Name: Date: Class:

Introduction Worksheet

Theory, definitions, calculations for a stress test
Theory: Stress testing of soft materials is conducted to understand how they respond to applied forces. This is essential for various applications, including medical devices, elastomers, and construction materials. The tests assess the material's elasticity, strength, and overall behavior under loads, providing valuable insights into its durability and performance in real-world conditions.

Definitions
Stress (σ): The force applied per unit area, measured in Pascals (Pa) or Newtons per square meter (N/m²).
Weight (W): The force exerted by gravity on an object, calculated as mass (in kilograms) multiplied by the acceleration due to gravity (9.8 m/s²), measured in Newtons (N).
Stretch Ratio (λ): The ratio of the change in length to the original length of a material.
Cross-Sectional Area (A): The area of a shape observed when cutting through an object perpendicular to its length, like slicing a loaf of bread.
Stress-Stretch Curves: Graphs that illustrate the elastic properties of a material by showing its stress response (force per area) as it stretches (deformation) under an applied force.

Calculations for a stress test
The following steps are used to find the stress corresponding to the applied force, cross-sectional area, and the change in length of a soft material.
1. Calculate stress.
    a. Stress (σ) is defined as the force (F) divided by the cross-sectional area (A).
    b. Formula: $\sigma = F / A$
2. Calculate the stretch ratio.
    a. The stretch ratio (λ) is the ratio of the change in length (ΔL) to the original length (L).
    b. Formula: $\lambda = (L + \Delta L) / L$ where λ is the stretch ratio, L is the original length of the material, and ΔL is the change in length.

Practice problem: A soft material sample with a length of 15 centimeters and a cross-sectional area of 1.5 square centimeters is subjected to a tensile force of 20 Newtons. Calculate the stress experienced by the material and the stretch ratio it undergoes.

Answer the following questions.

1. Stress is defined as_____

2. The unit of force unit is_____

3. The stretch ratio is defined as _____

4. An experiment is conducted on rubber strings. The table below shows the new length (L) when masses are added. Complete the table by finding the weight, stress, and stretch. Note: Cross-sectional area = 1.5 cm²

Mass (kg)	Weight (N)	Length (cm)	Stress (N/cm²)	Stretch (λ)
0.1		2.0		
0.2		2.1		
0.3		2.6		
0.4		2.9		
0.5		3.4		
0.6		4.4		
0.7		4.5		
0.8		5		
0.9		5.3		
1.0		5.6		

5. Using Excel, plot a graph of stress vs. stretch and find the slope. Add labels, title, and units to the graphs. Attach your graph to this worksheet.