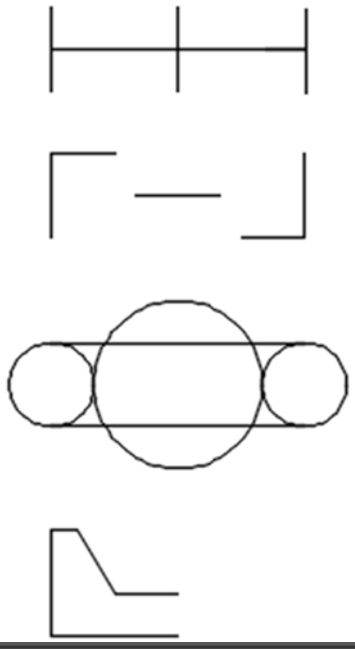
Engr 210 AA **– Engineering Graphics**

Lab #2 – Geometric Constructions

**Part 1: Basics Editing Commands**

In this exercise basic AutoCAD editing commands such as trim, extend, copy, and mirror will be introduced.

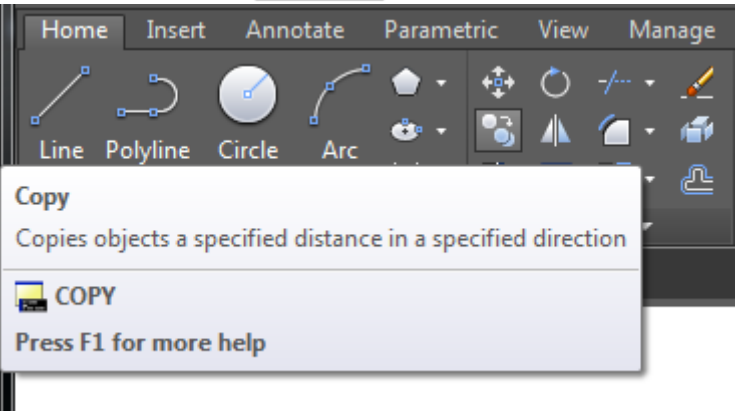
1. Starting with a blank AutoCAD drawing. The units and scale of the drawing are not important.



2. Using an open area, create the objects shown. The actual scale of the objects is arbitrary.

You should enable the SNAP and GRID settings to help locate the positions of points.

Use the Line command which is located in the Draw toolbar to draw straight lines, and the Circle command to draw circles.



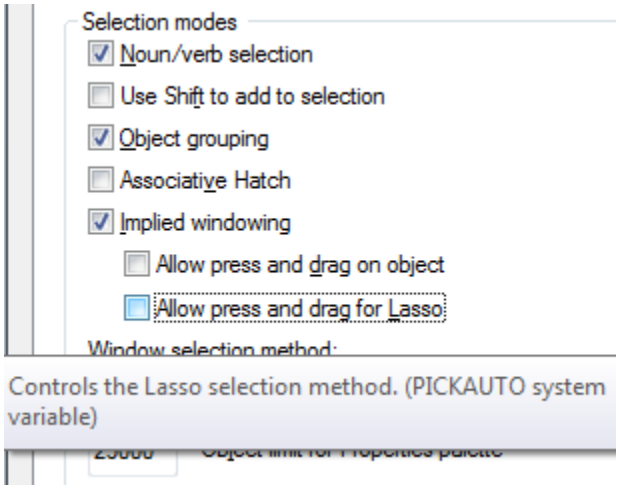

3. In the *Modify* menu, select the Copy command to copy all four objects.

4. The prompt "*Select objects:*" will appear in the command prompt area.

To ensure we select all of the components for the drawings we will create either a lasso path or a window around the objects we want to copy instead of selecting each individual component.

A lasso selection allows you to draw a path around the objects you want to select while a window selection allows you to create a rectangular window that selects all objects within the window.

