

AutoCAD 2D

Module 23

Arraying

Learning Outcomes

When you have completed this module, you will be able to:

1. Apply the ARRAY command to array objects in polar or rectangular patterns.

Arraying

The ARRAY command is used to create multiple copies of objects in a *polar* or *rectangular* pattern. See Figure 23-1 and 23-2. It is another one of those powerful commands that, when used at the right times, can prove to be very productive.

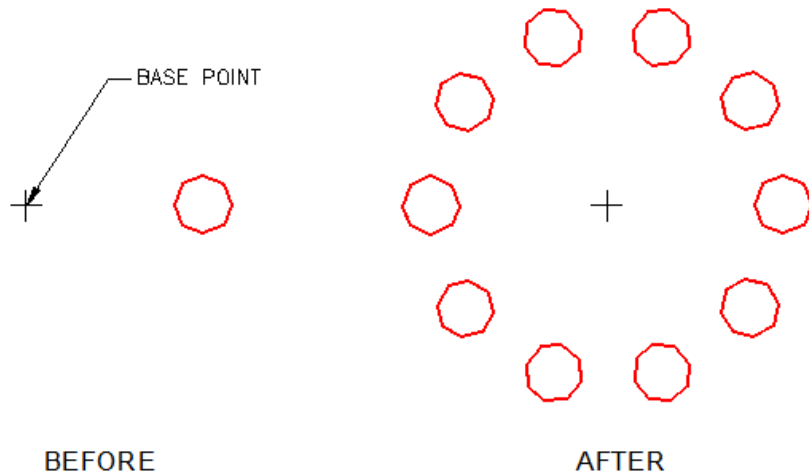


Figure 23-1
Polar Array

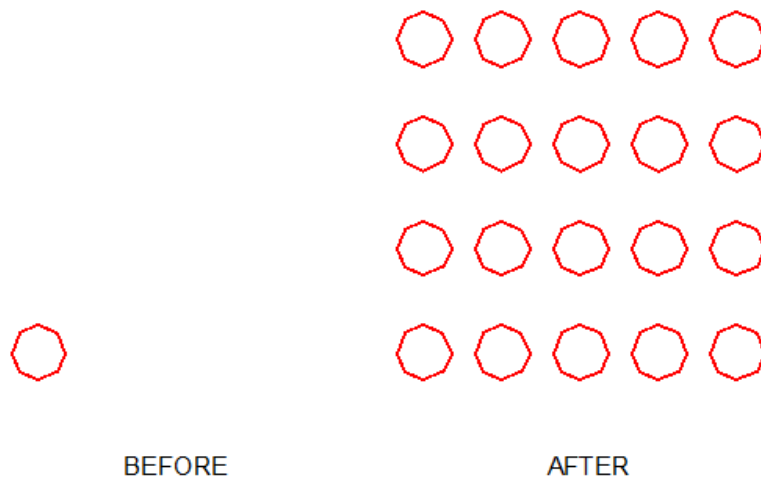
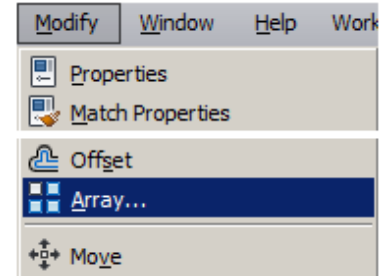


Figure 23-2
Rectangular Array

AutoCAD Command: **ARRAY**

The ARRAY command is used to make multiple copies of an object either in a rectangular or a polar pattern.

Shortcut: **AR**



Array...
Creates multiple copies of objects in a pattern: ARRAY

2009-2010



Array...

2007-2008

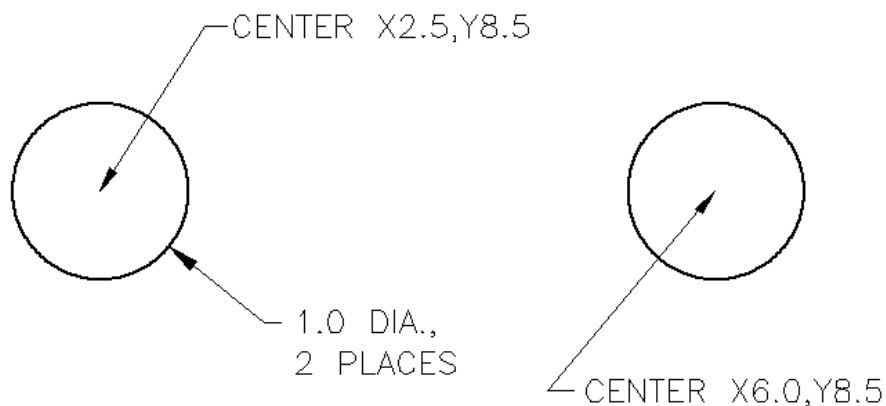
**WORK
ALONG**

Using the ARRAY Command - Part 1

Step 1 Start a new drawing using the template 2D Layout English.

Step 2 Save and name the drawing AutoCAD 2D Workalong 23-1.

Step 3 On layer Construction, draw the two circles shown in the dimensioned drawing.



Dimensioned Drawing

Step 4 On layer Text, using the text style 2D Modules, insert the text A and B. Select the location by eye and use a text height to match the figure as close as you can. (Figure Step 4)



Figure Step 4

Step 5 On layer Object, draw a 0.35 diameter circle and two lines snapping them from quad to quad as shown in the figure. Draw it anywhere on the drawing. (Figure Step 5)

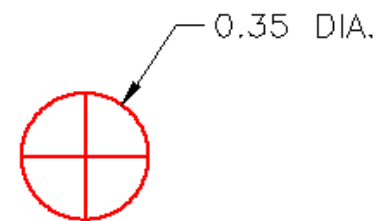


Figure Step 5

Step 6 Using the COPY command, copy the circle you drew in Step 5, four times to the absolute coordinates shown in the figure. Add the text C and D using the same specifications as the text in Step 4. (Figure Step 6)

Author's Comments: A faster method of creating the text C and D would be to copy the text A to the location of C and D. After you do that, edit the text and change the A to C and D.

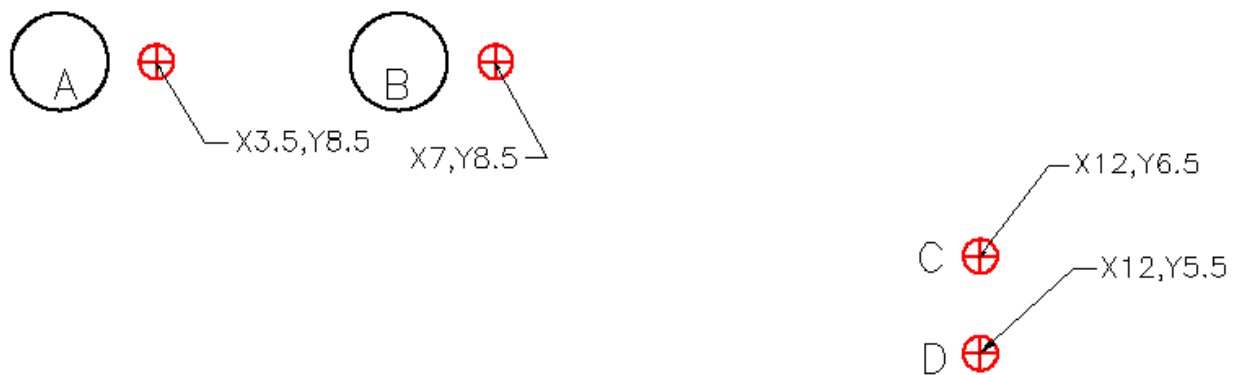


Figure Step 6

USER TIP

When you see a Show me icon inside a dialogue box, like the one shown on the right, it is telling you that you can pick an object, size or numerical value rather than entering data on the keyboard. Try to use these Show me icons whenever possible. They will help you draw faster.



Step 7 Enter the ARRAY command. In the Array dialogue box, enable Polar Array . Click the Pick Center Point show me button. When you are prompted for the center point of the array, snap to the center of circle A. (Figure Step 7A and 7B)

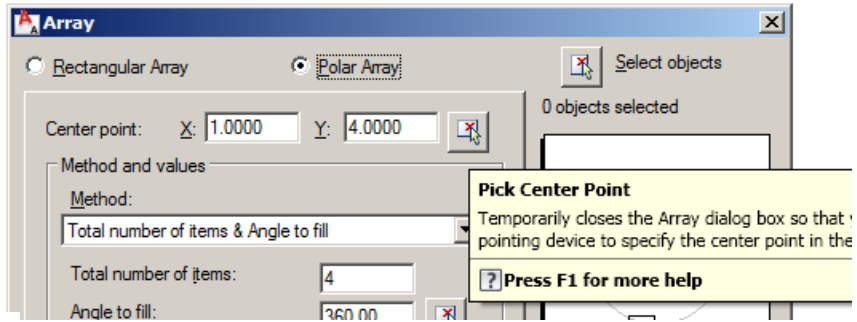


Figure Step 7A

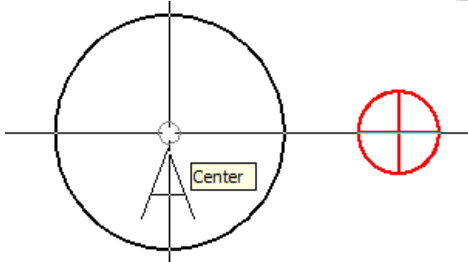


Figure Step 7B

Step 8 Enable Rotate items as copied. (Figure Step 8)



Figure Step 8

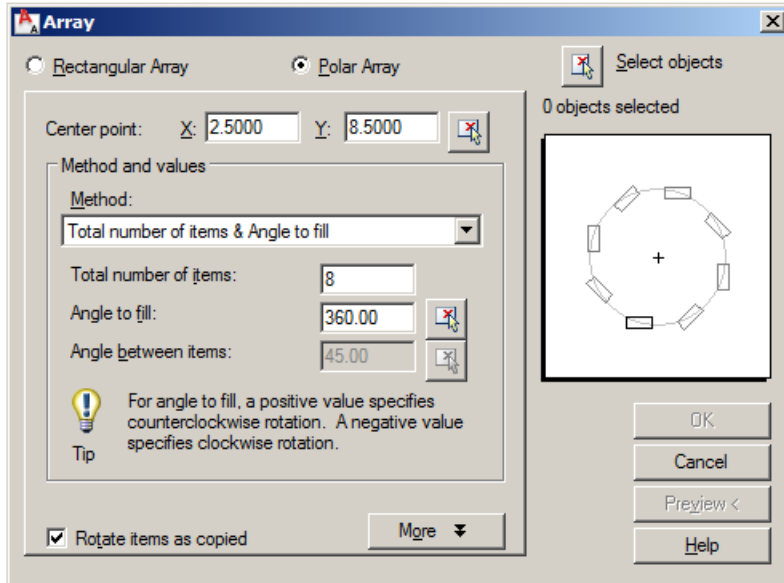


Figure Step 9A

Step 9 Click the Select objects button. When you are prompted to Select objects, use a window to select the small circle as shown in the figure. Set the Total number of items to 8 and Angle to fill: to 360.00. (Figure Step 9A and 9B)

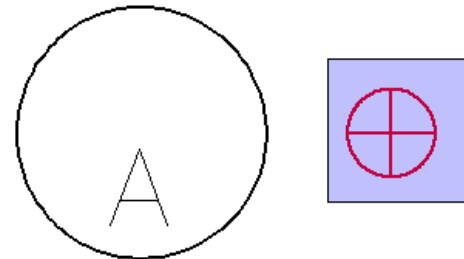


Figure Step 9B

Step 10 The Array dialogue box should match Figure Step 10A. Click OK and your array should appear as shown in Figure Step 10B. (Figure Step 10A, 10B and 10C)

