KÉPLETTÁR

BIOFIZIKA ÉS BIOSTATISZTIKA TÁRGYAKHOZ

Összeállította:

A Biofizikai és Sugárbiológiai Intézet

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GYAKORLATOK

I.FÉLÉV

MIKROSZKÓPIA I.

$$D = \frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \frac{1}{t} + \frac{1}{k}$$

$$D = \frac{1}{f_1} + \frac{1}{f_2} = D_1 + D_2$$

$$N = \frac{K}{T} = \frac{k}{t}$$

$$N_{össz} = N_{obj} \cdot N_{ok}$$

MIKROSZKÓPIA II.

$$\Delta s = d \sin \alpha_k = k\lambda$$

$$\delta = 0{,}61\frac{\lambda}{n \sin \omega}$$

$$NA = n \cdot \sin \omega$$

$$f = \frac{1}{\delta}$$

$$N_{szög} = -\frac{da}{f_{ok} f_{obj}}$$

$$N_{k=\infty} = -\frac{a}{f}$$

$$k_1 = d + f_{obj}$$

$$K = \frac{(J_{vil} - J_{söt})}{(J_{vil} + J_{söt})}$$

$$A_{eredő} = \sqrt{A_1^{\,2} + A_2^{\,2} + 2A_1A_2 \cos \Delta\varphi}$$

REFRAKTOMETRIA

$$c = f\lambda$$

$$n = \frac{c_{vákuum}}{c_{közeg}}$$

$$n_{21} = \frac{n_2}{n_1}$$

$$\frac{\sin \alpha}{\sin \beta} = \frac{c_1}{c_2} = \frac{n_2}{n_1} = n_{21}$$

$$\frac{1}{\sin \beta_h} = n_{21}$$

$$n = n_0 + kc$$

MÉRÉSTECHNIKA

$$H = \left|X_{mért} - X_{tényleges}\right|$$

$$h = \frac{\left|X_{mért} - X_{tényleges}\right|}{X_{tényleges}} \cdot 100\%$$

$$U = RI$$

$$R_{soros,eredő} = R_1 + R_2$$

$$\frac{1}{R_{párhuzamos,eredő}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$U_1 = U_0 \frac{R_1}{(R_1 + R_2)}$$

$$U_{cs\text{-}cs} = 2U_{max} = 2\sqrt{2}U_{eff}$$

REZONANCIA

$$F = -D\,x$$

$$F_{neh} = mg$$

$$x = A\sin(\varphi_0 + \omega t)$$

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{D}{m}}$$

$$\omega = 2\pi\, f$$

$$f = \frac{1}{T}$$

$$x = A_0 e^{-\delta t}\sin(\omega t)$$

$$A = A_0 e^{-\delta t}$$

$$D_{párhuzamos,eredő} = D_1 + D_2$$

$$\frac{1}{D_{soros,eredő}} = \frac{1}{D_1} + \frac{1}{D_2}$$

FÉNYEMISSZIÓ

$$\varepsilon = hf = h\frac{c}{\lambda}$$

$$\lambda_{\max} T = \mathrm{b}$$

$$hf = E_j - E_i$$

FÉNYABSZORPCIÓ

$$hf = E_j - E_i$$

$$\varepsilon = hf = h\frac{c}{\lambda}$$

$$T = \frac{J}{J_0}(100\%)$$

$$A = \lg\left(\frac{J_0}{J}\right) = \varepsilon(\lambda)cx$$

A SZEM OPTIKÁJA

$$D = \frac{n}{t} + \frac{n'}{k}$$

$$\Delta D = D_{\mathrm{p}} - D_{\mathrm{r}} = \frac{1}{t_{\mathrm{p}}} - \frac{1}{t_{\mathrm{r}}}$$

$$D_t = \sum_i D_i$$

$$\mathrm{visus} = \frac{1(')}{\alpha(')}100\%$$

$$\alpha(') \approx \frac{a}{x}(\mathrm{rad})\frac{360(^\circ)}{2\pi(\mathrm{rad})}60\left(\frac{'}{^\circ}\right)$$

$$a' = \frac{17a}{x}(\mathrm{mm})$$

$$\text{receptorsűrűség} \approx \frac{1}{(a')^2}\left(\frac{1}{\mathrm{mm}^2}\right)$$

$$d'_1 = 17\frac{d}{x_1}(\mathrm{mm}) \qquad d'_2 = 17\frac{d}{x_2}(\mathrm{mm})$$

POLARIMETRIA

$$\alpha = [\alpha]_D^{20}\, c\, l$$

$$\alpha = \sum \alpha_i$$

$$\alpha = \Delta n\, l\, \pi / \lambda$$

BŐRIMPEDANCIA

$$I = I_{\max}\sin(2\pi f t)$$

$$U = U_{\max}\sin(2\pi f t)$$

$$I_{eff} = \frac{I_{\max}}{\sqrt{2}}$$

$$U_{eff} = \frac{U_{\max}}{\sqrt{2}}$$

$$R = \frac{U_{gen}}{I}$$

$$Z = \frac{U_{\text{eff}}}{I_{\text{eff}}}$$

$$R = \rho \frac{l}{A}$$

$$\rho^* = RA$$

$$C = \varepsilon \frac{A}{l}$$

$$X_C = \frac{1}{2\pi f C}$$

$$\gamma^* = \frac{C}{A}$$

$$U_{gen} = U_{coarse} U_{fine} 5V$$

$$U_{gen.eff} = U_{coarse} U_{fine} 5V \frac{1}{\sqrt{2}}$$

$$|Z| = \frac{R}{\sqrt{1 + (2\pi f RC)^2}}$$

NUKLEÁRIS MÉRÉSTECHNIKA

$$N_j = N_{j+z} - N_z$$

$$E_\gamma = A + E_e$$

$$E_\gamma = A + E_e + E_\gamma^{'}$$

$$E_\gamma = 2m_e c^2 + E_e + E_p$$

GAMMAABSZORPCIÓ

$$J = J_0 \, e^{-\mu \cdot x}$$

$$J = J_0 \, e^{-\mu_m \cdot x_m}$$

$$x_{1/10} = \frac{D}{\lg 2}$$

$$\mu = \frac{\ln 2}{D}$$

$$\mu = \mu_m \cdot \rho$$

$$x_m = x \cdot \rho$$

$$D_m = D \cdot \rho$$

$$\mu_m = \tau_m + \sigma_m + \kappa_m$$

II.FÉLÉV

GAMMAENERGIA

$$\frac{\varepsilon_1}{\varepsilon_2} = \frac{U_1}{U_2}$$

IZOTÓPDIAGNOSZTIKA

$$\frac{1}{T_{\text{eff}}} = \frac{1}{T_{\text{fiz}}} + \frac{1}{T_{\text{biol}}}$$

