Messung der Avogadro-Konstante durch radioaktiven Zerfall

a)

$$N = \underline{\underline{3\Gamma t}}$$
$$N_\mathrm{A} = \underline{\underline{\frac{NRT}{pV}}}$$

b) $p = 1\ \mathrm{atm}$; $T = 273.15\ \mathrm{K}$; $V = 14\ \mathrm{mm}^3$; $\Gamma = 7.2 * 10^{12}\ 1/\mathrm{s}$

$$N_\mathrm{A} = \frac{NRT}{pV} = \underline{\underline{6.23 * 10^{23}\ 1/\mathrm{mol}}}$$

$$\Gamma(t) = \Gamma_0 \left(\frac{1}{2}\right)^{\frac{t}{T}}$$

From the equation above one can see that the bigger the half life T of an element, the less will the activity Γ decrease with time. So an element with longer half life is better suited in this case.

Ebene Wellen und Kugelwellen

a)

$$A_1(x,t) = \underbrace{A_0}_{\text{Amplitute}} \cos(kx - \omega t)$$

The Amplitude of the wave, denoted A_0, in case of water waves this tells us how high the wave can get (in respect to still water) and in respect to sound

b)

$$A_2(r,\theta,\varphi) = A_0 \cos(kr - \omega t)$$

$A_0 \propto \frac{1}{r^2}$ because the Energy of the wave gets spread out across an ever increasing surface (increasing with r^2)

c)

$$A_1(x,t) = A_0 \cos(kx - \omega t) = A_0\,\mathrm{e}^{ikx - i\omega t}$$
$$A_2(r,\theta,\varphi) = A_0 \cos(kr - \omega t) = A_0\,\mathrm{e}^{ikr - i\omega t}$$

Bragg-Reflexion

$$\rho = 8.91 \text{ g/cm3}; \quad m = 63.5 \text{ u}$$

a) $\rho = \frac{m}{a^3}$

$$a = \sqrt[3]{\frac{m}{\rho}} = \underline{\underline{2.28 * 10^{-10} \text{ m}}}$$

b) $\theta_1 = 20°; \quad d_1 = a$

$$\Delta s = 2d\sin(\theta) = k\lambda = \lambda \qquad (k = 1 \text{ for 1.Order})$$
$$\lambda = 2d\sin(\theta_1) = \underline{\underline{1.56 * 10^{-10} \text{ m}}}$$

c)

$$d_2 = \frac{a}{\sqrt{2^2+1^2+0^2}} = \frac{a}{\sqrt{5}} = \underline{\underline{1.02 * 10^{-10} \text{ m}}}$$
$$\theta_2 = \arcsin\left(\frac{\lambda}{2d_2}\right) = \underline{\underline{49.89°}}$$