

Contents: Basic course G3 and Upgrade course TNC 310

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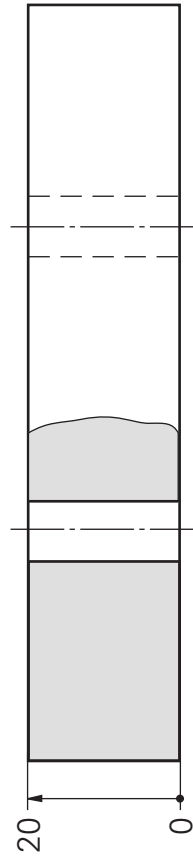
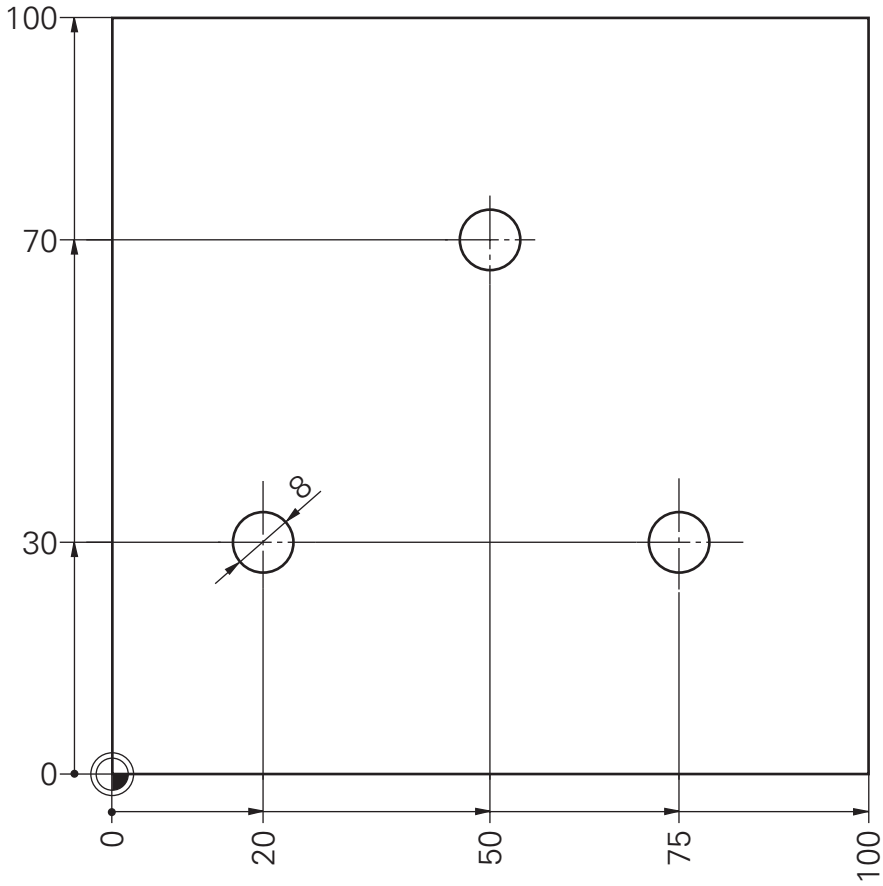
Contents: Basic course G3 and Upgrade course TNC 310

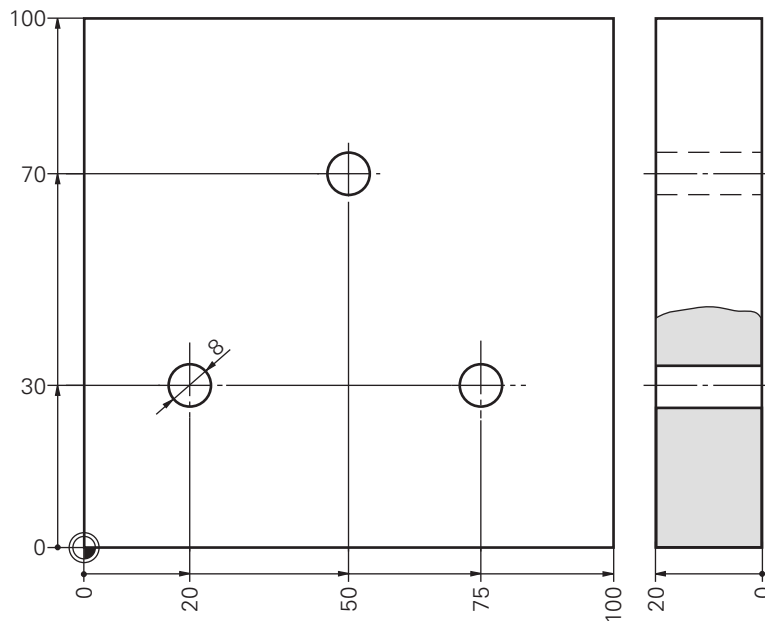
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Task: **Holes**

Program(s): _____

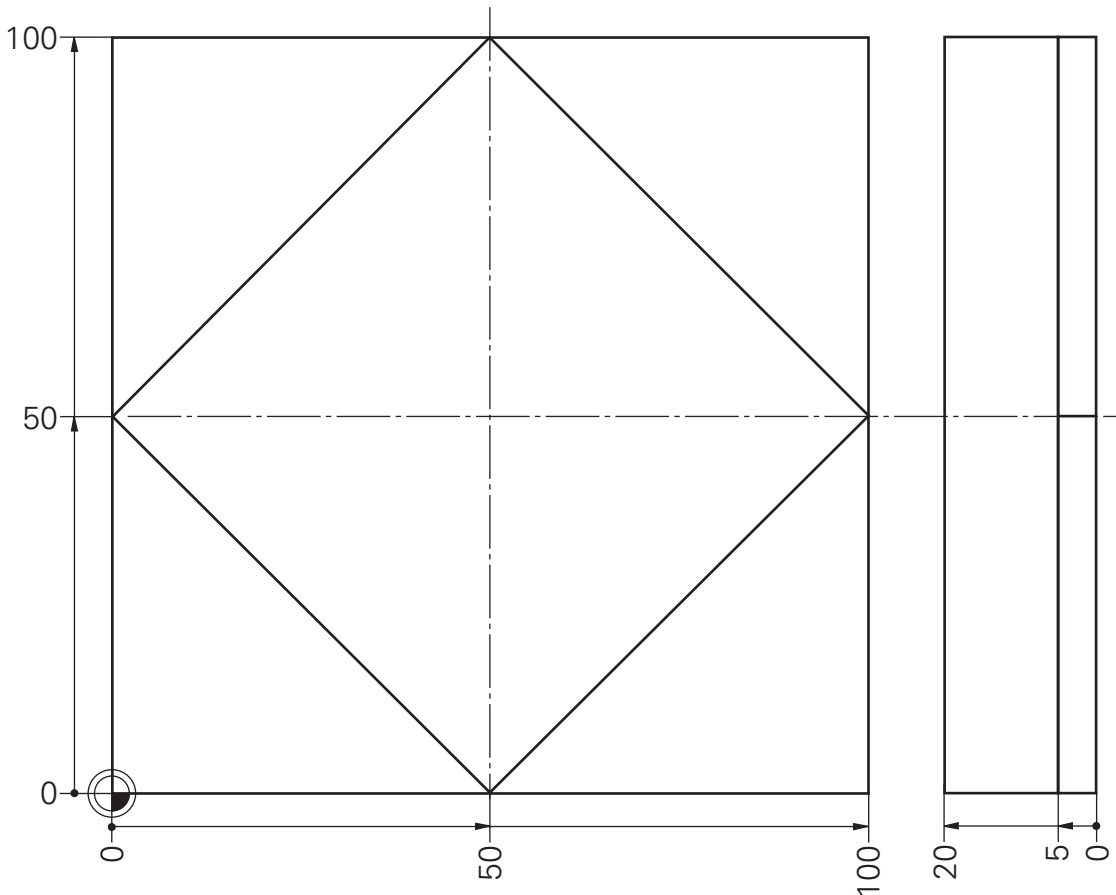




Complete program

```

0 BEGIN PGM 151 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0..... WORKPIECE BLANK DEFINITION
3 TOOL DEF 1 L+0 R+4 ..... DEFINE TOOL
4 TOOL CALL 1 Z S4000 ..... CALL TOOL DATA
5 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
6 L X+20 Y+30 R0 F MAX M3 ..... FIRST HOLE
7 L Z+2 R0 F MAX M8
8 L Z-22 R0 F400 ..... DRILL
9 L Z+2 R0 F MAX
10 L X+50 Y+70 R0 F MAX ..... SECOND HOLE
11 L Z-22 R0 F400
12 L Z+2 R0 F MAX
13 L X+75 Y+30 R0 F MAX ..... THIRD HOLE
14 L Z-22 R0 F400
15 L Z+100 R0 F MAX M2
16 END PGM 151 MM
    
```



Begin program
 Define workpiece blank

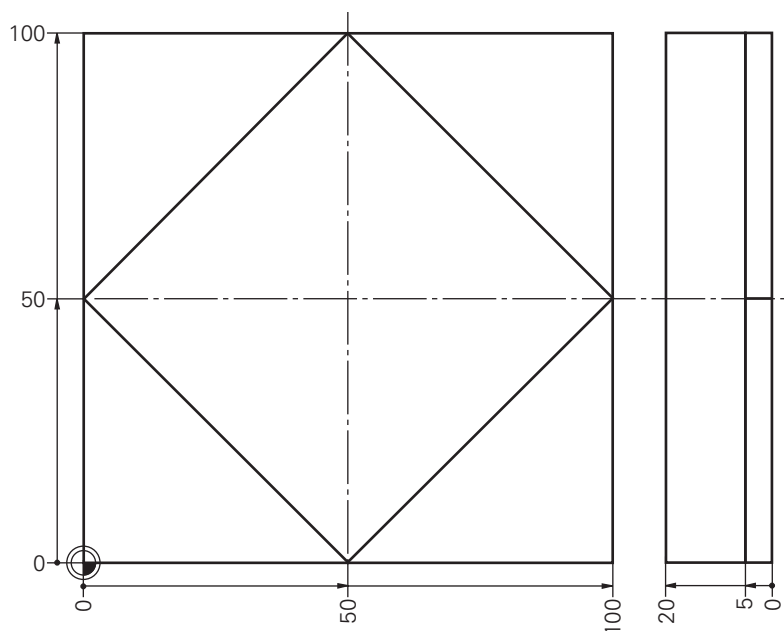
 Define tool
 Call tool data
 Move to clearance height
 Move to auxiliary point R0
 Plunging depth
 Contour starting point RL/RR
 Contour coordinates RL/RR
 ⋮
 Last contour point RL/RR
 Move to auxiliary point R0
 Retract tool, PGM end

```

BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL DEF... L... R...
TOOL CALL... S...
L Z+... R0 F...
L X... Y... R... F...
L Z... R... F... M...
L X... Y... RR/RL
L X... Y... RR/RL
⋮
L X... Y... RR/RL
L X... Y... R...
L Z... R... F... M...
    
```

Solution:

Square



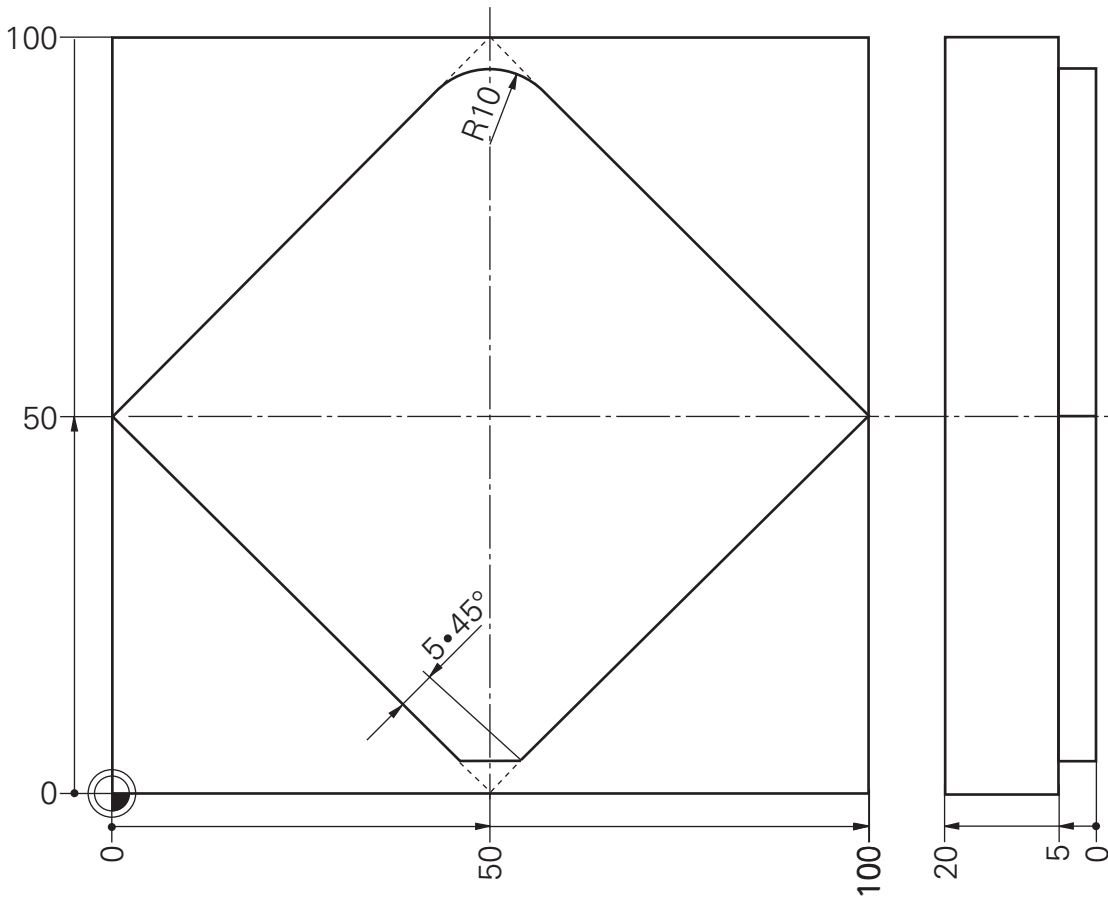
Complete program

```
0 BEGIN PGM 152 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0 ..... WORKPIECE BLANK DEFINITION
3 TOOL DEF 1 L+0 R+8 ..... DEFINE TOOL
4 TOOL CALL 1 Z S4000 ..... CALL TOOL DATA
5 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
6 L X-30 Y+50 R0 F MAX ..... AUXILIARY POINT (R0)
7 L Z-5 R0 F MAX M3 ..... PLUNGING DEPTH
8 L X+0 Y+50 RL F400 ..... CONTOUR START. POINT (RL/RR)
9 L X+50 Y+100
10 L X+100 Y+50
11 L X+50 Y+0
12 L X+0 Y+50 RL ..... LAST CONTOUR POINT
13 L X-30 R0 F MAX M5 ..... AUXILIARY POINT
14 L Z+100 R0 F MAX M2 ..... RETRACT TOOL/PGM END
15 END PGM 152 MM
```



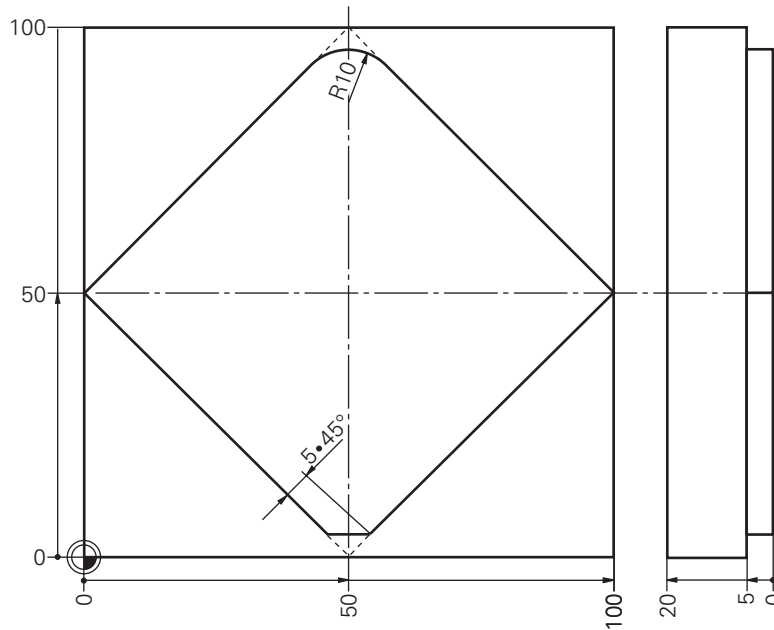
Task: **Rounding / chamfering corners**

Program(s): _____



Solution:

Rounding / chamfering corners



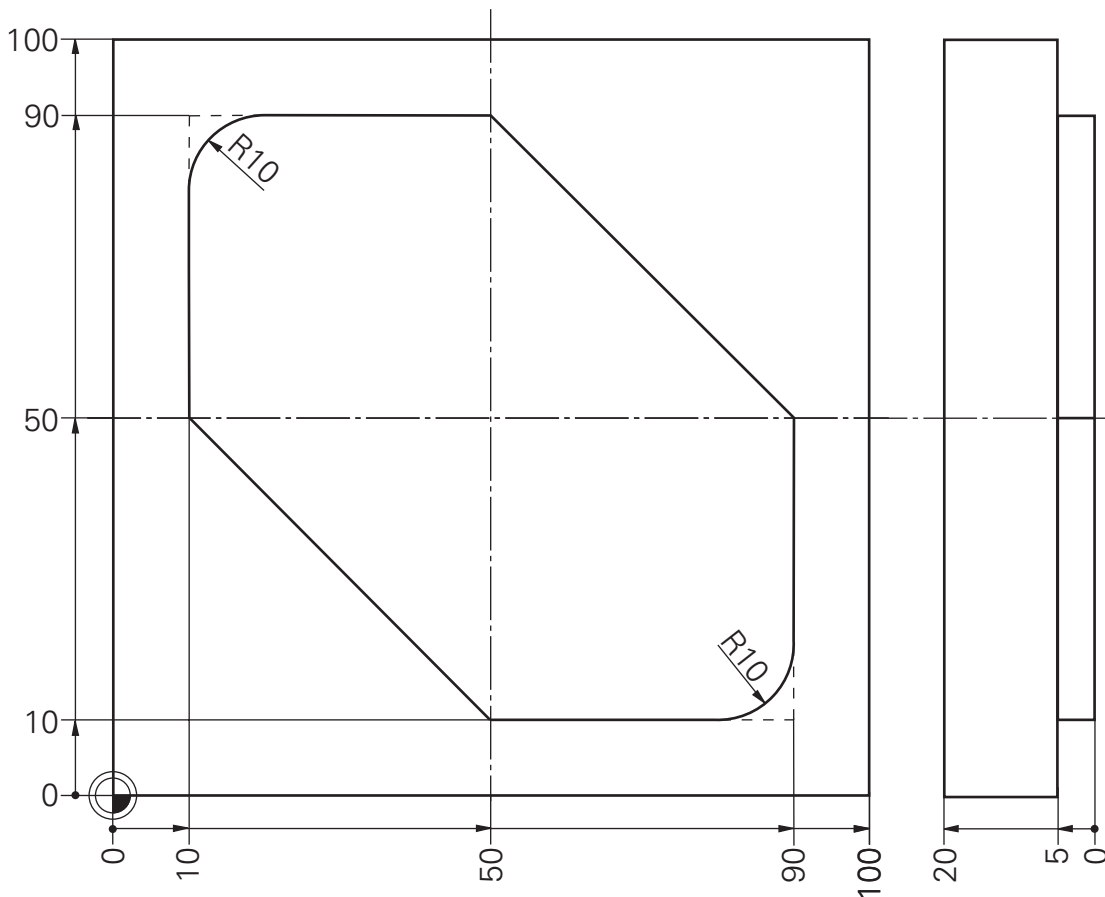
Complete program

```

0 BEGIN PGM 153 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0 ..... WORKPIECE BLANK DEFINITION
3 TOOL DEF 1 L+0 R+8 ..... DEFINE TOOL
4 TOOL CALL 1 Z S4000 ..... CALL TOOL DATA
5 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
6 L X-30 Y+50 R0 F MAX ..... AUXILIARY POINT (R0)
7 L Z-5 R0 F MAX M3
8 L X+0 Y+50 RL F200 ..... CONTOUR STARTING POINT RL
9 L X+50 Y+100
10 RND R10 ..... ROUND CORNERS
11 L X+100 Y+50
12 L X+50 Y+0
13 CHF 5 ..... CHAMFER
14 L X+0 Y+50 RL
15 L X-30 R0 M5 ..... AUXILIARY POINT (R0)
16 L Z+100 R0 F MAX M2 ..... PGM END
17 END PGM 153 MM

```





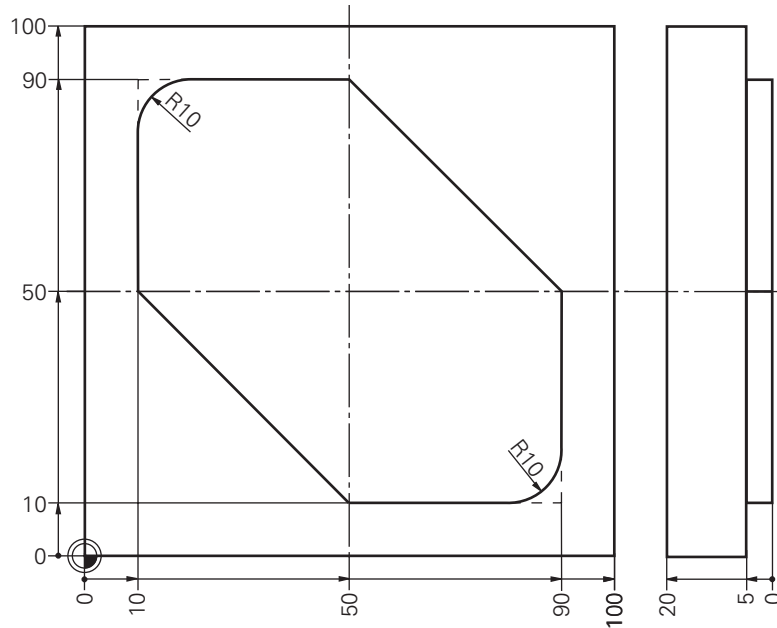
- Begin program
- Define workpiece blank
- Define tool
- Call tool data
- Move to clearance height
- Auxiliary point anfahren
- Plunging depth
- Approach tangentially
- Contour
- Depart tangentially
- Retract tool, PGM end

```

BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL DEF... L... R...
TOOL CALL..... S...
L Z...
L X... Y...
L Z...
APPR...
L...
DEP...
L Z...
    
```

Solution:

