The University of Jordan

School of Engineering

Mechanical Engineering Department

Engineering Drawing & Descriptive Geometry (0904131)

Fall 2022/2023

Practice to AUTOCAD

2D Drawing, 3D Modeling

Prepared by

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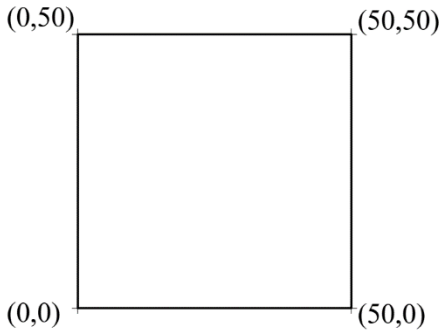
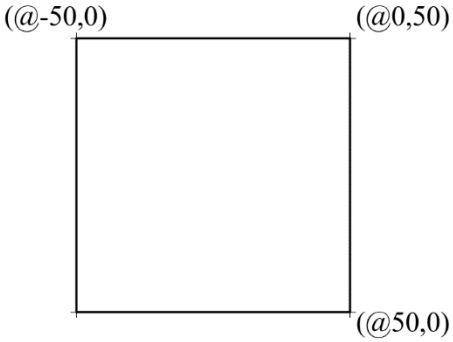
Introduction to 2D Drawing

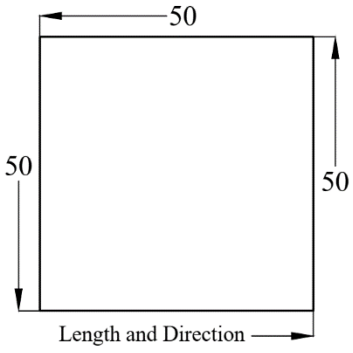
1. Introduction to the software worksheet.
2. Drawing Limits: Metric and Imperial.
3. Zoom and Pan.
4. Snap (F9) and Grid (F7).
5. Line and Polyline Commands: Ortho. (F8), Absolute, Relative, and Polar Coordinates.
6. Erase and Move Commands.



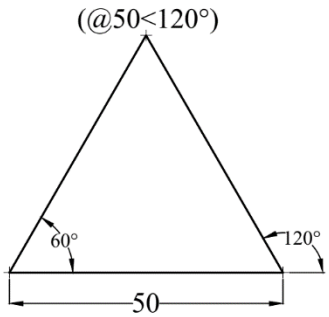
Absolute Coordinates



Relative Coordinates



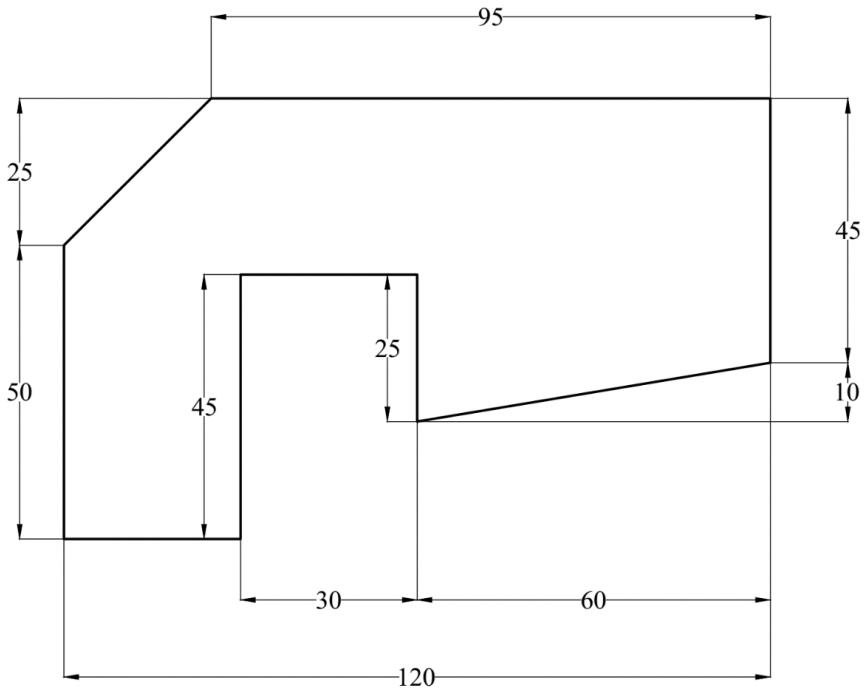
Ortho. Mode



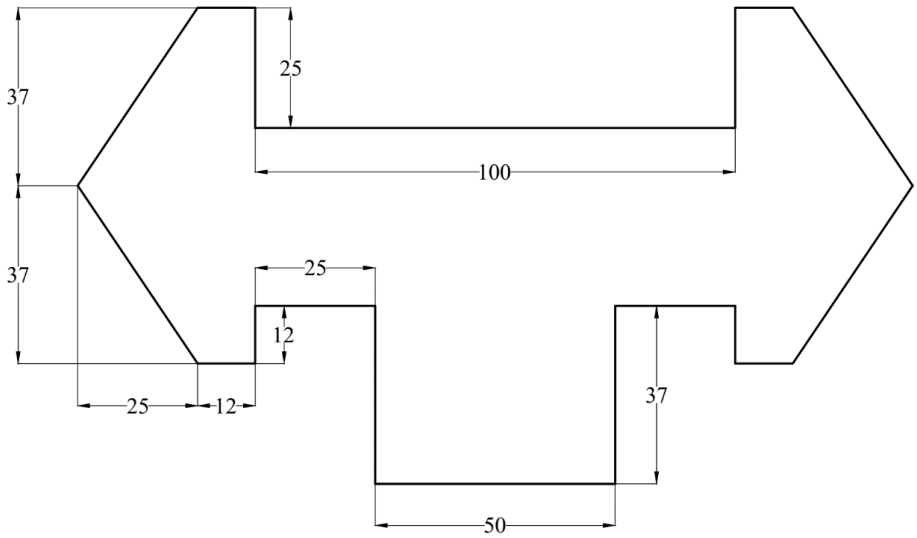
Polar Coordinates

Draw the following exercises. Dimensions are in millimeters.

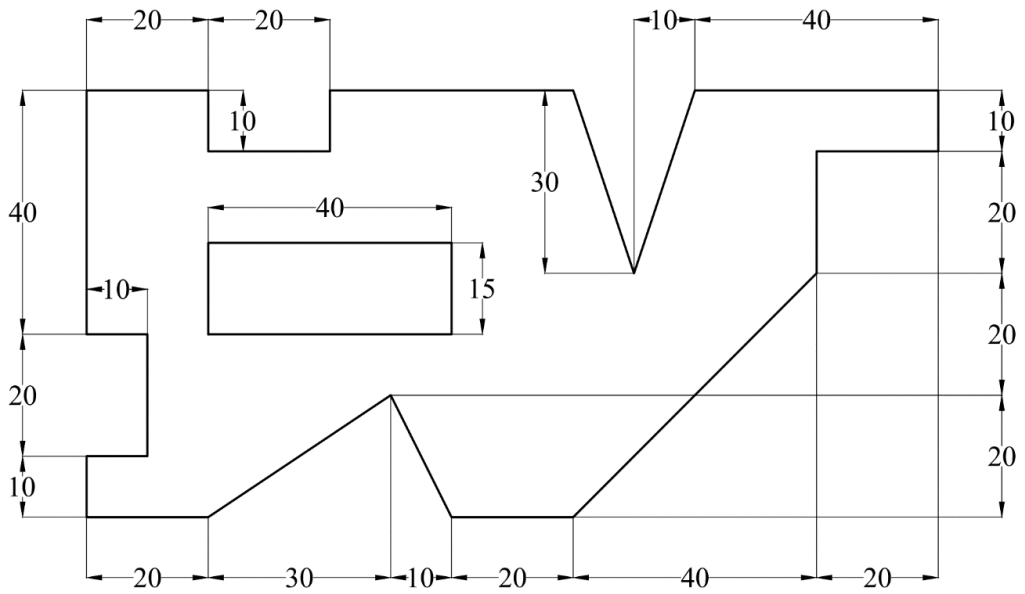
Ex. 1



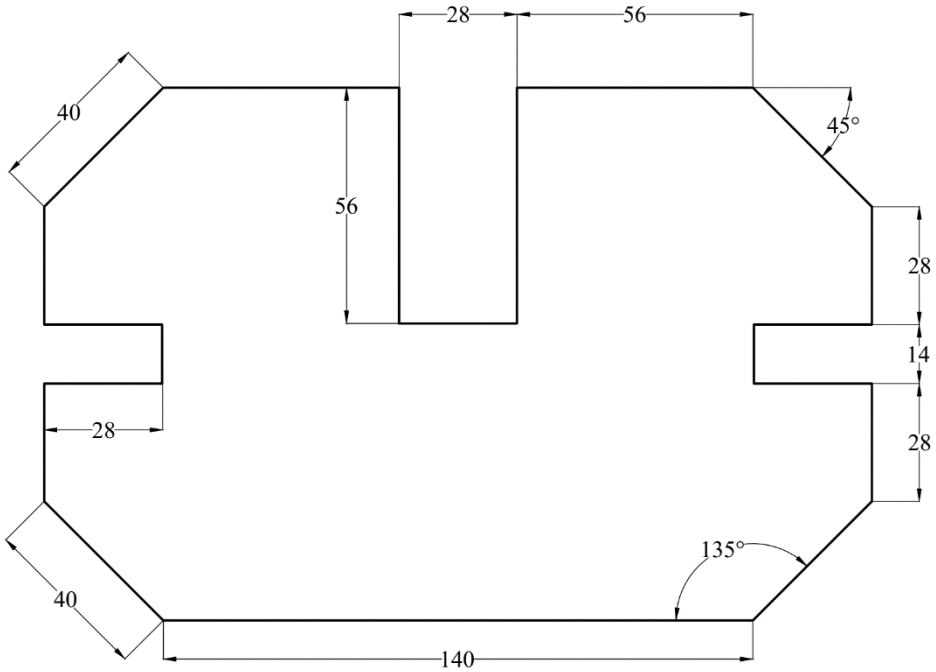
Ex. 2



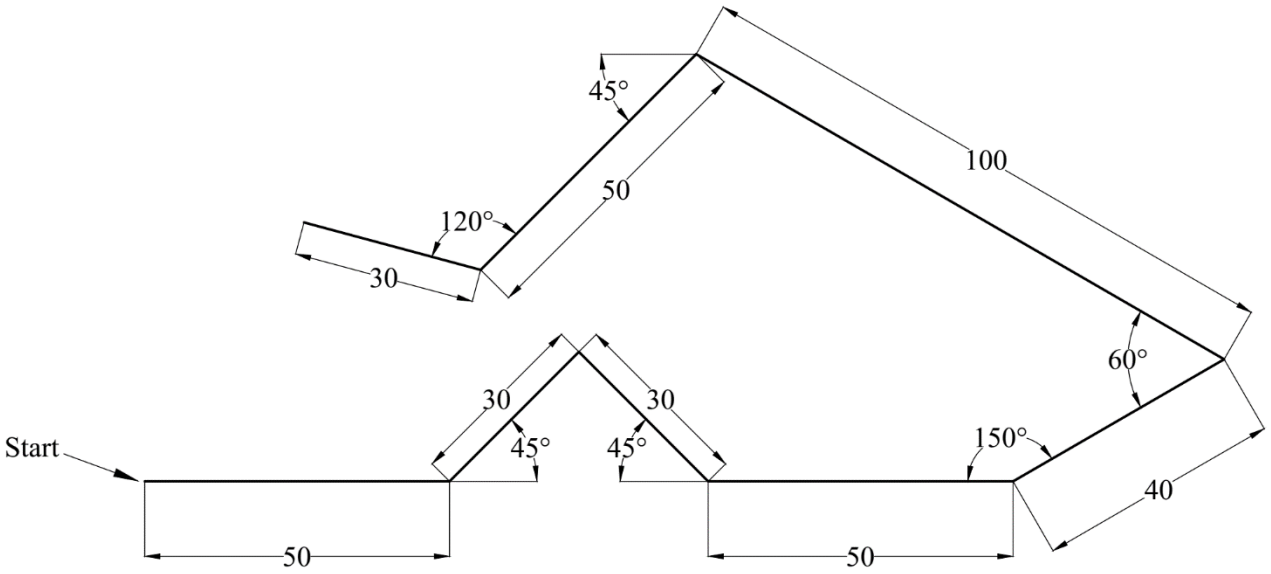
Ex. 3


20
20
10
40
10
30
40
10
40
15
10
20
20
20
10
20
30
10
20
40
20

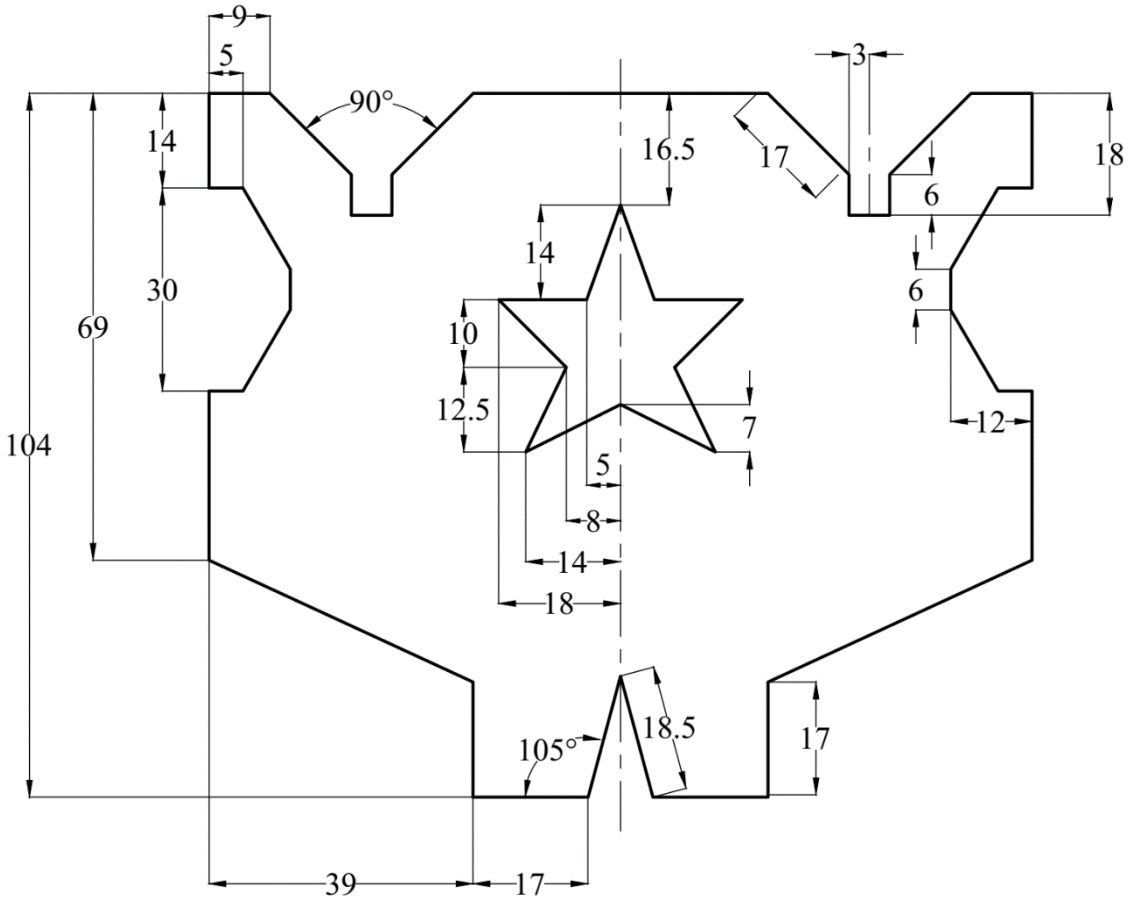
Ex. 4


28
56
40
45°
56
28
14
28
28
135°
40
140

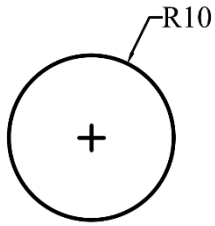
Ex. 5


45°
100
50
120°
30
60°
30
30
45°
45°
150°
Start
40
50
50

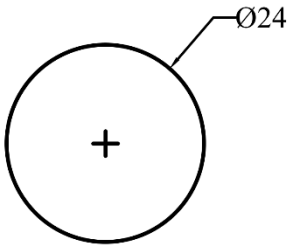
Ex. 6


9
5
90°
3
14
16.5
17
18
6
14
6
30
69
10
12.5
7
12
104
5
8
14
18
105°
18.5
17
39
17

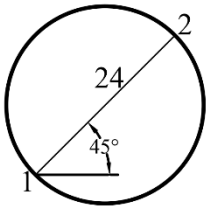
Circles



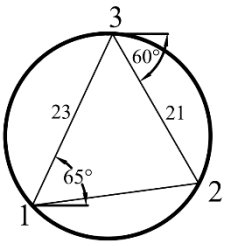
Circle, Radius



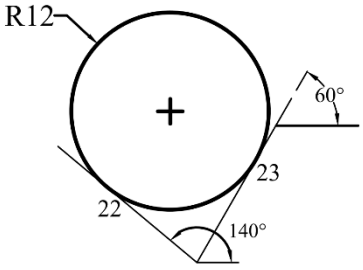
Circle, Diameter



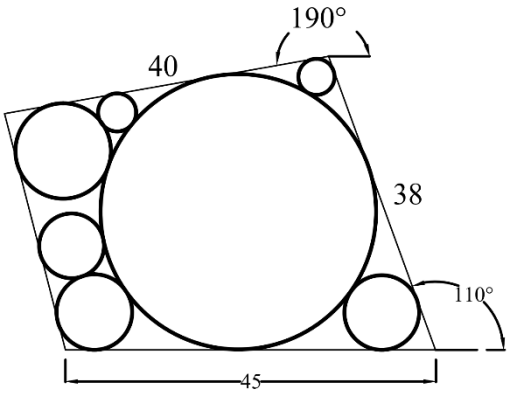
2-Point



3-Point



Tan,Tan, Radius



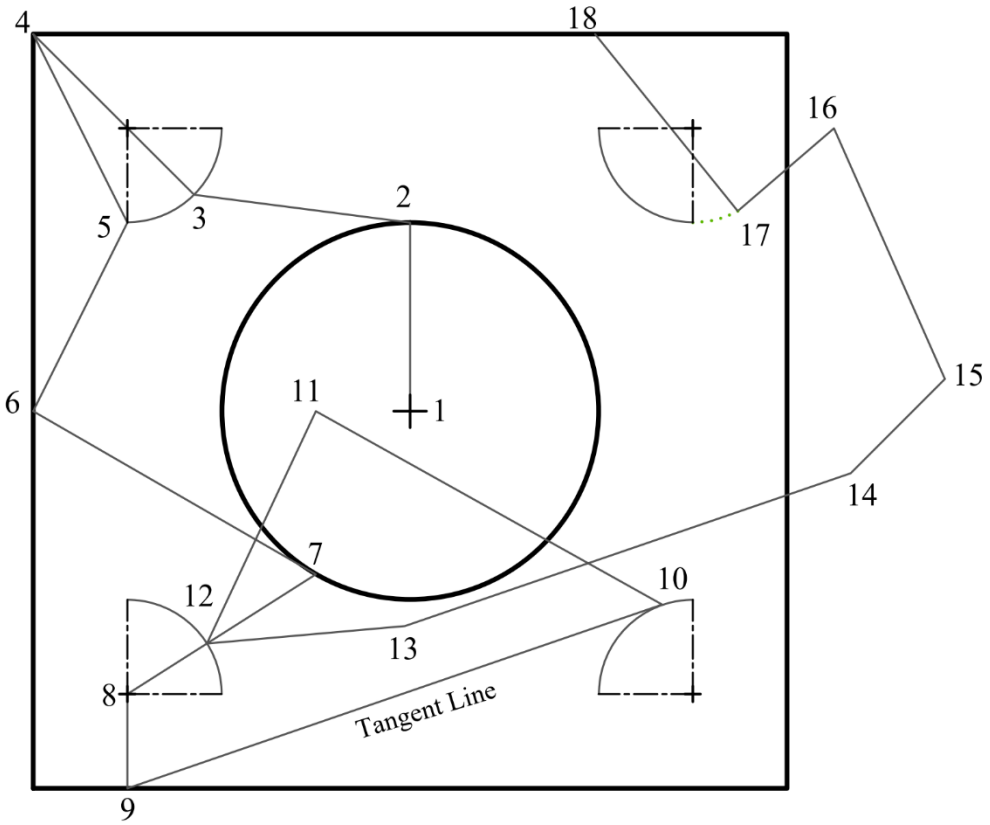
Tan,Tan, Tan

Object Snap

F(3),

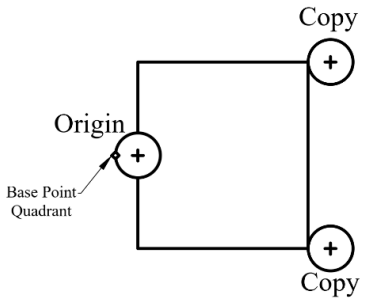
1. Using the **absolute coordinates**, draw a 4" **square** with lower left corner at (1.5, 2.5).
2. Draw a 1" radius **circle** with a center at (3.5, 4.5).
3. Draw four **circles** centered at (2,3), (5,3), (5,6) and (2,6) with 0.5 radius.
4. Draw a **point** at (6,4.5).
5. Use **Object Snap** to draw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

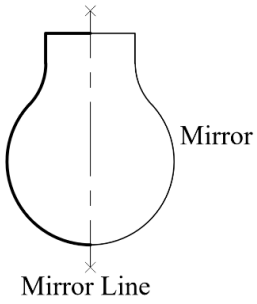
1	Center	10	Tangent
2	Quadrant	11	Midpoint between Quadrant and Center
3	Midpoint	12	Intersection
4	End	13	Apparent Intersection of Lines (1-2) and (6-7)
5	End	14	Parallel to line (9-10), distance = 2.5
6	Midpoint	15	Node (0.5,0.5)
7	Tangent	16	**From** the upper right corner at (0.25,-0.5)
8	Center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

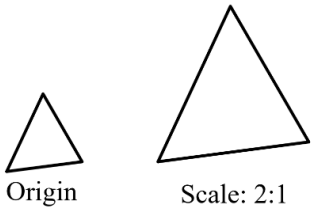


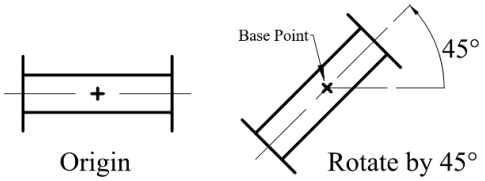
Modify Commands

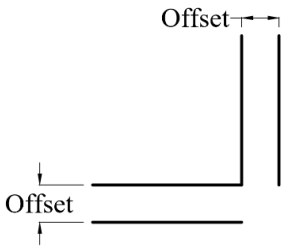
Basic Modify Commands: Copy, Mirror, Scale, Rotate, Offset, Trim, Fillet, Chamfer, Extend, Stretch, Explode, Break, Join, Divide, Properties, and Match Properties.

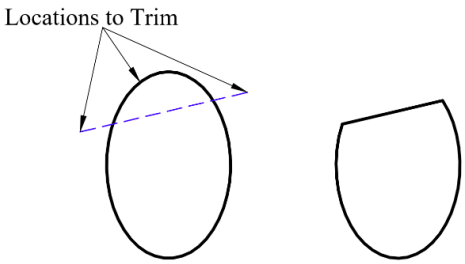


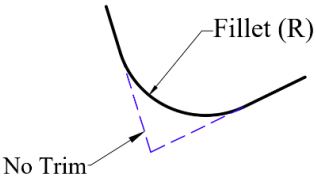


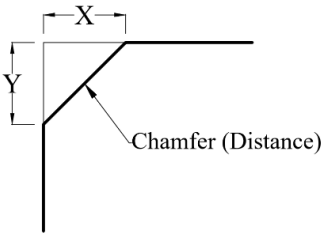




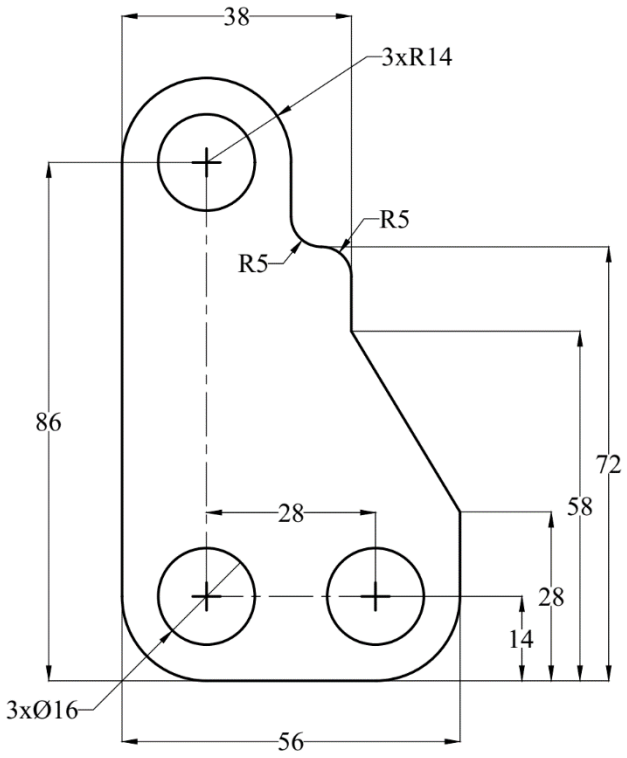




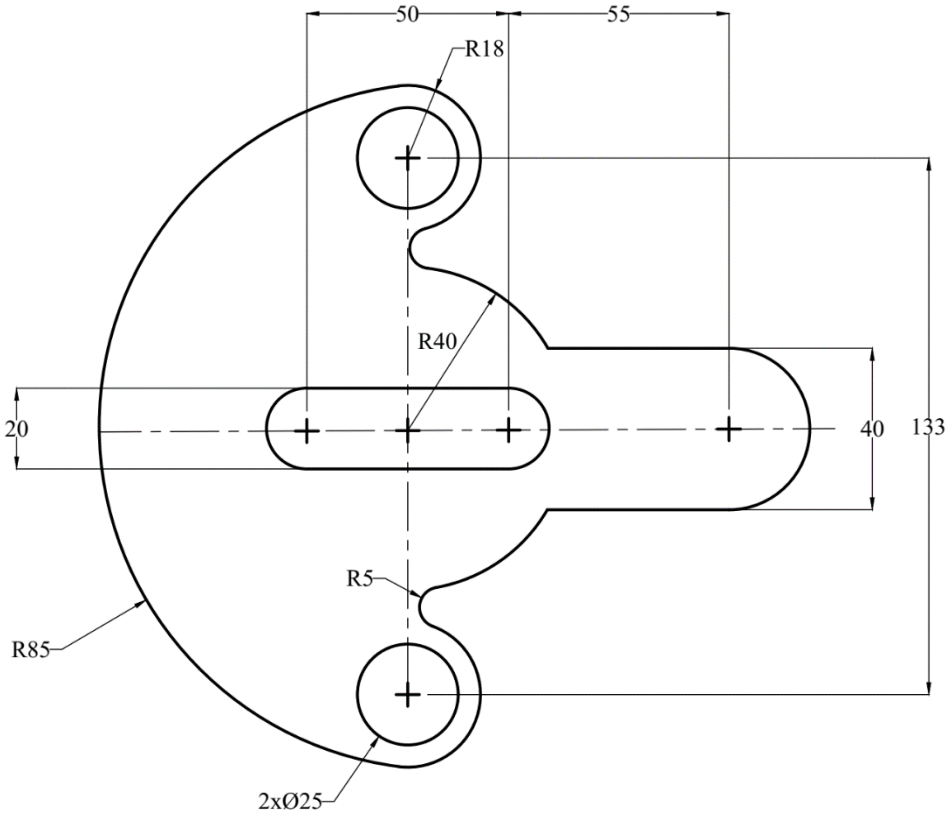




Ex. 1

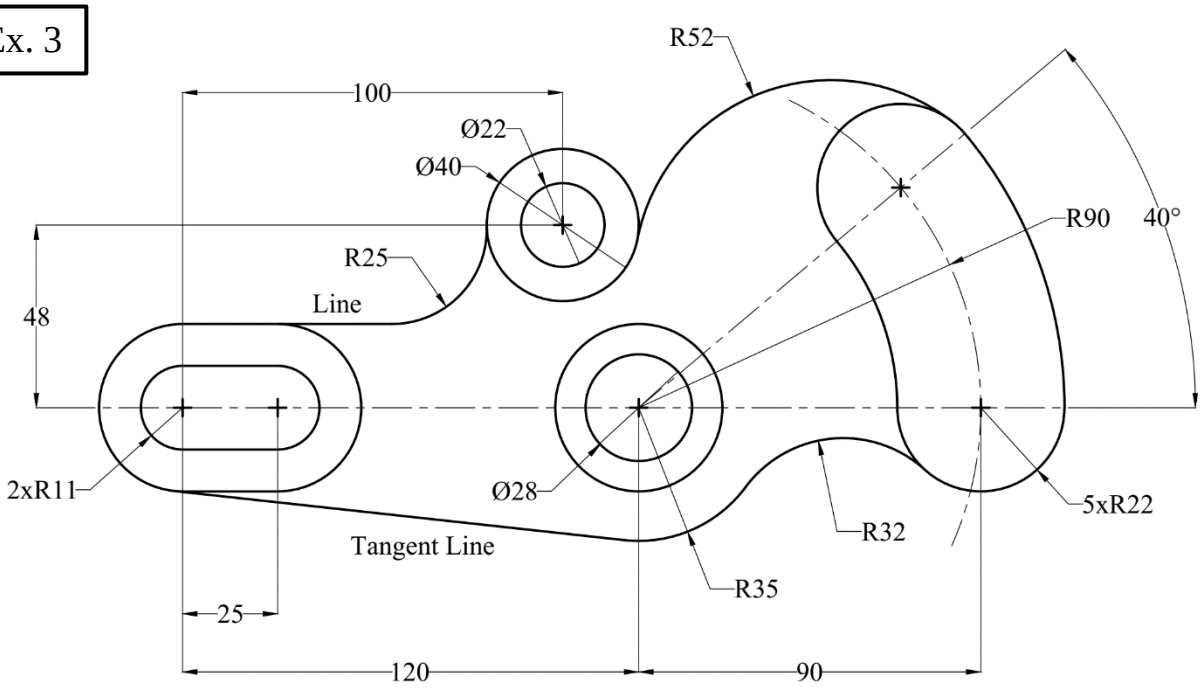

38
3xR14
R5
R5
86
72
58
28
28
14
3xØ16
56

Ex. 2

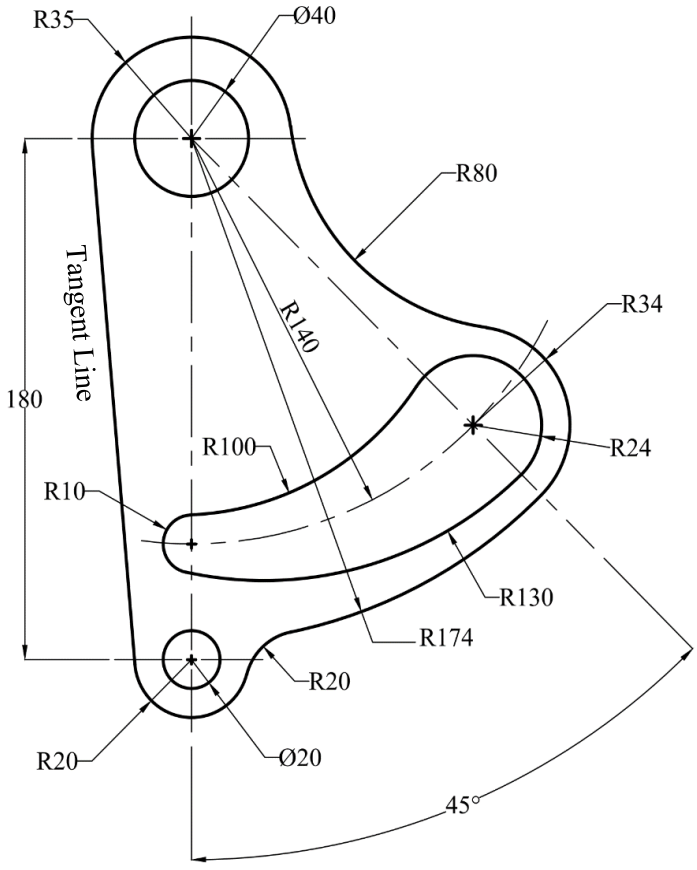

50
55
R18
R40
20
40
133
R5
R85
2xØ25

Note: Use Object **Snap to Tangent**  to draw the Tangent Line shown in the following exercises.