$$\lambda_{eff} = \lambda_{fiz} + \lambda_{biol}$$

DOZIMETRIA

$$D = \frac{\Delta E}{\Delta m}$$

$$D_t = \frac{D}{t}$$

$$X = \frac{\Delta q}{\Delta m}$$

$$D = f_0 \cdot X$$

$$H_T = \sum_R D_{T,R} \cdot w_R$$

$$E = \sum_{\mathrm{T}} H_{\mathrm{T}} \cdot w_{\mathrm{T}}$$

$$D_{\text{levegő}} = K_{\gamma} \frac{\Delta t}{r^2}$$

$$U = \frac{Q}{C} \sim X$$

$$U = IR = \frac{Q}{t} R \sim \frac{X}{t}$$

$$X_t = \frac{I_{tel}}{m}$$

$$D_t = f_0 \cdot X_t$$

RÖNTGEN

$$\varepsilon_{el} = \varepsilon_{kin} = \varepsilon_{foton} + Q = \varepsilon_{\text{foton, max}}$$

$$eU = h f_{\max} = h \frac{c}{\lambda_{\min}}$$

$$\lambda_{\min} = \frac{h \cdot c}{e \cdot U} = \frac{k}{U}$$

$$P_{befektetett} = P_{hasznos} + P_{veszteség}$$

$$P_{el} = P_{Rtg} + P_Q$$

$$P_{\mathrm{Rtg}} = c_{\mathrm{Rtg}} U^2 I Z$$

$$P_{\mathrm{be}} = U I$$

$$\eta = P_{\mathrm{Rtg}} / \mathrm{P_{be}} = c_{\mathrm{Rtg}} U Z$$

$$\tau_{\mathrm{m}} = C \lambda^3 Z^3$$

$$\mu = \frac{1}{x} \ln\left(\frac{J_0}{J}\right)$$

$$\mu_{\mathrm{m}} = \frac{\mu}{\rho}$$

$$\tau_{\mathrm{m}} = \mu_{\mathrm{m}} - 0{,}2 \frac{\mathrm{cm}^2}{\mathrm{g}}$$

$$P = \frac{\Delta E}{\Delta t}$$

$$P_Q = \frac{Q}{\Delta t}$$

$$J = \frac{P}{A}$$

$$A_{gömb} = 4r^2\pi$$

$$\sin\Theta = \frac{N\lambda}{2d}$$

RÖNTGEN – CT

$$J = J_0 e^{-(\mu_1 \Delta x + \mu_2 \Delta x + \ldots \mu_n \Delta x)} = J_0 e^{-\sum_{i=1}^{n} \mu_i \Delta x}$$

$$D_i = \lg \frac{J_{i_0}}{J_i} = \lg \mathrm{e} \cdot \sum_{\mathrm{j=1}}^{\mathrm{n}} \mu_{\mathrm{ij}} \Delta x$$

$$D = \lg \frac{J_0}{J} = \sum_{i=1}^{n} D_i$$

$$HU = \frac{\mu - \mu_{\text{víz}}}{\mu_{\text{víz}}} 1000$$

ERŐSÍTŐ

$$R = \frac{U}{I}$$

$$P = U \cdot I = \frac{U^2}{R} = I^2 \cdot R$$

$$U_1 = I \cdot R_1 = \frac{U_0}{R_1 + R_2} \cdot R_1 = konst. \cdot R_1$$

$$A_{\mathrm{P}} = \frac{P_{\mathrm{ki}}}{P_{\mathrm{be}}}$$

$$A_{\mathrm{U}} = \frac{U_{\mathrm{ki}}}{U_{\mathrm{be}}}$$

$$A_{\mathrm{P}} = \frac{U_{\mathrm{ki}}^2 / R_{\mathrm{ki}}}{U_{\mathrm{be}}^2 / R_{\mathrm{be}}} = A_{\mathrm{U}}^2 \frac{R_{\mathrm{be}}}{R_{\mathrm{ki}}} \approx A_{\mathrm{U}}^2$$

$$n = 10 \cdot \lg A_{\mathrm{P}} \ \ (\mathrm{dB})$$

$$n = 20 \cdot \lg A_{\mathrm{U}} + 10 \cdot \lg \frac{R_{\mathrm{be}}}{R_{\mathrm{ki}}} \approx 20 \log A_U \ \text{(dB)}$$

$$U = U_{\mathrm{be}} - U_{\mathrm{ki}} \cdot \beta$$

$$U_{\mathrm{ki}} = \left(U_{\mathrm{be}} - U_{\mathrm{ki}} \cdot \beta\right) \cdot A_{\mathrm{U}}$$

$$A_{\mathrm{U,NVCS}} = \frac{U_{\mathrm{ki}}}{U_{\mathrm{be}}} = \frac{A_{\mathrm{U}}}{1 + A_{\mathrm{U}}\beta}$$

$$A_{\mathrm{U,NVCS}} \cong \frac{1}{\beta}$$

$$U_{be,\max} = U_{coarse} \cdot U_{fine} \cdot 5V$$

COULTER SZÁMLÁLÓ

$$R = \rho \frac{l}{A}$$

$$U = I_{gen} \cdot R$$

$$h = \frac{c_{\text{tényl}}}{c_{\text{mért}}} = \frac{c_{\text{tényl}}}{n \cdot 10^4 / \mu\mathrm{l}}$$

$$c_{\text{tényl}} = h \cdot c_{\text{mért}} = h \cdot n \cdot 10^4$$

IMPULZUSGENERÁTOR

$$I = \frac{\Delta Q}{\Delta t}$$

$$U = \Delta\phi = \frac{\Delta E}{\Delta Q}$$

$$R = \frac{U}{I}$$

$$P = \frac{\Delta E}{\Delta t}$$

$$P = U \cdot I = \frac{U^2}{R} = I^2 \cdot R$$

$$E_C = \frac{1}{2} C U^2$$

$$\tau = R \cdot C$$

$$T_{AMV} = \tau_1 + \tau_2$$

$$\mathrm{D} = \frac{\tau_1}{\tau_1 + \tau_2} 100\%$$

$$f = \frac{1}{T}$$

$$U = U_{\mathrm{t=0}} \cdot \mathrm{e}^{-\frac{t}{RC}}$$

$$U = U_{\mathrm{t=\infty}} \cdot \left(1 - \mathrm{e}^{-\frac{t}{RC}}\right)$$

AUDIOMETRIA

$$c = \lambda \cdot f = \frac{\lambda}{T}$$

$$p(t) = p_1 \cdot \sin(\omega t + \varphi)$$

$$Z = c\rho$$

$$J = \frac{P}{A}$$

$$J = \frac{p_{\mathrm{eff}}{}^2}{Z}$$

$$R = \frac{J_{\mathrm{refl}}}{J_0} = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2}\right)^2$$

