Activity 5.2 Making Sketches in CAD

Introduction

It would be great if computer systems were advanced enough to take a mental image of an object, such as a sports car, and instantly generate it as a three-dimensional computer aided design (CAD) model on a computer screen. The capability of computers and software is astounding in some respects. For instance, a solid computer model can be created using a 3D scanner to analyze an existing object or space. Likewise, internal body organs and tissue can be "seen" using technology such as Magnetic Resonance Imaging (MRI). Unfortunately, commercially available computer systems have not advanced to the extent that they can document ideas and mental images from the human brain. For now engineers must continue to express ideas as sketches – hand drawn and computer generated.

A CAD model can quickly display an engineer's ideas in a realistic way. That is, once an engineer has developed a model in CAD representing an idea, the idea can be shared much more easily with a wider audience. As is the case with technical sketching, CAD models must begin as sketches of points, lines, or shapes. The major difference between a freehand sketch and a CAD sketch is accuracy. The lines of a CAD sketch can be drawn perfectly straight, with start and end points that occur in exact locations in space. A line may also be given precise length through the use of dimensions. If more than one line is being sketched, they can be made perfectly parallel or perpendicular. Likewise, they can be given a specific angle. CAD programs give designers the ability to sketch any kind of geometry, along with the ability to dimension, extend, rotate, mirror, copy, pattern, move, trim, or erase it.

The ability to realize CAD models through sequentially developing geometric sketches is a critical skill that designers in multiple engineering disciplines use in the process of converting mental images into money-making products.

Equipment

- Computer with 3D CAD solid modeling program
- CAD files
    - **Trim Practice**
    - **Move Practice**
    - **Rotate Practice**
    - **Geometric Constraints**
- Activity 3.4a Making Linear Measurements (Automoblox PREVIEW) or the Automoblox T9 Dimensioned Drawings.

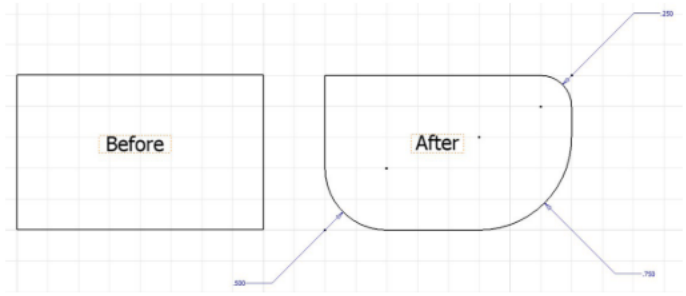
Procedure

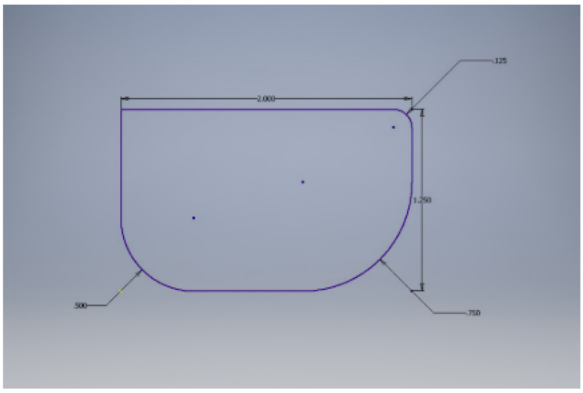
In order to effectively use a CAD program as a design tool, a designer must be familiar with the available and how they work. This activity will help you to understand and utilize the sketching tools that are common to most CAD programs.

Many of the exercises require the creation of a new CAD file and the replication of the images pictured. Other exercises require the manipulation of an already existing file(s). As you finish each exercise, initial the graphic, save the CAD file, document the file name and location on the line provided, and submit this activity to your instructor for evaluation.

Fillet

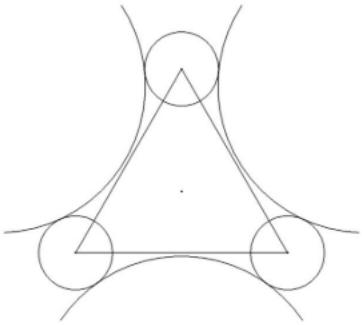
1. The **Fillet** tool creates a round where two lines meet at a corner. The size of the round is identified as a radius value. Create a new CAD file and draw a rectangle that is approximately 2 inches wide by 1.25 inches tall. Use the **Fillet** sketch tool to round off the top right to 0.25 inch radius. Then, round off the bottom right corner with a .75 inch radius. Lastly, round off the bottom left hand corner with a 0.5 inch radius.