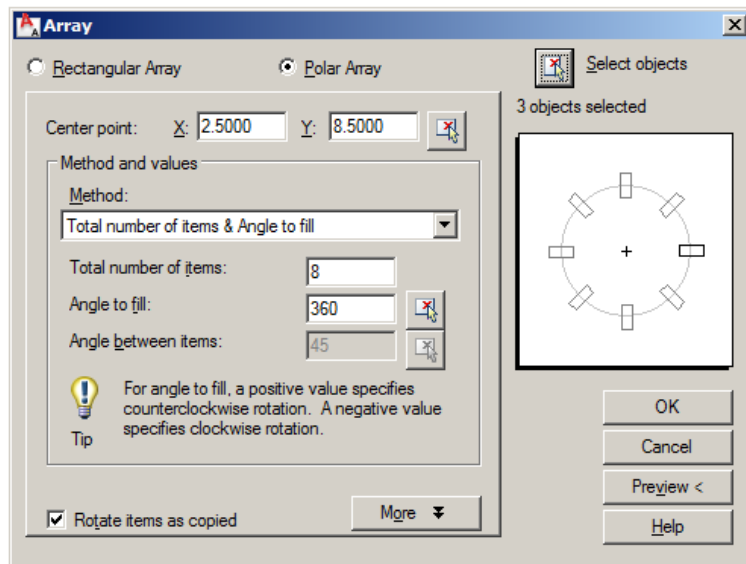


Figure Step 10A

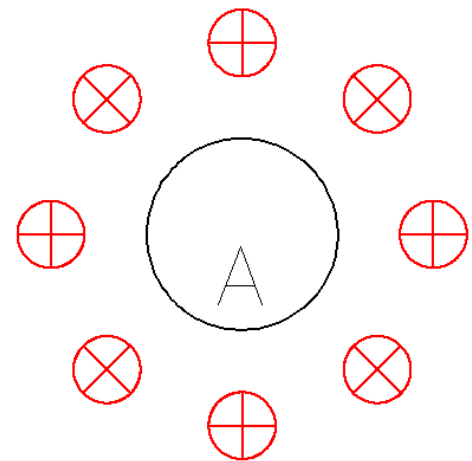
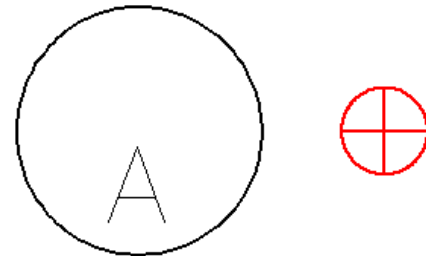


Figure Step 10B

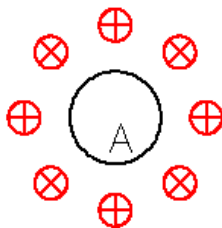


Figure Step 10C

Step 11 Enter the ARRAY command. In the Array dialogue box, enable Polar Array. Click the Pick Center Point button. When you are prompted for the center point of the array, snap to the center of circle B. (Figure Step 11A and 11B)

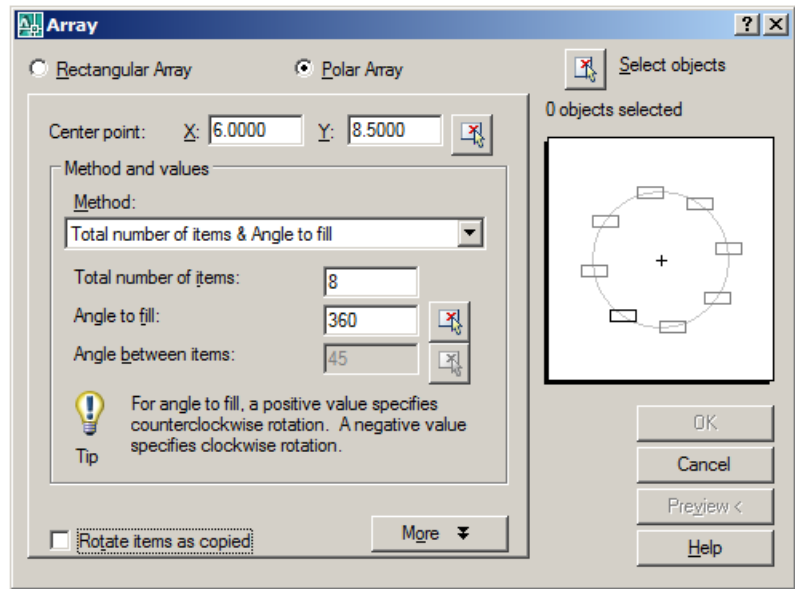


Figure Step 11A

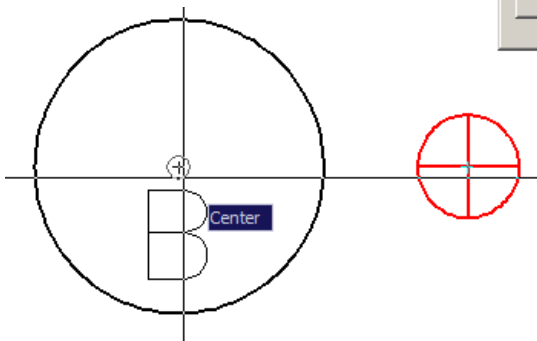


Figure Step 11B

Step 12 Disable Rotate items as copied. Click the More button, to the right of the Rotate items as copied button, to expand it. Click the Select Base Point show me button. When you are prompted to select the base point, snap to the center of small circle. (Figure Step 12A and 12B)

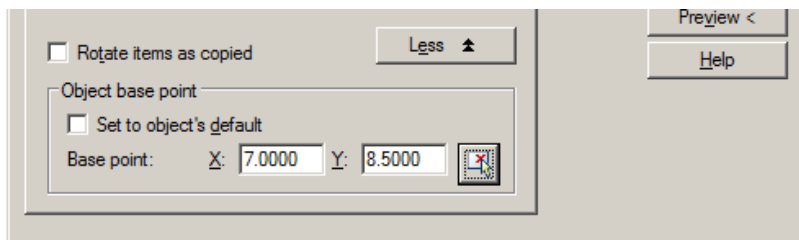


Figure Step 12A

Author's Comments: The base point on the object to be array and not rotated must be its center.

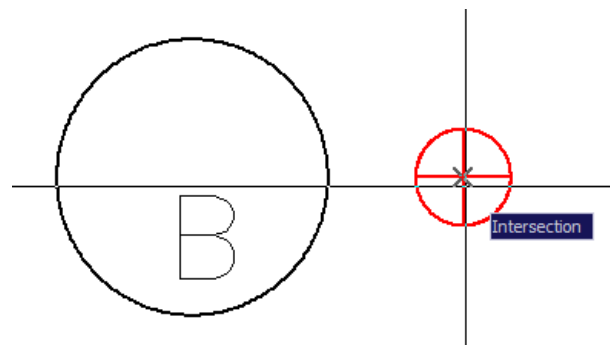


Figure Step 12B

Step 13 Click the Select objects button. When you are prompted to Select objects, use a window to select the small circle as shown in the figure. Set the Total number of items to 8 and Angle to fill: to 360.00. (Figure Step 13A, 13B, 13C and 13D)

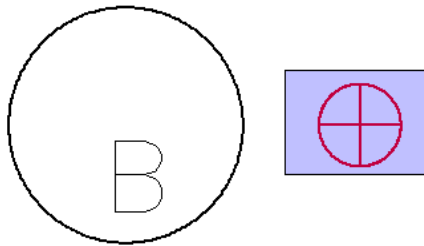


Figure Step 13B

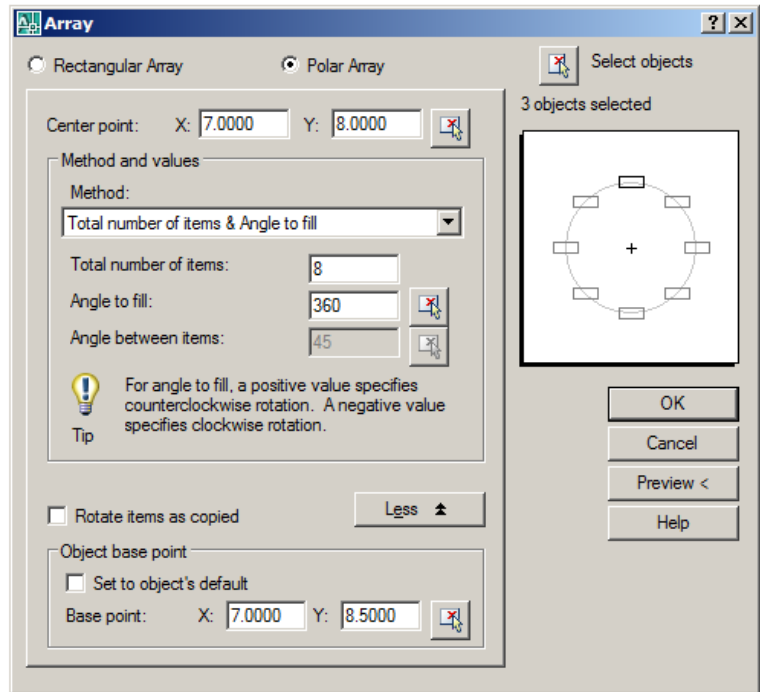


Figure Step 13A

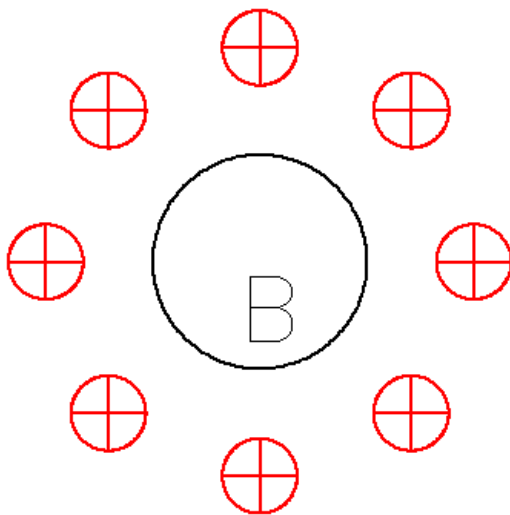
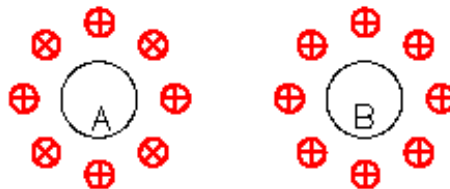


Figure Step 13C



Step 14 Save and close the drawing.

