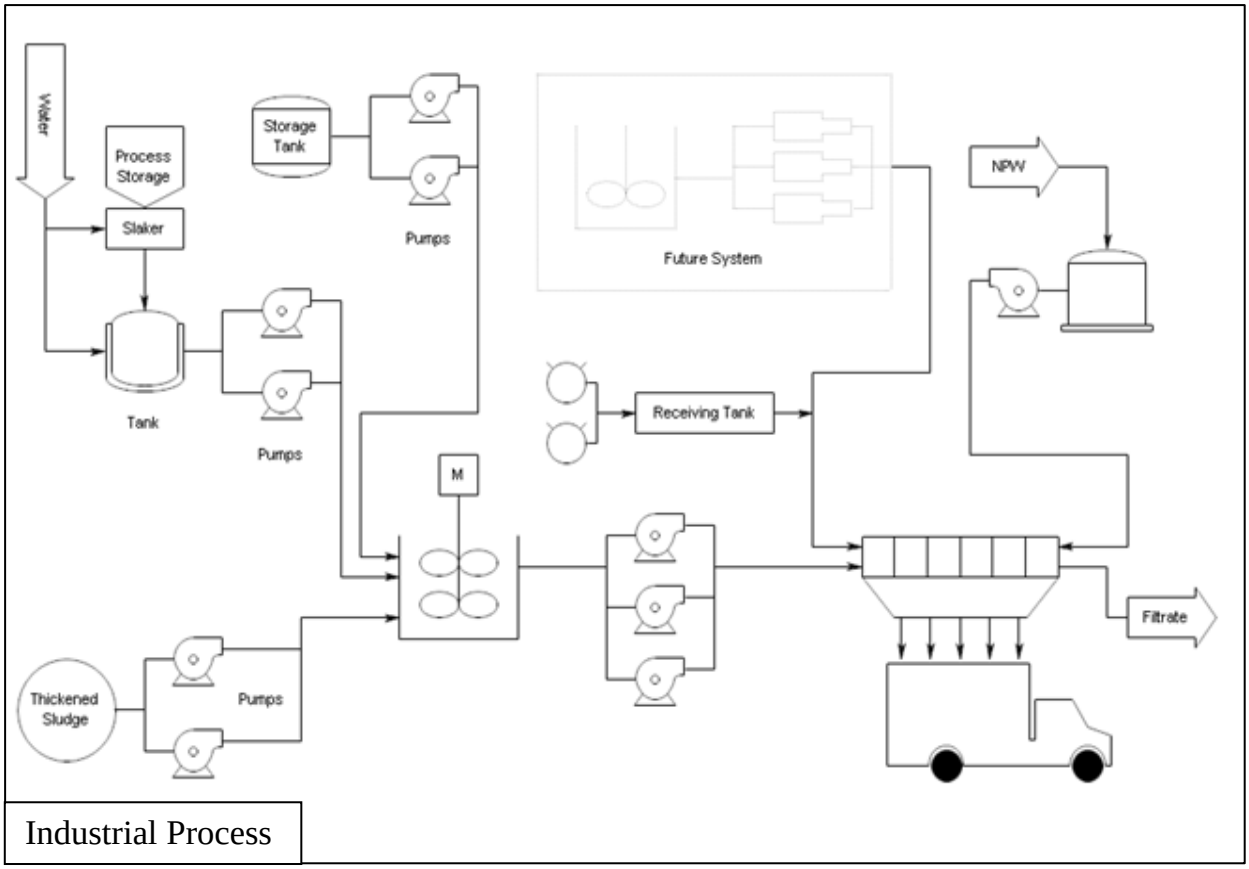
Playground Project



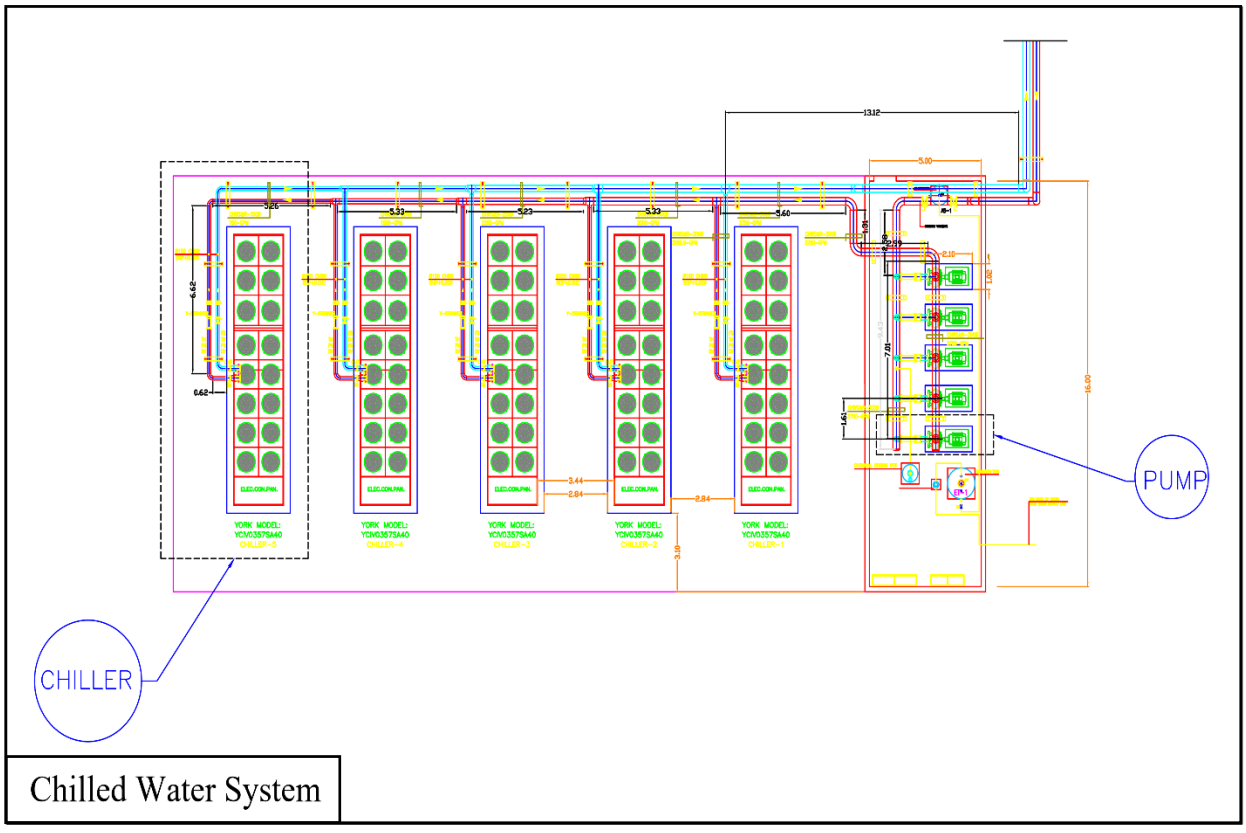
Light Bulb



Fighter Jet



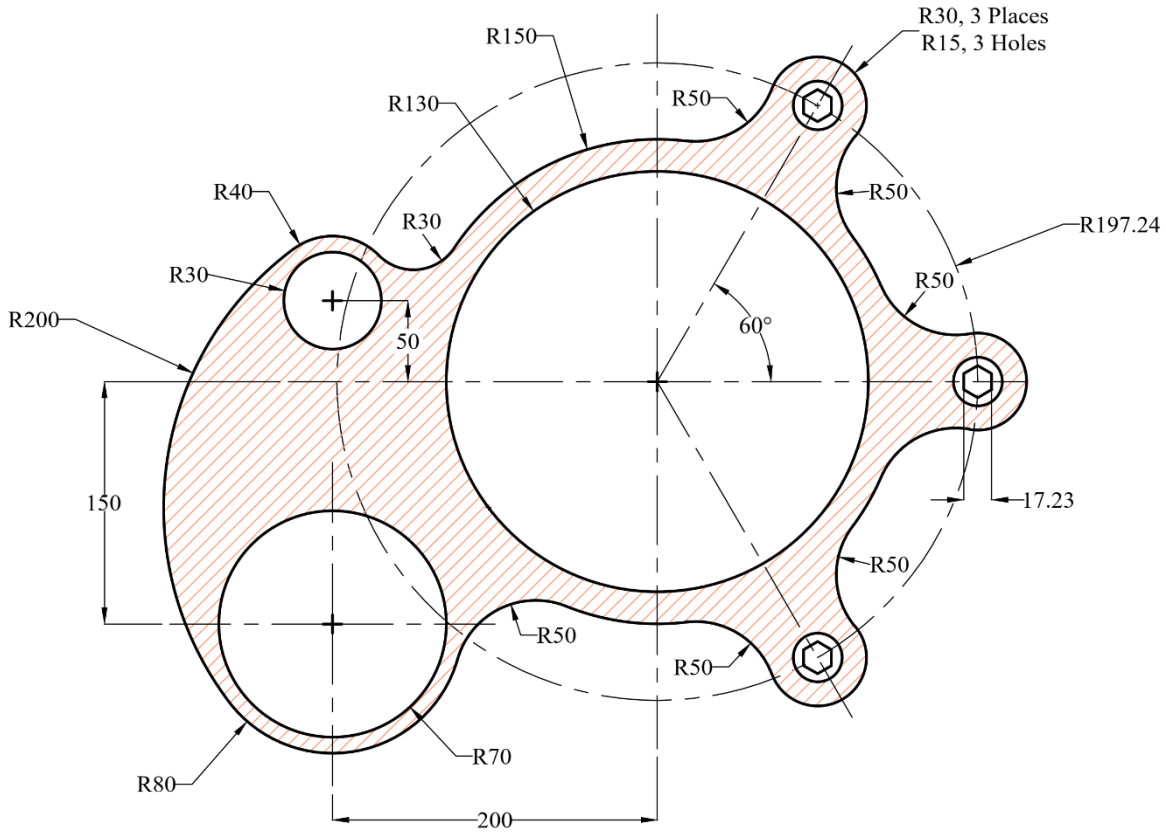
Industrial Process



Chilled Water System

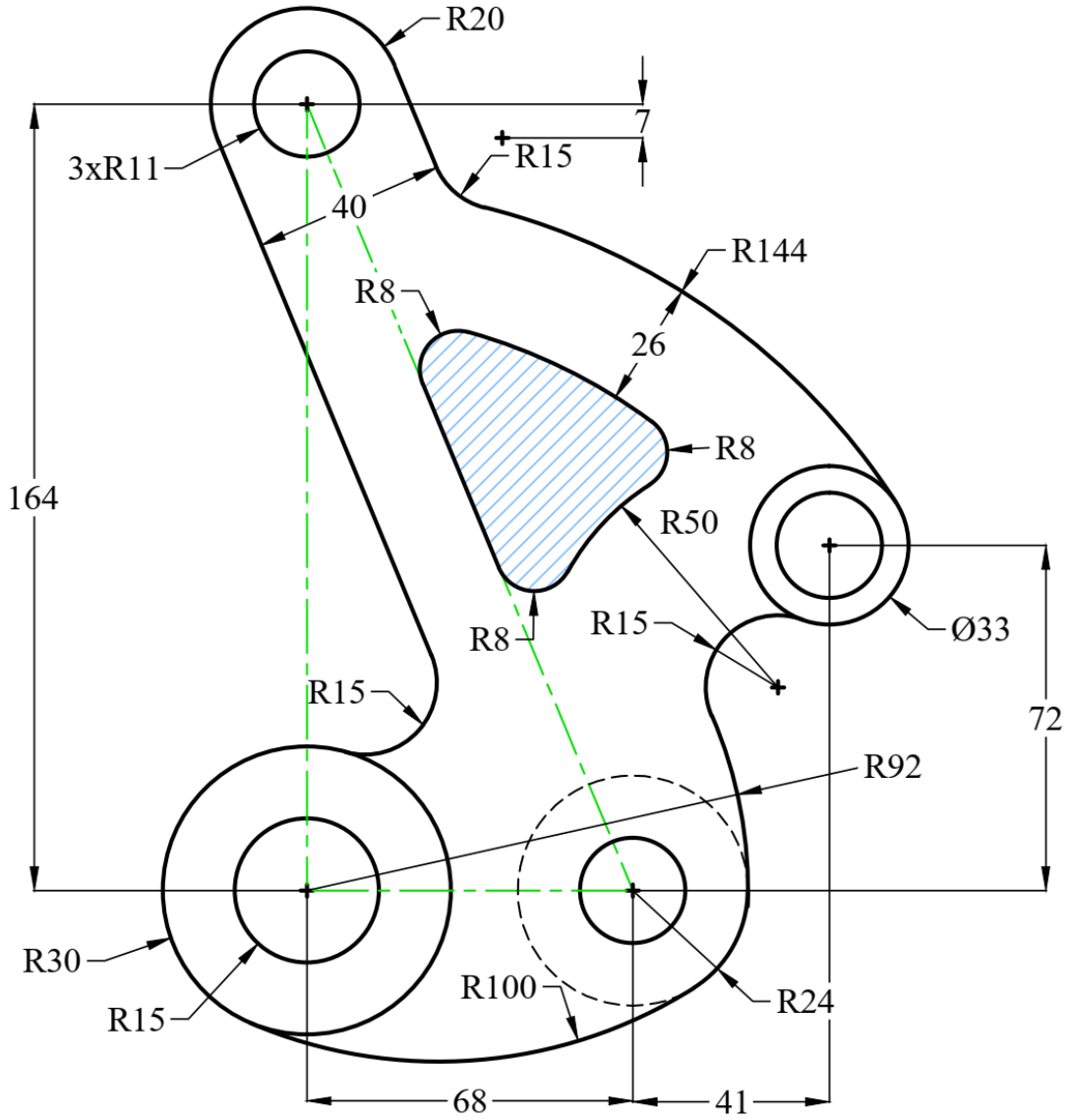
Past Exam (1)

1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (2) and a rotational **angle** (30º).