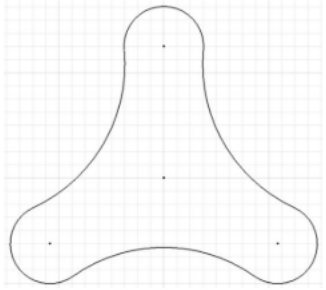


Trim

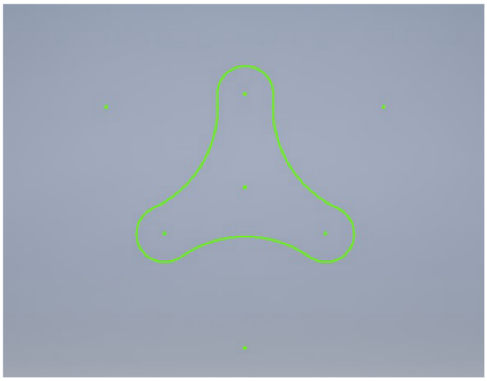
2. Open the file called **Trim Practice**. Use the **Trim** sketch tool and **Delete** keyboard function to revise the sketch to look like the After image. Save the file as a different name.



Before

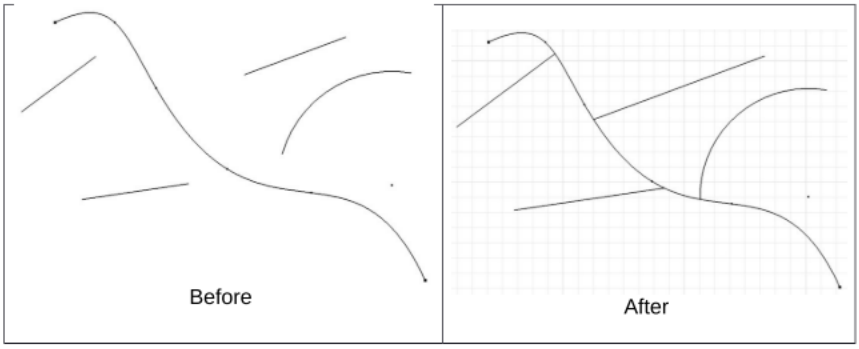


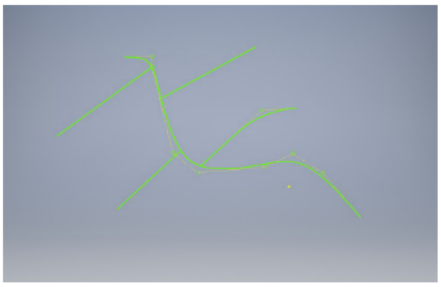
After



Extend

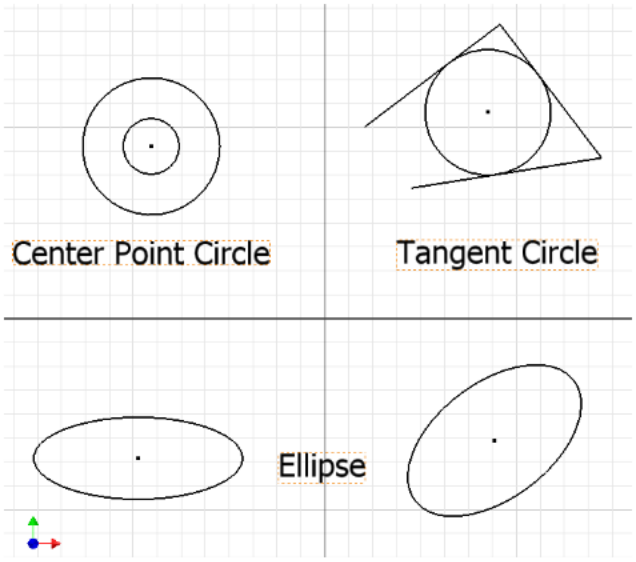
3. Create a new CAD and use the **Spline** and **Line** sketch tools to replicate the sketch shown below on the left. Use the **Extend** sketch tool to extend the straight lines to the spline. When finished, the sketch should look like the after image. Save the file and record the file name and location below.

