Exercise set I

1. A feeling for the numbers: molecular volumes and masses.

a) Estimate the mass of a "typical" amino acid in Daltons. Justify your estimate by explaining how many of each type of atom you chose. Compare your estimate to several key amino acids: glycine, proline, arginine and tryptophan.

b) On the basis of your result for part (a), deduce a rule of thumb for calculating the mass of a protein (reported in kDa) based on its number of residues. Apply this rule of thumb to myosin II and G-actin and compare your result to the actual mass of each of these proteins. *Use the Pubmed protein search and the Scripps protein calculator http://www.scripps.edu/~cdputnam/protcalc.html

c) Estimate the size of the same proteins, using an empirical formula for globular proteins $R_g = 0.395*N^{3/5} + 7.257$ [1], where N is the number of amino acids and R_g is the radius of gyration in Angstrom (the root mean square distance of the collection of atoms from their common center of mass). Rewrite your rule of thumb from **1b** to convert between mass and R_g.

[1] Narang et al. Phys. Chem. Chem. Phys., **2005, 7, 2364-2375**.

2. Areas, volumes and diffusion in organelles

a) Estimate the area of the ER (endoplasmic reticulum) when it is in recticular (smooth ER) form. Use a model for its structure of interpenetrating cylinders as shown in Figure 1a, and estimated values for a and d based on the electron micrograph in Figure 1b (scale bar = 1 μm).

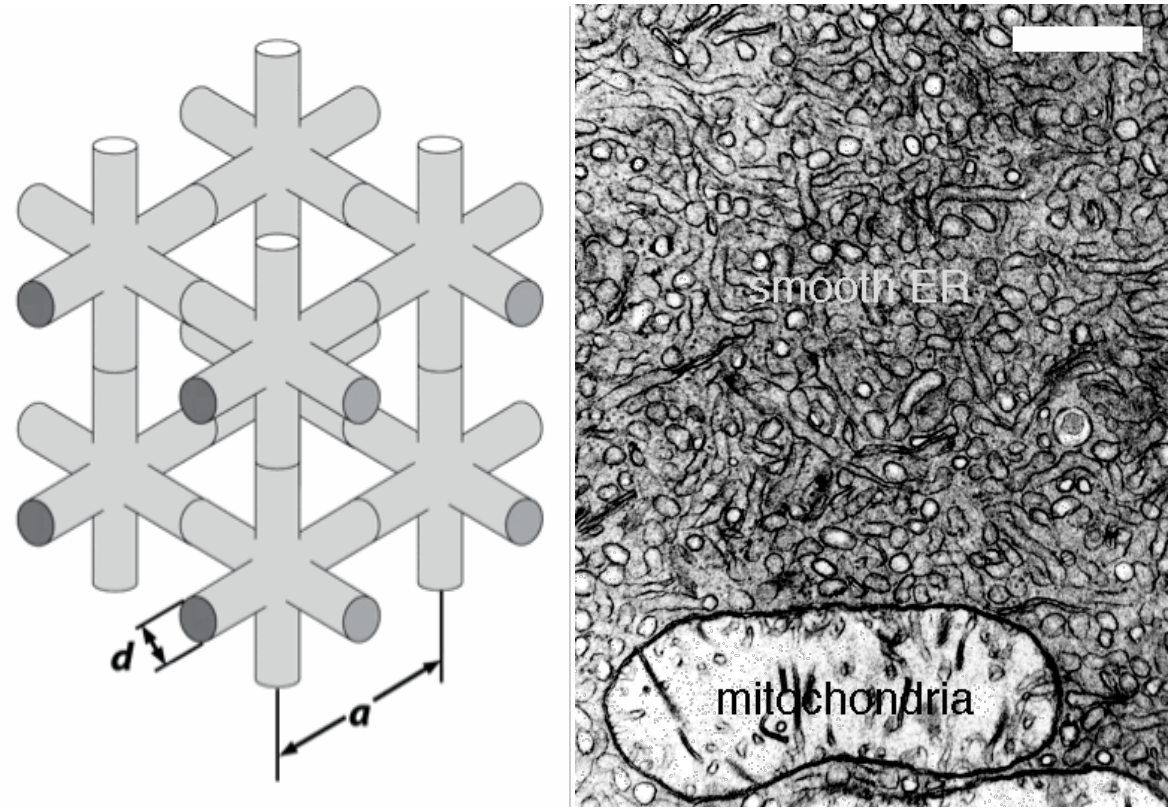

Figure 1a) (left) Approximate geometry of the smooth (reticular) ER. b) (right) Electron micrograph of ER and mitochondria.

b) Calculate the average length, volume and surface area of mitochondria in yeast based on the confocal image shown in figure 2.