Figure Step 13D

**WORK
ALONG**

Using the ARRAY Command - Part 2

Step 1 Open the drawing AutoCAD 2D Workalong 23-1. (Figure Step 1)

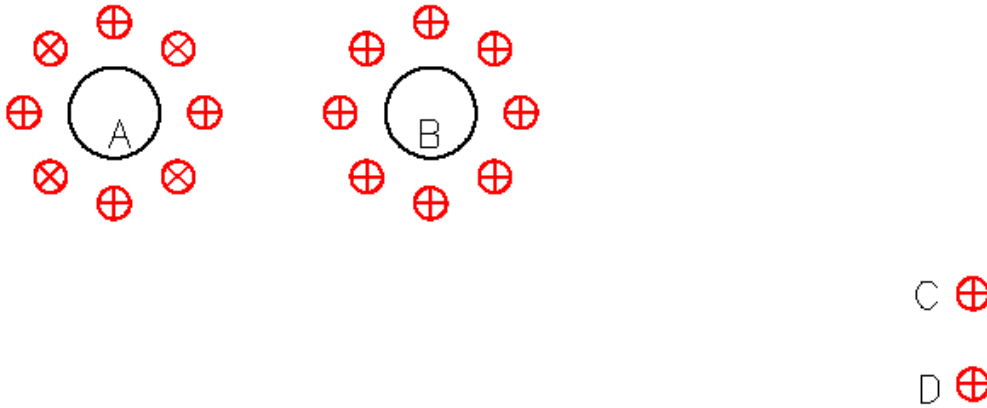


Figure Step 1

Step 2 Using the dimensioned drawing as a reference, draw the two circles and the line on layer Construction. On layer Object, draw the small inner circle. (Figure Step 2A and 2B)

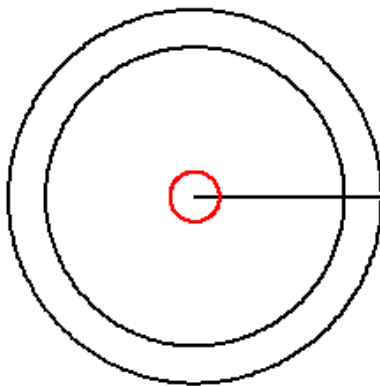
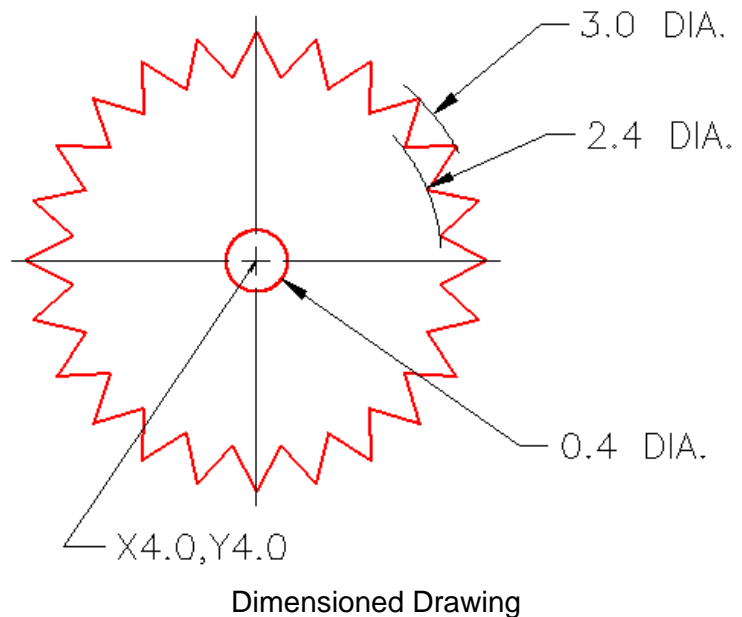


Figure Step 2A



**MUST
KNOW**

When an object is arrayed, all objects created in the array will retain the properties of the original object, even the layer the original object resides on. This happens regardless of the current layer when the ARRAY command is executed.

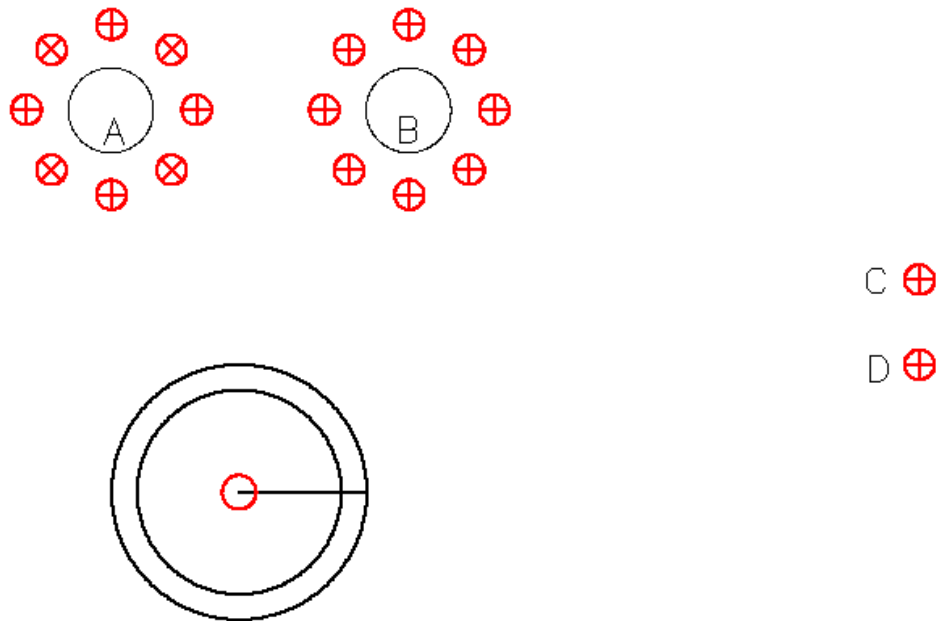


Figure Step 2B

Step 3 Using what you learned earlier in this module, array the line 48 times. Rotate the line as it is arrayed. (Figure Step 3A and 3B)

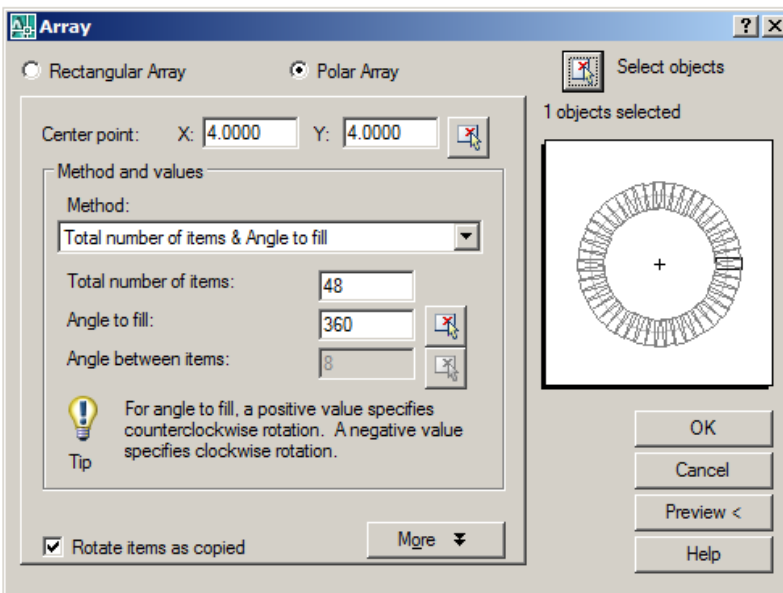


Figure Step 3A

Step 4 On layer Object, draw one tooth by snapping to the intersection of the lines and circles as shown on the figure. (Figure Step 4)

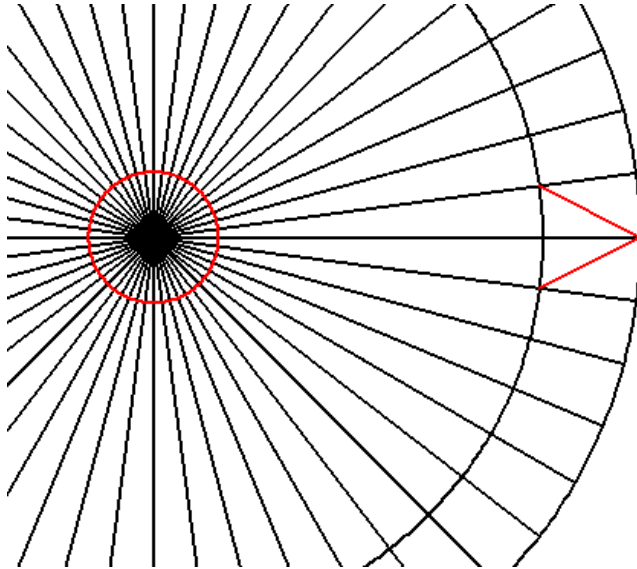


Figure Step 4

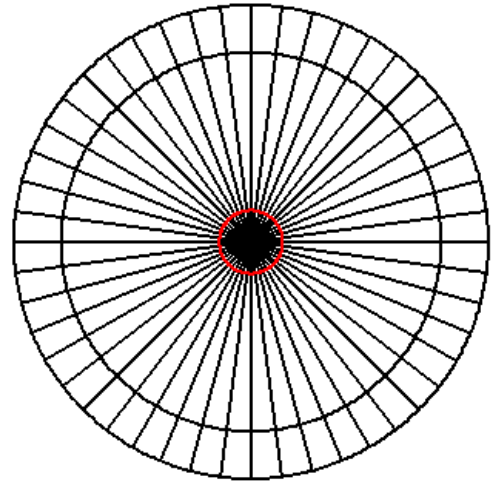


Figure Step 3B

Step 5 Array the tooth 24 times. (Figure Step 5)

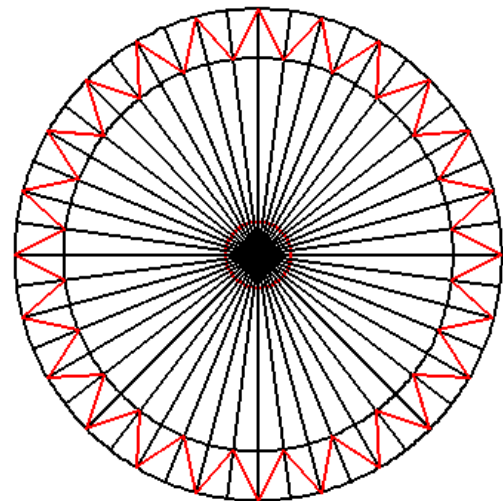
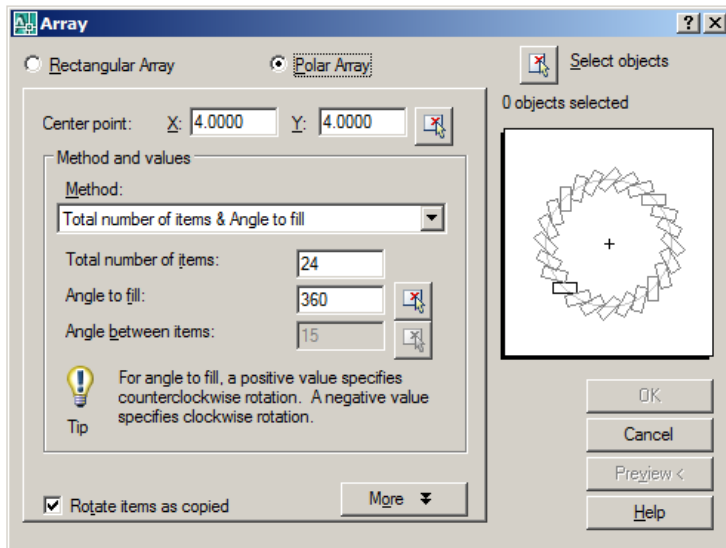


Figure Step 5

Step 6 Freeze layer Construction. Your completed drawing should match the figure. (Figure Step 6)

