Homework for "Composites and Polymers"

I. POLYMER TENSILE TESTING

(1) From the data files,
thermosetting.dat, polyethene.dat
plot Stress versus Strain (engineering) for
A) thermosetting polymer
B) polyethene polymer

(2) Determine the following for the above two curves,
Mudulus of elasticity,
0.2% Offset Yield Strength
Ultimate Strength
Percent Elongation and
Modulus of Toughness

(3) Answer the following:

a. How do the measured properties of the Thermosetting tested compare to the properties of the Thermoplastic? Why are they different?
b. Which polymer(s) would you choose to minimize deflection at low load levels? Why?
c. Which polymer(s) would you choose for absorbing energy? Why?
d. Briefly discuss the Macro and Microscopic failure progression in the thermosetting and thermoplastic tested.
e. Why is Acrylic considered to be high risks for "Catastrophic Failure"?
f. Why do you think PVC is a commonly used polymer for piping systems and yard furniture?
g. What are the major drawbacks of using thermosetting polymers for sundry-type items?

II. POLYMER STRESS RELAXATION TESTING

(4) From the data files,
acrylic.dat
plot Stress versus Time for acrylic tested.

(5) Determine the Relaxation Time Constant for acrylic.

(6) Compute the anticipated stress for acrylic if the constant strain applied in the experiment were held for one full week.

III. FIBER REINFORCED COMPOSITE TESTING

(7) From the data file
composite.dat

convert the Position-Load data to stress-strain data and plot out the Stress versus Strain curve for the Graphite Epoxy Composite (90 degree).

(8) From the Stress-Strain curve, determin the Elastic Modulus and Ultimate Strength.

(9) Suppose the elastic moduli of the component materials of a unidirectional graphite/epoxy composite are known to be as follows:

$$E_{graphite} = 75.0 \times 10^6 \, psi$$

$$E_{epoxy} = 0.35 \times 10^6 \, psi$$

If the composite material has a fiber volume fraction of 0.65, approximate the following using the Rule of Mixtures:

a) The composite's elastic modulus when it is loaded parallel to the fibers;
b) The composite's elastic modulus when it is loaded perpendicular to the fibers.