DP2 Milestone 3 (Individual): Materials Testing Lab

Team Number: 26

Please list full name and MacID.

Full Name:	MacID:
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IMPORTANT: **You may not know your Team Number yet.** THAT IS OKAY! Worksheets will be submitted as the individual portion of **DP-2 Milestone 3** (before your Wk-9 design studio). You can add your Team Number to the worksheet then.

L = 52 mm
b = 9 mm
h = 5 mm

MILESTONE 3 (STAGE 1) – MATERIALS TESTING LAB

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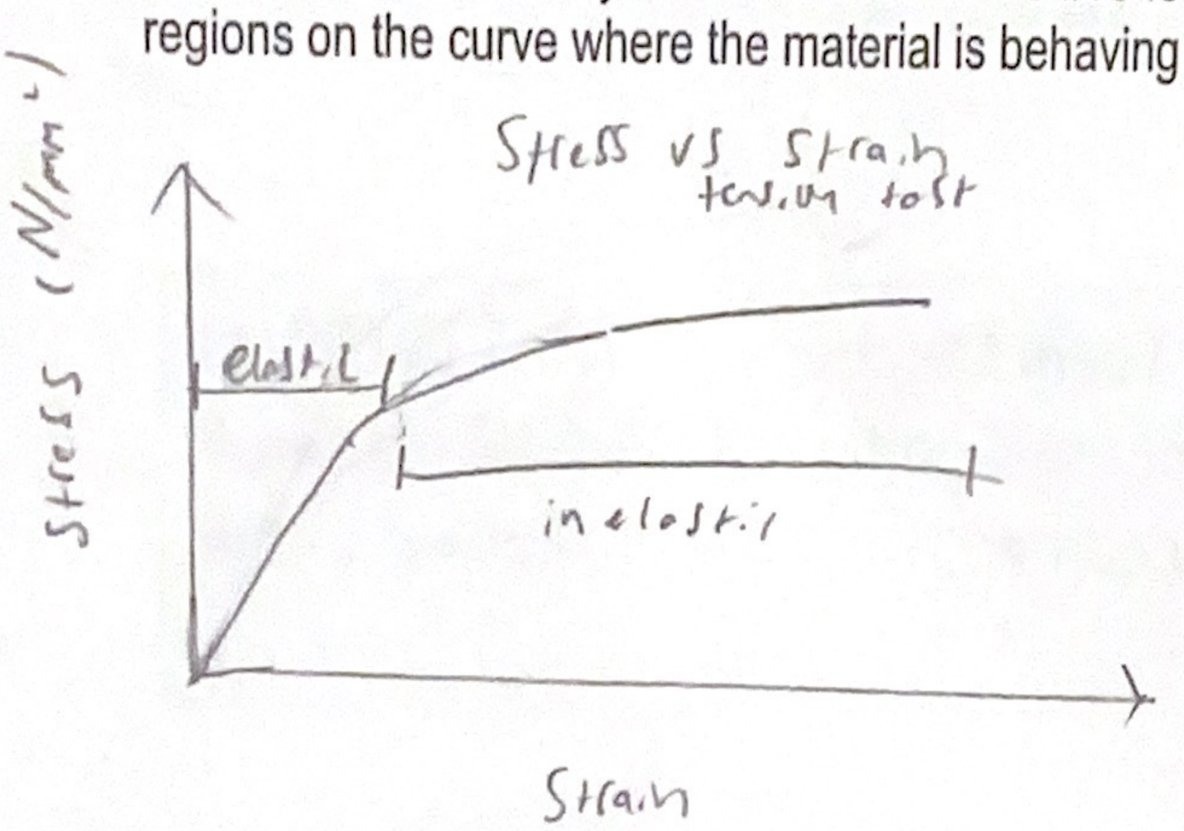
Summary Questions (answers can be in point form)