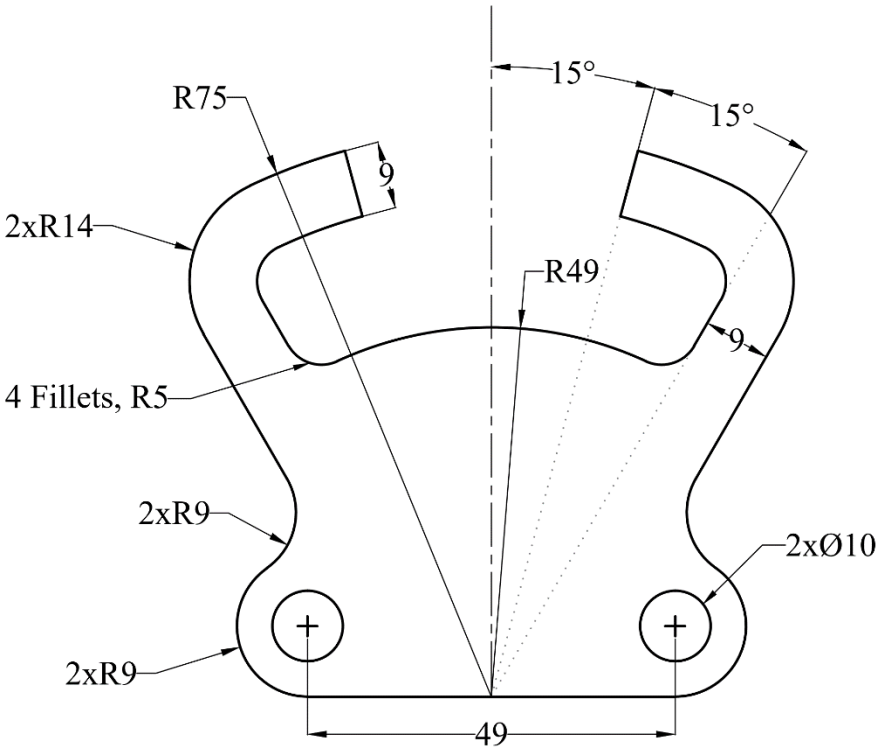
Ex. 3



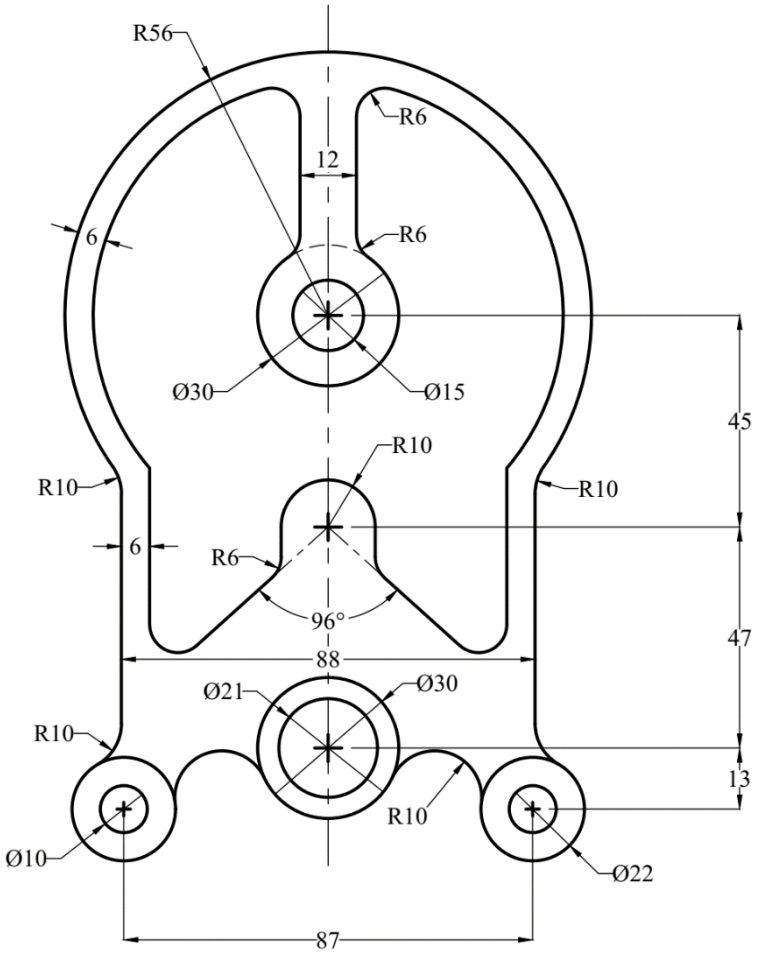
Ex. 4



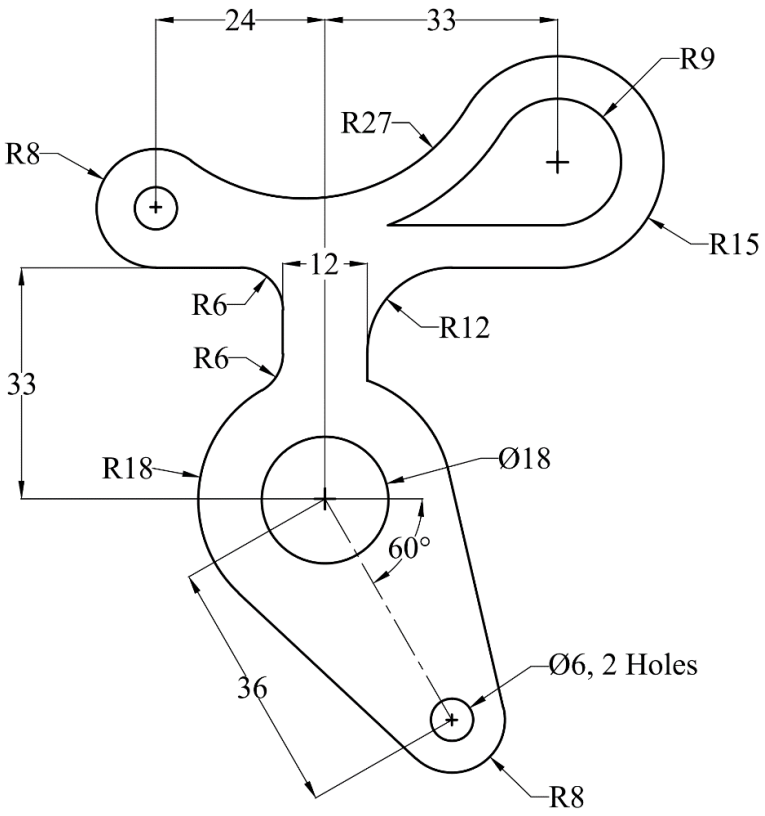
Ex. 5


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

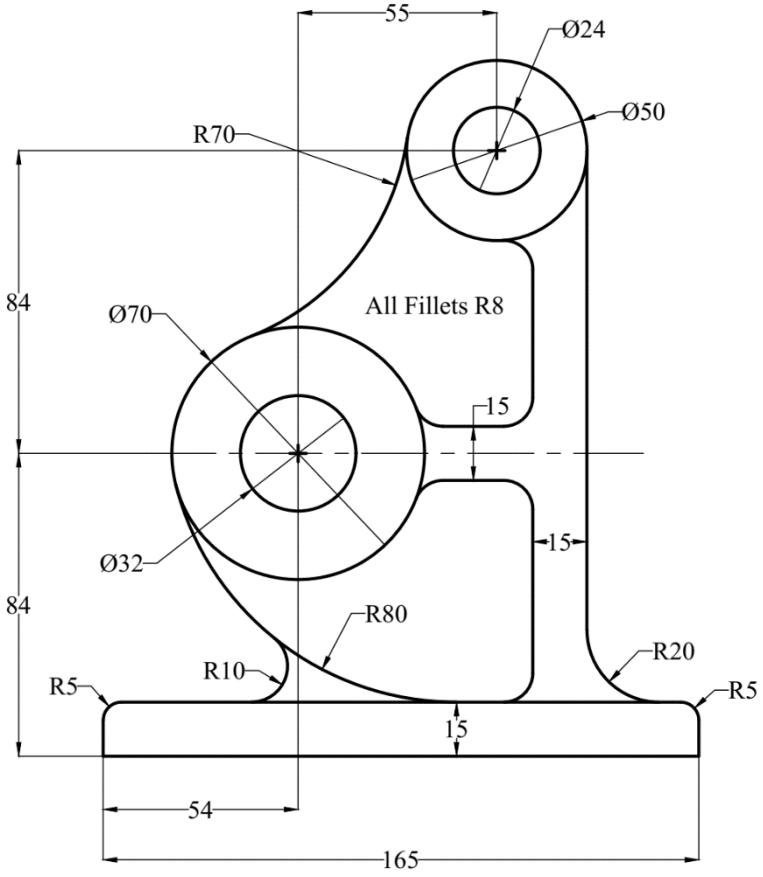
Ex. 6


R56
R6
12
6
R6
Ø30
Ø15
45
R10
R10
R10
6
R6
96°
47
88
Ø21
Ø30
R10
13
R10
Ø10
Ø22
87

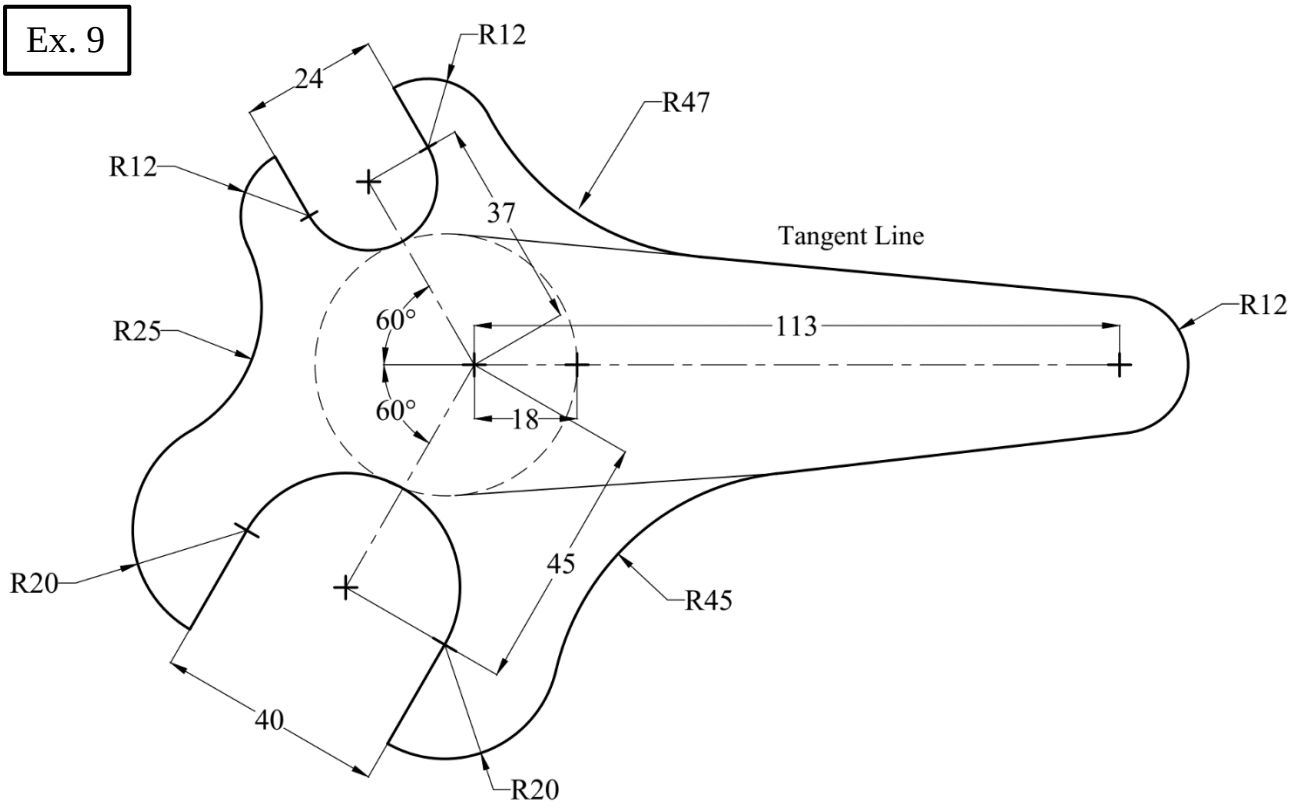
Ex. 7


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

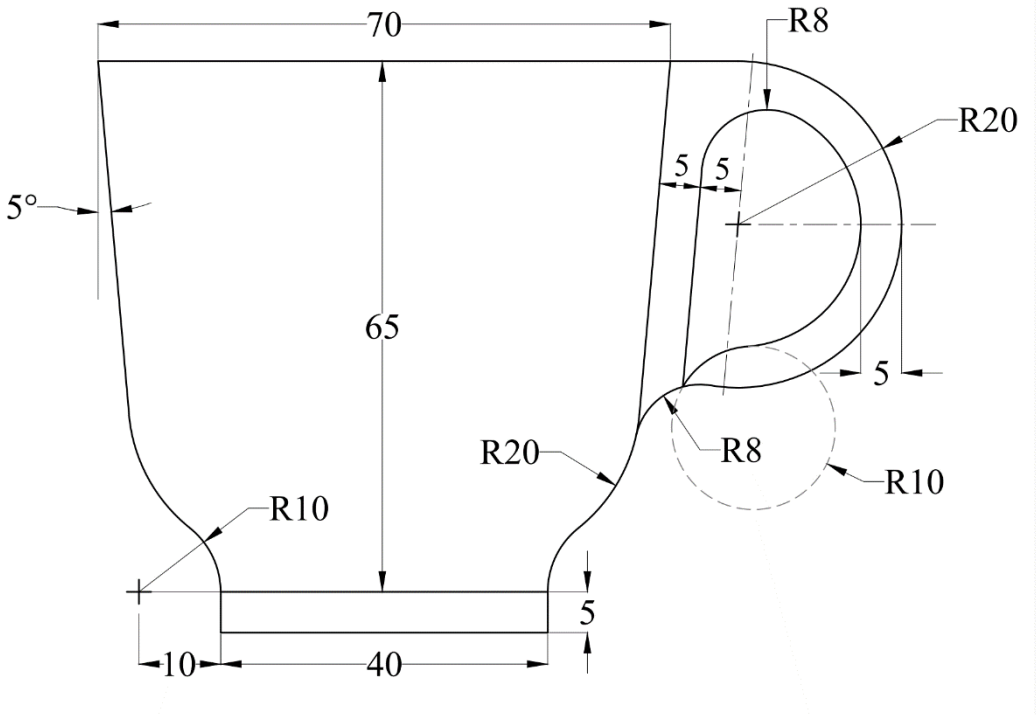
Ex. 8


55
Ø24
Ø50
R70
84
Ø70
All Fillets R8
15
15
Ø32
84
R80
R20
R10
R5
R5
15
54
165

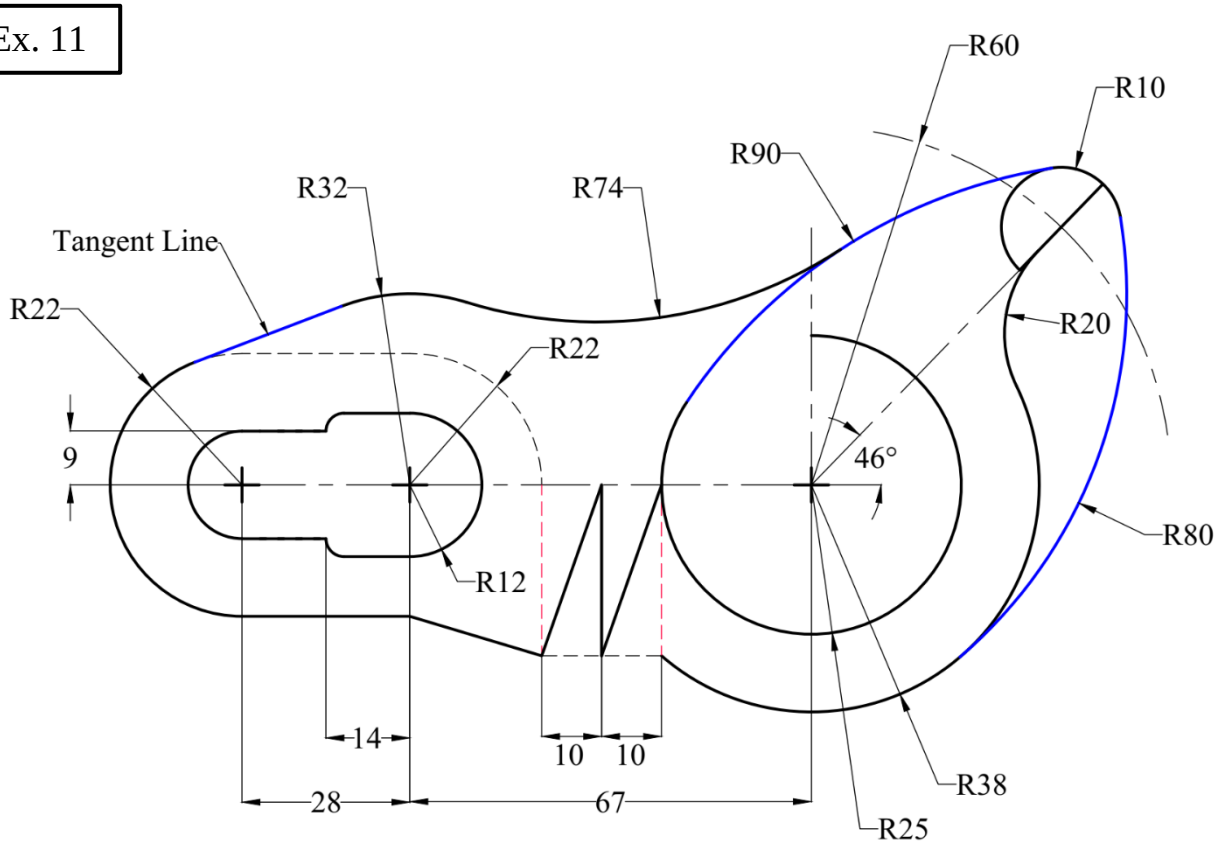
Ex. 9


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

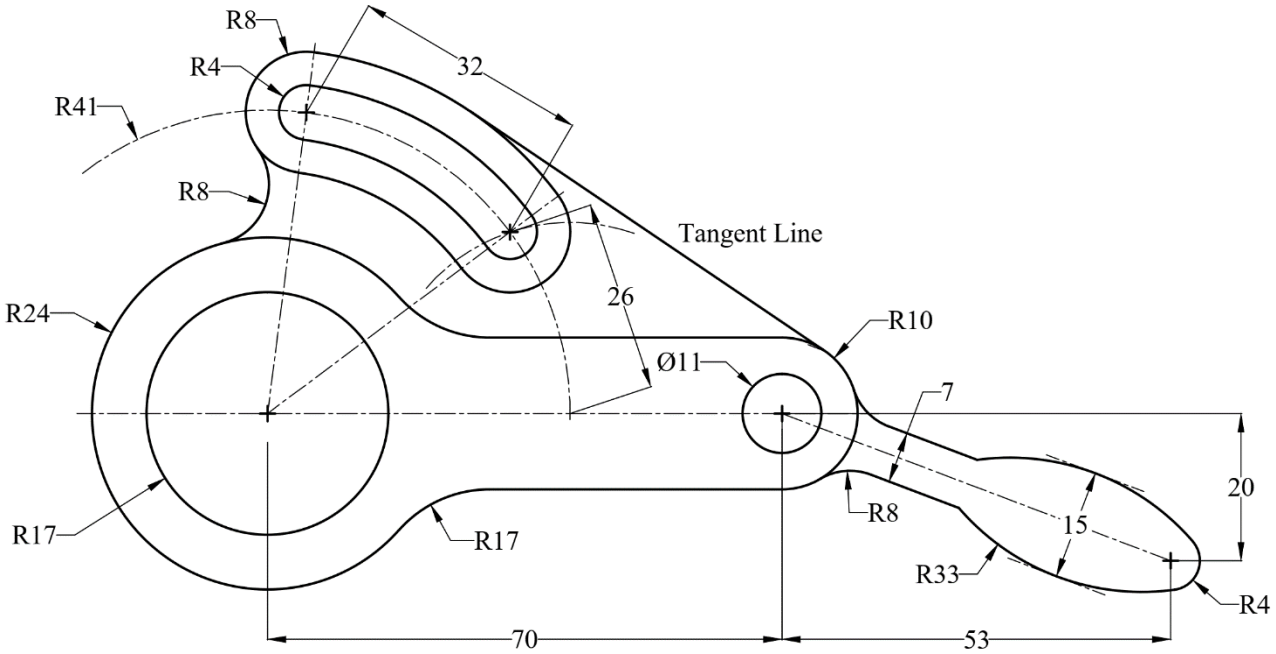
Ex. 10


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

Ex. 11

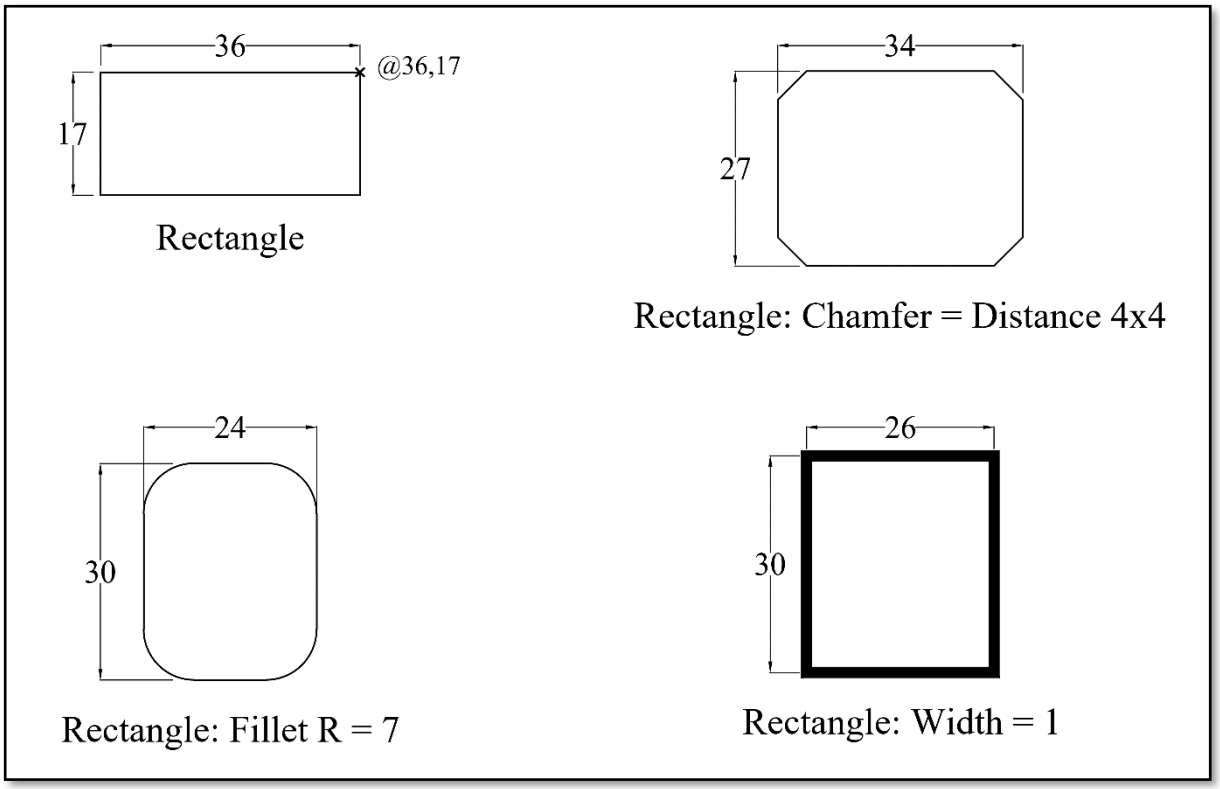

R60
R10
R90
R32
R74
Tangent Line
R22
R22
R20
9
46°
R80
R12
14
10
10
R38
28
67
R25

Ex. 12


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

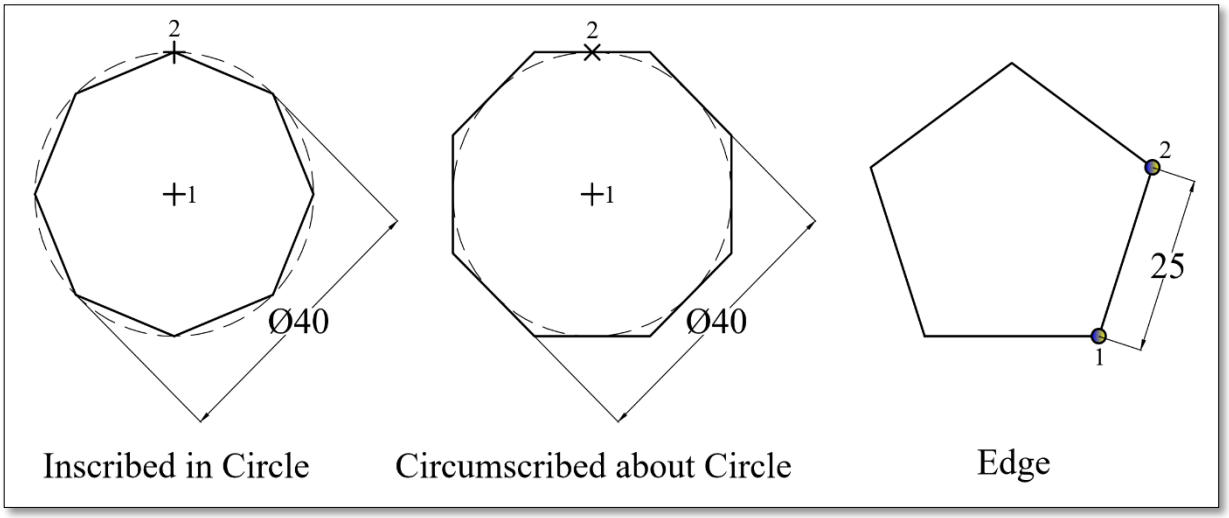
Rectangle and Polygon Commands

1. Rectangle

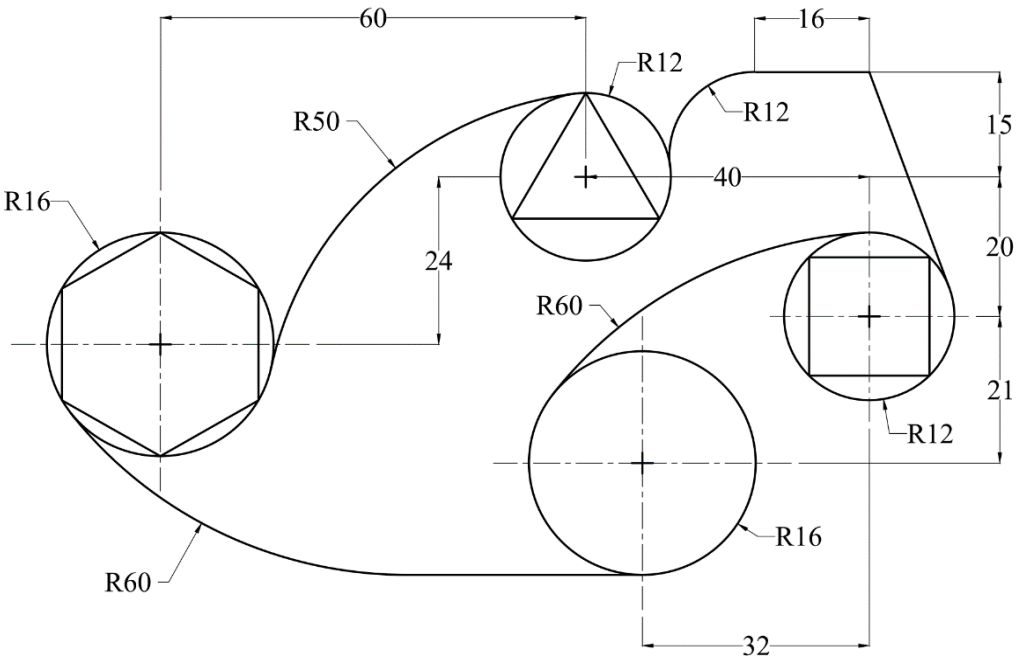


2. Polygons:

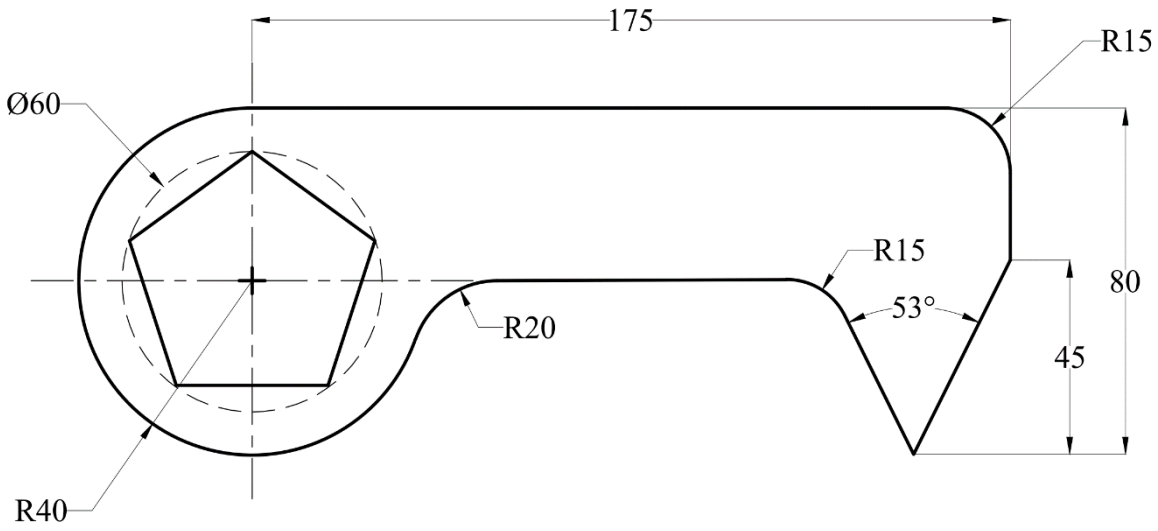
a. Center, Radius: Inscribed and circumscribed about the circle.
b. Edge.



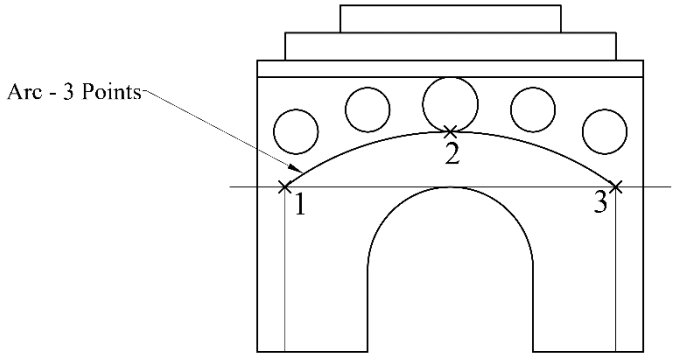
Ex. 1


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

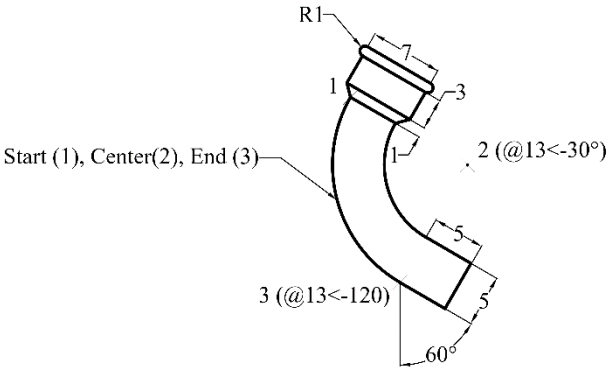
Ex. 2


175
R15
Ø60
R15
80
53°
R20
45
R40

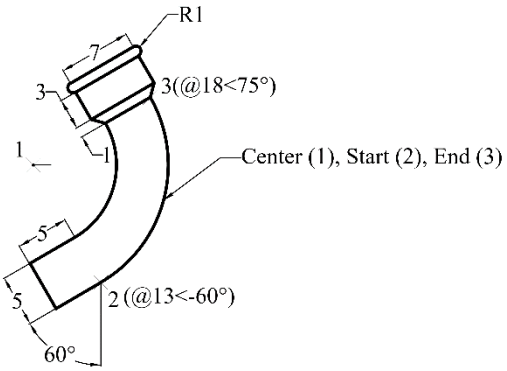
Arc Commands



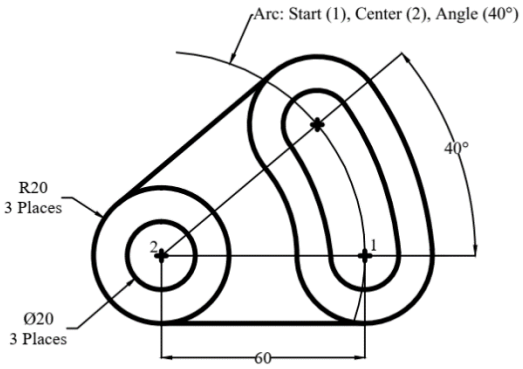
(a)



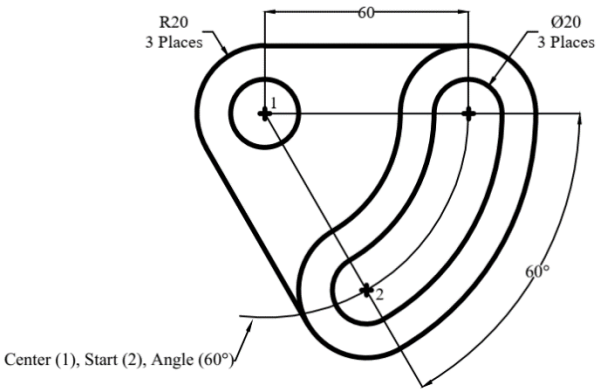
(b)



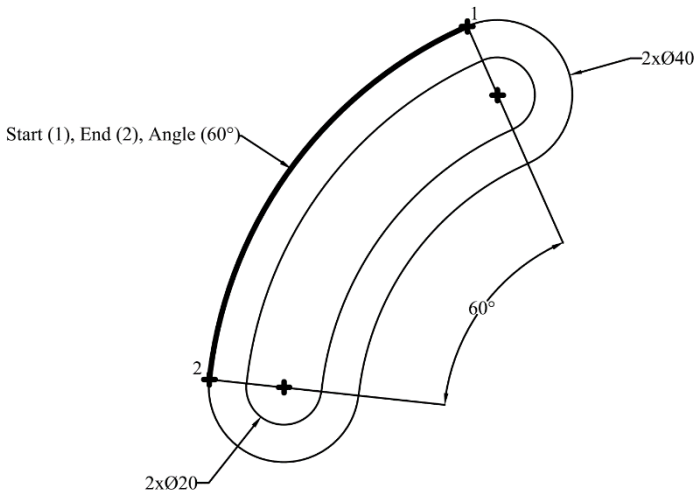
(c)



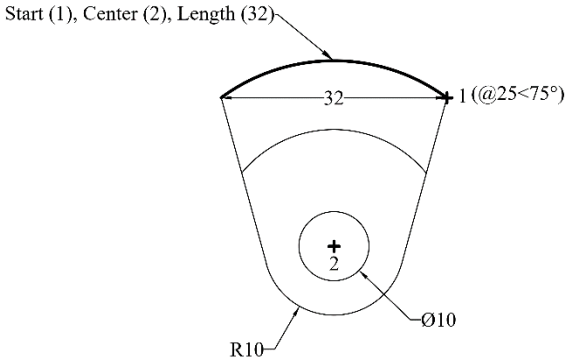
(d)



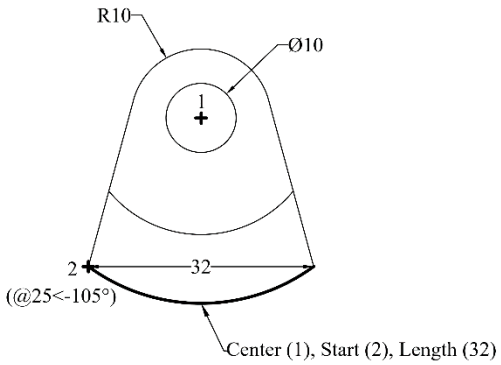
(e)


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

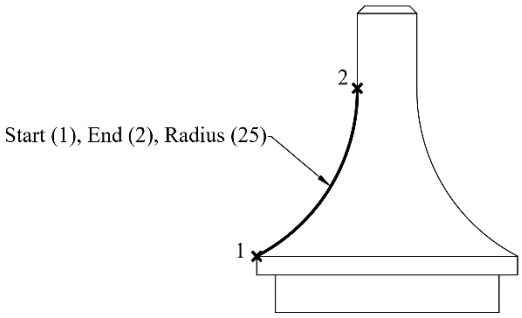
(f)


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

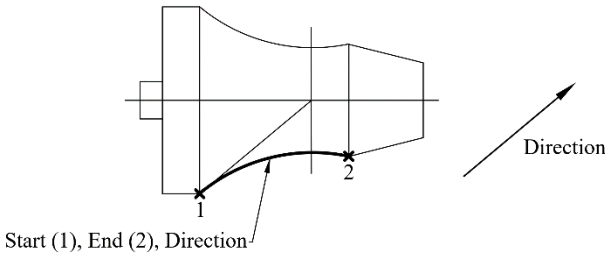
(g)


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

(h)