Rounding corners



Complete program

```
0 BEGIN PGM 154 MM
1 BLK FORM 0.1 Z X-20 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL DEF 1 L+0 R+8
4 TOOL CALL 1 Z S4000
5 L Z+100 R0 F MAX
6 L X-30 Y+70 R0 F MAX ..... AUXILIARY POINT (R0)
7 L Z-5 R0 F MAX M3
8 APPR LCT X+10 Y+70 R5 RL F400 ..... APPROACH STARTING POINT
TANGENTIALLY

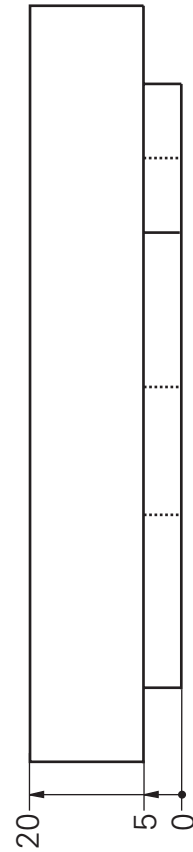
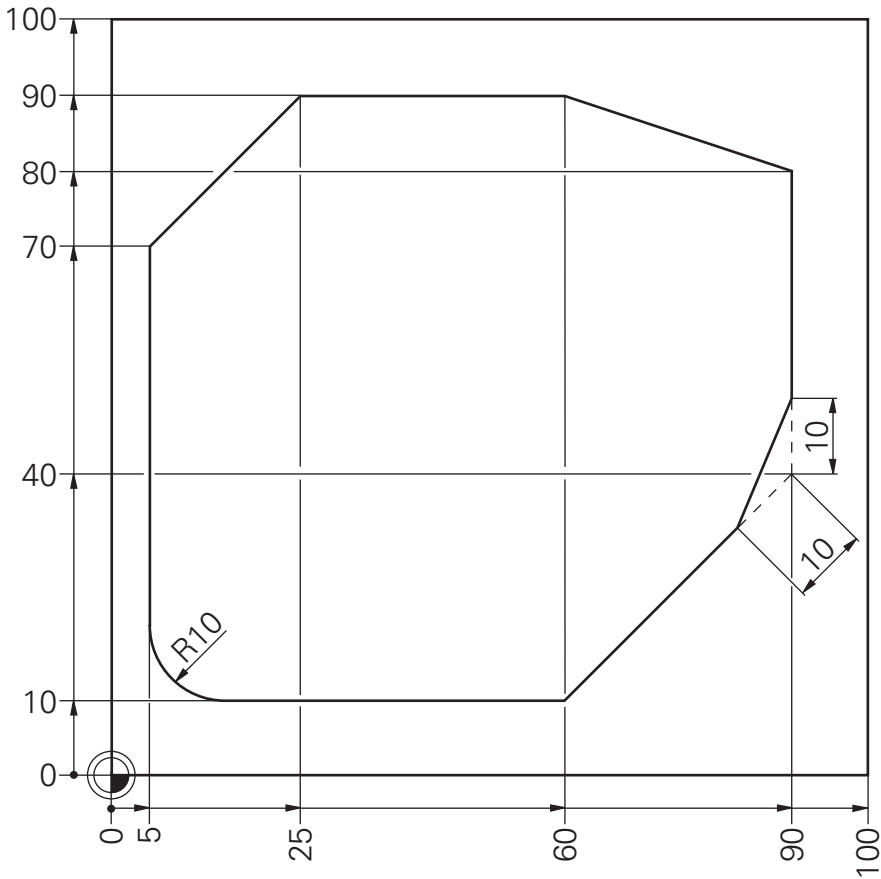
9 L X+10 Y+90
10 RND R10
11 L X+50 Y+90
12 L Y+50 X+90
13 L X+90 Y+10
14 RND R10
15 L X+50 Y+10
16 L X+10 Y+50
17 L Y+70 ..... LAST CONTOUR POINT RL
18 DEP LCT X-30 Y+70 R5 R0 ..... DEPART TANGENTIALLY TO
AUXILIARY POINT

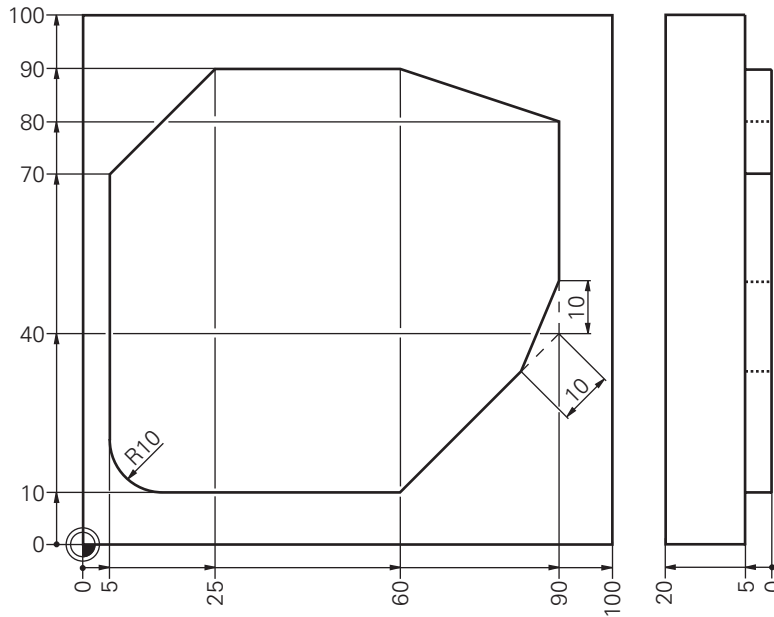
19 L Z+100 R0 F MAX M2
20 END PGM 154 MM
```



Task: Linear movements

Program(s): _____





Complete program

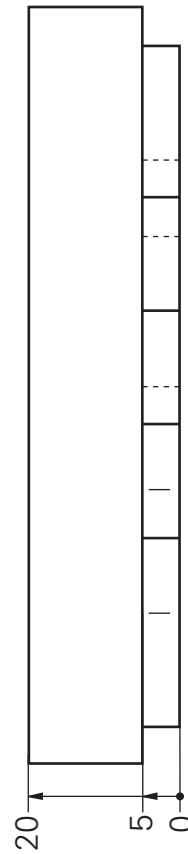
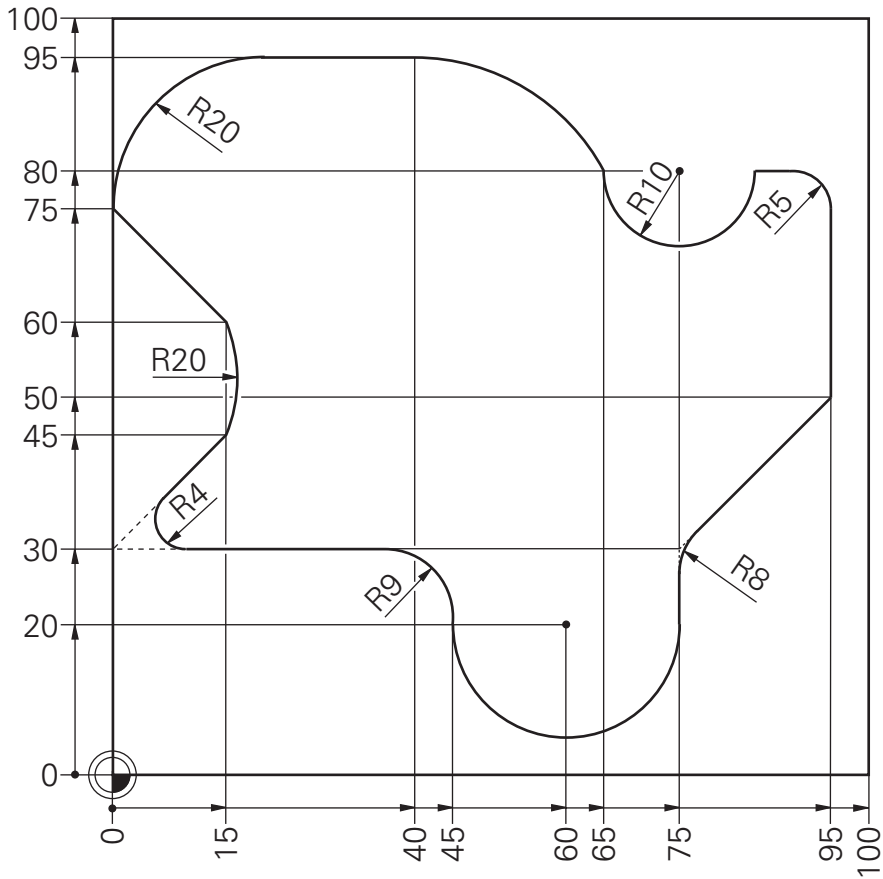
```

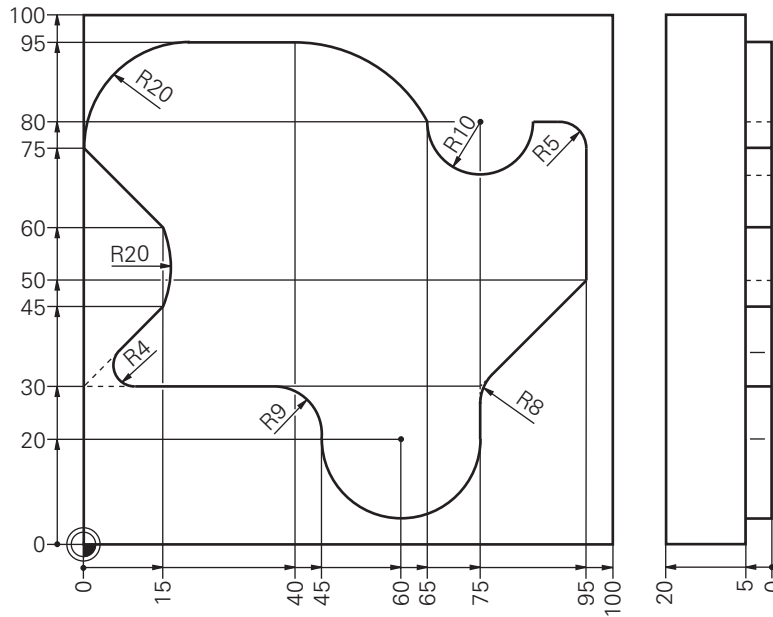
0 BEGIN PGM 250 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0 ..... WORKPIECE BLANK DEFINITION
3 TOOL CALL 7 Z S2500 ..... CALL TOOL DATA; R4
4 L Z+100 R0 F9999 ..... CLEARANCE HEIGHT
5 L X-20 Y+40 ..... AUXILIARY POINT (R0)
6 L Z+2 M3
7 L Z-5 F1000
8 APPR LCT X+5 Y+40 R3 RL F300 ..... CONTOUR STARTING POINT
9 L Y+90 (APPROACH TANGENTIALLY)
10 CHF 20
11 L X+60
12 L X+90 Y+80
13 L Y+40
14 CHF 10
15 L X+60 Y+10
16 L X+5
17 RND R10
18 L Y+40 ..... LAST CONTOUR POINT
19 DEP LCT X-20 Y+40 R3 R0 ..... AUXILIARY POINT (R0)
20 L Z+100 R0 F MAX M2 ..... RETRACT TOOL
21 END PGM 250 MM
    
```



Task: **Circular movements**

Program(s): _____

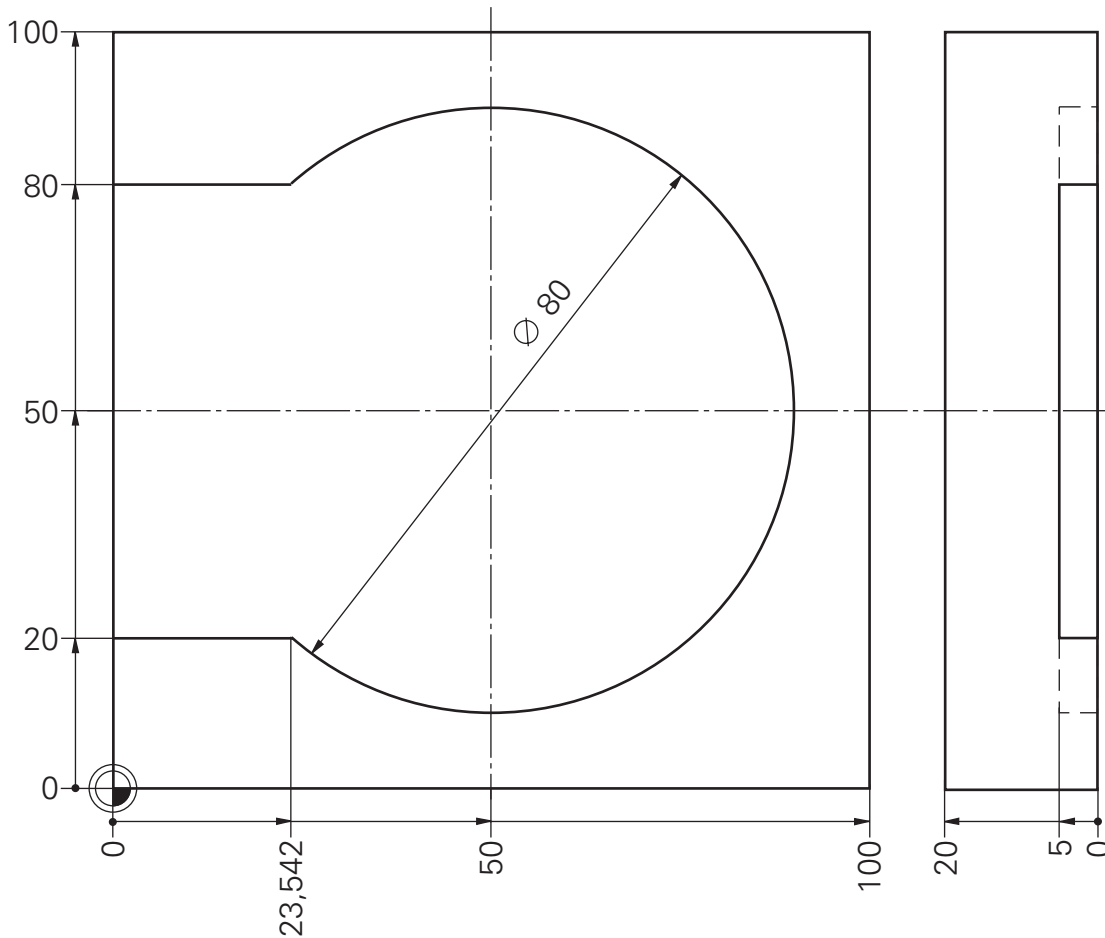




Complete program

```

0 BEGIN PGM 251 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 7 Z S2500 ..... R4
4 L Z+100 R0 F9999
5 L X+20 Y-20 ..... AUXILIARY POINT (R0)
6 L Z+2 M3
7 L Z-5 F500
8 APPR LCT X+20 Y+30 R3 RL F300 ..... CONTOUR STARTING POINT
9 L X+0 ..... (APPROACH TANGENTIALLY)
10 RND R4
11 L X+15 Y+45
12 CR X+15 Y+60 R+20 DR+
13 L X+0 Y+75
14 CR X+20 Y+95 R+20 DR-
15 L X+40
16 CT X+65 Y+80
17 CC X+75 Y+80
18 C X+85 Y+80 DR+
19 L X+95
20 RND R5
21 L Y+50
22 L X+75 Y+30
23 RND R8
24 L Y+20
25 CC X+60 Y+20
26 C X+45 Y+20 DR-
27 L Y+30
28 RND R9
29 L X+20 ..... LAST CONTOUR POINT
30 DEP LCT X+20 Y-20 R3 R0 F500 ..... AUXILIARY POINT (R0)
31 L Z+100 R0 F MAX M2
32 END PGM 251 MM
    
```



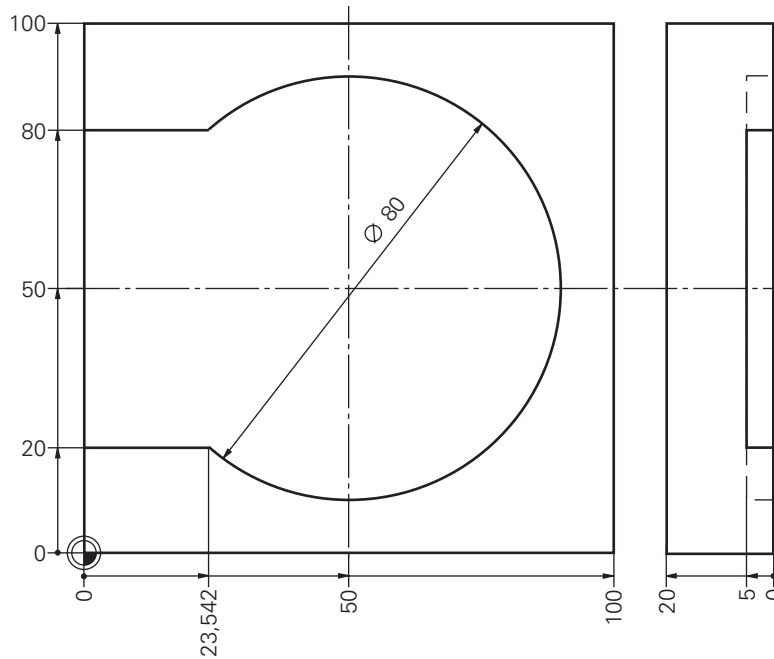
- Begin program
- Define workpiece blank
- Call tool data
- Move to clearance height
- Move to auxiliary point R0
- Plunging depth
- Approach contour tangentially
- Define circle center
- Circular movement
- Depart tangentially (aux.pt.)
- Retract tool, PGM end

```

BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL CALL... S...
L...
L... R0
L...
APPR... RL/RR
CC...
C...
DEP...
L...
    
```

Solution:

Circular arc with CC, C



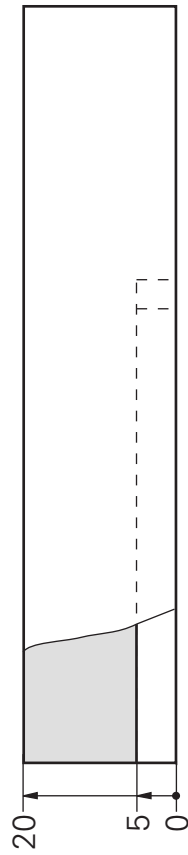
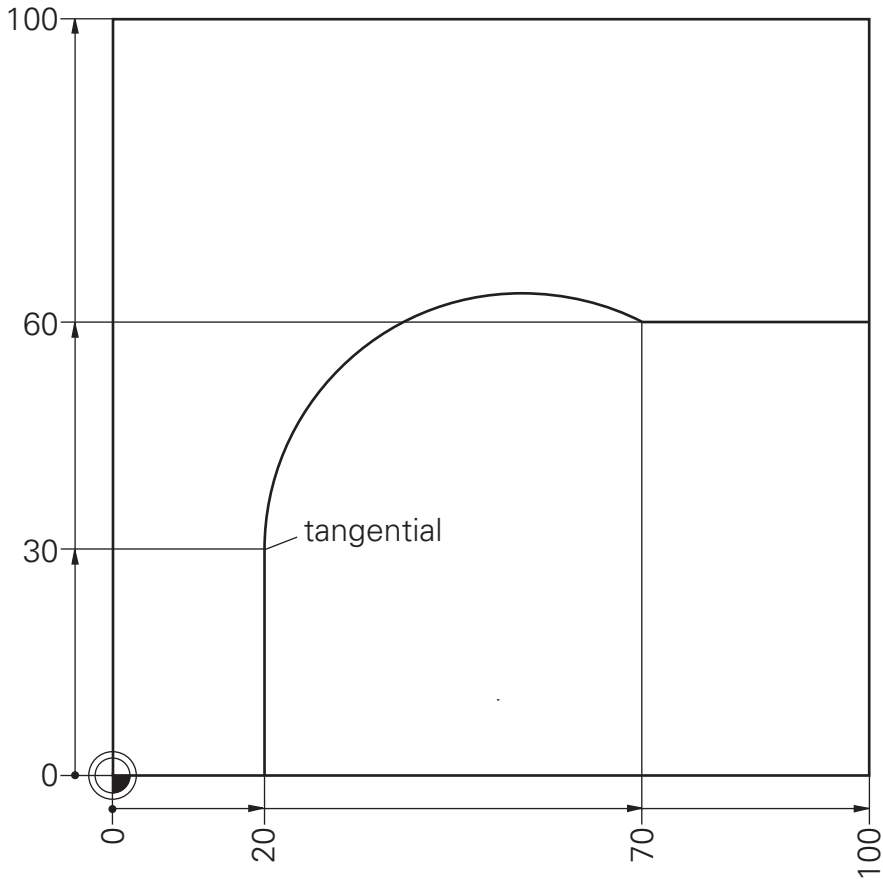
Complete program

```
0 BEGIN PGM 206 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX
5 L X-30 Y+50 R0 F MAX ..... AUXILIARY POINT
6 L Z-5 R0 F MAX M3
7 APPR LT X+0 Y+20 LEN10 RL F250 M8
8 L X+23,542 RL
9 CC X+50 Y+50 ..... CIRCLE CENTER
10 C Y+80 X+23,542 DR+ ..... CIRCULAR MOVEMENT
11 L X+0 RL
12 DEP LT LEN10 R0 ..... DEPART TANGENTIALLY (AUX.PT.)
13 L Z+100 R0 F MAX M2
14 END PGM 206 MM
```



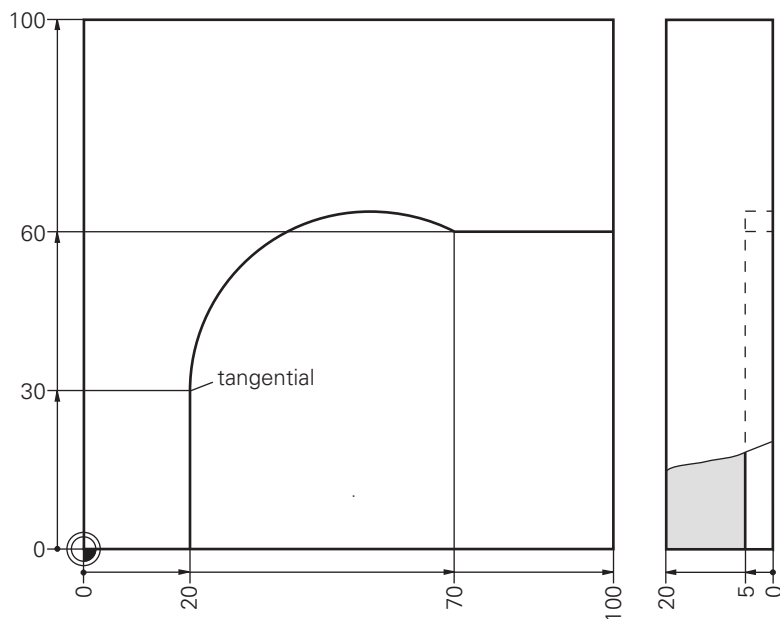
Task: **Tangential contour connection
(cartesian)**

Program(s): _____



Solution:

