Electromagnetics 2

1. Two parallel wires carry currents I_1 and $I_2 = 2\,I_1$ in opposite directions. Use Ampere's law to find the magnetic field at a point midway between the wires.

2. A cube of side L contains a flat plate with variable surface charge density of $\sigma = -3xy$. If the plate extends from $x = 0$ to $x = L$ and from $y = 0$ to $y = L$, what is the total electric flux through the walls of the cube?

3. Find the emf (electromotive force) induced in a square loop with sides of length a lying in the yz plane in a region in which the magnetic field changes over time t as $\vec{B}(t) = B_0 e^{-5t/t_0}\ \vec{i}$ (where t_0 is the start-time, B_0 is the maximum amplitude of the B-field and $\vec{i}$ is the elementary vector pointing in the direction of vector $\vec{B}$).

HW: Find the electric flux through the surface of a sphere containing 15 protons and 10 electrons. Does the size of the sphere matter? (hint: for numerical computations – use the elementary charge value) [$\Phi_E = 9.04 \cdot 10^{-8}$ V·m, the size of the sphere does not matter]