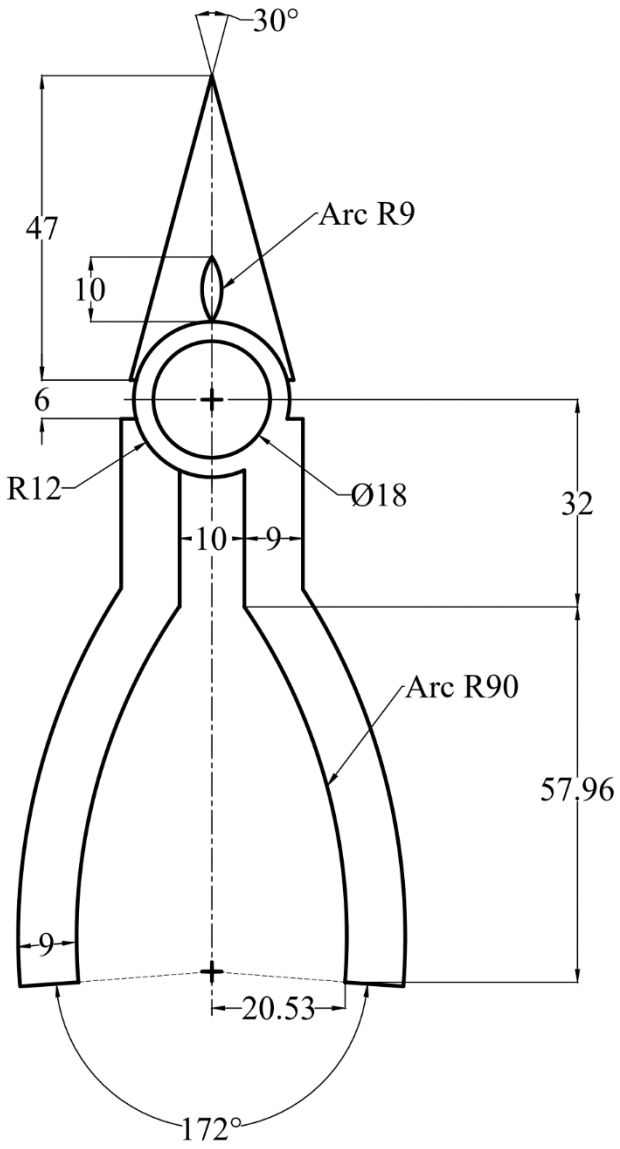

2
Start (1), End (2), Radius (25)
1

(i)

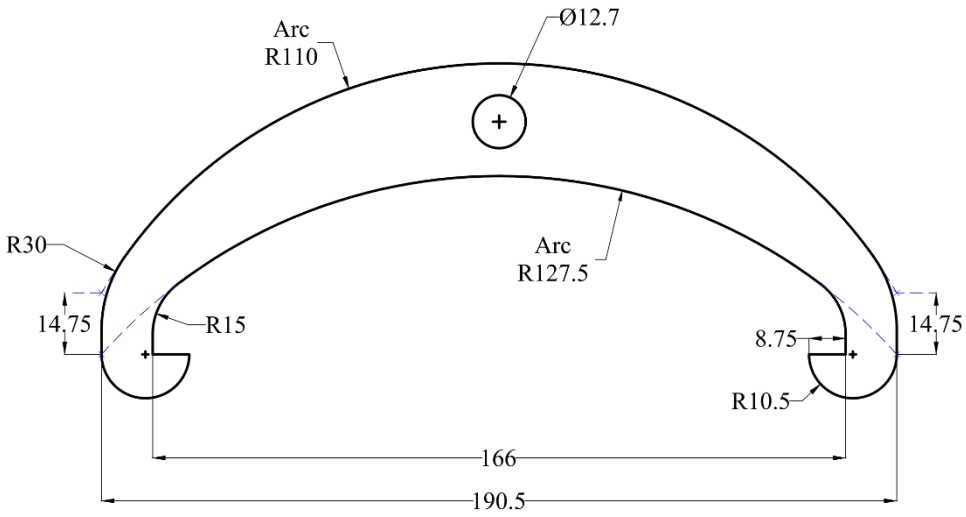

Direction
2
1
Start (1), End (2), Direction

(j)

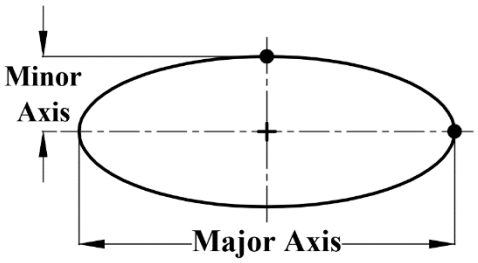
Ex. 1



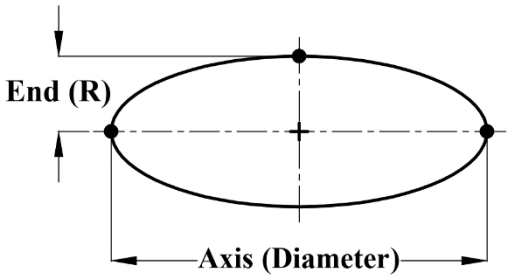
Ex. 2: Clamp of Laundry Machine



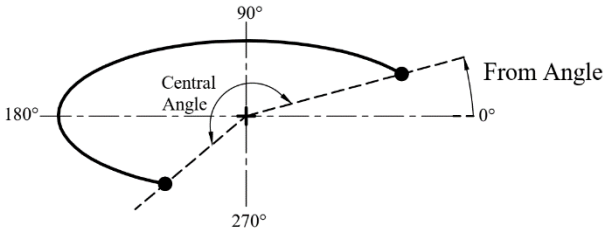
Ellipse Commands



Ellipse (Center, Radius)

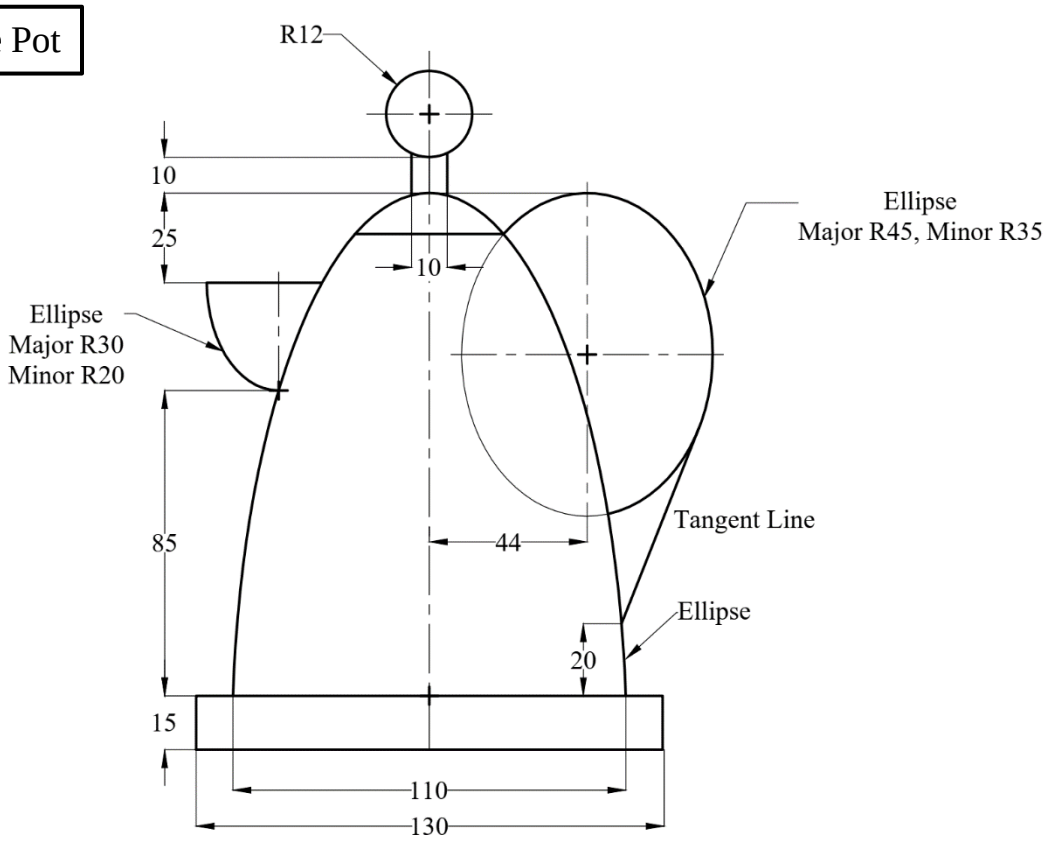


Ellipse (Axis, End)

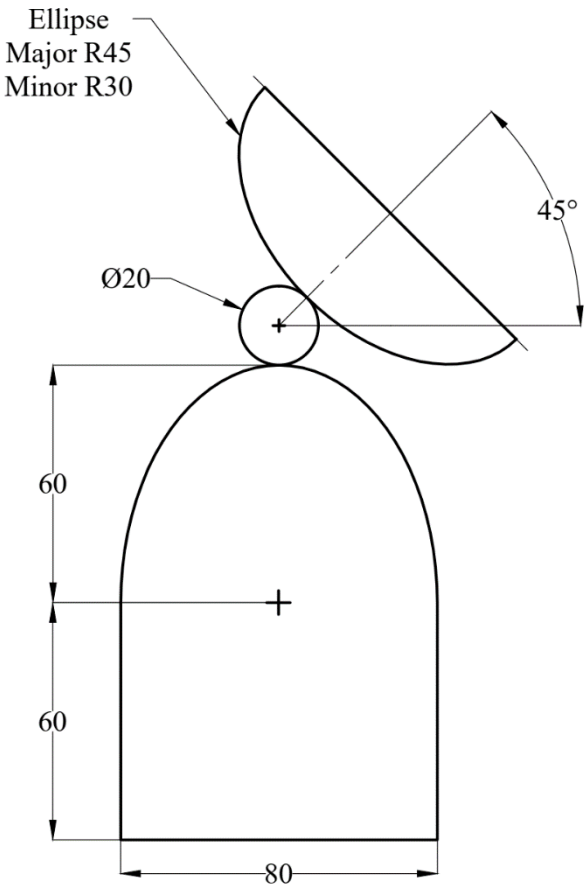


Elliptical Arc

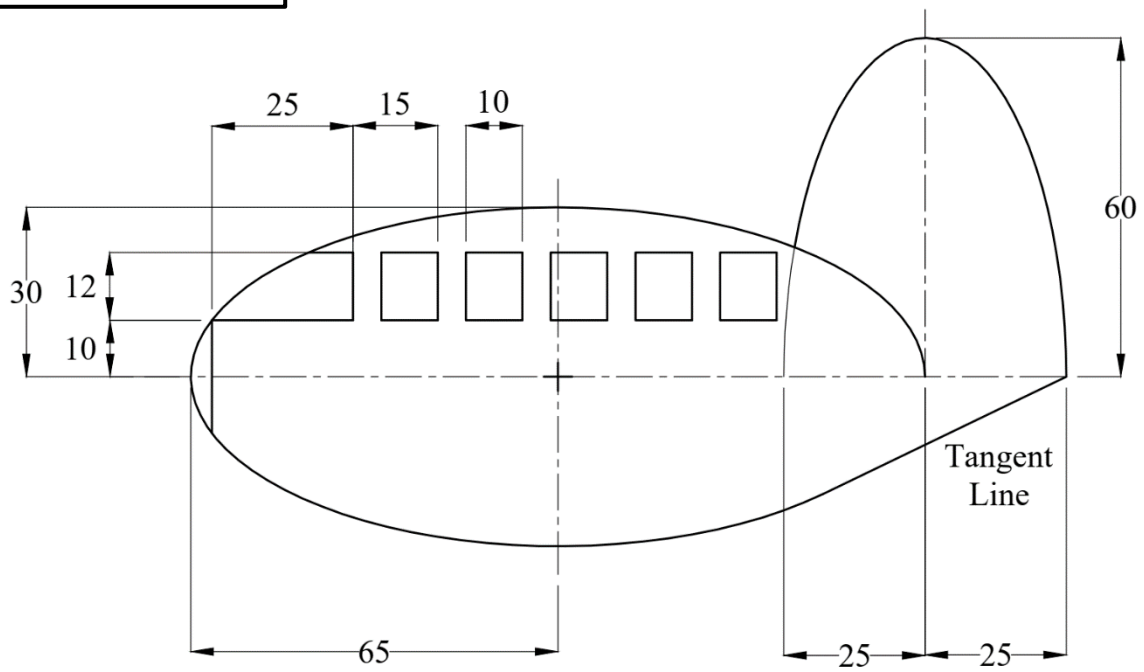
Ex. 1: Coffee Pot



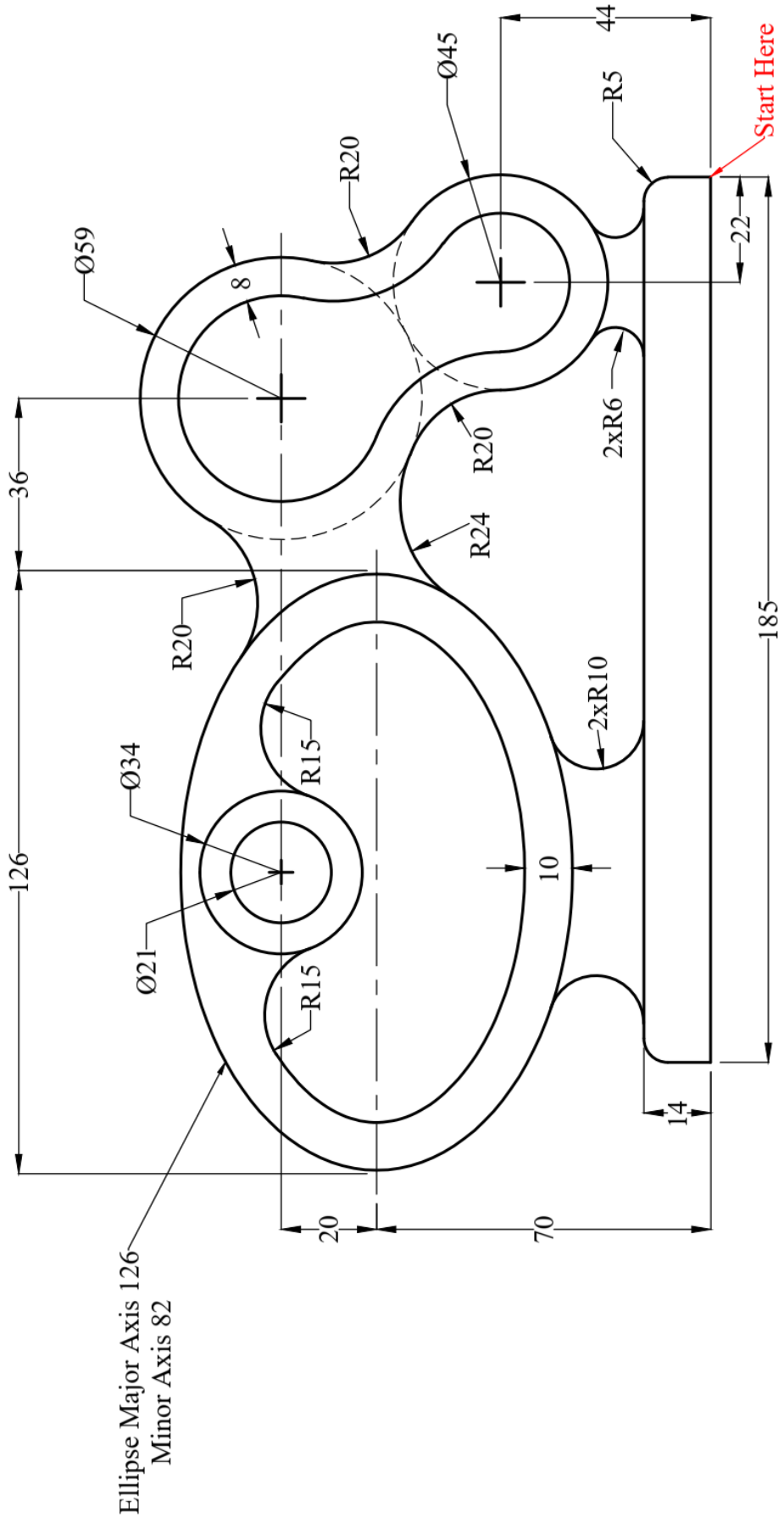
Ex. 2: Radar Station



Ex. 3: Toy Aeroplane

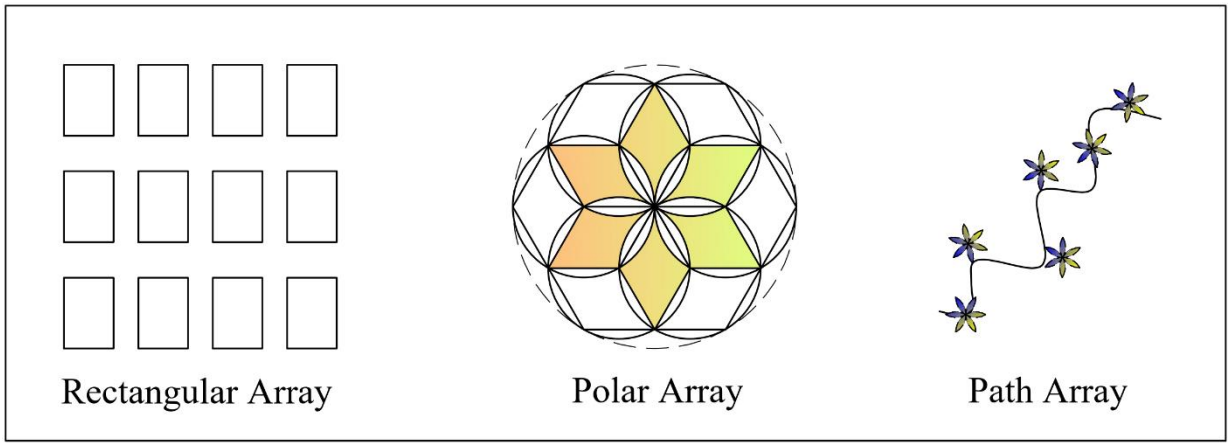


Ex. 4

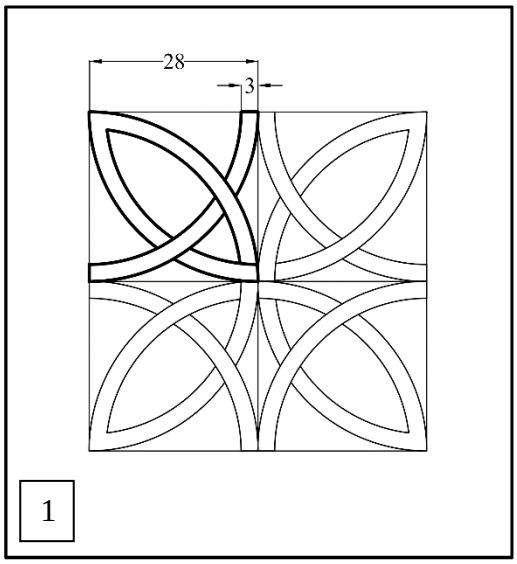

Start Here
44
Ø45
R5
R20
Ø59
8
22
2xR6
R20
36
R24
185
R20
2xR10
Ø34
R15
126
10
Ø21
R15
14
20
70
Ellipse Major Axis 126
Minor Axis 82

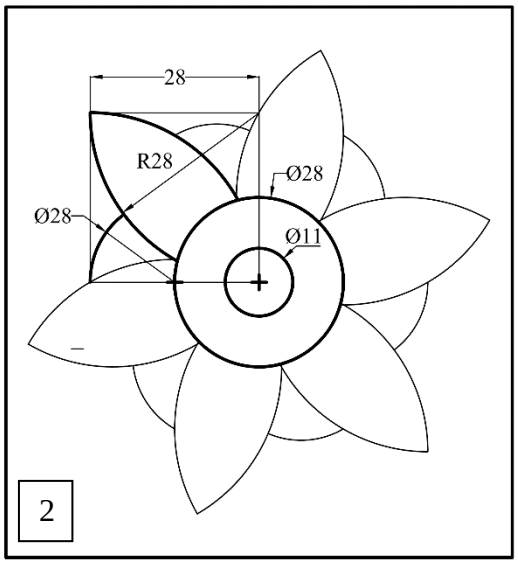
Array

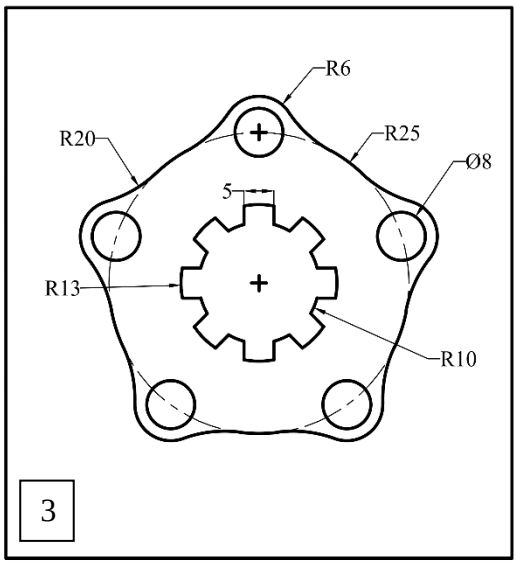
Associative and Explode

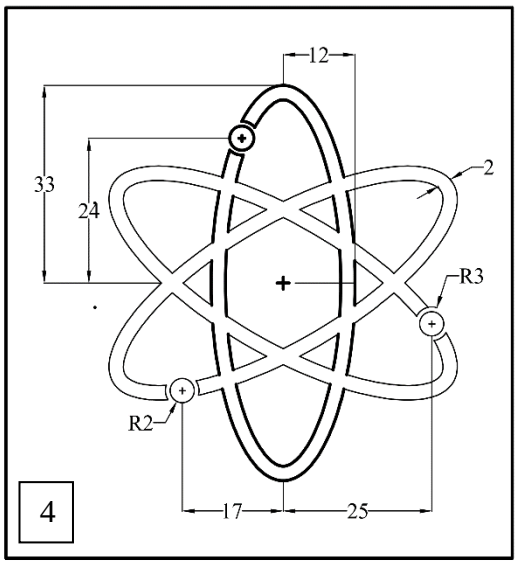


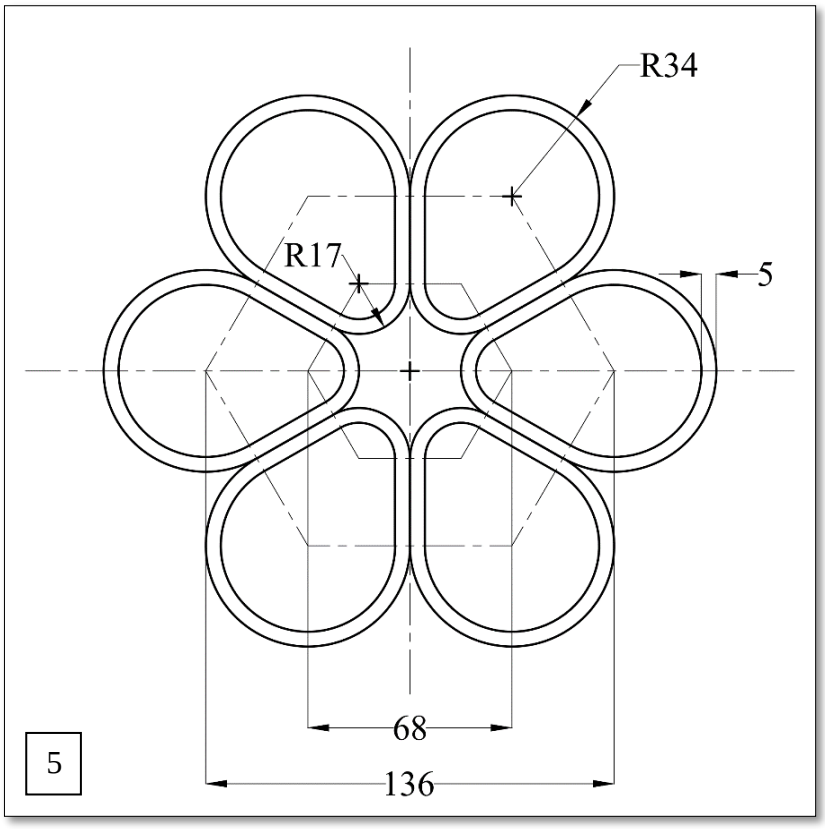
Draw the following patterns in exercise from (1) to (8) using Polar Array Command.

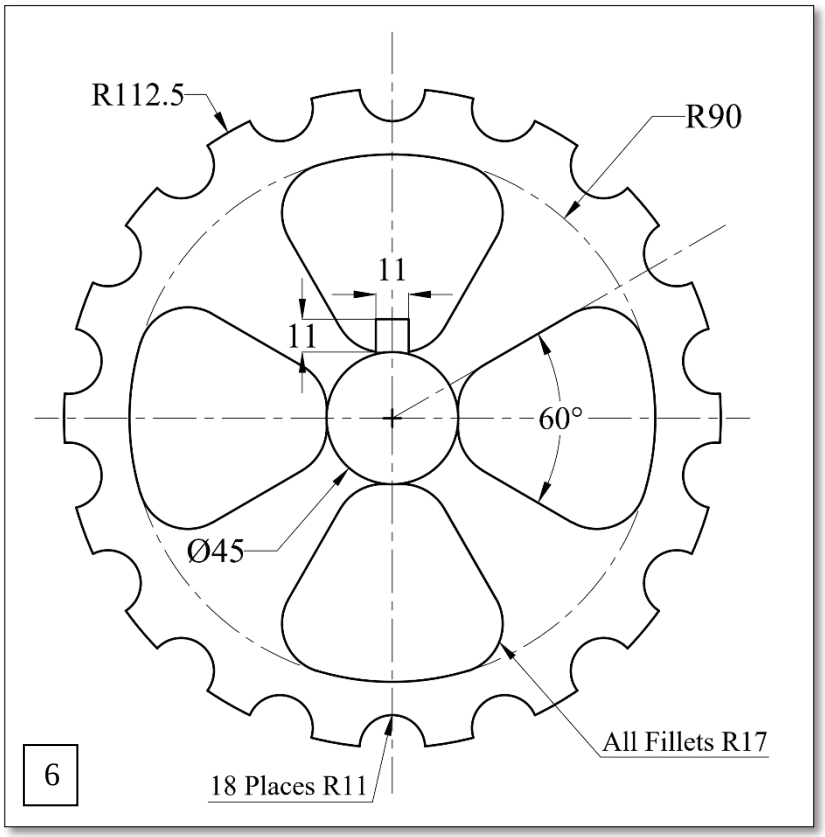


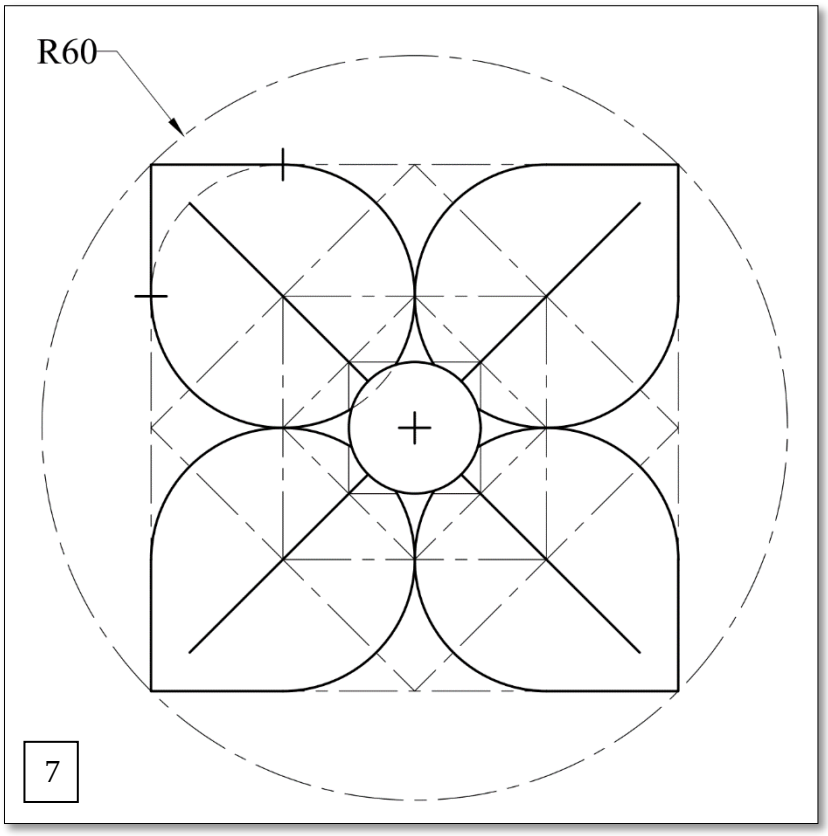


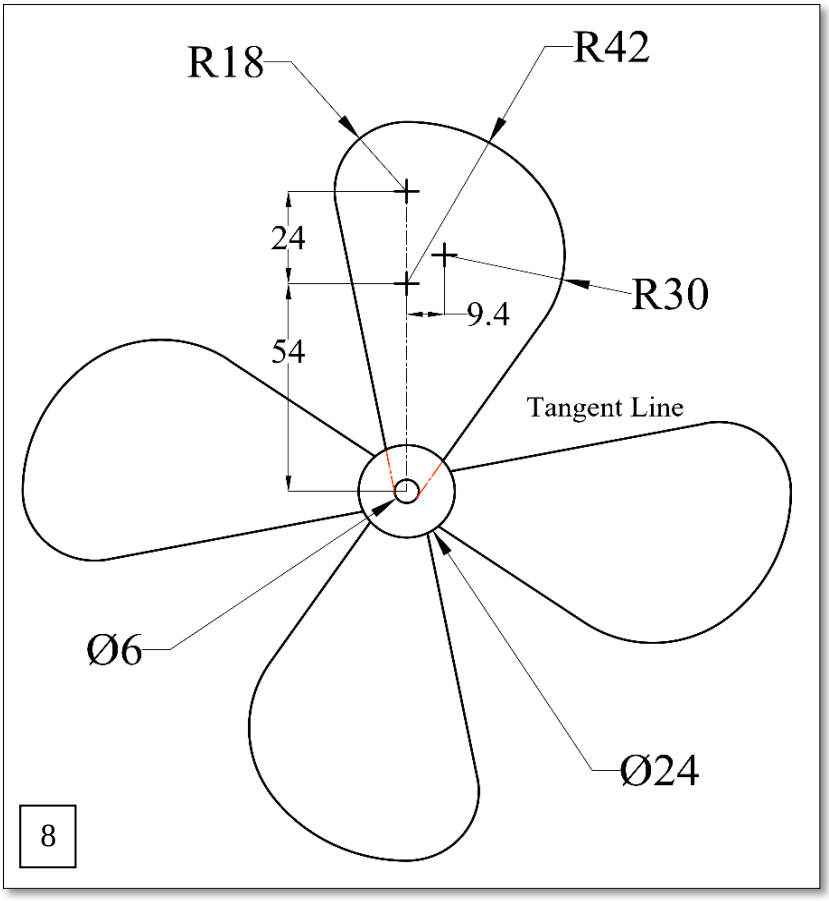




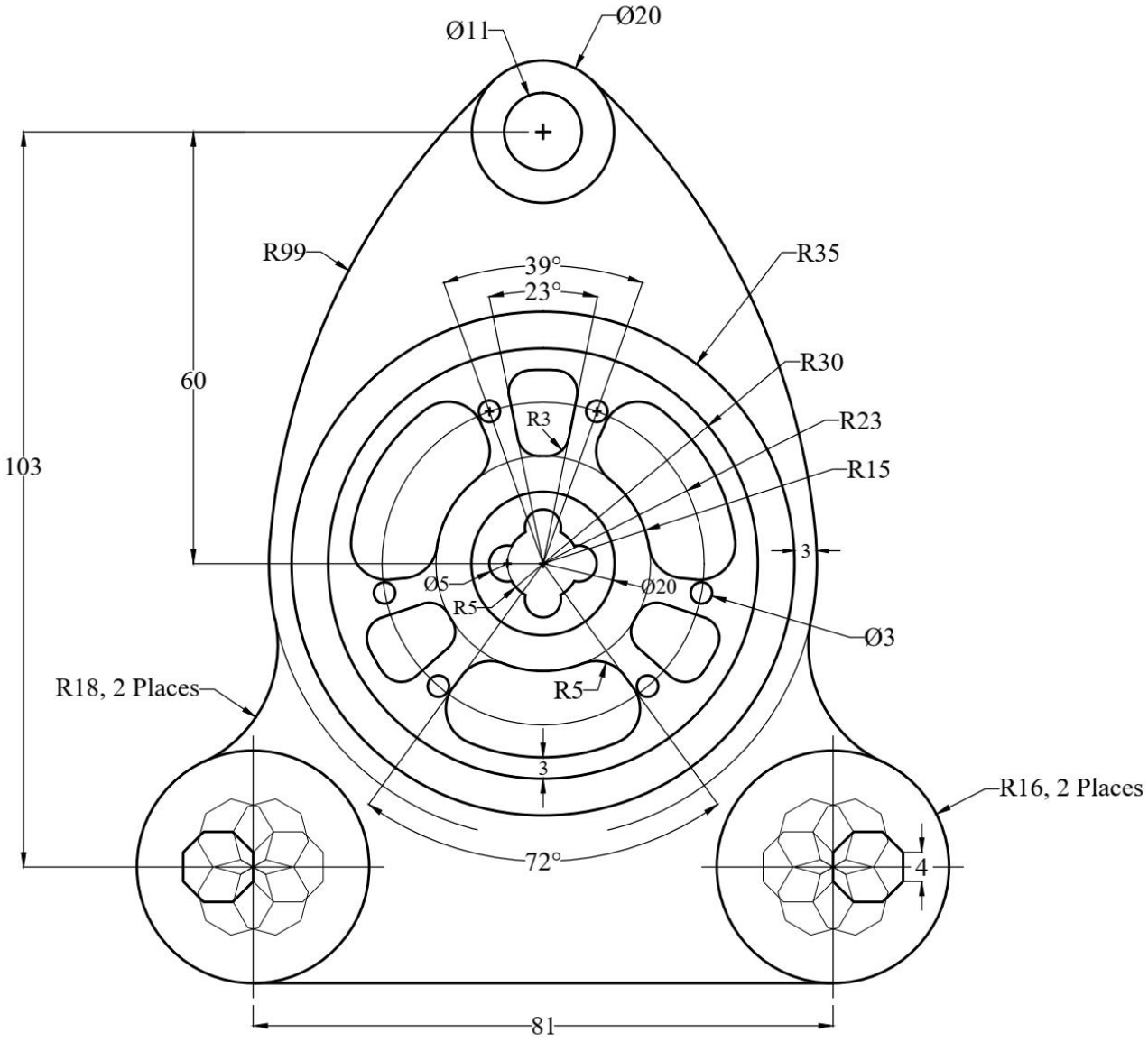

R34
R17
5
68
136
5


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

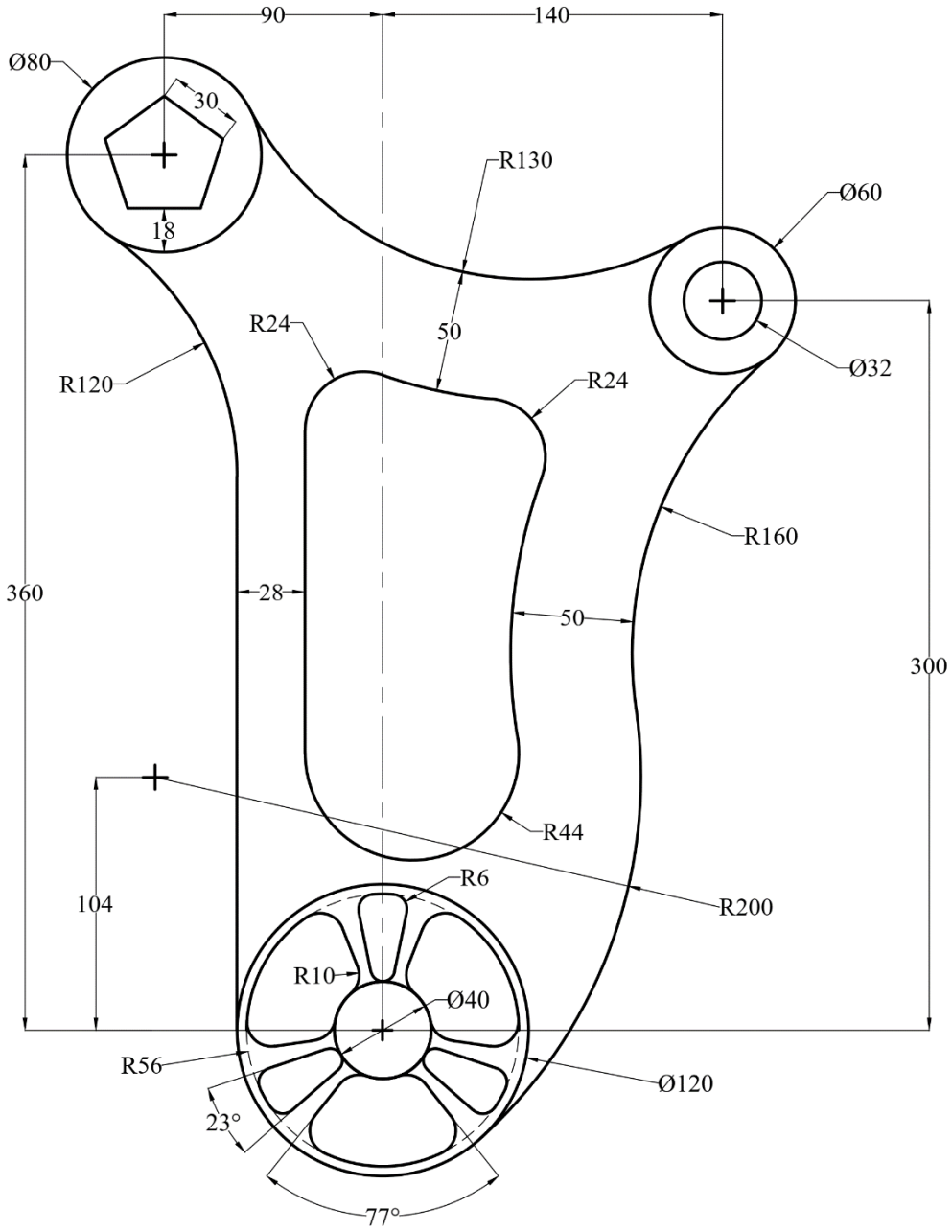

R60
7


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°

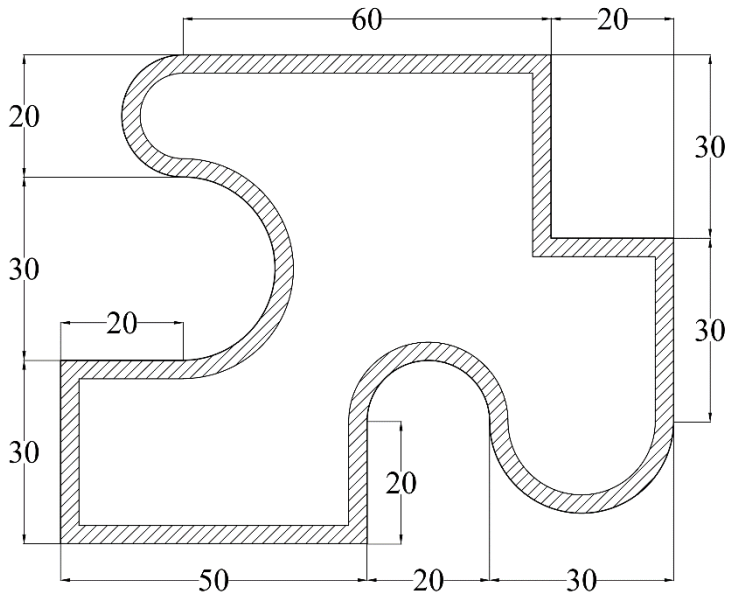
Join, Region, Boundary, Hatch, and Area

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:

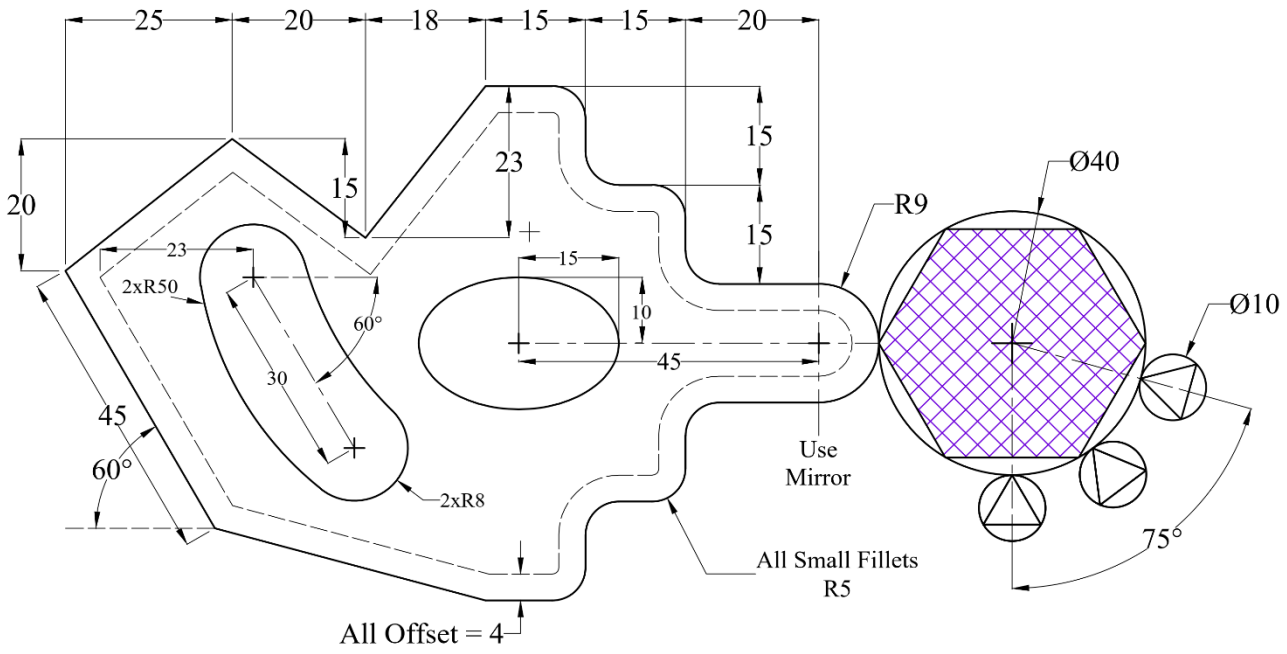
1. Use the **Line** command to draw the outlines of the given layout.
2. Use **Join or Boundary** commands to turn the outlines into one.
3. Use the **Offset** command for the inner wall. (Offset Distance = 3).
4. Use (Add and Subtract Area) command to find the **Area** of the inner wall.

Add Area =   Subtract Area =

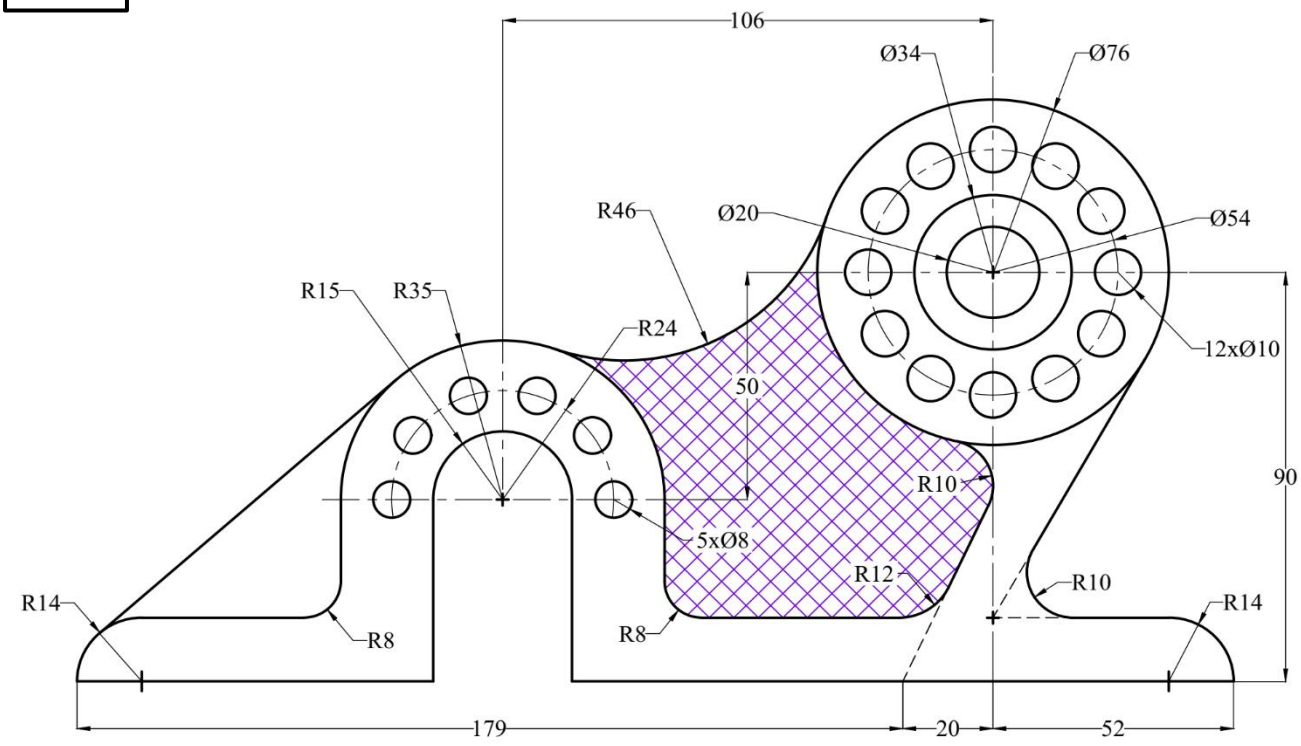
5. Use the **Text** command to insert the **Area** and the **Perimeter** values on the screen.
6. Put all **dimensions** on the Figure.

Draw the following exercises, then find the area of the hatched zone.

Ex. 1



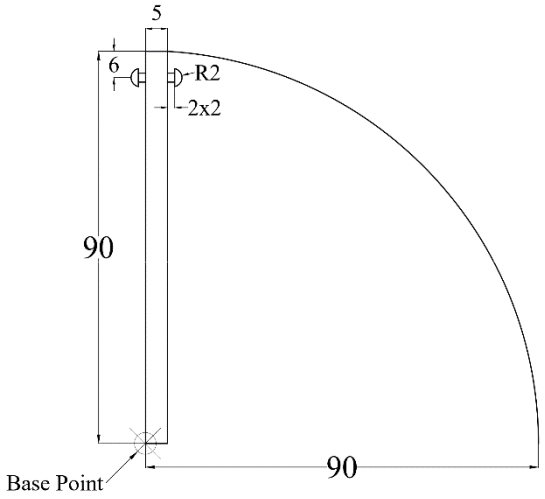
Ex. 2



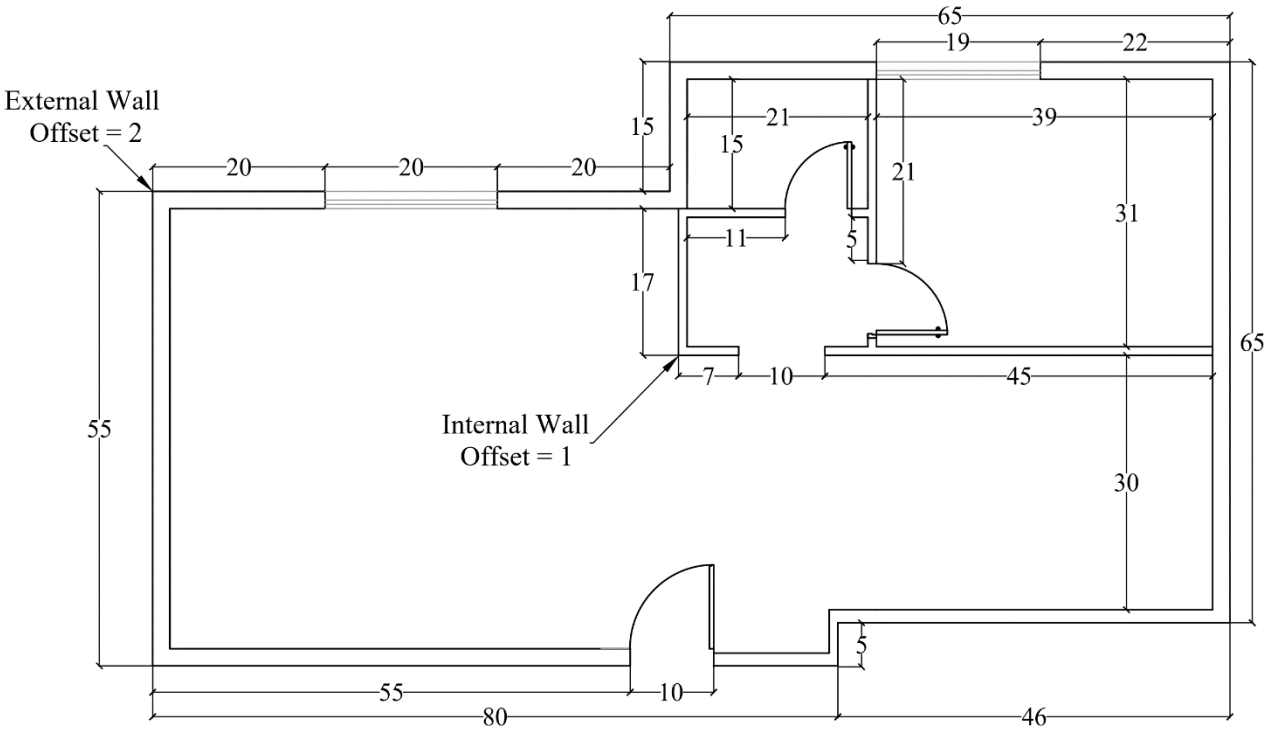
Block

Create, and Insert

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

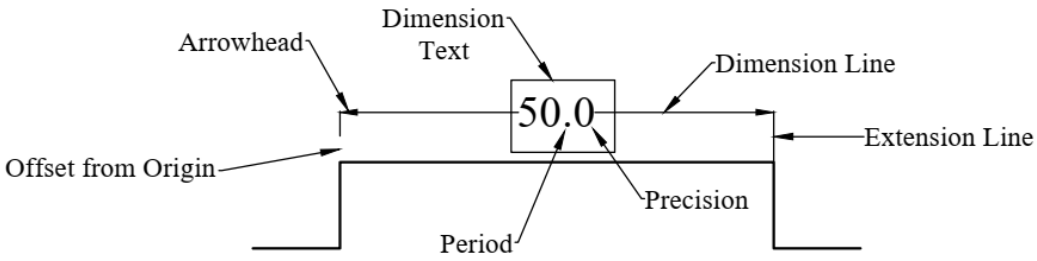


2. Insert the **"Door"** block in the proper places as shown in the given layout. Scale: 10:1

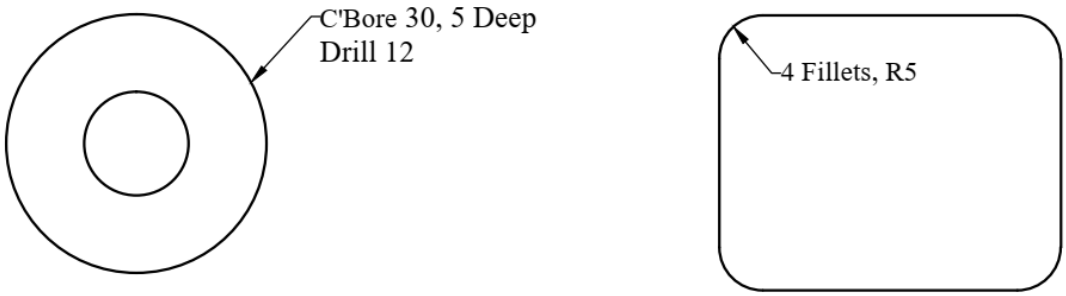



TEXT
Text Height


Dimensions


Arrowhead
Dimension Text
Dimension Line
50.0
Extension Line
Offset from Origin
Precision
Period


Leaders


C'Bore 30, 5 Deep
Drill 12
4 Fillets, R5

Dimensioning Rules

A. Dimension Placement

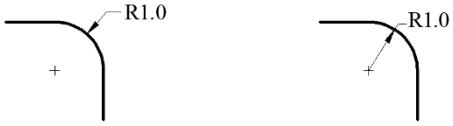
- Place dimensions on the most descriptive views.
- Take dimensions from visible lines not from hidden lines.
- Organize and align dimensions for ease of reading.
- The dimensions are normally positioned to maintain a minimum of 3/8" (9.52mm) open space around the object.
- Do not repeat dimensions.
- 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).



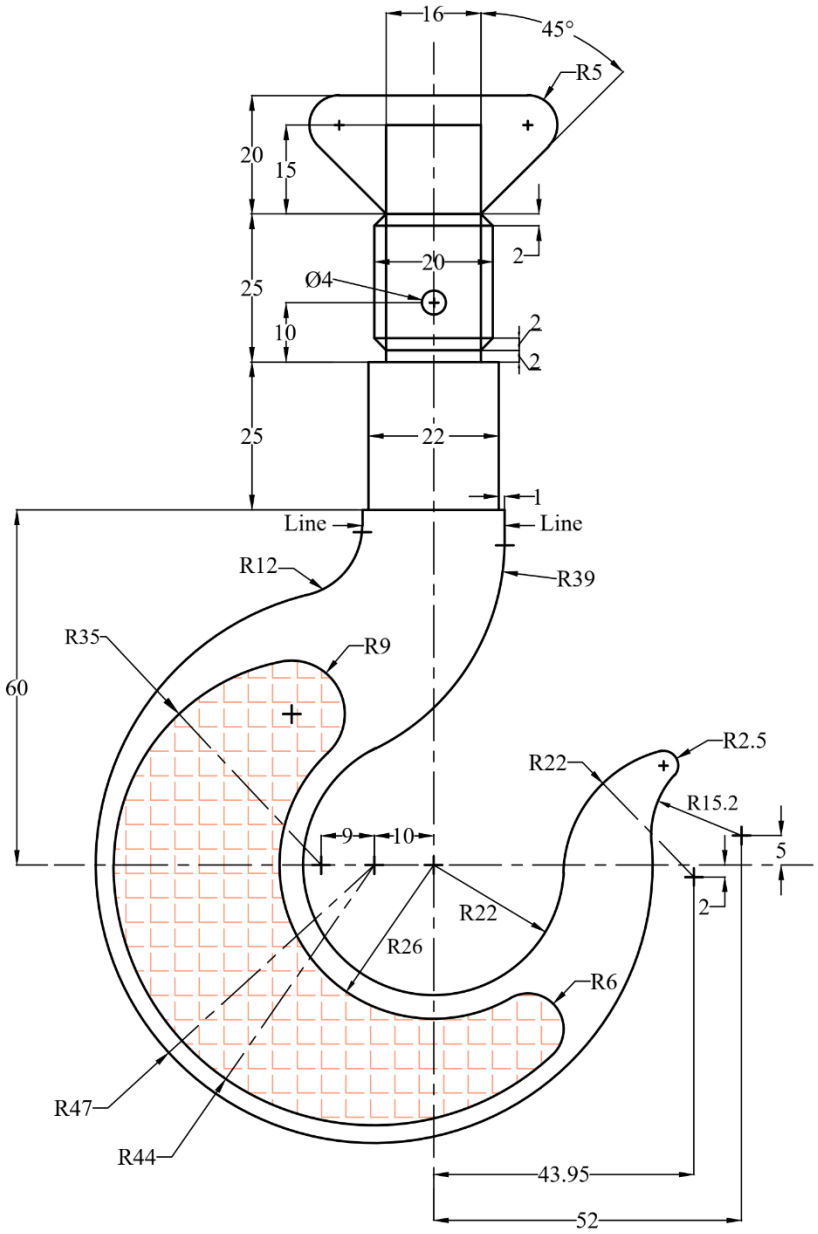
- A very slightly rounded corners may be denoted by: Break Corner.
- **Fillets** (inside rounded corners) are dimensioned by the same rules as rounds.
- If all fillets and rounds haveequal radii, the note “All Fillets and Rounds 1.0R” may be used instead of dimensioning each sperately.
- **Arcs** are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

Layers

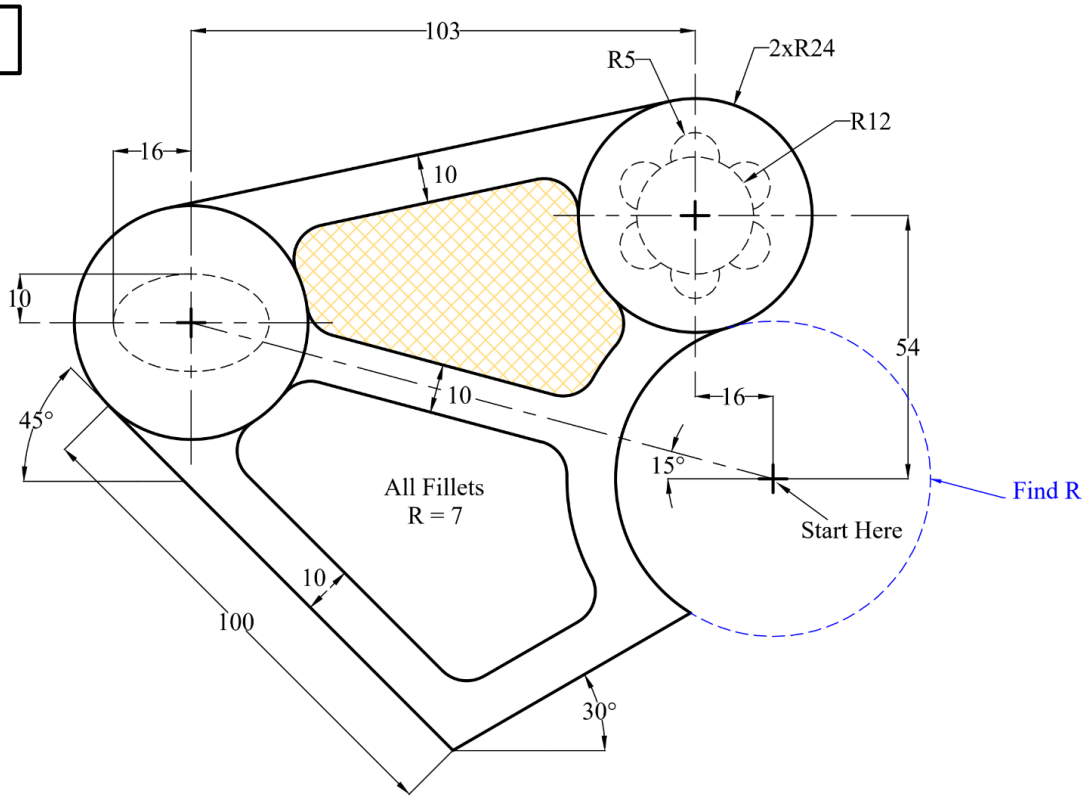
1. Create six layers as indicated in the table below with different colors.
2. Put all dimensions.
3. Find the area of the hatched zone and insert its value as a text on the screen.

Layer	Name	Line Type	Line Weight
1	Outlines	Continuous	0.53
2	Centerlines	Center	0.35
3	Hidden Lines	Hidden	0.40
4	Hatching	Continuous	0.30
5	Dimensions	Continuous	0.30
6	Text	Continuous	Default

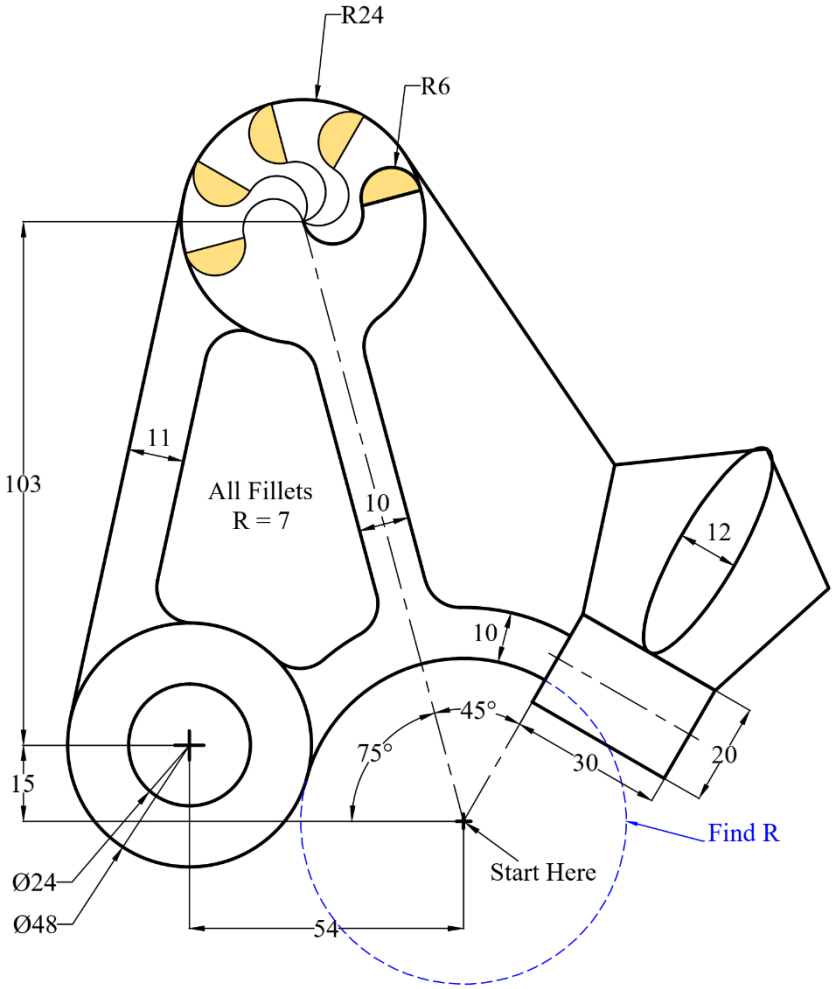
Ex. 1: Hook



Ex. 2


103
R5
2xR24
R12
16
10
10
54
16
10
45°
15°
All Fillets
R = 7
Find R
Start Here
10
100
30°

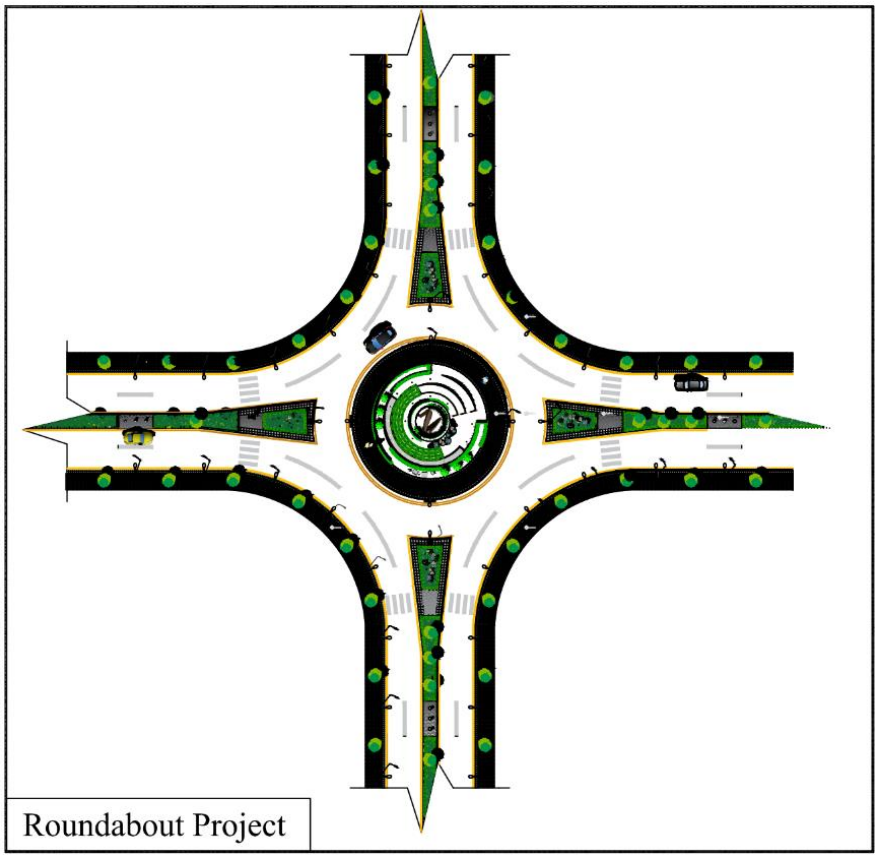
Ex. 3


R24
R6
11
103
All Fillets
R = 7
10
12
10
45°
75°
30
20
15
Find R
Start Here
Ø24
Ø48
54

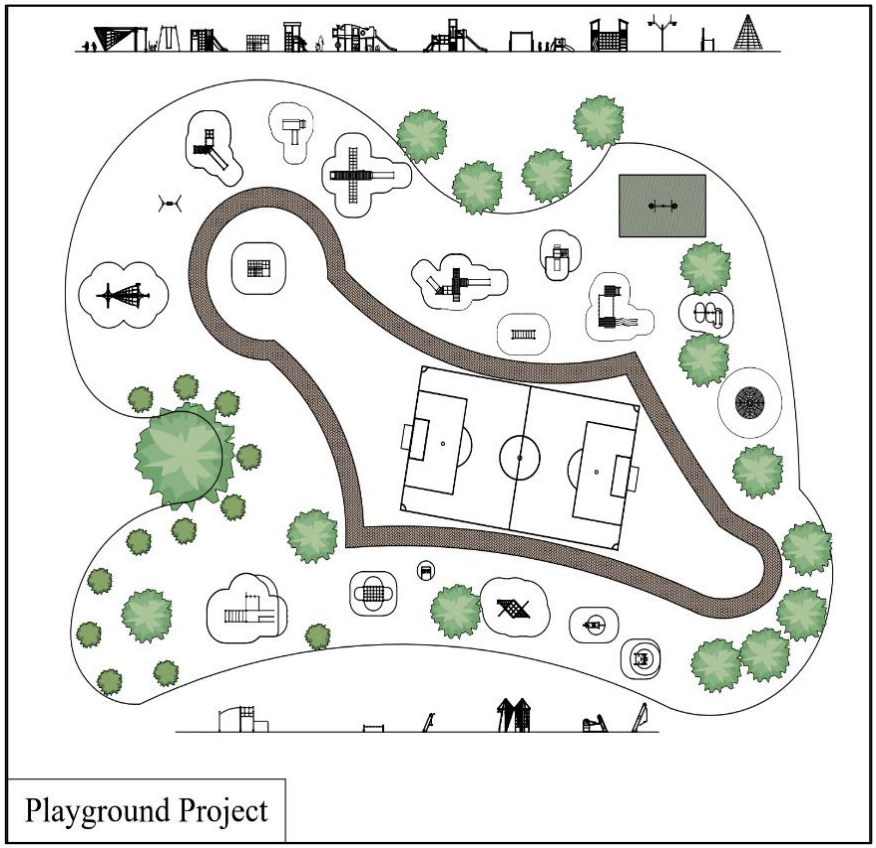
Layout Plot and Publish

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

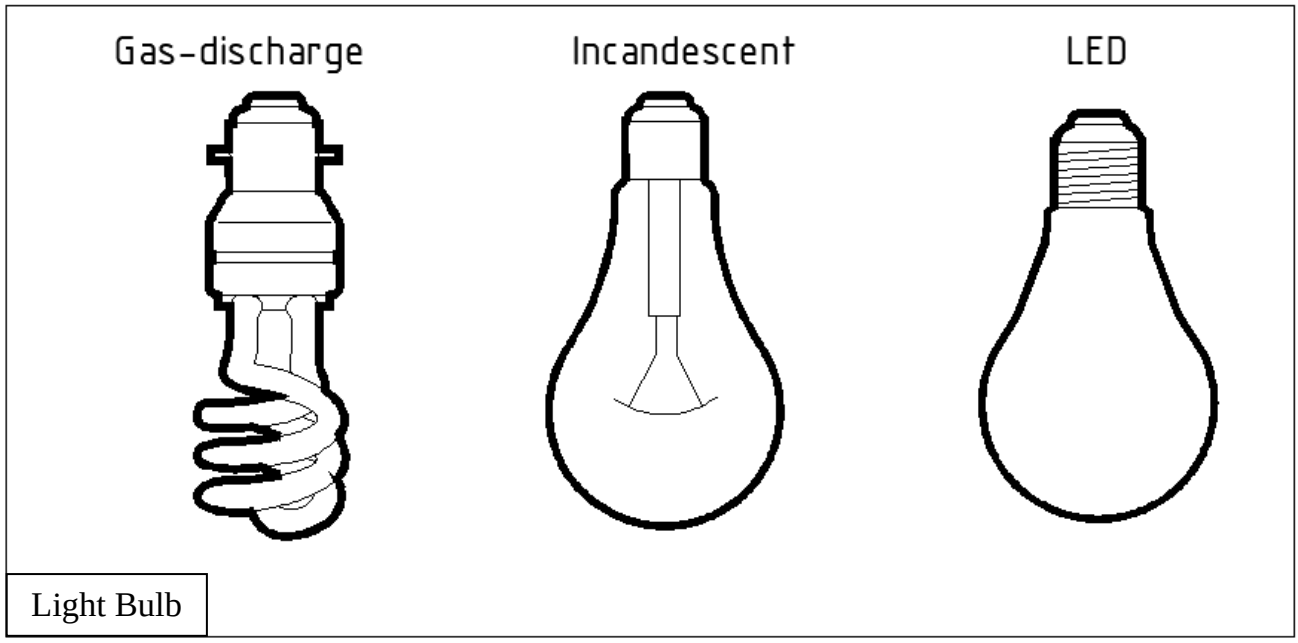
1. Create a new **Page Setup** and name it “Hook”.
2. Change the following settings:
    a. **Printer**: Your current **Windows system printer** or choose **DWF to PDF.pc3**.
    b. **Paper Size**: ISO A3 (420 × 297 mm).
    c. **Plot area:** Window or Layout.
    d. **Plot scale** = 1:1.
    e. **Orientation**: 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.