$$n_{\text{ oktáv}} = \log_2 \frac{f_2}{f_1}$$

$$J_{dB} = 10 \lg \left(\frac{J}{J_0}\right)$$

$$H_{\mathrm{phon}} = 10 \lg \left(\frac{J}{J_0}\right)_{1000\,Hz}$$

$$H_{\mathrm{son}} = \frac{1}{16} \left(\frac{J}{J_0}\right)_{1000\,Hz}^{0,3}$$

$$H_{phon} + 10\,phon = H_{son} \cdot 2$$

$$D_{hang} = J_{hang} \cdot t$$

$$J = \eta \frac{U_{\text{eff}}^{\ 2}}{R}$$

$$U_{gen} = U_{coarse} \cdot U_{fine} \cdot 5V$$

$$J_{\text{saját}} = AU^2 \left(= 1 \cdot 10^{-5} \cdot U^2 (W/m^2)\right)$$

$$J_{dB,saját} = 10 \lg\left(\frac{J_{saját}}{J_0}\right)$$

$$HV = J_{dB,saját} - J_{dB,norm}$$

SZENZOR

$$\Psi_W = konst. \log \frac{\Phi}{\Phi_0}$$

$$\Psi_S = konst. \left(\frac{\Phi}{\Phi_0}\right)^n$$

$$H_{\text{rel}} = konst. \left(\frac{J}{J_0}\right)^n$$

EKG

$$U = \Delta\varphi = \frac{\Delta E}{\Delta q}$$

$$U_{TM} = \varphi_{\text{intracell}} - \varphi_{\text{extracell}}$$

$$U_{\text{ki}} = (U_{\text{be}_1} - U_{\text{be}_2}) A_U$$

$$U_{\text{I}} = \varphi_{\text{L}} - \varphi_{\text{R}} = U_{frontal} \cdot \cos(0^\circ - \alpha) = U_{frontal} \cdot \cos(\alpha)$$

$$U_{\text{II}} = \varphi_{\text{F}} - \varphi = U_{frontal} \cdot \cos(60^\circ - \alpha)$$

$$U_{\text{III}} = \varphi_{\text{F}} - \varphi_{\text{L}} = U_{frontal} \cdot \cos(120^\circ - \alpha)$$

$$U_{\text{II}} = U_I + U_{III}$$

$$\phi_{\text{CT}} = (\phi_{\text{L}} + \phi_{\text{R}} + \phi_{\text{F}})/3 = 0$$

$$U_{\text{Vi}} = \phi_{Ci} - (\phi_{\text{L}} + \phi_{\text{R}} + \phi_{\text{F}})/3$$

$$U_{\text{aVR}} = \phi_{\text{R}} - (\phi_{\text{L}} + \phi_{\text{F}})/2$$

$$U_{\text{aVL}} = \phi_{\text{L}} - (\phi_{\text{R}} + \phi_{\text{F}})/2$$

$$U_{\text{aVF}} = \phi_{\text{F}} - (\phi_{\text{R}} + \phi_{\text{L}})/2$$

$$\sin(\alpha \pm \beta) = \sin\alpha \cos\beta \pm \cos\alpha \sin\beta$$

$$\cos(\alpha \pm \beta) = \cos\alpha \cos\beta \mp \sin\alpha \sin\beta$$

ÁRAMLÁS

$$I_{\text{V}} = \frac{\Delta V}{\Delta t}$$

$$I_{\text{V}} = \frac{A \cdot \overline{\Delta l}}{\Delta t} = A \cdot \bar{v}$$

$$A_1 \cdot \overline{v_1} = A_2 \cdot \overline{v_2} = konst.$$

$$I_V = -\frac{\pi}{8\eta} r^4 \frac{\Delta p}{\Delta l}$$

$$\text{Re} = \frac{\bar{v} \cdot \rho \cdot r}{\eta}$$

$$v_{\text{krit}} = 1160 \frac{\eta}{\rho \cdot r}$$

$$\eta = \frac{\pi}{8} \frac{r^4}{\Delta V} \frac{\overline{\Delta h} \rho g}{l} \Delta t$$

$$\Delta p = R_{\text{cső}} I_V \qquad (U = RI)$$

$$R_{\text{cső}} = 8\pi\eta \frac{l}{A^2}$$

$$R = \frac{U}{I}$$

$$R_{\text{párhuzamos, eredő}} = \frac{R}{n}$$

$$I_B = \frac{I_A}{n}$$

$$I_C = \frac{I_A}{m}$$

DIFFÚZIÓ

$$J_v = \frac{\Delta v}{\Delta t \Delta A}$$

$$J_v = -D \cdot \frac{\Delta c}{\Delta x}$$

$$D = \frac{kT}{6\pi\eta r_{Stokes}}$$

$$w = 6 \cdot \sqrt{2 \cdot D \cdot t} \qquad R_{átlag} = \sqrt{6 \cdot D \cdot t}$$

$$D \cdot \frac{\Delta\left(\frac{\Delta c}{\Delta x}\right)}{\Delta x} = \frac{\Delta c}{\Delta t}.$$

D = 1,38 *10^{-8} m^2/mm^2*$mered^2$

TANKÖNYVHÖZ KAPCSOLÓDÓ KÉPLETEK

I. AZ „ÉLŐ” ANYAG LEGFONTOSABB SZERKEZETI TULAJDONSÁGAI ÉS SZEREPÜK A BIOLÓGIAI FUNKCIÓKBAN

$$hf = E_m - E_i \qquad \text{(I.1)}$$

$$\lambda = \frac{h}{p} = \frac{h}{m\upsilon} \qquad \text{(I.3)}$$

$$\Delta M = [Z \cdot m_p + (A - Z) \cdot m_n] - M(A, Z) \qquad \text{(I.19)}$$

$$E = mc^2$$

$$n_i = n_0 e^{-\frac{\varepsilon_i - \varepsilon_0}{kT}} \qquad R = N_A k \qquad \text{(I.25)}$$

$$\frac{n_{(h)}}{n_{(0)}} = e^{-\frac{mgh}{kT}} \qquad \text{(I.26)}$$

$$\frac{n_A}{n_B} = e^{-\frac{qU}{kT}} \qquad \text{(I.28)}$$

$$\bar{\varepsilon}_{mozgási} = \frac{1}{2} m\overline{\upsilon^2} = \frac{3}{2} kT \qquad \text{(I.34)}$$