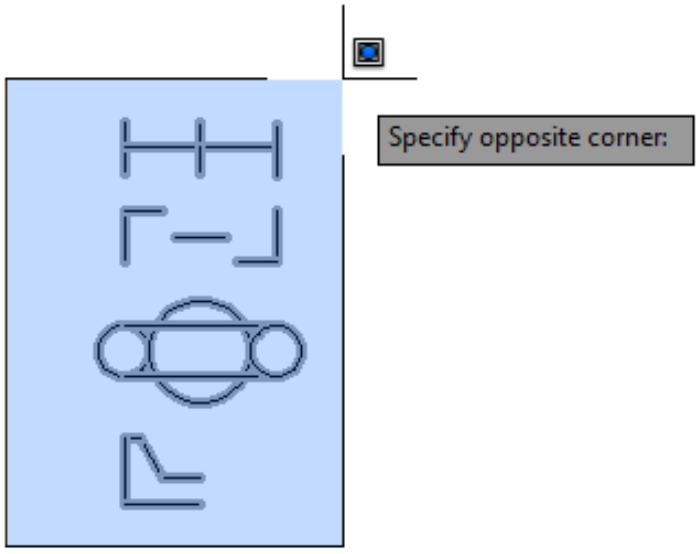
To deactivate lasso selection option click on the ***Tools*** tab on the ***Menu bar*** and select ***Options*** which is located towards the bottom. When the ***Options*** window opens deselect "*Allow press and drag for Lasso"*.




To use a lasso selection simply press and hold the ***Left-mouse-click*** and drag the cursor around the objects being copied to create a path.

To use a window selection simply press the ***Left-mouse-click*** at an empty spot below and to the left of the bottom object to indicate the initial position of our window that will enclose all of the objects being copied.

5. At the prompt "*Specify opposite corner:"* ***left-mouse-click*** at an empty spot above and to the right of the top object so that all




objects are inside the selection window.

6. ***Right-mouse-click*** or press **[Enter]** to finish the selection of the objects being copied.

7. At the prompt "*Specify base point or <Displacement>:"* ***left-mouse-click*** on any point in the drawing. This point will be used as the reference point in the copying.

8. At the prompt "*Specify second point or <use first point as displacement>:"* ***left-mouse-click*** on the desired position of the reference point for the copy to be made.

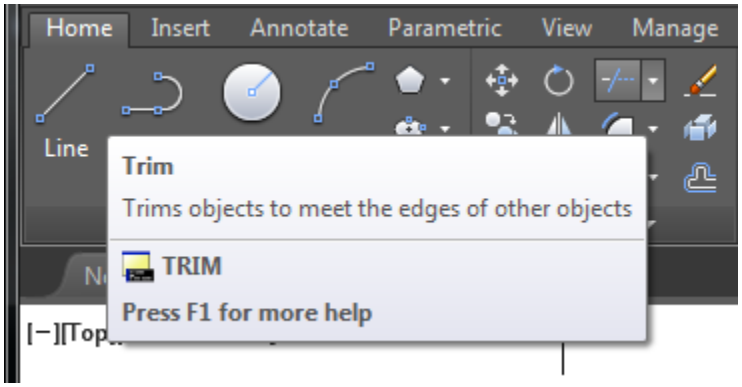
9. ***Right-mouse-click*** or press **[Enter]** to finish the *Copy* command

There should now be two copies of each object. We will use the *Trim, Extend,* and *Mirror*

commands to modify the copied portion of each object.

10. For the top object, the copied portion will be modified as shown.

a. In the *Home* tab locate the *Modify* window and select the ***Trim*** command icon.




b. At the prompt "*Select objects or <select all>:"* ***left-mouse-click*** the horizontal line.

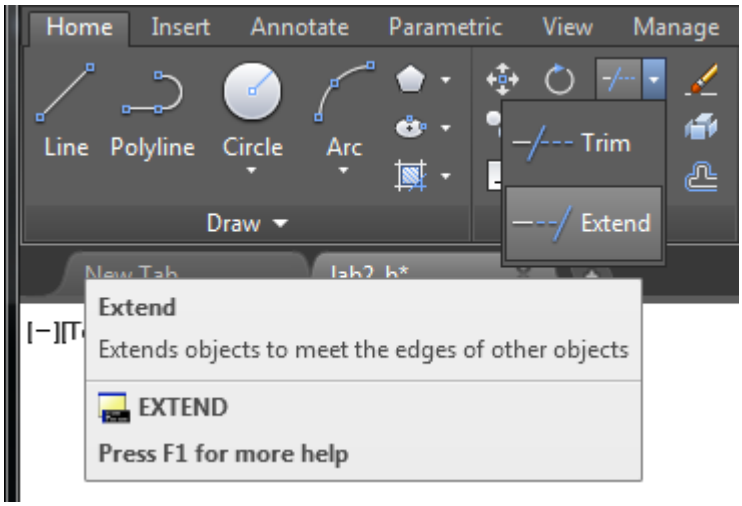
c. ***Right-mouse-click*** or press **[Enter]** to finish selecting the cutting edges.

d. At the prompt *"Select object to trim or shift-select to extend"* ***left-mouse-click*** on the part of the vertical lines that will be trimmed. These include the upper-half of the left and right vertical line, and the bottom-half of the middle line.

e. Press **[Enter]** to finish the Trim command.