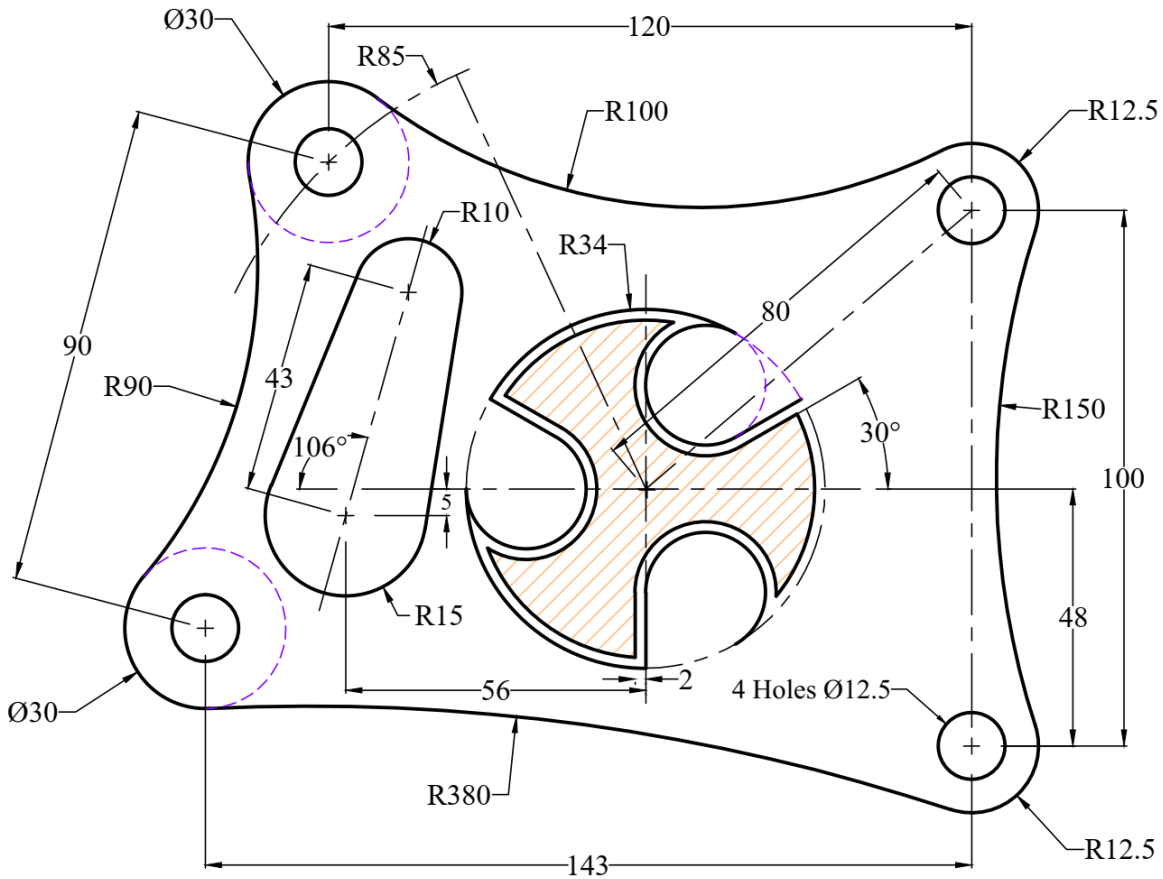
Past Exam (2)

1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.5) and a rotational **angle** (75º).



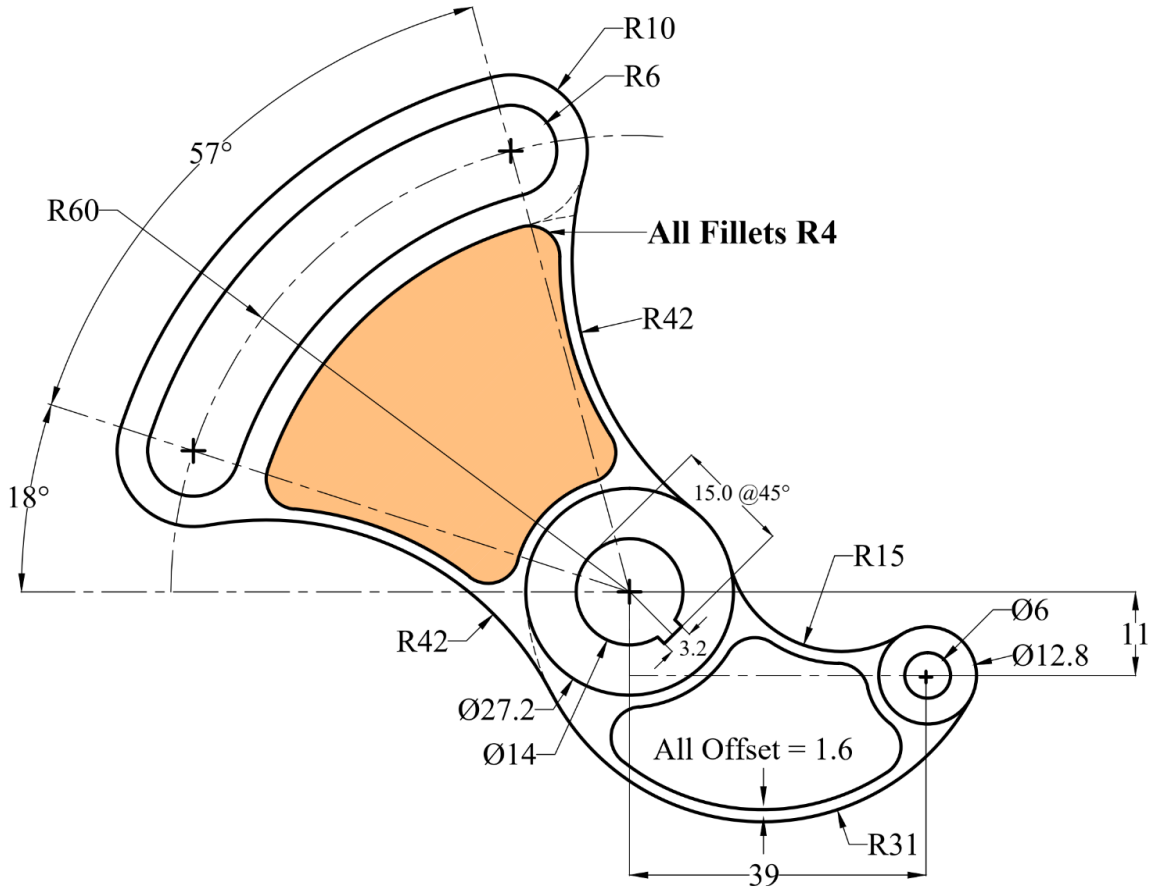
Past Exam (3)

1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.75) and a rotational **angle** (30º).



Past Exam (4)

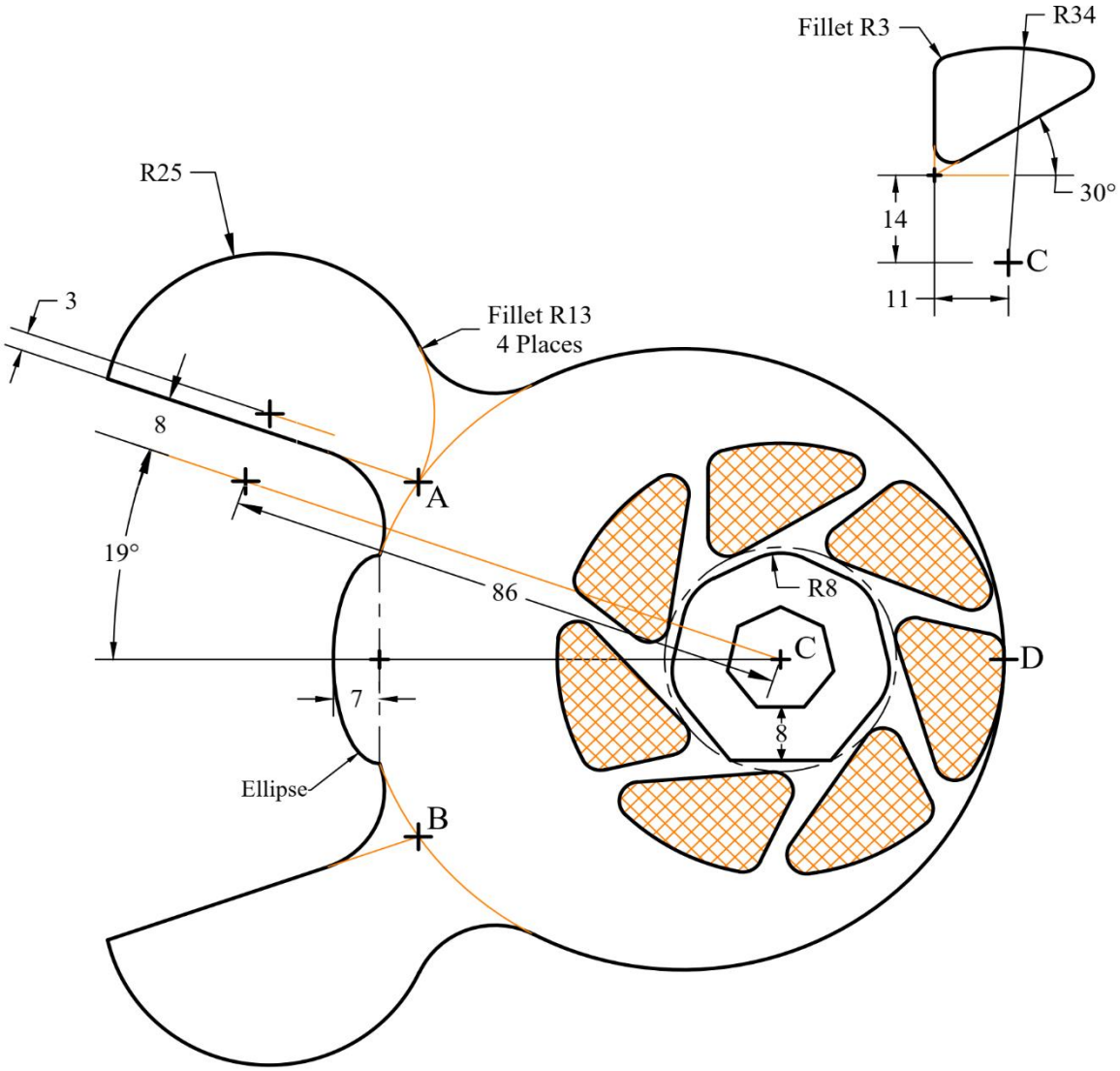
1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.5) and a rotational **angle** (60º).



Past Exam (5)

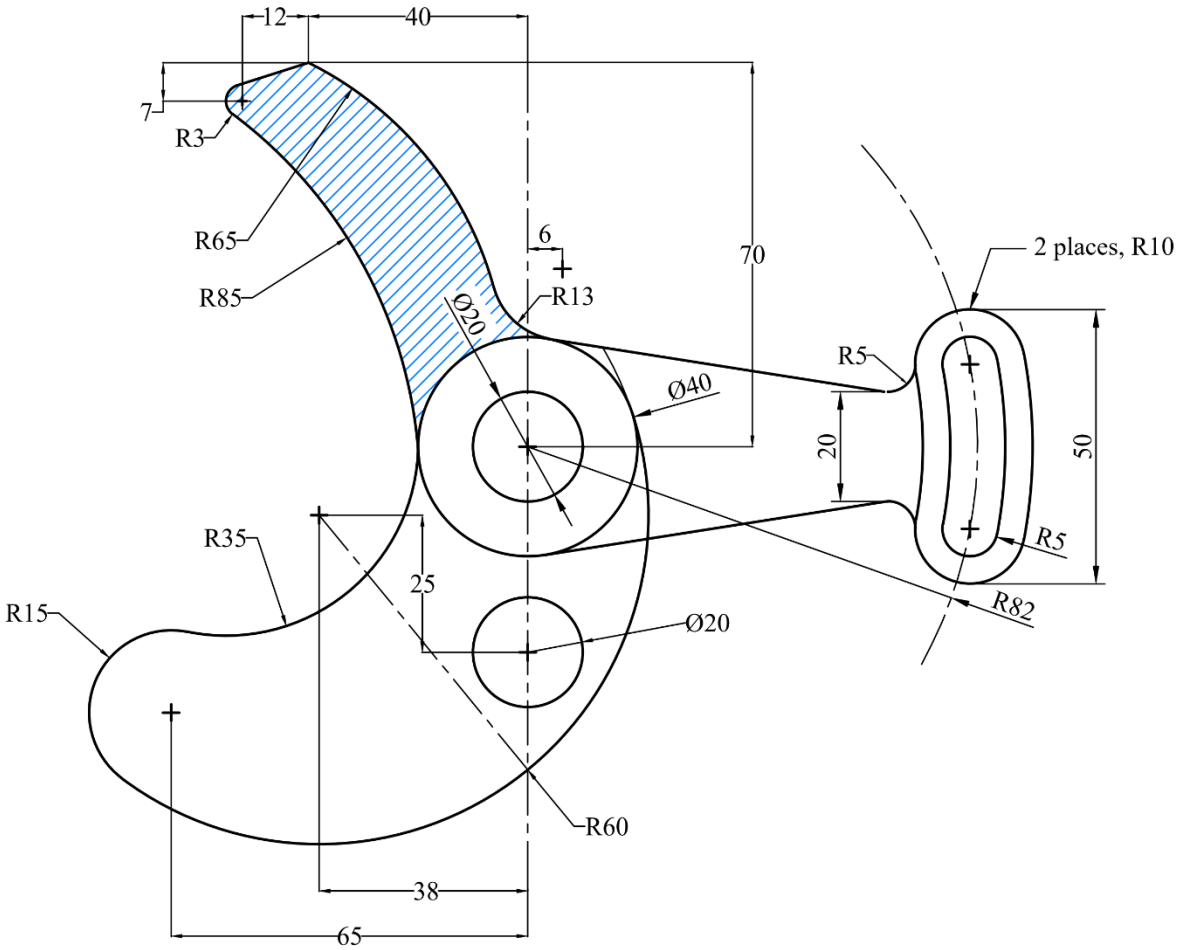
1. Draw the following sectional and frontal views using the appropriate layers. **Start from point C and create the array items first.**
2. Find the **area** of the hatched zone.
3. Copy the Figure and make it as a block.
4. Put all **dimensions** on the original drawing.
5. Insert the block with a **scale** (0.6) and a rotational **angle** (80º).

Note: Start by drawing the array pattern.



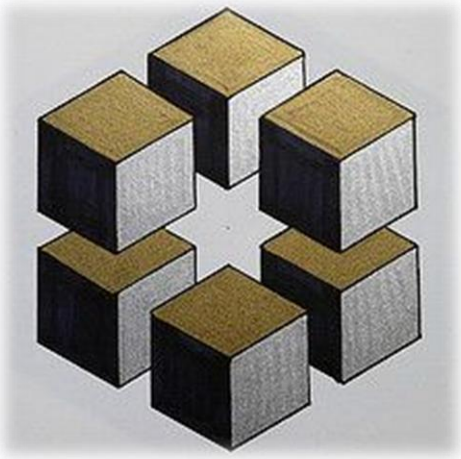
Past Exam (6)

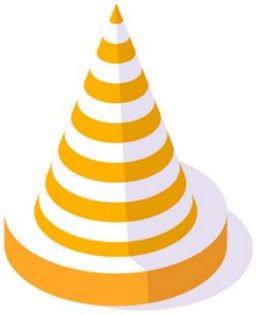
1. Draw the following sectional and frontal views using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.35) and a rotational **angle** (60º).

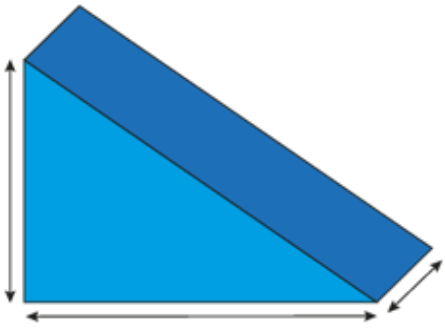


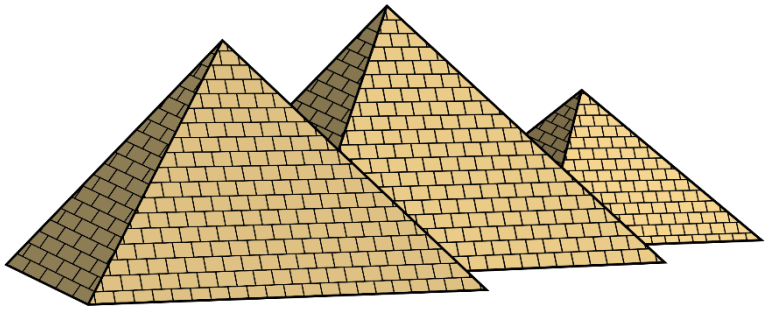
Solids and Universal Coordinates System

Using the solids in 3D Modeling worksheet to draw the following.