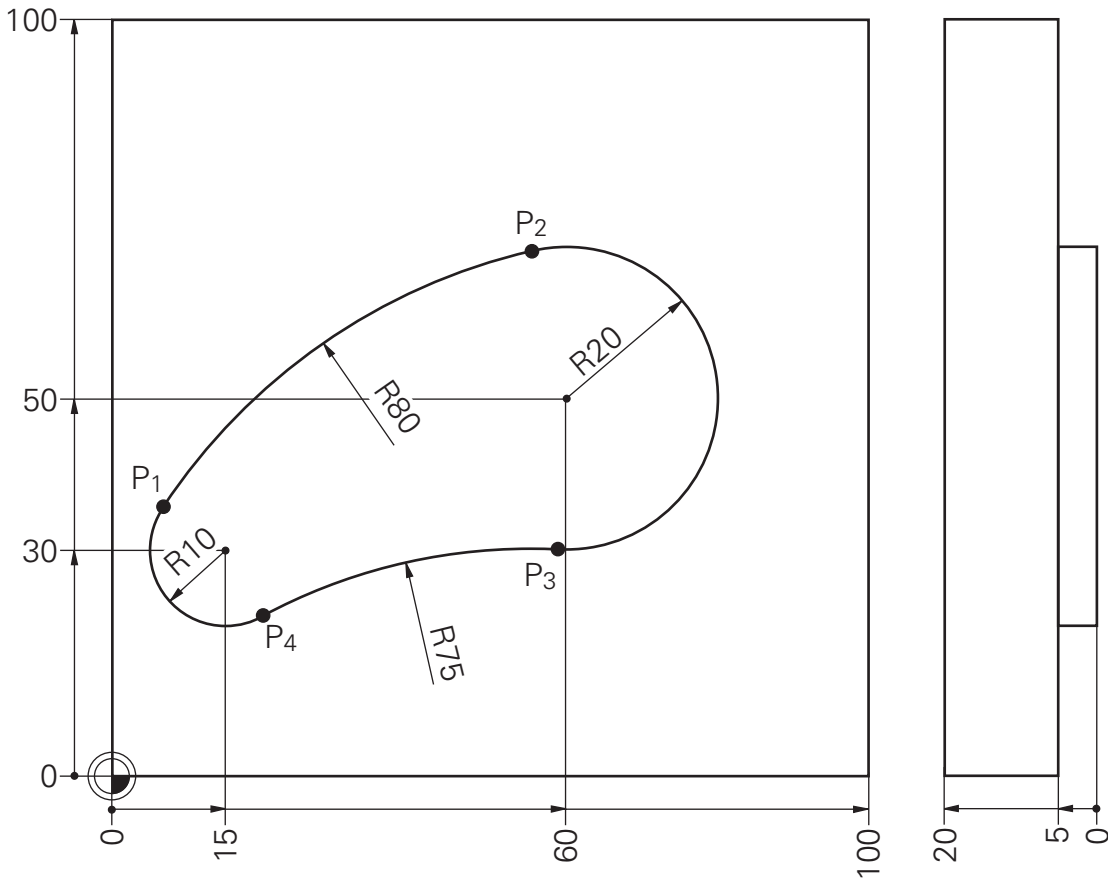
Tangential contour connection (cartesian)



Complete program

```
0 BEGIN PGM 207 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 11 Z S2500 ..... R10
4 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
5 L X+45 Y-25 R0 F MAX ..... AUXILIARY POINT
6 L Z-5 F MAX M13
7 APPR LT X+20 Y+0 LEN5 RR F250 ..... APPROACH STARTING POINT OF
8 L Y+30 ..... CONTOUR TANGENTIALLY
9 CT X+70 Y+60 ..... TANGENTIAL CIRCULAR PATH
10 L X+100
11 DEP LT LEN5 R0
12 L Z+100 R0 F MAX M2
13 END PGM 207 MM
```



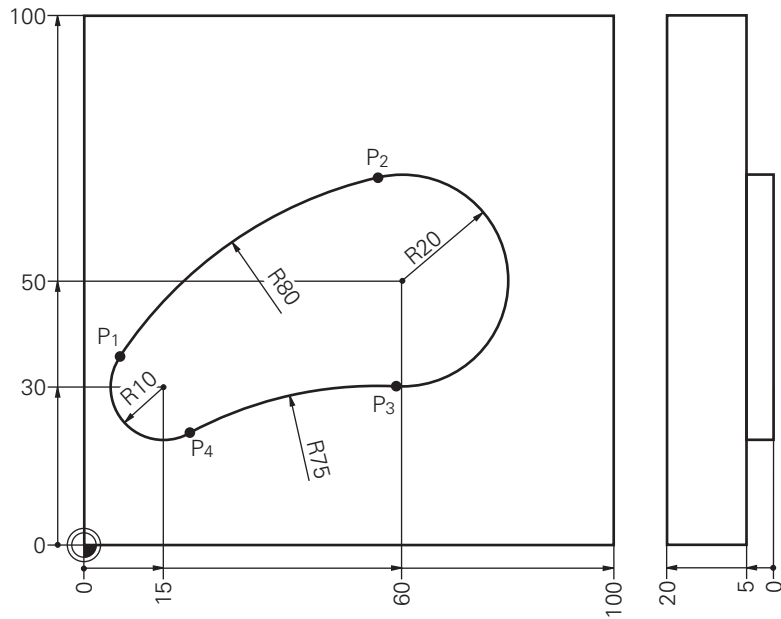


Point	X	Y
P ₁	6,645	35,495
P ₂	55,505	69,488

Point	X	Y
P ₃	58,995	30,025
P ₄	19,732	21,191

Solution:

Circular arcs



Complete program

```

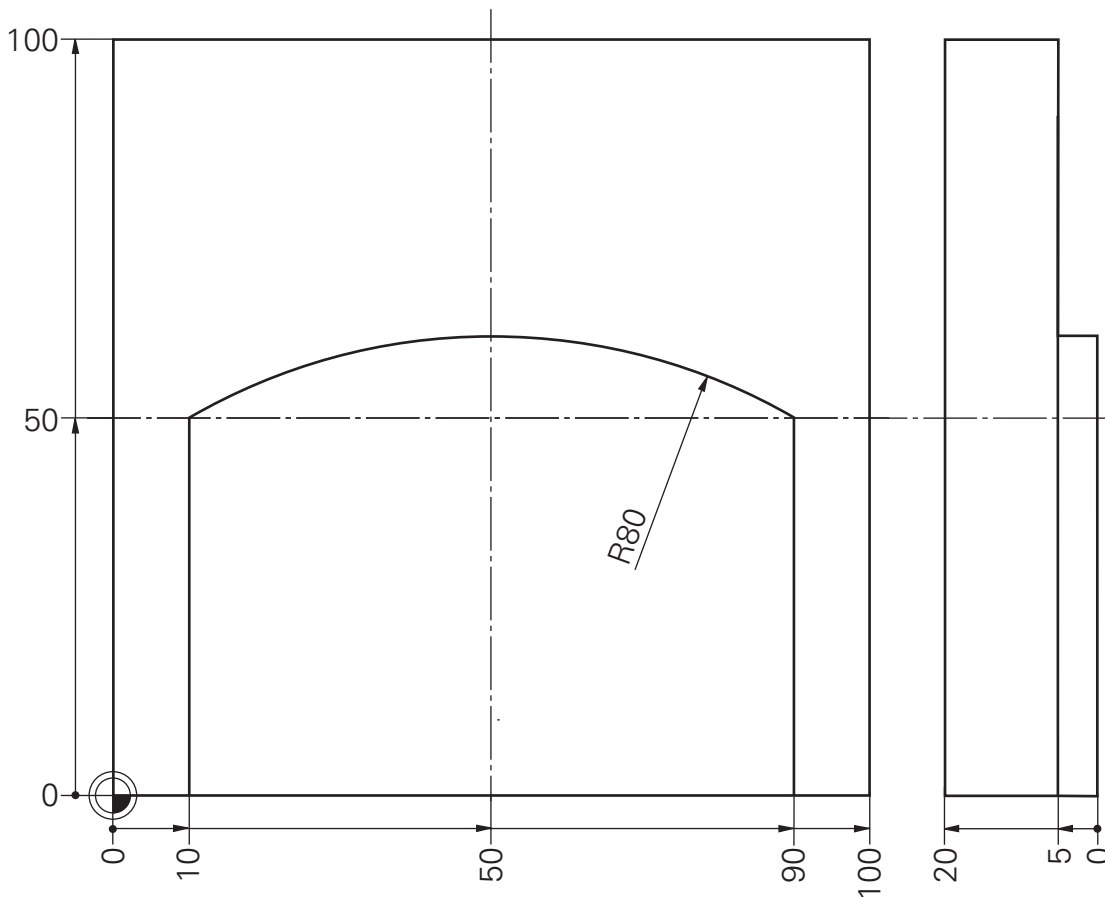
0 BEGIN PGM 208 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
5 L X-30 Y+30 R0 F MAX M3 ..... AUXILIARY POINT
6 L Z-5 F MAX ..... DEPTH
7 APPR LCT X+5 Y+30 R5 RL F250 M8 ..... APPROACH TANGENTIALLY
8 CC X+15 Y+30 ..... CIRCLE CENTER
9 C X+6,645 Y+35,495 DR- ..... CIRCLE
10 CT X+55,505 Y+69,488 ..... TANGENTIAL CIRCULAR PATH
11 CC X+60 Y+50
12 C X+58,995 Y+30,025 DR-
13 CT X+19,732 Y+21,191
14 CC X+15 Y+30
15 C X+5 Y+30 DR-
16 DEP LCT X-30 Y+30 R5 R0 ..... DEPART TANGENTIALLY
17 L Z+100 R0 F MAX M2
18 END PGM 208 MM

```



HEIDENHAIN

Basic course G3/Upgrade course D02



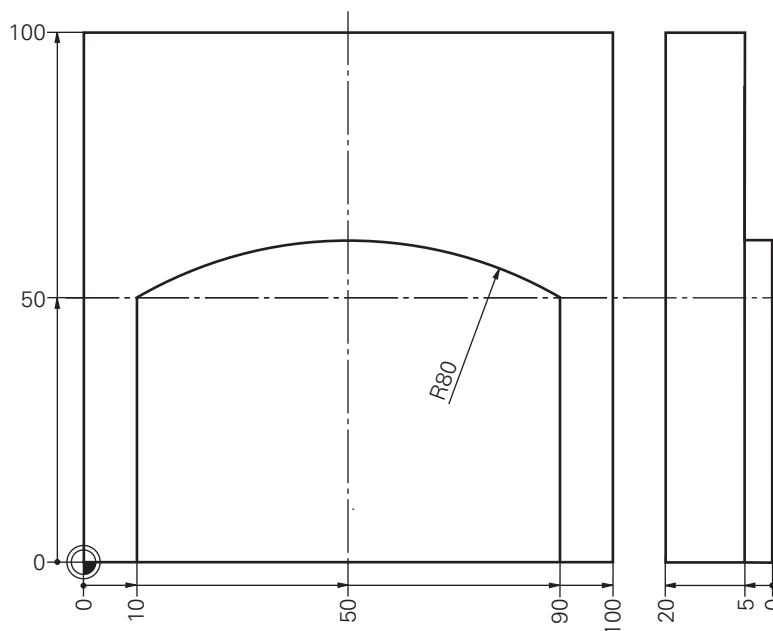
- Begin program
- Define workpiece blank
- Call tool data
- Move to clearance height
- Move to auxiliary point
- Plunging depth
- Approach tangentially
- Contour
- Depart tangentially
- Retract tool, PGM end

```

BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL CALL... S...
L...
...
...
...
...
...
    
```

Solution:

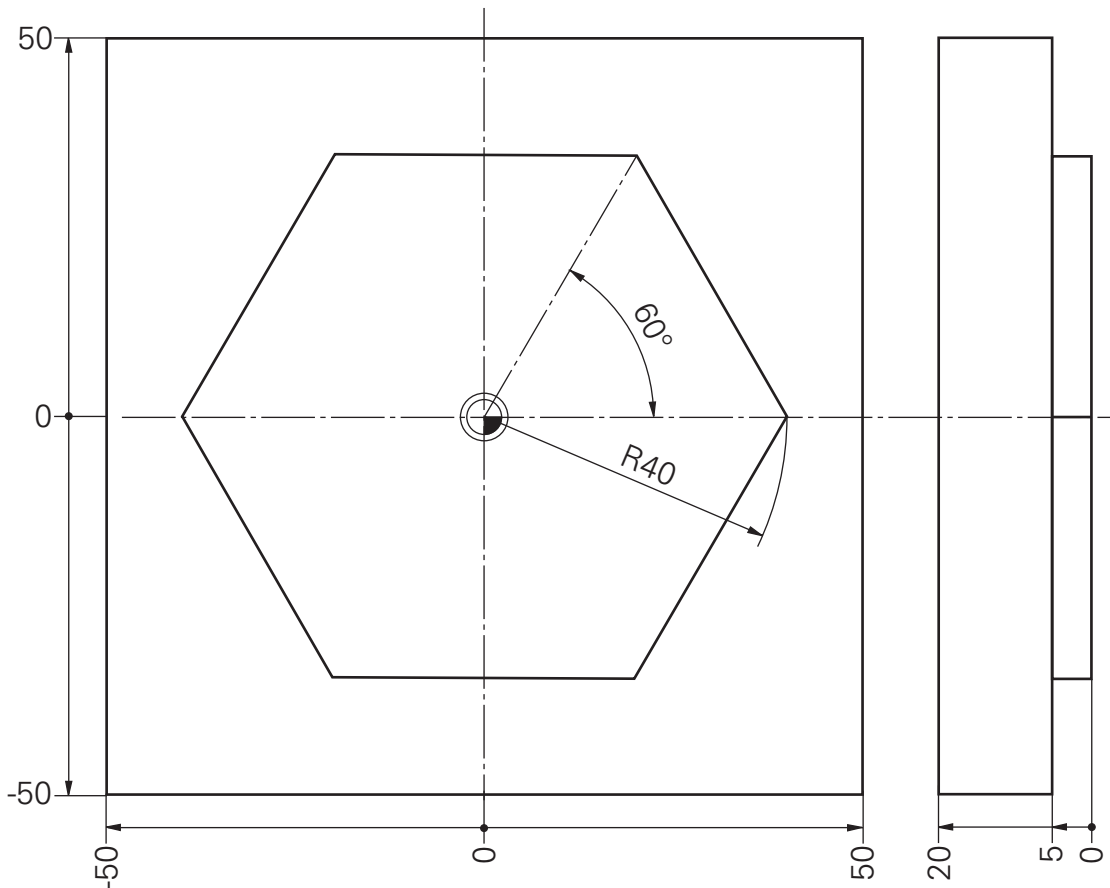
Circular arc with CR



Complete program

```
0 BEGIN PGM 209 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX
5 L X-30 Y-30 R0 F MAX M13 ..... AUXILIARY POINT
6 L Z-5 F MAX
7 APPR LT X+10 Y+0 LEN10 RL F250 ..... APPROACH STARTING POINT
TANGENTIALLY
8 L Y+50
9 CR X+90 Y+50 R+80 DR- ..... CIRCULAR ARC
10 L Y+0
11 DEP LT LEN10 R0 ..... DEPART TANGENTIALLY (AUX.PT.)
12 L Z+100 R0 F MAX M2
13 END PGM 209 MM
```





- Begin program
- Define workpiece blank
- Call tool data
- Move to clearance height
- Define pole
- Auxiliary point in polar coord.
- Plunging depth
- Approach tangentially
- Contour
- ⋮
- Depart tangentially
- Retract tool, PGM end

```

BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL CALL... S...
L Z...

CC X... Y...
LP PR... PA...

L Z...

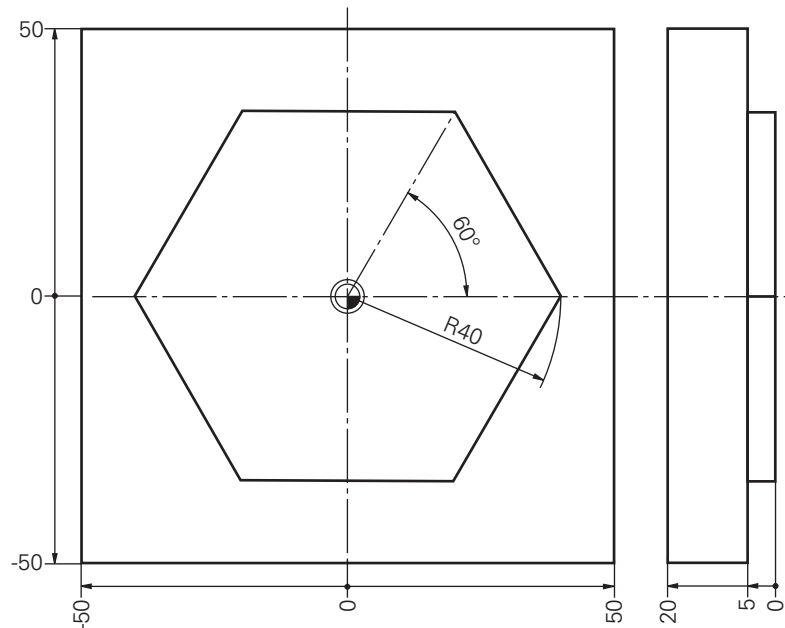
APPR LCT X... Y... R...

LP PR... PA...
⋮
DEP LCT X... Y... R...

L Z...
    
```

Solution:

Hexagon (polar)



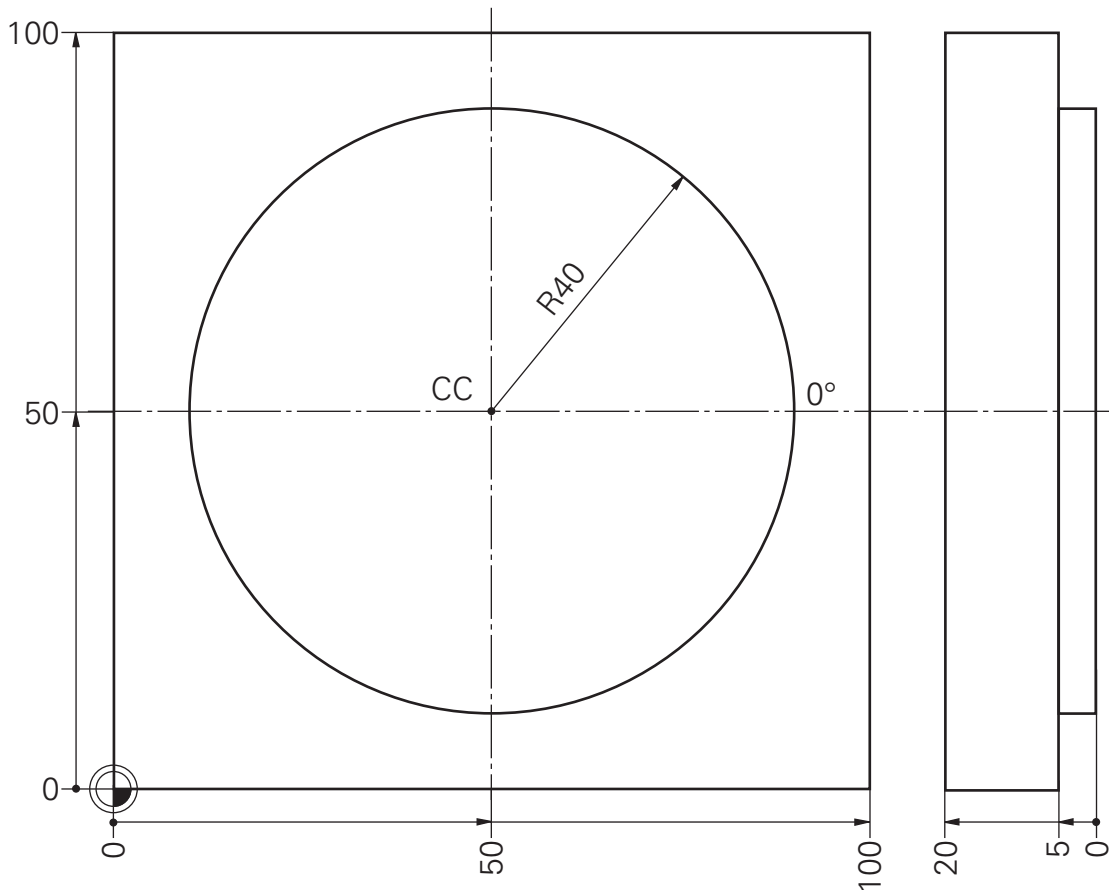
Complete program

```
0 BEGIN PGM 213 MM
1 BLK FORM 0.1 Z X-50 Y-50 Z-20
2 BLK FORM 0.2 X+50 Y+50 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX
5 CC X+0 Y+0 ..... POLE
6 LP PR+80 PA+0 R0 F MAX ..... AUXILIARY POINT (POLAR)
7 L Z-5 F MAX M3
8 APPR LCT X+40 Y+0 R5 RR F250 M8 ..... APPROACH STARTING POINT OF
9 LP PA+60 ..... CONTOUR TANGENTIALLY
10 LP PA+120
11 LP PA+180
12 LP PA+240
13 LP PA+300
14 LP PA+360
15 DEP LCT X+80 Y+0 R5 ..... DEPART TANGENTIALLY
16 L Z+100 R0 F MAX M2
17 END PGM 213 MM
```



Task: **Circle (polar) CP**

Program(s): _____

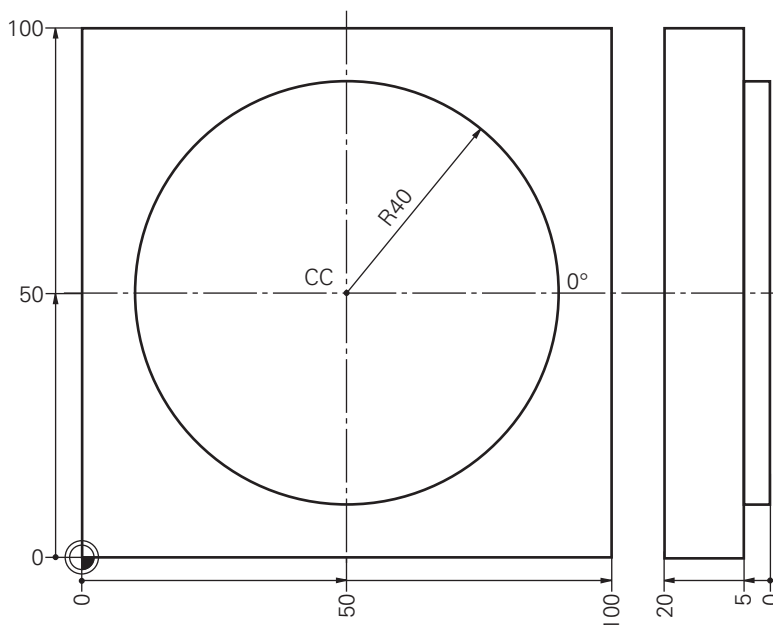


- Begin program
- Define workpiece blank
- Call tool data
- Move to clearance height
- Define pole
- Auxiliary point in polar coord.
- Contour
- Auxiliary point
- Retract tool, PGM end

```
BEGIN PGM... MM  
BLK-FORM 0.1... X... Y... Z...  
BLK-FORM 0.2 X... Y... Z...  
TOOL CALL... S...  
L...  
...  
...  
...  
...  
...
```