$$pV = NkT \qquad \text{(I.35)}$$

$$pV = nRT$$

$$p = \frac{NkT}{V - Nb} - an^2 \qquad \text{(I.36)}$$

$$\left(p + a\frac{N^2}{V^2}\right)(V - Nb) = nkT \qquad \text{(I.37)}$$

$$\sigma = konst \cdot e^{-\frac{\Delta\varepsilon}{2kT}} \qquad \text{(I.39)}$$

$$n_S \cong N \cdot e^{-\frac{\varepsilon_S}{kT}} \qquad \text{(I.40)}$$

$$c = \frac{\Delta Q}{m \cdot \Delta T}$$

$$L_O = \frac{\Delta Q_{olvadás}}{m}$$

$$L_P = \frac{\Delta Q_{párolgás}}{m}$$

$$n = \frac{c_{\text{vákuum}}}{c_{\text{közeg}}}$$

$$N = \frac{K}{T} = \frac{k}{t}$$

$$N_{\text{szög}} = -\frac{da}{f_{ok} f_{obj}}$$

$$f = \frac{1}{T}$$

$$c = f\lambda$$

$$\Delta s = d \sin \alpha_{\text{k}} = \text{k}\lambda$$

$$P = \frac{\Delta E}{\Delta t} \qquad \text{(II.1)}$$

$$M = \frac{\Delta P}{\Delta A} \qquad \text{(II.2)}$$

$$M_\lambda = \frac{\Delta M}{\Delta \lambda}$$

$$E_{\text{be}} = \frac{\Delta P}{\Delta A} \qquad \sim \frac{1}{r^2}, \sim \frac{1}{r} \qquad \text{(II.3)}$$

$$I_E = \frac{\Delta E}{\Delta t} \qquad \text{(II.4)}$$

$$J_E = \frac{\Delta E}{\Delta t \Delta A} \qquad \text{(II.5)}$$

$$E_{be} = E_{be,\max} \cdot \cos \alpha \qquad \text{(II.8)}$$

$$\Delta J = -\mu \Delta x J \qquad \text{(II.10)}$$

$$J = J_0 \text{e}^{-\mu x} \qquad \text{(II.11)}$$

$$\mu = \frac{1}{\delta}$$

$$J = J_0 2^{-\frac{x}{D}} \qquad \text{(II.12)}$$

$$\mu = \frac{\ln 2}{D} \qquad \text{(II.13)}$$

$$\frac{\sin \alpha}{\sin \beta} = \frac{c_1}{c_2} = n_{21} \qquad \text{(II.14)}$$

$$D = \frac{n_2 - n_1}{r} \qquad \text{(II.17)}$$

$$D = D_1 + D_2 \qquad \text{(II.21)}$$

$$\frac{1}{f} = D = \frac{1}{t} + \frac{1}{k} \qquad \text{(II.22)}$$

$$D = \frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \qquad \text{(II.23)}$$

$$c = \frac{\lambda}{T}, \text{ illetve } \quad c = \lambda f \qquad \text{(II.26)}$$

$$J \sim A^2 \qquad \text{(II.27)}$$

$$J_1 + J_2 \neq J_{\text{eredő}} \qquad \text{(II.28)}$$

$$A^2_{\text{eredő}} = 2A^2(1 + \cos \Delta\varphi) \qquad \text{(II.31)}$$

$$\Delta s = d \sin \alpha \qquad \text{(II.32)}$$

$$\Delta x \approx \Delta s \frac{L}{d} \qquad \text{(II.33)}$$

$$\Delta \varphi = \Delta s \frac{2\pi}{\lambda} \qquad \text{(II.34)}$$

$$d \approx \lambda \frac{L}{d} \qquad \text{(II.36)}$$

$$E_{\text{mozgási}} = hf - W_{\text{ki}} \qquad \text{(II.37)}$$

$$E = E_{\text{mozgási}} + E_{\text{elektron}} + E_{\text{rezgési}} + E_{\text{forgási}}$$

$$p = mc = \frac{hf}{c} = \frac{h}{\lambda} \qquad \text{(II.38)}$$

$$\frac{M_{\lambda_{\text{i}}}}{\alpha_{\lambda_{\text{i}}}} = \frac{M_{\lambda_{\text{j}}}}{\alpha_{\lambda_{\text{j}}}} \qquad \text{(II.39)}$$

$$M_{\text{fekete}}(T) = \sigma T^4 \qquad \text{(II.41)}$$

$$\Delta M = \sigma(T_{\text{test}}^4 - T_{\text{környezet}}^4)$$

$$\Delta E = \sigma(T_{\text{test}}^4 - T_{\text{környezet}}^4) \cdot A \cdot t$$

$$\lambda_{\max} T = \text{állandó} \qquad \text{(II.42)}$$

$$\Delta N_a = K_1 B_{12} N_1 J' \Delta t \qquad \text{(II.44)}$$

$$\Delta N_{se} = K_1 A N_2 \Delta t \qquad \text{(II.45)}$$

$$\Delta N_{ie} = K_1 B_{21} N_2 J' \Delta t \qquad \text{(II.46)}$$

$$\Delta J = JK(N_2 - N_1) \qquad \text{(II.54)}$$

$$\mu = K(N_1 - N_2) \qquad \text{(II.56)}$$

$$2L = m\lambda \qquad \text{(II.57)}$$

$$J = J_0 e^{-\frac{t}{\tau}}$$

$$\rho(\lambda) = \frac{J_{visszavert}(\lambda)}{J_0(\lambda)}$$

$$\rho(\lambda) = \left(\frac{n_2 - n_1}{n_2 + n_1}\right)^2$$

$$\sigma(\lambda) = \frac{J_{\text{szórt}}(\lambda)}{J_0(\lambda)}$$

$$\sigma(\lambda) \sim \frac{\mathrm{d}^6}{\lambda^4}$$

$$J_{szórt,\lambda} = J_0 \frac{8\pi^4 N \alpha^2}{\lambda^4 R^2}\left(1 + \cos^2(\beta)\right)$$

$$P_{\text{szórt}} \sim \frac{{p_0}^2}{c^3}\omega^4 \sim \frac{1}{\lambda^4} \qquad \text{(II.60)}$$

$$\alpha(\lambda) = \frac{J_{\text{elnyelt}}(\lambda)}{J_0(\lambda)}$$

$$J = J_0 e^{-a \cdot x}$$

$$a = \frac{1}{\delta}$$

$$a = \frac{\ln 2}{D}$$

$$A = \lg\left(\frac{J_0}{J}\right)$$

$$A = \varepsilon(\lambda) \cdot c \cdot x$$

$$\tau(\lambda) = \frac{J_{\text{áteresztett}}(\lambda)}{J_0(\lambda)}$$

$$\rho(\lambda) + \sigma(\lambda) + \alpha(\lambda) + \tau(\lambda) = 1$$

$$\alpha = [\alpha]_D^{20} \cdot c \cdot l$$

$$D = E \cdot t$$

$$H = E \cdot t \cdot S$$

$$2L = m \cdot \lambda$$

$$\kappa = \frac{-\frac{\Delta V}{V}}{\Delta p} \qquad \text{(II.63)}$$

$$c = \frac{1}{\sqrt{\rho\kappa}} \qquad \text{(II.64)}$$

$$Z = c\rho \qquad \text{(II.67)}$$

$$Z = \sqrt{\frac{\rho}{\kappa}} \qquad \text{(II.68)}$$

$$R = \frac{J_R}{J_0} \qquad \text{(II.76)}$$

$$R = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2}\right)^2 \qquad \text{(II.77)}$$