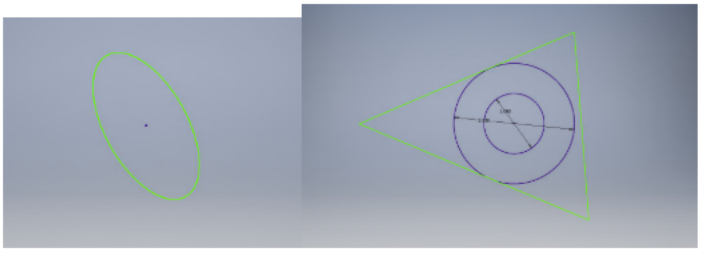




Circle and Ellipse

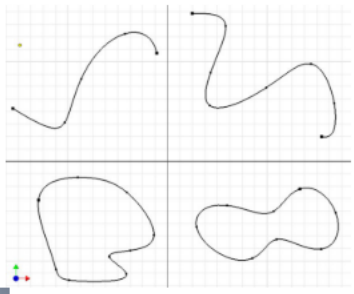
4. Create a new CAD file and use the **Circle** and **Ellipse** sketch tools to replicate the figures shown below. Label the images as shown using the **Text** tool. Note that you will need to use the Line tool to first create straight lines in order to create the tangent circle.

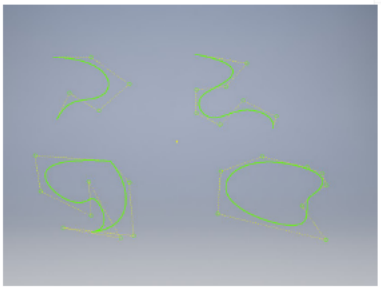




Spline

5. The **Spline** tool is used to create irregular curves, such as the involute curve on a gear tooth or the contour of a car body surface. Create a new CAD file and use the **Spline** sketch tool to draw two irregular curves and two closed shapes that approximate the figures pictured above. Note the locations and number of points in each spline. Save the file and record the file name and location below.

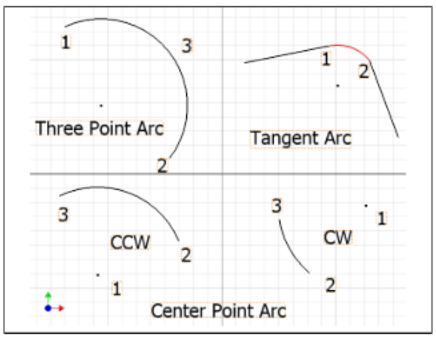


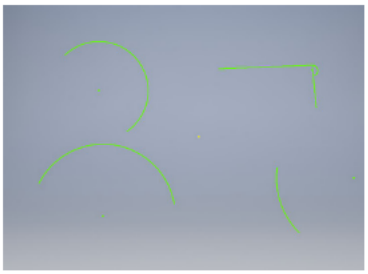


Arc

6. Many CAD programs give the user the ability to define arcs through several methods. These methods may include: defining the size of an arc by establishing three points of tangency, referencing two points of tangency, or identifying a center

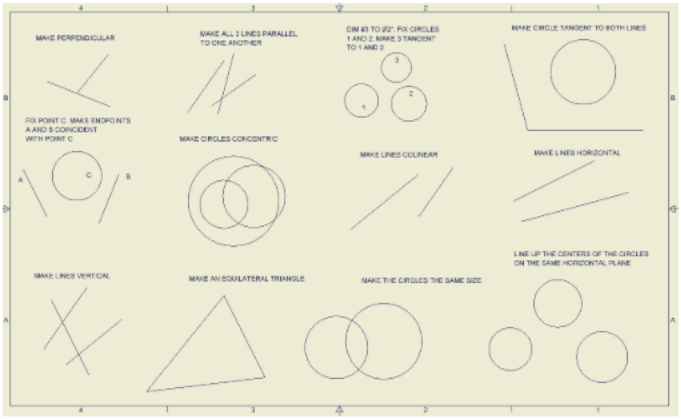
point and two points of tangency. Create a new CAD file and use the **Arc** sketch tool to replicate the figures shown below. Note that you will first need to sketch two straight lines in order to create the tangent arc. Label the images as shown using the **Text** tool.



