Problem 1 (70%) 

The part shown below is a sheet metal bracket. The problem is to create a process plan for this part, and to properly size the equipment.

For the part as shown:

a) Create a process plan for this part assuming a start from coiled sheet metal stock. Be sure to account for each feature. (While some steps can often be combined in a single process, for this problem assume that each distinct step is done on a different piece of equipment.

b) For each step in the plan identify the geometry change required and the physical mechanism for that change.

c) Using a sketch of the part, indicate where critical stresses will occur and describe (approximately) the state of stress that will exist at those locations.

d) For each mechanism, write the key constitutive equation that governs that process, assuming that our eventual goal is to properly size the equipment used to make the part.

e) Sketch the tooling that would be used for each step and identify the regions on the tools where critical stresses will occur.

For the process steps chosen in part 1a)

f) Describe the factors for each process that will cause variation in the final part dimensions, focusing on those dimensions shown in the figure.

g) Describe how each of the following will influence this variation
   a. material properties
   b. tooling properties
   c. machine properties

h) Outline how process capability of each step in the process will influence the overall quality of the part.
NB: All dimensions are in mm.
Problem 2 (30%)

Process Capability for Machine Selection

You are interested in producing a part through machining. This part has only one key dimension, which has been specified to be 60.0 cm ± 1.0 cm. Any parts falling outside of this specification are considered to be defective. You are trying to decide which machine to purchase in order to produce this part to your desired specifications. Prior to purchasing a machine, you are allowed to run a series of tests to evaluate the performance of each machine. The test data are shown below.

<table>
<thead>
<tr>
<th></th>
<th>Machine A</th>
<th>Machine B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Samples</td>
<td>300,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Sample Mean (cm)</td>
<td>60.4</td>
<td>59.9</td>
</tr>
<tr>
<td>Standard Deviation (cm)</td>
<td>0.3</td>
<td>0.4</td>
</tr>
</tbody>
</table>

a) Are either of these machines capable with respect to the specifications?
b) Assuming these are the only machines on the market, which machine would you choose to purchase? Why?