$$Z_{csatoló} \approx \sqrt{Z_{forrás} \cdot Z_{\text{bőr}}}$$

$$eU_{\text{anód}} = \varepsilon_{\max} = hf_{\max} \qquad \text{(II.79)}$$

$$\lambda_{\min} = \frac{hc}{eU_{\text{anód}}} \qquad \text{(II.80)}$$

$$P_{\text{Rtg}} = c_{\text{Rtg}} {U_{\text{anód}}}^2 Z I_{\text{anód}} = \eta U_{\text{anód}} I_{\text{anód}} \qquad \text{(II.82)}$$

$$\eta = \frac{P_{kisugárzott}}{P_{befektetett}} = c_{\text{Rtg}} \cdot U_{anód} \cdot Z \qquad \text{(II.83)}$$

$$J = J_0 e^{-\mu \cdot x} \qquad \text{(II.84)}$$

$$\mu = \mu_m \rho \qquad x_m = \rho x \tag{II.85}$$

$$\tau = \tau_m \rho \qquad \sigma = \sigma_m \rho \qquad \kappa = \kappa_m \rho$$

$$\varepsilon = hf = E_{\text{kötési}} + E_{\text{mozgási}} \tag{II.86}$$

$$\tau_m = \frac{\tau}{\rho} = C_{\text{foto}} \lambda^3 Z^3 \tag{II.87}$$

$$Z_{eff} = \sqrt[3]{\sum_{i=1}^{n} w_i Z_i^3} \tag{II.88}$$

$$hf = E_{\text{kötési}} + hf' + E_{\text{mozgási}} \tag{II.89}$$

$$\frac{\Delta N}{\Delta t} = -\lambda N \tag{II.95}$$

$$N = N_0 \mathrm{e}^{-\lambda t} \qquad \lambda = \frac{1}{\tau} \tag{II.96}$$

$$\frac{N_0}{2} = N_0 \mathrm{e}^{-\lambda T} \tag{II.97}$$

$$\lambda T = \ln 2 \tag{II.98}$$

$$\frac{1}{T_{\text{eff}}} = \frac{1}{T_{\text{fiz}}} + \frac{1}{T_{\text{biol}}}$$

$$\lambda_{eff} = \lambda_{fiz} + \lambda_{biol}$$

$$A = -\frac{\Delta N}{\Delta t} \tag{II.99}$$

$$A = A_0 \mathrm{e}^{-\lambda t} \tag{II.101}$$

$$s = \frac{\Delta E}{\Delta x}$$

$$s = s_m \rho$$

$$\mu = \tau + \sigma + \kappa \tag{II.102}$$

$$\mu_m = \tau_m + \sigma_m + \kappa_m$$

$$E_\gamma = A + E_{\text{e,kin}}$$

$$E_\gamma = A + E_{\text{e,kin}} + E'_\gamma$$

$$E_\gamma = hf = 2m_{\text{e}}c^2 + E_{\text{e,kin}} + E_{p,kin} \tag{II.103}$$

$$qvB = \frac{mv^2}{r}$$

$$D = \frac{\Delta E}{\Delta m} \tag{II.105}$$

$$D_{\text{levegő}} = K_\gamma \frac{At}{r^2}$$

$$X = \frac{\Delta Q}{\Delta m} \tag{II.106}$$

$$D_{\text{levegő}} = f_0 X \tag{II.107}$$

$$D \sim \mu_m J, \quad \text{illetve} \quad D \sim s_m$$

$$H_{\text{T}} = \sum_{\text{R}} w_{\text{R}} D_{\text{TR}} \tag{II.108}$$

$$\sum_{\text{T}} w_{\text{T}} = 1 \tag{II.109}$$

$$E = \sum_{\text{T}} w_{\text{T}} H_{\text{T}} \tag{II.110}$$

$$S = \sum_{\text{i}} N_{\text{i}} E_{\text{i}} \tag{II.111}$$

$$S_T = \sum_{\text{i}} N_{\text{i}} H_{\text{T,i}} \tag{II.112}$$

$$I_V = \frac{\Delta V}{\Delta t} \qquad \text{(III.1)}$$

$$I_V = A\bar{\upsilon} = \text{állandó} \qquad \text{(III.4)}$$

$$p + \frac{1}{2}\rho\upsilon^2 + \rho g h = \text{állandó} \qquad \text{(III.5)}$$

$$F = \eta A \frac{\Delta \upsilon}{\Delta h} \qquad \text{(III.6)}$$

$$\eta = \frac{\tau}{D}$$

$$I_V = -\frac{\pi}{8\eta} R^4 \frac{\Delta p}{\Delta l} \qquad \text{(III.12)}$$

$$R_{\text{cső}} = 8\pi\eta \frac{\Delta l}{(r^2\pi)^2} \qquad \text{(III.14)}$$

$$\text{Re} = \frac{\bar{v} \cdot \rho \cdot r}{\eta}$$

$$\upsilon_{\text{krit}} = \text{Re}\frac{\eta}{\rho r} \qquad \text{(III.17)}$$

$$\sigma_\theta = \frac{P \cdot r}{t} = \frac{F}{t \cdot l}$$

$$C = \frac{\Delta V}{\Delta P}$$

$$\Delta p = \frac{2\gamma}{R}$$

$$p_{total} = \sum_{i=1}^{n} p_i$$

$$p = k_H c$$

$$F = 6\pi\eta r\upsilon \qquad \text{(III.18)}$$

$$u = \frac{\upsilon}{F} = \frac{1}{6\pi\eta r} \qquad \text{(III.19)}$$

$$v_{átl} = \sqrt{\frac{3kT}{m}} \qquad \text{(III.24)}$$

$$l = \bar{\upsilon}\tau \qquad \text{(III.25)}$$

$$\upsilon_{\text{drift}} = \frac{F}{m}\tau \qquad \text{(III.26)}$$

$$I_N = \frac{\Delta N}{\Delta t} \qquad \text{(III.28)}$$

$$I_\nu = \frac{\Delta \nu}{\Delta t} \qquad \text{(III.29)}$$

$$J_\nu = \frac{\Delta I_\nu}{\Delta A} \qquad \text{(III.30)}$$

$$J_\nu = -D\frac{\Delta c}{\Delta x} \qquad \text{(III.31)}$$

$$D = \frac{1}{3}\upsilon l = ukT \qquad \text{(III.33)}$$

$$D = \frac{k \cdot T}{6 \cdot \pi \cdot \eta \cdot r_{Stokes}} \qquad \text{(III.34)}$$