11. For the second object, the copied portion will be modified as shown

a. In the *Home* tab locate the *Modify* window and select the ***Extend*** command icon. It's located in the same spot as the ***Trim*** command under the small drop down window.




b. At the prompt "*Select objects or <select all>:"* ***left-mouse-click*** the left and right vertical lines.

c. ***Right-mouse-click*** or press **[Enter]** to finish selecting the edges.

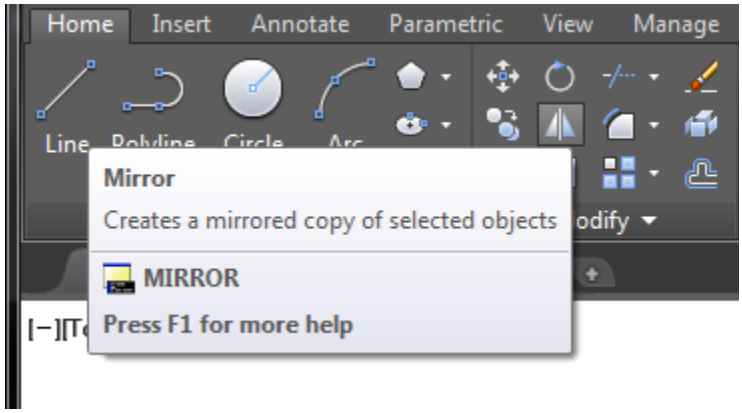
d. At the prompt "*Select object to extend or shift-select to trim"* click the right side of the top horizontal line, the left and right side of the middle line, and the left side of the bottom line.

e. Press **[Enter]** to finish the ***Extend*** command.

12. For the third object, the copied portion will be modified as shown. Use the *Trim* command with two horizontals lines and the larger center circle as the *cutting edges* and the inner arcs of the circles and inner portion of the horizontal lines will be the objects to *Trim*. Make sure to **left-mouse-click** the correct portion of the circles and horizontal lines.

13. For the last object, the copied portion will be modified as shown.

a. In the *Home* tab locate the *Modify* window and select the ***Mirror*** command icon.




b. At the prompt *"Select objects:"* create a window around the object to be mirrored.

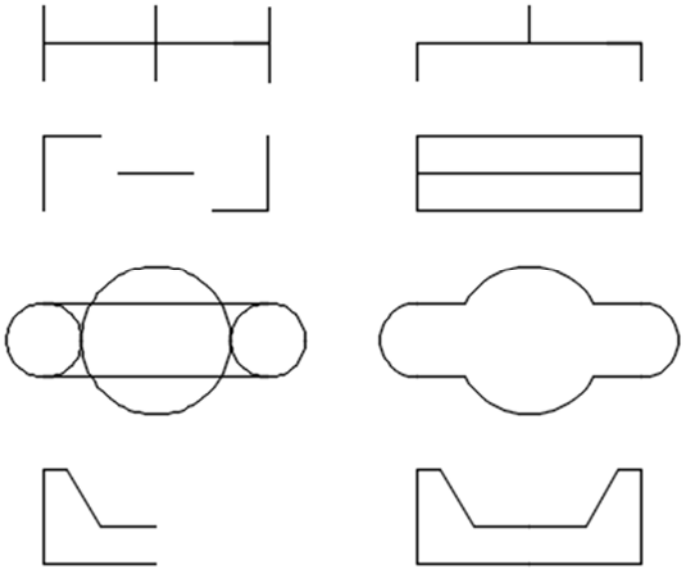
c. ***Right-mouse-click*** or press **[Enter]** to finish selecting the objects to be mirrored.

d. At the prompt "*Specify first point to of mirror line:*" **left-mouse-click** on the right end of the bottom horizontal line.

e. At the prompt *"Specify second point of mirror line:"* **left-mouse-click** on the right end of the other horizontal line. Make sure that the mirror line is vertical. (the ORTHO option might be useful).