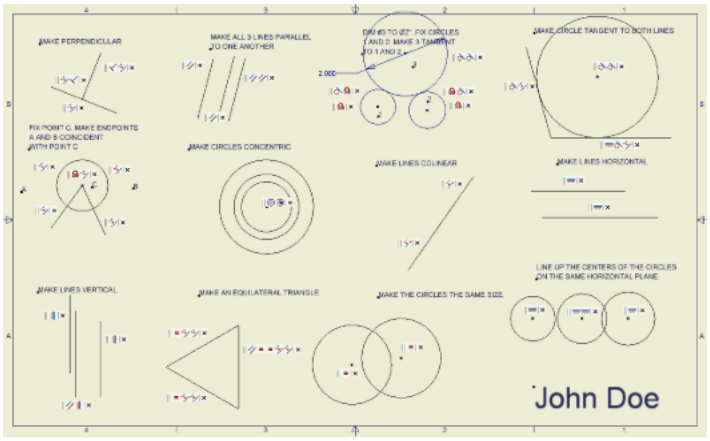


Geometric Constraints

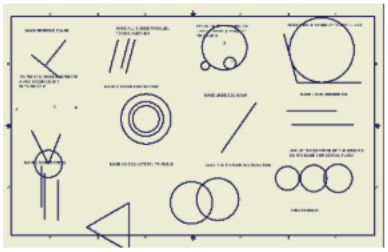
7. Open the file called **Geometric Constraints**. Read the directions and use the **Geometric Constraint** tools to complete each of the 12 exercises. Your completed sheet should look similar to the sheet pictured. Make the geometric constraints visible and add your name to the bottom right corner of the sheet. Save the file as a different name, print it out, and submit it along with this activity to your instructor for evaluation.



Before



After

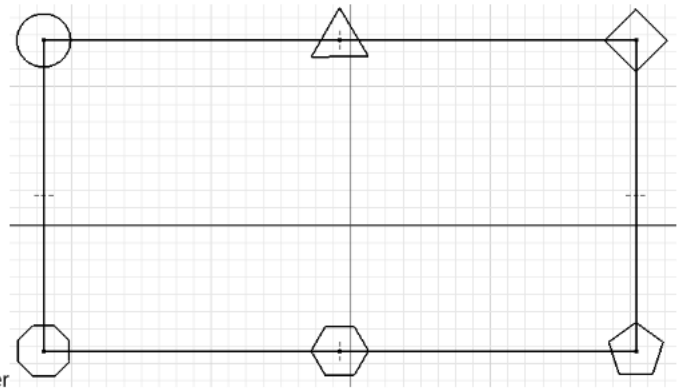


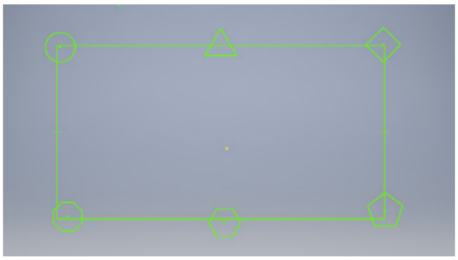
Move

8. Open the file called **Move Practice**. Use the **Move** sketch tool to move the geometric shapes to the positions shown in the after image. Save the file as a different name.

Before

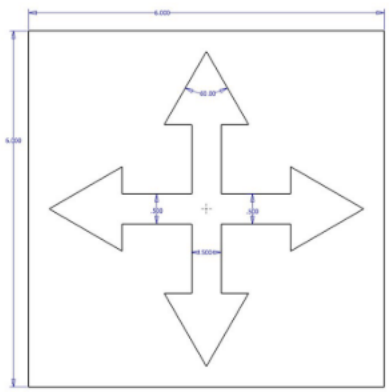
After



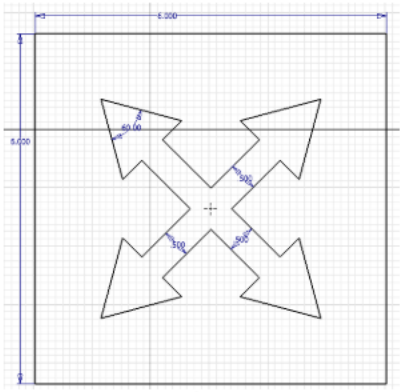


Rotate

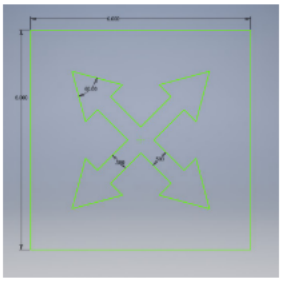
9. Open the file called **Rotate Practice**. Use the **Rotate** sketch tool to rotate the shape shown in the before image to look like the after image. Save the file as a different name.