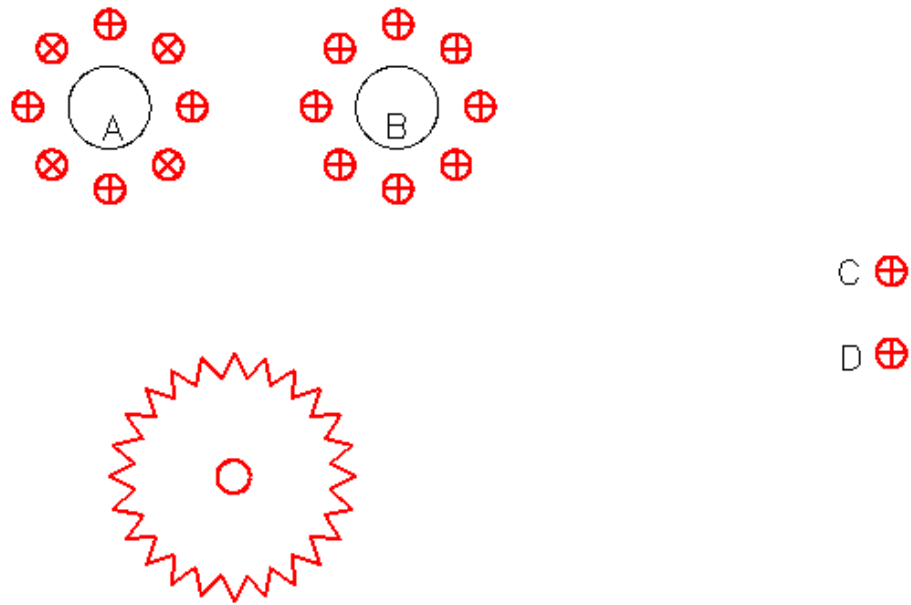
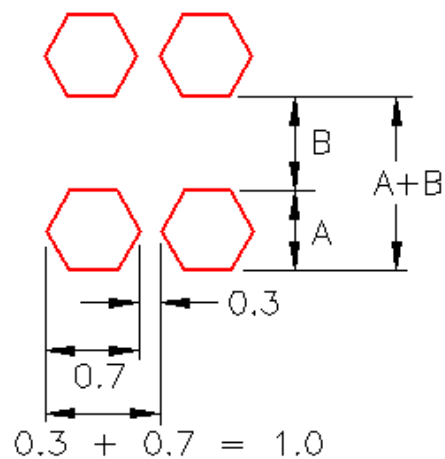


Figure Step 6

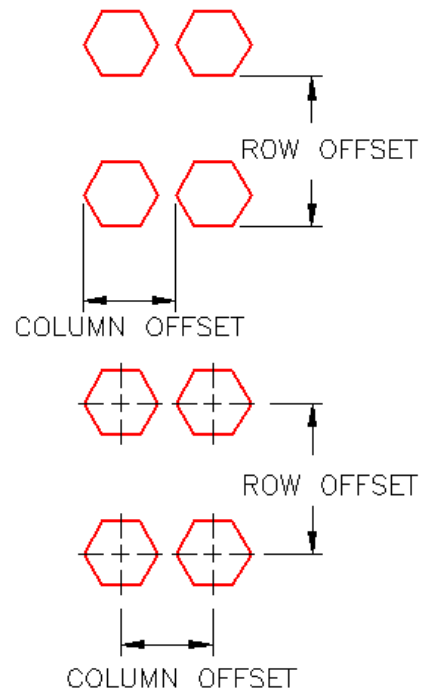
Step 7 Save and close the drawing.

USER TIP

In a rectangular array, the offset distance is measured from the one point on the object to the same point on the arrayed object.



If you are arraying an object where you only know the distance between the objects, you must add the width of the object to the spacing for the column offset and height of the object to the spacing for the row offset.

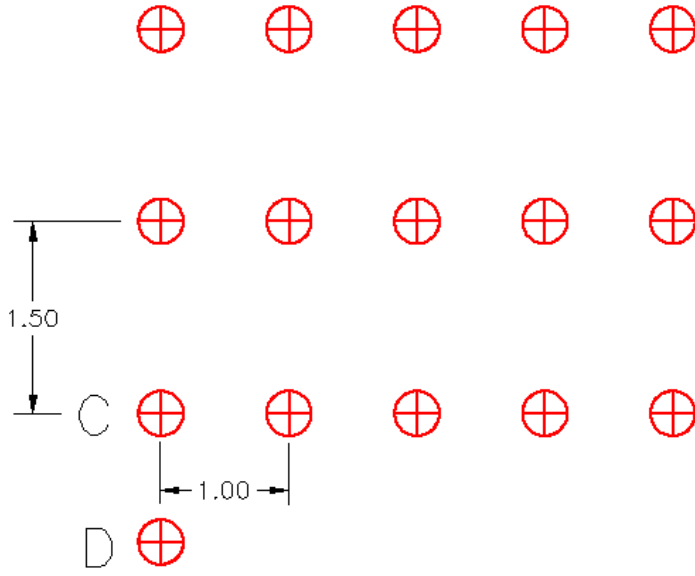
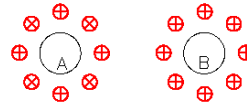


If you know the distances from center to center of the object, simply use them as the offset distances.

WORK ALONG

Using the ARRAY Command - Part 3

Step 1 Open the drawing AutoCAD 2D Workalong 23-1. (Figure Step 1)



Dimensioned Drawing



C ⊕
D ⊕

Figure Step 1

Step 2 Enter the ARRAY command. In the Array dialogue box, enable Rectangular Array. Set the number of rows to 3 and number of columns to 5. Set the Row offset to 1.5 and Column offset to 1.0. Click the Select object button and when prompted to Select objects, use a window to select circle C plus the lines. (Figure Step 2A, 2B and 2C)

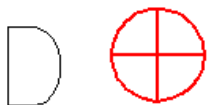
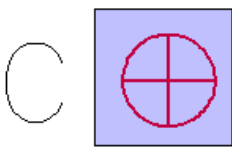


Figure Step 2B

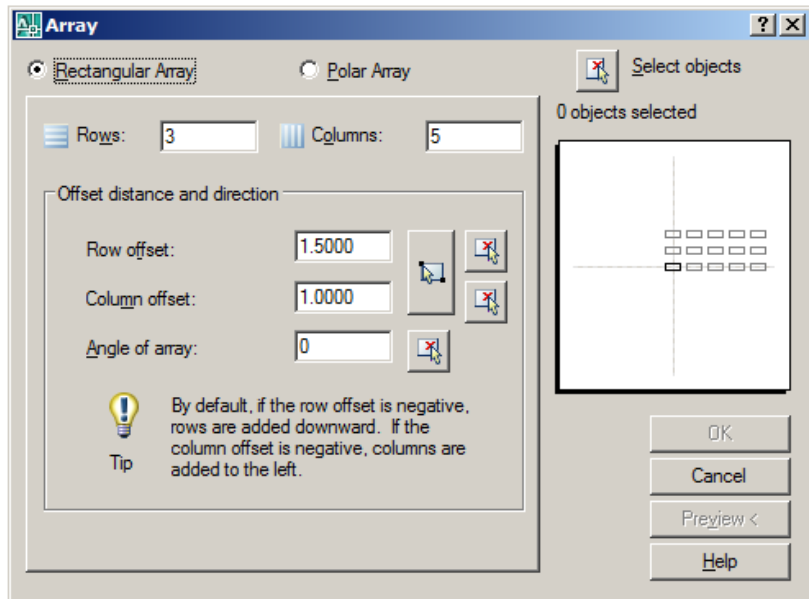


Figure Step 2A

Author's Comments: The Row offset and the Column offset are both positive in this array since you want to array in the positive X and positive Y direction.

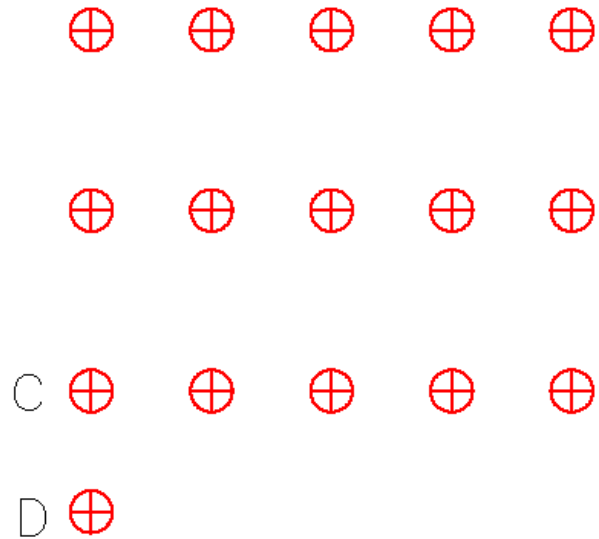
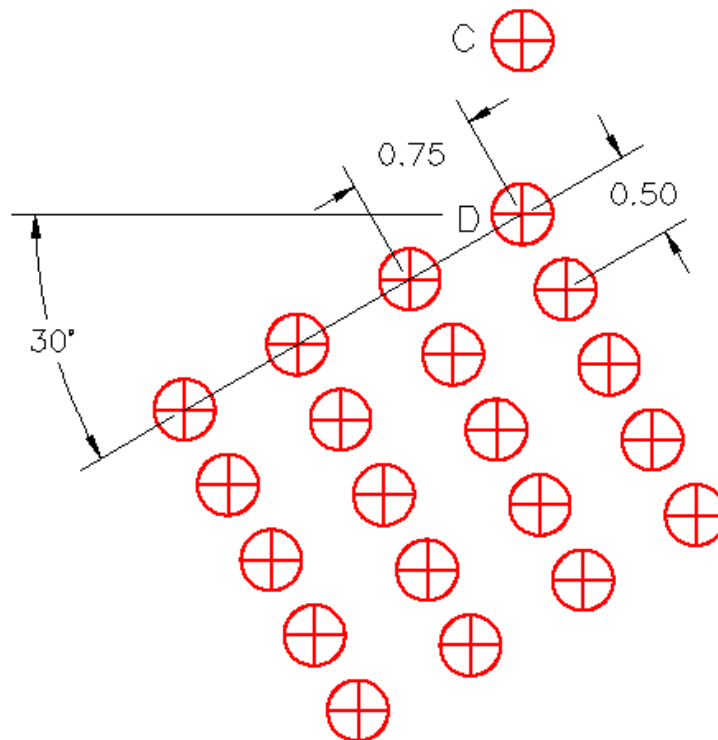


Figure Step 2C



Dimensioned Drawing

Step 3 Enter the ARRAY command. In the Array dialogue box, enable Rectangular Array. Set the number of row to 5 and number of columns to 4. Set the Row offset to -0.5 and Column offset to -0.75. Click the Select object button and when you are prompted to Select objects, use a window to select circle D and lines. (Figure Step 3A, 3B and 3C)

