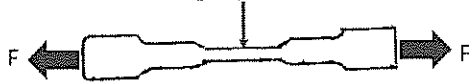


Write your name and show your work on a separate sheet of paper. Closed book. One page note sheet, no other resources.

Put a box around your final answers!

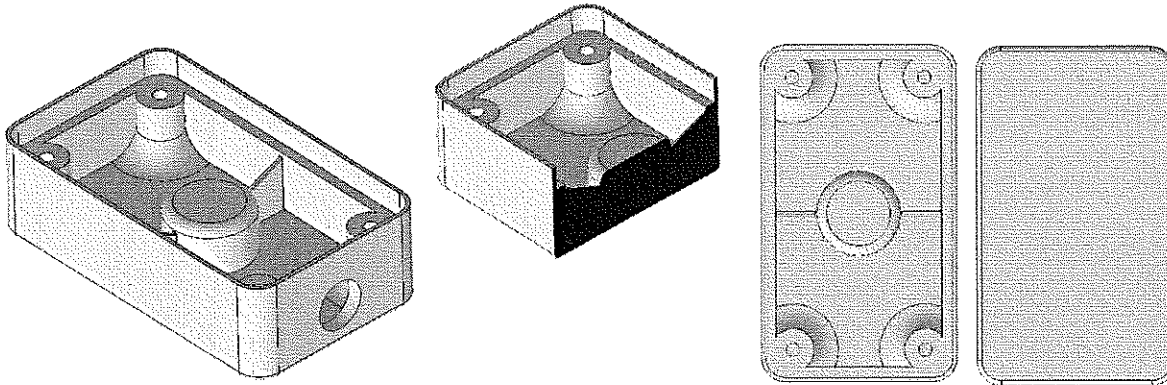
1. Microstructurally, a polymer can be thought of as a bunch of wet spaghetti where the noodles represent long polymer chains. Draw a clear representation of the microstructure (molecular structure) for each of the following:

- a. Tensile tested polymer at room temperature. Region of interest: necked region.



- b. Un-stressed rubber band
c. Thermoset (eg. Epoxy glue) in its hardened/cured state

2. Make a table of common features and unique features comparing injection molding machines (including the mold) with polymer extrusion machines.
3. The part below is poorly designed for injection molding. Indicate the mold opening directions and find at least four (4) features that do not follow appropriate design rules and indicate how they should be improved. A quick sketch of the feature before/after and a short description would be a very clear way to communicate your answer.



4. For a 75% fiber volume, Kevlar fiber, polyamide matrix long-fiber composite with $E_{kev}=22 \times 10^6 \text{ psi}$, $E_{PA}=0.5 \times 10^6 \text{ psi}$, $D_{kev}=0.46 \times 10^{-3} \text{ in.}$, $\sigma_{UTS,kev}=400 \times 10^3 \text{ psi}$, and $\sigma_{f/m \text{ bond}}=2352 \text{ psi}$. Determine the following:
- The fraction (ratio) of load taken by the fibers.
 - The minimum fiber length, where the fibers take all/most of the load.
- Note: The loading is uniaxial and aligned in the fiber direction.