Before

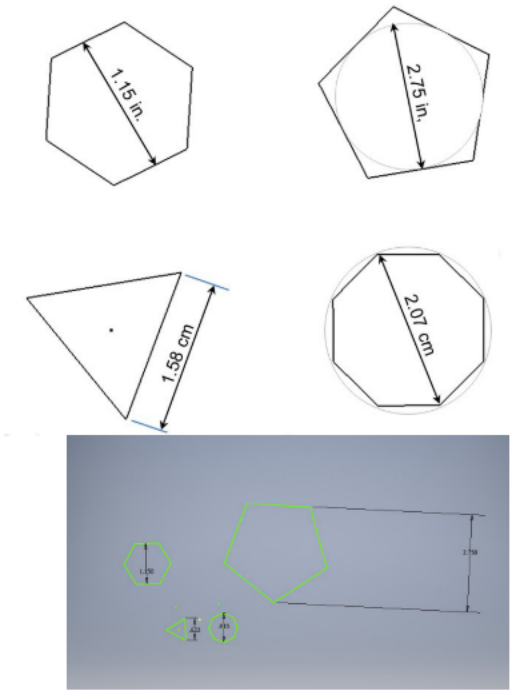


After



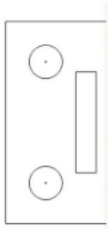
Regular Polygons

10. Regular polygons are multi-sided shapes that have sides of equal length. They may be inscribed or circumscribed within a given radius. The raw materials that are used to produce engineered objects are often manufactured in the shape of regular polygons. Create a new CAD file and use the **Polygon** sketch tool to draw the series of shapes pictured below. **Use the text tool to identify the shape** with a label for each of the regular polygons

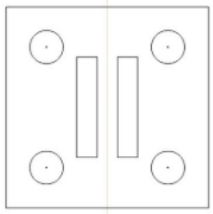


Mirror

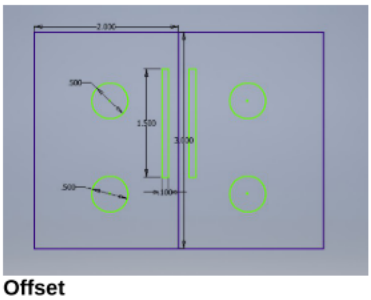
11. CAD programs allow the designer to mirror images across lines, which is a useful tool when designing parts that have high degrees of symmetry. Create a new CAD file and use the line and circle sketch tools to create a similar figure to the one shown in the Before image below. A regular vertical line may be used as the mirror line. The top and bottom horizontal edges must terminate at the vertical mirror line. Use the **Mirror** sketch tool to mirror the figure across the mirror line.



Before

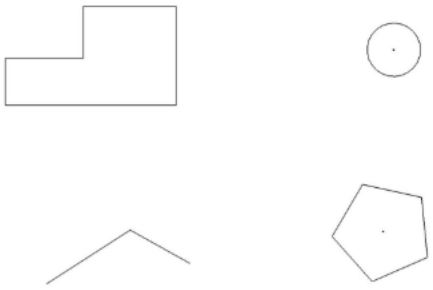


After

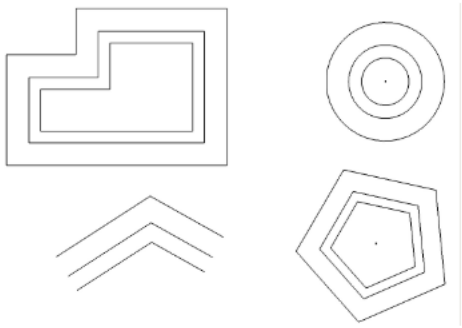


Offset

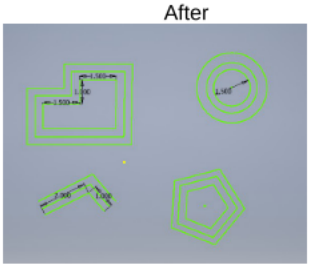
12. The need to create geometry that is identical in shape and parallel is very common in engineering design. The **Offset** sketch tool is used to make this process quick and accurate. Create a new CAD file and draw the figures pictured in the Before image. Use the **Offset** sketch tool to offset the geometry of each figure outward two times such that the sketch resembles the After image.