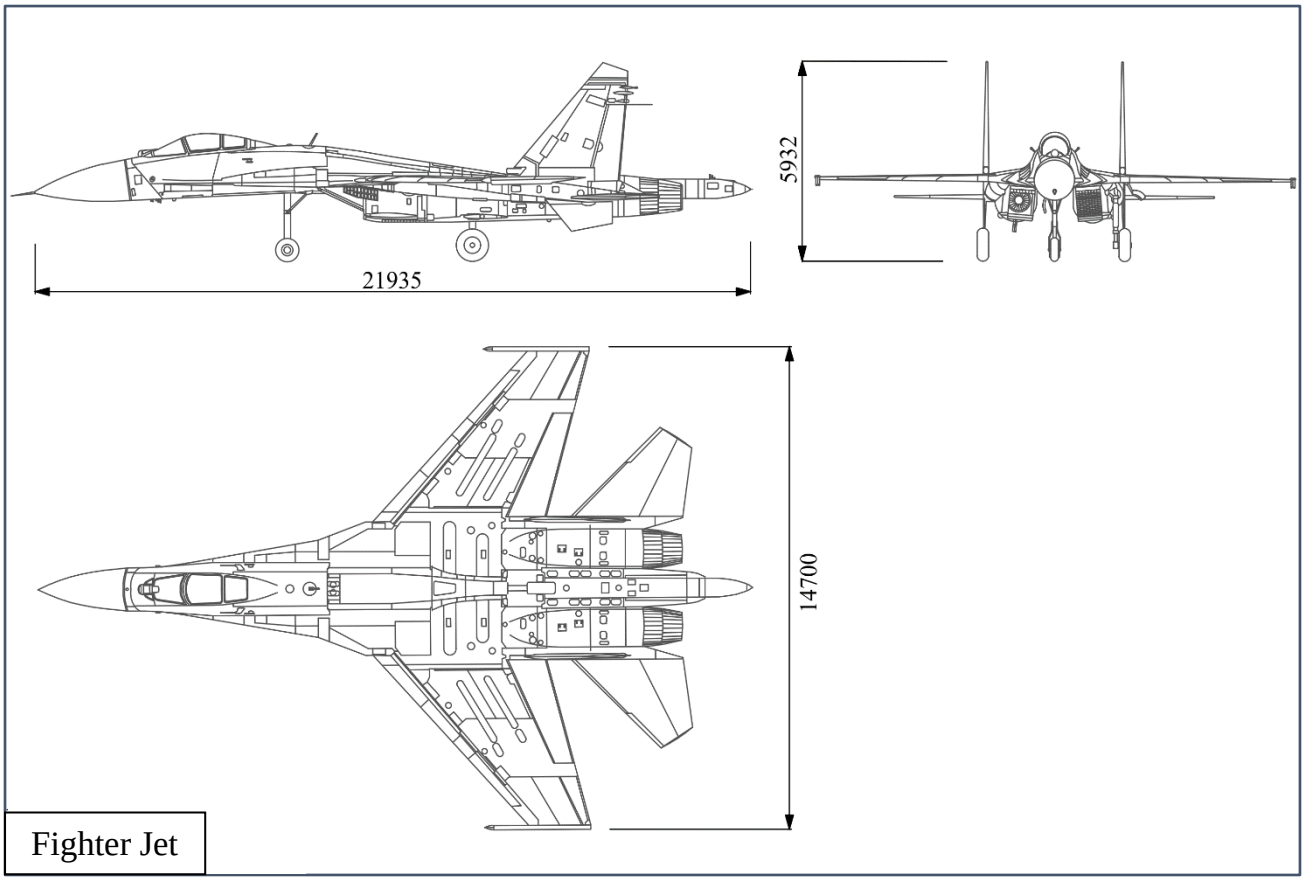
Roundabout Project



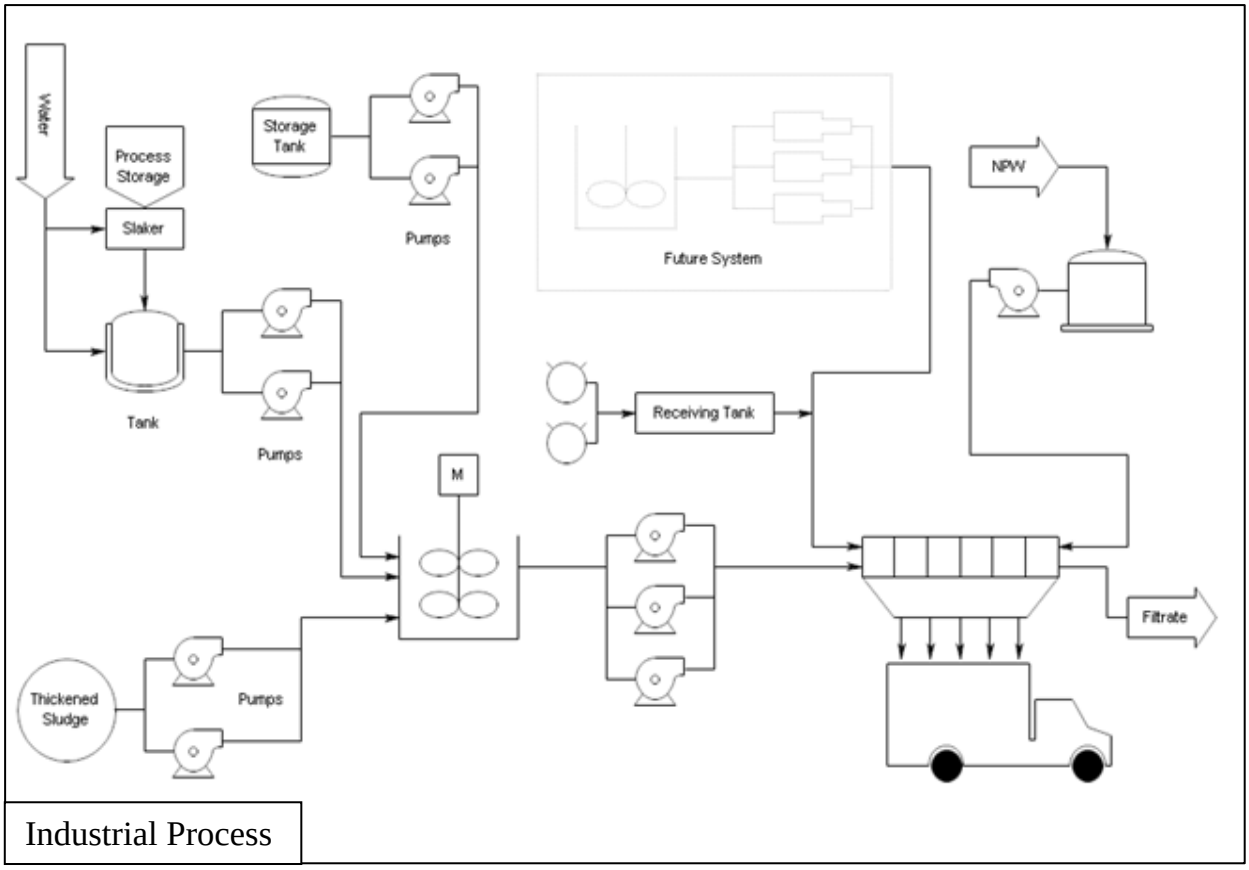
Playground Project



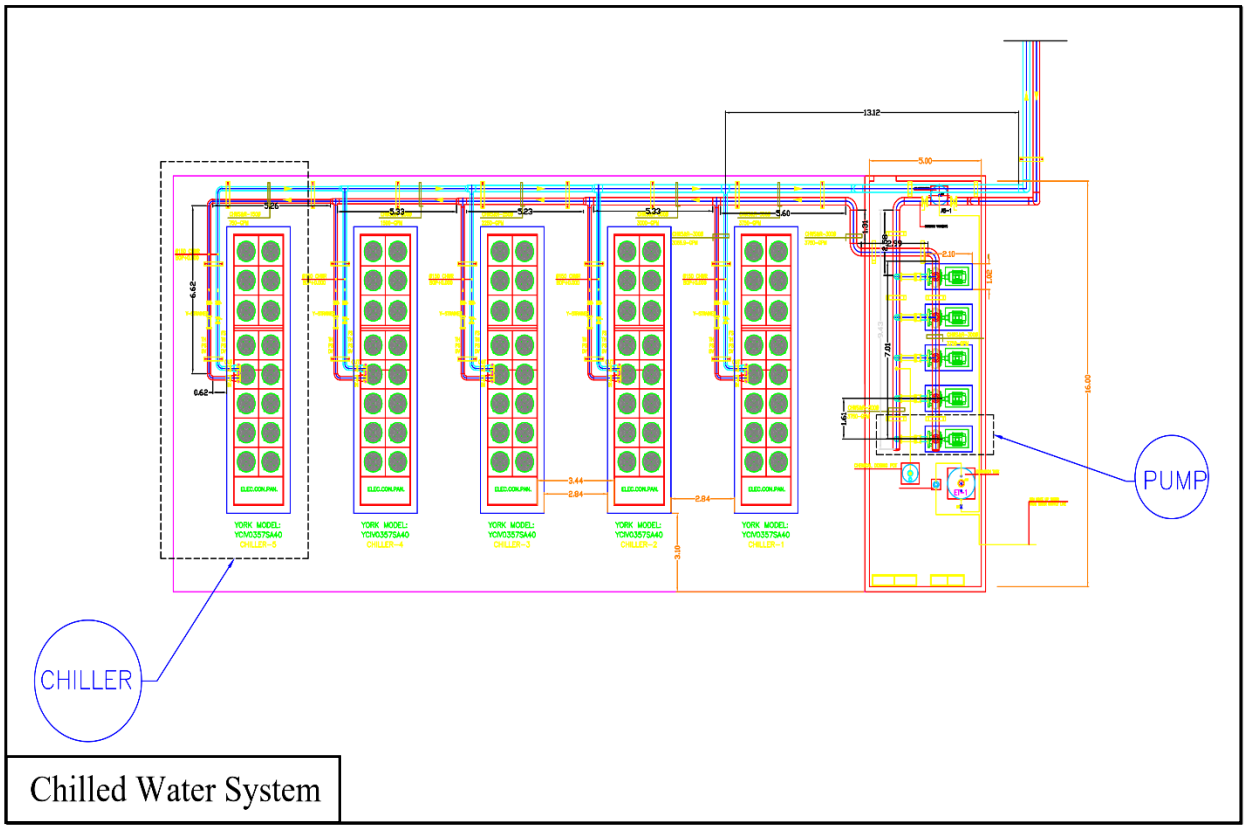
Light Bulb



Fighter Jet



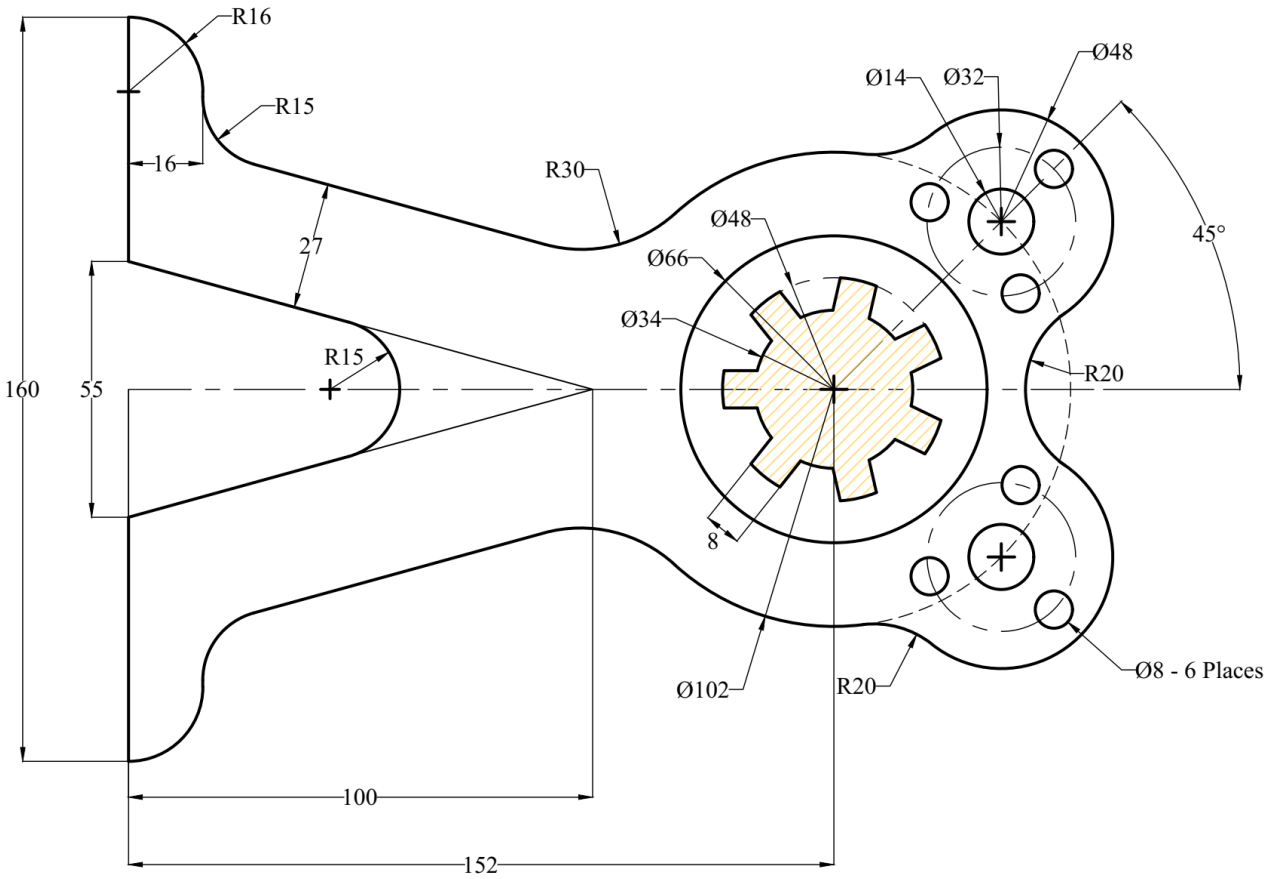
Industrial Process



Chilled Water System

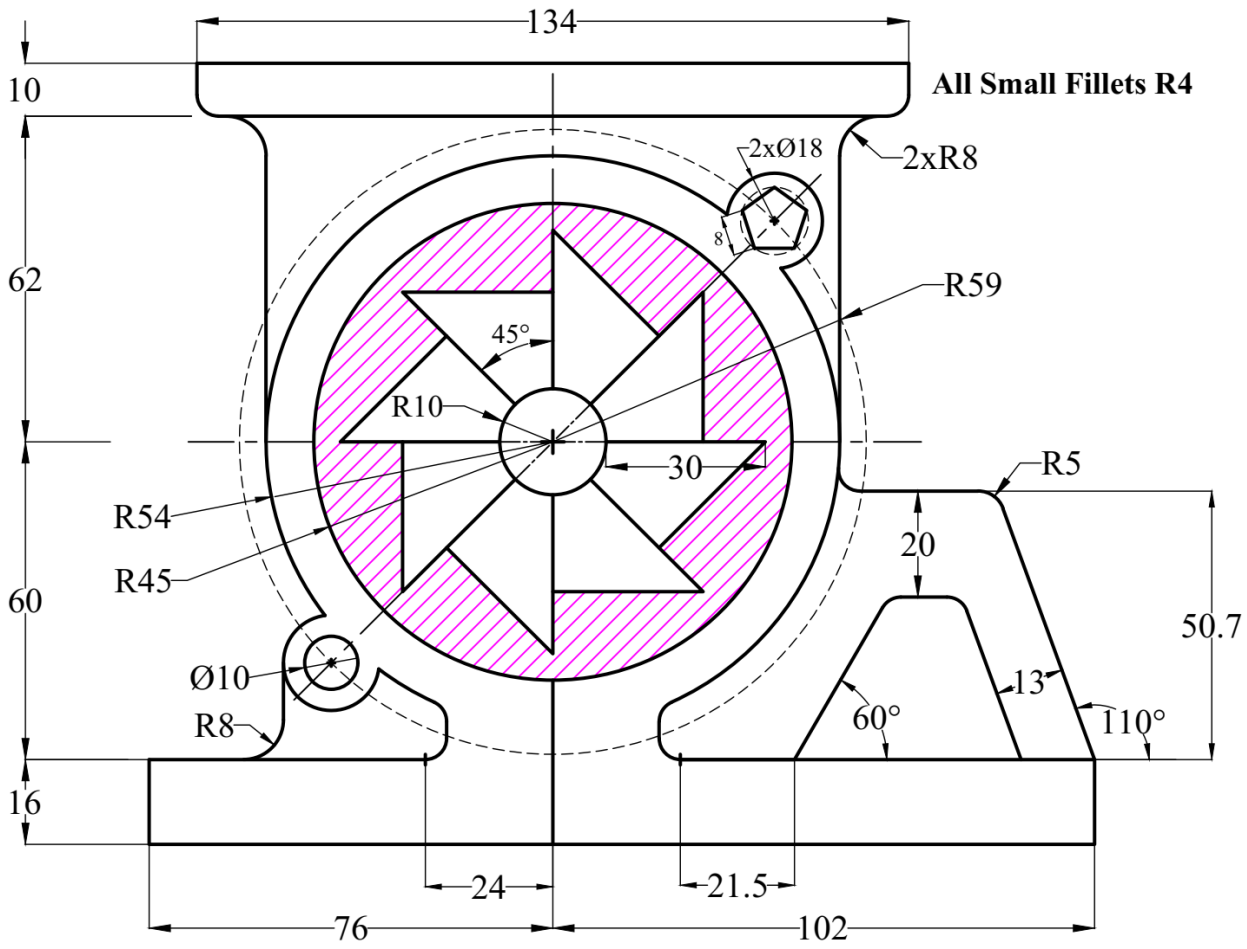
Past Exam (1)

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).



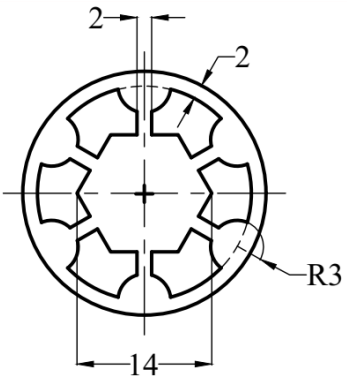
Past Exam (2)

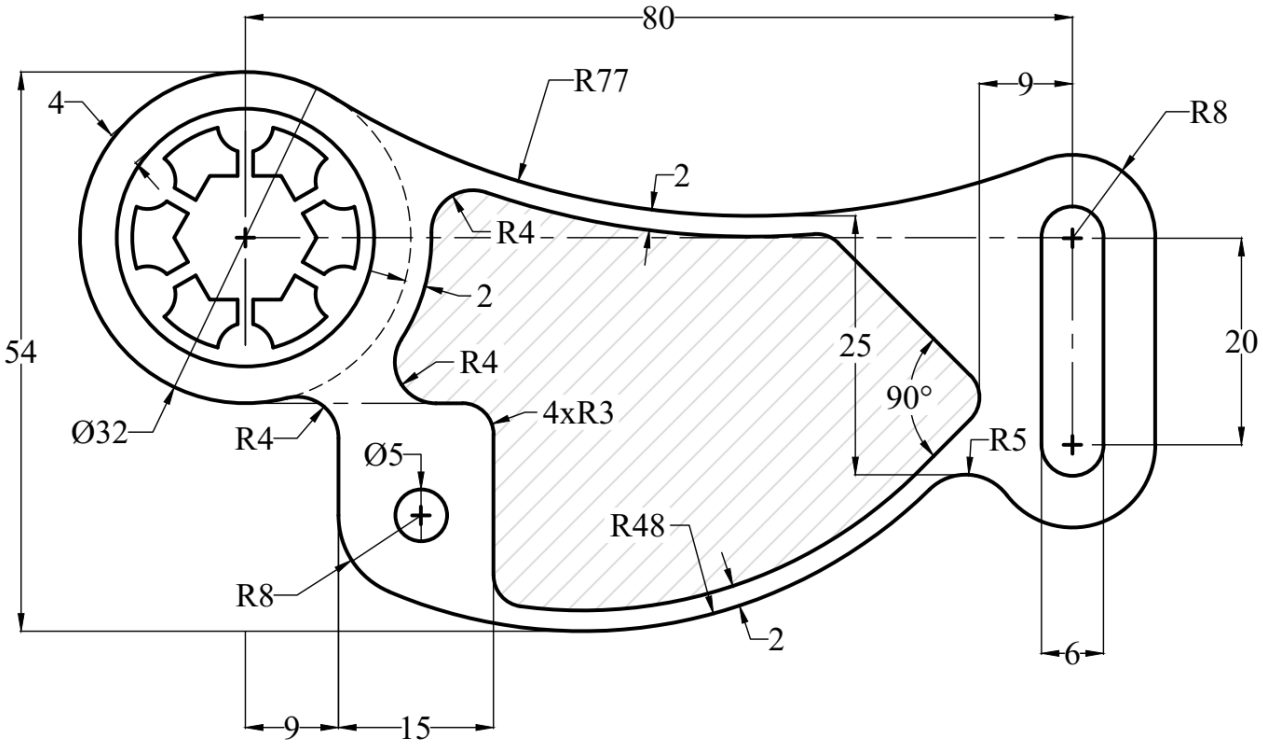
1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.5) and a rotational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



Past Exam (3)

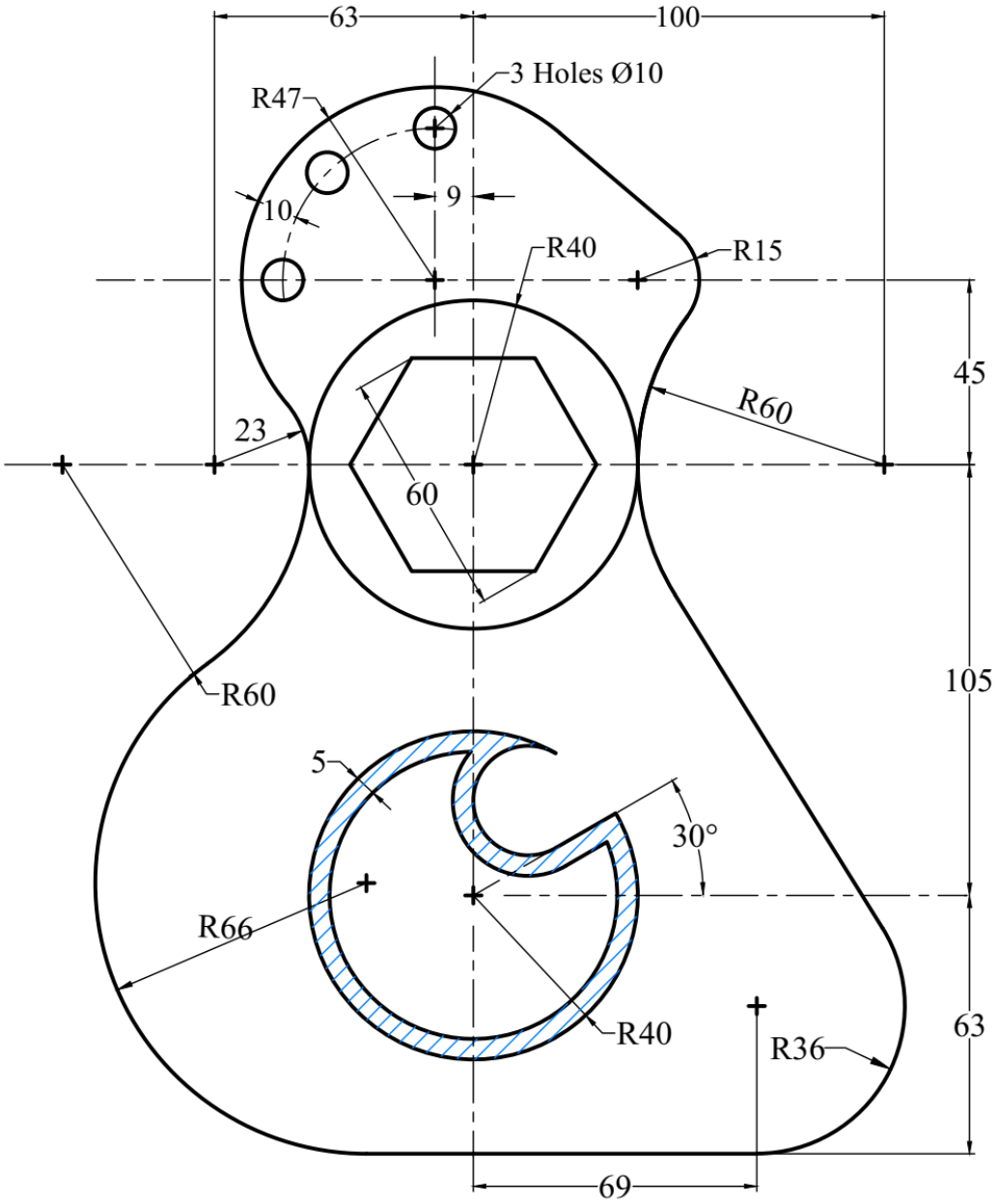
1. Draw the following Figure using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.75) and a rotational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





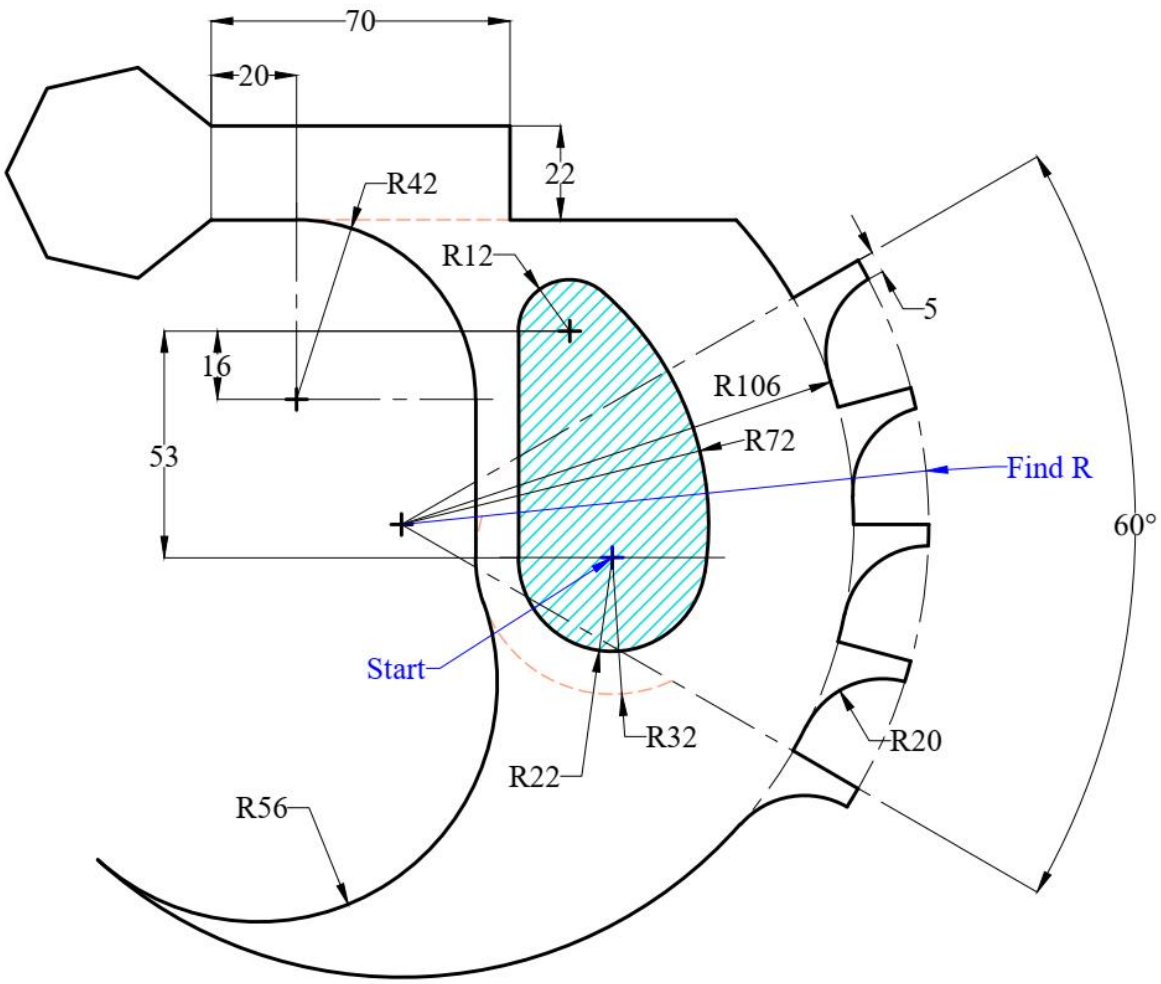
Past Exam (4)

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).



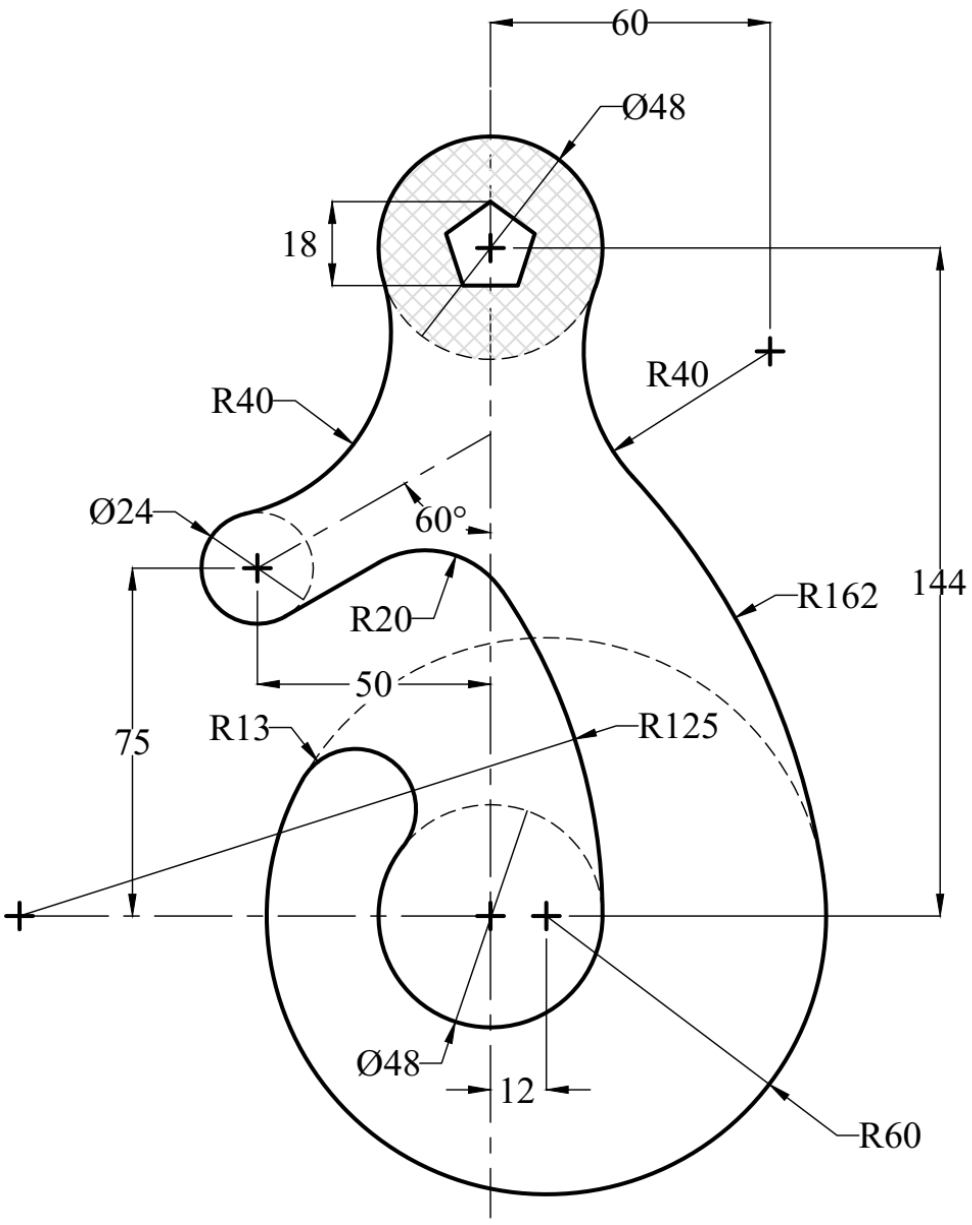
Past Exam (5)

1. Draw the following sectional and frontal views using the appropriate layers.
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).



