Study Guide Test 4

In order to do well on the next test, you should be able to do the following:

1. Explain in your own words for the Shrinking Core Model *Film Diffusion Controls*, *Ash Diffusion Controls*, and *Reaction Controls* as well as Shrinking spheres.

2. Be able to determine τ, t/τ, and conversion of the solid reactant X(t) for various shapes of particles in the shrinking core models.

3. Be able to develop/derive the models for different reaction mechanisms (i.e. 1^{st}, 2^{nd} order reactions and M-M kinetics) for each limiting situation (film layer, reacted layer, reaction) and each geometrical shape (plate, cylinder, sphere).

4. Be able to determine the significant resistance in fluid solid reactions and calculate the reaction time for a given conversion (i.e. Practice Problem 2).

5. Explain in your own words for difference between the units/dimensions of the reaction rate, r, for homogeneous vs. heterogeneous reactions.

Practice problems:

Problem 1:

Part 1. For a chemical reaction in which film layer mass transport controls the overall reaction, a flat plate (total thickness 2L) requires 10 minutes to be completely reacted. Under the same reaction conditions, calculate how long it would take a) a cylinder and b) a sphere made of the same material to be completely reacted, assuming R = L in both cases.
Part 2. For the same system, as in part 1, calculate the time needed to achieve a conversion of X= 0.80 for a flat plate, a cylinder, and a sphere made of the same material under the same conditions (R=L).

- What if ash layer diffusion controls the overall reaction?

- What if chemical reaction controls the overall reaction?

Problem 2:

A 20 cm (total thickness) flat plate composed of reactant B is reacted with fluid reactant A via an enzymatic reaction. No single resistance controls the reaction process, i.e. film, reacted layer, and reaction are all significant.
Data:

C_{Ag}= 0.52 gm/cm^3	r_B = 3.5 gm/cm^3	b = 6.3
k_g= 5.7 cm/min	*De*=0.352 cm^2/min	Vm = 0.5 gm/cm^2-min
Km = 0.7 gm/cm^3		

A. Which resistance is the most important? Explain/justify your answer.
B. Assuming all resistances are significant, given the information above, calculate how long (min) it would take to convert 75% of the solid reactant into product.