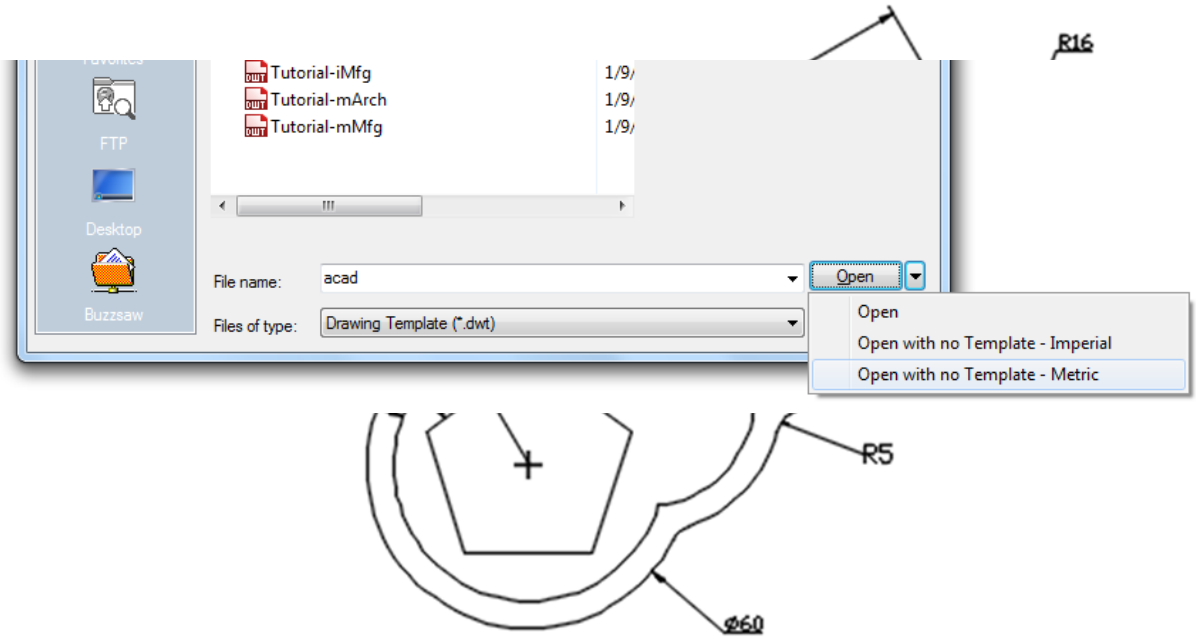
f. At the prompt *"Erase source objects? [Yes/No]:"* press **[ENTER]** to select the default "*No*" answer.

14. Save the drawing as **lab2-a.dwg.**



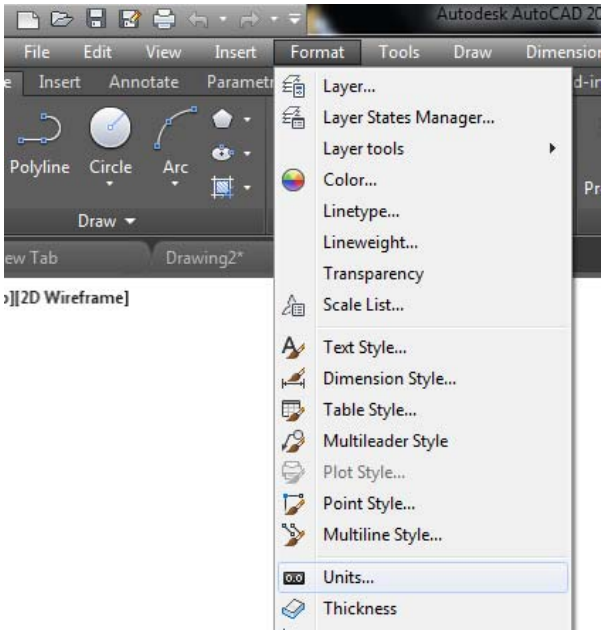
**Part 2: Geometric Constructions**

In this exercise, more AutoCAD construction and editing techniques will be used to create the given figure. AutoCAD commands covered in this exercise include Object Snaps, Trim, Fillet, Polyline, and Explode.



