Quiz Name:

1. (2 points) What is the difference between the units/dimensions of the reaction rate, r, for homogeneous vs. heterogeneous reactions?

For homogeneous reactions, r [=] mass/volume-time
For heterogeneous reactions, r [=] mass/area-time

The difference is that heterogenous reactions are based on surface area whereas homogeneous reactions are based on reactant volume. This is because in heterogeneous reactions, the reaction only takes place at a surface and not in the bulk volume of the reactant/system.

2. (4 points) What is the Thiele modulus, i.e. what does it measure/quantify and how is it used? Please show the definition of the Thiele modulus in equation form, i.e. M_T = …

The Thiele modulus measures the rate of the intrinsic reaction (k) vs. the diffusive transport of the reactant (D), i.e. the ratio of intrinsic rate vs. mass transport. Since heterogeneous reactions depend on transport of the reactant to the surface, the overall rate of reaction depends on both the intrinsic reaction mechanism and the rate at which the reactant is transported to the surface where reaction occurs.
$M_T = (k/D)^{1/2} * L$ where k = reaction constant, D = diffusivity, and L = length
Note that M_T is dimensionless.

3. (4 points) What is the effectiveness factor, i.e. what does it measure/quantify and how is it used?

The effectiveness factor is defined as the ration of the diffusive limited rate of reaction divided by the rate of reaction without diffusive limitation. It is a measure of the extent of the impact of diffusion/mass transport limitation on a heterogeneous chemical reaction.