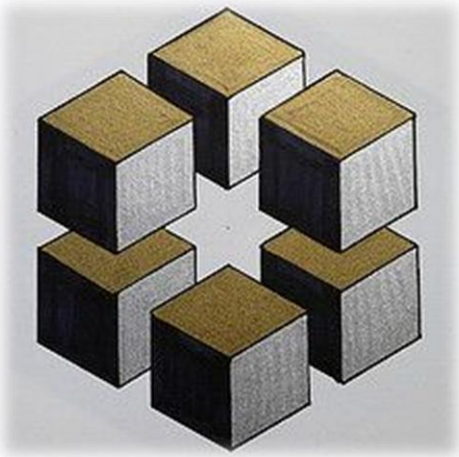
Past Exam (6)

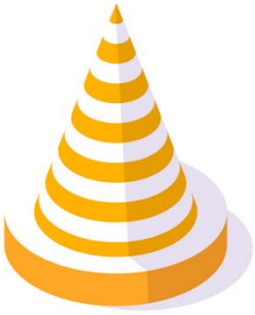
1. Draw the following sectional and frontal views using the appropriate layers.
2. **Hatch** the zone as shown in the Figure.
3. Find the **area** of the hatched zone.
4. Copy the Figure and make it as a block.
5. Put all **dimensions** on the original drawing.
6. Insert the block with a **scale** (0.35)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

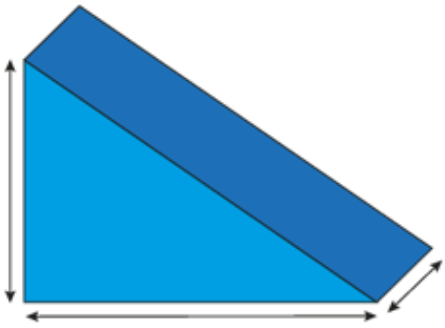


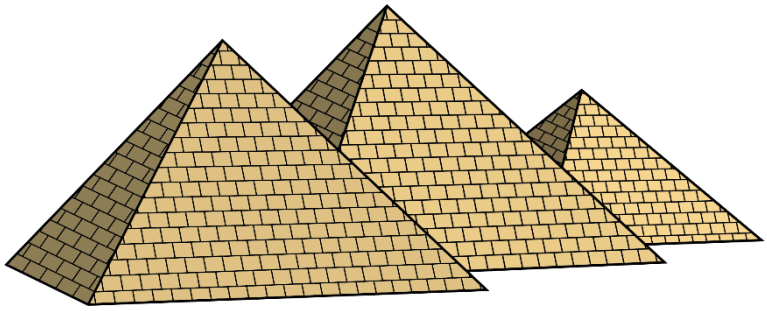
Solids and Universal Coordinates System

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





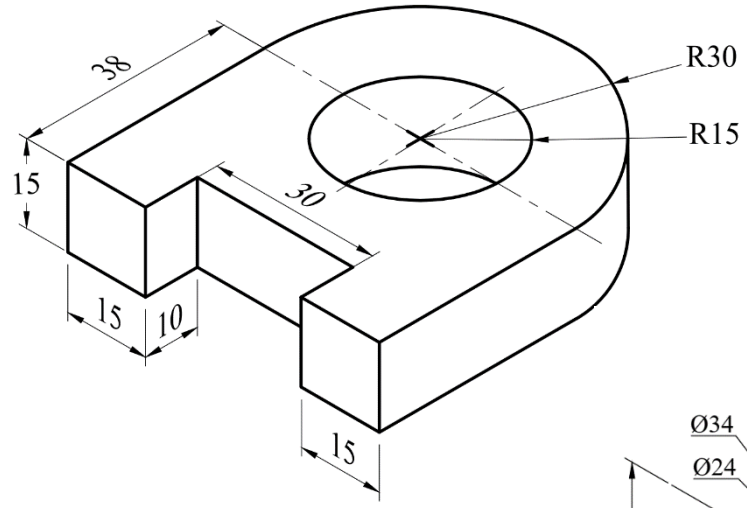




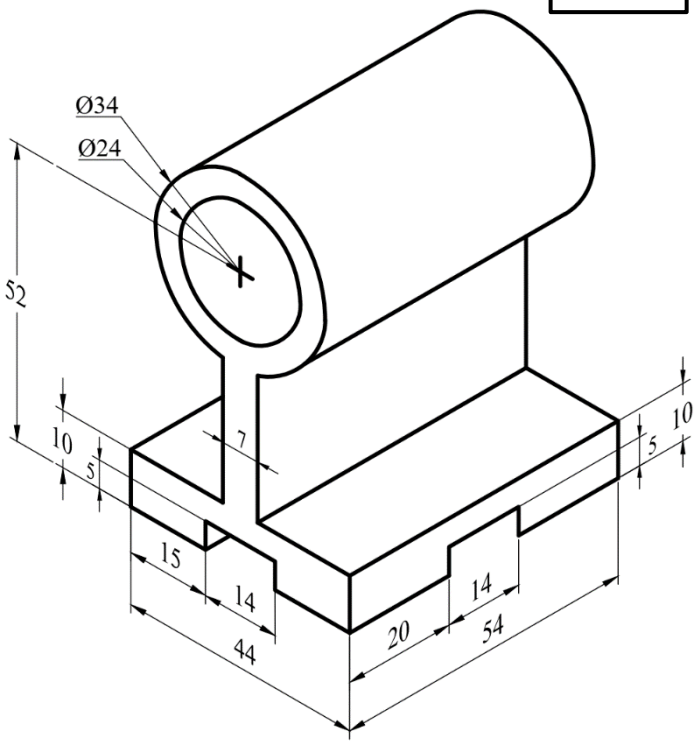
Basic Drawing of 3D Solids

UCS , Extrude , Subtract , and Union

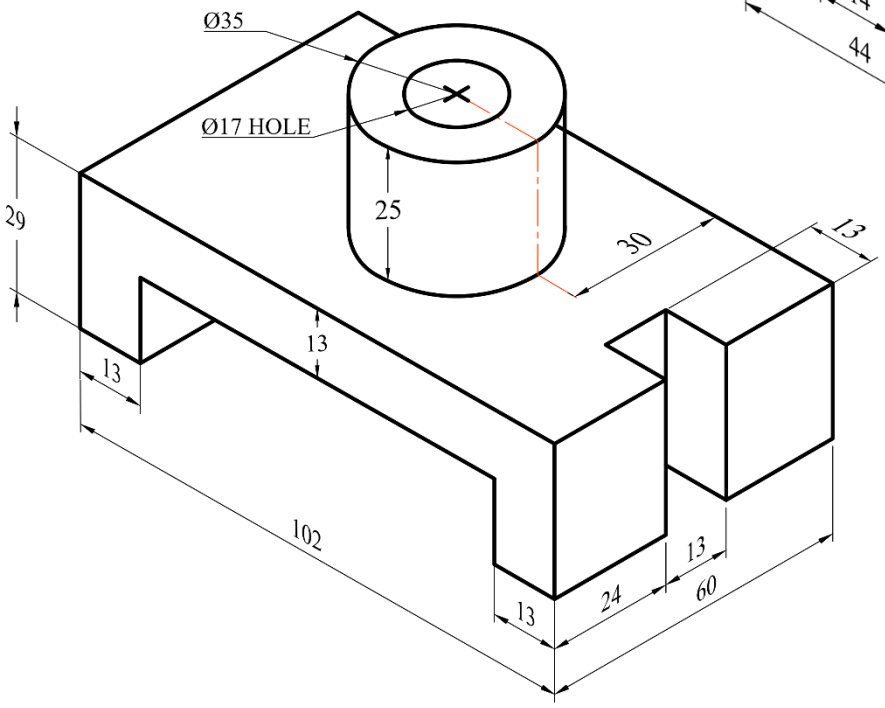
Ex. 1



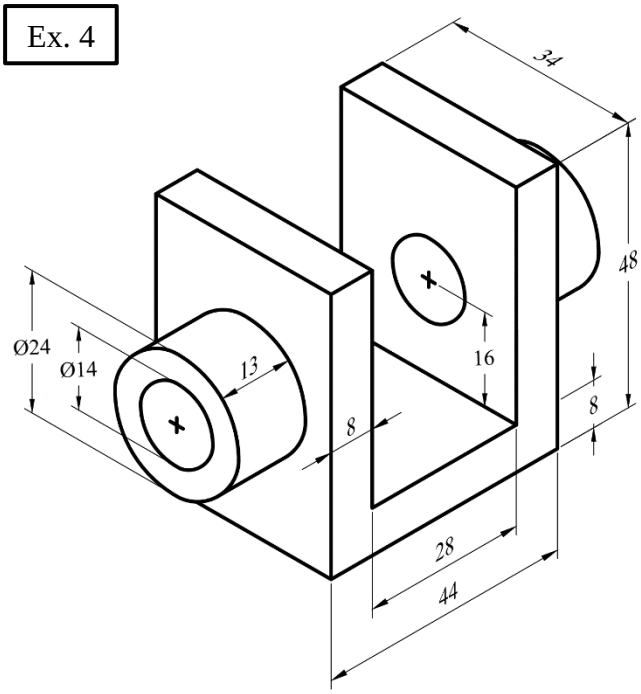
Ex. 2



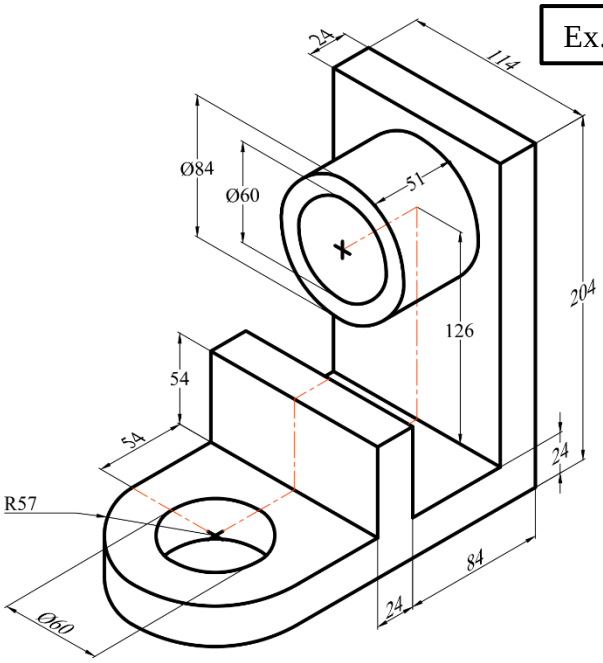
Ex. 3



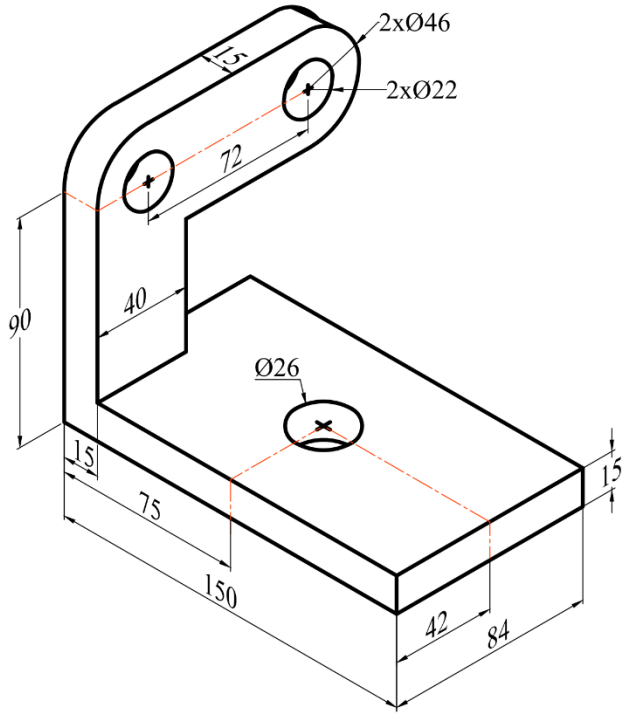
Ex. 4



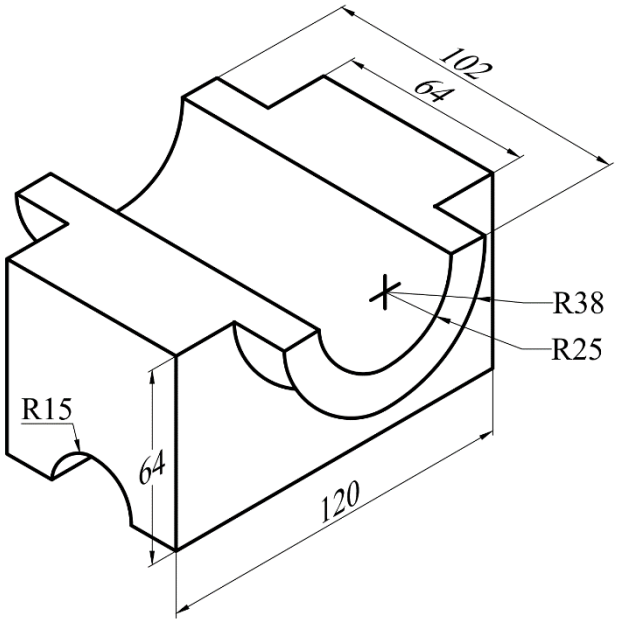
Ex. 5



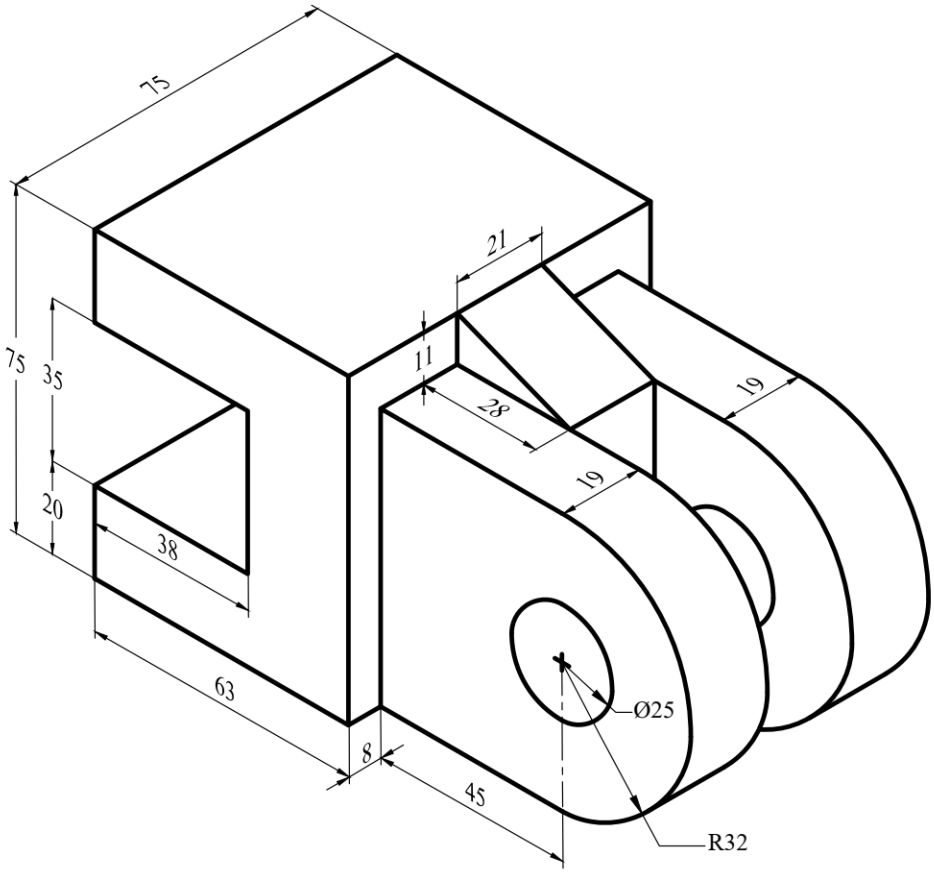
Ex. 6



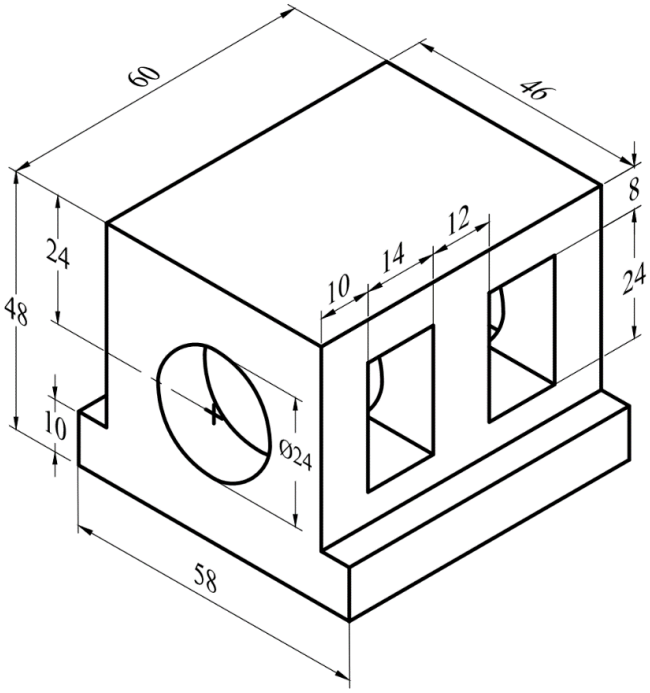
Ex. 7



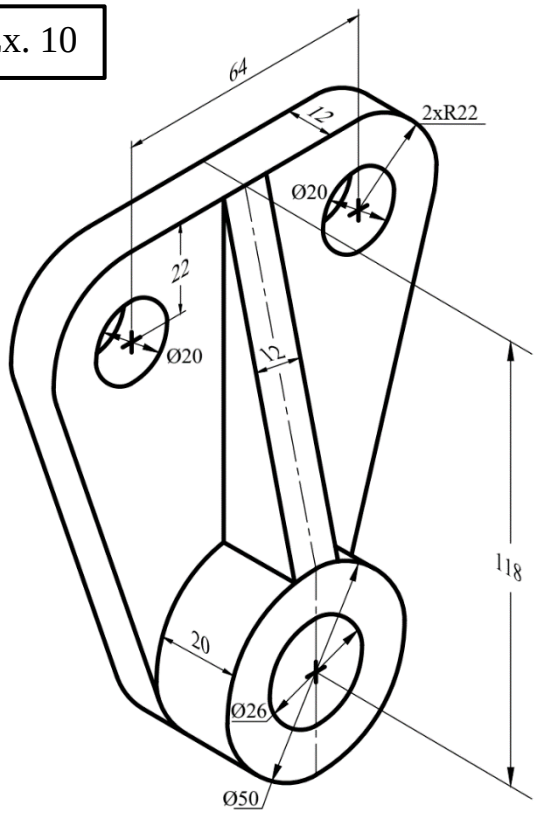
Ex. 8


75
21
75
35
11
28
19
19
20
38
63
8
45
Ø25
R32

Ex. 9

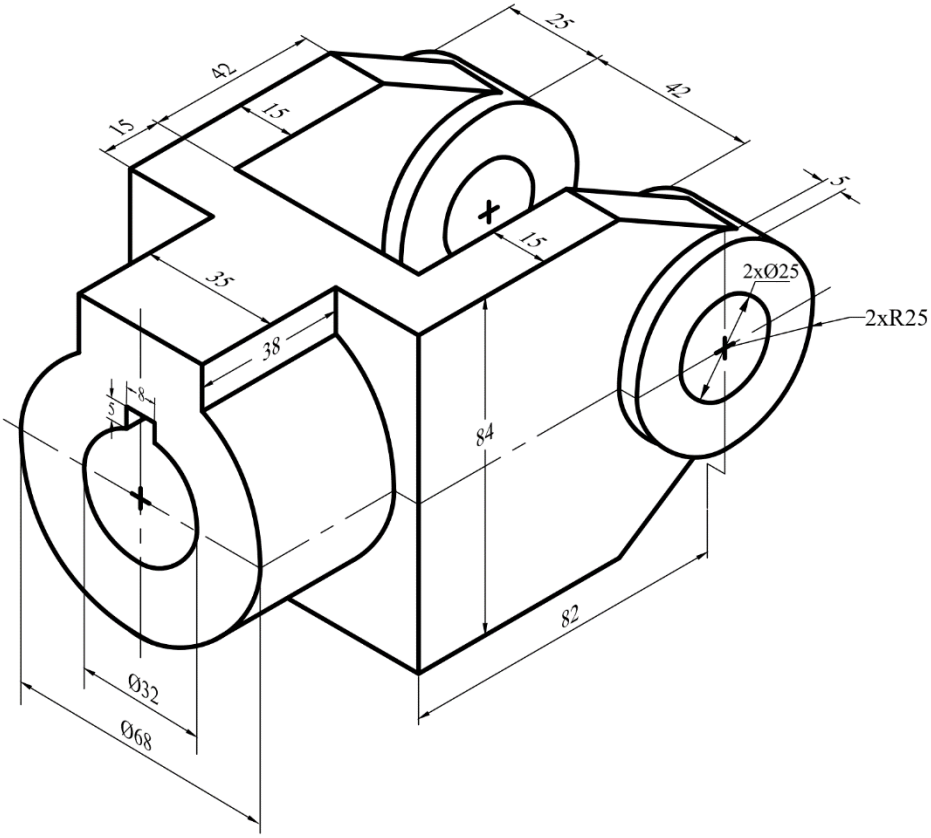

60
46
8
24
48
12
14
10
24
10
Ø24
58

Ex. 10

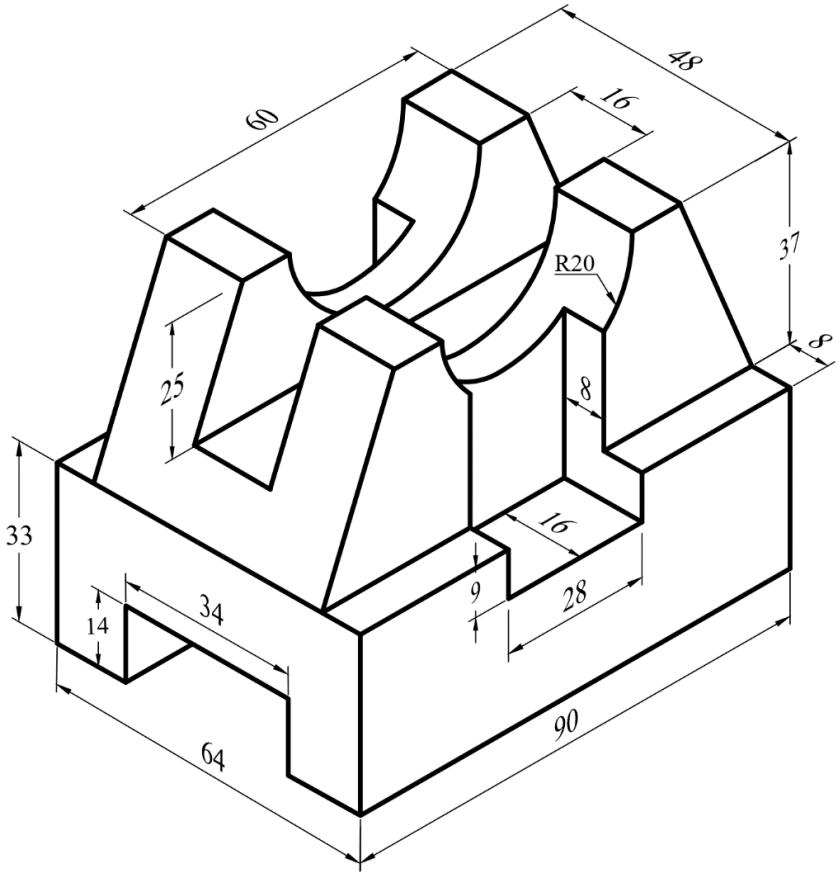

64
12
2xR22
Ø20
22
Ø20
12
118
20
Ø26
Ø50

Creating Solids using Presspull

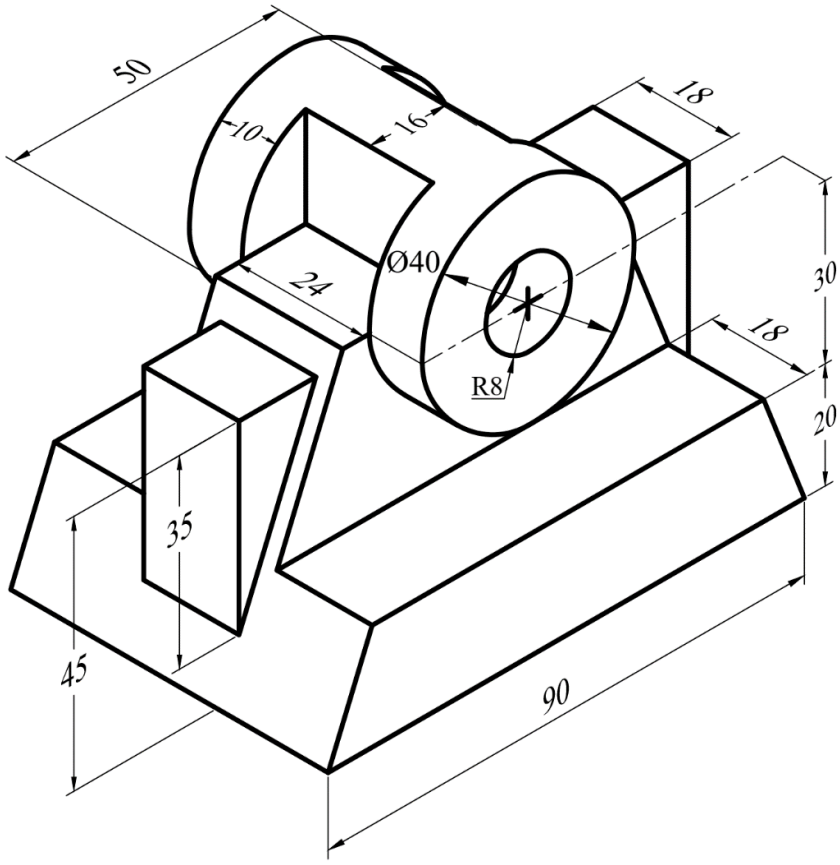
Ex. 1



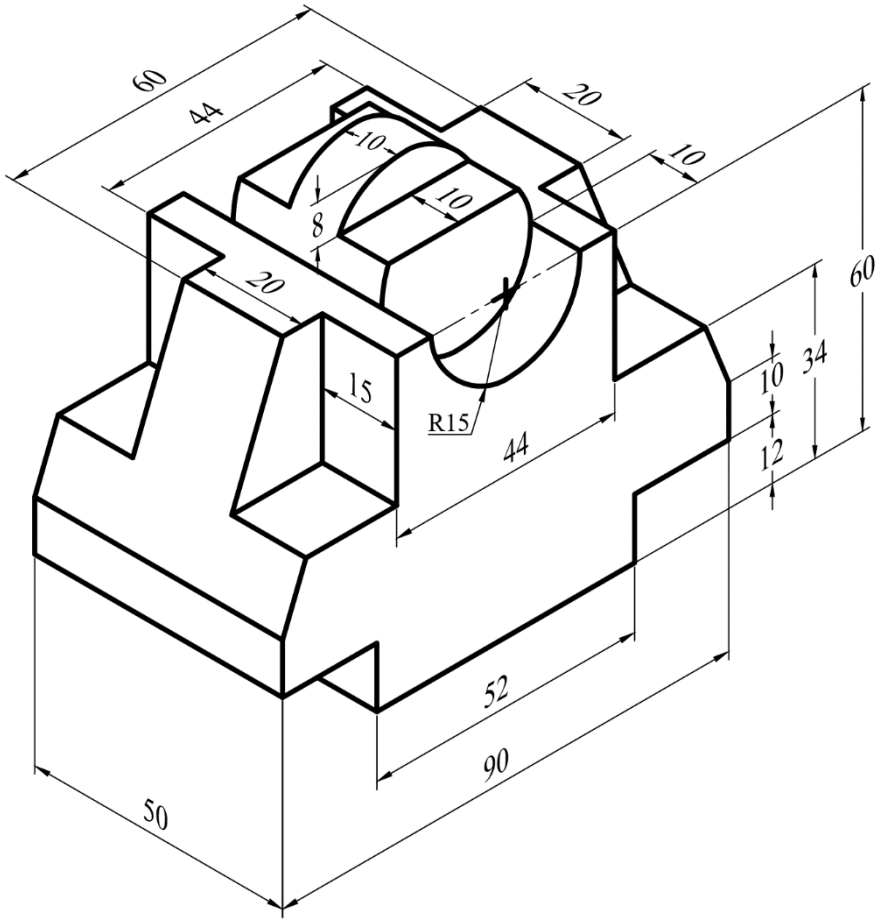
Ex. 2



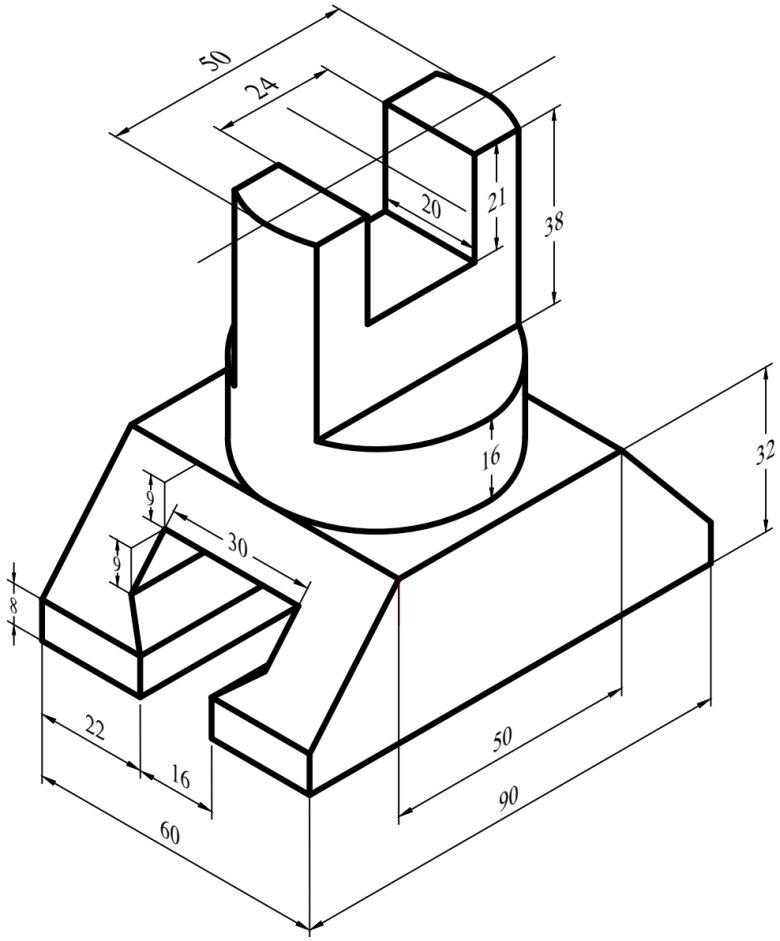
Ex. 3


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

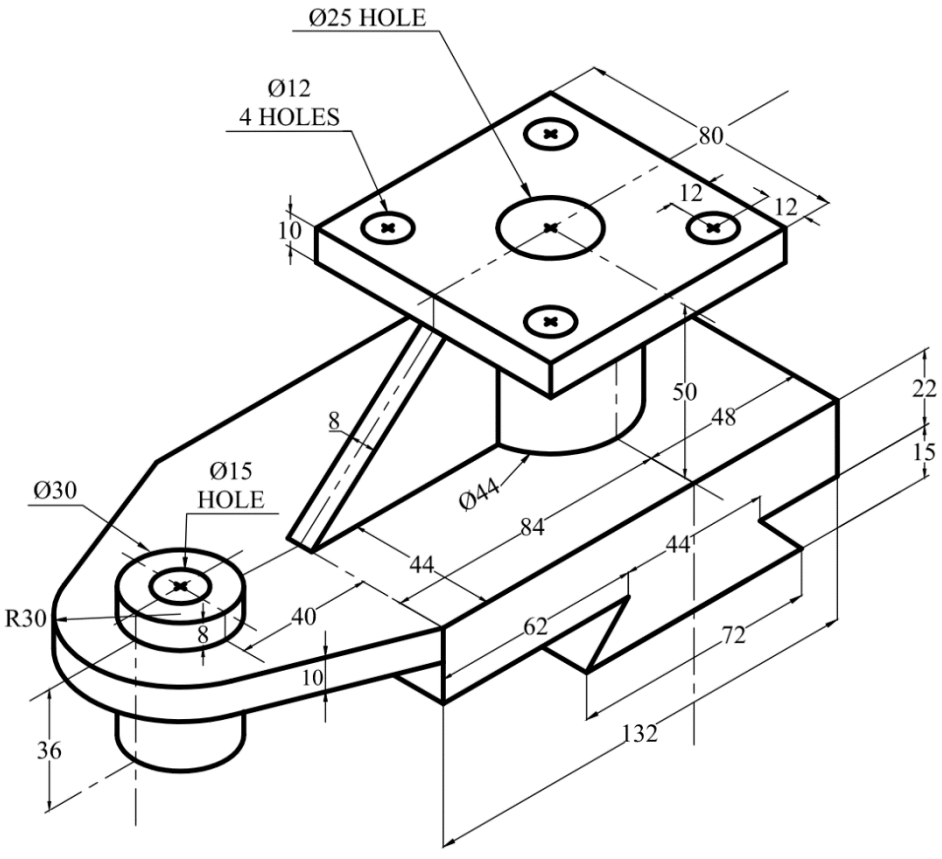
Ex. 4


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

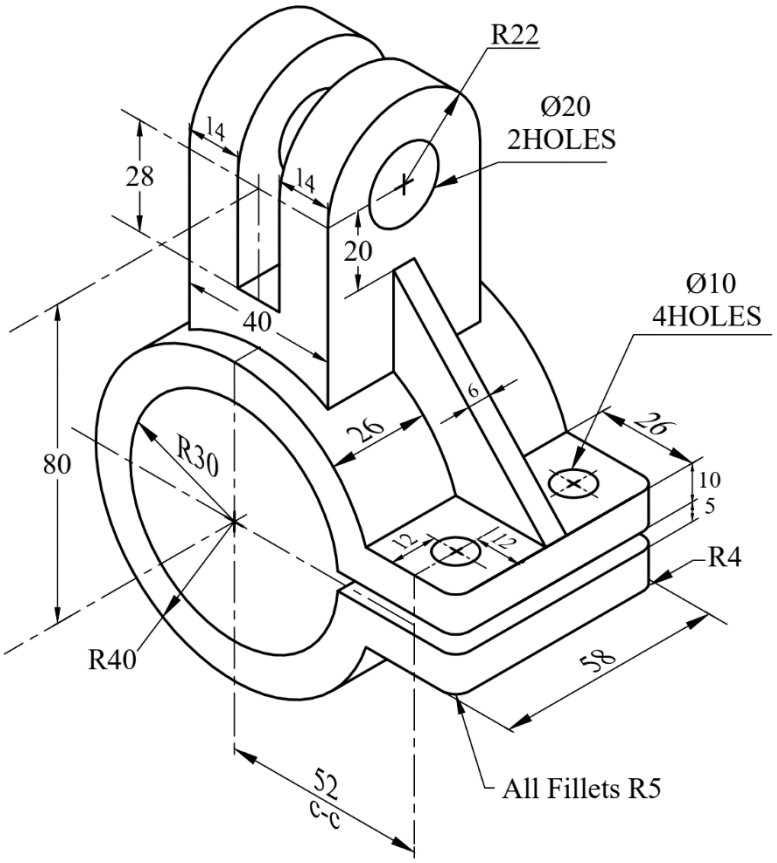
Ex. 5


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

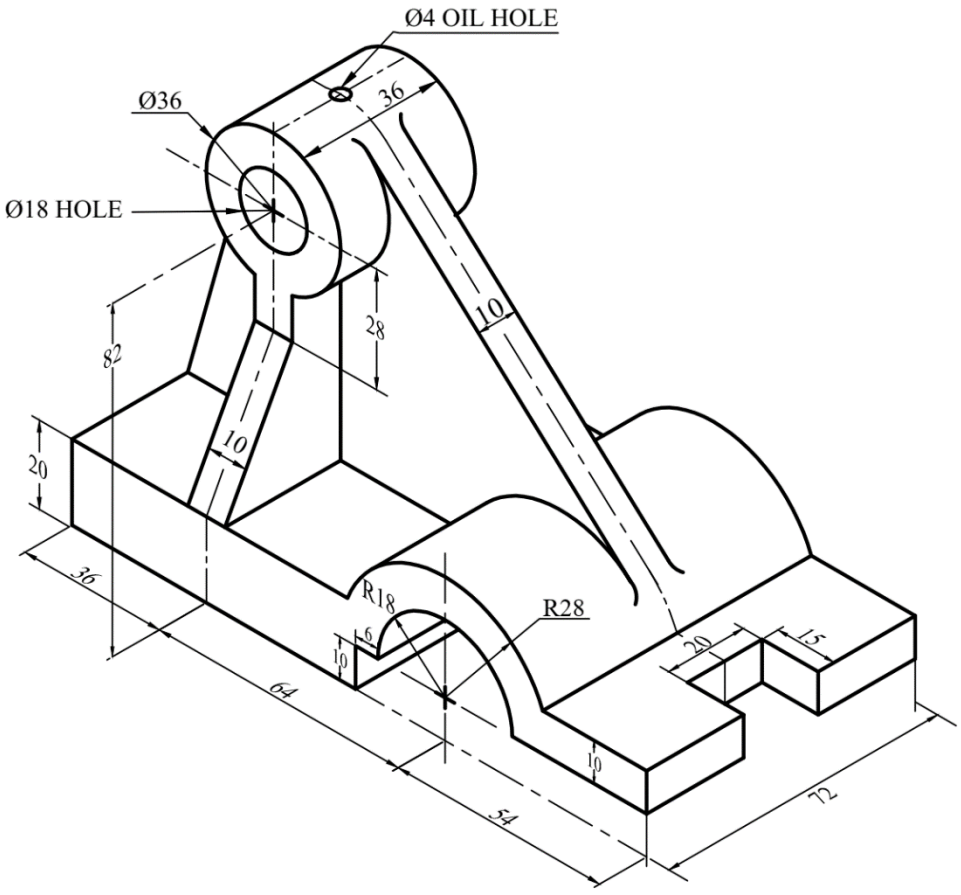
Ex. 6


Ø25 HOLE
Ø12
4 HOLES
80
12
12
10
8
50
48
22
15
Ø44
84
44
44
Ø30
Ø15
HOLE
R30
40
8
62
72
10
36
132

Ex. 7

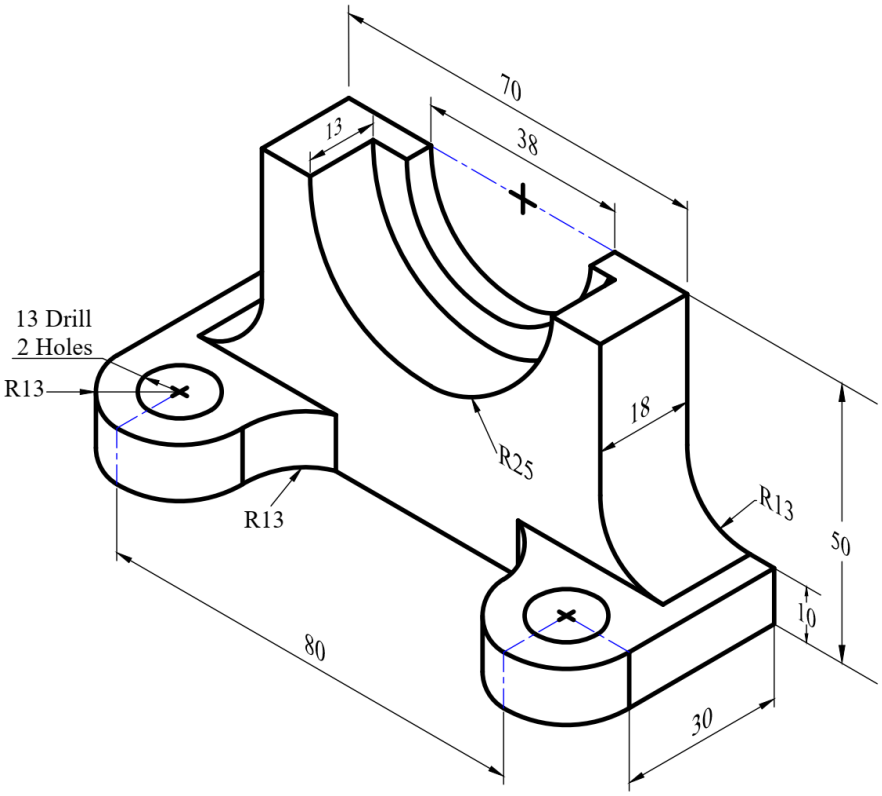

R22
Ø20
2HOLES
Ø10
4HOLES
14
14
28
20
40
80
R30
26
6
26
10
5
12
12
R4
R40
58
52
c-c
All Fillets R5

