MAT 498

Glass in Energy

Final exam – March 1, 2012

(Note: **only access to the printed lecture notes is allowed**)

1 – Consider a sodium *trisilicate* glass (molar composition = 3 SiO2.Na2O).

a) Would you expect a commercial window glass to have a composition like this one? Why? (5)

b) How would you expect the density, refractive index, thermal expansion coefficient, Tg and electrical conductivity of this glass to compare with those of v-SiO2? Justify briefly. (15)

2 – State two advantages and two disadvantages of the use of oxy-fuel fired glass furnaces, compared to air-fuel fired. What is the fuel normally used in either furnace? (10)

Explain what is *cullet* and how it can save energy during glass melting. What is the maximum percentage of cullet that could be added to a container glass batch? (10)

3 – Consider a double glazed glass window with a low-E coating on the interior pane. Explain how does this type of window save energy in buildings. (5)

Explain what is the “white glass” used in solar thermal CSP mirrors and in PV solar cell module substrates. And where is borosilicate glass used in CSP? (10)

4 – Stress corrosion is one of the major problems for glass fiber applications in the field of energy. Identify one important application of fiberglass, indicate where in particular is the glass used and which type of glass is used in it and explain the source and consequences of the stress corrosion phenomenon. (15)

5 – Using the Arrhenius plot on the fourth exam page and the Arrhenius equation:

a) Determine the activation energy for the electrical conductivity, E (in kJ/mol) and the pre-exponential factor, σo for the glass 25 Li2O-75 B2O3. (R = 8.314 J K-1 mol-1). (8)

b) Estimate the Li+ ion conductivity for the same glass at room temperature (298 K). Would this be sufficient for Li battery operation? (7)

6 – Explain why are low refractive index glasses desirable for application in lasers and amplifiers for inertia confined nuclear fusion. From that viewpoint, would BeF2-based glasses be adequate? Please justify. (15)

