A. The magnetization of Ni is 500 emu/cm^3. Calculate the moment per atom in μ_B if there are 4 atoms per fcc unit cell with lattice constant 3.524Å. (0.5 points)

B. Estimate the shape anisotropy for a monolayer that forms an infinite plane. (0.5 points)

C. A (001) Ni monolayer is grown on an fcc Cu substrate so that the Ni atoms have the same lattice spacing and crystal orientation as the Cu layer below. In other words the Ni atoms are forced to adopt the Cu lattice constant of 3.615Å along the directions parallel to the interface. Find the easy axis or plane and estimate the magnetoelastic anisotropy. You may assume that the stress $\sigma=10^{12}$ ergs/cm^3*e where e is the strain. (1.0 point)

D. The total uniaxial anisotropy of the sample is 2.5 x 10^6 ergs/cm^3. What is the physical origin of the remaining anisotropy and what is it called? (0.5 points)

E. Calculate the switching field if the applied field is aligned along the anisotropy axis. (0.5 points)

F. Only considering conservation of angular momentum, calculate the switching current density if the incoming current is 100% polarized and the Ni monolayer completely polarizes the transmitted current in the opposite direction. Assume the current switches the sample in 1 nS. (0.5 points)

G. Give a reason why the true switching current may be larger. (0.5 points)

Useful equations:

Magnetoelastic energy =

$$-(3/2)\lambda_{100}\sigma((\alpha_x\gamma_x)^2+(\alpha_y\gamma_y)^2+(\alpha_z\gamma_z)^2)-3\lambda_{111}\sigma(\alpha_x\alpha_y\gamma_x\gamma_y+\alpha_y\alpha_z\gamma_y\gamma_z+\alpha_z\alpha_x\gamma_z\gamma_x)$$

where α = direction cosines of magnetization
γ = direction cosines of stress
λ_{100} = -46 x 10^{-6}
λ_{111} = -24 x 10^{-6}
μ_B = 0.927x10^{-20} erg/Oe
Q_e (charge of electron) = -1.6 x 10^{-19} Coulombs