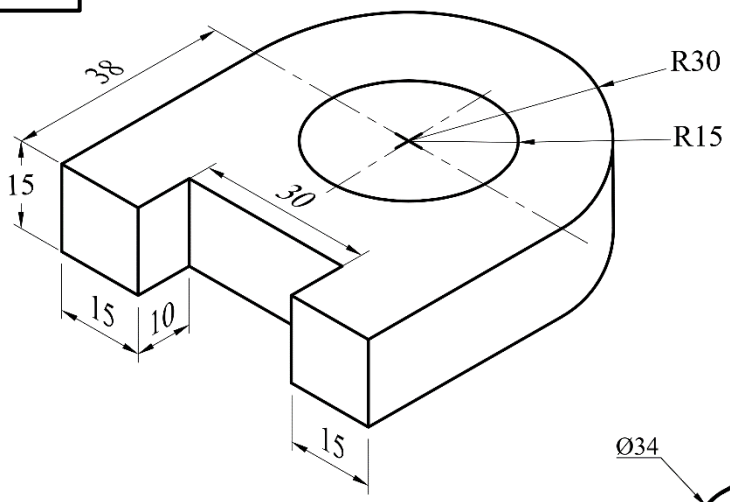




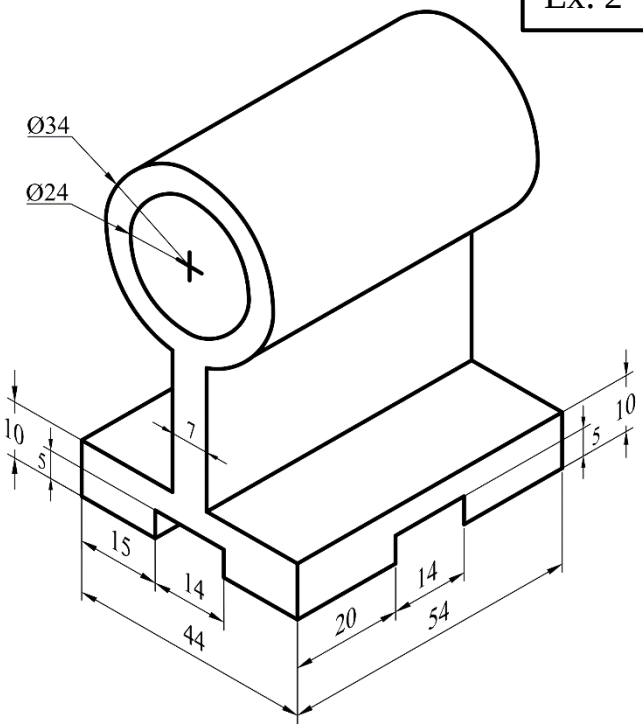
Basic Drawing of 3D Solids

UCS , Extrude , Subtract , and Union

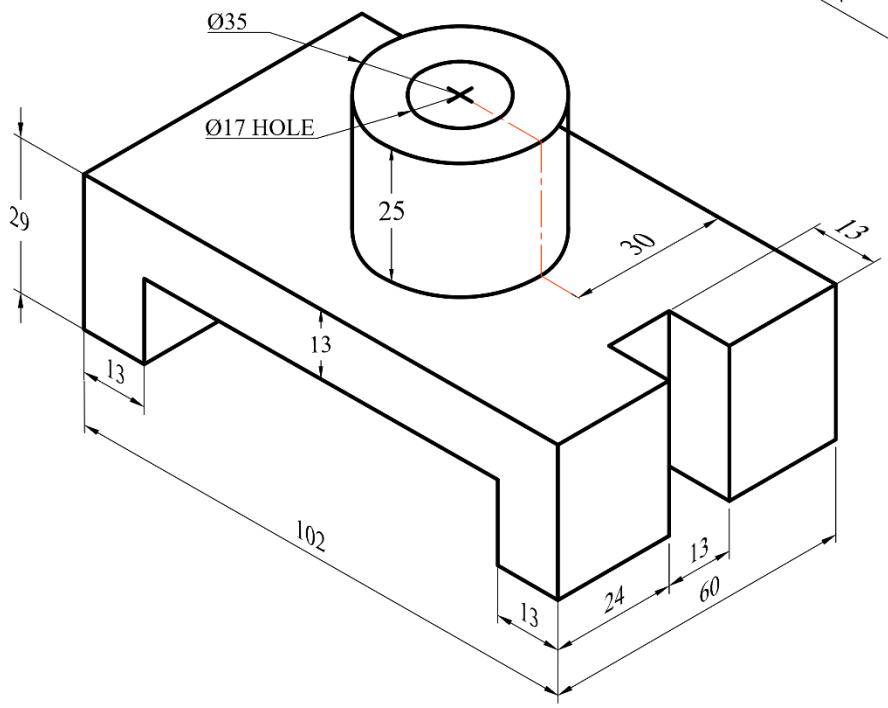
Ex. 1



Ex. 2



Ex. 3



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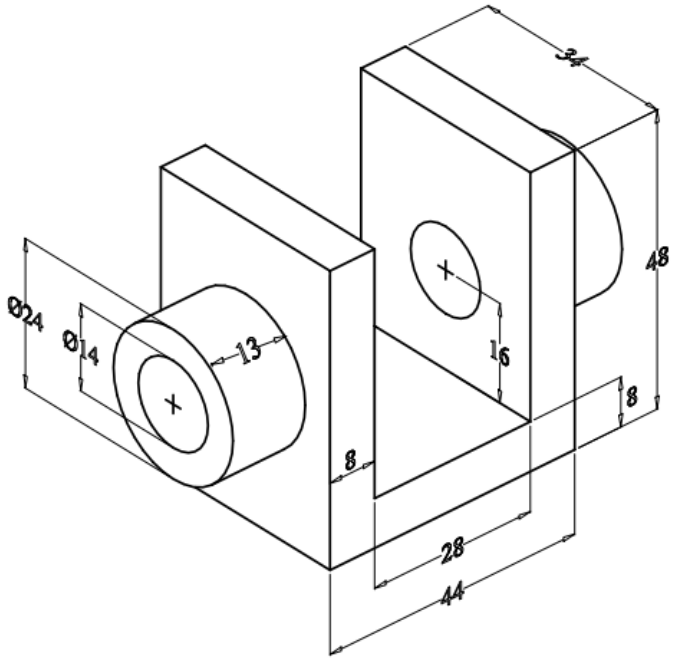
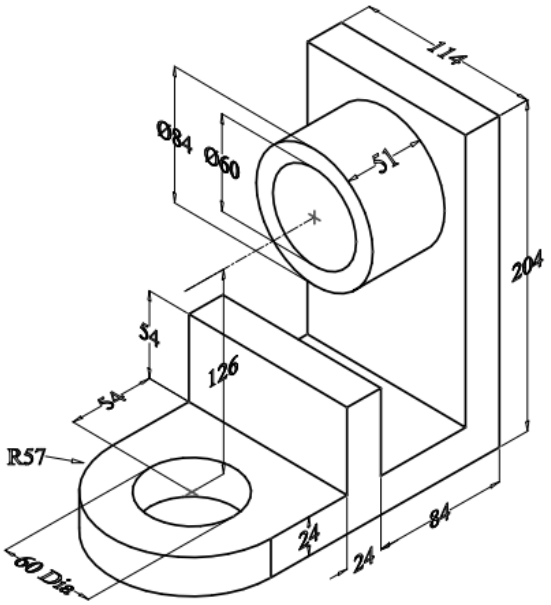
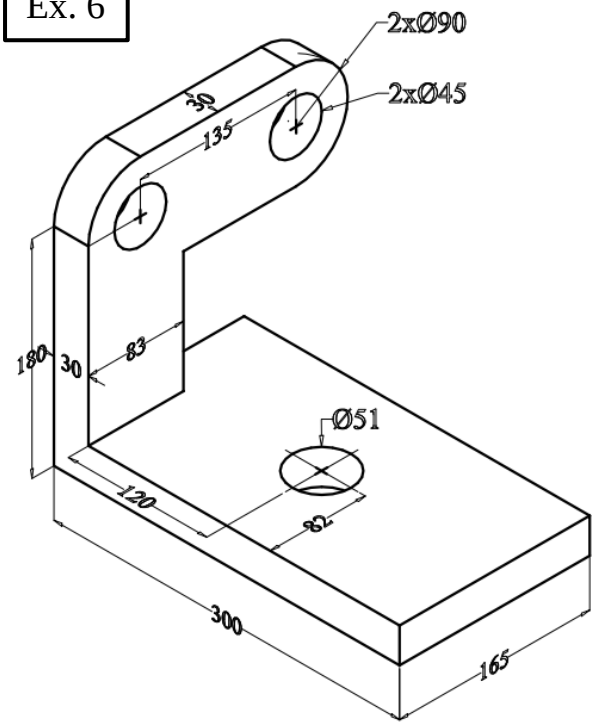


