Thoms. Měr. Náb. A)el pol; $m\frac{d^2x}{dt^2}=0, m\frac{d^2y}{dt^2}, m\frac{d^2z}{dt^2}=-eE$;Poč pod: x=vt,y=0 ; $\frac{d^2z}{dt^2}=\frac{d}{dt}\left(\frac{dz}{dt}\right)=\frac{d}{dx}\left(\frac{dz}{dx}\frac{dx}{dt}\right)\frac{dx}{dt}=\frac{d^2z}{dx^2}v^2$; $\frac{d^2z}{dx^2}=-\frac{eE}{mv^2}$; $\Delta z=-\frac{eE}{mv^2}\int_0^l\left(\int_0^x Edx\right)dx \rightarrow per.p \rightarrow \Delta z=-\frac{eE}{mv^2}\left[l\int_0^l Edx-\int_0^l xEdx\right]=-\frac{eE}{mv^2}\int_0^l(l-x)Edx$; $\int_0^l(l-x)Edx=a\left(l-\frac{a}{2}\right)E$; $\Delta z_E=-\frac{eEa(l-a/2)}{mv^2}$ B)mag pol $\frac{d^2z}{dt^2}=-\frac{evB}{m}\rightarrow\frac{d^2z}{dx^2}=-\frac{eB}{mv}$; $\Delta z=-\frac{e}{mv}\int_0^l(l-x)Bdx$; $\int_0^l(l-x)Bdx=\frac{Bl^2}{2}$; $\Delta z_B=\frac{\Delta z_E}{\Delta z_B^2}$; $-\frac{e}{m}=\Delta z\frac{4aU}{dB^2l^2}\left(l-\frac{a}{2}\right)$

Bohr. Mod. At H; $\frac{mv^2}{r}=\frac{Ze^2}{4\pi\epsilon_0 r^2}$; $W=\frac{mv^2}{2}-\frac{Ze^2}{4\pi\epsilon_0 r}=\frac{Ze^2}{8\pi\epsilon_0 r^2}$; $rmv=nh$; $v_n=\frac{Ze^2}{n4\pi\epsilon_0 h}=\frac{Z\alpha c}{n}$; $r_n=\frac{n^2h}{Z\alpha mc}=\frac{n^2\lambda_2}{Z\alpha}$; $W_n=\frac{-Z^2\alpha^2mc^2}{2n^2}$; $\omega_n=\frac{v_n}{r_n}=\frac{Z^2\alpha^2mc^2}{n^3h}$; $E_n=\frac{Ze}{4\pi\epsilon_0 r_n^2}=\frac{Z^3\alpha^3m^2c^3}{n^4eh}$; $B_n=\frac{\mu_0 I_n}{2r_n}=\frac{ev_n}{4\epsilon_0c^2\pi r_n^2}=\frac{Z^3\alpha^4m^2c^2}{n^5eh}$; $\mu_0=\frac{1}{\epsilon_0c^2}$; $I_n=\frac{e}{T}=\frac{e\omega_n}{2\pi}=\frac{ev_n}{2\pi r_n}$

Fot ef pouze pro vln.d. 200nm; $eV=1.6\cdot10^{-19}$; $E=\frac{2\pi hc}{\lambda eV}$; $U=1{,}5V$; $Q=4\pi\epsilon_0 aU=1{,}6\cdot10^{-11}c$; $N_f=100\,Q/E=10^{10}$; $E_f=N_f6eV=10^{-8}J$; $P=E_f/\tau=10^{-8}/10^{-3}=10^{-5}W$;

deBrogle vln delk. $\lambda_{dB}=\frac{2\pi h}{p}$; $E=\frac{mv^2}{2}=eU\rightarrow mv^2=2eU$; $p^2=\left(\frac{E}{c}\right)^2-m^2c^2$; $E=mc^2+eU$; $p^2=2meU+\left(\frac{eU}{c}\right)^2$; $dos\ p\ do\ 1.R$

