

# 0601D: Diffusion

## 09/17/21: Practice HW on the topic of Diffusion

1.

Write a short paragraph describing the phenomenon and the dimensions of the diffusion coefficient.

2.

The following equation gives a relationship between the effective diffusion distance and the coefficient of diffusion:

$$6Dt = L^2 \quad (1)$$

for the case of diffusion in three dimensions (as opposed to two dimensions as in a grain boundary).

The diffusion coefficient of H<sub>2</sub>O in water is given by the equation

$$\eta = \frac{k_B T}{6\pi\Omega^{1/3} D_{H_2O}} \quad (2)$$

where, "eta" is the viscosity (equal to 10<sup>-3</sup> Pa s), k<sub>B</sub> is the Boltzmann's constant (1.38\*10<sup>-23</sup> J atom<sup>-1</sup> K<sup>-1</sup>, and "Omega" is the volume per H<sub>2</sub>O molecule in water.

A drop of a dye molecule of about the same size as that of H<sub>2</sub>O (and, therefore, about the same diffusivity) is dropped into the middle of a container of water.

Calculate the time it would take for the dye to spread to a distance of 1 cm.

3.

Lattice or Volume diffusion in zirconia (ZrO<sub>2</sub>) is controlled by the diffusivity of