Ex. 8

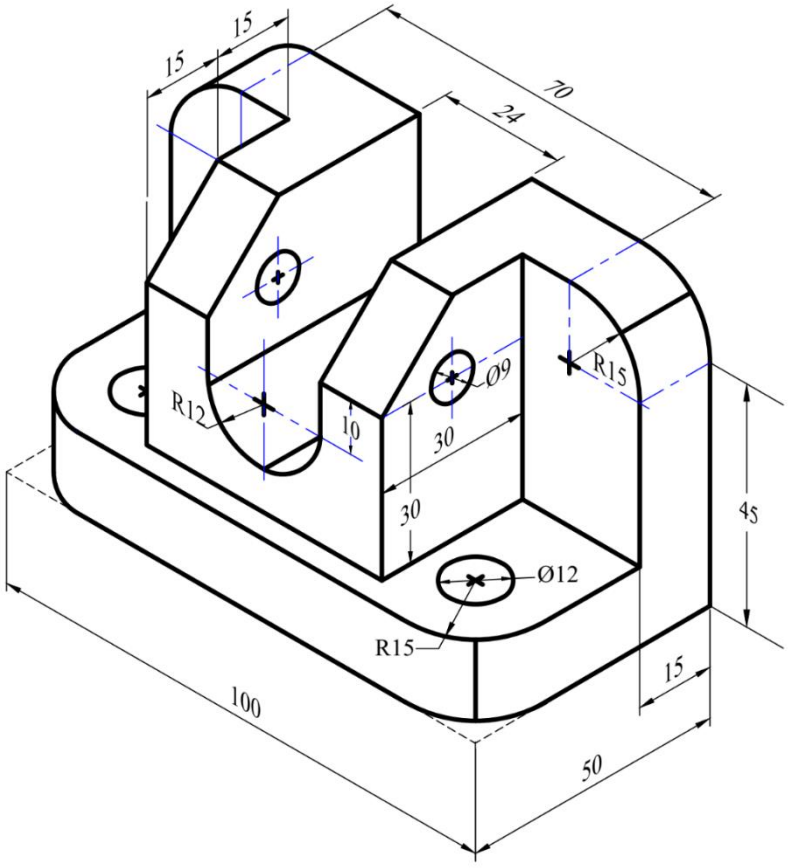

Ø4 OIL HOLE
Ø36
36
Ø18 HOLE
28
10
82
10
20
36
R18
R28
6
10
20
15
64
10
54
72

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

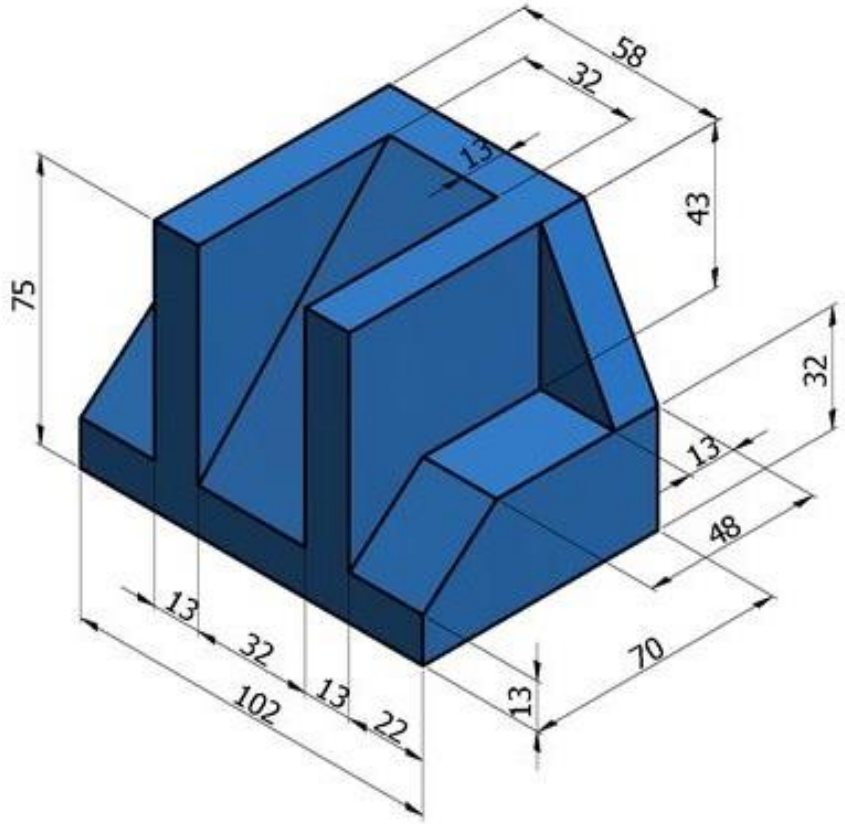
Ex. 1



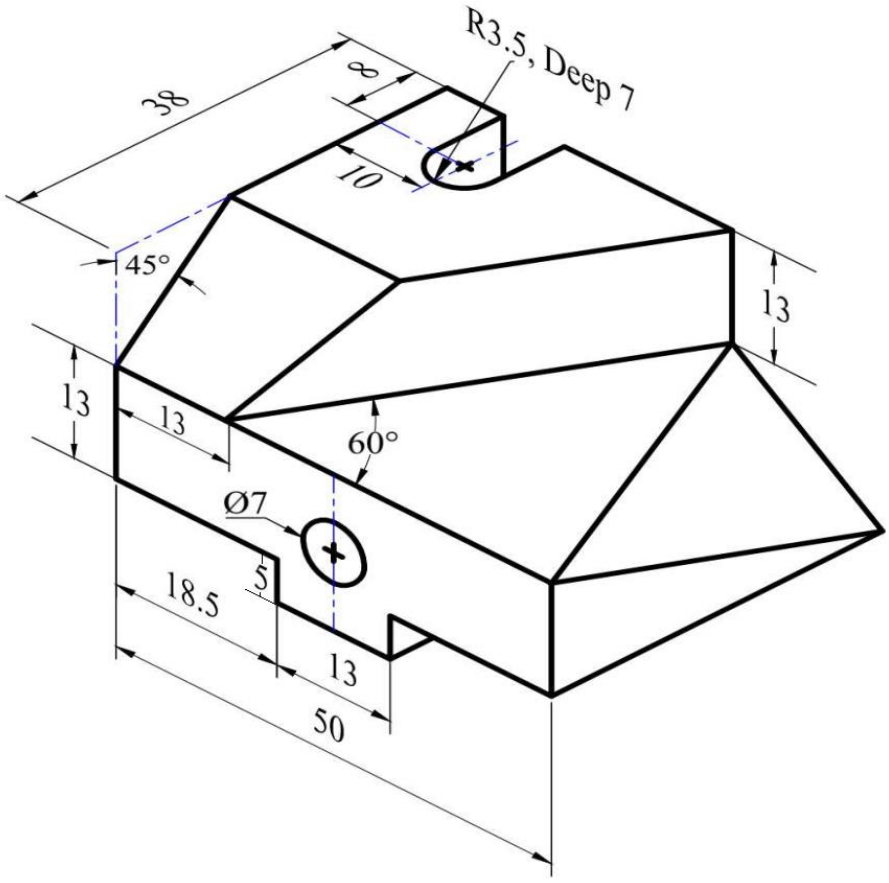
Ex. 2



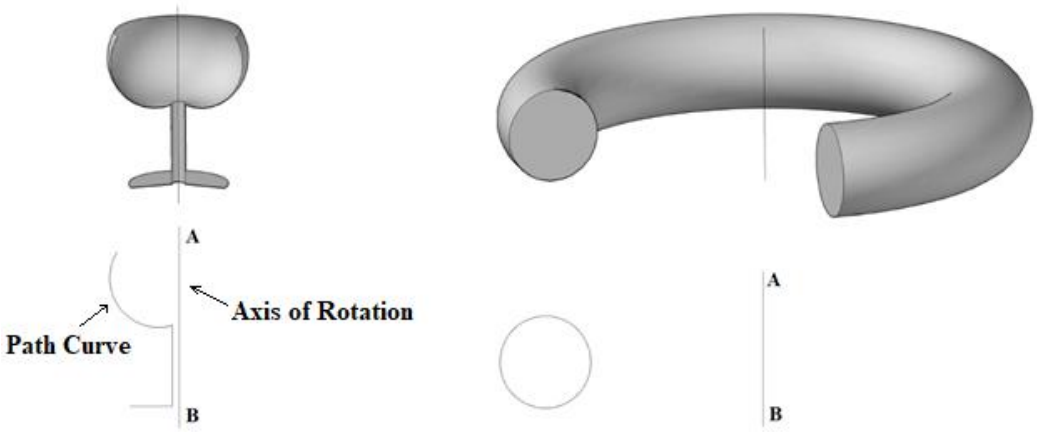
Ex. 3


58
32
13
43
75
32
13
48
13
32
13
22
102
13
70

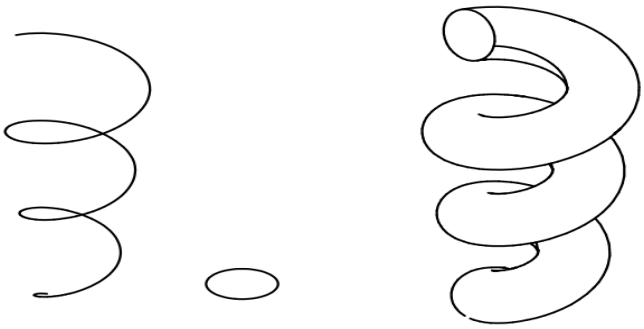
Ex. 4


R3.5, Deep 7
8
38
10
45°
13
13
13
60°
Ø7
5
18.5
13
50

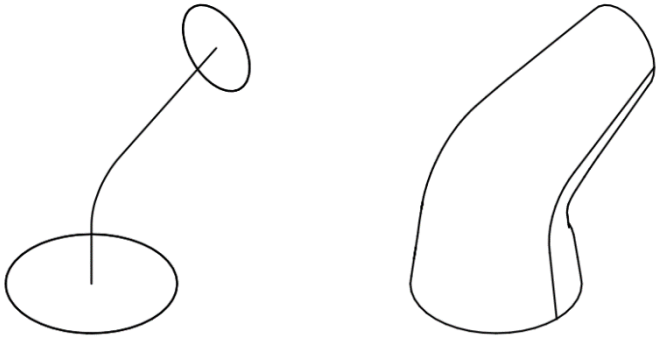
Revolve



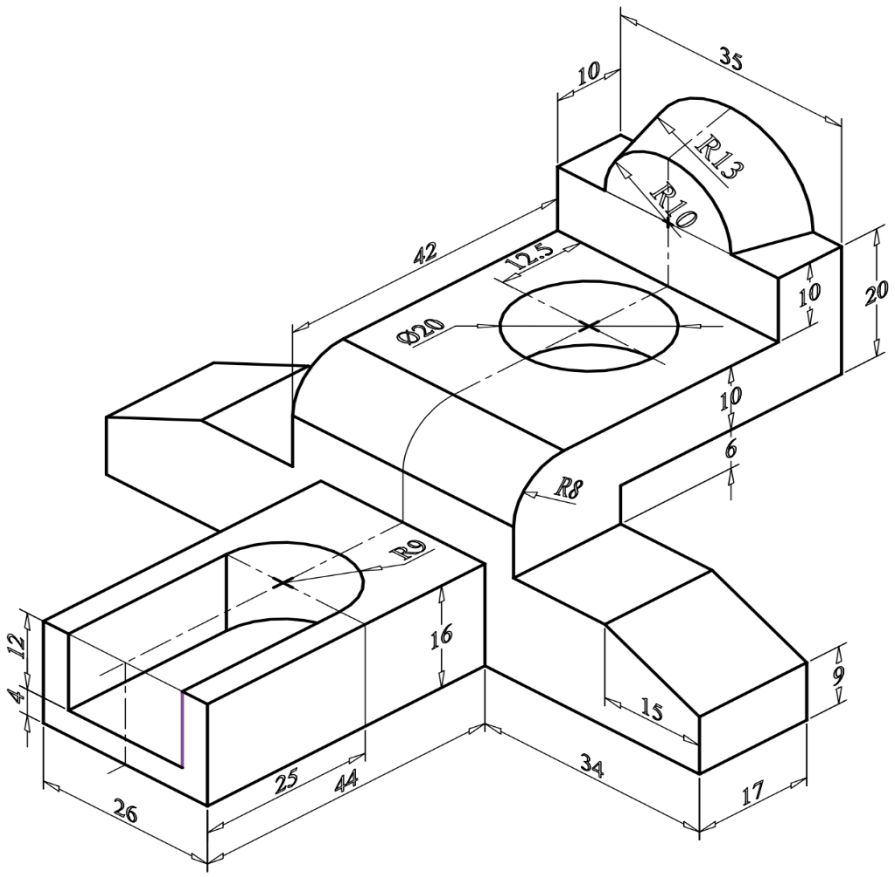
Sweep



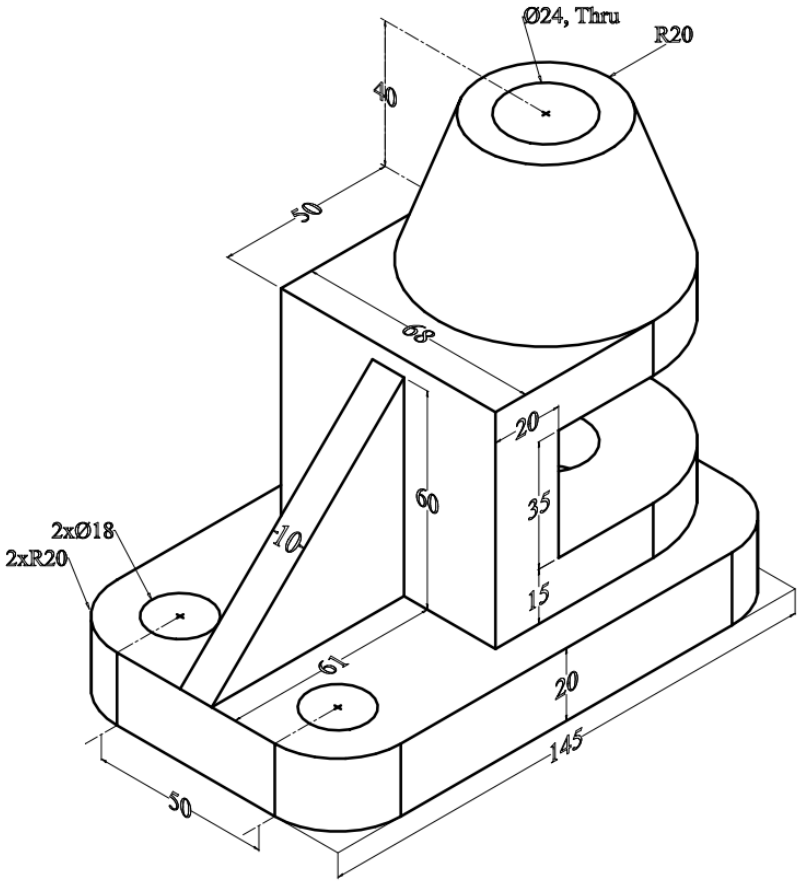
Loft



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

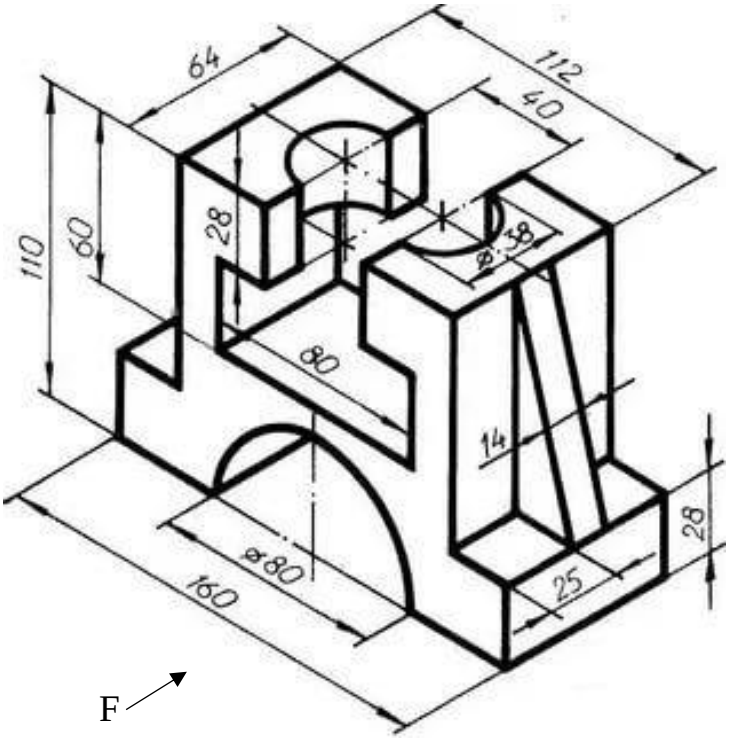
Ex. 2


Ø24, Thru
R20
40
50
60
20
35
15
2xØ18
2xR20
10
61
20
145
50

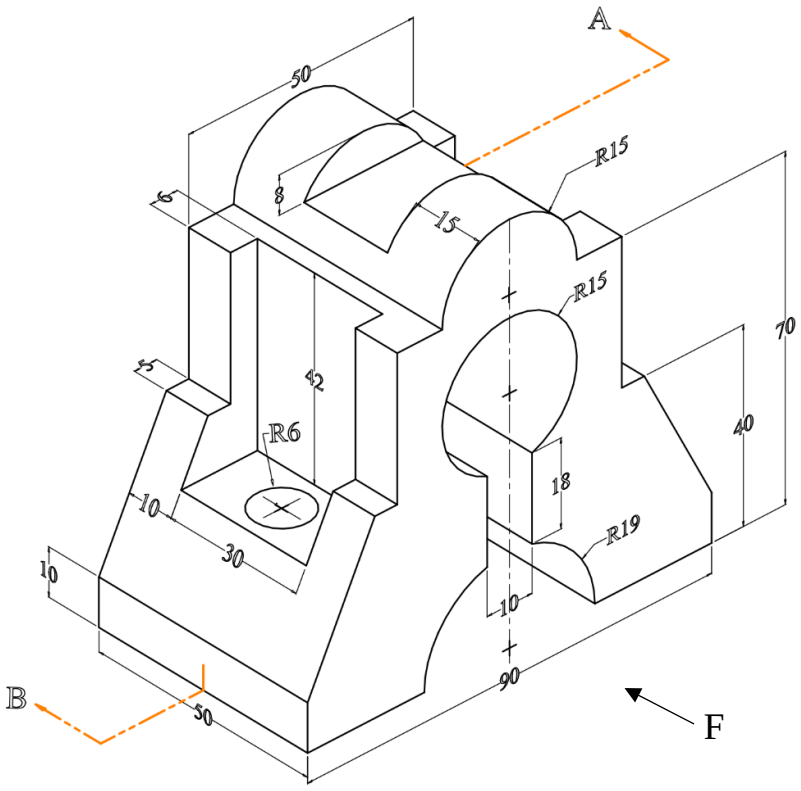
Sectioning and Hatching

Draw the following 3D solid, make a **copy** of the object then make a **full sectional front** view.

Ex. 1



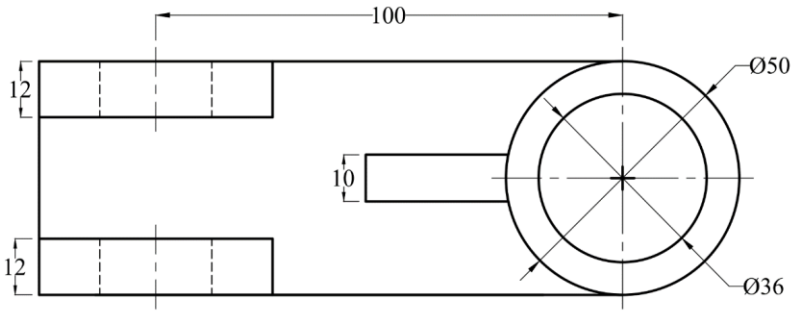
Ex. 2



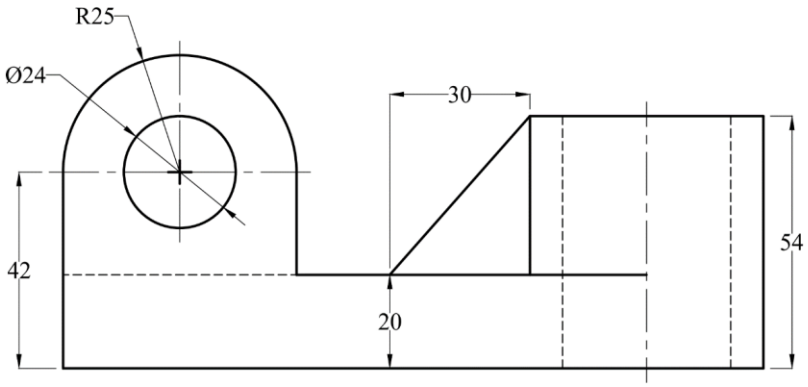
Isometric Drawing

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

Ex. 1

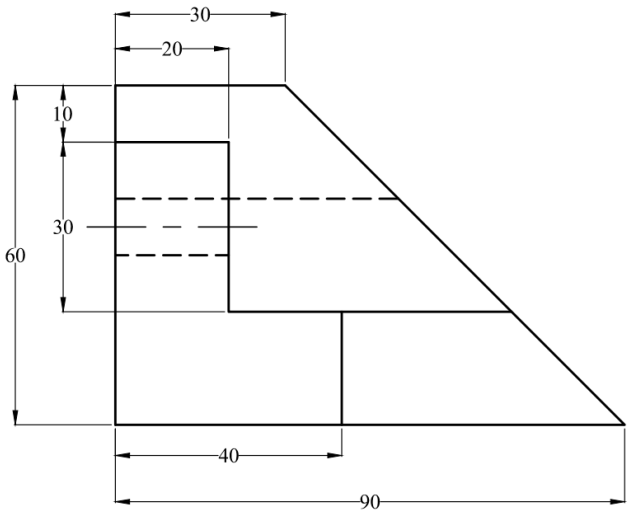


Top View

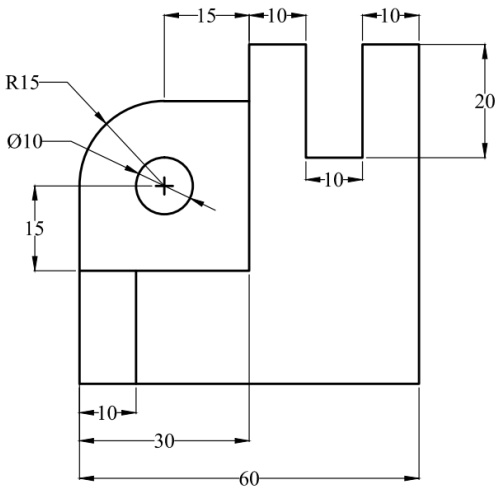


Front View

Ex. 2

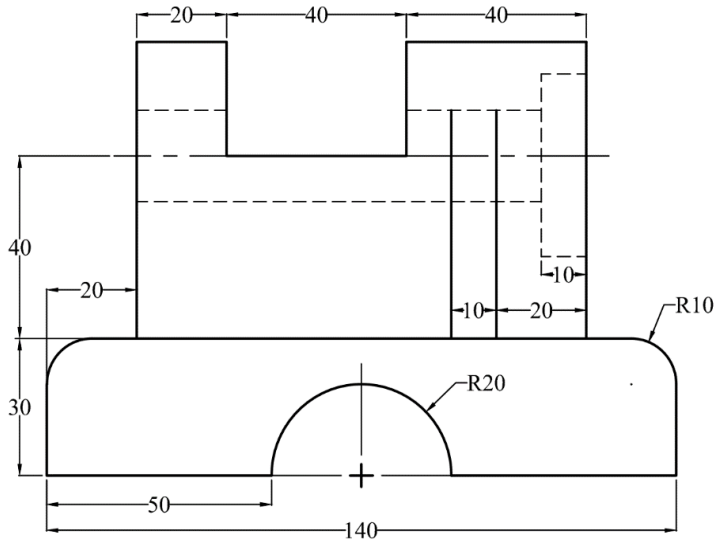


Front View

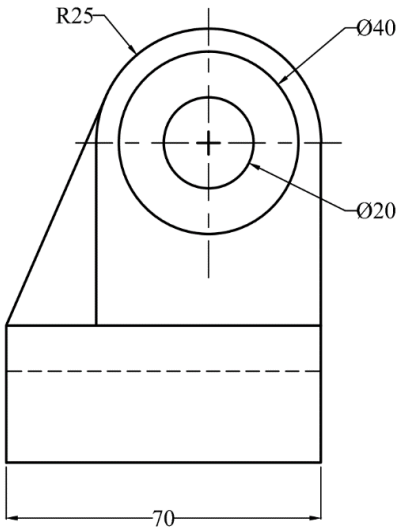


Right Side View

Ex. 3

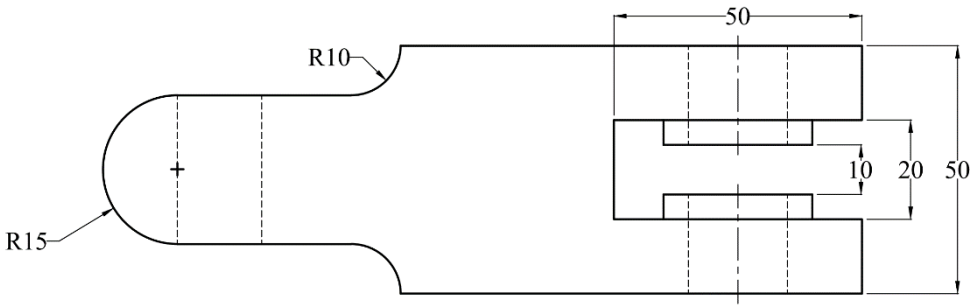


Left Side

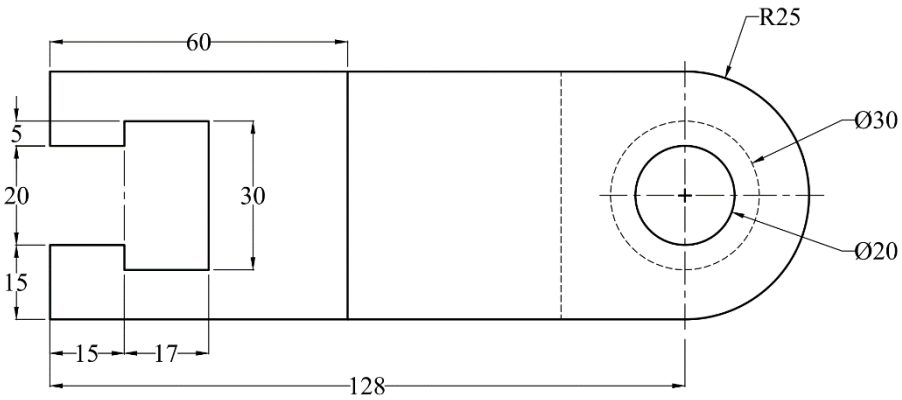


Front View

Ex. 4

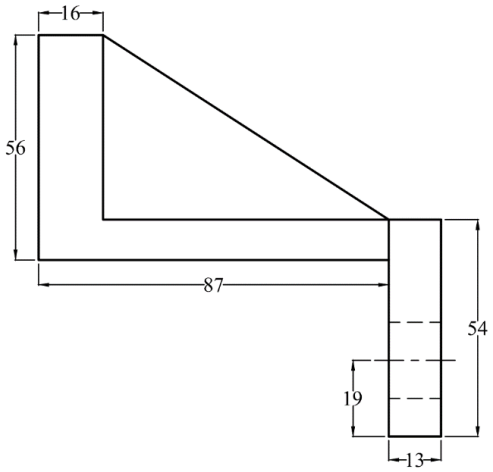


Top View

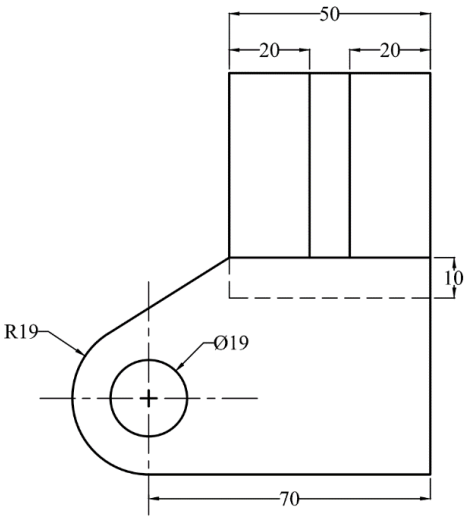


Front View

Ex. 5

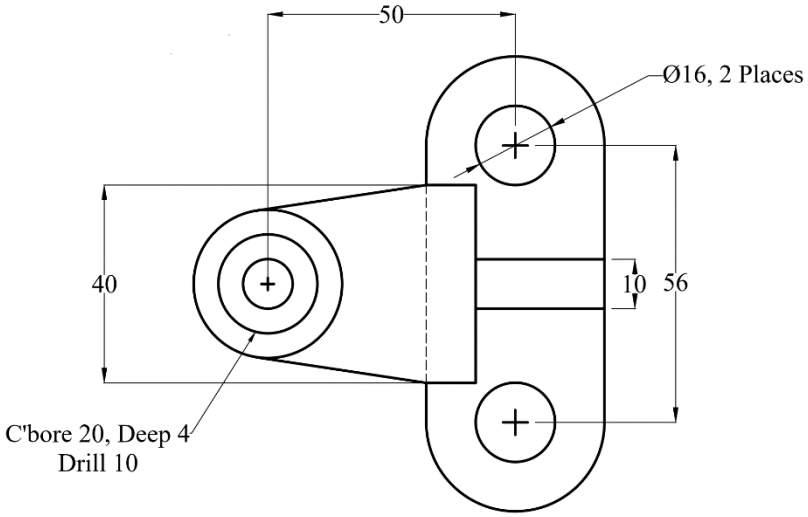


Front View

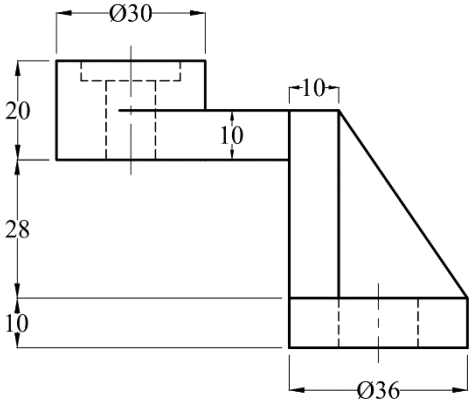


Right Side View

Ex. 6



Top View



Front View

Past Exam (1)

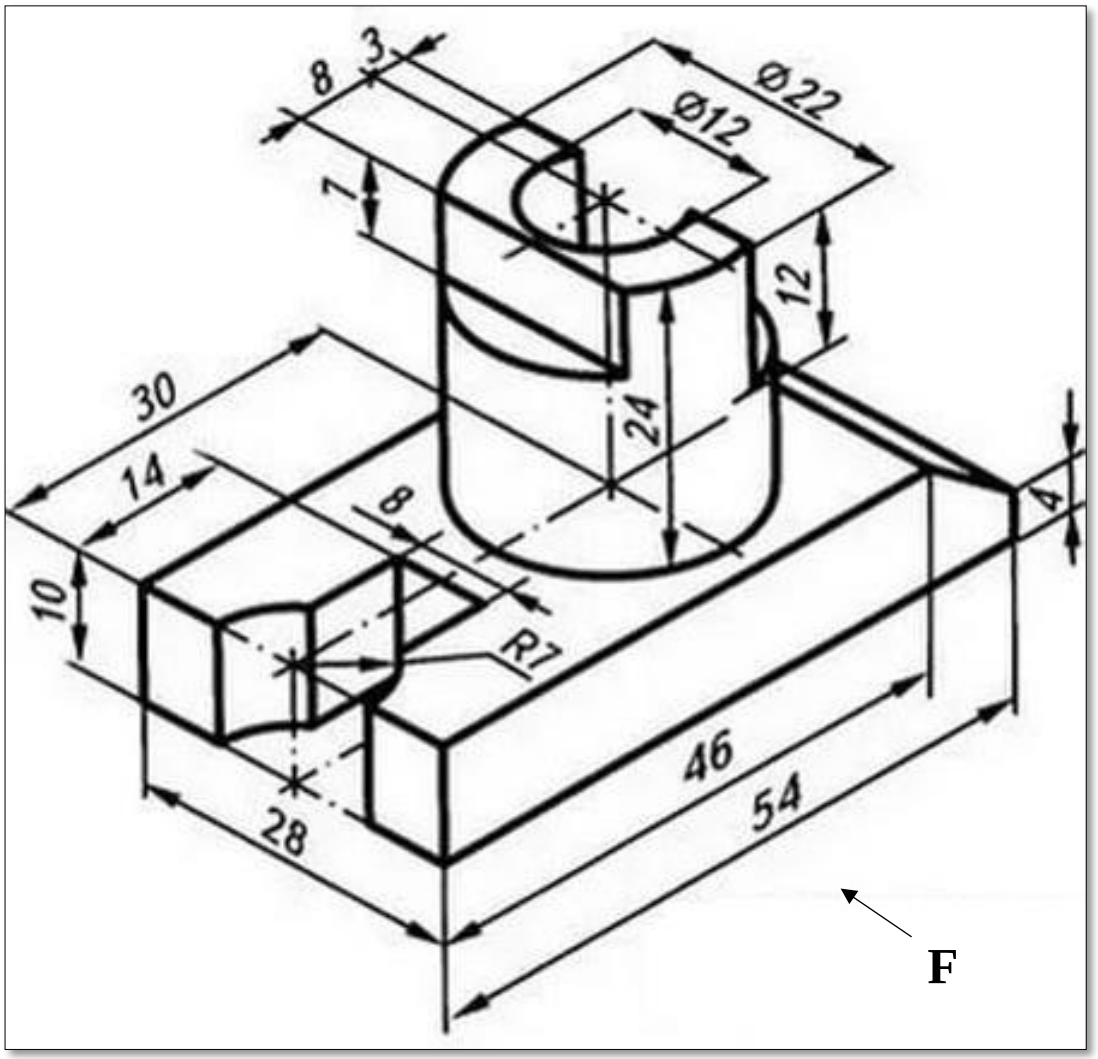
Problem (1): Draw the following 3D solid

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)

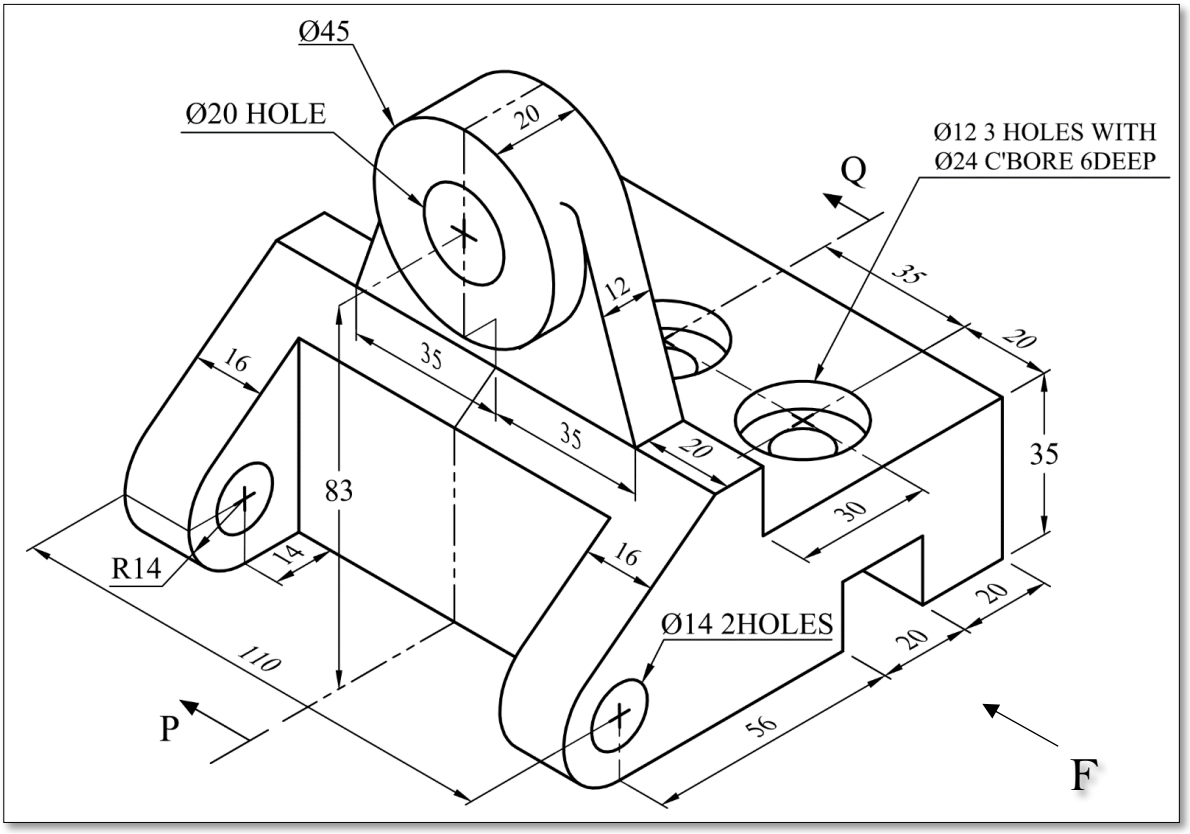
Problem (1): Draw the following 3D solid

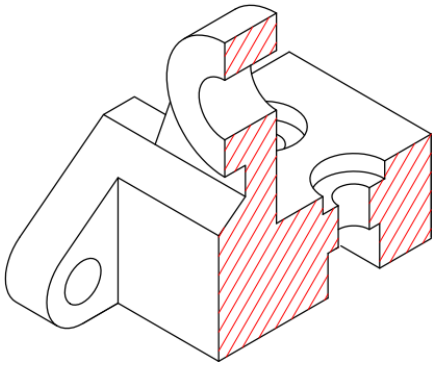
Use one layer for each of the following: (3D solid, Hatch line, Text, and Dimension lines).