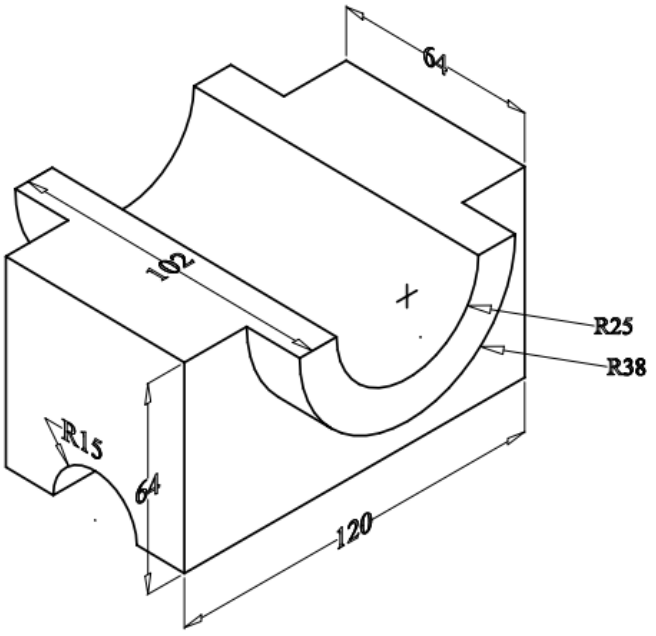
Ex. 5



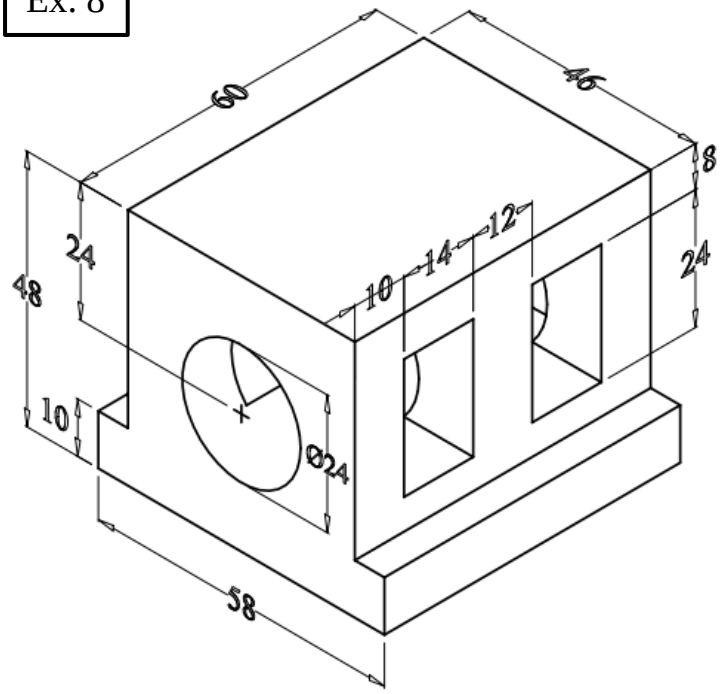
Ex. 6



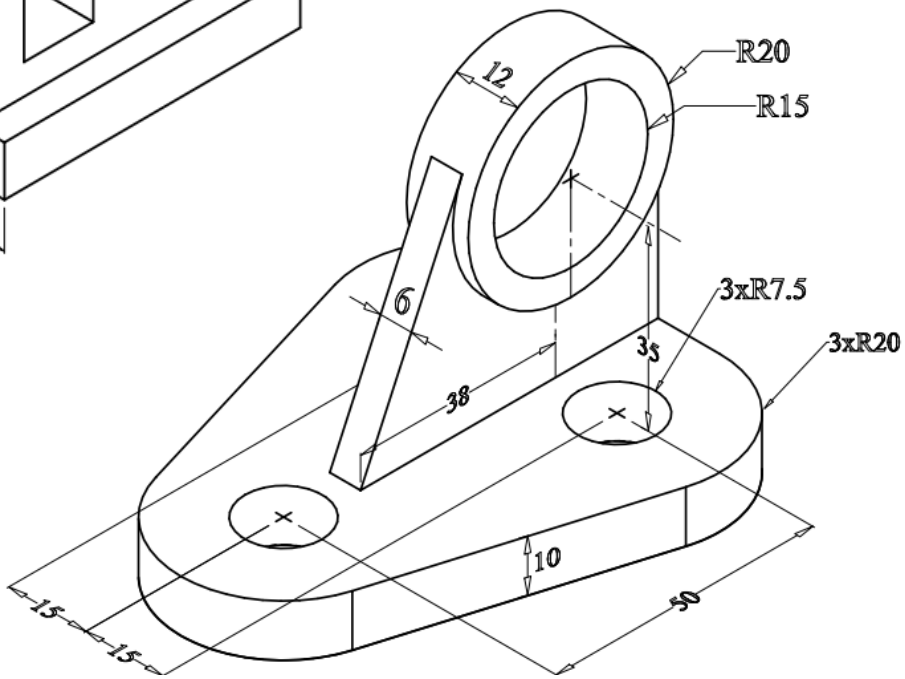
Ex. 7



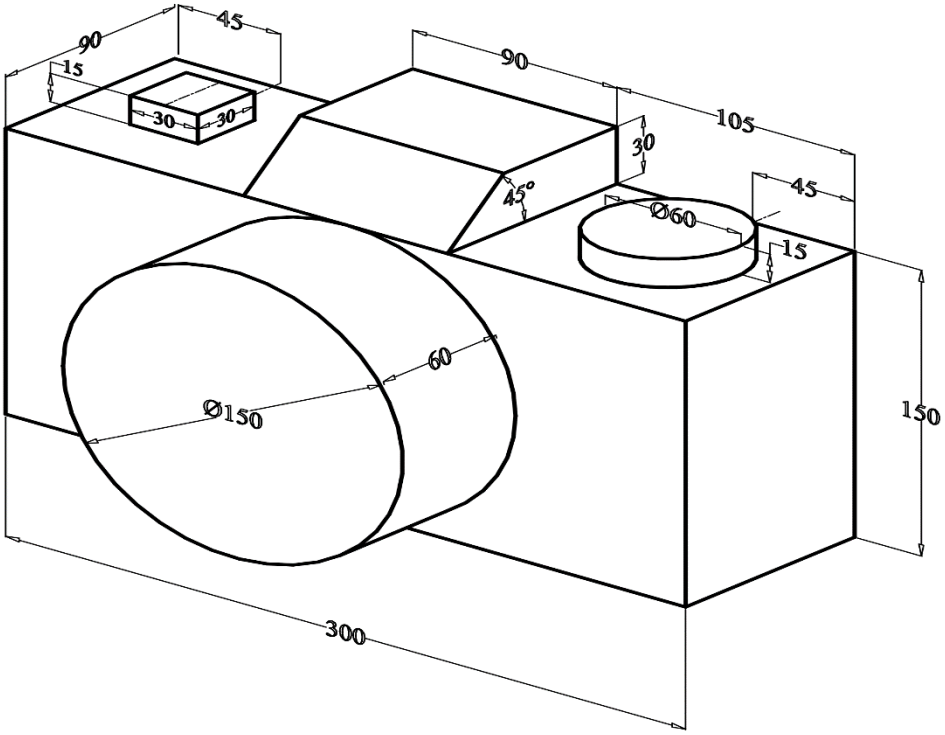
Ex. 8


60
46
8
24
48
10
14
12
24
10
Ø24
58

Ex. 9

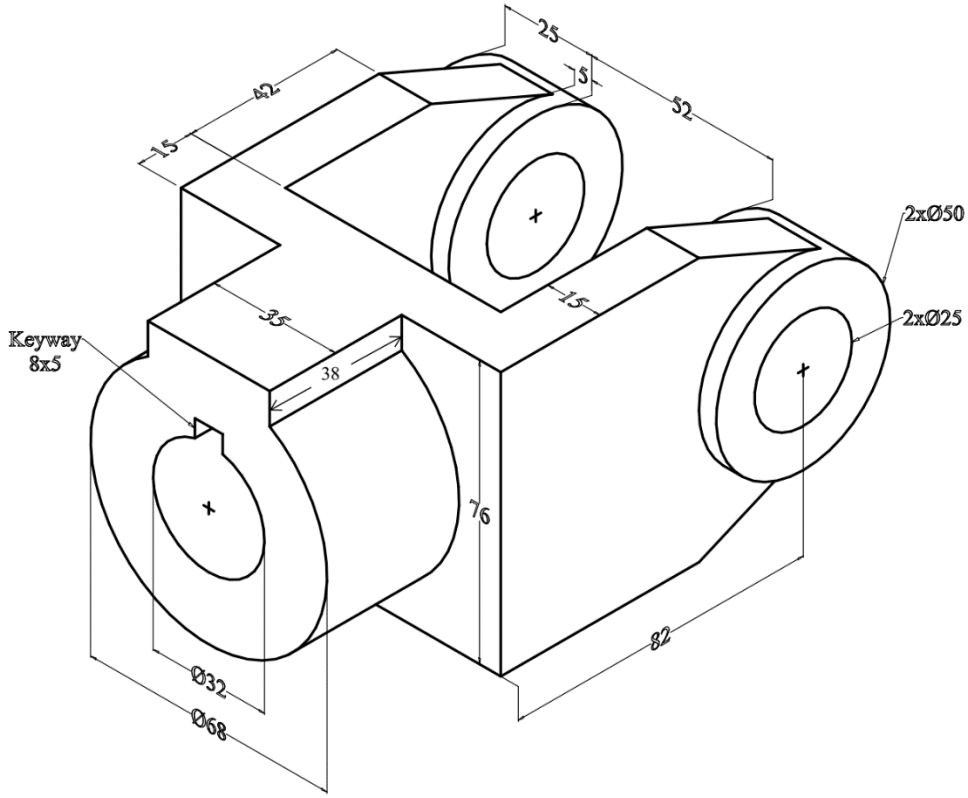

R20
R15
12
6
3xR7.5
3xR20
35
38
10
15
15
50

Ex. 10

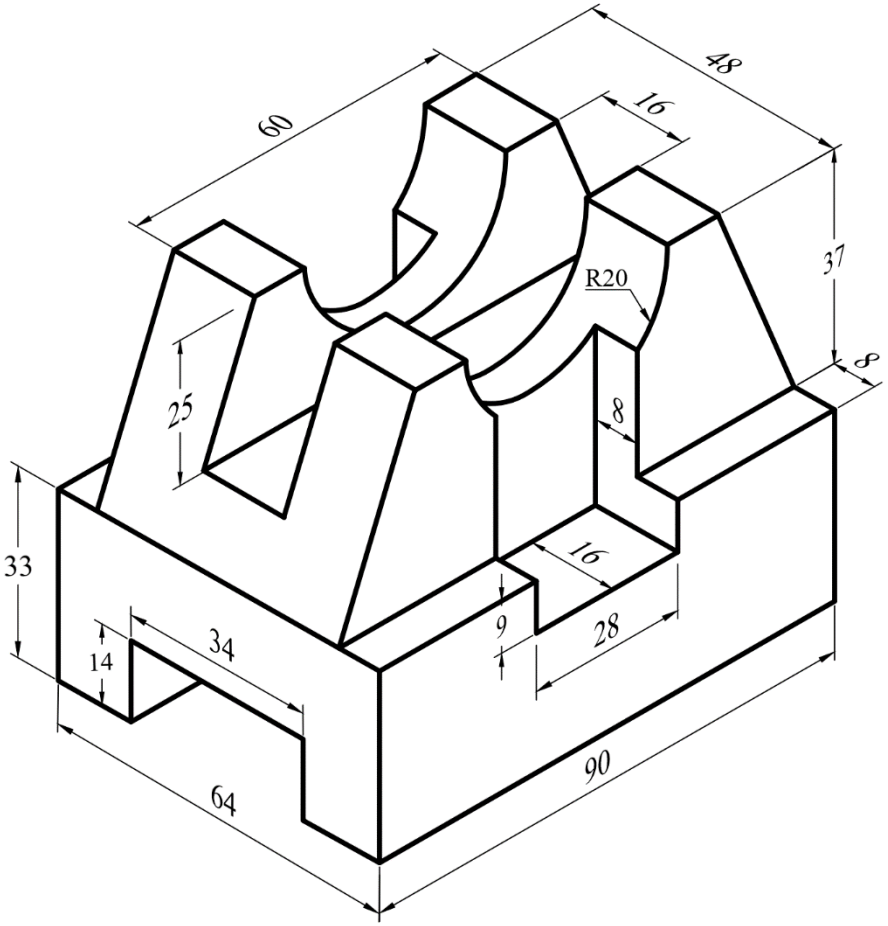

90
45
15
30
30
90
105
30
45°
45
Ø60
15
60
Ø150
150
300

Creating Solids using Presspull

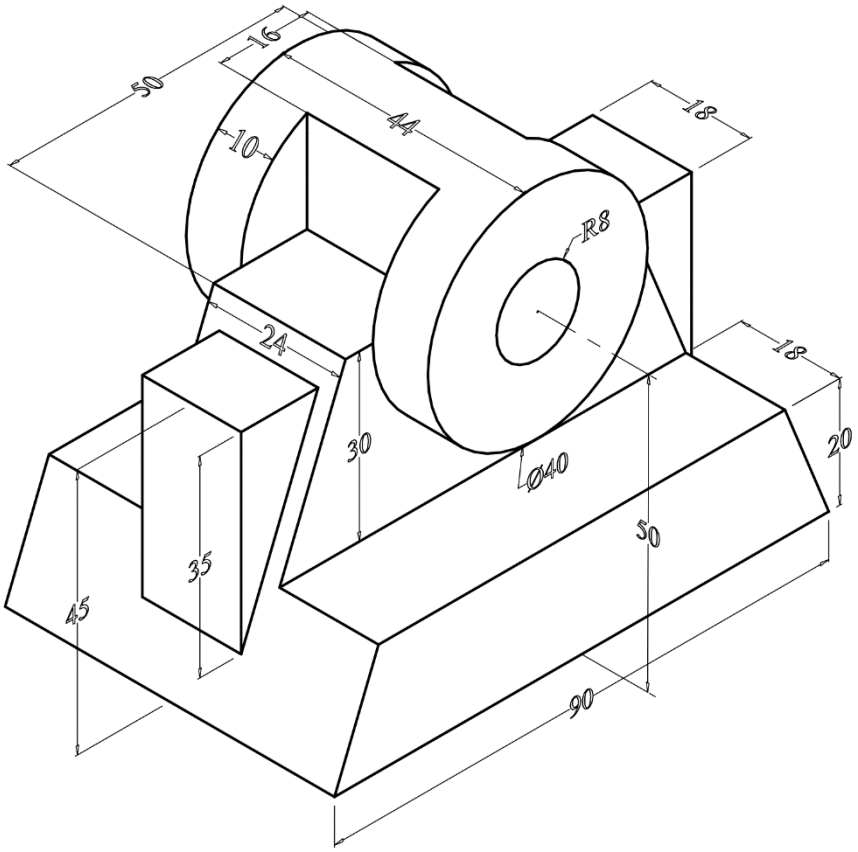
Ex. 1



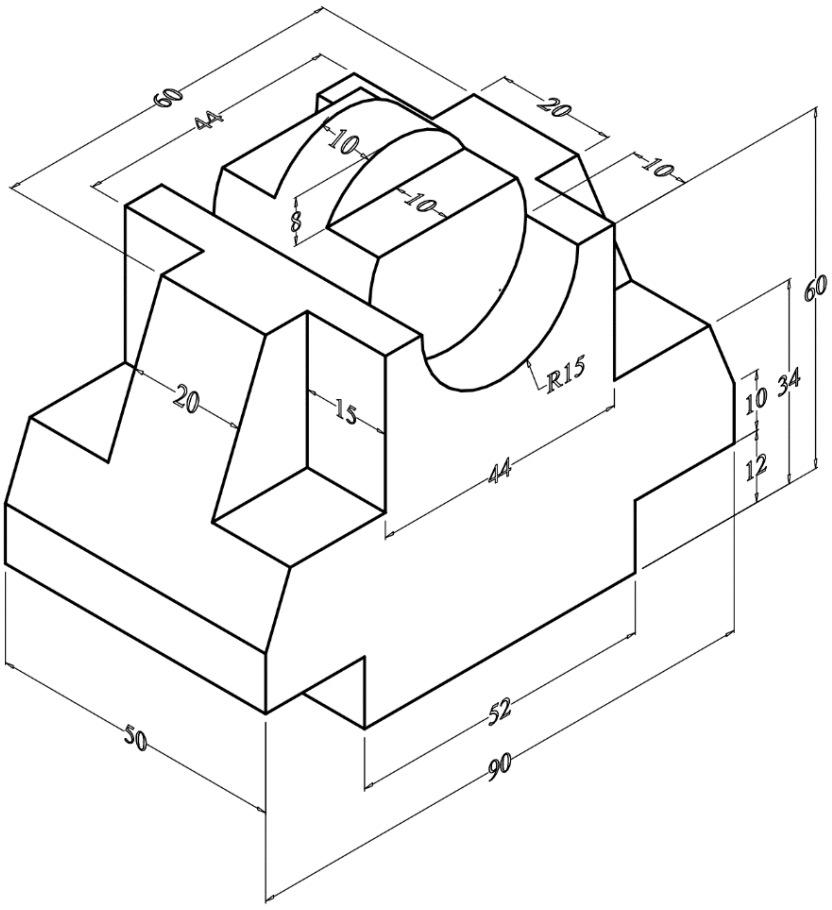
Ex. 2