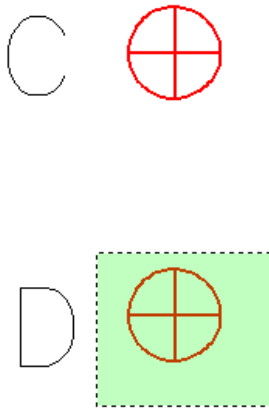


Figure Step 3B

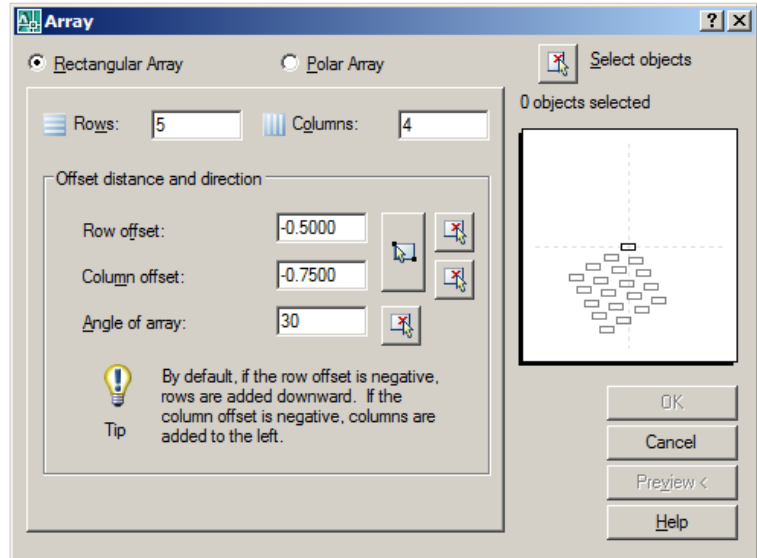


Figure Step 3A

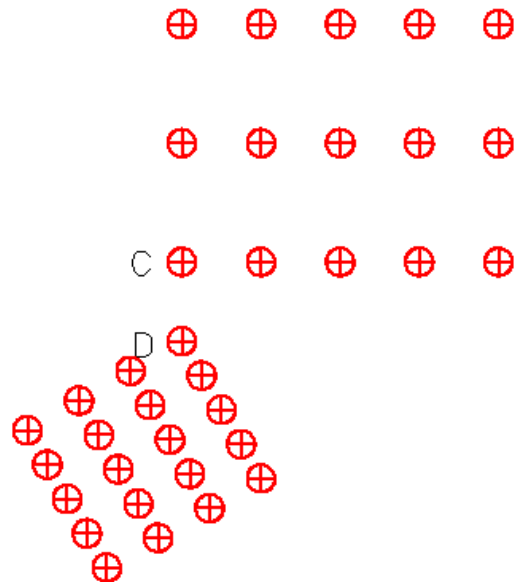
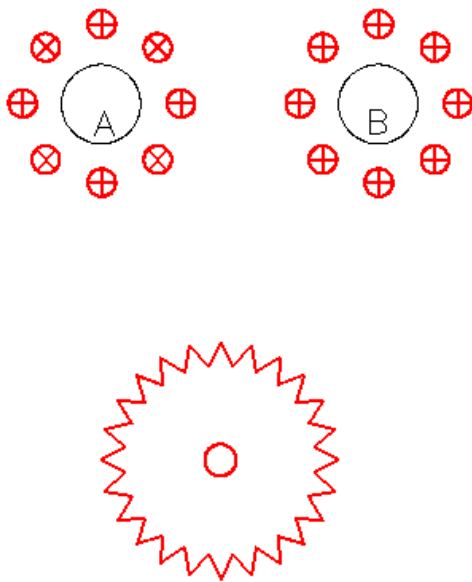


Figure Step 3C

Author's Comments: The Row offset and the Column offset are both negative in this array since you want to array in the negative X and negative Y direction.

Step 4 Save and close the drawing.

Methods of Selecting Objects			
Method	Abb.	Description	Display
Window Polygon	WP	<p>Selects all drawing objects that are totally inside a window defined by a polygon. The polygon shaped window will appear as a solid line. Do not close the polygon. Simply press the enter or space key when you are at the last location, in this example, <u>P8</u></p> <p>Command: ERASE Select objects: WP</p>	
Cross Polygon	CP	<p>Selects all drawing objects that are totally inside and the ones that cross a window defined by a polygon. The polygon will appear as a dashed line. Do not close the polygon. Simply press the enter or space key when you are at the last location, in this example, <u>P9</u>.</p> <p>Command: ERASE Select objects: CP</p>	
Fence	F	<p>Selects all drawing objects that are crossed by a line or a series of lines. The fence line will appear as a dashed line.</p> <p>Command: ERASE Select objects: F</p>	

Figure 23-3
Selecting Objects

WORK ALONG

Using Polygon Windows and Fences to Select Objects

Step 1 Open the drawing AutoCAD 2D Workalong 23-1.

Step 2 Using the SAVEAS command, save and name the drawing AutoCAD 2D Workalong 23-2.

Step 3 Turn layers Construction and Text off. (Figure Step 3)

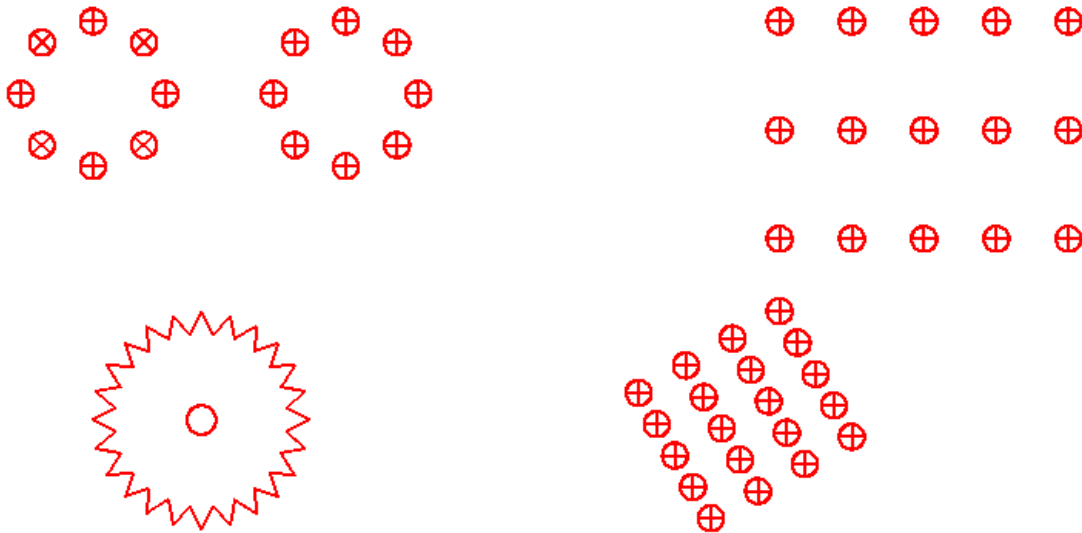


Figure Step 3

Author's Comments: Rectangular windows and crossing windows are implied, therefore you do not have to enter a W or C when you use them. To use all other windows and fences to select objects, you must enter the abbreviation after the Select objects prompt. See Figure 25-3 for the abbreviations.

Step 4 Enter the ERASE command as shown below. Use a window polygon to select the objects. (Figure Step 4A and 4B)

Command: **ERASE**

Select objects: **WP**

First polygon point:

Specify endpoint of line or [Undo]:

Specify endpoint of line or [Undo]:

Specify endpoint of line or [Undo]:

Specify endpoint of line or [Undo]:

Specify endpoint of line or [Undo]:

Select objects:

Command:

Author's Comments: Do not join the last endpoint of the window to the first point. AutoCAD will do that automatically.

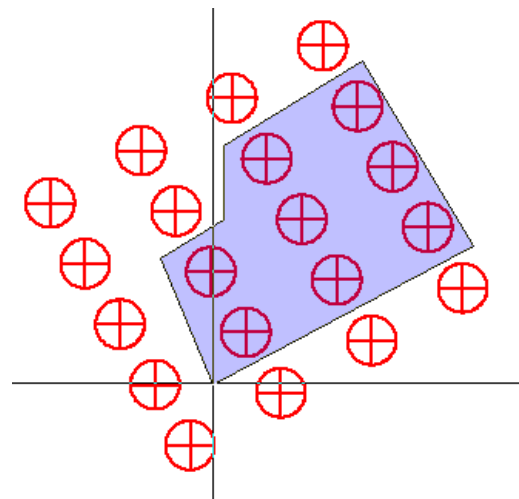


Figure Step 4A

Step 5 Enter the ERASE command as shown below. Use a cross polygon window to select the objects to be erased. (Figure Step 5A and 5B)

Command: **ERASE**
 Select objects: **CP**
 First polygon point:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Select objects:
 Command:

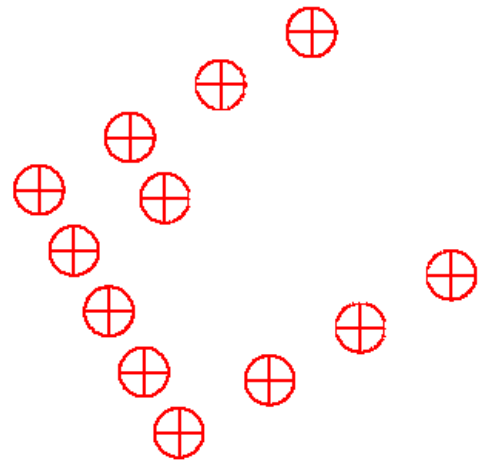


Figure Step 4B

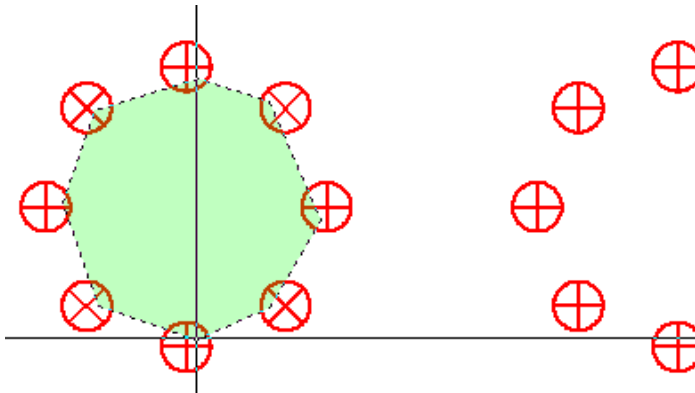


Figure Step 5A

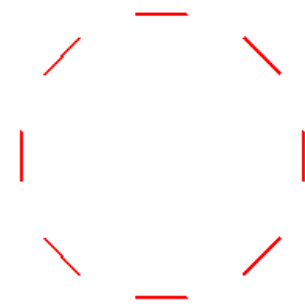


Figure Step 5B

Step 6 Enter the ERASE command as shown below. Use a fence to select the objects to be erased. (Figure Step 6A and 6B)

Command: **ERASE**
 Select objects: **F**
 First polygon point:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Specify endpoint of line or [Undo]:
 Select objects:
 Command:

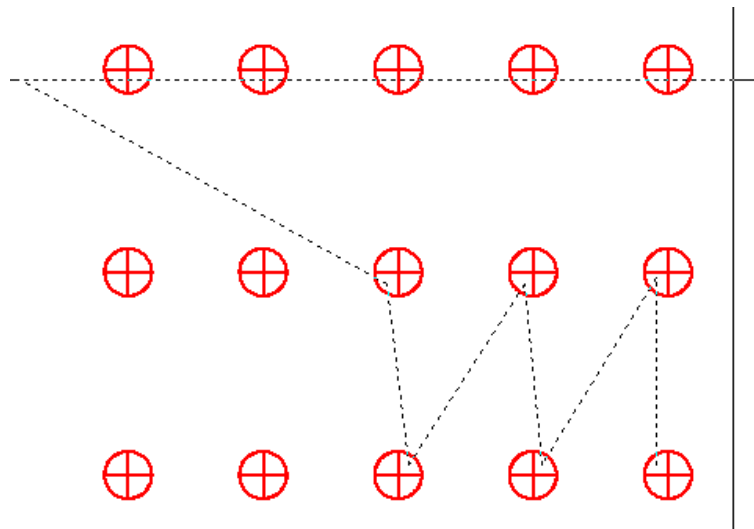


Figure Step 6A

Step 7 Using what you learned, use the COPY command and a cross polygon window to select the objects, copy the 4 circles and their lines as shown in the figure. (Figure Step 7A, 7B and 7C)

