(12.3) In a Rutherford scattering experiment ^{2}D atoms of 150 keV are used to bombard a thin ^{58}Ni foil having a surface density of $67*10^{-6}$ g cm^{-2}. The detector subtends a solid angle of $1.12*10^{-4}$ sr and detects 4816 deuterons out of a total of $1.88*10^{12}$ incident on target. Calculate (a) the differential cross-section (in barns). (b) What is the distance between target and the solid state detector, which has a surface area of 0.2 cm^2?

(a) Use eqn (12.18) and $N_V*x=x*\rho*\boldsymbol{N}_A/M$, where $x*\rho$ is the surface density.

$M := 58\cdot10^{-3}\cdot\frac{kg}{mole}$ $\quad N_A := 6.022\cdot10^{23}\cdot mole^{-1}$ $\quad x\rho := 67\cdot10^{-6}\cdot10^{4}\cdot10^{-3}\cdot kg\cdot m^{-2}$

$xN_V := x\rho\cdot\frac{N_A}{M}$ $\quad xN_V = 6.956\cdot10^{21}\cdot m^{-2}$

$n := 4816$ $\quad n_0 := 1.88\cdot10^{12}$ $\quad \Delta\Omega := 1.12\cdot10^{-4}$

$d\sigma d\Omega := \frac{n}{n_0\cdot xN_V\cdot\Delta\Omega}$ $\quad d\sigma d\Omega = 3.288\cdot10^{-27}\cdot m^2$

or $\frac{3.288\cdot10^{-27}}{10^{-28}} = 32.9$ barn/sr

(b) Use eqn (12.19) to calculate distance r:

$A_d := 0.2\cdot10^{-4}\cdot m^2$ $\quad r := \sqrt{\frac{A_d}{\Delta\Omega}}$ $\quad r = 0.423\cdot m$ or $r = 42.258\cdot cm$