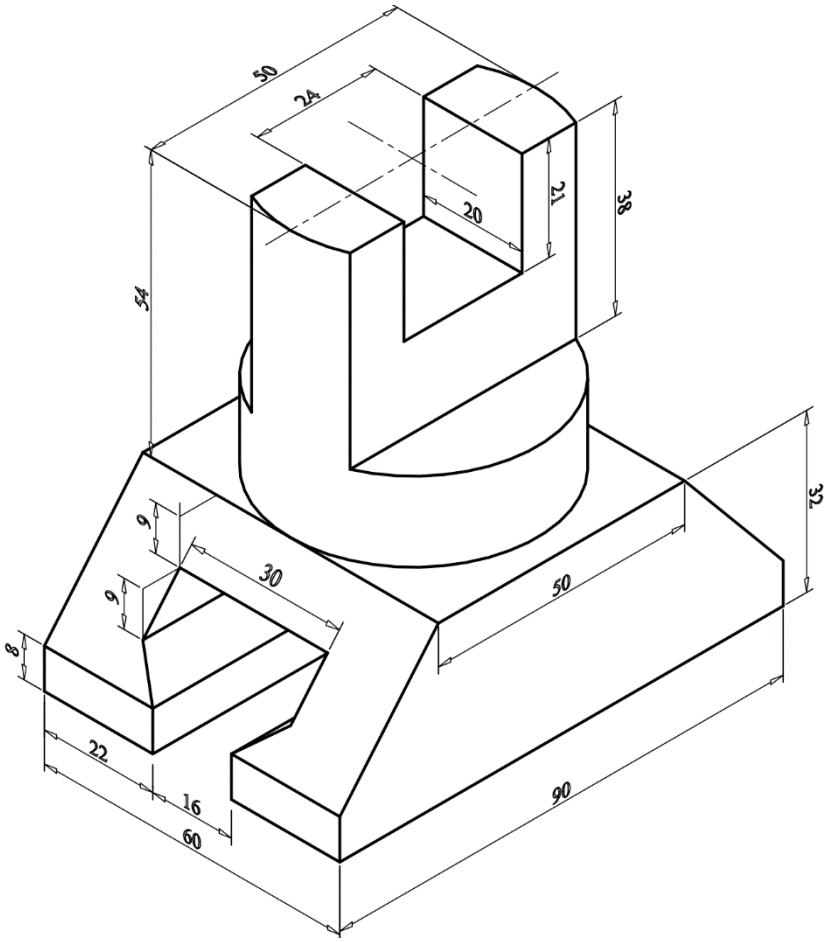
Ex. 3


50
16
44
10
18
R8
24
18
30
20
Ø40
50
35
45
90

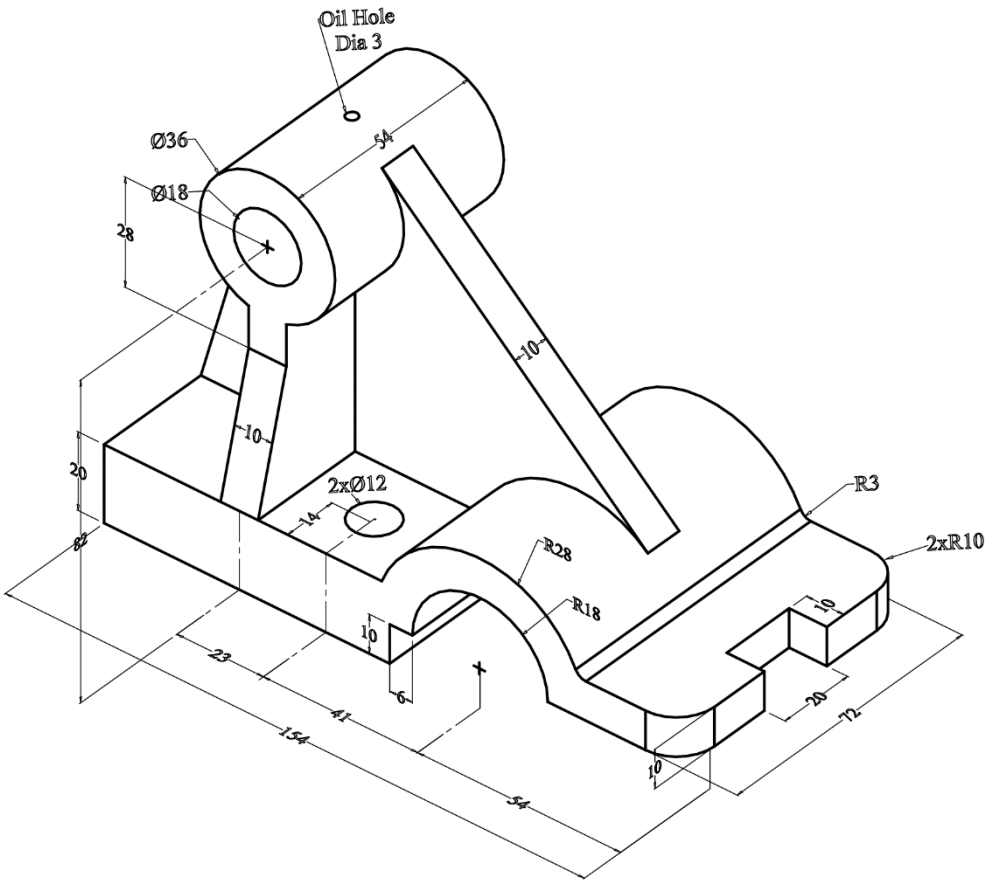
Ex. 4


60
44
20
10
10
10
8
60
R15
20
15
10
34
44
12
50
52
90

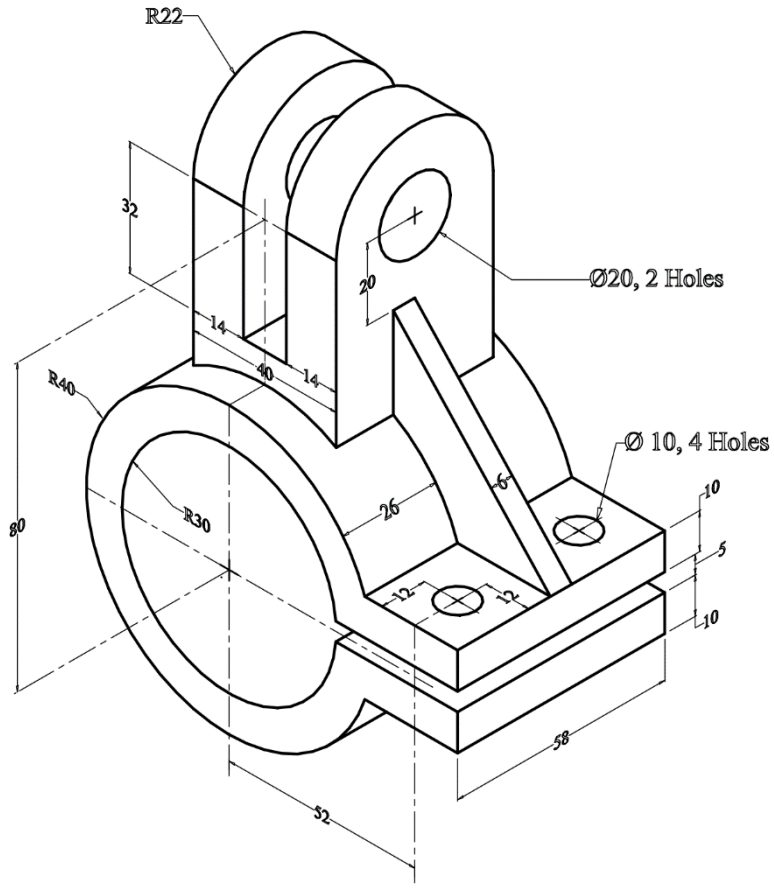
Ex. 5


50
24
21
38
20
54
9
9
30
32
50
8
22
16
60
90

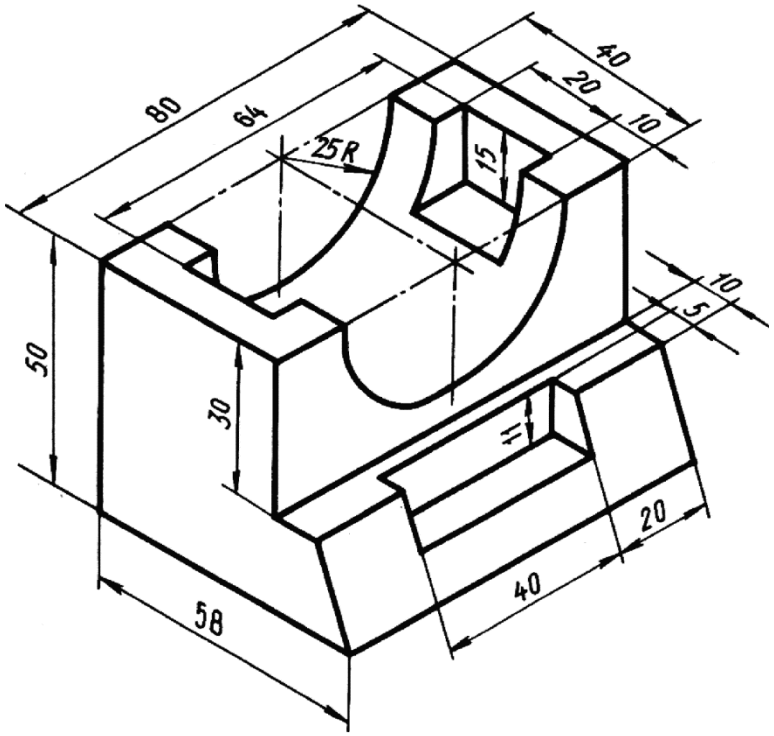
Ex. 6


Oil Hole
Dia 3
Ø36
Ø18
54
28
10
10
20
2xØ12
14
R3
2xR10
R28
R18
10
10
23
41
154
6
54
20
72
10

Ex. 7

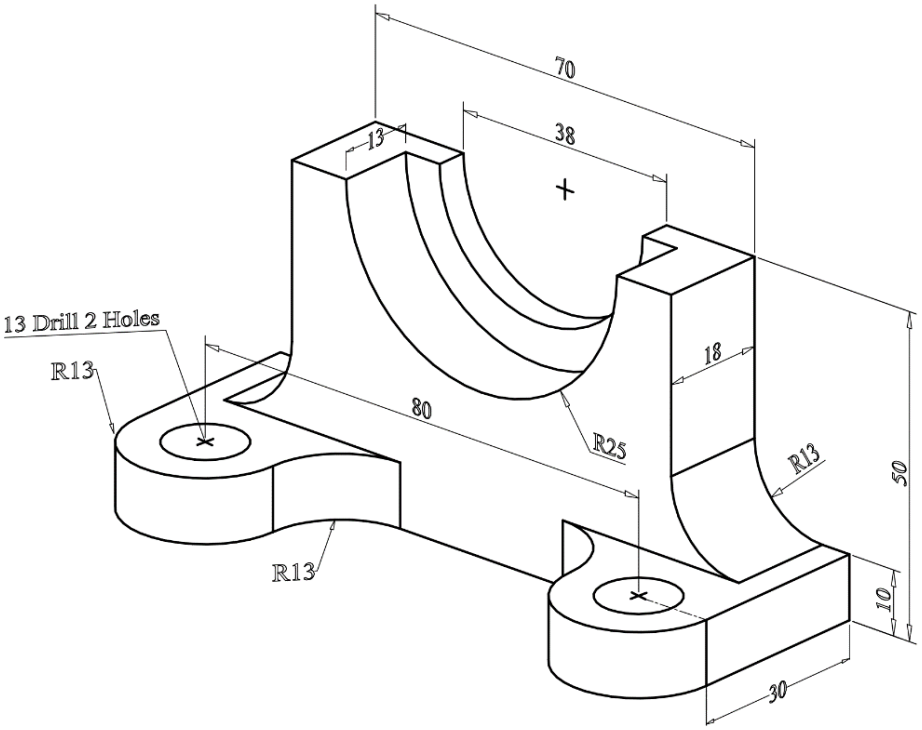

R22
32
20
Ø20, 2 Holes
14
40
14
R40
Ø 10, 4 Holes
80
R30
26
5
10
5
10
12
12
58
52

