1. At an energy of 5 MeV, the phase shifts describing the elastic scattering of neutrons by a certain nucleus have the following values:

$$\delta_0 = 32.5° \qquad \delta_1 = 8.6° \qquad \delta_2 = 0.4°$$

Assume all the other phase shifts are negligible.

(a) Plot $d\sigma/d\Omega$ as a function of θ (in barns/sr). What is the total cross-section (in barns)?

(b) Repeat (a), but now assume the sign of each phase shift is reversed (negative).

(c) Repeat (a), but now assume the sign of only δ_1 is reversed (i.e., $\delta_1 = -8.6°$), with δ_0 and δ_2 unchanged (positive).

(d) Using the results of (a), calculate the *total* number of neutrons scattered per second out of a beam of 2×10^{10} neutrons per sec, incident on a foil containing 10^{21} nuclei per cm^2. How many neutrons per sec would be scattered into a disk-shaped detector of radius 1 cm placed 1 m from the sample at a scattering angle of 90°?