interf.;$u_1+u_2=\frac{Ae^{ikl_1}}{l_1}+\frac{Ae^{ikl_2}}{l_2}$; $I=|u|^2=\frac{A^2}{l^2}\left|e^{ikl_1}+e^{ikl_2}\right|^2$; $l_1-l_2=\sqrt{l^2+\left(x+\frac{a}{2}\right)^2}-\sqrt{l^2+\left(x-\frac{a}{2}\right)^2}=a\frac{x}{l}$; $I=\frac{2A^2}{l^2}\left(1+\cos\left(ak\frac{x}{l}\right)\right)$; $k=\frac{2\pi l}{a\Delta x}$; $E=\frac{p^2}{2m}=\frac{h^2k^2}{2m}$; $dos\ k$

nekon jám.; $\Psi''+k^2\Psi=0$; $k^2=2mE/h^2$; $\Psi=A\sin(kx)++B\cos(kx)$ poč p: $pro.\,x=0\rightarrow B=0, pro\ x=l\rightarrow 0=\sin(kl)\rightarrow kl=n\pi$; $\Psi=A\sin(n\pi x/l)+0$; $(kl=n\pi)^2 dosad\ k^2$; $vyjád\ E$

schod; $\frac{-h^2}{2m}\frac{d^2\Psi}{dx}+V_x\Psi=E\Psi$; $V_x=\begin{cases}O\_x<0\\V_0\_x>0\end{cases}$; $pro\ E>V_0: x<0: \Psi''+\frac{2mE}{h^2}\Psi=0\rightarrow\Psi=Ae^{ikx}+Be^{-ikx}, x>0: \Psi''+\frac{2m(E-V_0)}{h^2}\Psi=0\rightarrow\Psi=Ce^{ik'x}+De^{-ik'x}$; $\widehat{p_x}e^{ikx}=ih\frac{de^{ikx}}{dx}=hke^{ikx}\ doprava$; $\widehat{p_x}e^{-ikx}=-ih\frac{de^{-ikx}}{dx}=-hke^{-ikx}\ doleva$; $podminky\ spoj: \Psi_L(0)=\Psi_P(0), 1+r=t, \Psi_L'(0)=\Psi_P'(0), ik(1-r)=ik't, r=\frac{k-k'}{k+k'}, t=\frac{2k}{k+k'}$; $pro\ E<V_0: x<0: \Psi''=\frac{2m(E-V_0)}{h^2}\Psi=0, x>0: \Psi=\frac{2ke^{-k''x}}{-k''x}$

en harm osc; $E = \frac{p^2}{2m} + \frac{m\omega^2 x^2}{2}$; $\omega = \sqrt{k/m}; platí: p = h/2L ; dosad\ za\ p, čtverec;\ E_{min} = \frac{h\omega}{2} při\ L^2 = \frac{h}{2m\omega}$ at H; $E = \frac{p^2}{2m} + \frac{e^2}{4\pi\epsilon_0 r}; plati\ p = \frac{h}{a};\ dosad\ za\ p, čtverec;\ E_{min} = \frac{-me^4}{32(h\pi\epsilon_0)^2}\ při\ a = \frac{4\pi\epsilon_0 h^2}{me^2}$

at He; $E = \frac{2h^2}{2mR^2} - \frac{4e^2}{4\pi\epsilon_0 R} + \frac{e^2}{4\pi\epsilon_0 R_{12}}; plati\ R_{12} = 2R;\ dosad\ za\ R_{12}, čtverec;\ E_{min} = \frac{49-me^4}{256(h\pi\epsilon_0)^2}\ při\ R = \frac{16\pi\epsilon_0 h^2}{7me^2}$

en molek;
$k = \frac{2Ry}{a_B^2} = \frac{\alpha^2 mc^2}{(h/\alpha mc)^2} = \frac{\alpha^4 m^3 c^4}{h^2}\ ; E_{EL} = Ry\ ;\ E_{vib} = h\omega = h\sqrt{k/M} = \alpha^2 mc^2\sqrt{m/M} = Ry\sqrt{m/M}\ ;\ E_{rot} = 0{,}5M_1r_1^2\Omega^2 + 0{,}5M_2r_2^2\Omega^2; I = M_1r_1^2 + M_2r_2^2\ ; L = M_1r_1^2\Omega + M_2r_2^2\Omega = I\Omega\ ;\ E_{rot} = 0{,}5I\Omega^2 = L^2/2I\ ;\ L^2 \approx h^2\ ;\ E_{rot} = h^2/2I = h^2/(2Ma_B^2) = (\alpha^2 m^2 c^2)/2M = (Ry\ m)/M; E_{EL}: E_{vib} : E_{rot} = 1: \sqrt{m/M} : m/M$

