

## Problem Set #10

### Due December 5<sup>th</sup>

For the following problems, state whether the statement is True or False and briefly explain your answer:

1. The modulus of toughness is a measure of the area under a full stress-strain curve, and the energy at break is a measure of the area under a full load-deformation curve.
2. The modulus of resilience is a measure of the area under the elastic portion of a stress-strain curve, and the energy at yield is a measure of the area under the elastic portion of a load-deformation curve.
3. The sound heard at fracture of a tension specimen is caused by the plastic energy stored in the bar.

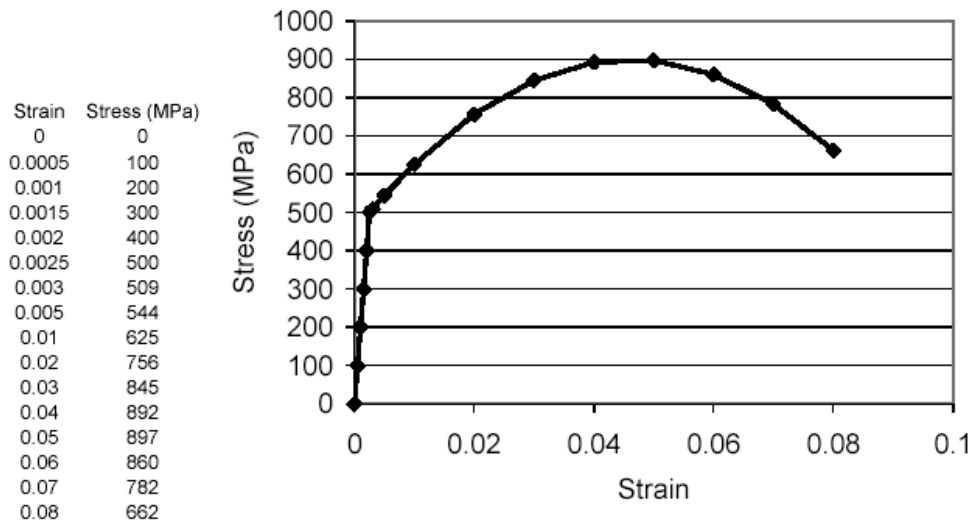
Choose the correct answer for the following statements:

4. The tensile strength of a material refers to the:
  - a. Yield point loading
  - b. Fracture load
  - c. Fracture stress
  - d. Modulus of toughness
  - e. Stress calculated from the maximum load and original cross-sectional area
5. One common relative measure of ductility is the:
  - a. Rockwell hardness
  - b. Percent reduction in area
  - c. Modulus of elasticity
  - d. Toughness
  - e. Ultimate strength

6. For this problem, do the following:

- Calculate the modulus of resilience of the aluminum alloy 6061-T6, for which the needed properties are given in Appendix H of the Gere textbook.
- Assume as a very rough approximation that for this same aluminum alloy, the stress-strain curve is linear after yielding, and that the material breaks at the ultimate stress at the percent elongation given in the appendix (17%). Calculate the modulus of toughness  $U_{MOT}$  of the alloy, its plastic work of fracture ( $U_P$ ) and energy released upon fracture ( $U_{elastic}$ ).

7. The following idealized data was obtained from tensile testing of steel. Answer (a) through (c) for the following data: (you can enter the data into an excel spreadsheet if you'd prefer).



- Determine the yield strength ( $\sigma_Y$ ) and ultimate tensile strength ( $\sigma_{UTS}$ ) of this material. You do not need to do any construction. Eyeballing it should be enough.
- Calculate the modulus of resilience.
- Calculate the modulus of toughness ( $U_{MOT}$ ), the plastic work of fracture ( $U_P$ ) and energy released upon fracture ( $U_{elastic}$ ). To calculate the area under the curve for the plastic part, you can approximate the area as the sum of the areas of the trapezoids delimited by the data points. This is a standard approximation technique, and will be briefly discussed in the recitation. Show the work you did in obtaining your answers.