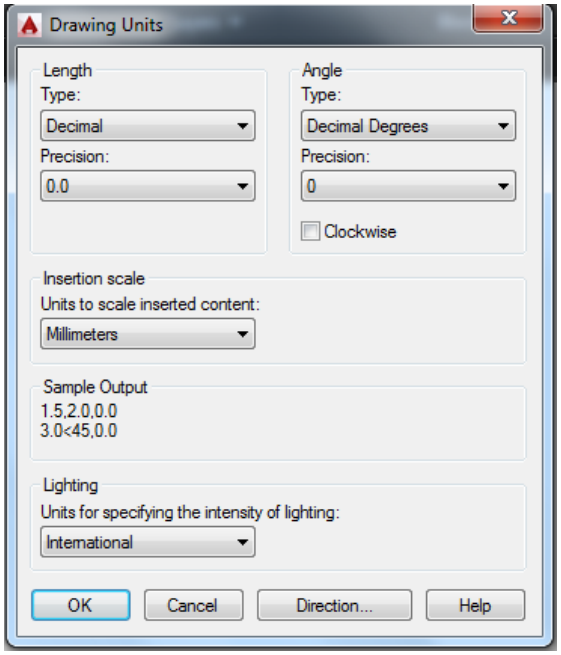

1. Start with a new AutoCAD drawing.

2. In the *Select Template manager*, **left-mouse-click** on the ***triangular*** button to the right of the ***Open*** button, and select ***Open with no Template – Metric***.




3. In the pull-down menus, select: **[Format] => [Units]** The Drawing Units dialog box will appear. This allows the drawing units settings to be modified.

4. In the Drawing Units dialog box, set the Length Type to Decimal, the Precision to one decimal place, and the Units to Millimeters.




5. Click **OK** to confirm the settings and exit the dialog box.

6. In the pull-down menus, select: **[Format] => [Drawing Limits]**

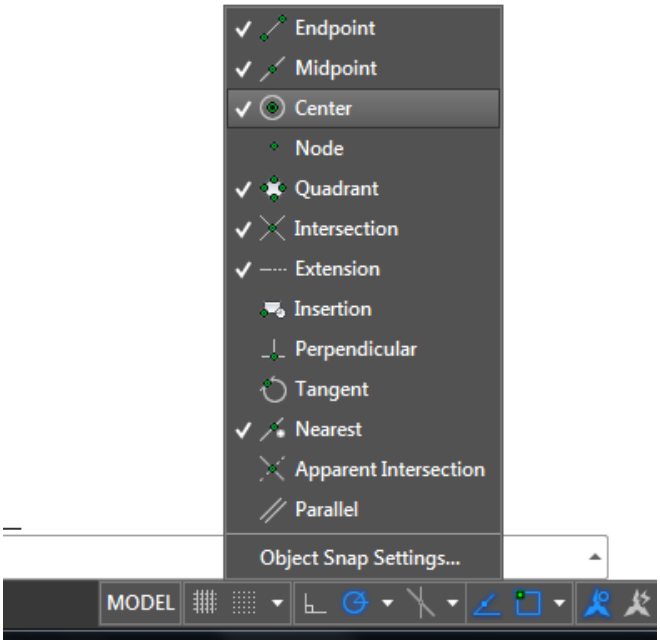
7. In the command prompt area, enter the coordinates of the lower left corner. "*Specify lower left corner or [ON/OFF] <0.0,0.0>:"* **(0,0) [Enter]**

8. In the Command Prompt area, enter the coordinates of (200,160) for the upper right corner. "*Specify upper right corner <12.0,9.0>:"* **(200,160) [Enter]**

9. Create a circle with a center at the coordinates **(50,50)**, and of a radius of **25.**

10. In the pull-down menus, select: **[View] => [Zoom] => [All]** to display the entire drawing limits region.

11. Locate the *Object Snap* icon on the lower left portion of the screen. **Left-mouse-click** the **triangular** button to the right of the *Object Snap* icon. Make sure the ***Center*** icon has a check mark to its left.