Before



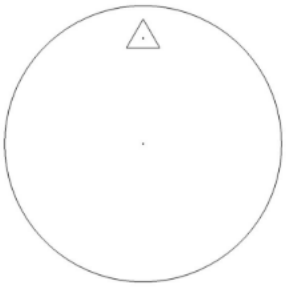
After



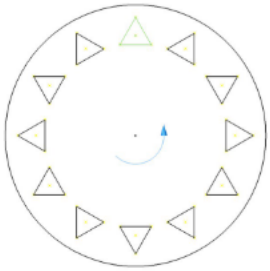
Circular Pattern

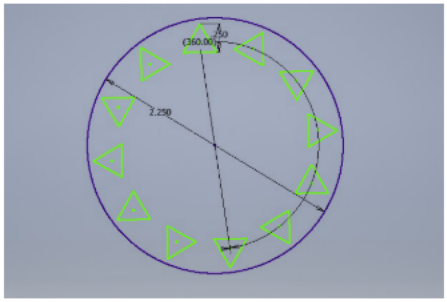
13. The ability to pattern a shape or element allows the designer to save time and maintain accuracy. Create a new CAD file and draw a circle with a diameter of approximately 2.25 inches. Use the polygon sketch tool to create an isosceles triangle that would fit within a .25 inch diameter circle. Orient the triangle so that it is pointing toward the top quadrant of the circle. The center of the triangle should be approximately 7/8 inch from the center of the circle. Use the **Pattern** sketch tool to create a copy of the triangle 12 times (the number of instances includes the object being patterned) around the center of the circle.

Before



After

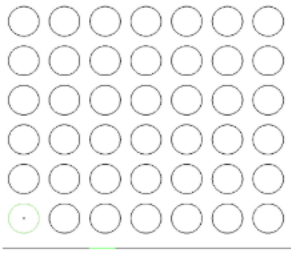




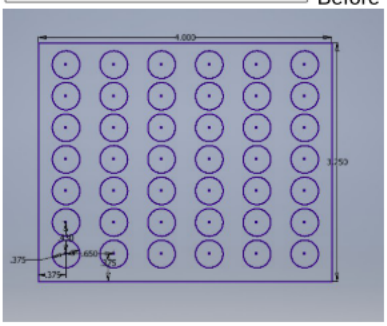
Rectangular Pattern

14. The **Pattern** sketch tool allows the designer to create a pattern from one or several objects. The direction or orientation of the pattern is derived from existing lines on the sketch. Create a new CAD file and draw a rectangle that is approximately 4 inches wide by 3.25 inches tall. Create a 3/8 inch diameter circle in the lower left hand corner. Locate the center of the circle approximately 3/8 inch from the bottom and left edges. Use the **Pattern** sketch tool to create multiple copies of the circle. The rectangular pattern must have seven columns and six rows, and must fit within the boundaries of the rectangle.

Before



After



Conclusion

1 What is a geometric constraint?

A tool to make a geometry act a certain way.

15. What are the different types of geometric constraints that are applied to sketches, and what are their functions?

Move, change position, size, etc.

16. Review the After image in number 20 above and answer each of the following.

a. Describe the angle formed between the two lines in the MAKE PERPENDICULAR exercise. What is the angle measure?

b. Describe the angle formed between the two lines in the MAKE COLINEAR exercise. What is the angle measure?

c. What type of angle is shown in the image to the left? Define this type of angle.

Obtuse, more than 90 degrees.

d. What type (in terms of interior angle measure) of triangle is shown in the image to the left? How do you know?

180 degrees. All triangles are 180 degrees.

17. Define “tangent”.

A line; both straight and curved.

a. Sketch a line tangent to two circles.

-O-O-

b. Sketch three circles such that all circles are tangent to the other two.

OOO

18. How is a geometric constraint different from a numeric constraint?

Geometric-shapes Numeric-Numbers

19. What types of numeric constraints may be applied to sketches?

Dimensions

20. What advantages do CAD sketches have over freehand sketches?

More precise and neat.

21. What disadvantages do CAD sketches have when compared to freehand sketches?

Less freedom.