1. Provide a sketch of your stress vs. strain curve for the **Tensile Test** in the space below. *Indicate the regions on the curve where the material is behaving elastically and inelastically.*



$$\text{Stress} = \frac{F}{A_0}$$

$$\text{stress} = \frac{-0.034\ N}{3\ mm^2}$$

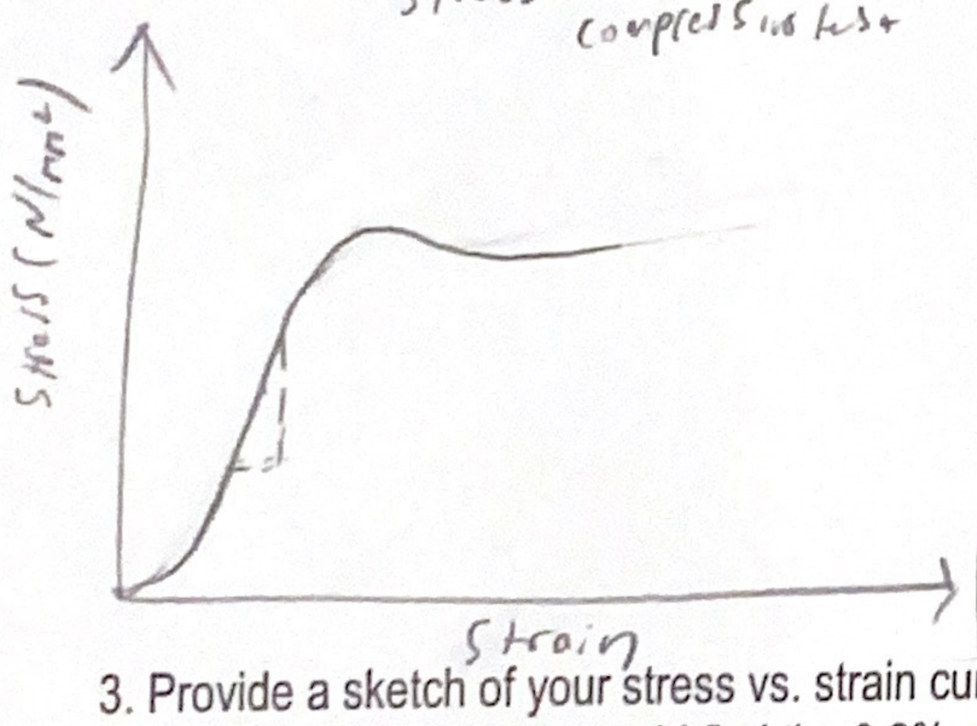
$$= -0.0113$$

$$\text{Strain} = \frac{0\ mm}{48.975\ mm}$$

$$\text{Strain} = \frac{\Delta l}{l_0}$$

$$=$$

2. Provide a sketch of your stress vs. strain curve for the **Compression Test** in the space below. Briefly describe how you would find the elastic modulus from this curve.