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

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

c. Add all dimensions as shown in the Figure.





Past Exam (3)

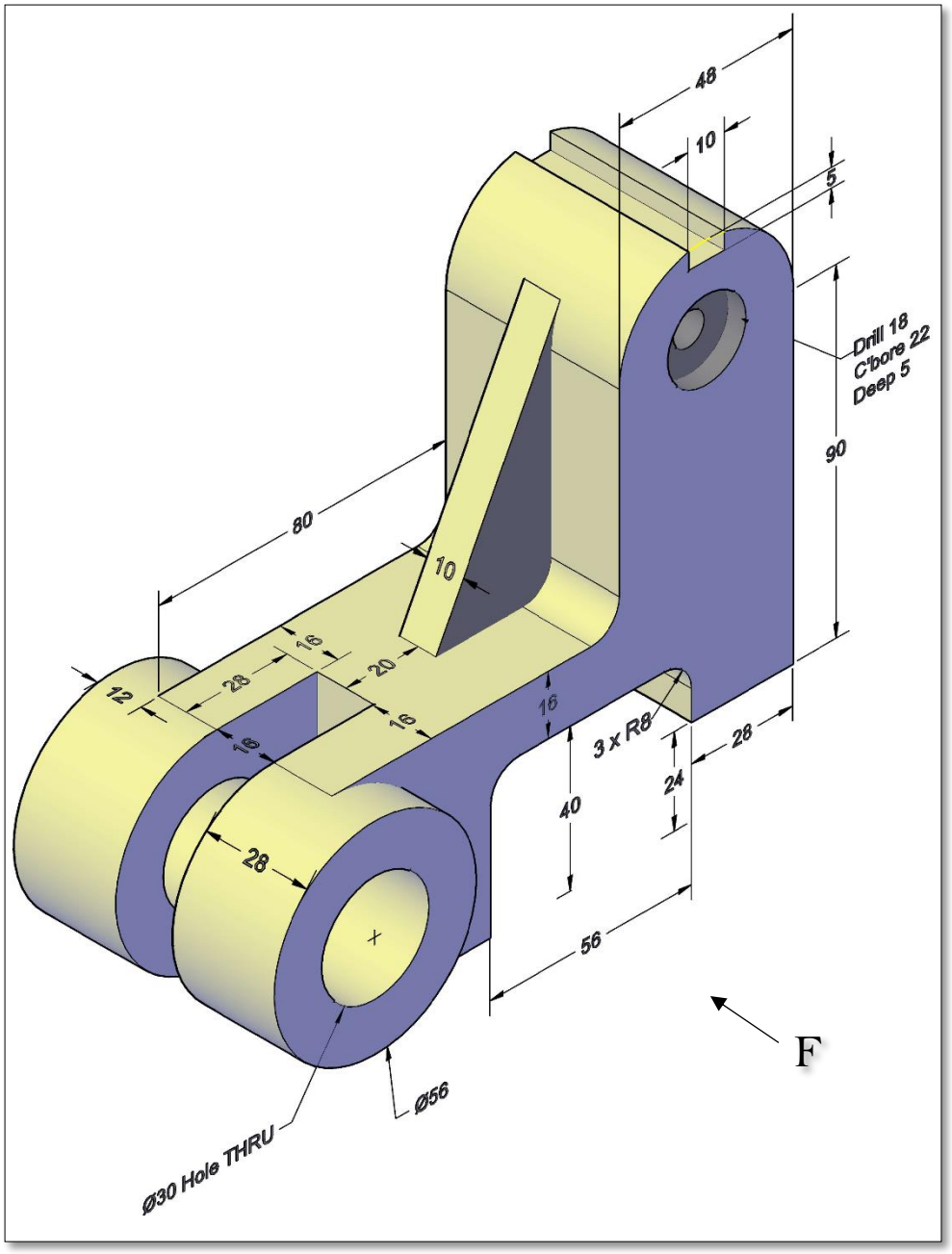
Problem (1): Draw the following 3D solid

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)

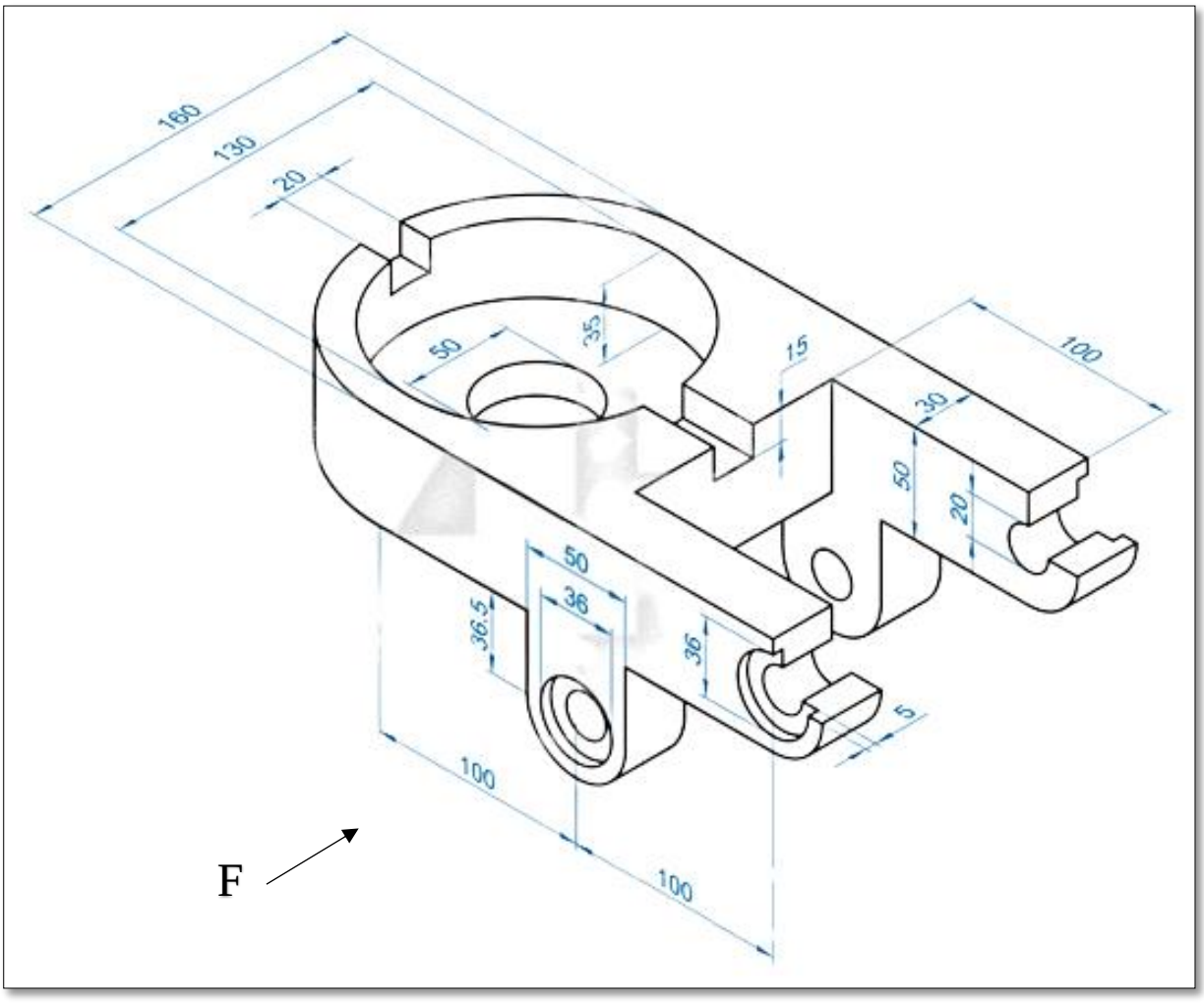
Problem (1): Draw the following 3D solid

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)

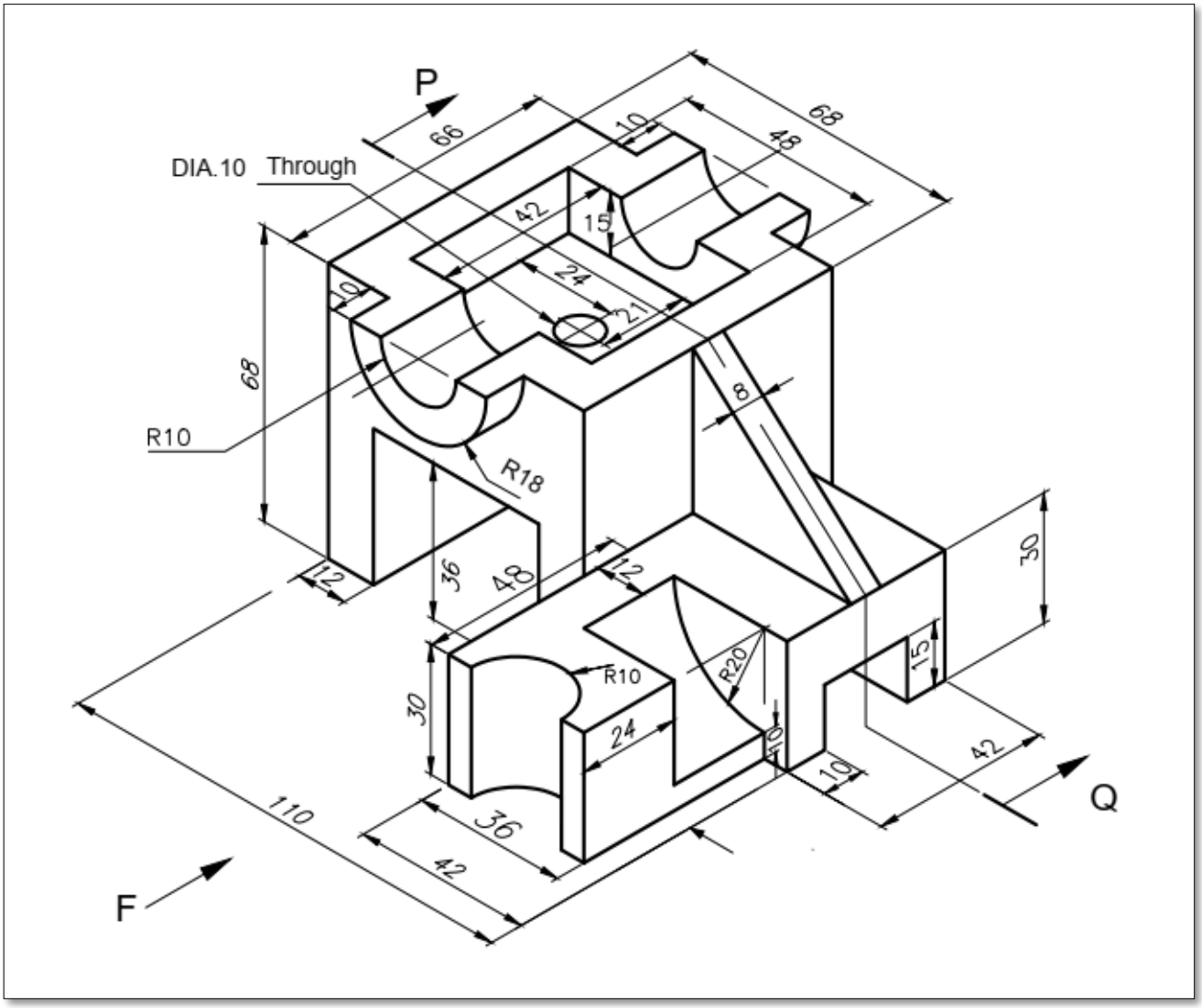
Problem (1): Draw the following 3D solid

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 at **P-Q** (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.



Past Exam (6)

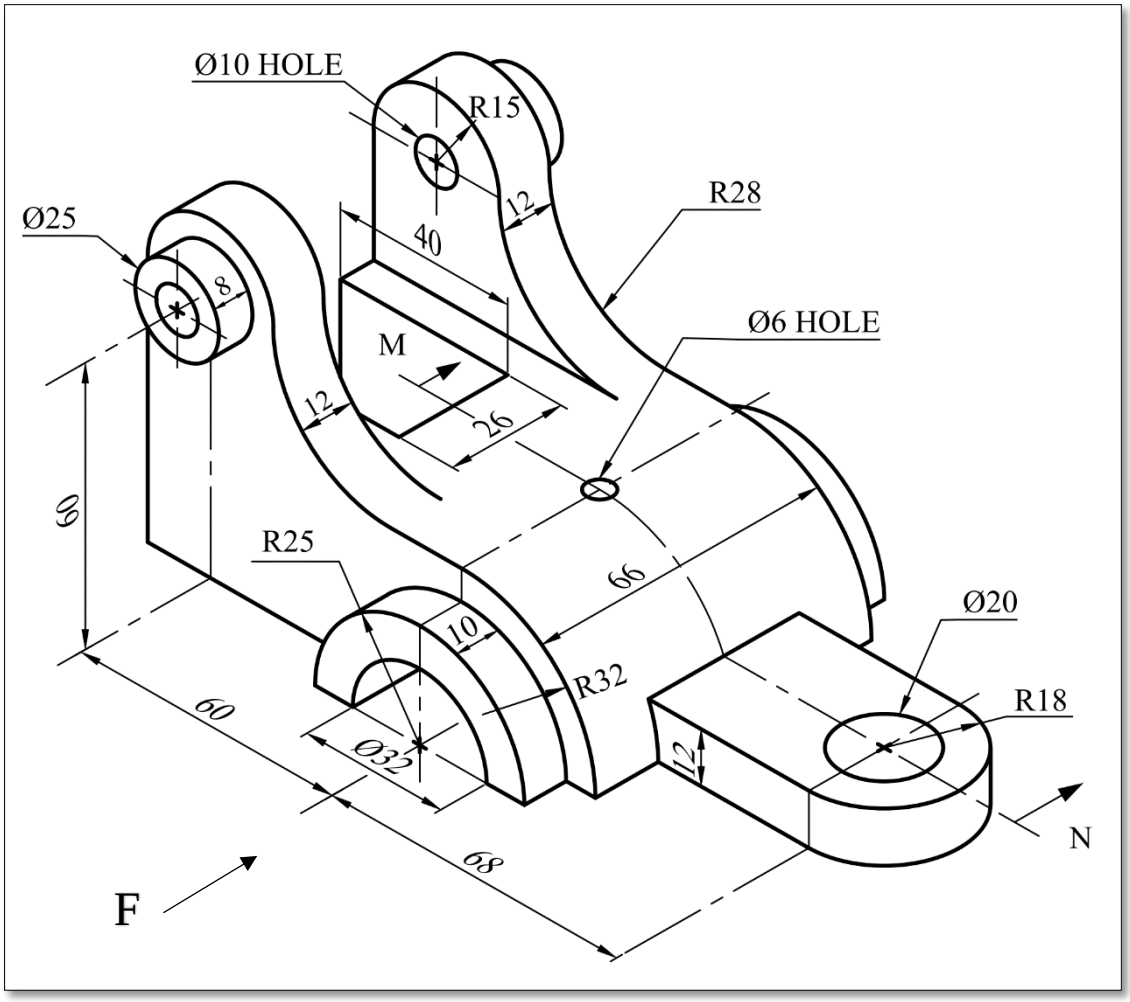
Problem (1): Draw the following 3D solid

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

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

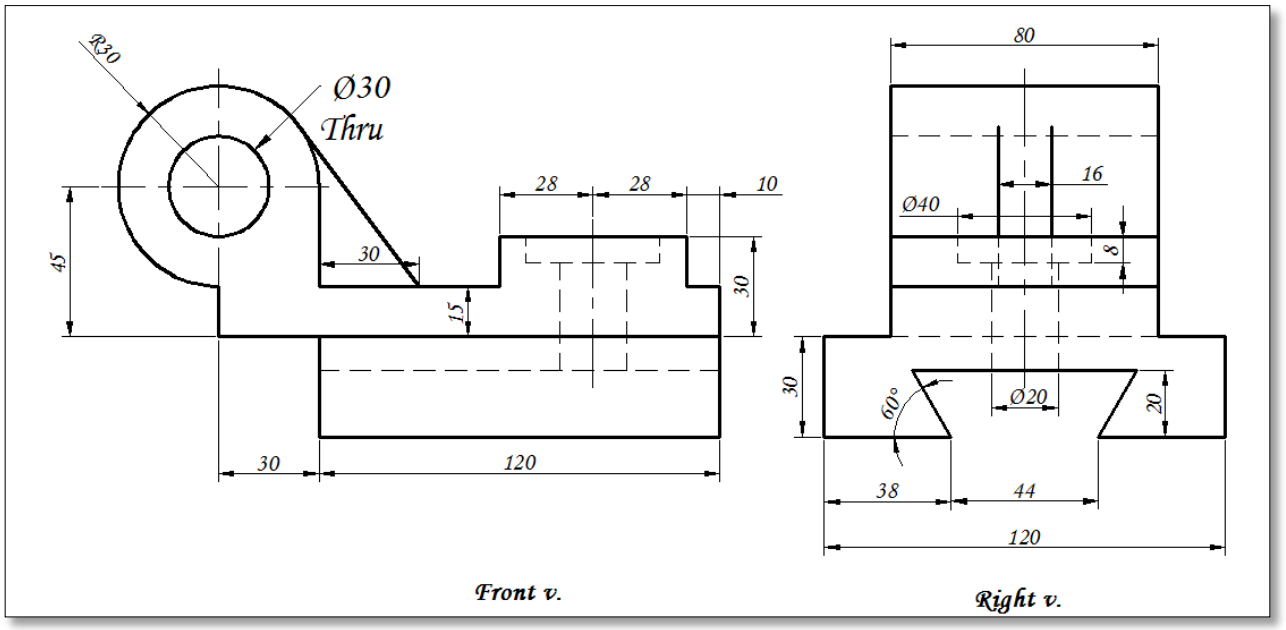
b. Make a slice to obtain the full front sectional view at **M-N** (on a copy of the Figure), keep and hatch the back.

c. Add all dimensions as shown in the Figure.

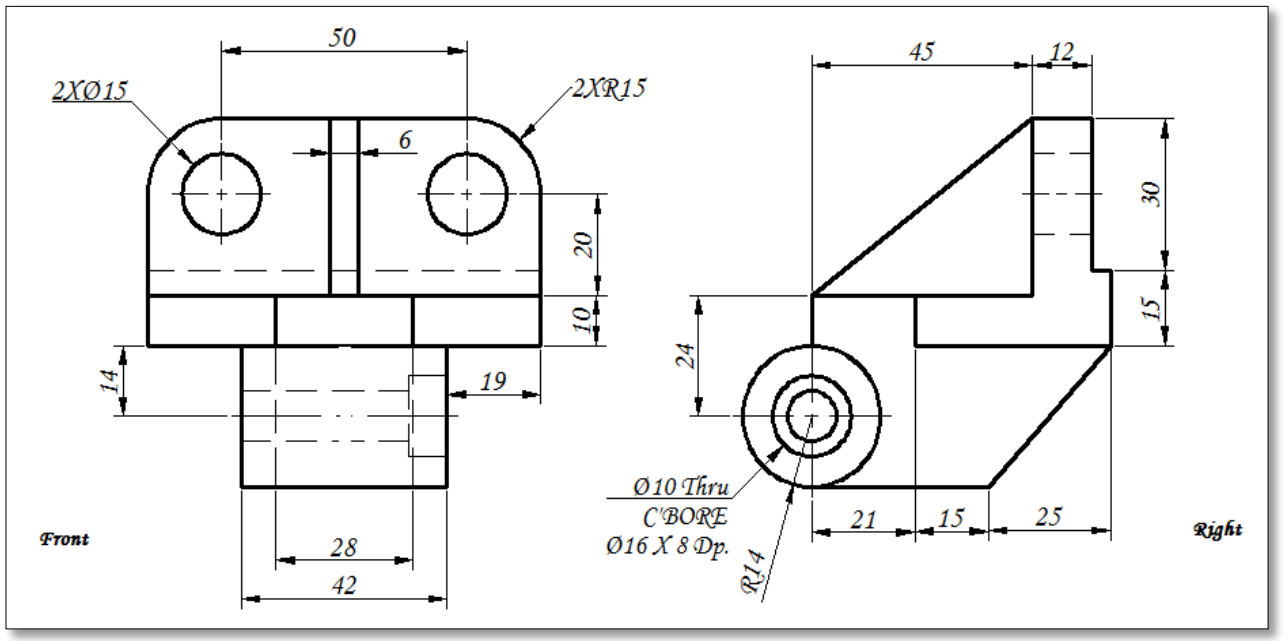


Isometric Drawing
Past Exams

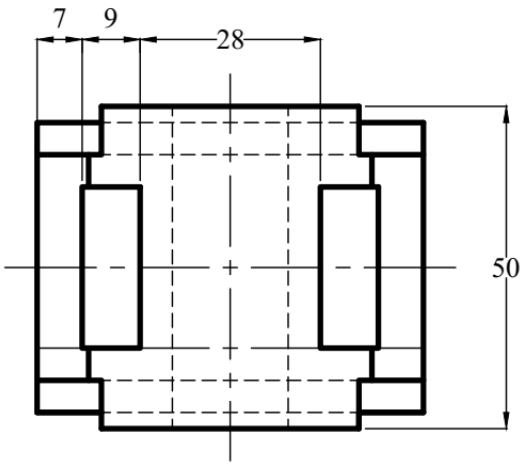
Ex. 1: For the given front and right views, construct a 3D-Solid.



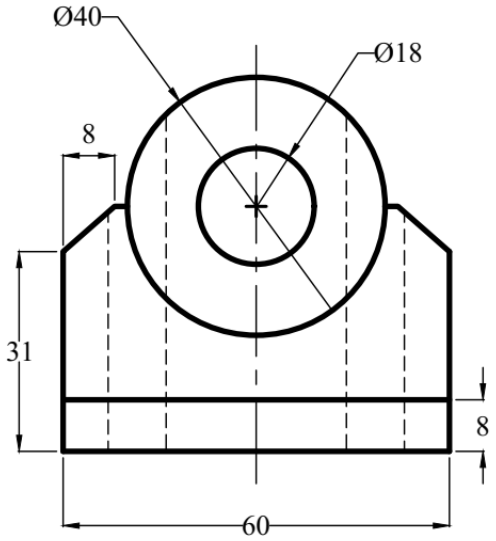
Ex. 2: For the given front and right views, construct a 3D-Solid.



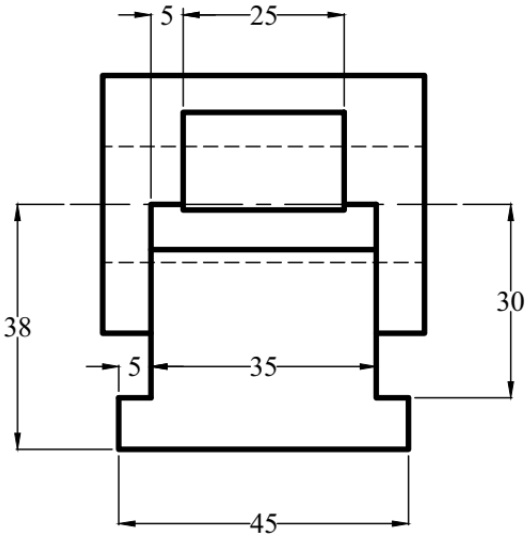
Ex. 3: For the given views, construct a 3D-Solid.



Top View

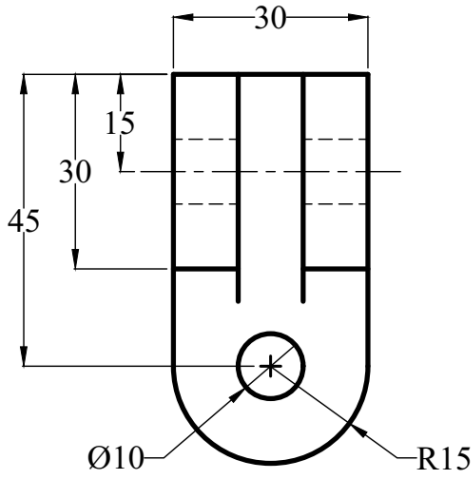


Front View

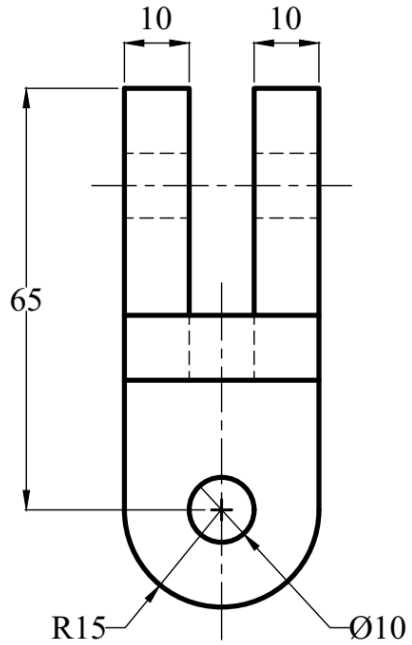


Right Side View

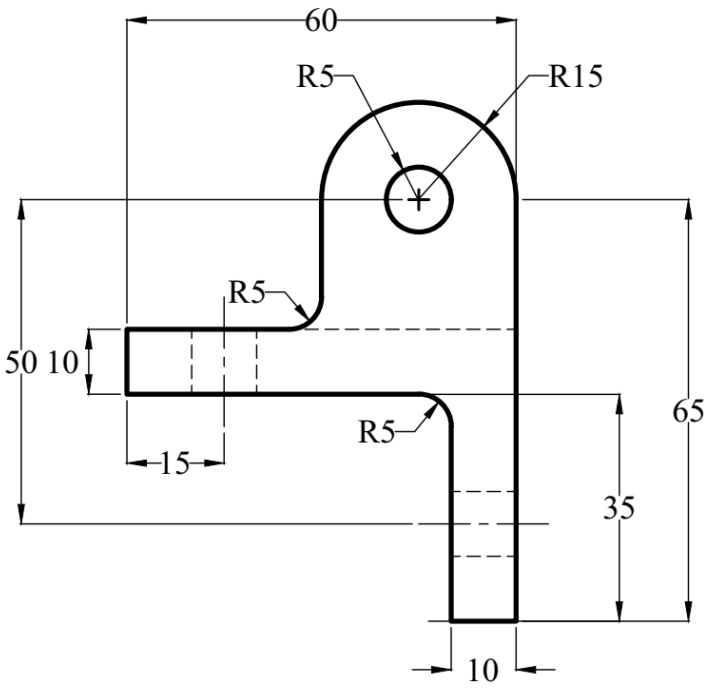
Ex. 4: For the given views, construct a 3D-Solid.



Top View

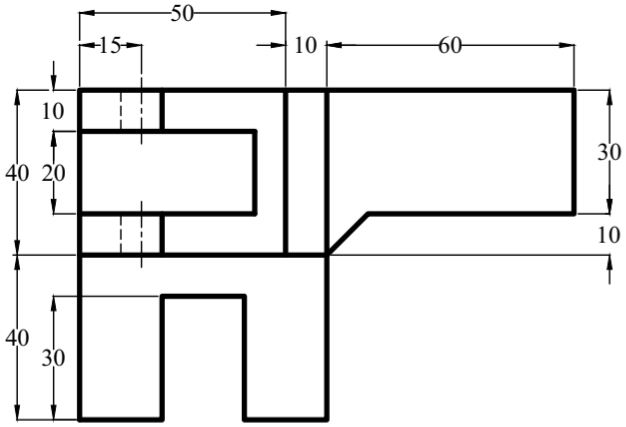


Front View

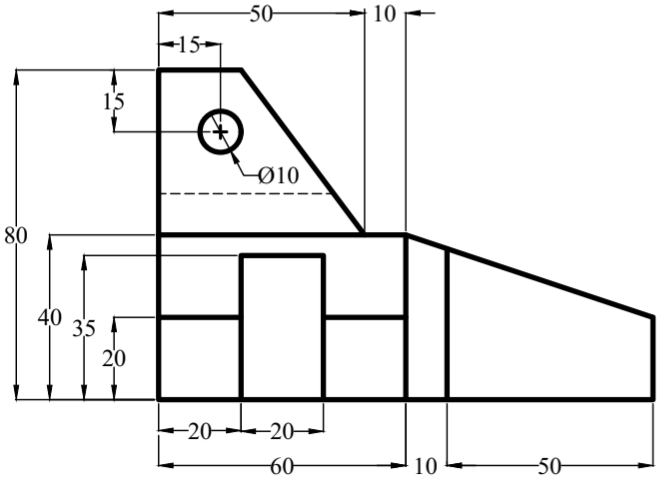


Right Side View

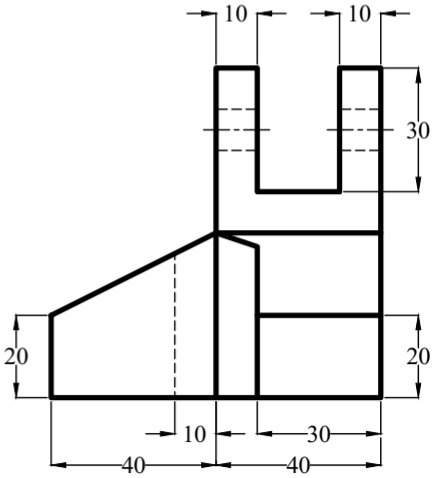
Ex. 5: For the given views, construct a 3D-Solid.



Top View

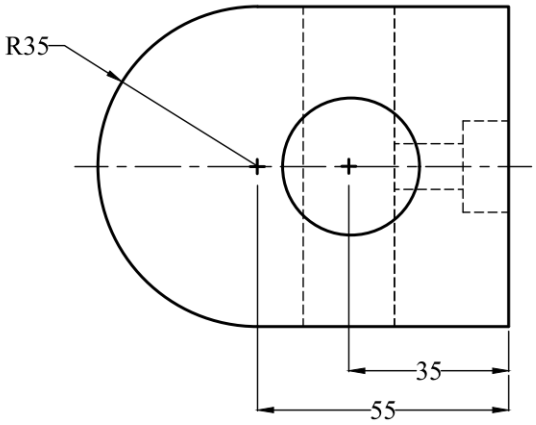


Front View

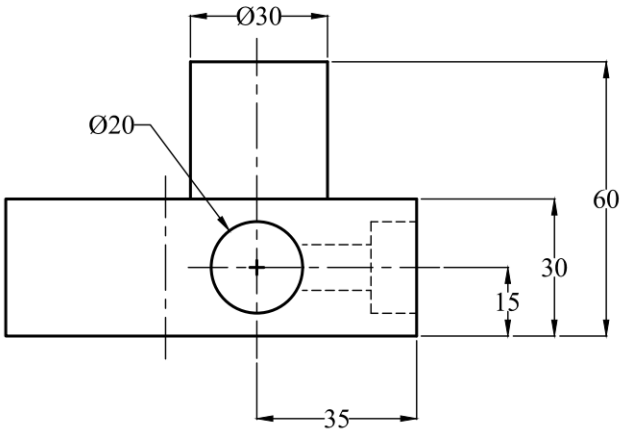


Right Side View

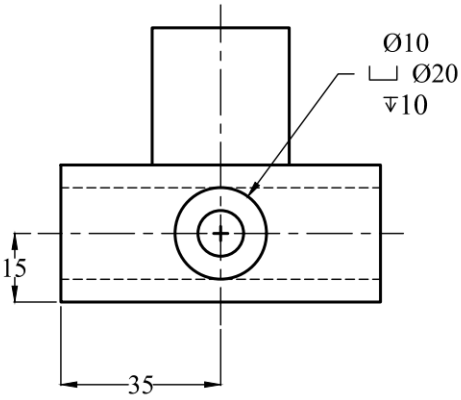
Ex. 6: For the given views, construct a 3D-Solid.



Top View



Front View



Right Side View