$$-\frac{\Delta J_\nu}{\Delta x} = \frac{\Delta c}{\Delta t} \qquad \text{(III.38)}$$

$$D\frac{\Delta\left(\frac{\Delta c}{\Delta x}\right)}{\Delta x} = \frac{\Delta c}{\Delta t} \qquad \text{(III.39)}$$

$$\sigma_x \sim \overline{R(t)} \sim \sqrt{Dt} \qquad \text{(III.40)}$$

$$\overline{R(t)} = \sqrt{Nl^2} = \sqrt{3Dt}$$

$$p_{\text{ozmózis}} = cRT \qquad \text{(III.50)}$$

$$ozm. = \sum\left(\varphi_i n_i c_i\right)$$

$$J_\nu = -L_T\frac{\Delta T}{\Delta x} \qquad \text{(III.51)}$$

$$J_E = -\lambda\frac{\Delta T}{\Delta x} \qquad \text{(III.53)}$$

$$J = LX \qquad J = \frac{\Delta x_{ext}}{A\Delta t} \qquad X = -\frac{\Delta y_{int}}{\Delta x} \qquad \text{(III.54)}$$

$$\Delta E = Q_E + W \qquad Q_E = cm\Delta T \qquad \text{(III.56)}$$

$$W_V = -p\Delta V \quad W_Q = \varphi\Delta Q \quad W_\nu = \mu\Delta\nu \quad \text{(III.58)}$$

$$W^{(\mathrm{i})} = y_{\mathrm{int}}{}^{(\mathrm{i})}\Delta x_{\mathrm{ext}}{}^{(\mathrm{i})} \quad \text{(III.59)}$$

$$W_{\nu Q} = W_\nu + W_Q = (\mu + zF\varphi)\Delta\nu = \mu_{\mathrm{e}}\Delta\nu \quad \text{(III.61)}$$

$$Q_E = T\Delta S \quad \text{(III.63)}$$

$$\Delta E = \sum_{(\mathrm{i})} y_{\mathrm{int}}{}^{(\mathrm{i})}\Delta x_{\mathrm{ext}}{}^{(\mathrm{i})} \quad \text{(III.64)}$$

$$W_{mech} = -n \cdot R \cdot T \cdot \ln\frac{V_2}{V_1}$$

$$W_{kém} = -n \cdot R \cdot T \cdot \ln\frac{c_2}{c_1}$$

$$\Delta S = c \cdot m \cdot \ln\frac{T_2}{T_1}$$

$$\Delta S = \frac{\Delta E_1}{T_1} + \frac{\Delta E_2}{T_2} = \Delta E\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \quad \text{(III.67)}$$

$$S = k\ln\Omega \quad \text{(III.72)}$$

$$\frac{P_i}{P_j} = \frac{\Omega_i}{\Omega_j} = \frac{e^{\frac{S_i}{k}}}{e^{\frac{S_j}{k}}} = e^{\frac{S_i - S_j}{k}} \quad \text{(III.74)}$$

$$\Delta U = T\Delta S - p\Delta V + \sum_{i=1}^{n}\mu_i\Delta\nu_i + \varphi\Delta q + A\Delta\xi$$

$$E = TS - pV + \mu\nu \quad \text{(III.83)}$$

$$H = E + pV \quad \text{(III.84)}$$

$$\Delta H_p = Q_E + W_\nu \quad \text{(III.87)}$$

$$\Delta H_{p,\nu} = Q_E \quad \text{(III.88)}$$

$$F = E - TS \quad \text{(III.89)}$$

$$\Delta F_T = W_V + W_\nu \quad \text{(III.91)}$$

$$\Delta F_{T,\nu} = W_V \quad \text{(III.92)}$$

$$\Delta F_{T,V} = W_\nu \quad \text{(III.93)}$$

$$G = H - TS \quad \text{(III.94)}$$

$$\Delta G_{T,p} = W_\nu \quad \text{(III.96)}$$

$$\Delta G_{T,p} \le 0 \quad \text{(III.99)}$$

$$\Delta F_{T,V} \le 0 \quad \text{(III.100)}$$

$$\Delta H_{S,p} \le 0 \quad \text{(III.101)}$$

$$G = \mu_{\mathrm{A}}\nu_{\mathrm{A}} + \mu_{\mathrm{B}}\nu_{\mathrm{B}} \quad \text{(III.105)}$$

$$\mu_{\mathrm{A}} = \mu^0{}_{\mathrm{A}} + RT\ln(c_{\mathrm{A}}) \quad \text{(III.109)}$$

$$\mu^e = \mu + ZF\varphi$$

$$J_{\mathrm{m}} = -p(c_{\mathrm{v}_2} - c_{\mathrm{v}_1}) \quad \text{(III.113)}$$

$$p = \frac{D}{d}$$

$$J_{\mathrm{k}} = -L_{\mathrm{k}}\frac{\Delta\mu_{\mathrm{e}}}{\Delta x} \quad \text{(III.116)}$$

$$L_{\mathrm{k}} = c_{\mathrm{k}}\frac{D_{\mathrm{k}}}{RT} = \frac{c_{\mathrm{k}}u_{\mathrm{k}}}{N_{\mathrm{A}}} \quad \text{(III.118)}$$

$$J_{\mathrm{k}} = -D_{\mathrm{k}}\left(\frac{\Delta c_{\mathrm{k}}}{\Delta x} + c_{\mathrm{k}}\frac{z_{\mathrm{k}}F}{RT}\frac{\Delta\varphi}{\Delta x}\right) \quad \text{(III.119)}$$

$$U = \frac{RT}{F}\ln\frac{\sum_{\mathrm{k}=1}^{\mathrm{m}} p_{\mathrm{k}}^{+}c_{\mathrm{k,II}}^{+} + \sum_{\mathrm{k}=1}^{\mathrm{n}} p_{\mathrm{k}}^{-}c_{\mathrm{k,I}}^{-}}{\sum_{\mathrm{k}=1}^{\mathrm{m}} p_{\mathrm{k}}^{+}c_{\mathrm{k,I}}^{+} + \sum_{\mathrm{k}=1}^{\mathrm{n}} p_{\mathrm{k}}^{-}c_{\mathrm{k,II}}^{-}} \quad \text{(III.121)}$$

$$U = \varphi^{\mathrm{II}} - \varphi^{\mathrm{I}} = \frac{RT}{z_{\mathrm{i}}F}\ln\frac{c_{\mathrm{i}}^{\mathrm{I}}}{c_{\mathrm{i}}^{\mathrm{II}}} \quad \text{(III.123)}$$