Solution:

Circle (polar) CP



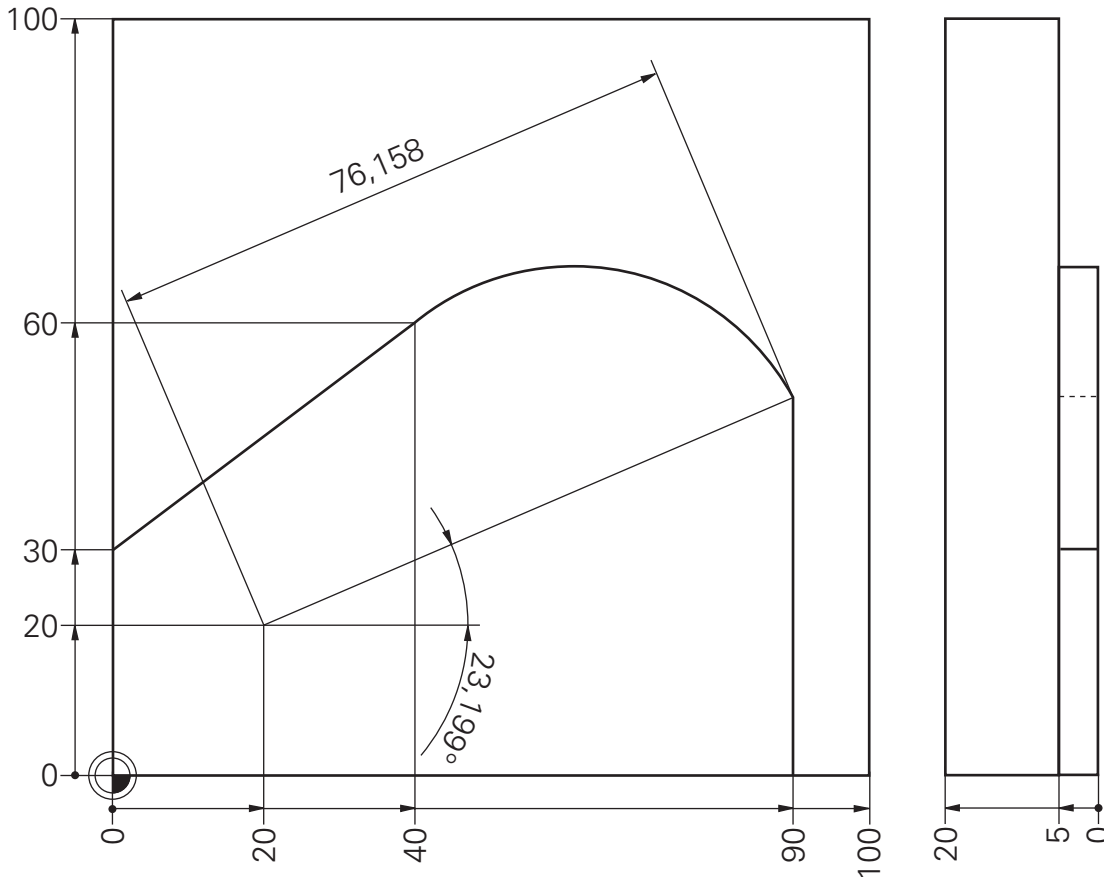
Complete program

```
0 BEGIN PGM 211 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX
5 CC X+50 Y+50 ..... POLE
6 LP PR+80 PA+180 R0 F MAX M3 ..... AUXILIARY POINT
7 L Z-5 F MAX
8 APPR LCT X+10 Y+50 R5 RL F250 M8 ..... APPROACH STARTING POINT OF
CONTOUR TANGENTIALLY
9 CP IPA+360 DR- ..... CIRCLE PATH (POLAR)
10 DEP LCT X-30 Y+50 R5 R0 ..... DEPART TANGENTIALLY
11 L Z+100 F MAX M2
12 END PGM 211 MM
```



Task: **Circular path with tangential connection (polar) CTP**

Program(s): _____



- Begin program
- Define workpiece blank
- Call tool data
- Move to clearance height
- Define pole
- Auxiliary point in polar coord.
- Contour
- Auxiliary point
- Retract tool, PGM end

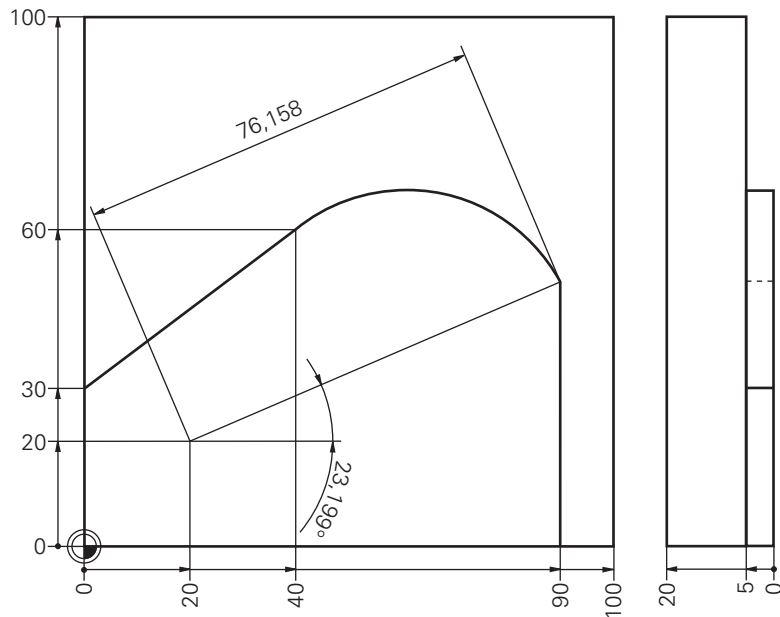
```

BEGIN PGM ... MM
BLK-FORM 0.1 ... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL CALL ... S...
L ...
...
...
...
...
...
...

```

Solution:

Circular path with tangential connection (polar) CTP



Complete program

```

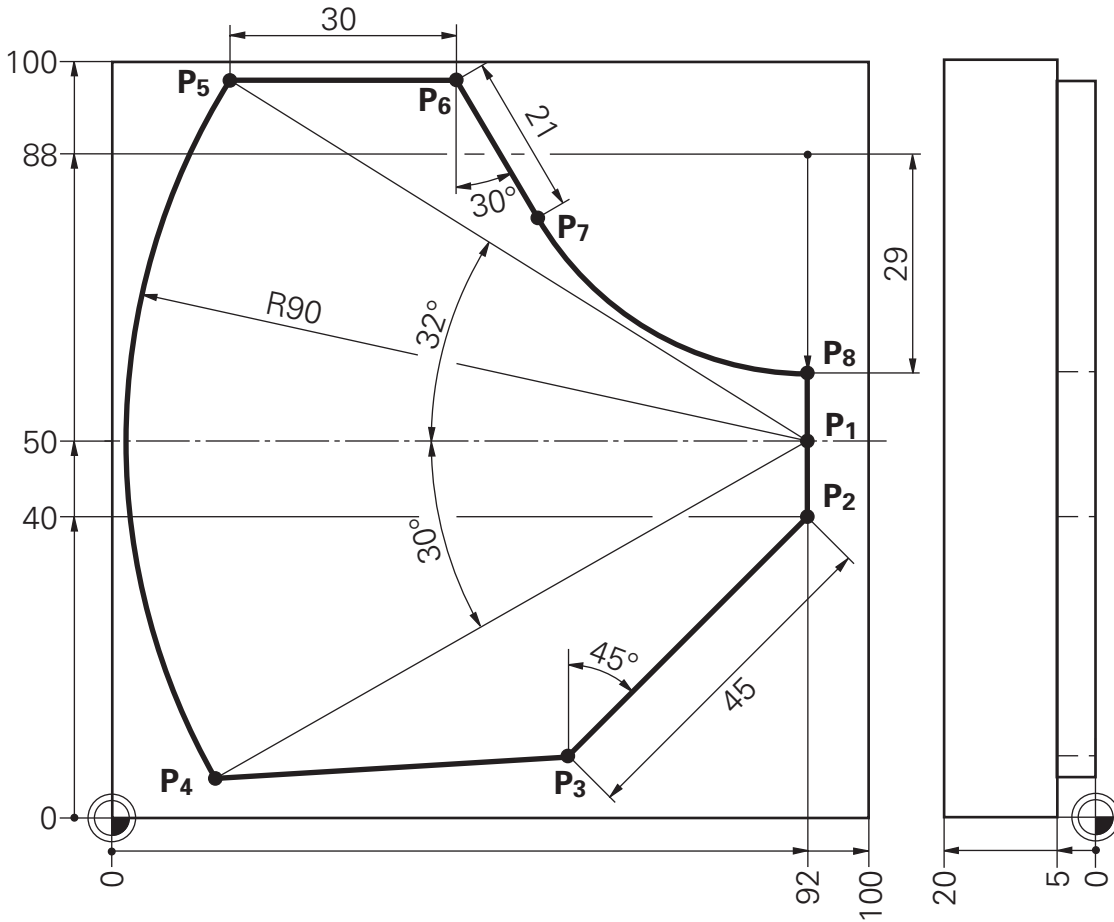
0 BEGIN PGM 212 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+70 Z+0
3 TOOL CALL 13 Z S4000 ..... R20
4 L Z+100 R0 F MAX
5 L X-30 Y-30 R0 F MAX M3 ..... AUXILIARY POINT
6 L Z-5 F MAX
7 APPR LT X+0 Y+0 LEN5 RL F250 M8 ..... APPROACH STARTING POINT OF
8 L X+0 Y+30 ..... CONTOUR TANGENTIALLY
9 L X+40 Y+60
10 CC Y+20 X+20 ..... POLE
11 CTP PR+76,158 PA+23,199 ..... TANGENTIAL CIRCULAR PATH
(POLAR)
12 L Y+0
13 DEPT LT LEN5 R0 ..... DEPART TANGENTIALLY
14 L Z+100 R0 F MAX M2
15 END PGM 212 MM

```



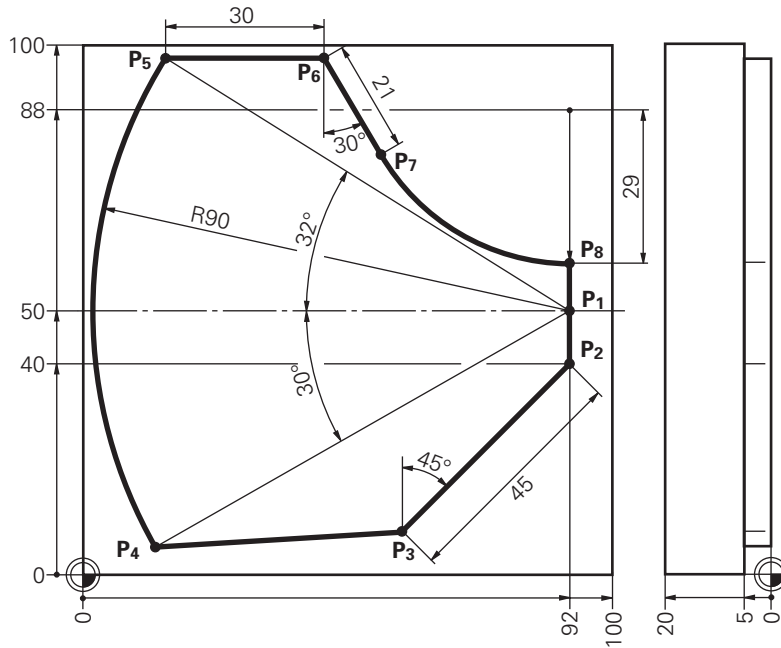
HEIDENHAIN

Basic course G3/Upgrade course D02



Solution:

Polar coordinates (general)



Complete program

```

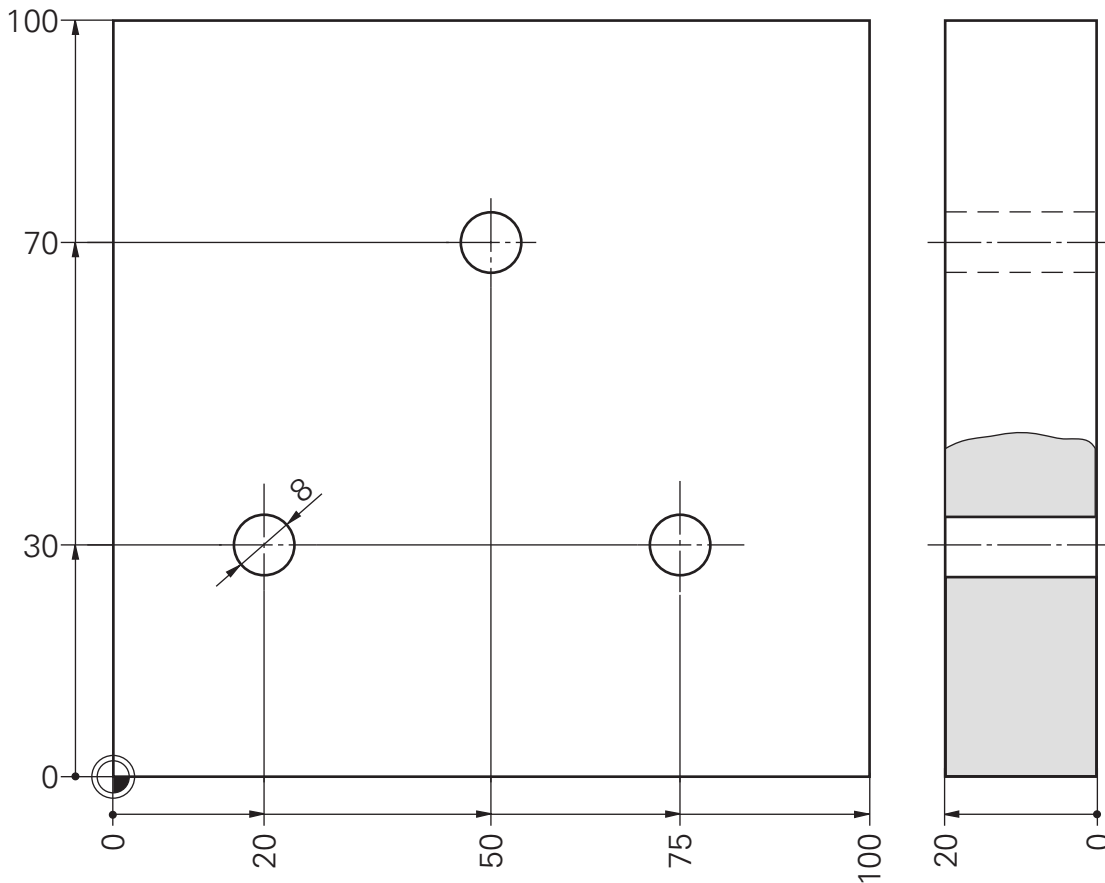
0 BEGIN PGM 252 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX
5 L X+130 Y+50 F MAX M3
6 L Z-5 F MAX
7 APPR LCT X+92 Y+50 R5 RL F250 M8 ..... APPROACH STARTING POINT OF
8 L Y+40 ..... CONTOUR TANGENTIALLY
9 CC X+92 Y+40 ..... POLE
10 LP PR+45 PA-135 ..... STRAIGHT LINE (POLAR)
11 CC X+92 Y+50
12 LP PR+90 PA-150
13 CP PA+148 DR- ..... CIRCULAR PATH (POLAR)
14 L IX+30 IY+0
15 CC ..... DEFINE AS POLE POSITION
16 LP PR+21 PA-60
17 CC X+92 Y+88
18 CTP PR+29 PA-90 ..... TANGENTIAL PATH (POLAR)
19 L Y+50
20 DEP LCT X+130 Y+50 R5 R0 ..... DEPART TANGENTIALLY
21 L Z+100 R0 F MAX M2
22 END PGM 252 MM

```



HEIDENHAIN

Basic course G3/Upgrade course D02



- Begin program
- Define workpiece blank
- Call tool data
- Define cycle
- Move to clearance height
- Starting point first hole / call cycle
- Second hole / call cycle
- Third hole / call cycle
- Retract tool, PGM end

```

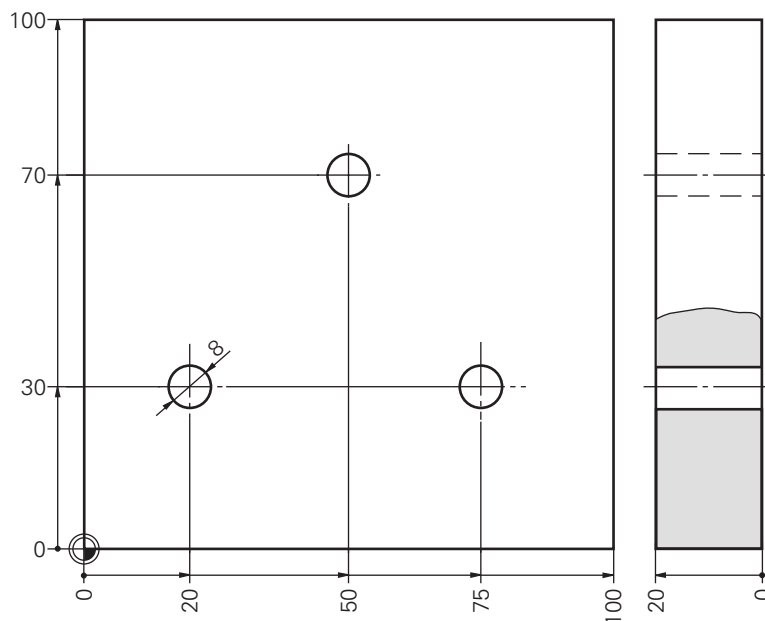
BEGIN PGM... MM
BLK-FORM 0.1... X... Y... Z...
BLK-FORM 0.2 X... Y... Z...
TOOL CALL..... S...
CYCL DEF...
L Z+...
L X... Y... M99

L X... Y... M99

L X... Y... M99
...
    
```

Solution:

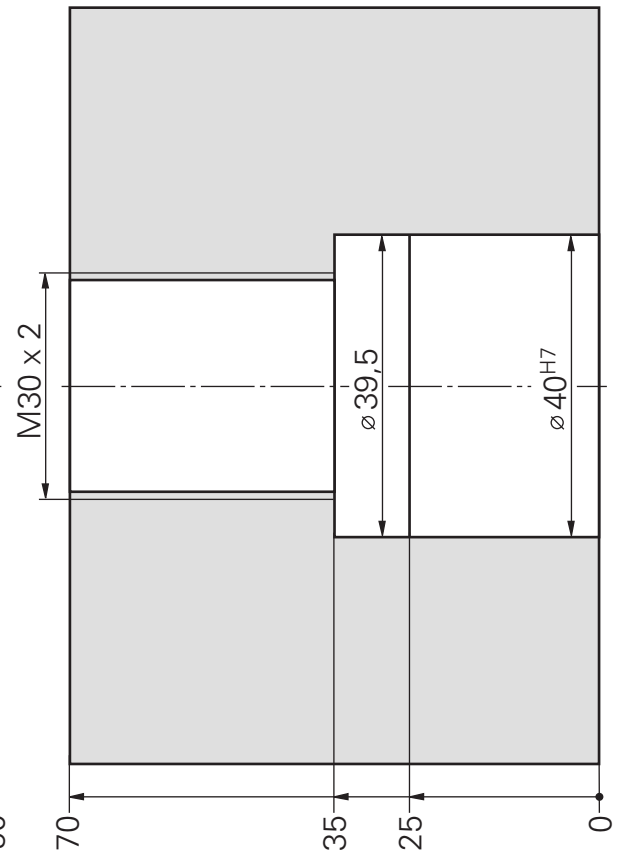
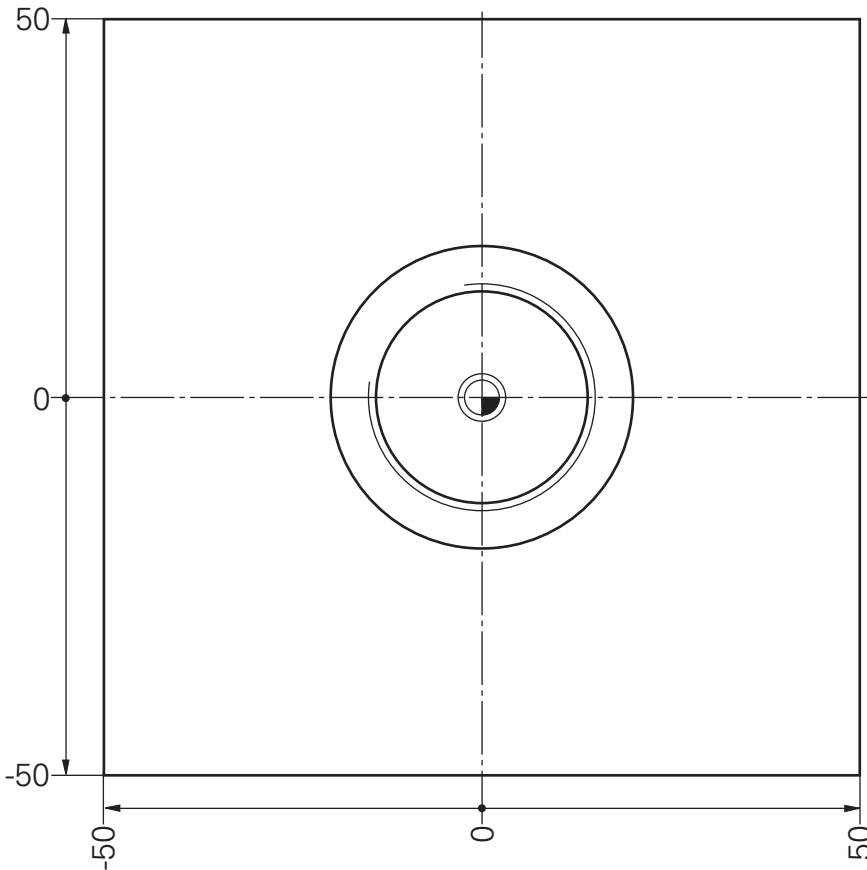
Drilling cycle



Complete program

```
0 BEGIN PGM 201 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 7 Z S1000 ..... R4
4 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-23 ..... DEPTH
  Q206=150 ..... FEED RATE FOR PLUNGING
  Q202=5 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
5 L Z+100 R0 F9999 M3
6 L X+20 Y+30 M99 ..... STARTING POSITION
7 L X+50 Y+70 M99 ..... 2ND HOLE
8 L X+75 Y+30 M99 ..... 3RD HOLE
9 L Z+100 R0 F MAX M2
10 END PGM 201 MM
```





Procedure:

- Centering
- Drilling diameter 28 mm
- Boring
- Reaming
- Tapping

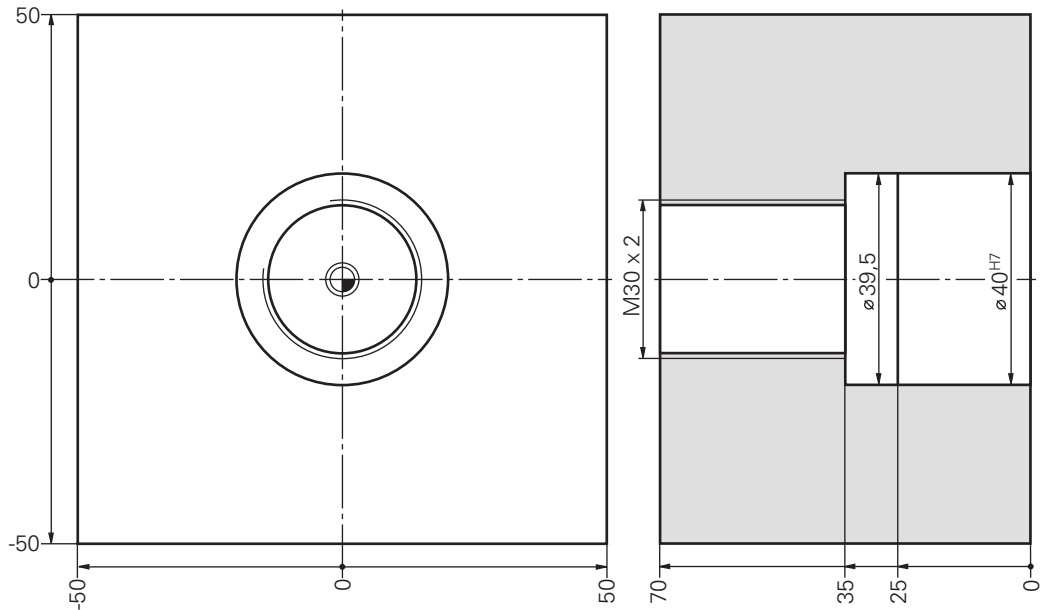
Cycle 1

Cycle 203

Cycle 202

Cycle 201

Cycle 2



Complete program

```

0 BEGIN PGM 260 MM
1 BLK FORM 0.1 Z X-50 Y-50 Z-70
2 BLK FORM 0.2 X+50 Y+50 Z+0
3 TOOL CALL 9 Z S1000 ..... R6
4 L Z+100 R0 F MAX
5 CYCL DEF 1.0 PECKING
6 CYCL DEF 1.1 SET UP 2
7 CYCL DEF 1.2 DEPTH -5
8 CYCL DEF 1.3 PECKG 5
9 CYCL DEF 1.4 DWELL 0
10 CYCL DEF 1.5 F200
11 L X+0 Y+0 R0 F9999 M3
12 L Z+2 M99
13 L Z+100 M6

```

Centering

Drilling

```

14 TOOL CALL 11 Z S350 ..... R10
15 CYCL DEF 203 UNIVERSAL DRILLING
    Q200=5 ..... SET UP CLEARANCE
    Q201=-80 ..... DEPTH
    Q206=100 ..... FEED RATE FOR PLUNGING
    Q202=15 ..... PLUNGING DEPTH
    Q210=0 ..... DWELL TIME AT TOP
    Q203=+0 ..... SURFACE COORDINATE
    Q204=20 ..... 2ND SET UP CLEARANCE
    Q212=2 ..... DECREMENT
    Q213=2 ..... NR OF BREAKS
    Q205=5 ..... MIN. PLUNGING DEPTH
    Q211=0 ..... DWELL TIME AT DEPTH
    Q208=500 ..... RETRACTION FEED RATE
16 CYCL CALL M3
17 L Z+100 M6

```



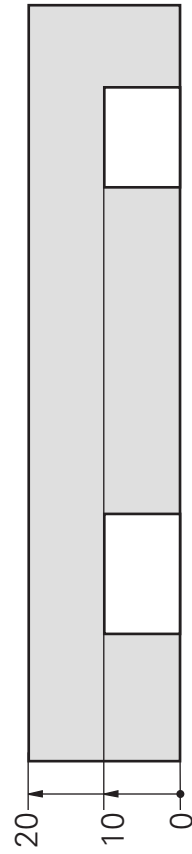
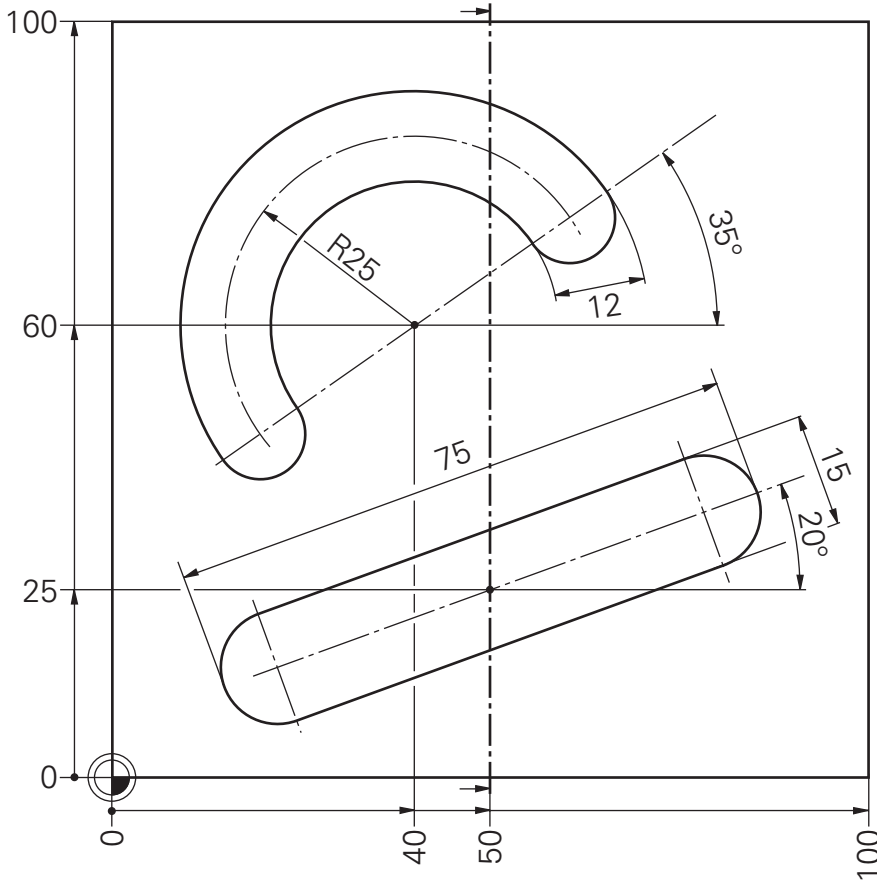
Solution: Drilling with 200-series cycles

Boring	18	TOOL CALL 13 Z S500	R20
	19	CYCL DEF 202 BORING	
		Q200=2	SET UP CLEARANCE
		Q201=-35	DEPTH
		Q206=250	FEED RATE FOR PLUNGING
		Q211=0	DWELL TIME AT DEPTH
		Q208=500	RETRACTION FEED RATE
		Q203=+0	SURFACE COORDINATE
		Q204=20	2ND SET UP CLEARANCE
		Q214=0	DISENGAGING DIRECTION
		20	CYCL CALL M3
	21	L Z+100 M6	
Reaming	22	TOOL CALL 13 Z S100	R20
	23	CYCL DEF 201 REAMING	
		Q200=5	SET UP CLEARANCE
		Q201=-25	DEPTH
		Q206=100	FEED RATE FOR PLUNGING
		Q211=0	DWELL TIME AT DEPTH
		Q208=300	RETRACTION FEED RATE
		Q203=+0	SURFACE COORDINATE
		Q204=20	2ND SET UP CLEARANCE
		24	CYCL CALL M3
	25	L Z+100 M6	
Tapping	26	TOOL CALL 12 Z S50	R15
	27	CYCL DEF 2.0 TAPPING	
	28	CYCL DEF 2.1 SET UP 5	
	29	CYCL DEF 2.2 DEPTH -45	
	30	CYCL DEF 2.3 DWELL 0	
	31	CYCL DEF 2.4 F100	
	32	L Z-30 M3	
	33	CYCL CALL	
	34	L Z+100 M2	
	35	END PGM 260 MM	



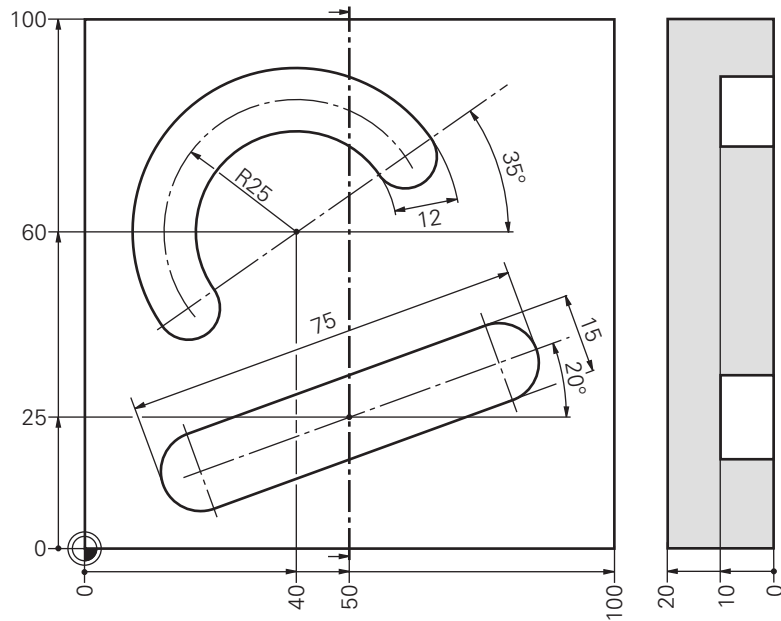
Task: **Slot plate**

Program(s): _____



Solution:

Slot plate



Complete program

```

0 BEGIN PGM 210 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 8 Z S1000 ..... R5
4 L Z+100 R0 F9999 M3
5 CYCL DEF 210 SLOT RECIP. PLNG
  Q200=2 ..... SET UP CLEARANCE
  Q201=-10 ..... DEPTH
  Q207=100 ..... FEED RATE FOR MILLING
  Q202=5 ..... PLUNGING DEPTH
  Q215=0 ..... MACHINING OPERATION
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
  Q216=+50 ..... CENTER IN 1ST AXIS
  Q217=+25 ..... CENTER IN 2ND AXIS
  Q218=75 ..... FIRST SIDE LENGTH
  Q219=15 ..... SECOND SIDE LENGTH
  Q224=+20 ..... ANGLE OF ROTATION
6 CYCL CALL

7 CYCL DEF 211 CIRCULAR SLOT
  Q200=2 ..... SET UP CLEARANCE
  Q201=-10 ..... DEPTH
  Q207=250 ..... FEED RATE FOR MILLING
  Q202=5 ..... PLUNGING DEPTH
  Q215=0 ..... MACHINING OPERATION
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
  Q216=+40 ..... CENTER IN 1ST AXIS
  Q217=+60 ..... CENTER IN 2ND AXIS
  Q244=50 ..... PITCH CIRCLE DIAMETER
  Q219=12 ..... SECOND SIDE LENGTH
  Q245=+35 ..... STARTING ANGLE
  Q248=180 ..... ANGULAR LENGTH
8 CYCL CALL

9 L Z+100 M2
10 END PGM 210 MM

```

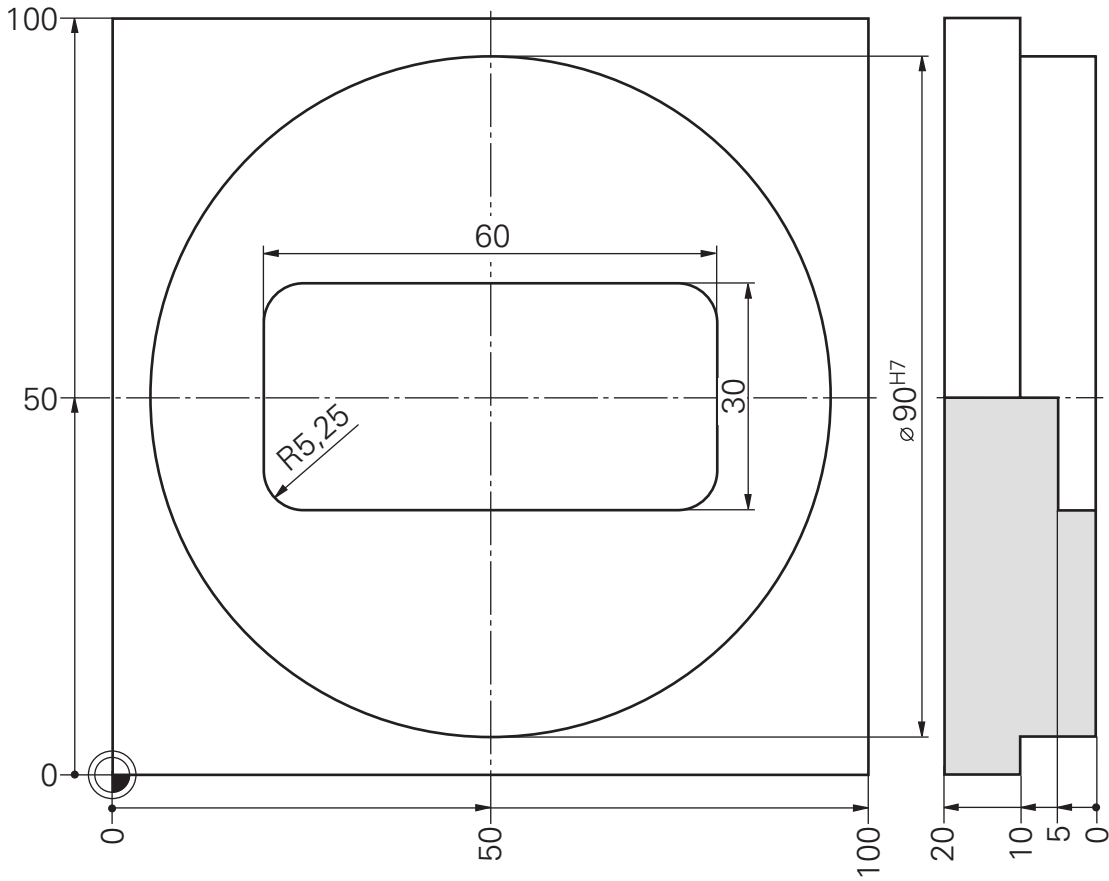


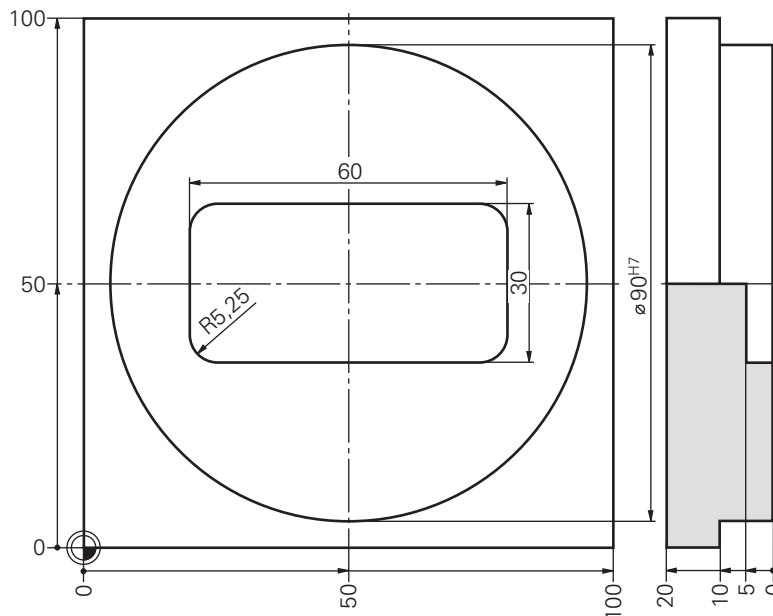
HEIDENHAIN

Basic course G3/Upgrade course D02

Task: **Die I**

Program(s): _____





Complete program

```

0 BEGIN PGM 265 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 9 Z S500 DR+1 ..... R6
4 L Z+100 R0 F9999
5 CC X+50 Y+50
6 LP PR+70 PA+0
7 L Z+2 M3
8 L Z-10 F200
9 CP PA+360 DR-
10 LP PR+60
11 CP PA+360 DR-
12 LP PR+45 RL
13 CP PA+360 DR-
14 LP PR+65 PA+0 R0
15 L Z+2
16 CYCL DEF 4.0 POCKET MILLING
17 CYCL DEF 4.1 SET UP 2
18 CYCL DEF 4.2 DEPTH -5
19 CYCL DEF 4.3 PECKG 5 F100
20 CYCL DEF 4.4 X60
21 CYCL DEF 4.5 Y30
22 CYCL DEF 4.6 F250 DR- RADIUS 7
23 L X+50 Y+50 R0 F MAX M99
24 L Z+100 F MAX M6

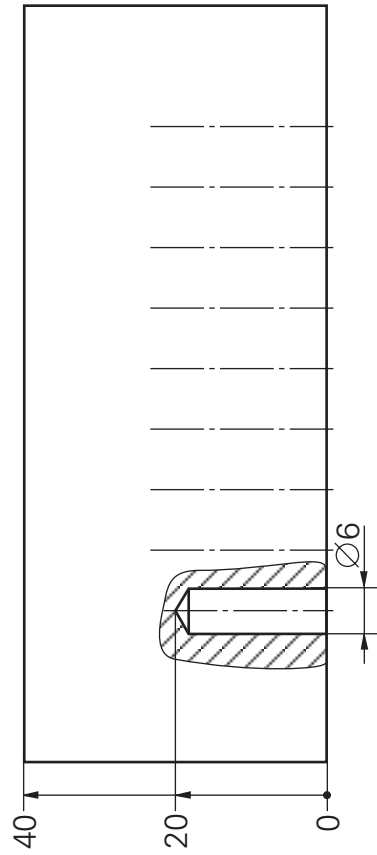
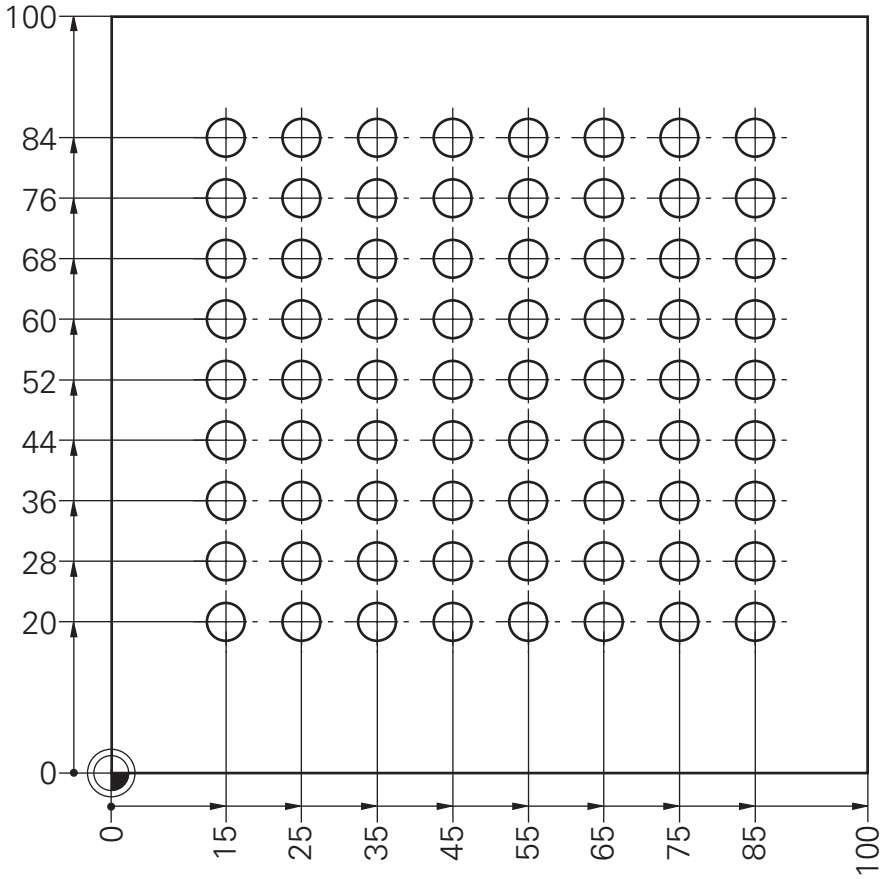
```

25	TOOL CALL 8 Z S1000	R5
26	CYCL DEF 212 POCKET FINISHING	
	Q200=2	SET UP CLEARANCE
	Q201=-5	DEPTH
	Q206=250	FEED RATE FOR PLUNGING
	Q202=5	PLUNGING DEPTH
	Q207=250	FEED RATE FOR MILLING
	Q203=+0	SURFACE COORDINATE
	Q204=20	2ND SET UP CLEARANCE
	Q216=+50	CENTER IN 1ST AXIS
	Q217=+50	CENTER IN 2ND AXIS
	Q218=60	FIRST SIDE LENGTH
	Q219=30	SECOND SIDE LENGTH
	Q220=5,25	CORNER RADIUS
	Q221=0	ALLOWANCE IN 1ST AXS
27	CYCL CALL M3	
28	CYCL DEF 215 C. STUD FINISHING	
	Q200=2	SET UP CLEARANCE
	Q201=-10	DEPTH
	Q206=250	FEED RATE FOR PLUNGING
	Q202=10	PLUNGING DEPTH
	Q207=250	FEED RATE FOR MILLING
	Q203=+0	SURFACE COORDINATE
	Q204=20	2ND SET UP CLEARANCE
	Q216=+50	CENTER IN 1ST AXIS
	Q217=+50	CENTER IN 2ND AXIS
	Q222=92	WORKPIECE BLANK DIAMETER
	Q223=90	FINISHED PART DIAMETER
29	CYCL CALL	
30	L Z+100 R0 F MAX M2	
31	END PGM 265 MM	



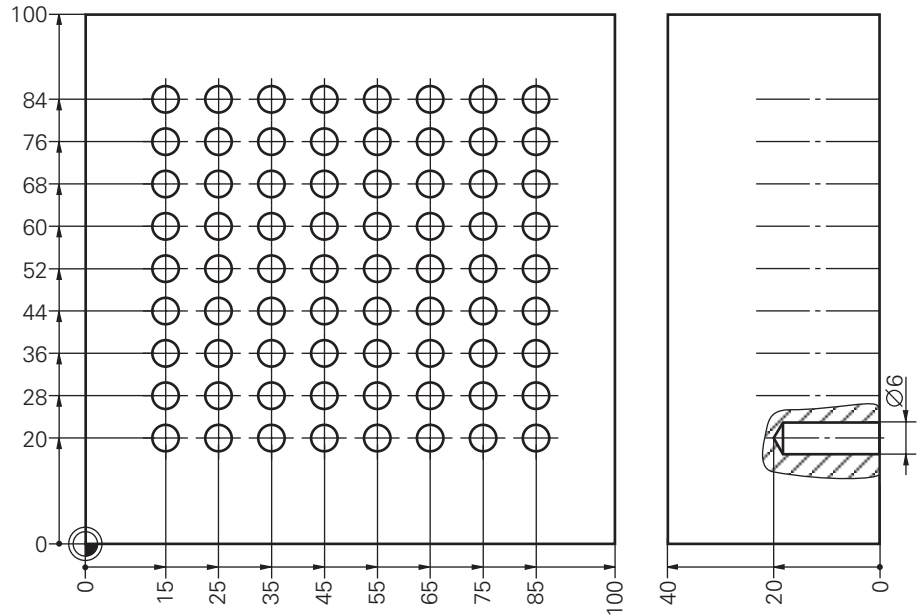
Task: Linear hole pattern

Program(s): _____



Solution:

Linear hole pattern



Main program

```

0 BEGIN PGM 220 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-40
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 6 Z S1500 ..... R3
4 L Z+100 R0 F9999 M3
5 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-20 ..... DEPTH
  Q206=100 ..... FEED RATE FOR PLUNGING
  Q202=5 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
6 CALL LBL 1

Retract tool, end      7 L Z+100 M2
  
```

SPGM

```

8 LBL 1
9 CYCL DEF 221 CARTESIAN PATTRN
  Q225=+15 ..... STARTNG PNT 1ST AXIS
  Q226=+20 ..... STARTNG PNT 2ST AXIS
  Q237=+10 ..... SPACING IN 1ST AXIS
  Q238=+8 ..... SPACING IN 2ND AXIS
  Q242=8 ..... NUMBER OF COLUMNS
  Q243=9 ..... NUMBER OF ROWS
  Q224=+0 ..... ANGLE OF ROTATION
  Q200=2 ..... SET UP CLEARANCE
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
10 LBL 0
11 END PGM 220 MM
  
```

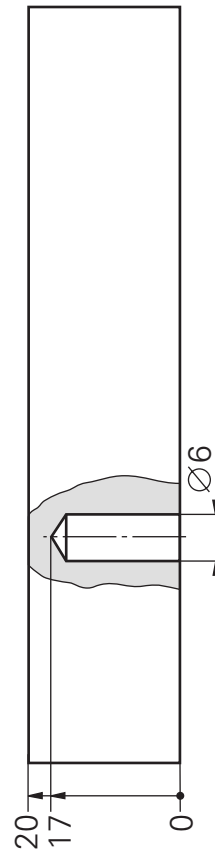
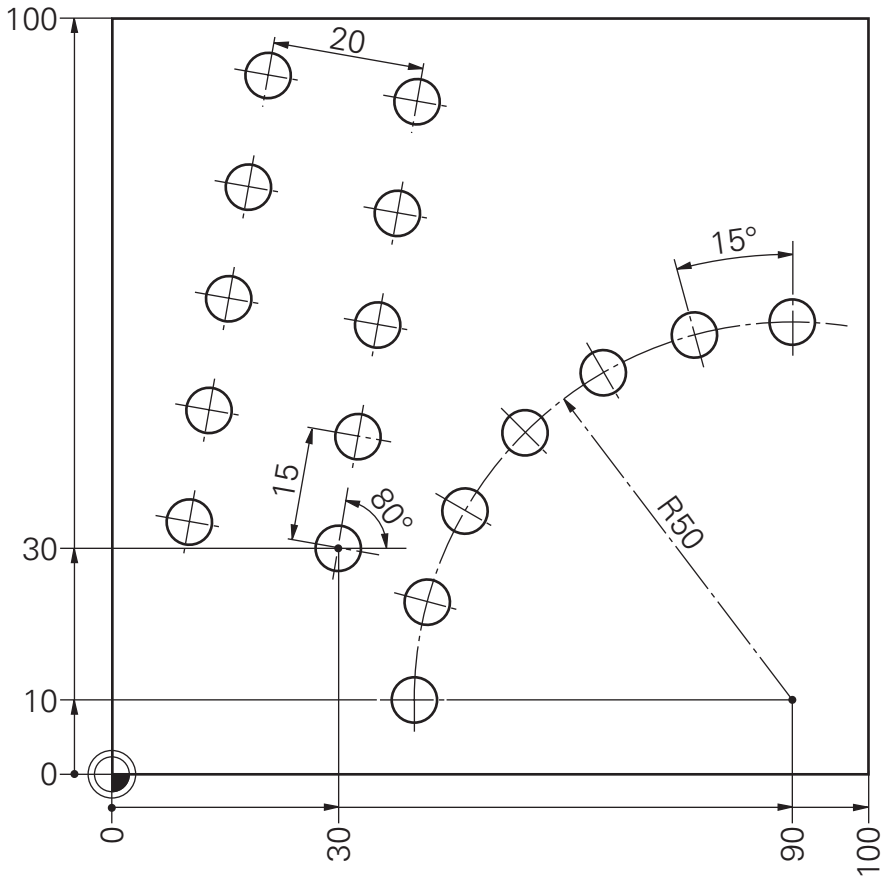


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Basic course G3/Upgrade course D02

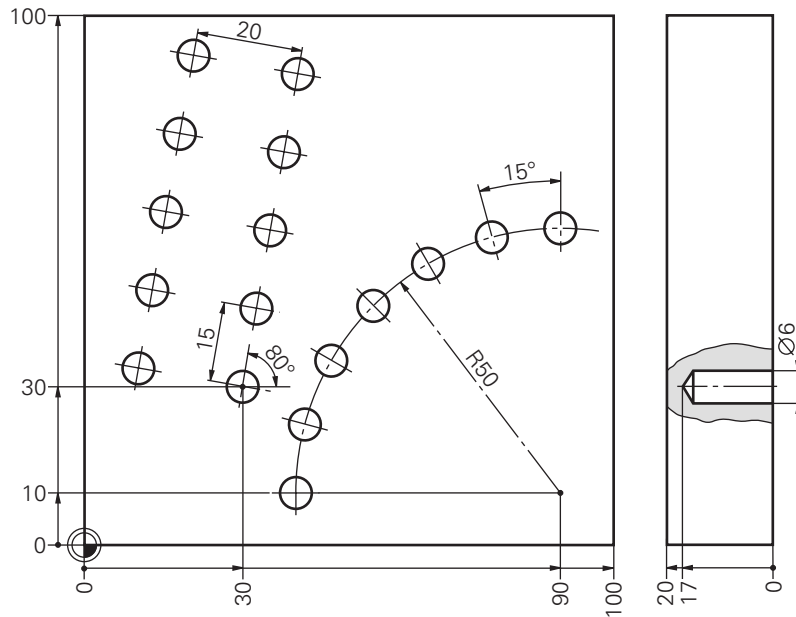
Task: **Hole pattern**

Program(s): _____



Solution:

Hole pattern



Main program

```

0 BEGIN PGM 221 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 6 Z S1500 ..... R3
4 L Z+100 R0 F9999 M3
5 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-17 ..... DEPTH
  Q206=150 ..... FEED RATE FOR PLUNGING
  Q202=6 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
6 CALL LBL 1
7 CALL LBL 2

Retract tool, end      8 L Z+100 M2
  
```

SPGM

```

9 LBL 1
10 CYCL DEF 220 POLAR PATTERN
  Q216=+90 ..... CENTER IN 1ST AXIS
  Q217=+10 ..... CENTER IN 2ND AXIS
  Q244=100 ..... PITCH CIRCLE DIA.
  Q245=+90 ..... STARTING ANGLE
  Q246=+180 ..... STOPPING ANGLE
  Q247=15 ..... STEPPING ANGLE
  Q241=7 ..... NR OF REPETITIONS
  Q200=2 ..... SET UP CLEARANCE
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
11 LBL 0
  
```



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Basic course G3/Upgrade course D02

Solution:

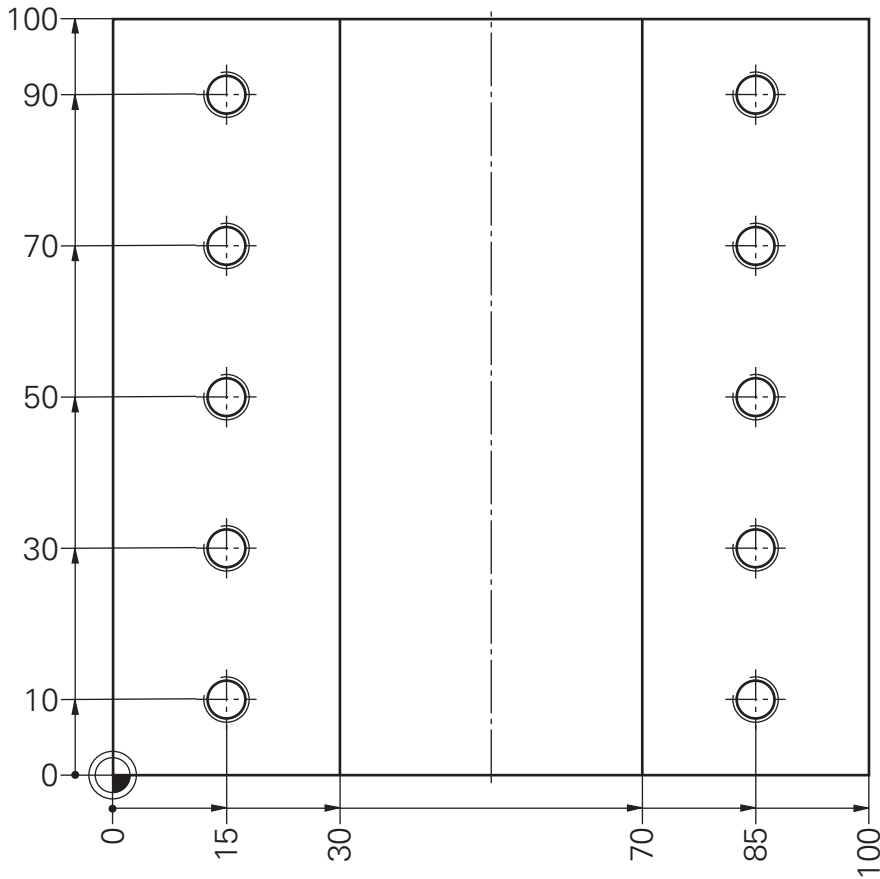
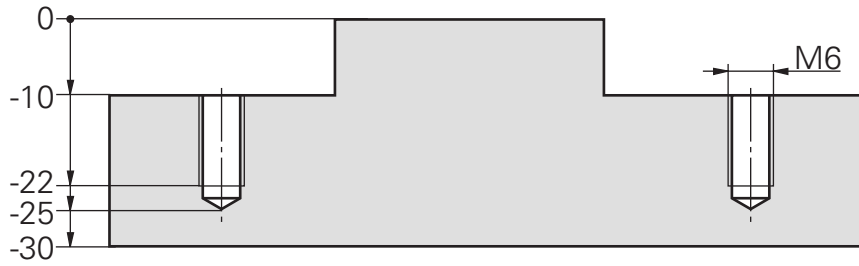
Hole pattern

```
12 LBL 2
13 CYCL DEF 221 CARTESIAN PATTRN
    Q225=+30..... STARTNG PNT 1ST AXIS
    Q226=+30..... STARTNG PNT 2ND AXIS
    Q237=+15..... SPACING IN 1ST AXIS
    Q238=+20..... SPACING IN 2ND AXIS
    Q242=5..... NUMBER OF COLUMNS
    Q243=2..... NUMBER OF ROWS
    Q224=+80..... ANGLE OF ROTATION
    Q200=2..... SET UP CLEARANCE
    Q203=+0..... SURFACE COORDINATE
    Q204=2..... 2ND SET UP CLEARANCE
14 LBL 0
15 END PGM 221 MM
```



Task: Guide plate

Program(s): _____

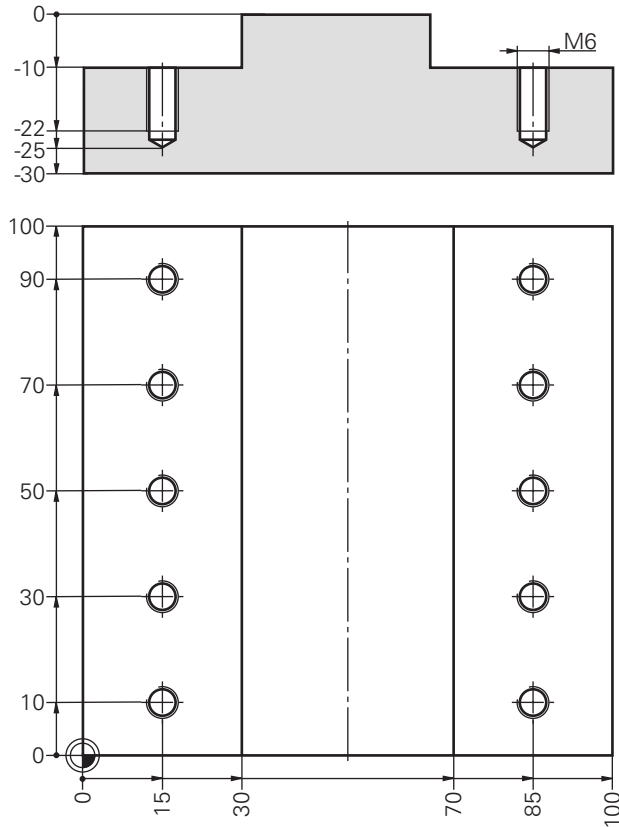


- Procedure:**
- Shoulders
 - Centering
 - Drilling
 - Tapping

Cycle 200
Cycle 200
Cycle 2

Solution:

Guide plate



Main program

```
0 BEGIN PGM 261 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-30
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S500 ..... R20
4 L Z+100 R0 F9999
5 L X-50 Y-50
6 L Z+2 M3
7 L Z-10 F200
8 APPR LCT X+30 Y+0 R2 RL
9 L Y+100
10 DEP LCT X+0 Y+150 R2 R0
11 L X+100 F MAX
12 APPR LCT X+70 Y+100 R2 RL
13 L Y+0
14 DEP LCT X+100 Y-50 R2 R0
15 L Z+100 R0 F9999 M6

16 TOOL CALL 4 Z S2000 ..... R2,5
17 CYCL DEF 200 DRILLING
    Q200=2 ..... SET UP CLEARANCE
    Q201=-3,5 ..... DEPTH
    Q206=250 ..... FEED RATE FOR PLUNGING
    Q202=3,5 ..... PLUNGING DEPTH
    Q210=0 ..... DWELL TIME AT TOP
    Q203=-10 ..... SURFACE COORDINATE
    Q204=20 ..... 2ND SET UP CLEARANCE
18 L Z+5 M3
19 CALL LBL 1
20 L Z+100 M6
```



HEIDENHAIN

Basic course G3/Upgrade course D02

21	TOOL CALL 5 Z S2000	R2,5
22	CYCL DEF 200 DRILLING	
	Q200=2	SET UP CLEARANCE
	Q201=-15	DEPTH
	Q206=250	FEED RATE FOR PLUNGING
	Q202=5	PLUNGING DEPTH
	Q210=0	DWELL TIME AT TOP
	Q203=-10	SURFACE COORDINATE
	Q204=20	2ND SET UP CLEARANCE
23	L Z+5 M3	
24	CALL LBL 1	
25	L Z+100 M6	
26	TOOL CALL 6 Z S300	R3
27	CYCL DEF 2.0 TAPPING	
28	CYCL DEF 2.1 SET UP 2	
29	CYCL DEF 2.2 DEPTH -12	
30	CYCL DEF 2.3 DWELL 0	
31	CYCL DEF 2.4 F300	
32	L Z+5 M3	
33	CALL LBL 1	
<hr/>		
Retract tool, end	34	L Z+100 R0 F MAX M2

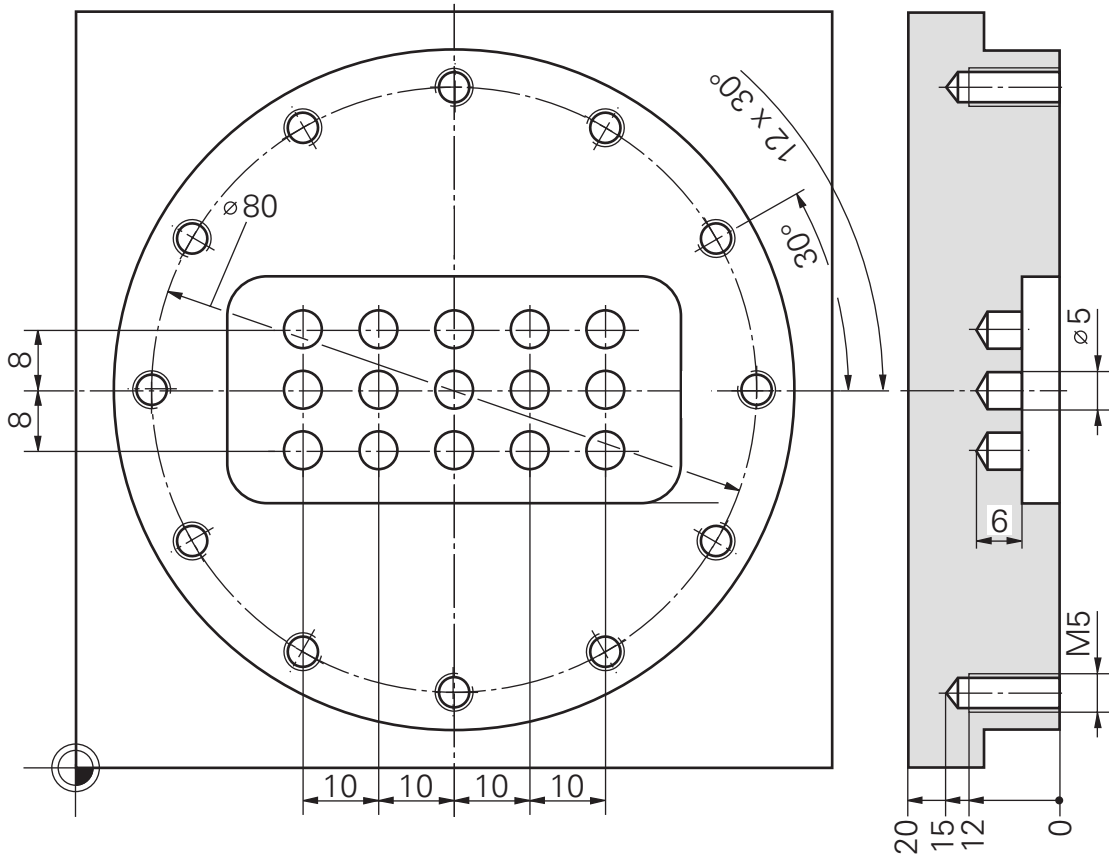
SPGM

35	LBL 1	
36	CYCL DEF 221 CARTESIAN PATTRN	
	Q225=+15	STARTNG PNT 1ST AXIS
	Q226=+10	STARTNG PNT 2ND AXIS
	Q237=+70	SPACING IN 1ST AXIS
	Q238=+20	SPACING IN 2ND AXIS
	Q242=2	NUMBER OF COLUMNS
	Q243=5	NUMBER OF LINES
	Q224=+0	ANGLE OF ROTATION
	Q200=2	SET UP CLEARANCE
	Q203=-10	SURFACE COORDINATE
	Q204=20	2ND SET UP CLEARANCE
37	LBL 0	
38	END PGM 261 MM	

SPGM, end

Task: **Die II**

Program(s): _____



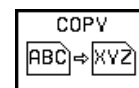
Program layout: **Die II**

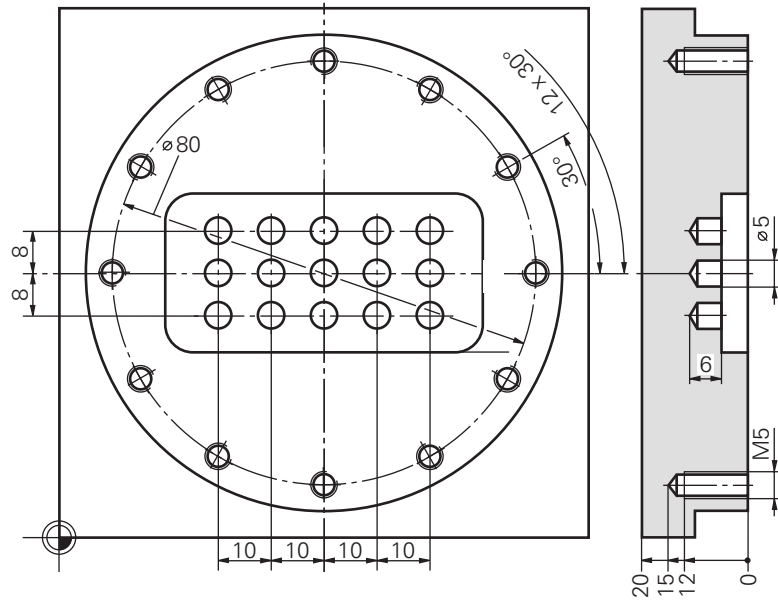
Define workpc. blank	<i>BLK FORM</i>	
	<i>CALL PGM...</i>	PGM-Call
Drilling \varnothing 5 mm	<i>CYCL DEF...</i>	
	<i>CALL LBL...</i>	SPGM1-Call
	<i>L Z100... M6</i>	Tool change
Centering, pitch circle	<i>CYCL DEF...</i>	
	<i>CALL LBL...</i>	SPGM2-Call
	<i>L Z100... M6</i>	Tool change
Drilling, pitch circle	<i>CYCL DEF...</i>	
	<i>CALL LBL...</i>	SPGM2-Call
	<i>L Z100... M6</i>	Tool change
Tapping	<i>CYCL DEF...</i>	
	<i>CALL LBL...</i>	SPGM2-Call
Retract tool, end	<i>L Z... M2</i>	

SPGM1	<i>LBL 1</i>
Cartesian pattern	<i>CYCL DEF...</i>
	<i>LBL 0</i>
SPGM2	<i>LBL 2</i>
Polar pattern	<i>CYCL DEF...</i>
	<i>LBL 0</i>



Copy help program from PGM 265





Main program

```

0 BEGIN PGM 266 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 CALL PGM 26501 ..... HELP PROGRAM
4 TOOL CALL 5 Z S2000 ..... R2,5
5 L Z+100 M3
6 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-6 ..... DEPTH
  Q206=200 ..... FEED RATE FOR PLUNGING
  Q202=6 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=-5 ..... SURFACE COORDINATE
  Q204=20 ..... 2ND SET UP CLEARANCE
7 CALL LBL 1
8 L Z+100 R0 F9999 M6

  9 TOOL CALL 4 Z S2000 ..... R2
10 L Z+100 M3
11 CYCL DEF 1.0 PECKING
12 CYCL DEF 1.1 SET UP 2
13 CYCL DEF 1.2 DEPTH -2,8
14 CYCL DEF 1.3 PECKG 2,8
15 CYCL DEF 1.4 DWELL 0
16 CYCL DEF 1.5 F200
17 CALL LBL 2
18 L Z+100 M6

  19 TOOL CALL 5 Z S1500 ..... R2,5
20 L Z+100 M3
21 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-15 ..... DEPTH
  Q206=200 ..... FEED RATE FOR PLUNGING
  Q202=8 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=20 ..... 2ND SET UP CLEARANCE
22 CALL LBL 2
23 L Z+100 M6
    
```



```

24 TOOL CALL 6 Z S300 ..... R3
25 L Z+100 M3
26 CYCL DEF 2.0 TAPPING
27 CYCL DEF 2.1 SET UP 2
28 CYCL DEF 2.2 DEPTH -12
29 CYCL DEF 2.3 DWELL 1
30 CYCL DEF 2.4 F300
31 CALL LBL 2

32 L Z+100 R0 F MAX M2

