The picture below shows a part to be machined. The part is made of aluminum. The taper on the front is 10 degrees. You are asked to machine this part in the shop on a 3-axis vertical milling machine. Here are some questions:

a) What “stock material” would you start from? The stock material is the unmachined billet that you would put into the milling machine to then reduce to the specified shape. Explain how this stock material that you picked might itself have been manufactured.

b) Provide a detailed process plan for machining the specified part from the stock material. Please provide neat drawings of the setups, how you would fixture the part, and the sequence of operations. We need a drawing for each setup. The quality of you drawing will not be judged as long as it is legible — only the clarity — so please use words if necessary.

c) The Young’s Modulus, Yield Strength and Brinell Hardness of the Aluminum you are machining are 70 GPa, 300 MPa and 270 MPa respectively. You are asked now to consider machining titanium, which has corresponding numbers of 116 GPa, 830 MPa and 716 MPa. How would your process plan likely change, how would the process parameters change, and approximately how much more or less time (give us a factor) will the machining take?

d) If thousands of the part have to be manufactured out of aluminum, what process would you use. How would you modify the part to be more suitable for this new process? Please describe the tooling for this new process.

e) If you had to make thousands of parts out of steel, what process would you specify? What modifications would you make to the part? Also, please specify the steps in the process as well as the tooling.
f) If you had to make thousands of parts out of plastic, how would you make them? Once again, please describe the tooling and any changes to the design. If I insisted that you made the part as I have shown it, what compromises would you have to make in processing time and qualities?