Ex. 8

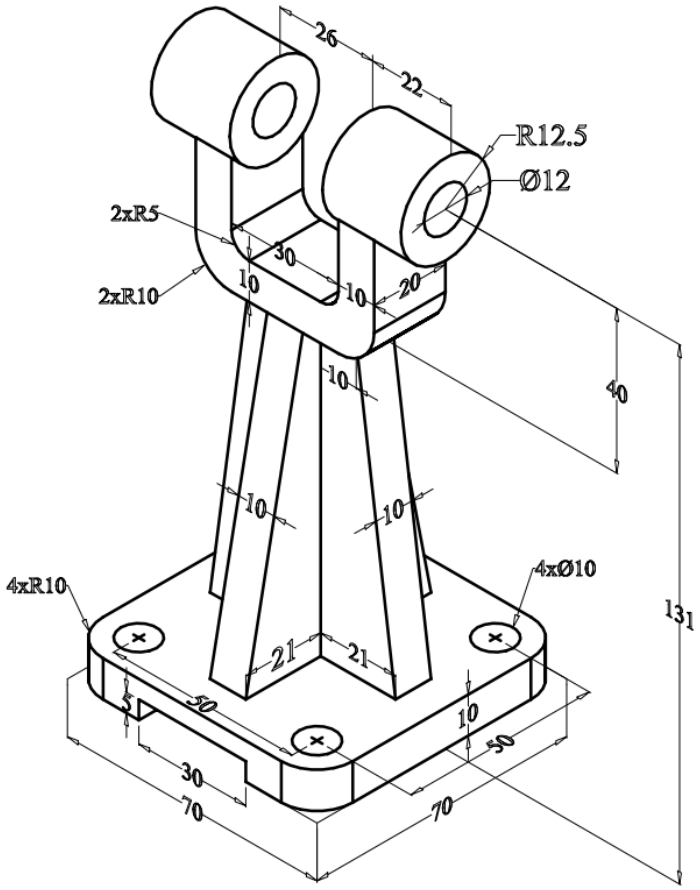

80
64
25R
40
20
10
15
10
5
50
30
11
20
40
58

Solids with 3D Mirror, Fillet, Chamfer, and Slice

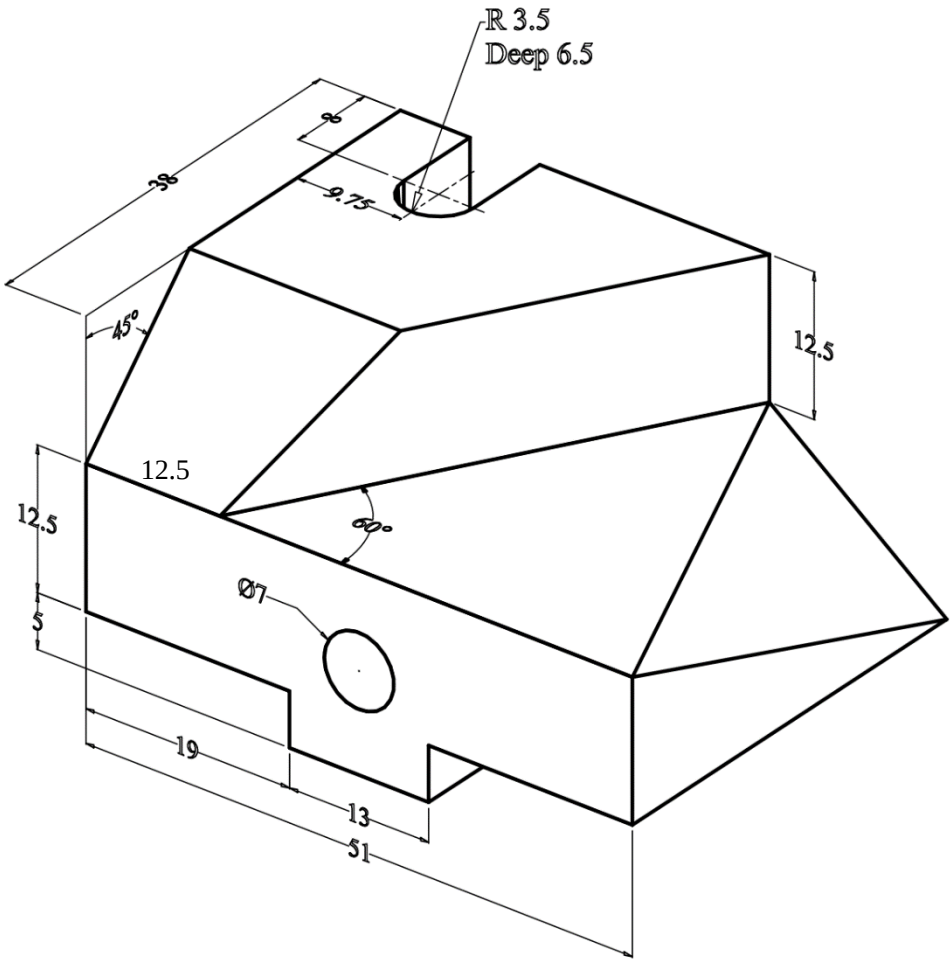
Ex. 1



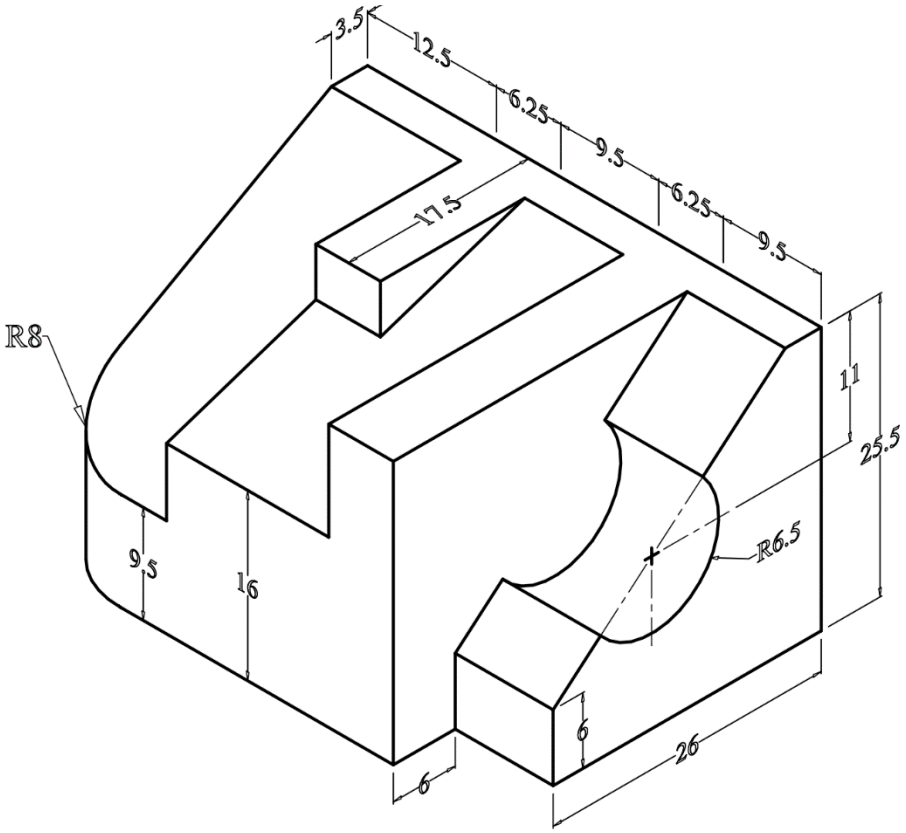
Ex. 2



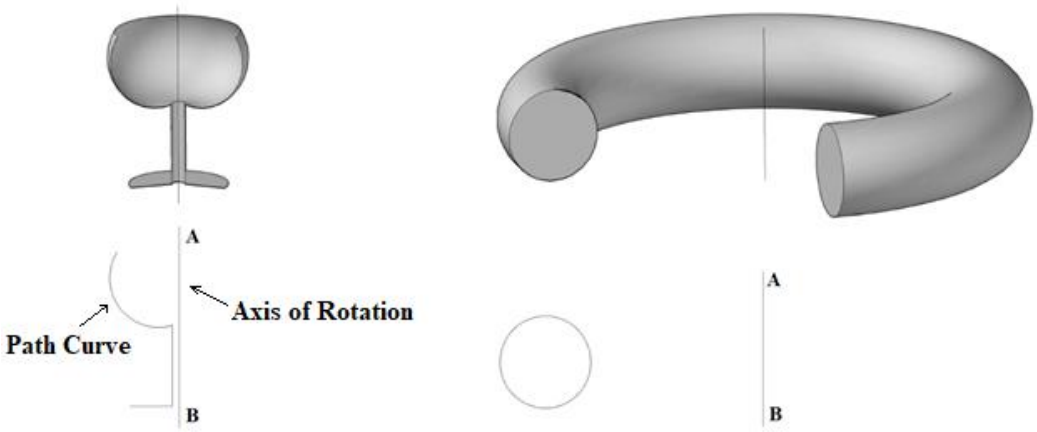
Ex. 3


R 3.5
Deep 6.5
6
9.75
38
45°
12.5
12.5
12.5
90°
Ø7
5
19
13
51

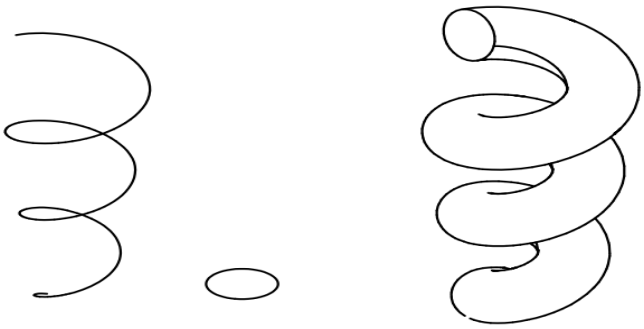
Ex. 4


3.5
12.5
6.25
9.5
6.25
9.5
17.5
R8
11
25.5
R6.5
9.5
16
6
6
26

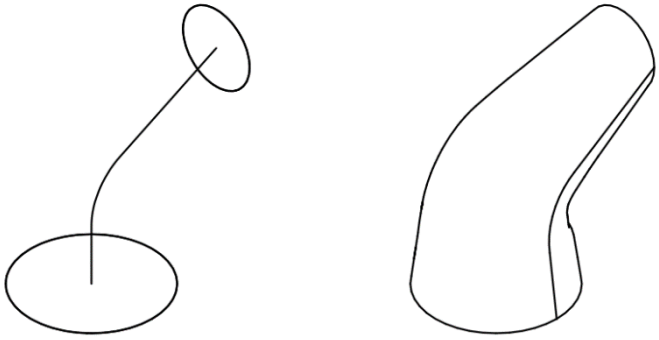
Revolve



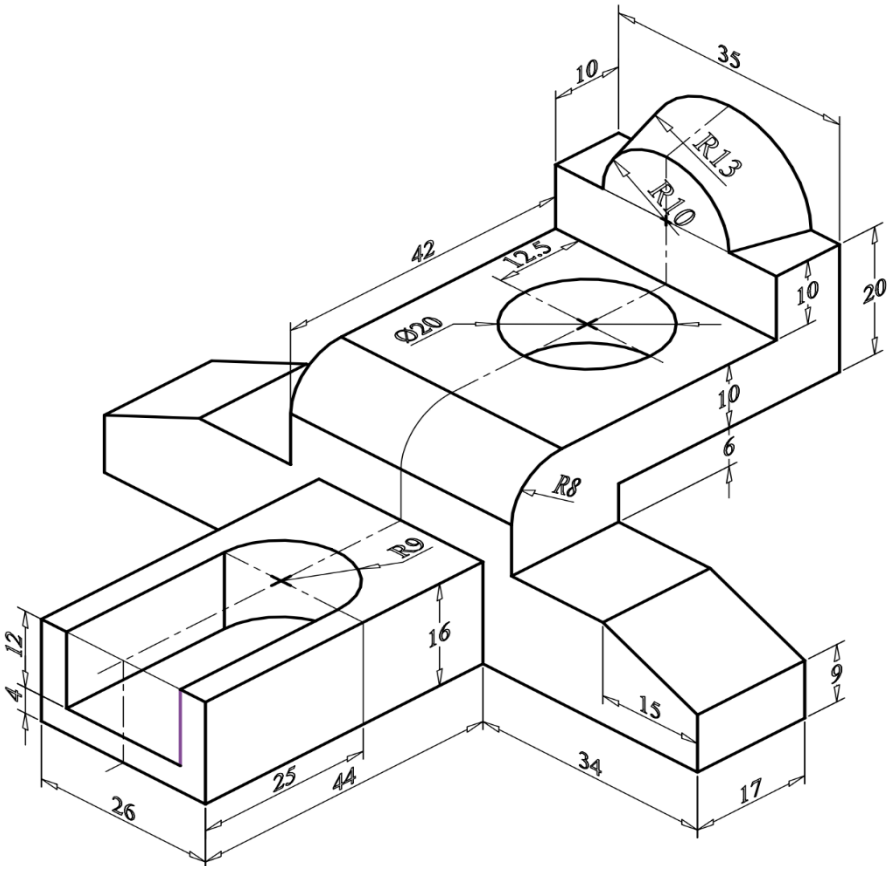
Sweep



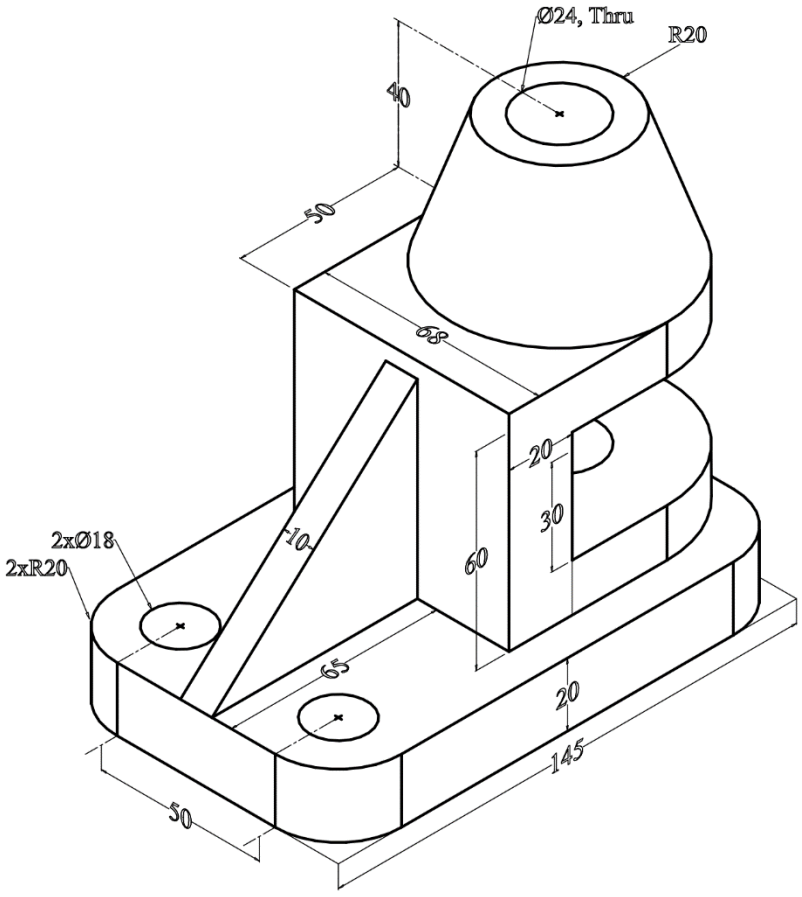
Loft



Ex. 1


10
35
R13
R10
42
12.5
Ø20
10
20
10
6
R8
R9
16
12
4
9
15
25
44
34
26
17

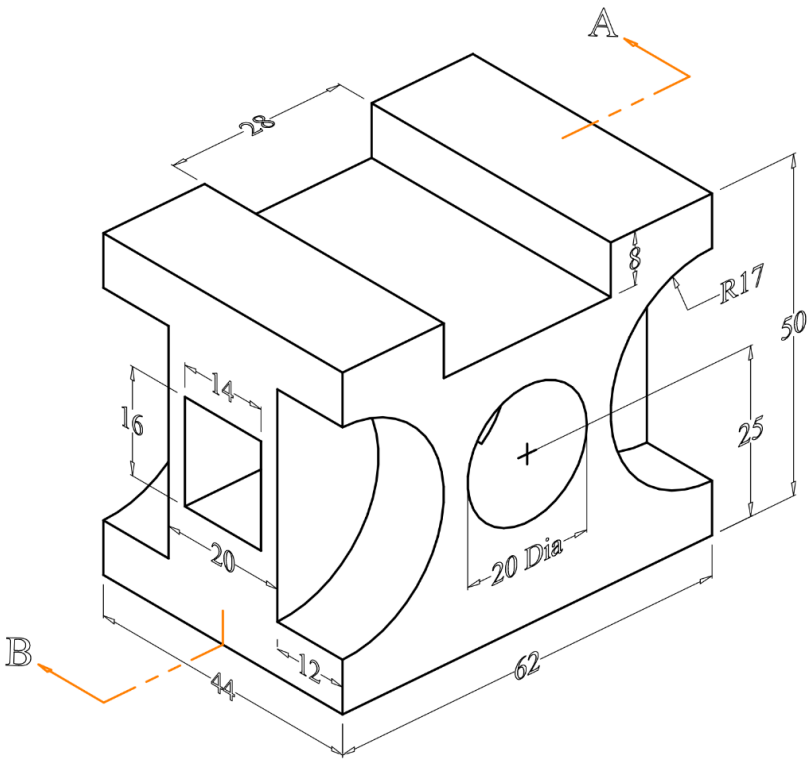
Ex. 2


Ø24, Thru
R20
40
50
68
20
30
60
2xØ18
2xR20
10
65
20
145
50

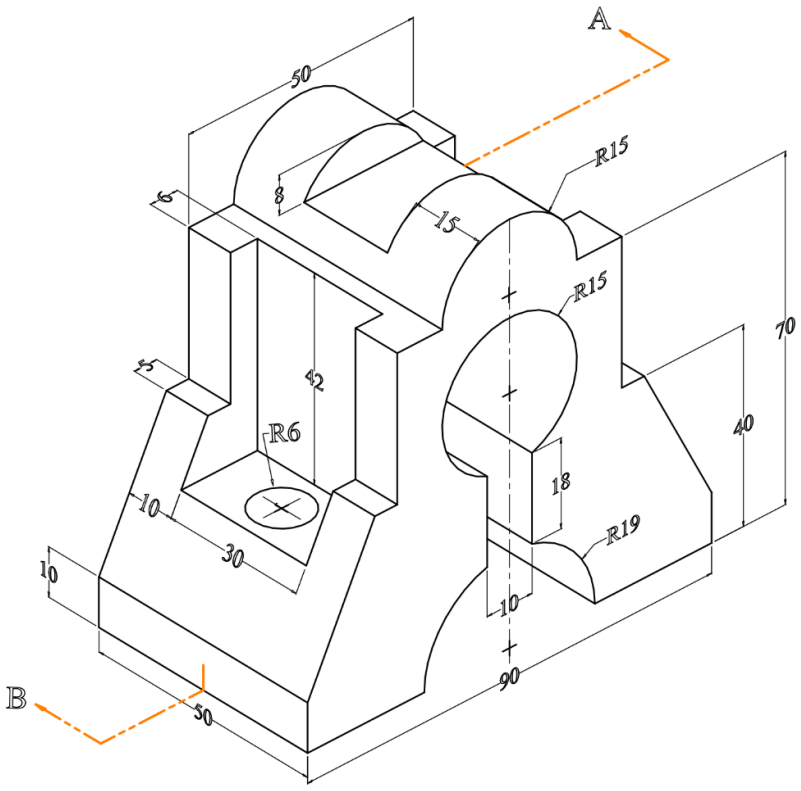
Sectioning and Hatching

Draw the following 3D solid, make a **copy** of the object then make a **full sectional front** view using the cutting plane **A-B**.

Ex. 1



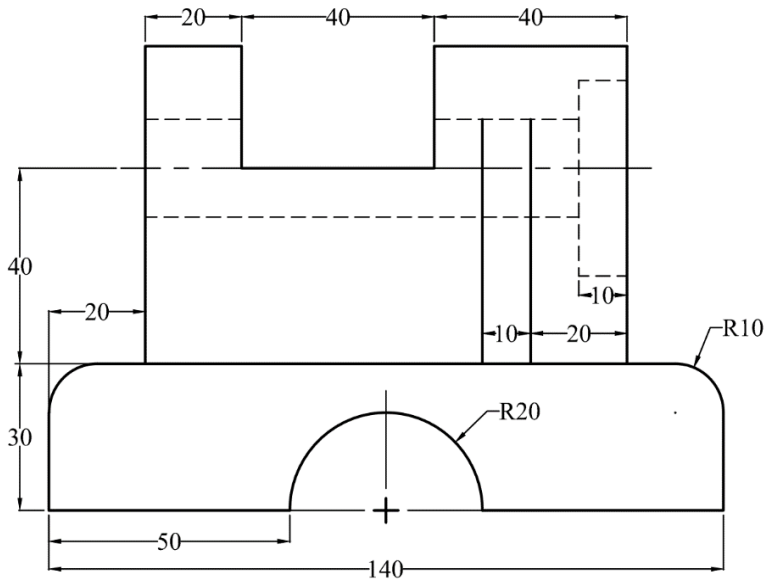
Ex. 2



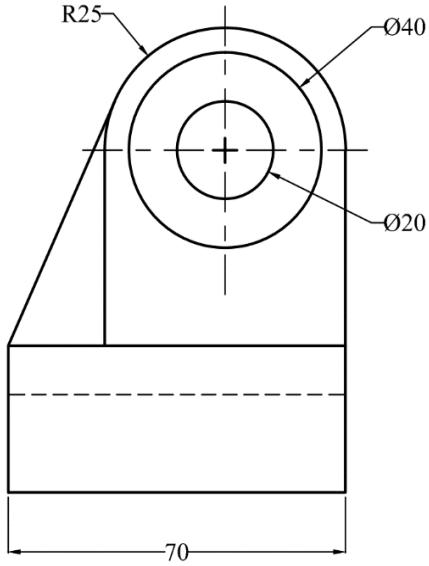
Isometric Drawing

For the given front and side views, construct a 3D-Solid for each of the following exercises.