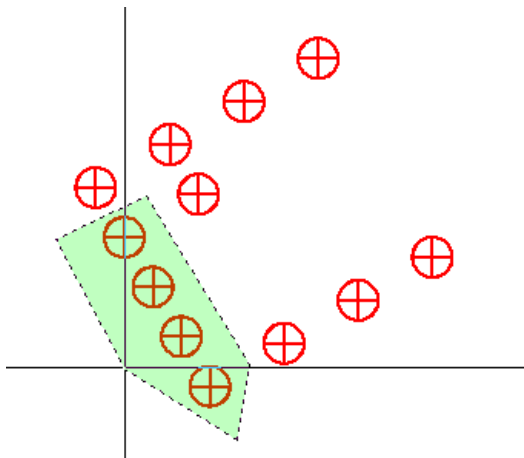


Figure Step 7A

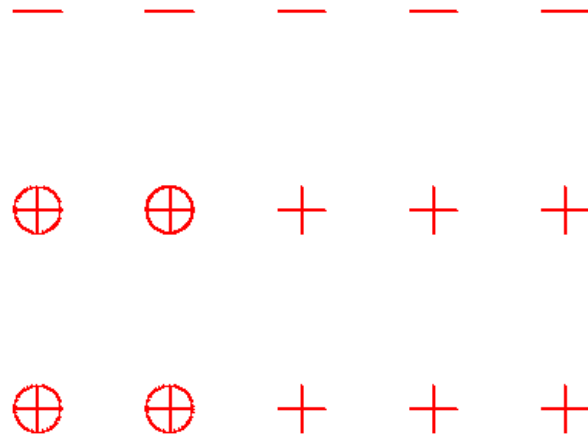


Figure Step 6B

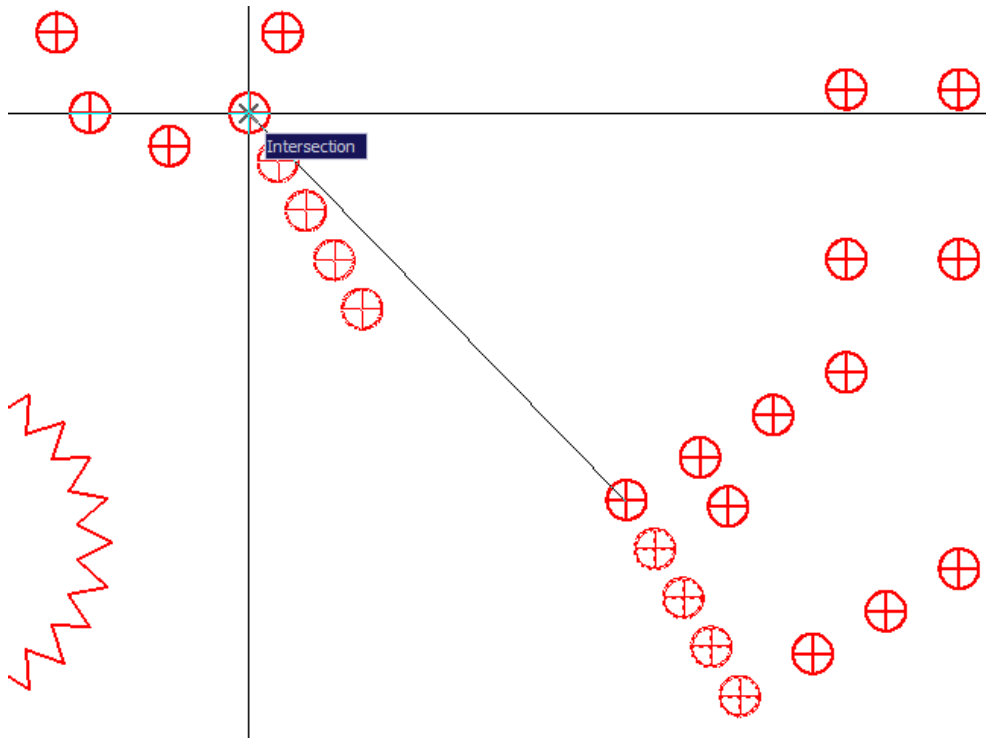


Figure Step 7B

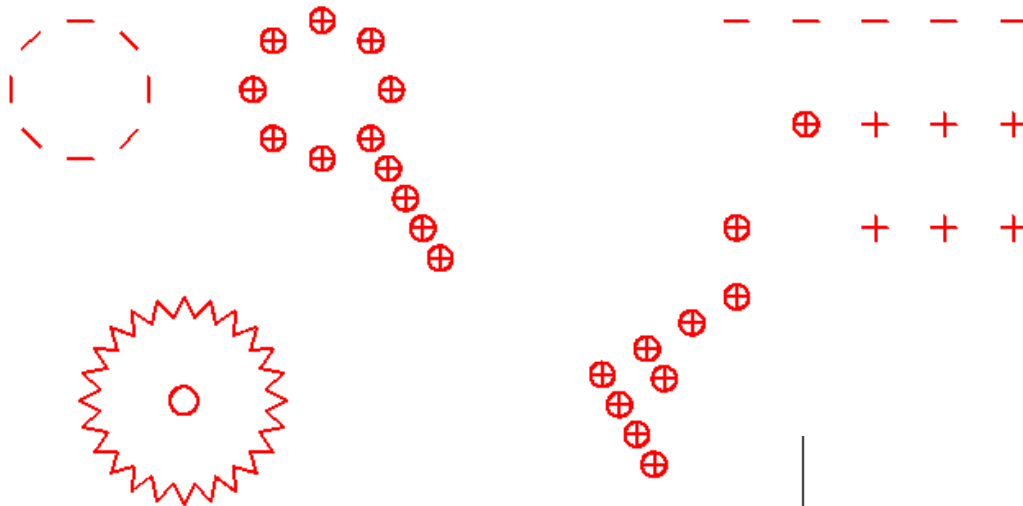


Figure Step 7C

Step 8 Using what you learned, use the ERASE command and a fence to select the objects, erase the objects to match the figure. (Figure Step 8A and 8B)

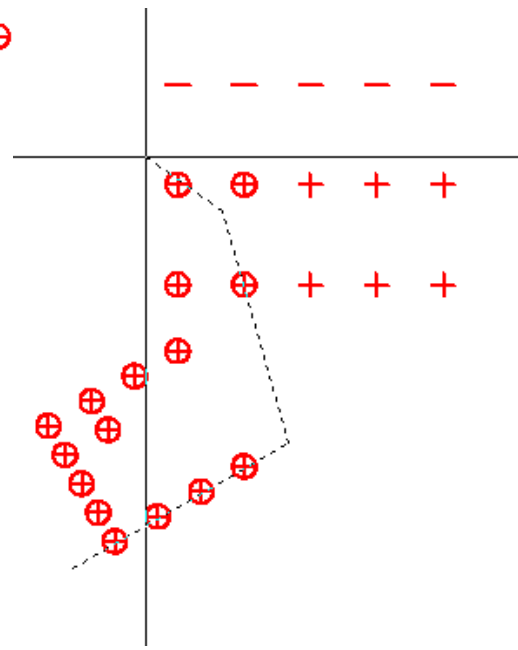


Figure Step 8A

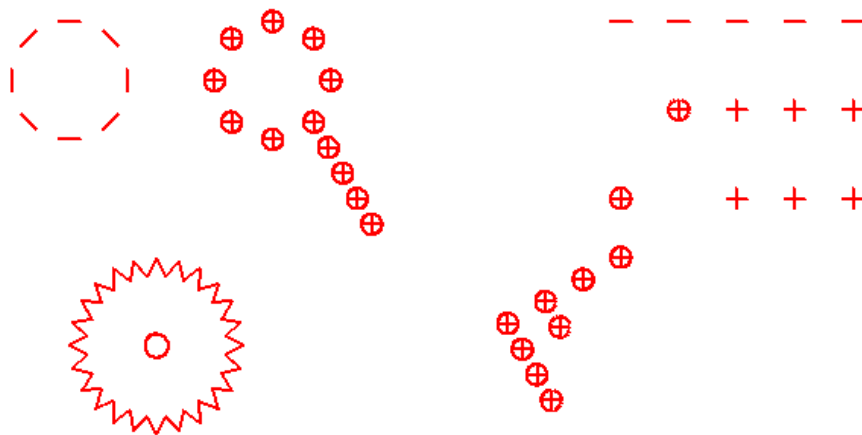


Figure Step 8B

Step 9 Save and close the drawing.

Geometry Lesson

Finding Centers and Placing Circles inside Regular Polygons

Method 1

Insert a circle that is tangent to the midpoint of three sides of the regular polygon. The center of the circle is the center of the polygon. See Figure 23-4.

Insert a circle using the 3P option in the CIRCLE command. For the three points, snap to the midpoints of any three lines.

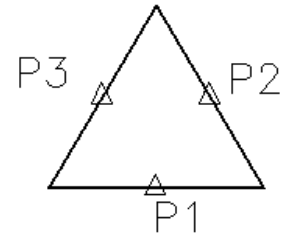
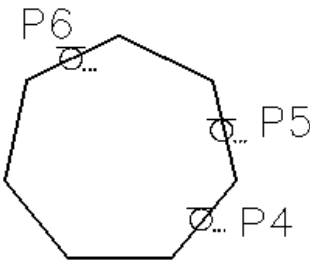


Figure 23-4

Command: **CIRCLE**
 Specify center point for circle or [3P/2P/Ttr (tan tan radius)]: **3P**
 Specify first point on circle: (*mid*) **P1**
 Specify second point on circle: (*mid*) **P2**
 Specify third point on circle: (*mid*) **P3**
 Command:

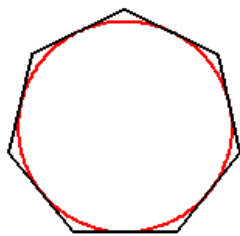


Figure 23-5

Method 2

Insert the circle using the 3P option in the CIRCLE command and snap to the tangent point of any three of sides of the regular polygon. See Figure 23-5.

Command: **CIRCLE**
 Specify center point for circle or [3P/2P/Ttr (tan tan radius)]: **3P**
 Specify first point on circle: (*tan*) **P4**
 Specify second point on circle: (*tan*) **P5**
 Specify third point on circle: (*tan*) **P6**
 Command:

Author's Comments: Keep in mind that this only works for regular polygons. All the sides of a regular polygon are equal in length.