$$U_{\mathrm{m}}(t) = U_{\mathrm{t}}\left(1 - \mathrm{e}^{-\frac{t}{R_{\mathrm{m}}C_{\mathrm{m}}}}\right) \quad \text{(III.130)}$$

$$\tau = R_m C_m \quad \text{(III.131)}$$

$$\lambda \approx \sqrt{\frac{R_m}{R_i + R_e}} \approx \sqrt{\frac{R_m}{R_i}}$$

$$U_{\mathrm{m}}(t) = U_{\mathrm{t}}\mathrm{e}^{-\frac{t}{R_{\mathrm{m}}C_{\mathrm{m}}}} \quad \text{(III.132)}$$

$$U_{\mathrm{m}}(x) - U_{\mathrm{m}}(0) = U_{\mathrm{t}}\mathrm{e}^{-\frac{x}{\lambda}} \quad \text{(III.133)}$$

$$\Psi_W = konst.\log\frac{\Phi}{\Phi_0} \quad \text{(IV.6)}$$

$$\Psi_S = konst.\left(\frac{\Phi}{\Phi_0}\right)^n \quad \text{(IV.8)}$$

$$P = J\cdot\pi\cdot\left(\frac{d}{2}\right)^2 \quad \text{(IV.9)}$$

$$\frac{P_{\max}}{P_{\min}} = \left(\frac{d_{\max}}{d_{\min}}\right)^2 = 16 \quad \text{(IV.10)}$$

$$D = \frac{n-n'}{r} \quad \text{(IV.11)}$$

$$D = \frac{n_t}{t} + \frac{n_k}{k} \quad \text{(IV.12)}$$

$$\text{visus} = \frac{1(')}{\alpha(')}100\% \quad \text{(IV.14)}$$

$$\alpha_H = 1{,}22\cdot\frac{\lambda}{d} \quad \text{(IV.15)}$$

$$A = \frac{E_{ion}}{E_{foton}} = \frac{ne\Delta\varphi}{hf}$$

$$X = rR + gG + bB$$

$$n_{\text{oktáv}} = \log_2\frac{f_2}{f_1} \quad \text{(IV.22)}$$

$$p(t) = p_{\max}\cdot\sin(\omega t + \varphi) \quad \text{(IV.23)}$$

$$R = \frac{J_{\text{refl}}}{J_0} = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2}\right)^2$$

$$F_{dob} = p_{lev}\cdot A_{dob}$$

$$n = 10\lg\left(\frac{P_{\text{ki}}}{P_{\text{be}}}\right) = 10\lg\left(\frac{J_{\text{ki}}}{J_{\text{be}}}\right) \quad \text{(IV.26)}$$

$$n = n_{\text{erősítés}} + n_{\text{csillapítás}} \quad \text{(IV.27)}$$

$$n = 10\lg\left(\frac{J}{J_0}\right) \quad \text{(IV.28)}$$

$$H_{\text{phon}} = 10\lg\left(\frac{J}{J_0}\right)_{1000\,Hz} \quad \text{(IV.29)}$$

$$H_{\text{son}} = \frac{1}{16}\left(\frac{J}{J_0}\right)^{0{,}3}_{1000\,Hz} \quad \text{(IV.31)}$$

$$H_{phon} + 10\,phon = H_{son}\cdot 2$$

V. BIOMECHANIKA

$$\frac{F}{A} = E\frac{\Delta L}{L} \quad \text{(V.1)}$$

$$\sigma = \frac{F}{A}$$

$$\varepsilon = \frac{\Delta L}{L}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$c_{hang} = \frac{1}{\sqrt{\rho\cdot\kappa}}$$

$$\kappa = \frac{-\Delta V / V}{\Delta p}$$

$$\sigma = \eta \frac{\Delta \varepsilon}{\Delta t}$$

$$\left(R^2\right)_{átlag} = 2L_p L \qquad \text{(V.3)}$$

$$r = \frac{\tau_{be}}{\tau_{be} + \tau_{ki}} = \frac{\tau_{be}}{\tau_{teljes}} \qquad \text{(V.4)}$$

$$v_{csapás} = \frac{\delta}{\tau_{be}}$$

$$\tau_{teljes} = \frac{1}{k_{ATPáz}}$$

$$r = \frac{\delta \cdot k_{ATPáz}}{v_{csapás}}$$

$$P = Fv \qquad \text{(V.5)}$$

$$(F + a)(v + b) = (F_0 + a)b$$

$$v_{\max} = \frac{bF_0}{a}$$

$$\frac{\Delta L}{L} = \alpha \cdot \Delta T$$

$$\frac{\Delta V}{V} = \beta \cdot \Delta T$$

VI. A MOLEKULÁRIS ÉS SEJTDIAGNOSZTIKA FIZIKAI MÓDSZEREI

$$N_{\text{szög}} = \frac{\operatorname{tg}\beta}{\operatorname{tg}\alpha} = a\left(\frac{1}{f} - \frac{1}{k}\right) \qquad \text{(VI.18)}$$

$$N_{k=\infty} = -\frac{a}{f} \qquad \text{(VI.20)}$$

$$N_{\text{szög}} = -\frac{da}{f_1 f_2} \qquad \text{(VI.23)}$$

$$\Delta s = d \sin \alpha_{\text{k}} = \text{k}\lambda \qquad \text{(VI.24)}$$

$$\delta = 0{,}61\frac{\lambda}{n \sin \omega} \qquad f = \frac{1}{\delta} \qquad \text{(VI.28)}$$

$$J = J_0\, e^{-\mu \cdot x} \qquad \text{(VI.29)}$$

$$T = \frac{J}{J_0}(100\%) \qquad \text{(VI.33)}$$

$$A = \lg\left(\frac{J_0}{J}\right) = \varepsilon(\lambda) c x \qquad \text{(VI.34)}$$

$$Q_F = \frac{k_f}{k_f + k_{nr}} = \frac{k_f}{k_f + k_{ic} + k_{isc} + k_Q} \qquad \text{(VI.36)}$$

$$Q_{ST} = \frac{k_{isc}}{k_f + k_{nr}}$$

$$Q_{ph} = Q_{ST}\frac{k_{ph}}{k_{ph} + k_{nr,ph}} \qquad \text{(VI.37)}$$

$$\Delta N = -\left(k_f + k_{nr}\right) \cdot N \cdot \Delta t \qquad \text{(VI.38)}$$

$$N = N_0 \text{e}^{-(k_\text{f} + k_\text{nr})t} \qquad \text{(VI.39)}$$

$$\tau = \frac{1}{k_\text{f} + k_\text{nr}} \qquad \text{(VI.40)}$$

$$Q_\text{f} = k_\text{f}\tau \qquad \text{(VI.41)}$$

$$p = \frac{J_{\text{VV}} - J_{\text{VH}}}{J_{\text{VV}} + J_{\text{VH}}} \qquad \text{(VI.43)}$$