en nab kul; $r < R: E = \frac{Qr}{4\pi\epsilon_0 R^3}; r > R: E = \frac{Q}{4\pi\epsilon_0 r^2}\ ; W = \iiint \frac{1}{2}\epsilon_0 E^2 dS\ ; zintegruj; W = \frac{3Q^2}{20\pi\epsilon_0 R}; \frac{3e^2}{20\pi\epsilon_0 R} = m_e c^2; vyjadri\ R$

náboj; $M(A,Z) = ZM_p + (A-Z)M_n - \alpha A + \beta A^{2/3} + \gamma Z^2 A^{-1/3} + \delta(A/2 - Z)^2 A^{-1}\ ; 0 = \frac{\partial M}{\partial Z} = Z = \frac{M_n - M_p + \delta}{2\delta A^{-1} + 2\gamma A^{-\frac{1}{3}}}; lich\ A\ 1\ parabol, suda\ A\ 2\ parabol$

Sekularní rovn; $\frac{dn_1}{dt} = -\lambda_1 n_1\ ;\ n_1 = n_{10}e^{-\lambda_1 t};\ \frac{dn_2}{dt} = \lambda_1 n_1 - \lambda_2 n_2\ ; \frac{dn_2}{dt} + \lambda_2 n_2 = \lambda_1 n_{10} e^{-\lambda_2 t}\ ;\ n_2 = Ce^{-\lambda_2 t} + part; Ae^{-\lambda_1 t} - \lambda_1 Ae^{-\lambda_1 t} + \lambda_2 Ae^{-\lambda_1 t} = \lambda_1 n_{10} e^{-\lambda_1 t} \rightarrow A = \frac{\lambda_1 n_{10}}{\lambda_2 - \lambda_1}\ ;\ n_2 = Ce^{-\lambda_2 t} + \frac{\lambda_1 n_{10} e^{-\lambda_1 t}}{\lambda_2 - \lambda_1}\ ;\ n_{20} = C + \frac{\lambda_1 n_{10}(e^{-\lambda_1 t} - e^{-\lambda_2 t})}{\lambda_2 - \lambda_1}\ ;\ \frac{n_2}{n_1} = \frac{n_{20}}{n_{10}} e^{(\lambda_1 t - \lambda_2 t)} + \frac{\lambda_1(1 - e^{\lambda_1 t - \lambda_2 t})}{\lambda_2 - \lambda_1}\ ;\ \lambda_2 > \lambda_1; \frac{n_2}{n_1} \approx \frac{\lambda_1}{\lambda_2 - \lambda_1}$

Stat rozpad; $Bin\ roz;\ P_n = \binom{N}{n} p^n (1-p)^{N-n}\ ;\ \binom{N}{n} = \frac{N!}{n!(N-n)!}\ ; N \rightarrow \infty: P_n \approx \frac{N^n p^n}{n!}(1 - p)^{\frac{Np}{p}}\ ; np \rightarrow \mu :\ \frac{n^n}{n!}\left[(1-p)^{\frac{1}{p}}\right]^{\mu};\ (1-p)^{\frac{1}{p}} \rightarrow p = \frac{1}{k}\ ;\ \left(1 - \frac{1}{k}\right)^k \rightarrow \frac{1}{e}\ ;\ \left(1 + \frac{1}{k}\right)^k \rightarrow e;\ p_n =$

$\frac{\mu^n e^{-\mu}}{n!}$ $poison;$ $\langle n \rangle = \sum np_n$; $\langle n \rangle = \sum_0^\infty n \frac{\mu^n e^{-\mu}}{n!} = \mu e^{-\mu} \sum_0^\infty \frac{\mu^{n-1}}{(n-1)!} = \mu$; $\delta^2 = \langle n^2 \rangle - \langle n \rangle^2 - \mu^2;$ $\langle (n-\mu)^2 \rangle, \langle n(N-1) \rangle + \langle n \rangle;$ $\delta^2 = \mu$