Ex. 1

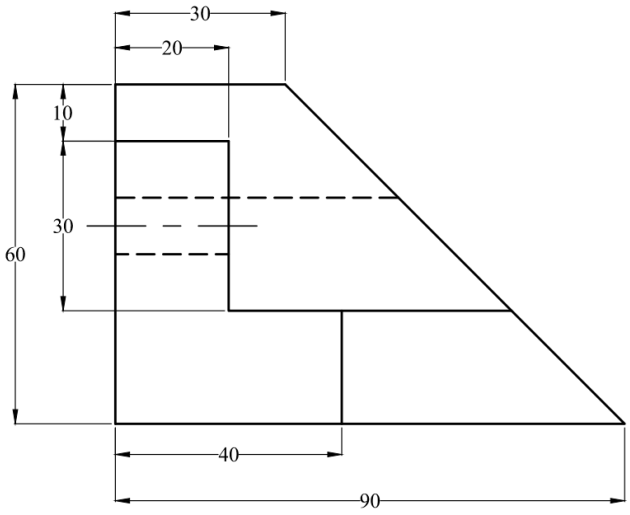


Left Side

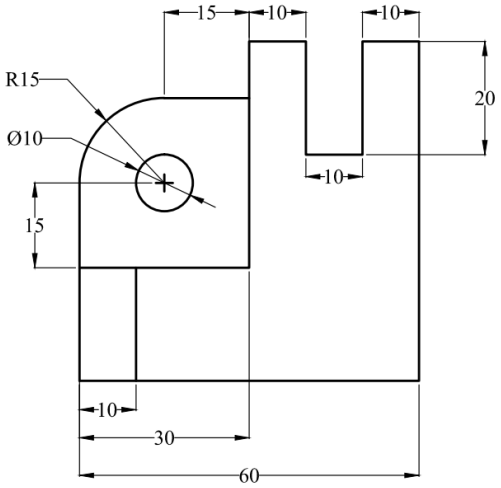


Front View

Ex. 2

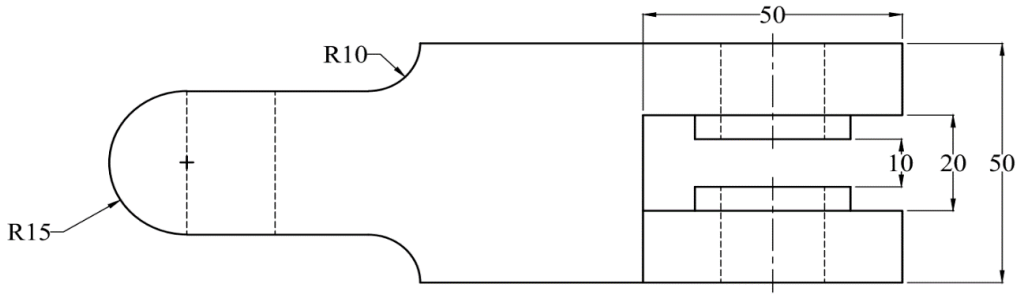


Front View

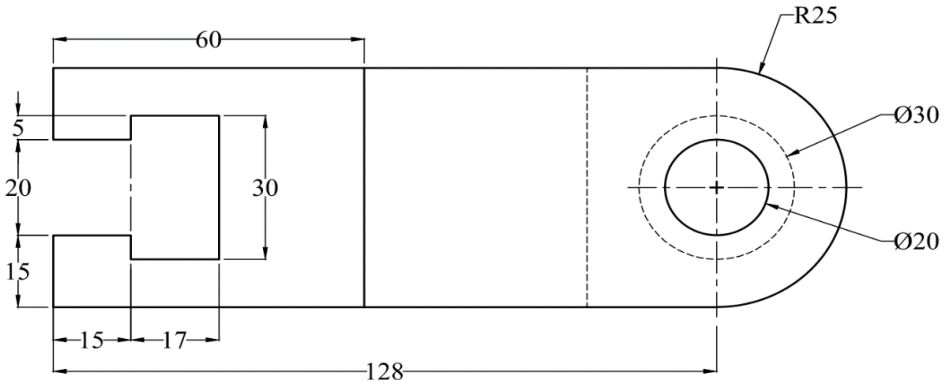


Right Side

Ex. 3

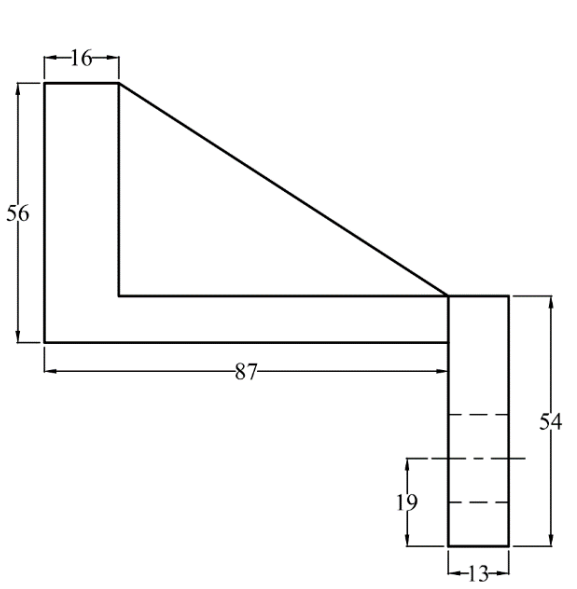


Top View

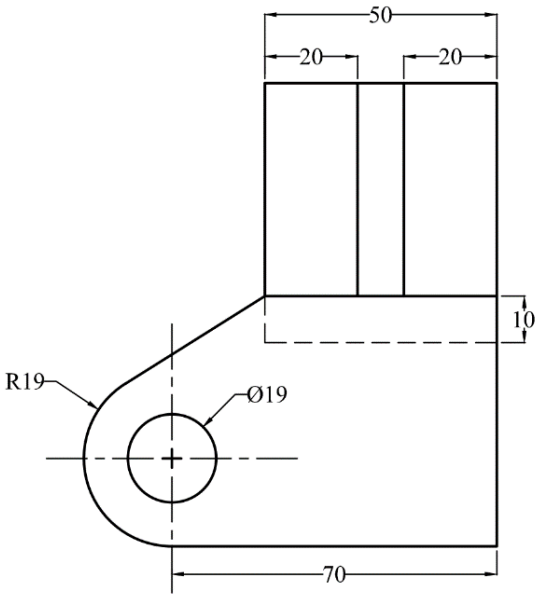


Front View

Ex. 4



Front View



Right Side View

Past Exam (1)

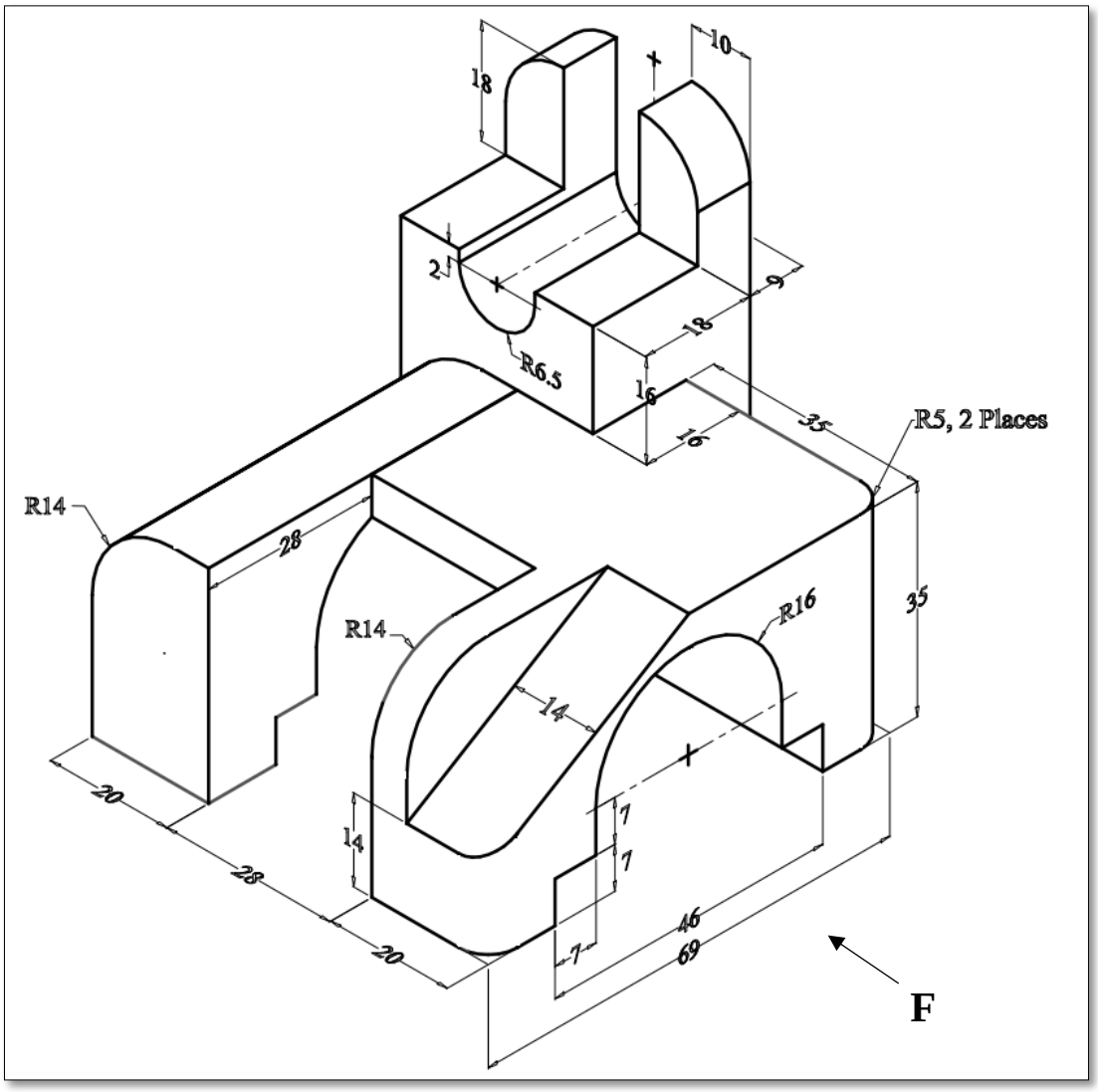
Problem (1): Draw the following 3D solid

Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

a. Write your Name, Reg. No, and Department.

b. Make a slice to obtain the full front sectional view (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (2)

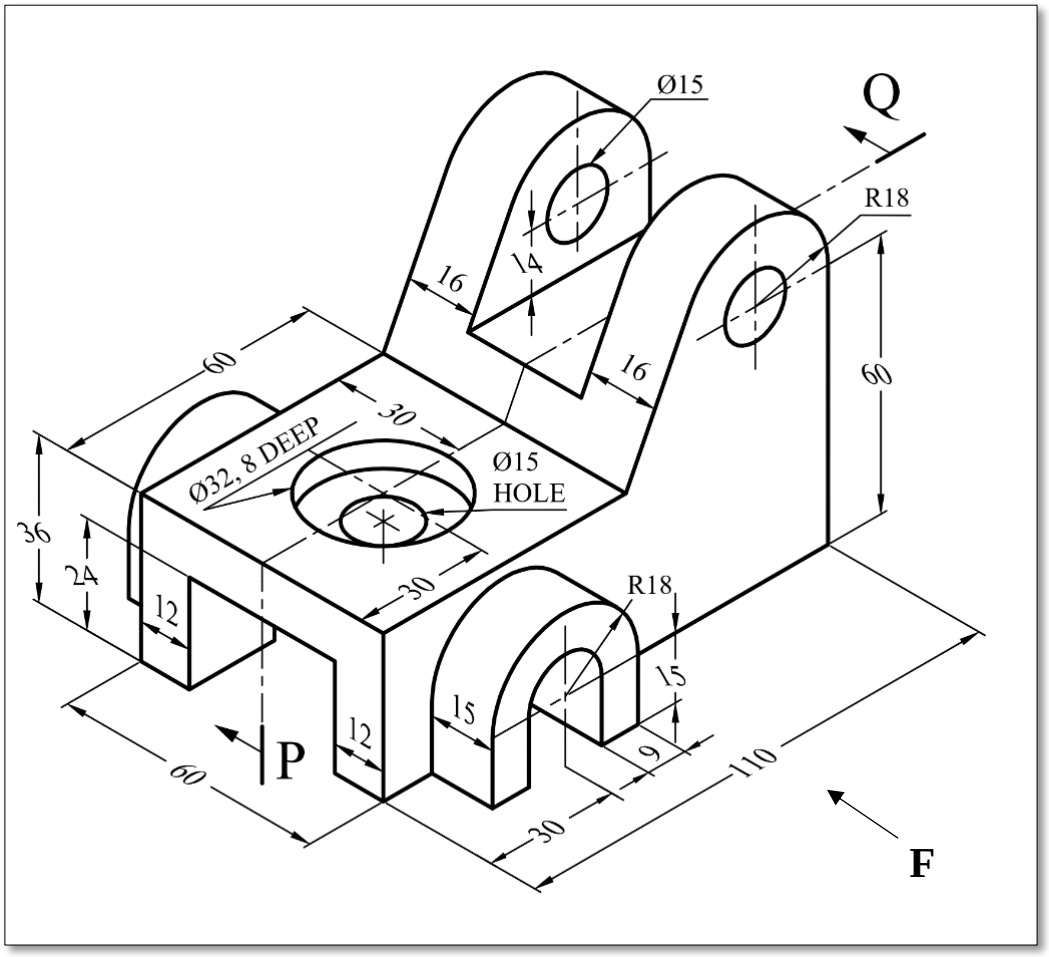
Problem (1): Draw the following 3D solid

Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

a. Write your Name, Reg. No, and Department.

b. Make a slice to obtain the full front sectional view at **PQ** (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (3)