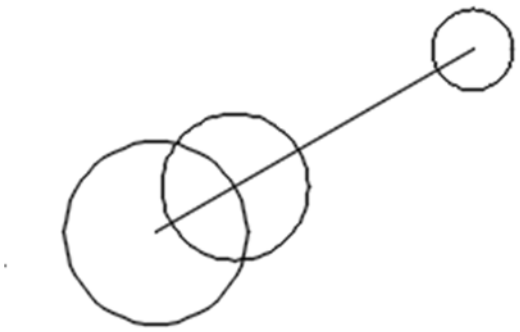



12. Select the ***Line*** command icon in the *Draw* toolbar.

13. At the prompt for the starting point, "*Specify first point:"* choose the *Center* of the **25 radius circle**.

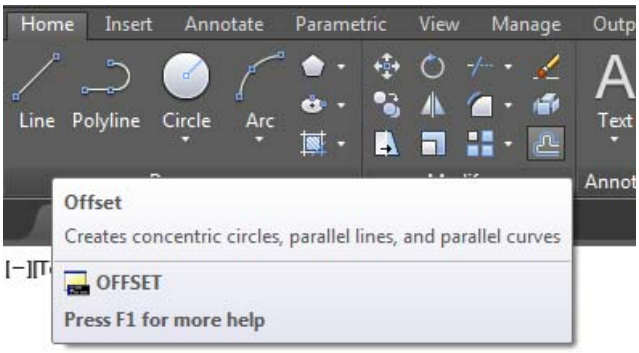
14. At the prompt "*Specify next point [or Undo]:"* enter the relative polar coordinates of the lines endpoint by typing **@100<30 [Enter]**.

15. Create one circle located on the construction lines endpoint of radius **11**, and one circle at the intersection of the construction line and the circle of radius **20.**.



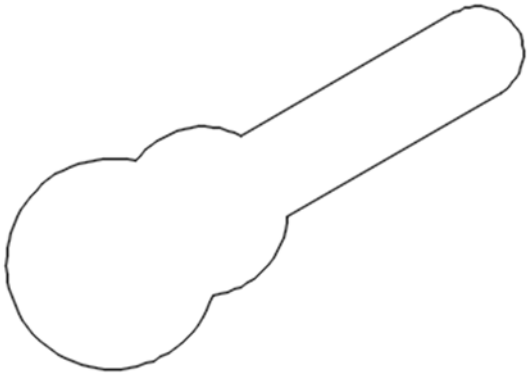
16. Next the ***Offset*** command will be used to copy the construction line twice at a distance of **11mm** on both sides of the line.

a. In the *Modify* menu select the ***Offset*** command.




b. Enter an offset distance of **11** in order to match the upper circles radius and press **[Enter]**.
c. **Left-mouse-click** on the line to select the object to offset.
d. **Left-mouse-click** on any location below the line to make a copy of the line.

17. Repeat to make a copy of the line above the construction line.
    *Trim* and *Erase* line so that the drawing is as shown:



18. Next, all the objects will be combined into a single **compound object** using the ***Polyline*** command. A *polyline* is a two dimensional collection of line and arc segments.

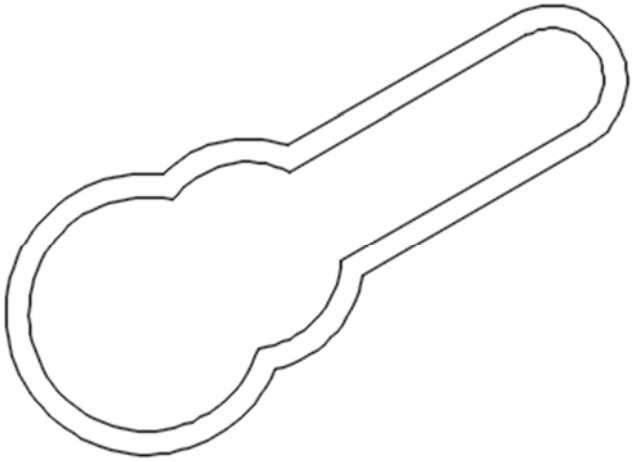
    a. In the pull-down menus, select: **[Modify] => [Object] => [Polyline]**.
    b. At the prompt "*Select polyline:*" select any of the objects on the drawing.
    c. At the prompt "*Object selected is not a polyline. Do you want to turn it into one? :*" press **[ENTER]** to accept the *Yes* default response.
    d. At the prompt "*Enter an option [Close/Join/Width/Edit vertex/Fit/Spline/Decurve/ Ltypegen/Undo]:*" type **j** (for join).
    e. At the prompt "*Select objects:*" select all the other objects to join the polyline and then press **[ENTER]** to finish the command.
    f. All the entities in the drawing are now joined together as a single polyline.

