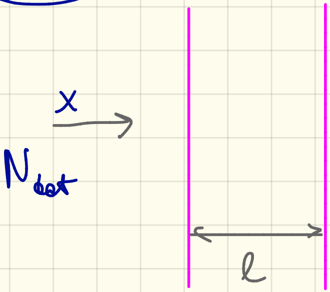
14.5



Beam of x → area A

$N = 2 N_A \cdot l \cdot A \cdot$ ← total number of atom
2 atoms per molecule

$A_{covered} = 2 N_A \cdot l \cdot A \cdot \sigma$

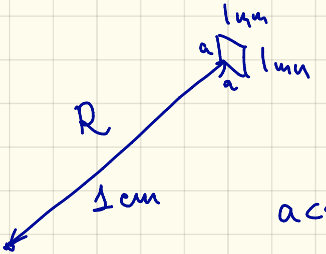
prob. scatter: $\frac{A_{covered}}{A} = 2 N_A \, l \cdot \sigma$

$$N_{scatter} = N_{tot} \cdot 2 \cdot N_A \cdot l \cdot \sigma =$$

$$= 10^{11} \cdot \cancel{2} \cdot 6 \cdot 10^{23} \cdot \frac{1}{22 \cdot 10^{-3}} \, 10^{-1} \cdot \cancel{0.5} \cdot 10^{-28} =$$

$$= 10^{11+23-1-28+3} \, \frac{6}{22} \approx 3 \cdot 10^{7}$$

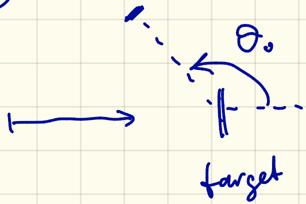
14.8



$$\Omega = \frac{a^2}{R^2} \simeq 10^{-2}\ \text{sr.}$$

$a \ll R$

14.11



$$\frac{d\sigma}{d\Omega}(\theta_0) = 0.5\ \frac{b}{sr}$$

$$\rho = 10.5 \cdot 10^3\ kg/m^3$$

$\cdot\ A = 108$

$$n = \rho / A \cdot m_p = \frac{10.5 \cdot 10^3}{108 \cdot 1.66\, 10^{-27}} = 0.6 \cdot 10^{29}\ \frac{1}{m^3}$$

$$\Delta\Omega = \frac{0.1\ mm^2}{(1\ cm)^2} = \frac{0.1}{10^2} = 10^{-3}$$

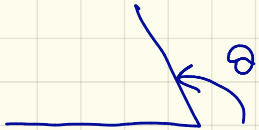
$$W_{registred} = N_0 \cdot l \cdot n \cdot \frac{d\sigma}{d\Omega} \cdot \Delta\Omega = 10^{10} \cdot 10^{-6} \cdot 0.6 \cdot 10^{29} \cdot 10^{-3} \cdot 0.5 \cdot 10^{-28}$$

$$= 3 \cdot 10^{10-6+\cancel{28}-3-\cancel{28}} = 30$$

14.18

$$\frac{d\sigma}{d\Omega} = \frac{\sigma_0(E)}{\sin^4\frac{\theta}{2}}$$

reflection backward:



$$\theta > \frac{\pi}{2} \qquad \sigma_{(\theta > \frac{\pi}{2})} = \int\limits_{\theta > \frac{\pi}{2}} \frac{d\sigma_0}{d\Omega}\, d\Omega =$$

$$= \int_{\frac{\pi}{2}}^{\pi} \int_0^{2\pi} \frac{d\sigma_0}{d\Omega}\, d\varphi \sin\theta\, d\theta = 2\pi\sigma_0 \int_{\pi/2}^{\pi} \frac{1}{\sin^4\frac{\theta}{2}}\, 2\sin\frac{\theta}{2}\cos\frac{\theta}{2}\, d\theta =$$

$$= 8\pi\sigma_0 \int_{\pi/2}^{\pi} \frac{d\left(\sin\frac{\theta}{2}\right)}{\sin^3\frac{\theta}{2}} = 8\pi\sigma_0 \int_1^0 \frac{du}{u^3} = 8\pi\sigma_0 \left(-\frac{1}{2u^2}\right)\Big|_1^0 = 4\pi\sigma_0$$

$$N_{sc}\left(\theta > \frac{\pi}{2}\right) = N_{inc} \cdot 4\pi\sigma_0(E) \cdot n_{tar}$$

$$\sigma_0(E) = \left(\frac{\frac{1}{4\pi\varepsilon_0} \cdot q \cdot Q}{4E} \right)^2 = \left[\frac{(9 \cdot 10^9 \ N \cdot m^2/C^2) \cdot 2 \cdot 78 \cdot (1.6 \cdot 10^{-19} \cdot C)^2}{4 \cdot 7.8 \cdot 1.6 \cdot 10^{-19} \cdot J} \right]^2 \simeq 5 \cdot 10^{-29} \ m^2$$

$$n_{foil} = \frac{\rho \cdot l}{m_{Pt}} = \frac{21 \cdot 10^3 \ kg/m^3 \cdot 3 \cdot 10^{-6} \ m}{195 \cdot 1.66 \cdot 10^{-27} \ kg} \approx 2 \cdot 10^{23} \ 1/m^2$$

$$\frac{N_{sc}(\theta > \frac{\pi}{2})}{N_{inc}} = 4\pi \ 2 \cdot 10^{23} \cdot 5 \cdot 10^{-29} = 4\pi \cdot 10^{-5} \simeq 1.3 \cdot 10^{-4}$$

<u>1 particle in 7750 would scatter back.</u>