```

SPGM

```

33 LBL 1
34 CYCL DEF 221 CARTESIAN PATTRN
  Q225=+30 ..... STARTNG PNT 1ST AXIS
  Q226=+42 ..... STARTNG PNT 2ND AXIS
  Q237=+10 ..... SPACING IN 1ST AXIS
  Q238=+8 ..... SPACING IN 2ND AXIS
  Q242=5 ..... NUMBER OF COLUMNS
  Q243=3 ..... NUMBER OF LINES
  Q224=+0 ..... ANGLE OF ROTATION
  Q200=2 ..... SET UP CLEARANCE
  Q203=-6 ..... SURFACE COORDINATE
  Q204=20 ..... 2ND SET UP CLEARANCE
35 LBL 0

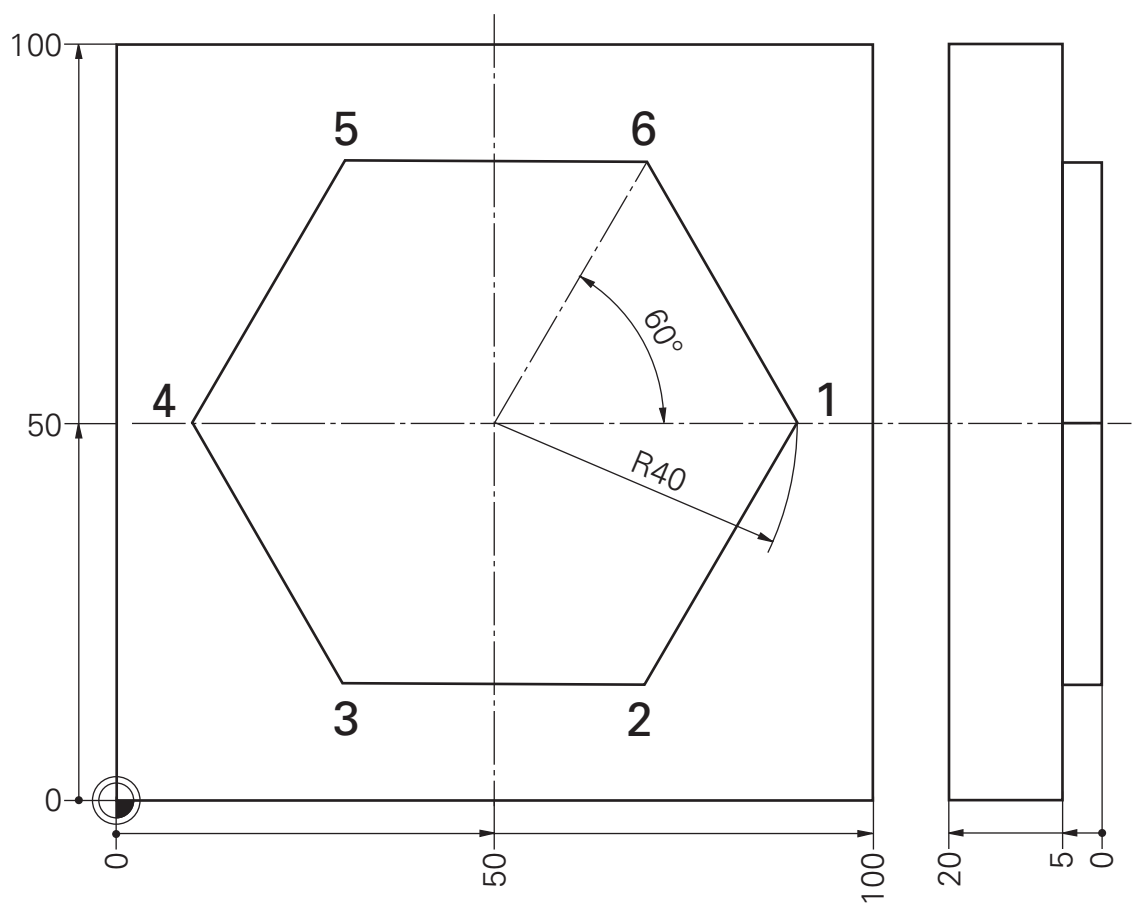
36 LBL 2
37 CYCL DEF 220 POLAR PATTERN
  Q216=+50 ..... CENTER IN 1ST AXIS
  Q217=+50 ..... CENTER IN 2ND AXIS
  Q244=80 ..... PITCH CIRCLE DIA.
  Q245=+0 ..... STARTING ANGLE
  Q246=+360 ..... STOPPING ANGLE
  Q247=30 ..... STEPPING ANGLE
  Q241=12 ..... NR OF REPETITIONS
  Q200=2 ..... SET UP CLEARANCE
  Q203=+0 ..... SURFACE COORDINATE
  Q204=20 ..... 2ND SET UP CLEARANCE
38 LBL 0
39 END PGM 266 MM

```



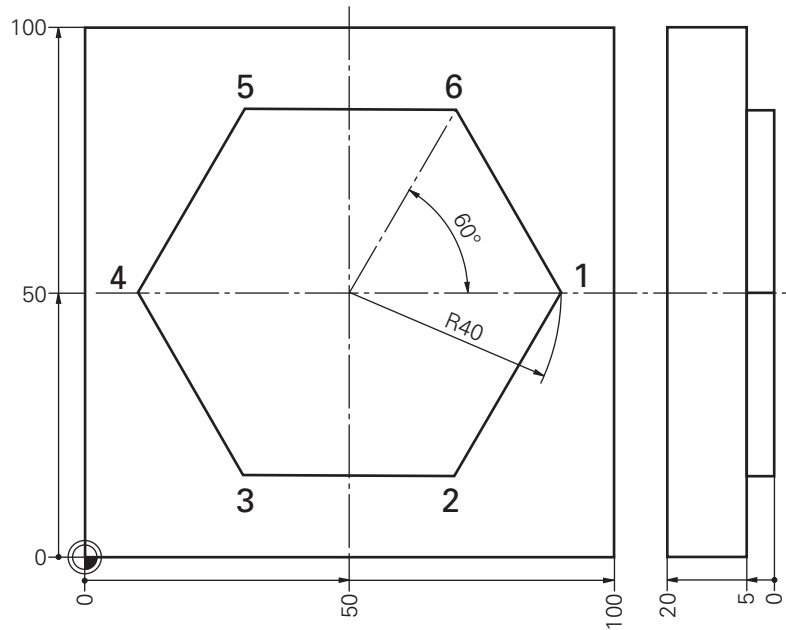
Task: **Hexagon**

Program(s): _____



Solution:

Hexagon



Complete program

```
0 BEGIN PGM 268 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 12 Z S500 ..... R15
4 L Z+100 R0 F9999
5 CC X+50 Y+50 ..... POLE
6 LP PR+80 PA+0 R0 ..... AUXILIARY POINT
7 L Z-5 M3
8 APPR LCT X+90 Y+50 R2 RL F100 ..... STARTING POINT

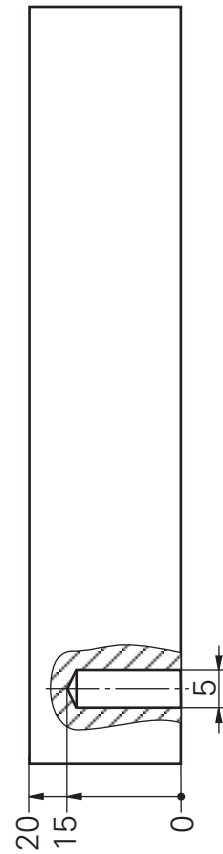
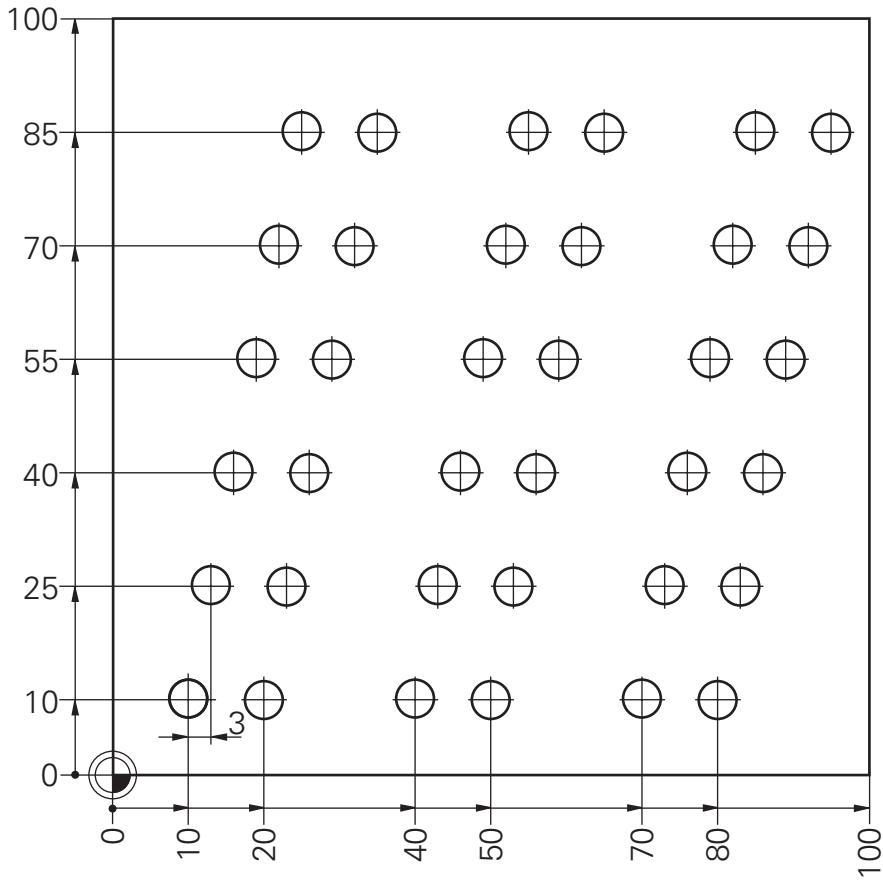
9 LBL 1 ..... DEFINE LABEL
10 LP PR+40 IPA-60
11 CALL LBL 1 REP 5/5 ..... CALL LABEL WITH REPEATS

12 DEP LCT X+130 Y+50 R2 R0 F200 ..... AUXILIARY POINT
13 L Z+100 R0 F MAX M2
14 END PGM 268 MM
```

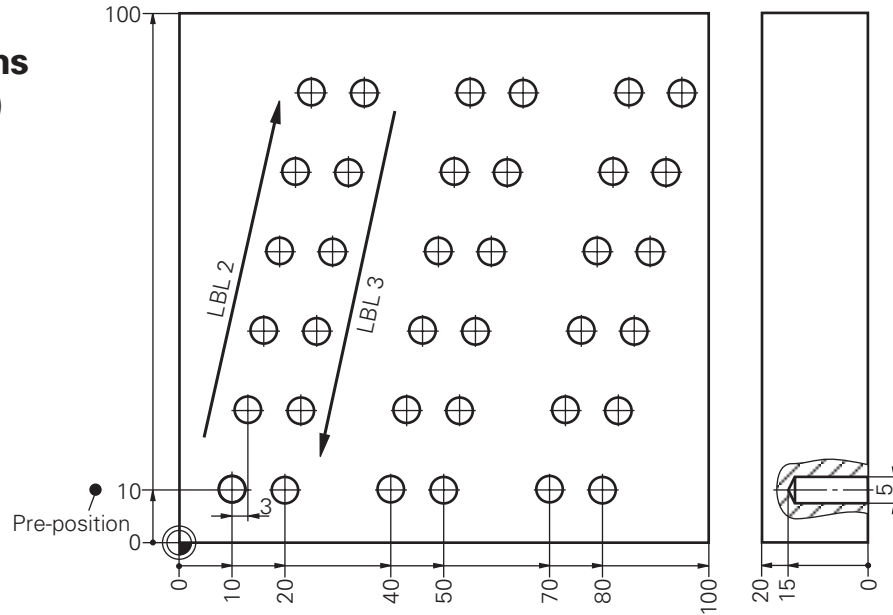


Task: **Drilled plate – slanted columns**

Program(s): _____



Move up and down columns (meandering)

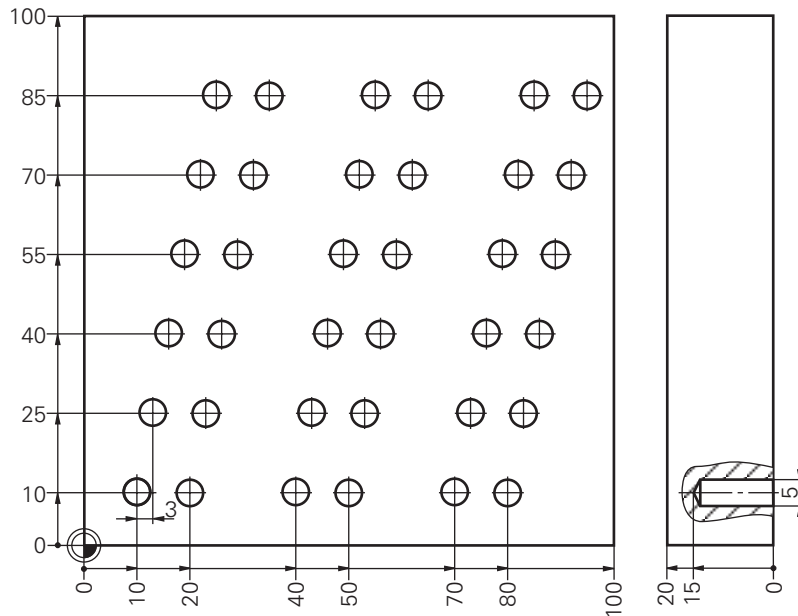


Drilling pattern

<i>L X... Y...</i> <i>L Z...</i>	Absolute pre-position Set up clearance
<i>LBL 1</i>	Define label 1
<i>L IX... M99</i>	Cross over to first hole
<i>LBL 2</i>	Define label 2
<i>L IY... M99</i>	Move up the column
<i>CALL LBL 2 REP...</i>	
<i>L IX... M99</i>	Cross over two second column
<i>LBL 3</i>	Define label 2
<i>L IY... M99</i>	Move down the column
<i>CALL LBL 3 REP...</i> <i>CALL LBL 1 REP...</i>	Remaining groups

Solution:

Drilled plate – slanted columns



Main program

```
0 BEGIN PGM 270 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 L Z+100 R0 F MAX

4 TOOL CALL 5 Z S4000 ..... R2,5
5 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-15 ..... DEPTH
  Q206=250 ..... FEED RATE FOR PLUNGING
  Q202=8 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=20 ..... 2ND SET UP CLEARANCE

6 L X-10 Y+10 R0 F9999 M3
7 L Z+2

8 LBL 1
9 L IX+20 M99

10 LBL 2
11 L IX+3 IY+15 M99
12 CALL LBL 2 REP 4/4

13 L IX+10 M99

14 LBL 3
15 L IX-3 IY-15 M99
16 CALL LBL 3 REP 4/4

17 CALL LBL 1 REP 2/2

18 L Z+100 R0 F MAX M2
19 END PGM 270 MM
```

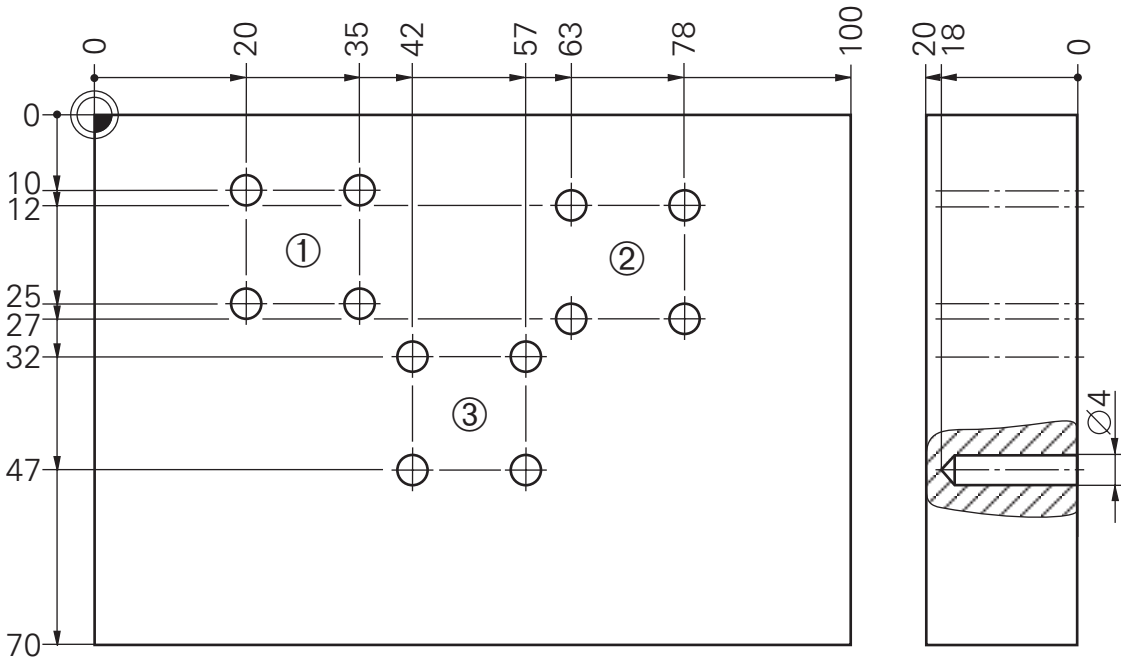


HEIDENHAIN

Basic course G3/Upgrade course D02

Task: **Subprogram
(Groups of holes)**

Program(s): _____



Begin program

```

BEGIN PGM... MM
:
TOOL CALL...
CYCL DEF...
L Z+...
L X... Y...
L Z...
CALL LBL...
L X... Y...
CALL LBL...
L X... Y...
CALL LBL...
  
```

- Call tool data
- Define cycle
- Move to clear. height
- Start. pos.-hole group ①
- Set up clearance
- Call SPGM
- Start. pos.-hole group ②
- Call SPGM
- Start. pos.-hole group ③
- Call SPGM

Retract tool, end

```
L Z +100 R0 F9999 M2
```

SPGM

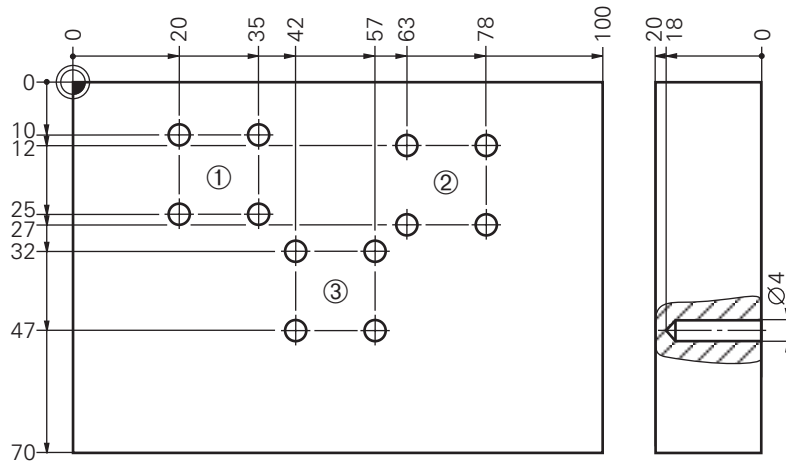
```
LBL...
```

SPGM end

```
LBL 0
```

Solution:

Subprogram (Groups of holes)



Main program

```

0 BEGIN PGM 215 MM
1 BLK FORM 0.1 Z X+0 Y-70 Z-20
2 BLK FORM 0.2 X+100 Y+0 Z+0
3 TOOL CALL 4 Z S4000 ..... CALL TOOL DATA, R2
4 CYCL DEF 200 DRILLING
  Q200=2 ..... SET UP CLEARANCE
  Q201=-18 ..... DEPTH
  Q206=200 ..... FEED RATE FOR PLUNGING
  Q202=4 ..... PLUNGING DEPTH
  Q210=0 ..... DWELL TIME AT TOP
  Q203=+0 ..... SURFACE COORDINATE
  Q204=2 ..... 2ND SET UP CLEARANCE
5 L Z+100 R0 F MAX ..... CLEARANCE HEIGHT
6 L X+20 Y-10 R0 F MAX ..... STARTING POINT-HOLE GROUP ①
7 L Z+2 R0 F MAX M13
8 CALL LBL 1 ..... CALL SPGM

9 L X+63 Y-12 F MAX ..... STARTING POINT-HOLE GROUP ②
10 CALL LBL 1 ..... CALL SPGM

11 L X+42 Y-32 F MAX ..... STARTING POINT-HOLE GROUP ③
12 CALL LBL 1 ..... CALL SPGM

Retract tool, end
13 L Z+100 R0 F MAX M2
  
```

SPGM

```

14 LBL 1
15 CYCL CALL
16 L IX+15 F MAX M99
17 L IY-15 F MAX M99 ..... DRILLING PATTERN
18 L IX-15 F MAX M99
19 LBL 0
20 END PGM 215 MM
  
```

SPGM, end

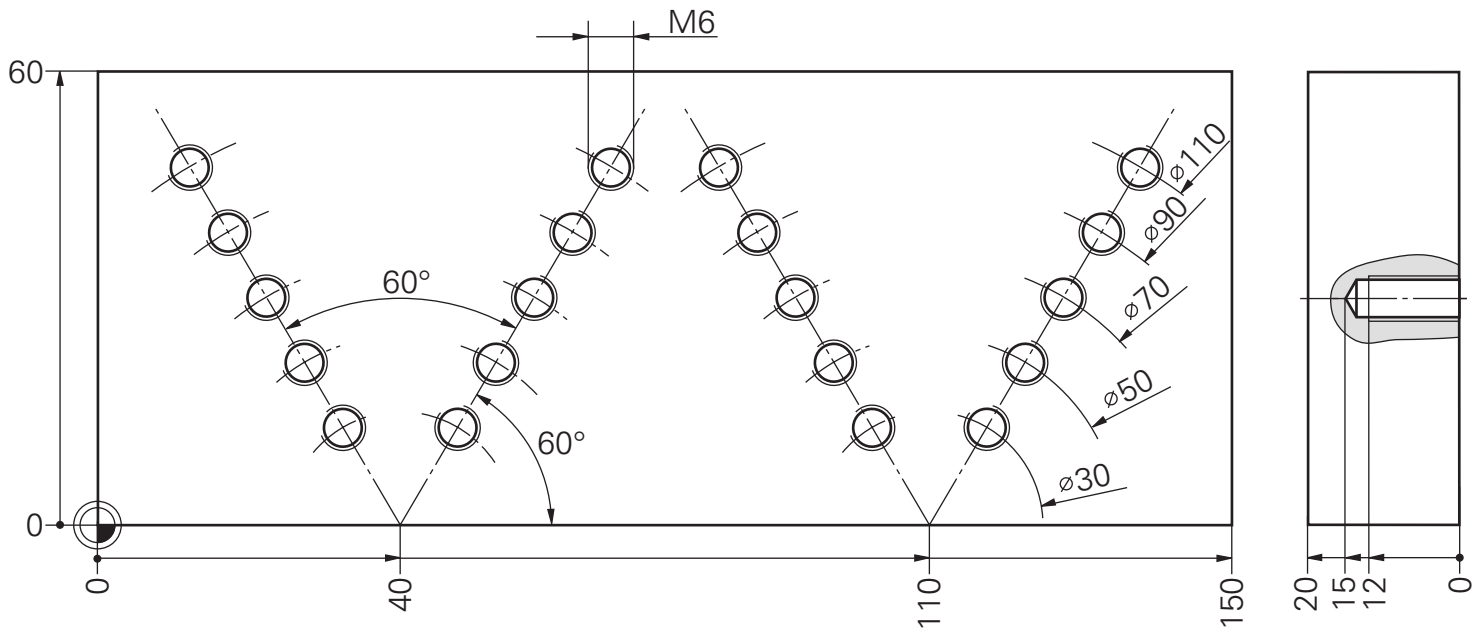


HEIDENHAIN

Basic course G3/Upgrade course D02

Task: **Bolt hole circle segments with several tools**

Program(s): _____



Program layout:

Nesting for double bolt hole circles

Conventional Preparation:

BLK- FORM

Centering

*TOOL CALL ...
CYCL DEF / L Z+100*

CALL LBL 1

Drilling

*TOOL CALL ...
CYCL DEF ...*

CALL LBL 1

Tapping

*TOOL CALL ...
CYCL DEF ...*

CALL LBL 1

Retract tool, end

L Z100 M2

SPGM1

LBL 1

CC X... Y...