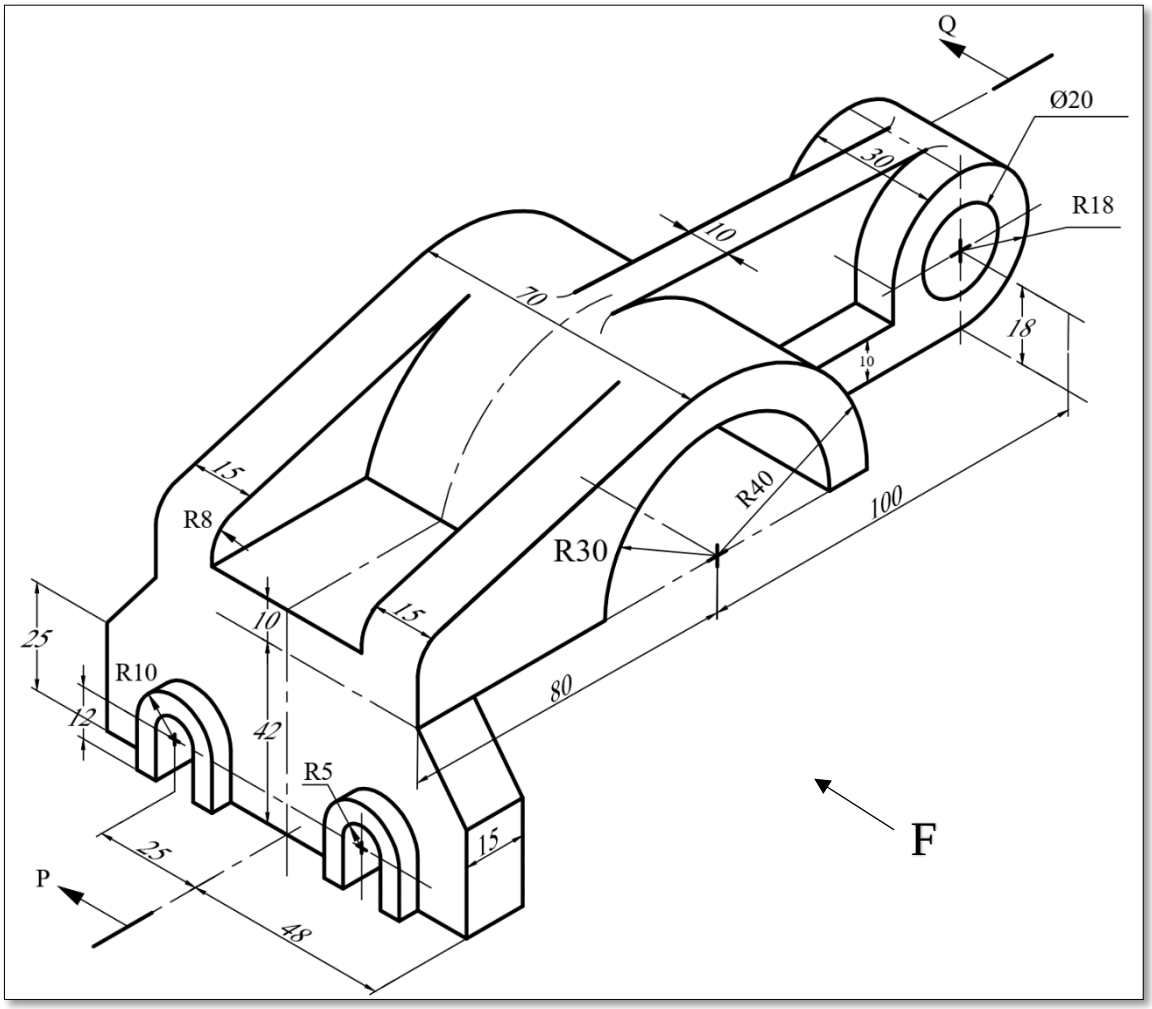
Problem (1): Draw the following 3D solid

Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

a. Write your Name, Reg. No, and Department.

b. Make a slice to obtain the full front sectional view at **PQ** (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (4)

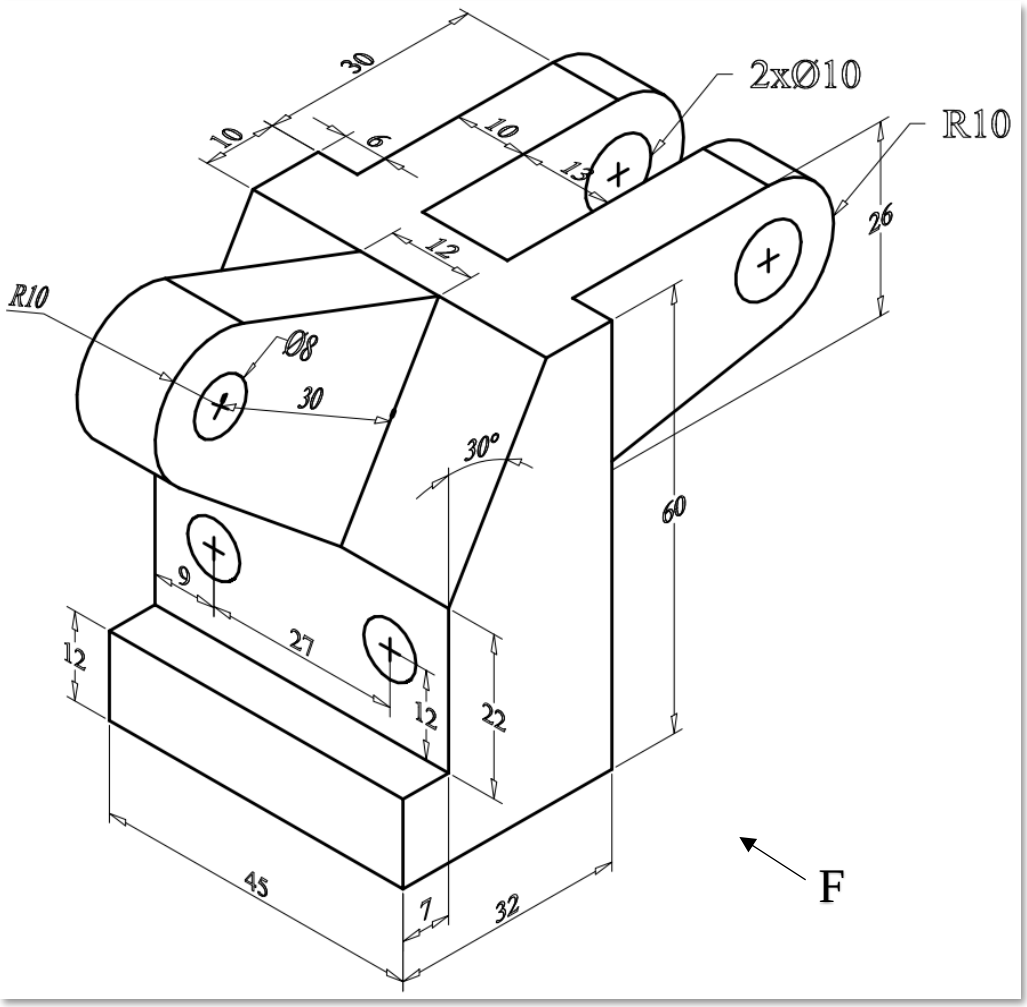
Problem (1): Draw the following 3D solid

Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

a. Write your Name, Reg. No, and Department.

b. Make a slice to obtain the full front sectional view (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (5)

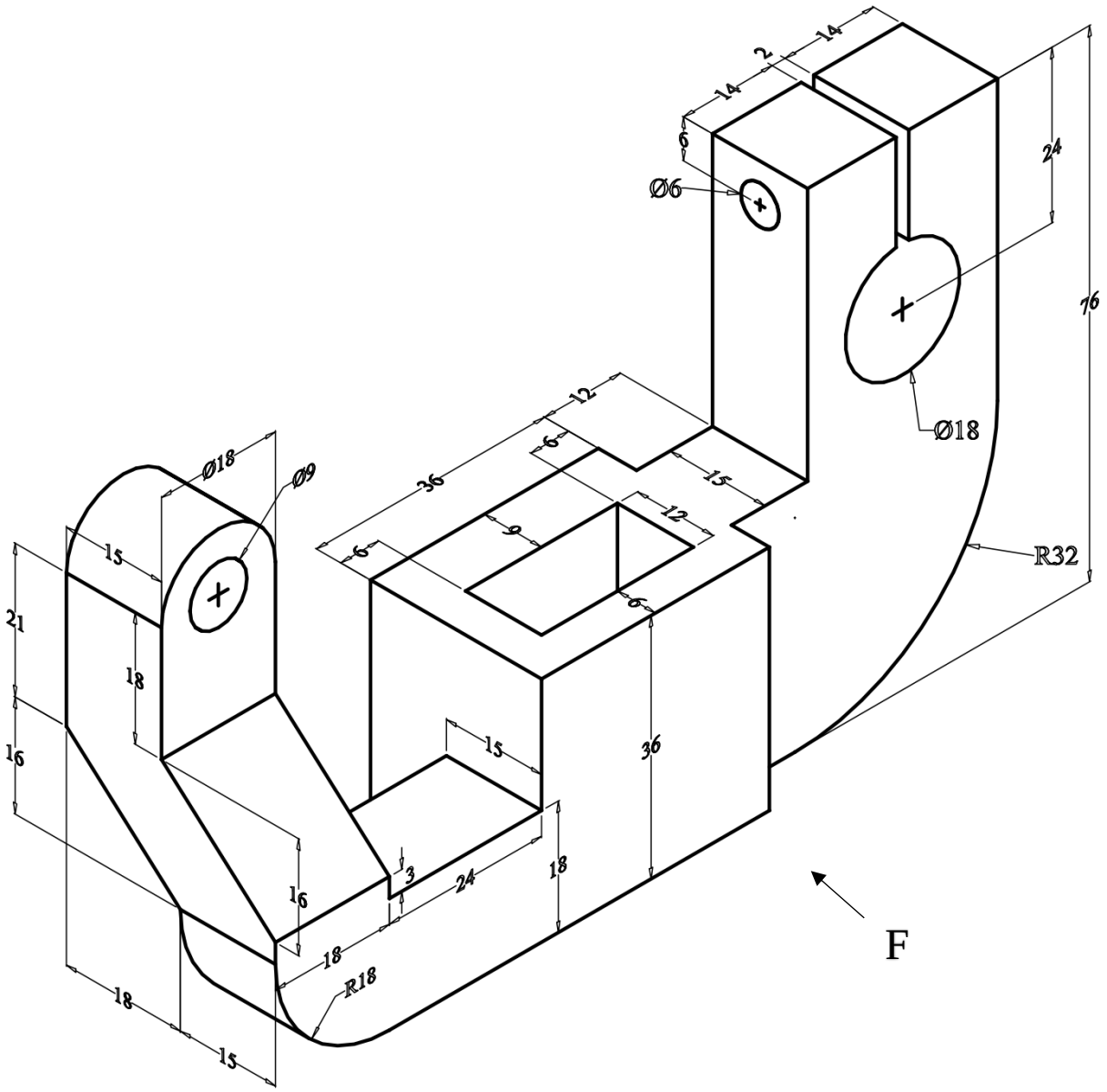
Problem (1): Draw the following 3D solid

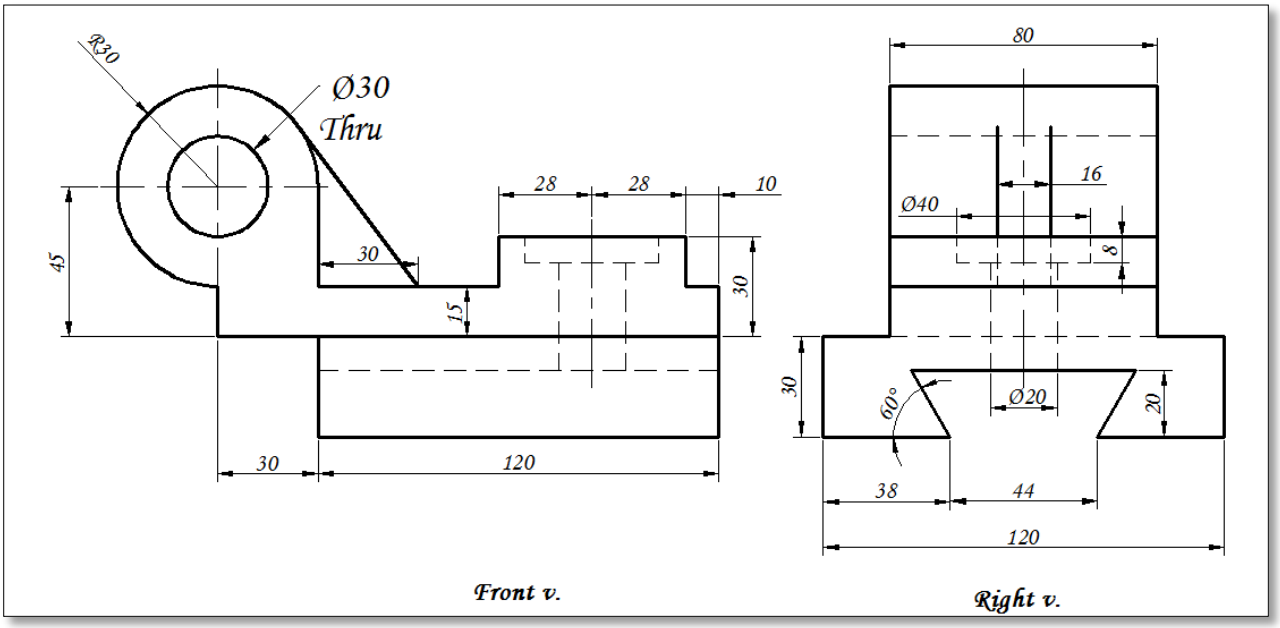
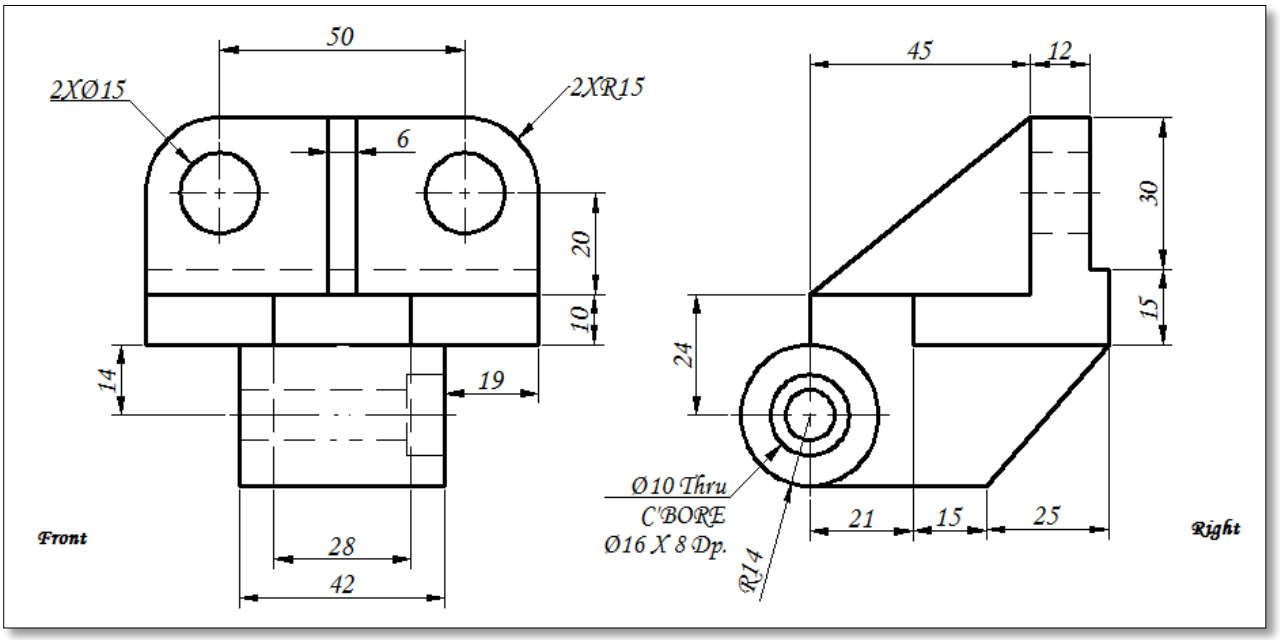
Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

a. Write your Name, Reg. No, and Department.

b. Make a slice to obtain the full front sectional view (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (6)

For the given front and right views, construct a 3D-Solid.