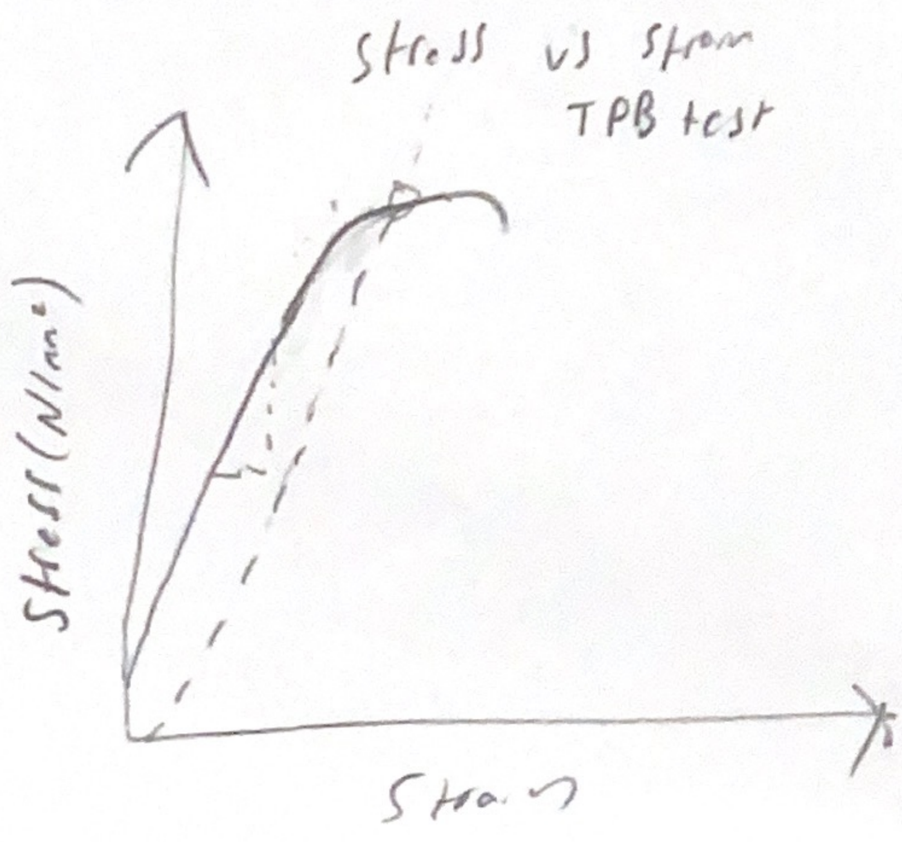
refer to question 1 for calculations

3

the elastic modulus would be found by finding the slope of the linear portion of the curve

$$\text{Elastic modulus} = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - \varepsilon_1}$$

3. Provide a sketch of your stress vs. strain curve for the **Three-Point Bending Test** in the space below. Briefly describe how you would find the 0.2% offset yield strength of this material.



$$\sigma = \frac{3FL}{2bh^2}$$

$$\sigma = \frac{3(7.76)(52)}{2(9)(5)^2}$$

$$\sigma = \frac{121056}{450}$$

$$\sigma = 269.01\ N/mm^2$$

$$\varepsilon = \frac{6(0.03)(5)}{(52)^2}$$

$$\varepsilon = \frac{0.9}{2704}$$

$$\varepsilon = 3.32 \times 10^{-7}$$

$$\varepsilon = \frac{6\Delta L h}{L^2}$$

- find slope of linear part
- shift linear slope by 0.02 on x axis
- find point of intersection of the line with graph

MILESTONE 3 (STAGE 1) – MATERIALS TESTING LAB

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Reflective Questions (answers can be in point form)

- different stresses

- Perform all three can help find kind of optimal material for an application

1. Why is it ideal to perform tensile, compressive, and three-point bend tests when they all provide stress, strain, and modulus? Is it necessary to perform all three for a single material?

- each test provides the same information but is used to test depending on its application
- tensile test for materials meant to be stretched
- compressive for materials meant to be compressed
- three point test required for materials meant to be bent
- the reason why you may not have to do all three is dependent on the application of the material. Some applications may not require testing for all three

2. What are some limitations of these tests, individually and as a whole, with respect to implant design decisions? How often are uniaxial loads placed on our joints?

these tests are conducted in a perfect lab environment and on a single axis with no additional stresses existing the results as the real world differ in an implant design/practical environment

tensile strength

doesn't account for
- misaligned axis
- uneven grip
- doesn't account for movement or environment in implant etc
- uniaxial

compressive testing

- furthermore doesn't account for movement
- assumed dry conditions etc
- could be angled leading to uneven load distribution
- uniaxial

three-point bend

- doesn't account for twisting, friction and other external factors
- assumed even surface
- over simplified
- Possibilities of application
- uniaxial

- uniaxial loads are not placed on our joints very often. Most joints move in various directions and impacts often have various types of sheer, stress and strain loads on multiple axis all at once.