Circle center-left

CALL LBL 2

Call bolt hole circle seg.

CC X... Y...

Circle center-right

CALL LBL 2

Call bolt hole circle seg.

⋮

SPGM1 end

LBL 0

**SPGM2,
Bolt hole circle
segments**

LBL 2

*LP PR... PA... M3
L Z+2 M99*

Starting position

LBL 3

Remaining holes

⋮

CALL LBL 3 REP...

Partial repeat

LP PR... PA...

LBL 4

⋮

CALL LBL 4 REP...

SPGM2 end

LBL 0

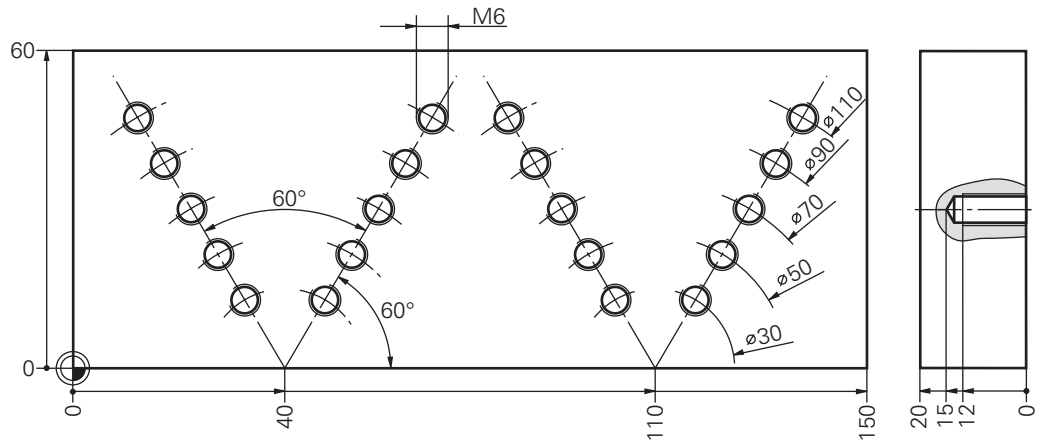


HEIDENHAIN

Basic course G3/Upgrade course C03

Solution:

Bolt hole circle segments with several tools



Main program

```

0 BEGIN PGM 280 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+150 Y+60 Z+0
3 TOOL CALL 4 Z S2000 ..... R2
4 L Z+100 R0 F9999
5 CYCL DEF 1.0 PECKING
6 CYCL DEF 1.1 SET UP 2
7 CYCL DEF 1.2 DEPTH -3,5
8 CYCL DEF 1.3 PECKG 3,5
9 CYCL DEF 1.4 DWELL 0
10 CYCL DEF 1.5 F200
11 CALL LBL 1
12 L Z+100 M6

13 TOOL CALL 5 Z S1500 ..... R2,5
14 CYCL DEF 200 DRILLING
    Q200=2 ..... SET UP CLEARANCE
    Q201=-15 ..... DEPTH
    Q206=250 ..... FEED RATE FOR PLUNGING
    Q202=8 ..... PLUNGING DEPTH
    Q210=0 ..... DWELL TIME AT TOP
    Q203=+0 ..... SURFACE COORDINATE
    Q204=20 ..... 2ND SET UP CLEARANCE
15 CALL LBL 1
16 L Z+100 M6

17 TOOL CALL 6 Z S300 ..... R3
18 CYCL DEF 2.0 TAPPING
19 CYCL DEF 2.1 SET UP 2
20 CYCL DEF 2.2 DEPTH -12
21 CYCL DEF 2.3 DWELL 1
22 CYCL DEF 2.4 F300
23 CALL LBL 1

24 L Z+100 R0 M2
    
```



HEIDENHAIN

Basic course G3/Upgrade course D02

Solution:

Bolt hole circle segments with several tools

SPGM

```
25 LBL 1
26 CC X+40 Y+0
27 CALL LBL 2
28 CC X+110 Y+0
29 CALL LBL 2
30 LBL 0

31 LBL 2
32 LP PR+55 PA+120 R0 M3
33 L Z+2 M99

34 LBL 3
35 LP IPR-10 M99
36 CALL LBL 3 REP 3/3

37 LP PR+15 PA+60 R0 M99

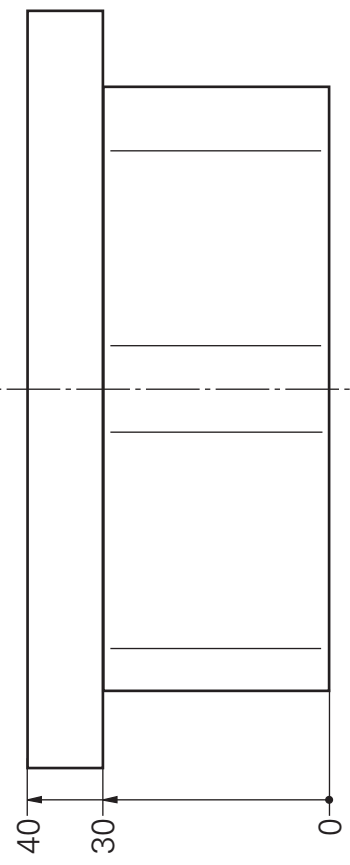
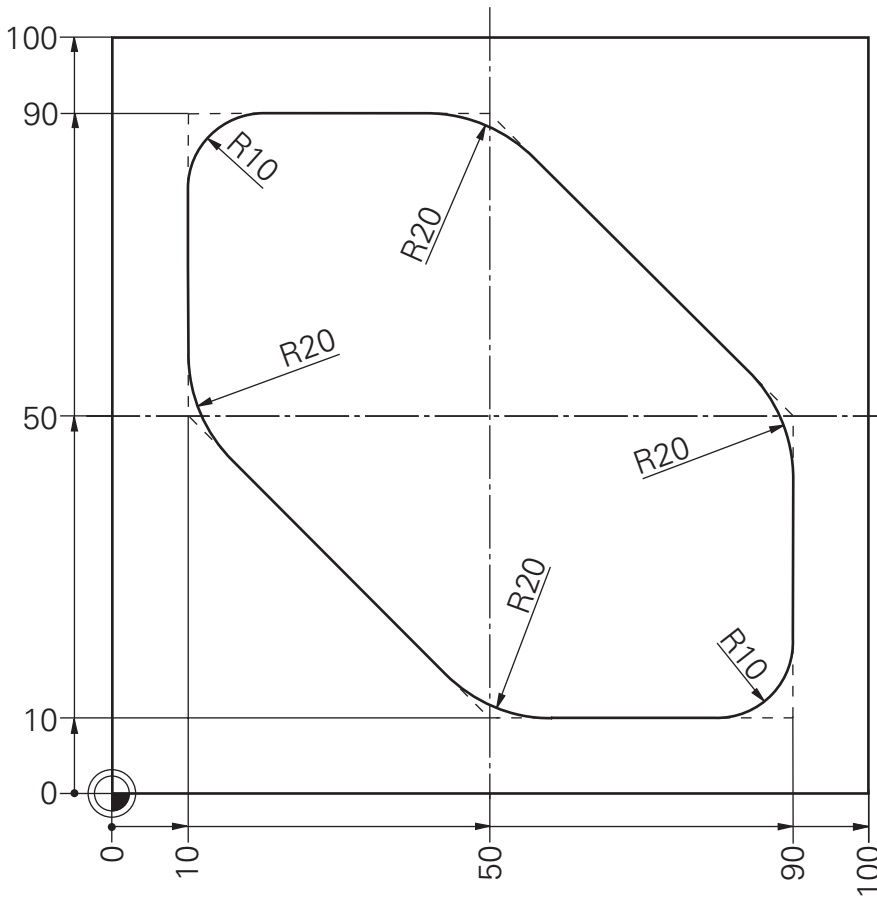
38 LBL 4
39 LP IPR+10 M99
40 CALL LBL 4 REP 3/3

41 LBL 0
42 END PGM 280 MM
```



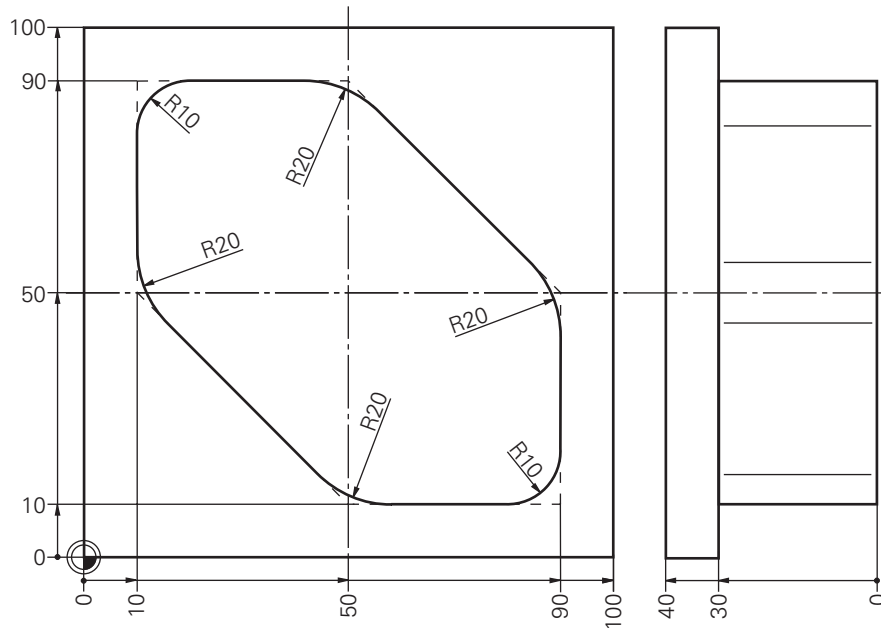
Task: **Milling with several settings**

Program(s): _____



Solution:

Milling with several settings



Main program

```
0 BEGIN PGM 223 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-40
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 13 Z S2500 ..... R20
4 L Z+100 R0 F MAX M3
5 L X-30 Y+70 R0 F MAX ..... STARTING POSITION
6 L Z+0 F MAX

7 LBL 2
8 L IZ-5 R0 F MAX M3 ..... SETTING
9 CALL LBL 1 ..... CALL CONTOUR

10 CALL LBL 2 REP 5/5 ..... FURTHER CONTOUR SECTIONS

Retract tool, end      11 L Z+100 R0 F MAX M2
```

SPGM, Contour

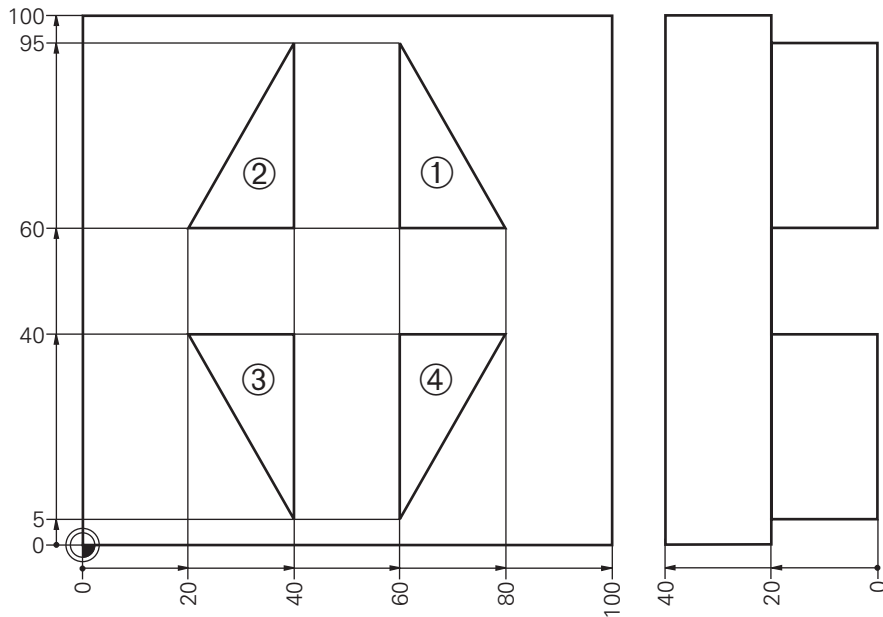
```
12 LBL 1
13 APPR LCT X+10 Y+70 R5 RL F250 M3
14 L X+10 Y+90 RL
15 RND R10
16 L X+50 Y+90
17 RND R20
18 L X+90 Y+50
19 RND R20 ..... CONTOUR
20 L X+90 Y+10
21 RND R10
22 L X+50 Y+10
23 RND R20
24 L X+10 Y+50
25 RND R20
26 L X+10 Y+70
27 DEP LCT X-20 Y+70 R5 F500
28 LBL 0
29 END PGM 223 MM
```

SPGM end



HEIDENHAIN

Basic course G3/Upgrade course D02



MAIN PROGRAM

```

0 BEGIN PGM 229 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 7 Z S4000 ..... R4
4 L Z+100 R0 F MAX
5 CYCL DEF 7.0 DATUM SHIFT
6 CYCL DEF 7.1 X+50
7 CYCL DEF 7.2 Y+50
8 CALL LBL 1

```

```

9 CYCL DEF 8.0 MIRROR IMAGE
10 CYCL DEF 8.1 X
11 CALL LBL 1

```

```

12 CYCL DEF 8.0 MIRROR IMAGE
13 CYCL DEF 8.1 Y
14 CALL LBL 1

```

```

15 CYCL DEF 8.0 MIRROR IMAGE
16 CYCL DEF 8.1 X Y
17 CALL LBL 1

```

Retract tool, end

```

18 L Z+100 R0 F MAX M2

```

SPGM, Contour

```

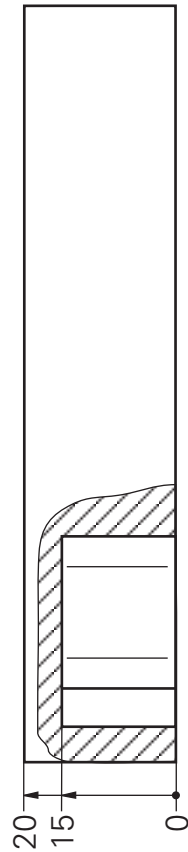
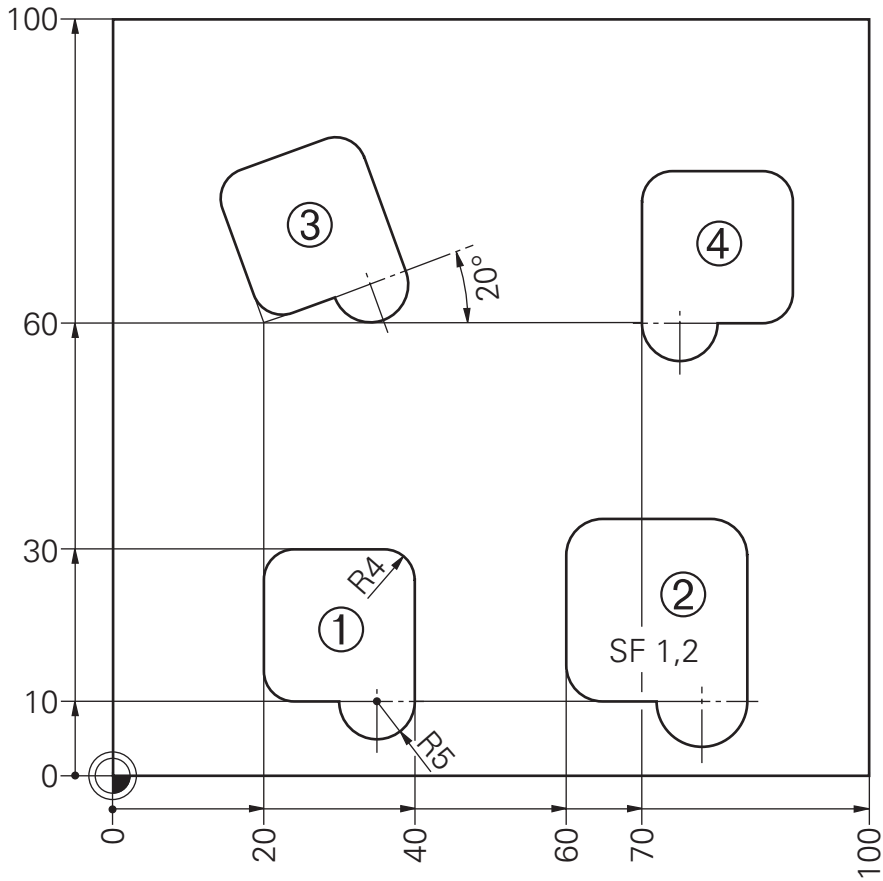
19 LBL 1
20 L X+0 Y+0 R0 F MAX M3 ..... AUXILIARY POINT R0
21 L Z+2 F MAX
22 L Z-15 R0 F100 ..... PLUNGING DEPTH
23 APPR LCT X+10 Y+10 R5 RL F200 ..... APPROACH STARTING POINT
OF CONTOUR TANGENTIALLY
24 L Y+45
25 L X+30 Y+10
26 L X+10 Y+10
27 DEP LCT X+0 Y+0 R5 R0 ..... DEPART TANGENTIALLY
28 LBL 0
29 END PGM 229 MM

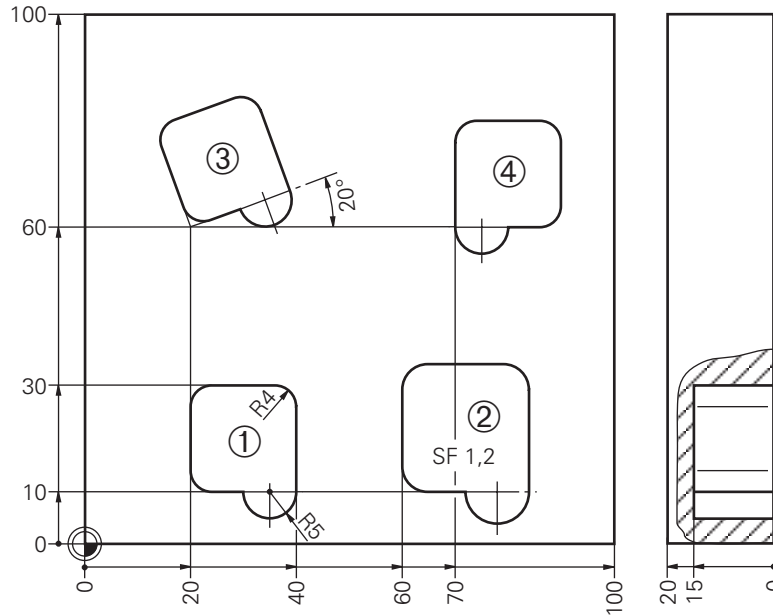
```



Task: **Coordinate transformations**

Program(s): _____





MAIN PROGRAM

```

0 BEGIN PGM 232 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-20
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 6 Z S4000 ..... R3
4 L Z+100 R0 F MAX M3
5 CYCL DEF 7.0 DATUM SHIFT
6 CYCL DEF 7.1 X+20
7 CYCL DEF 7.2 Y+10
8 CALL LBL 1

9 CYCL DEF 7.0 DATUM SHIFT
10 CYCL DEF 7.1 X+60
11 CYCL DEF 7.2 Y+10
12 CYCL DEF 11.0 SCALING
13 CYCL DEF 11.1 SCL1,2
14 CALL LBL 1

15 CYCL DEF 11.0 SCALING
16 CYCL DEF 11.1 SCL1
17 CYCL DEF 7.0 DATUM SHIFT
18 CYCL DEF 7.1 X+20
19 CYCL DEF 7.2 Y+60
20 CYCL DEF 10.0 ROTATION
21 CYCL DEF 10.1 ROT+20
22 CALL LBL 1

23 CYCL DEF 10.0 ROTATION
24 CYCL DEF 10.1 ROT+0
25 CYCL DEF 7.0 DATUM SHIFT
26 CYCL DEF 7.1 X+90
27 CYCL DEF 7.2 Y+60
28 CYCL DEF 8.0 MIRROR IMAGE
29 CYCL DEF 8.1 X
30 CALL LBL 1
    
```



Solution:

Coordinate transformations

```
31 CYCL DEF 8.0 ROTATION
32 CYCL DEF 8.1
33 CYCL DEF 7.0 DATUM SHIFT
34 CYCL DEF 7.1 X+0
35 CYCL DEF 7.2 Y+0
```

Retract tool, end

```
36 L Z+100 R0 F MAX M2
```

SPGM, Contour

```
37 LBL 1
38 L X+10 Y+10 R0 F MAX M3
39 L Z+2 F MAX
40 L Z-15 R0 F100
41 APPR LCT X+0 Y+10 R2 RR
42 L Y+20 X+0
43 RND R4
44 L X+20 Y+20
45 RND R4
46 L Y+0
47 CC X+15 Y+0
49 C X+10 Y+0 DR-
49 L X+0 Y+0
50 RND R4
51 L X+0 Y+10
52 DEP LCT X+10 Y+10 R2 R0
53 L Z+2 R0 F MAX
54 LBL 0
55 END PGM 232 MM
```