The Key Principles in Module 23

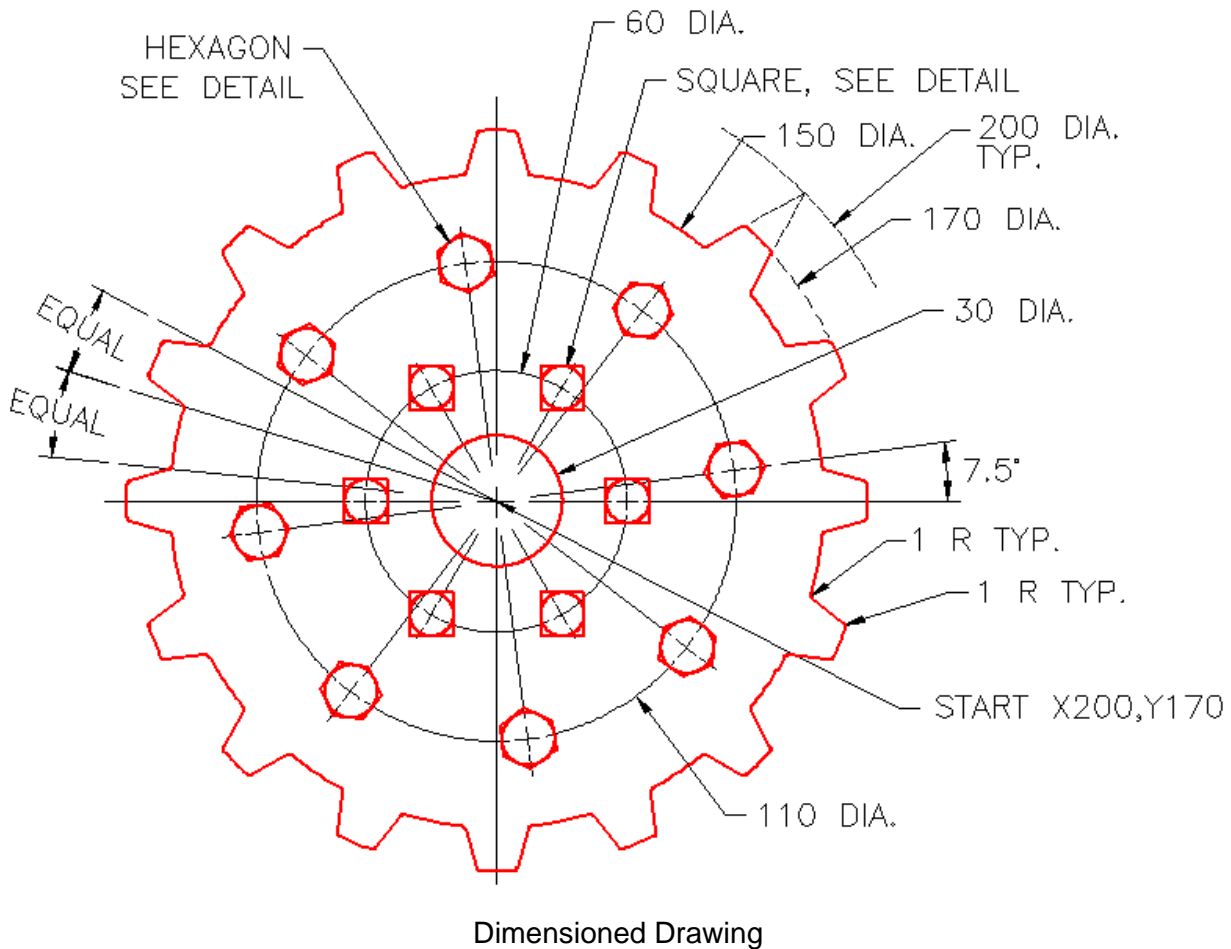
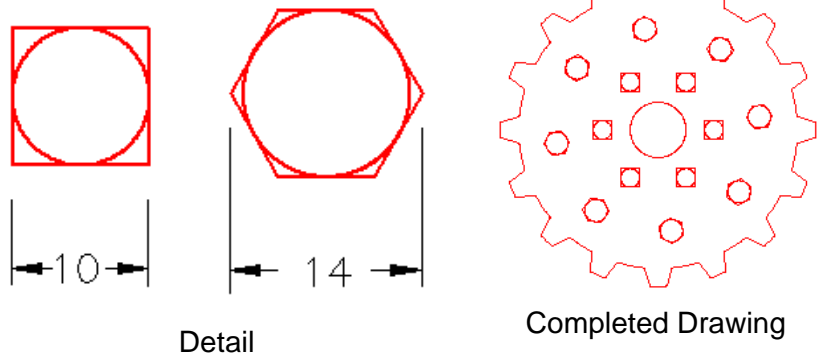
1. When an object is arrayed, all objects created in the array will retain the properties of the original objects, even the layer they reside on. This happens regardless of the current layer when the ARRAY command is executed.
2. In a rectangular array, the offset distance is measured from the one point on the object to the same point on the arrayed object.
3. A Window Polygon selects all drawing objects that are totally inside a window defined by a polygon. The polygon shaped window will appear as a solid line. A Cross Polygon selects all drawing objects that are totally inside and the ones that cross a window defined by a polygon. The polygon will appear as a dashed line. A Fence selects all drawing objects that are crossed by a line or a series of lines.

Lab Exercise 23-1		Time Allowed: 60 Min.
Name	Template	Units
AutoCAD 2D Lab 23-1	2D Layout Metric	Millimeters

Instructions:

Step 1 On layer Object, draw the object shown in the dimensioned drawing.

Step 3 Set the insertion units and insert the key. Check your drawing for accuracy.



Author's Construction Hints: Do your best to complete the lab exercise drawing without using the following hints. If you get stuck and cannot complete it on your own, use the following hints to help you.

Hint 1 Draw and then array the line 64 times (Figure Hint 1A).

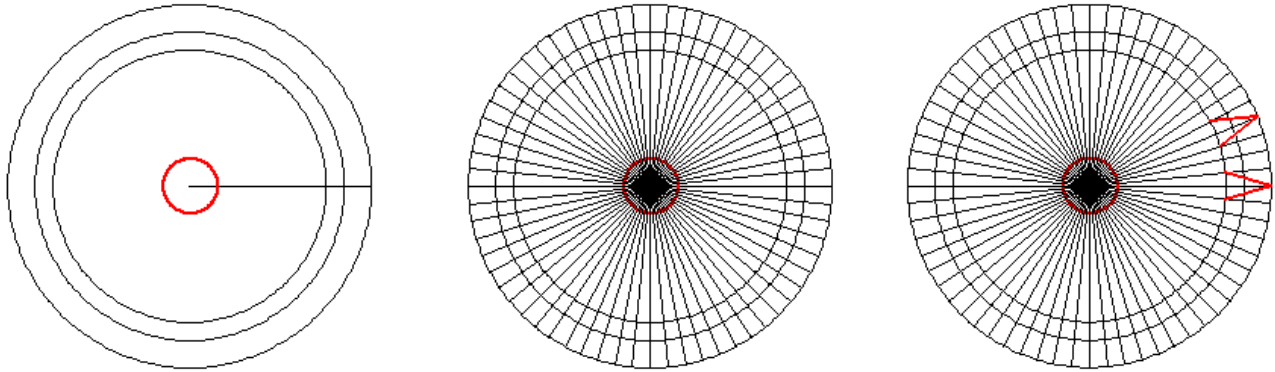


Figure Hint 1A

Hint 2 Trim the circles and lines as shown in the figure. (Figure Hint 2A, 2B and 2C)

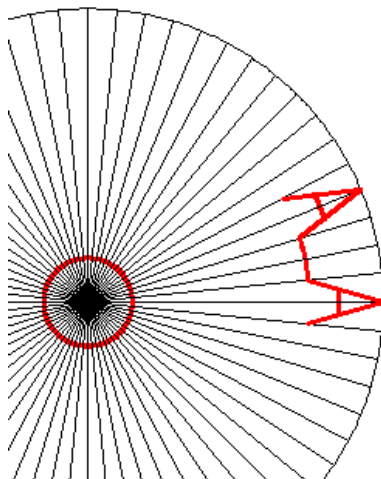


Figure Hint 2B

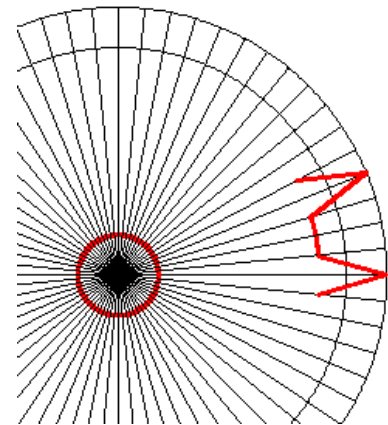


Figure Hint 2A

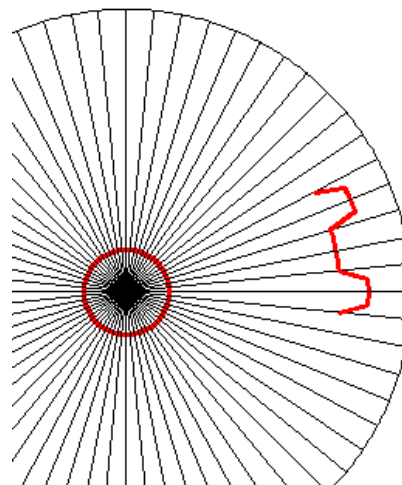


Figure Hint 2C

Hint 3 Delete unnecessary lines and arcs. (Figure Hint 3)

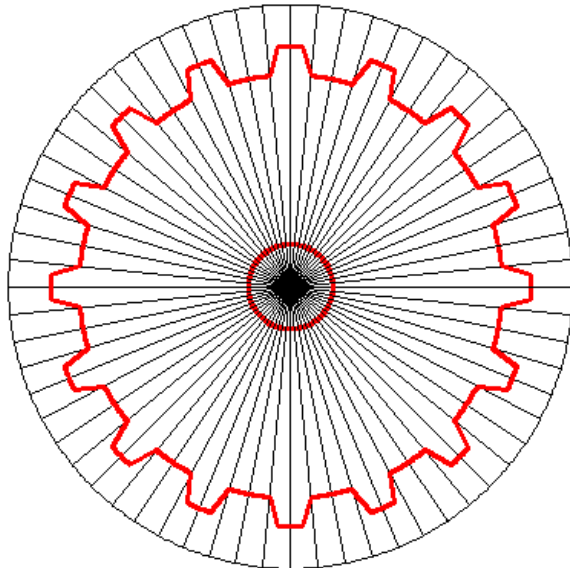


Figure Step 4

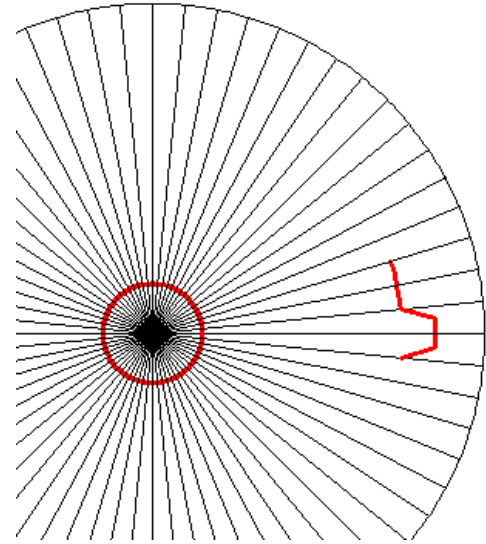


Figure Step 3

Hint 4 Array the objects 16 times. (Figure Hint 4)

Hint 5 Draw the hexagon first with the top and bottom lines horizontal. Locate its center using the dimensioned drawing. After it is drawn, rotate it, using a Reference, to the correct angle.

