

Field of education:  
**Mechanical engineering**

Professional qualification:  
**CNC operator**

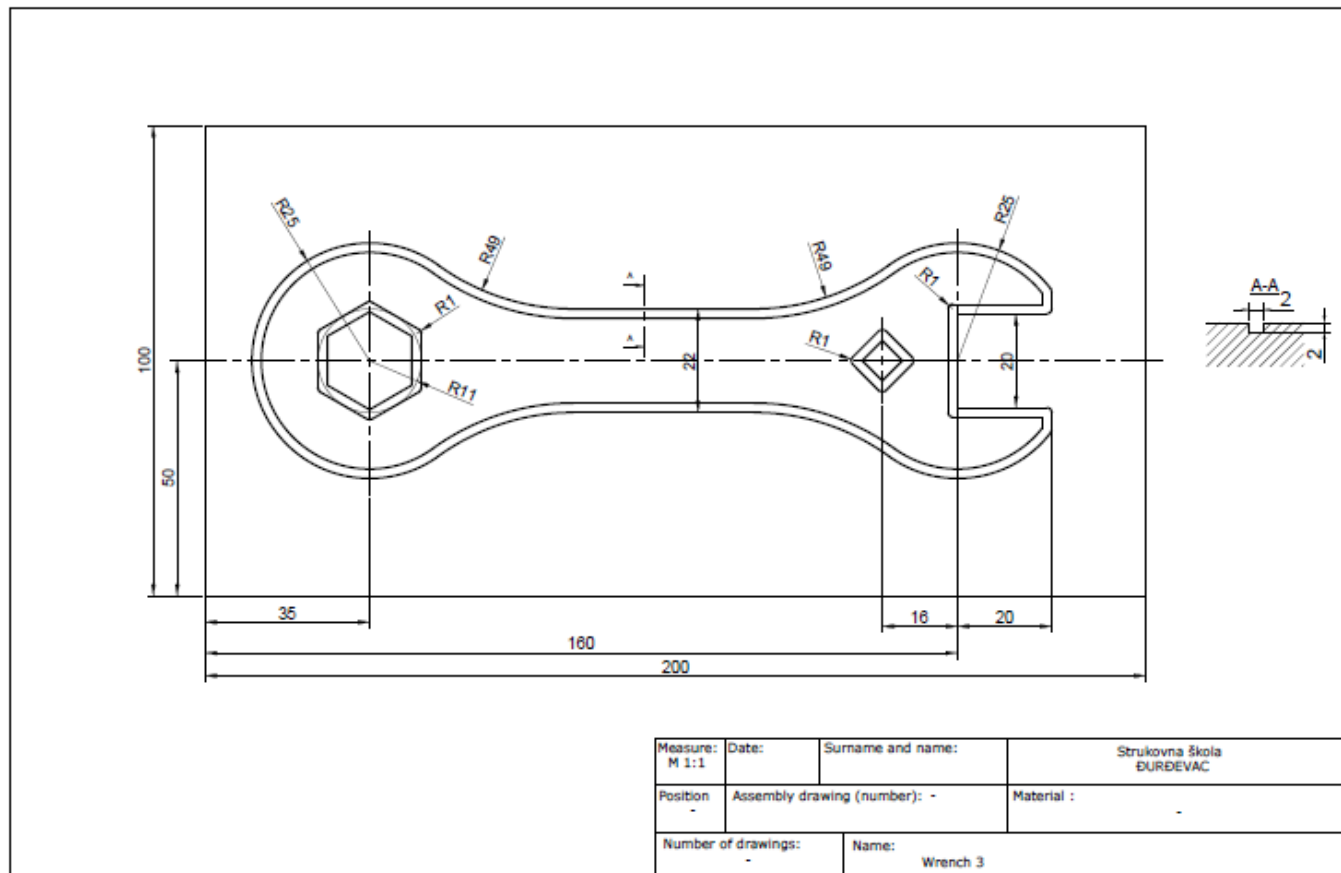
Exercise:  
**Programming of CNC machine**

Variant:  
Task 10 – Wrench 3.4.

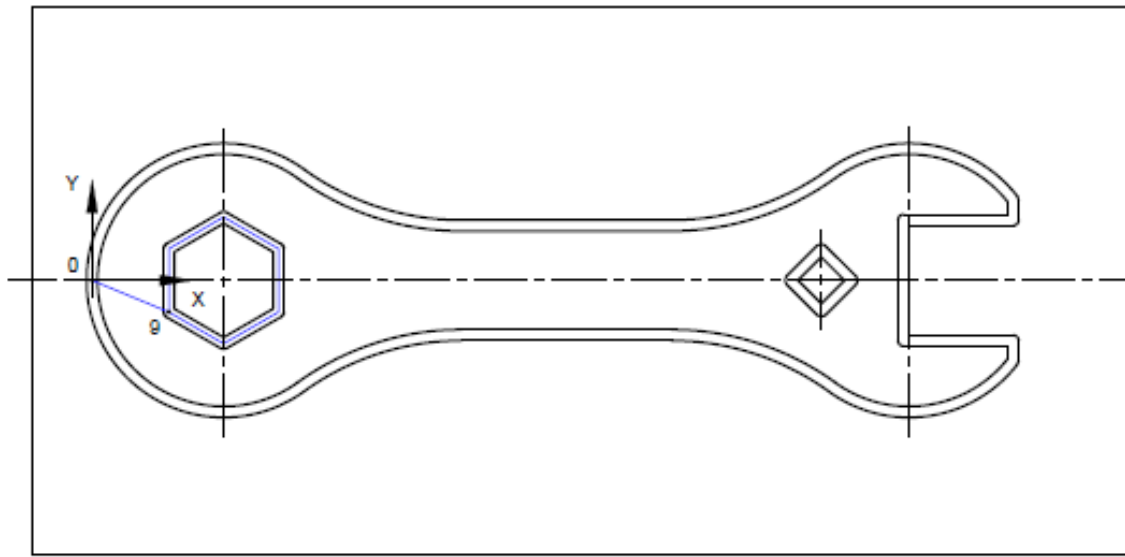
### Instructions for exercise:

According to the given workshop drawing make the following tasks:

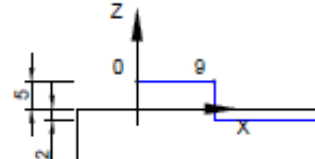
- Draw the appearance of the 3D model in Fusion 360.



- According to the given path and the given start or end point (blue line), determine the other necessary points.



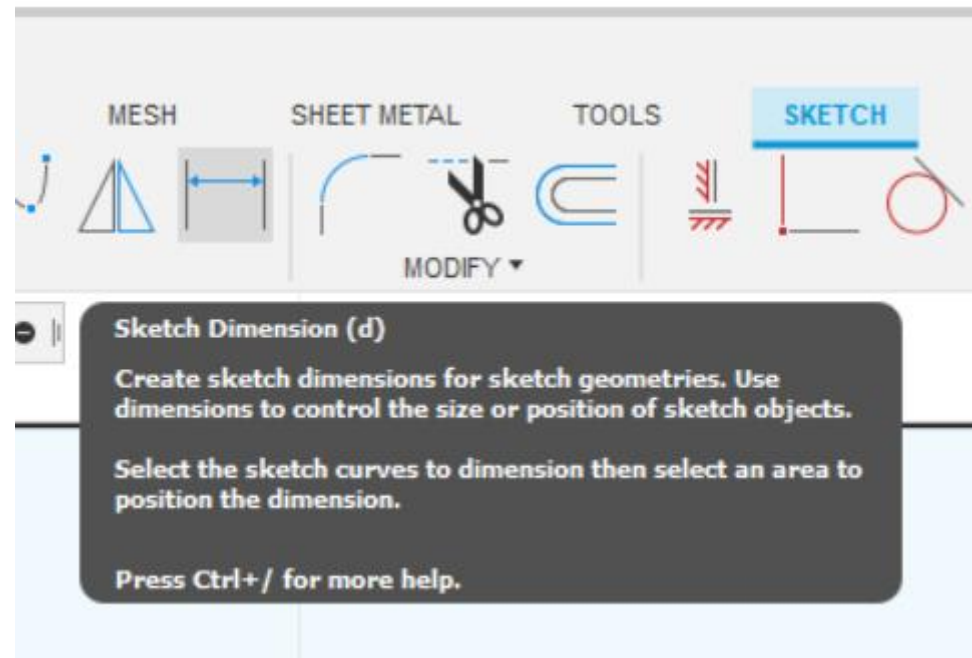
The drawing shows a mechanical part with a complex shape. A coordinate system is defined with the origin O at the center of the leftmost circular feature. The X-axis points to the right, and the Y-axis points upwards. A blue line indicates the start of a path at point O, moving horizontally to the right, then vertically down, then horizontally to the right again, ending at point P. The path is intended to follow the outer contour of the part.



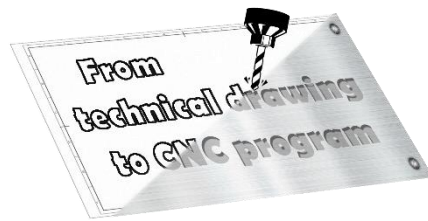
A smaller coordinate system is shown below the main drawing. The Z-axis points upwards, and the X-axis points to the right. The origin O is at the top-left corner of a rectangular area. A blue line starts at O, moves horizontally to the right to point P, then vertically down. Dimensions are given: 5 units for the vertical distance from the top edge to the start of the path, and 2 units for the horizontal distance from the left edge to the start of the path.

Task 1	Measure: M 1:1
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- To make it easier to determine the coordinates, use Sketch Dimension option in the drawn sketch for precise G-code writing.



- Consider the position of your coordinate system.
- Write a G-code.
- Tighten the workpiece on the machine.
- Set the coordinate system on the machine (reset all coordinates to 0).
- Load the program into the machine control unit.
- Move the machine via the control unit to perform operations.



### Brief description of commands in G-code:

- G0 - fast pace, straight movement, when we are not in contact with the object of processing

The command for programming the high-speed movement is modal, and the form of programming is:

G0 X ... Y ... Z ... - in a rectangular coordinate system,

where X, Y, Z are the coordinates of the point which the tool should reach.

- G1 - working stroke, straight movement, when processing the object

It is used for processing, i.e. we enter the material with a tool. The tool moves in a straight line with an offset which is specified before or in the block with the G1 command. The command is modal. Form of programming in a rectangular coordinate system is:

G1 X ... Y ... Z ...

where X, Y, Z are the coordinates of the point to which the tool should reach.

- G2 - circular clockwise movement
- G3 - circular motion counterclockwise
- In addition to linear interpolation, the control unit also allows circular interpolation. The first piece of information is the point where the tool is currently located, and that is the starting point of circular arc. The other two data are a logical combination of the following data:

X, Y, Z - coordinates of the end point of the circular arc,

R - radius of a circular arc, or

I, J, K - coordinates of the center of the circular arc