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Answer according to Question No. 1

let  $r = 16$

$$p_0 = 1 - \pi = 1 - 16 = -15$$

Initial point  $(x_0, y_0) = (0, 16)$

$k$	$p_k$	$x_{k+1}, y_{k+1}$	$2x_{k+1}$	$2y_{k+1}$
0	-15	1, 16	2	32
1	-12	2, 16	4	32
2	-7	3, 16	6	32
3	0	4, 16	8	32
4	9	5, 15	10	30
5	-10	6, 15	12	30

$$(p_k < 0) \quad p_1 = -15 + 2 \times 1 + 1 = -15 + 3 = -12$$

$$(p_k < 0) \quad p_2 = -12 + 2 \times 2 + 1 = -12 + 5 = -7$$

$$(p_k < 0) \quad p_3 = -7 + 3 \times 2 + 1 = 0$$

$$(p_k < 0) \quad p_4 = 0 + 4 \times 2 + 1 = 9$$

$$(P_k > 0)$$

$$P_5 = 9 + 2 \times 5 - 2 \times 15 + 1 = 10 + 10 - 30 = -10$$

$$(P_k < 0)$$

$$P_6 = -10 + 2 \times 6 + 1 = -10 + 13 = 3$$

$$(P_k < 0)$$

$$P_7 = 3 + 2 \times 7 - 2 \times 14 + 1 = 14 + 4 - 28 = -10$$

$$(P_k < 0)$$

$$P_8 = -10 + 2 \times 8 + 1 = -10 + 17 = 7$$

$$(P_k \geq 0)$$

$$P_9 = 7 + 2 \times 9 - 2 \times 13 + 1 = 18 + 8 - 26 = 0 \Rightarrow \text{Terminates}$$

$$(P_k < 0)$$

$$P_{10} = 0 + 2 \times 10 + 1 = 21$$

$$(P_k > 0): P_{11} = 21 + 2 \times 11 - 2 \times 12 + 1 = 22 + 22 - 24 = 20$$

i	$P_i$	$x_{i+1}, y_{i+1}$	$2x_{i+1}$	$2y_{i+1}$
6	3	7, 14	14	28
7	-10	8, 14	16	28
8	7	9, 13	18	26
9	0	10, 13	20	26 // Terminates
10	21	11, 12	22	24
11	20	12, 11	24	22
12	23	13, 10	26	20
13	30	14, 9	28	18

$$(P_k > 0)$$

$$P_{12} = 20 + 2 \times 12 - 2 \times 11 + 1 = 21 + 24 - 22 = 23$$

$$(P_k > 0)$$

$$P_{13} = 23 + 2 \times 13 - 2 \times 10 + 1 = 24 + 26 - 20 = 30$$

Answer according to Question No. 2  
 Therefore the coordinates of circle are:

Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
$(x, y)$	$(-x, y)$	$(-x, -y)$	$(x, -y)$
0, 16	0, 16	0, -16	0, -16
1, 16	-1, 16	-1, -16	1, -16
2, 16	-2, 16	-2, -16	2, -16
3, 16	-3, 16	-3, -16	3, -16
4, 16	-4, 16	-4, -16	4, -16
5, 15	-5, 15	-5, -15	5, -15
6, 15	-6, 15	-6, -15	6, -15
7, 14	-7, 14	-7, -14	7, -14
8, 14	-8, 14	-8, -14	8, -14
9, 13	-9, 13	-9, -13	9, -13
10, 13	-10, 13	-10, -13	10, -13
13, 10	-13, 10	-13, -10	13, -10
13, 9	-13, 9	-13, -9	13, -9
14, 8	-14, 8	-14, -8	14, -8
14, 7	-14, 7	-14, -7	14, -7
15, 6	-15, 6	-15, -6	15, -6
15, 5	-15, 5	-15, -5	15, -5



continued

$Q_1$	$Q_2$	$Q_3$	$Q_4$
16, 4	-16, 4	-16, -4	16, -4
16, 3	-16, 3	-16, -3	16, -3
16, 2	-16, 2	-16, -2	16, -2
16, 1	-16, 1	-16, -1	16, -1
16, 0	-16, 0	-16, 0	16, 0

There are 2 conditions for this Mid point algo.

If

$$P_k < 0 \Rightarrow x_{k+1} = x_k + 1$$

$$y_{k+1} = y_k$$

$$P_{k+1} = P_k + 2x \cdot x_{k+1} + 1$$

$$P_k \geq 0 \Rightarrow x_{k+1} = x_k + 1$$

$$y_{k+1} = y_k + 1$$

$$P_{k+1} = P_k - 2x \cdot y_{k+1} + 2x \cdot x_{k+1} + 1$$

Answer according to question no 2

The algo for Mid point algo is

Input radius  $r$  and circle centre  $(x_c, y_c)$ ,  
then set the coordinates for first point on  
circumference of circle centre on origin

as :

$$(x_0, y_0) = (0, r)$$

\* calculate the initial value of decision parameter

as

$$P_0 = \frac{5}{4} - r$$

Starting with  $k=0$ , at each position  $x_k$ ,

perform the following test. If  $P_k < 0$ , the

next point along the circle centred on  $(0,0)$  is

$(x_{k+1}, y_k)$  and

$$P_{k+1} = P_k + 2x_{k+1} + 1$$

otherwise the next point along the circle is  $(x_{k+1}, y_{k+1})$

and

$$P_{k+1} = P_k + 2x_{k+1} + 1 - 2y_{k+1}$$

determine symmetry points in other seven octants.

Move each calculated pixel position  $(x, y)$  onto the circular path centred at  $(x_c, y_c)$  to plot the coordinate values.

$$x = x + x_c$$

$$y = y + y_c$$

Repeat 3 and 5 until  $x \geq y$