19. In the *Modify* Tool Bar select the ***Offset*** command.

20. Enter an *offset distance* of **5** and press **[Enter].**

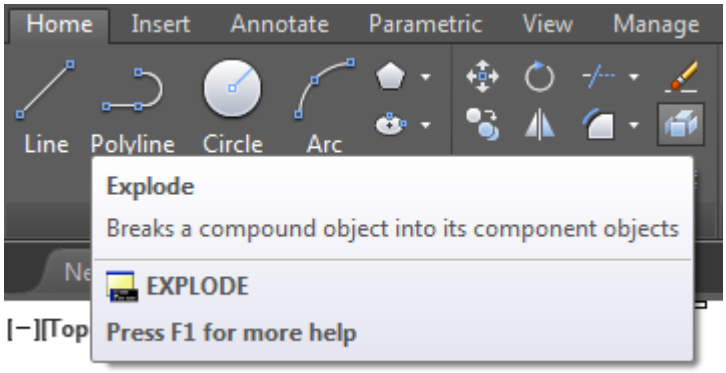
21. Click anywhere on the object to select the object to offset.

22. Click anywhere outside the polyline to specify the side to offset. The drawing should now look like the following:



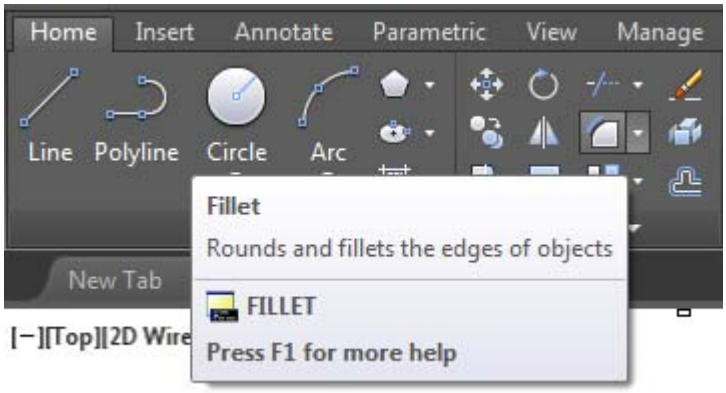
23. Next we are going to use the ***Explode*** command to break an object into its components.

    a. Select the ***Explode*** command icon in the *Modify* menu.



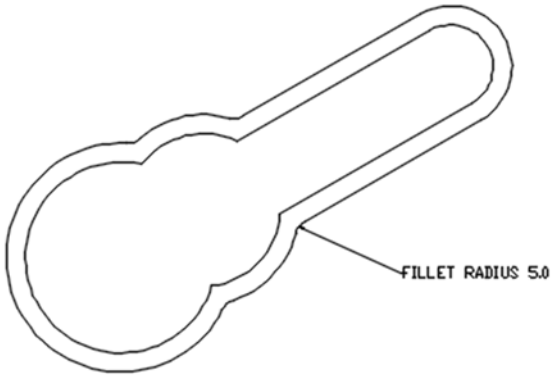

    b. Pick the outer polyline when prompted to "*select objects*".
    c. ***Right-mouse-click*** *or press* **[Enter]** to separate the shapes entities.

24. Select the ***Fillet*** command icon in the *Modify* menu.



a. At the prompt "*Select first object or [Polylin/Radius/Trim/mUltiple]:"* right-mouse-click inside the graphics window to activate the option menu and select the ***Radius*** option.
b. Enter **5** as the fillet radius and press **[Enter]**.

25. **Left-mouse-click** on the bottom straight line and the outer lower circle to select objects to fillet, and press **[ENTER]** to finish the *Fillet* command.




26. ***Fillet*** the remaining three outer intersections.

27. Using the ***Polygon*** command icon in the *Draw* menu, create the pentagon with the same center as the big circular arcs, and inscribed in a circle of radius 20.

28. **(Optional)** add dimensions and labels to the drawing. Save the drawing as **lab2-b.dwg**.

**Part 3: Instruction-less Assignment.**

On your own, create the following drawing. Save it as **Lab2-c.dwg**.

Note: The figure has two pairs of parallel lines tangent to circular arcs.