WELCOME NEWBIES!!!

For this assignment, we will do a quick dive into critical engineering fundamentals which will be used over and over again throughout your work in ESB and beyond. Using the information we covered in Monday's boot camp session, answer the questions below to the best of your ability. Please write out any assumptions you have made throughout the assignment. Make a copy of this document to work on it. You may discuss this assignment with other newbies but remember that the point of this assignment is for you to gain engineering skills and knowledge.

Part 1: Short Response (with Math!)

1. What type of heat transfer methods are used in a radiator? Explain each one and how they are applied. (Hint: There should be 2)

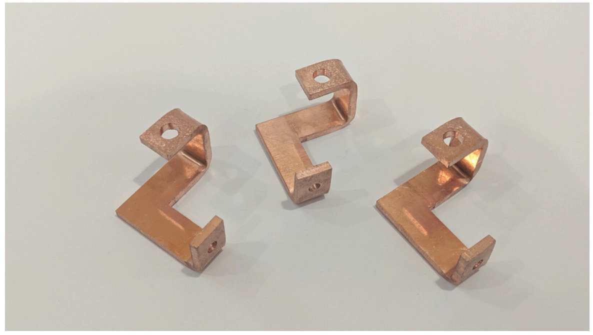
- convection currents → air circulate around hot fluid and hot air fill room
- radiation → infrared radiation transfer heat to nearby objects

2. Knowing the difference between laminar and turbulent flow which would we prefer the coolant to have as it progresses through its cycle in a radiator? Explain why.

Turbulent → better heat transfer bc of mixing
→ more contact btwn coolant & walls

3. We have a material that is undergoing a cyclic load and after testing, we discover that 30 cycles. If we wanted to raise it to 100 cycles what can we change about this part?

- Run FEA to determine points w/ high stress
- Pick material w/ higher fatigue strength



4. We want to manufacture copper busbars (essentially copper wires) which you can see in the photo below. How would you manufacture these busbars?

water jet → bend

@Jacobs

5. You have three beams, one is steel, one is Aluminum, and one is wood. They are uniaxially stretched the same amount and they have the same cross-section. Which one is under more stress (Tesla interview question)

$\sigma = \frac{F}{A}$ All have same amount of stress

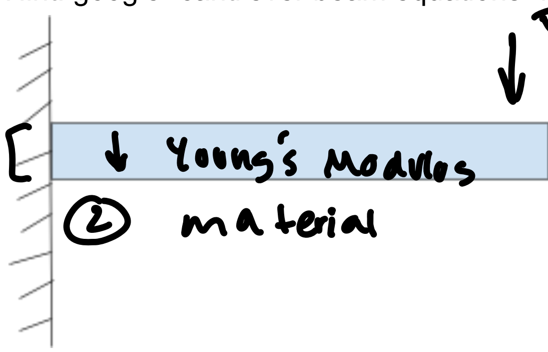
6. You are a diver standing at the edge of the diving board getting ready to jump however the board is not bending as much as you would like it to, what can you change about the beam to make it bend more? (modified version of a tesla interview question)
   * To simplify the problem, assume the beam's Free Body Diagram is as follows, where it is fixed on the left side but can flex if enough force is applied to the right side (a person standing on the diving board):

   Hint: google "cantilever beam equations" for the deflection under load for this beam

Jump to add force

$\delta = \frac{FL^3}{3EI}$

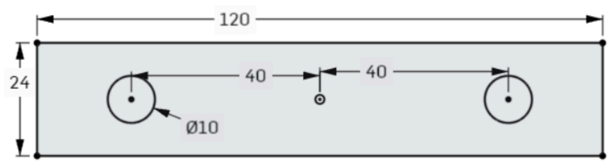
Make thinner to lower moment of inertia

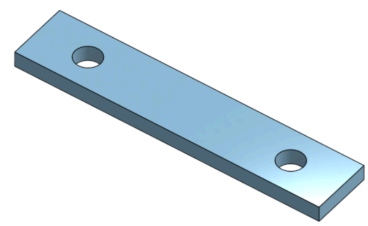


② material

→ increase length of beam ①

7. You want to make the following part out of plastic and metal, for low-volume (10 parts) and high-volume (10,000 parts). Assume that you want to manufacture the part such that the holes are as precise in diameter as possible, and the thickness of the part is as exact as possible (all dimensions are in mm). View the part image below and write a less than one-sentence manufacturing plan for the part in each box: (Challenge Question: Youre cracked if you get this one) *1st newbie to get this far send a meme into general to skip ¼ sections below*