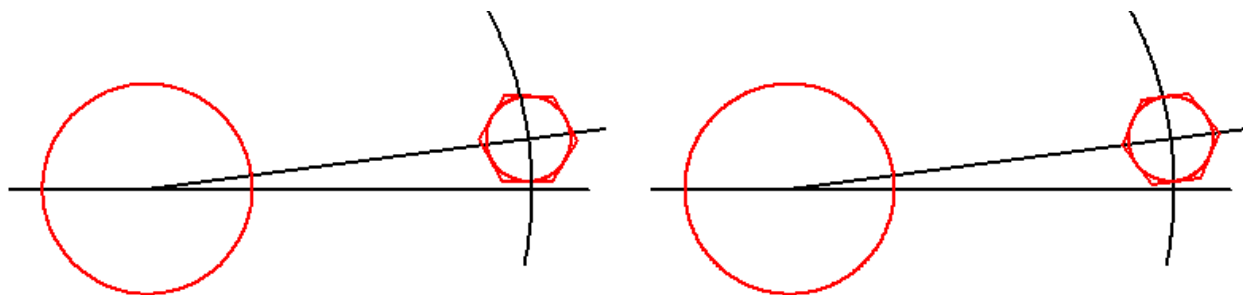


Figure Step 5

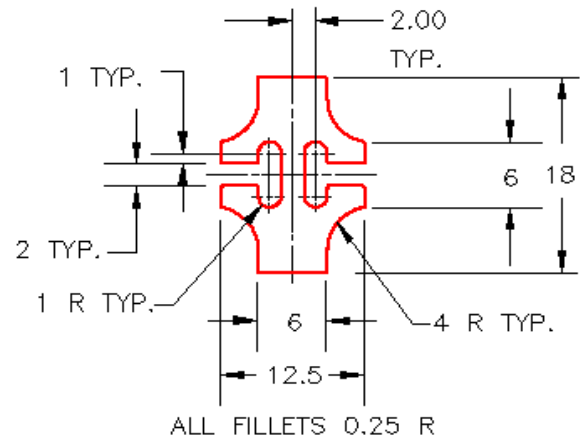
Lab Exercise 23-2 **Time Allowed: 60 Min.**

Name	Template	Units
AutoCAD 2D Lab 23-2	2D Layout Metric	Millimeters

Instructions:

Step 1 On layer Object, draw the object shown in the dimensioned drawing. Draw it anywhere on the drawing.

Step 2 Copy the object to each location as shown in the figure. (Figure Step 2)



Dimensioned Drawing

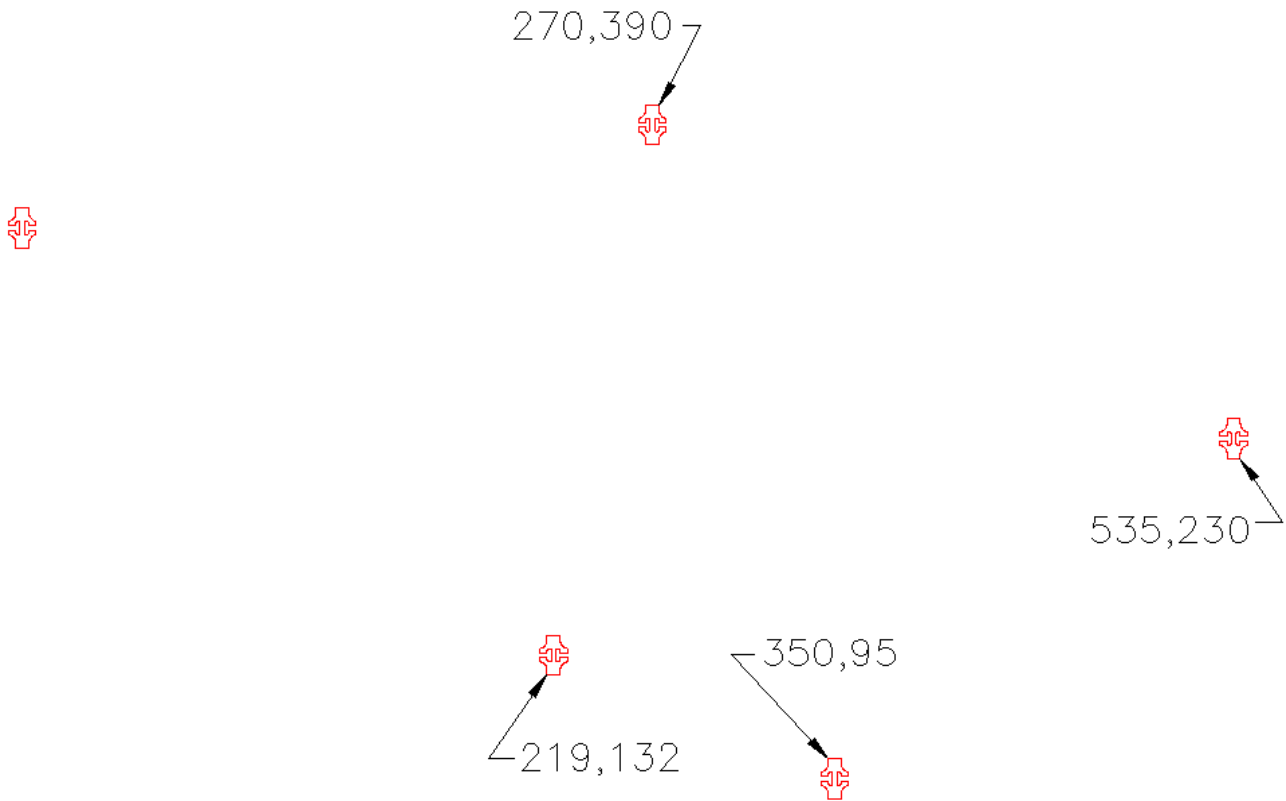


Figure Step 2

Step 3 Array the object as shown below. (Figure Step 3)

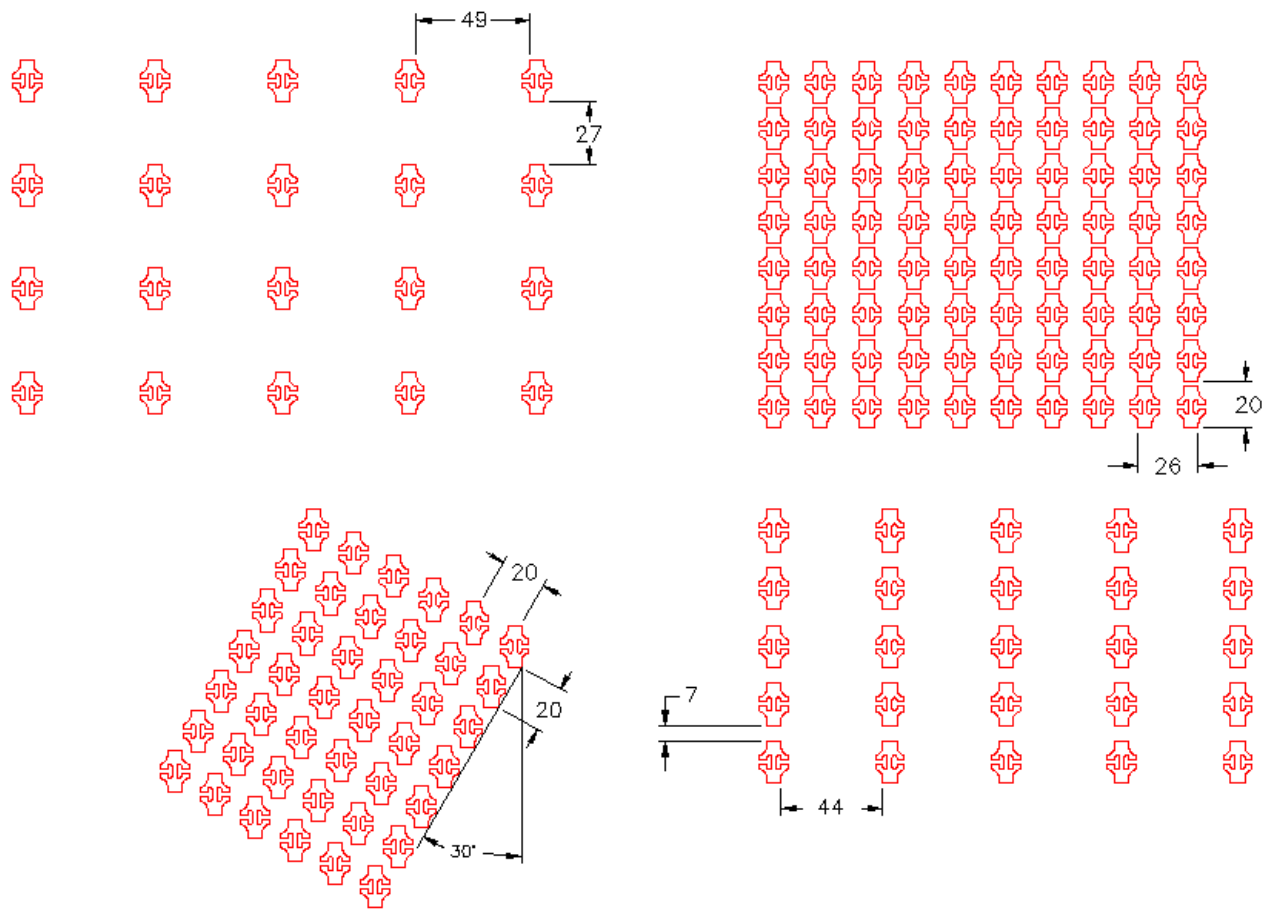
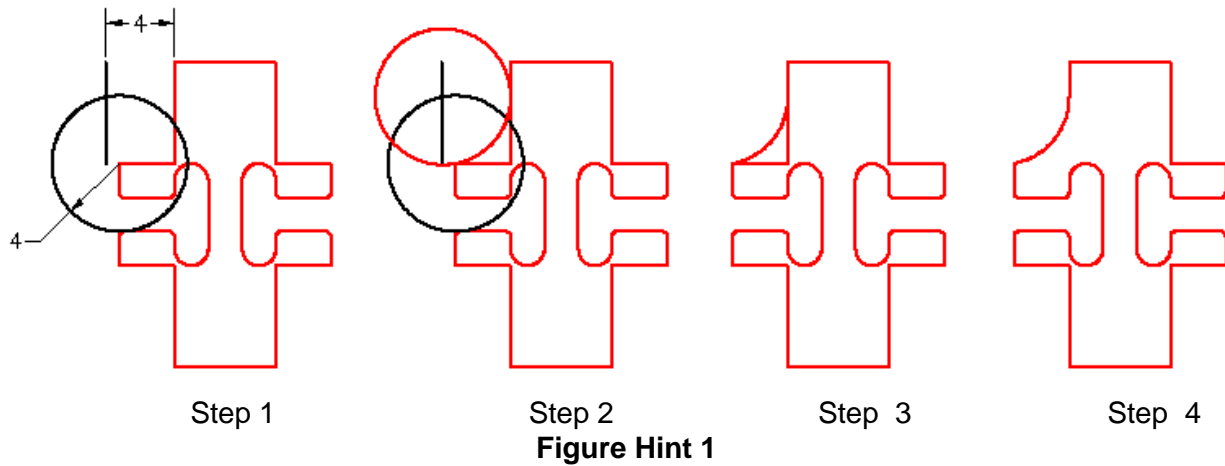


Figure Step 3

Author's Comments: Be careful of the spacing as the dimensions are tricky. See the User Tip on page 23-11 to help you figure out the Row offset and the Column offset. In a rectangular array, the offset distance is measured from the one point on the object to the same point on the arrayed object.

Author's Construction Hints: Do your best to complete the lab exercise drawing without using the following hints. If you get stuck and cannot complete it on your own, use the following hint to help you.

Hint 1 Draw one arc as shown. The four step are shown in the figure. If you need help understanding you can see the Geometry Lesson on page 20-17 in Module 20. (Figure Hint 1)



Hint 2 After one arc is drawn, mirror it to the right side. Then mirror the two top arc to the bottom. Trim and erase the lines to complete. (Figure Hint 2)