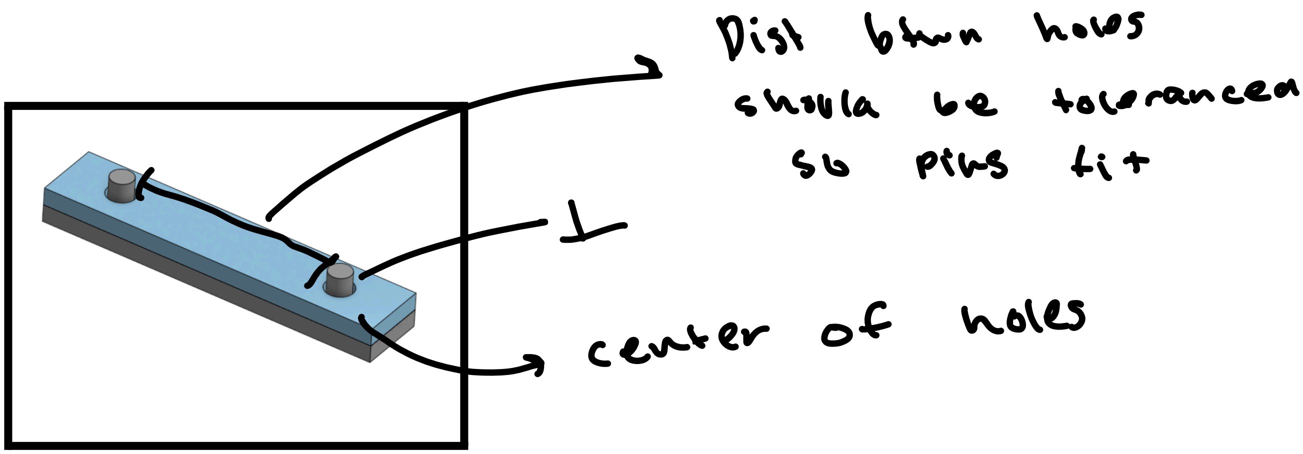




	Low-Volume	High-Volume
Plastic	CNC parts on 1 sheet.	Injection Moulding to mass produce
Metal	CNC/waterjet parts on 1 sheet	skip

Please add any considerations such as cost, tolerancing, etc.: All have good tolerancing for holes. injection moulding will have high cost bc custom

Please list below what GD&T datuming features you would add to make it such that a part with two pins (gray part) can fit into it with a clearance fit. Assume the pins are 1mm in diameter smaller than the holes they're going into:



Part 2: Design a Simple Three-Part Pencil Sharpener

Design a functional three-part pencil sharpener using CAD software. Emphasize creating detailed sketches, defining measurements, and specifying part materials AND manufacturing processes. The goal is to apply precise design techniques to ensure a manufacturable, well-structured model.

1. **Objective**
   - Break Down the Pencil Sharpener into Three Parts
     i. Outer Casing: The body that holds the internal components.
     ii. Blade Holder: The component where the blade is secured.
     iii. Shavings Container (Base): A container that collects the pencil shavings (if included in your design).
   - Make sure your design is unique. Ask what would make you want to buy a pencil sharpener?
2. **Detailed CAD sketches**
   - For each part, create detailed 2D sketches to serve as the basis for your 3D models.
     i. Ensure that your sketches accurately constrain all important geometric features, <u>such as the blade slot, pencil entry point, and snap-fit or fastening mechanisms.</u>
     ii. Use constraints and dimensions to ensure the parts fit together correctly.
   - Clearly define and label the axis systems for each part (e.g., central axis for rotation, alignment for the blade holder).
   - Ensure that all axes are aligned properly to enable seamless assembly in your final model.
3. **Detailed Manufacturing Plan**
   - Once your designs are completed, create 2 manufacturing plans for EACH component
     i. 1 manufacturing plan for an initial prototype (per part)
     ii. 1 manufacturing plan for production at scale (per part)
   - Ensure that your material selection makes sense for each manufacturing process
4. **EECSifying your design**:

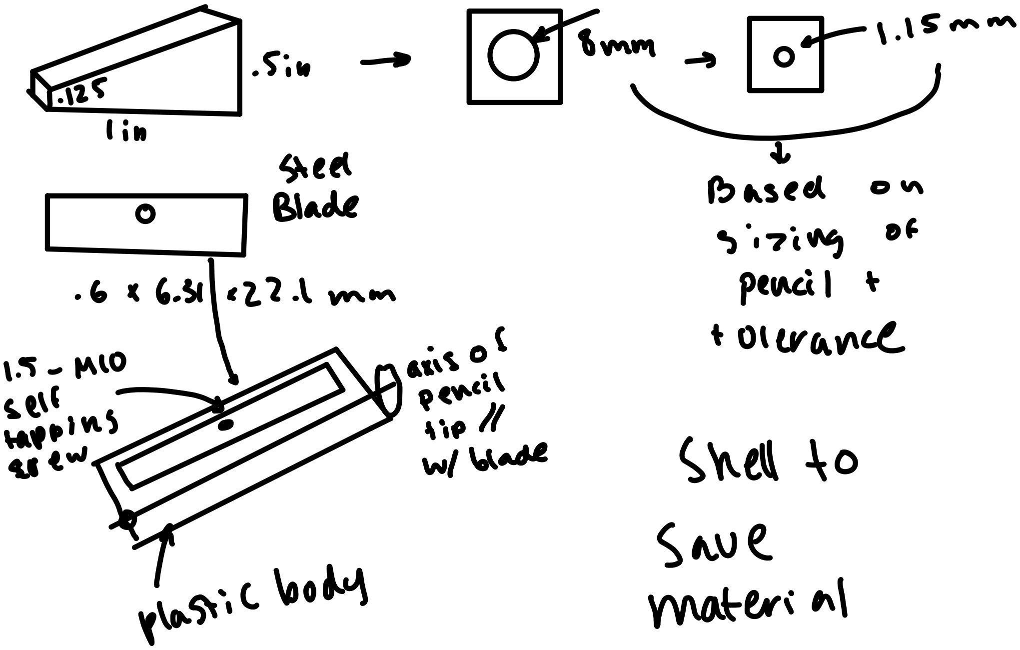
- You do not need to CAD this section; create a high level outline for potential modifications to incorporate an electronic sharpening mechanism and subsequent details (power, sensor, safety, etc)

5. **Assembly & Fitment**
    - Once individual parts are completed, assemble them in your CAD software, ensuring proper alignment and functionality.
    - Pay attention to **tolerances** for parts that will fit together (e.g., the connection between the blade holder and the casing).
    - Indicate material properties in your CAD model (e.g., density, hardness) and include this in your submission.
6. **Incorporate Workshop Concepts**
    - **Post-Processing**: Adjust the design to minimize post-processing efforts. This could involve reducing surface irregularities, optimizing wall thickness, or adding features that make post-processing easier.
    - **Support Structures**: Reassess the use of support structures. Apply workshop techniques to reduce the amount of support needed, adjust spacing, and simplify removal.
    - **Cost Optimization**: Consider materials, part geometry, and manufacturing processes that reduce costs. Focus on minimizing material waste, using fewer supports, or selecting more cost-efficient materials without compromising quality.
    - **Design for Manufacturability**: Use techniques that make your design easier to manufacture (e.g., simplifying complex geometries, considering tolerance stack-ups, etc.).
7. **Organize Your Assembly**
    - **Hierarchical Assembly**: Organize parts based on the diagram shown in the slides
    - **Naming & Structure**: Use a clear, logical naming convention for parts and assemblies. Ensure that all components are grouped appropriately to simplify navigation and future modifications.
    - **Khaled would like you guys to implement MasterModeling**

8. **Submit the Following**:
    1) Your solutions to Part 1
    2) All written justifications for Part 2
    3) You will receive information regarding how to submit your cad and drawings in bootcamp day 3
        a) CAD Models: Submit the complete 3D models of the pencil sharpener, including all three parts and the final assembly.
        b) Drawings: Provide detailed 2D technical drawings for each part with dimensions, material callouts, and tolerances.

Sketches

Basic Shape:



Shell to save material