$$D = \frac{w^2}{4t_D}$$

$$F = k\frac{Q_1 Q_2}{r^2}$$

$$E = \frac{F}{q}$$

$$U_{21} = \frac{W_{1\to 2}}{q} \qquad \phi_i = \frac{W_{0\to i}}{q}$$

$$U_{21} = E \cdot s$$

$$C = \frac{Q}{U}$$

$$C = \varepsilon_0 \varepsilon_r \frac{A}{l}$$

$$W == \frac{1}{2}UQ = \frac{1}{2}CU^2 = \frac{1}{2}\frac{Q^2}{C}$$

$$C_{párhuzamos,eredő} = C_1 + C_2$$

$$\frac{1}{C_{soros,eredő}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$J = \frac{\Delta Q}{A \cdot \Delta t}$$

$$R = \frac{U}{I}$$

$$G = \frac{1}{R} = \frac{I}{U}$$

$$R = \rho\frac{l}{A}$$

$$\sigma = \frac{1}{\rho}$$

$$R_{soros,eredő} = R_1 + R_2$$

$$\frac{1}{R_{párhuzamos,eredő}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$W = U \cdot I \cdot t$$

$$P = U \cdot I = \frac{U^2}{R} = I^2 \cdot R$$

$$U_R = U_T e^{-\frac{t}{RC}} \quad U_C = U_T\left(1 - e^{-\frac{t}{RC}}\right) \quad \text{(VII.2)}$$

$$I = I_{max}\sin(2\pi \cdot f \cdot t)$$

$$U = U_{max}\sin(2\pi \cdot f \cdot t)$$

$$I_{eff} = \frac{I_{max}}{\sqrt{2}}$$

$$U_{eff} = \frac{U_{max}}{\sqrt{2}}$$

$$P = U_{eff} \cdot I_{eff}$$

$$Z = \frac{U_{eff}}{I_{eff}}$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{\omega C} \quad \text{(VII.4)}$$

$$U_{ki} = U_{be}\frac{R}{\sqrt{R^2 + X_C^2}} \quad \text{(VII.5)}$$

$$U_{ki,\text{ alulvágó}} = U_{be}\frac{RC\omega}{\sqrt{1 + C^2R^2\omega^2}}$$

$$U_{ki,\text{ felülvágó}} = U_{be}\frac{1}{\sqrt{1 + C^2R^2\omega^2}}$$

$$f_0 = \frac{1}{2\pi RC}$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$A_U = \frac{U_{\text{ki}}}{U_{\text{be}}} \qquad A_P = \frac{P_{\text{ki}}}{P_{\text{be}}} \qquad \text{(VII.6)}$$

$$A_P = A_U{}^2 \quad \text{ha } R_{\text{ki}} = R_{\text{be}} \qquad \text{(VII.8)}$$

$$n = 10\lg A_P = 20\lg A_U \qquad \text{(VII.10)}$$

$$U_{ki} = \frac{R_2}{R_1 + R_2} \cdot U_{be}$$

$$U_{\text{ki}} = (U_{\text{be}_1} - U_{\text{be}_2})A_U \qquad \text{(VII.11)}$$

$$A_{U,V^+} = \frac{A_U}{1 - A_U\beta}$$

$$A_{U,V^-} = \frac{A_U}{1 + A_U\beta} \qquad \text{(VII.14)}$$

$$\beta = \frac{U_{vissza}}{U_{ki}}$$

$$H = \sum_i p_i \cdot \log_2 \frac{1}{p_i}$$

VIII. KÉPALKOTÓ MÓDSZEREK

$$J = J_0 e^{-(\mu_1 \Delta x + \mu_2 \Delta x + \ldots \mu_n \Delta x)} = J_0 e^{-\sum_{i=1}^{n} \mu_i \Delta x}$$

$$\lg \frac{J_0}{J} = (\mu_1 x_1 + \mu_2 x_2 + \ldots)\lg \mathrm{e} \qquad \text{(VIII.2)}$$

$$hf_0 = g_{\text{N}}\mu_{\text{N}}H_0 \qquad \text{(VIII.3)}$$

$$M_{long}(t) = M_{long}(0) \cdot \left(1 - e^{-\frac{t}{T_1}}\right)$$

$$M_{transz}(t) = M_{transz}(0) \cdot e^{-\frac{t}{T_2}}$$

$$P = d \times \frac{F}{A}$$

$$\frac{\Delta l}{l} = E \times d$$

$$c = \sqrt{\frac{Y}{\rho}} = \sqrt{\frac{1}{\kappa\rho}}$$

$$f' = f\left(1 \pm \frac{\upsilon}{c}\right) \qquad \text{(VIII.4)}$$

$$f_{\text{D}} = f' - f = \frac{\pm\upsilon}{c} f \qquad f_{\text{D}} = \frac{\pm 2\upsilon}{c} f \qquad \text{(VIII.5)}$$

$$HU = \frac{\mu - \mu_{\text{víz}}}{\mu_{\text{víz}}} 1000 \qquad \text{(VIII.10)}$$

IX. TERÁPIÁS MÓDSZEREK FIZIKAI ALAPJAI

$$a_{\text{küszöb}} = \frac{q}{\tau} + r$$

$$2r = \frac{q}{C} + r$$

$$k_t = \frac{1}{\tau_D}\frac{R_0^6}{R^6} \qquad \text{(X.6)}$$

$$2d\sin\theta = n\cdot\lambda$$

$$\vec{F}_{el} = \vec{E}\cdot q$$

$$\vec{F}_{mágn} = q\cdot\vec{v}\times\vec{B}$$

$$\vec{F}_{cp} = m\cdot\frac{\vec{v}^2}{r}$$

$$\frac{m}{q} = \frac{\vec{E}+\vec{v}\times\vec{B}}{\vec{a}}$$

$$r_{el} = \frac{mv^2}{Eq}$$

$$r_m = \frac{1}{B}\sqrt{\frac{2mU}{q}}$$

$$t = \frac{d}{\sqrt{2U}}\sqrt{\frac{m}{q}}$$

$$L = \sqrt{l(l+1)}\hbar \qquad \text{(X.26)}$$

$$M_N = \gamma_N L = g_N\mu_N\sqrt{l(l+1)} \qquad \text{(X.28)}$$

$$M_e = -g\mu_\beta\sqrt{S(S+1)} \qquad \text{(X.29)}$$

$$\Delta E = hf_0 = g_N\mu_N H_0 \qquad \text{(X.30)}$$

$$\Delta E = \frac{h\omega_0}{2\pi}$$

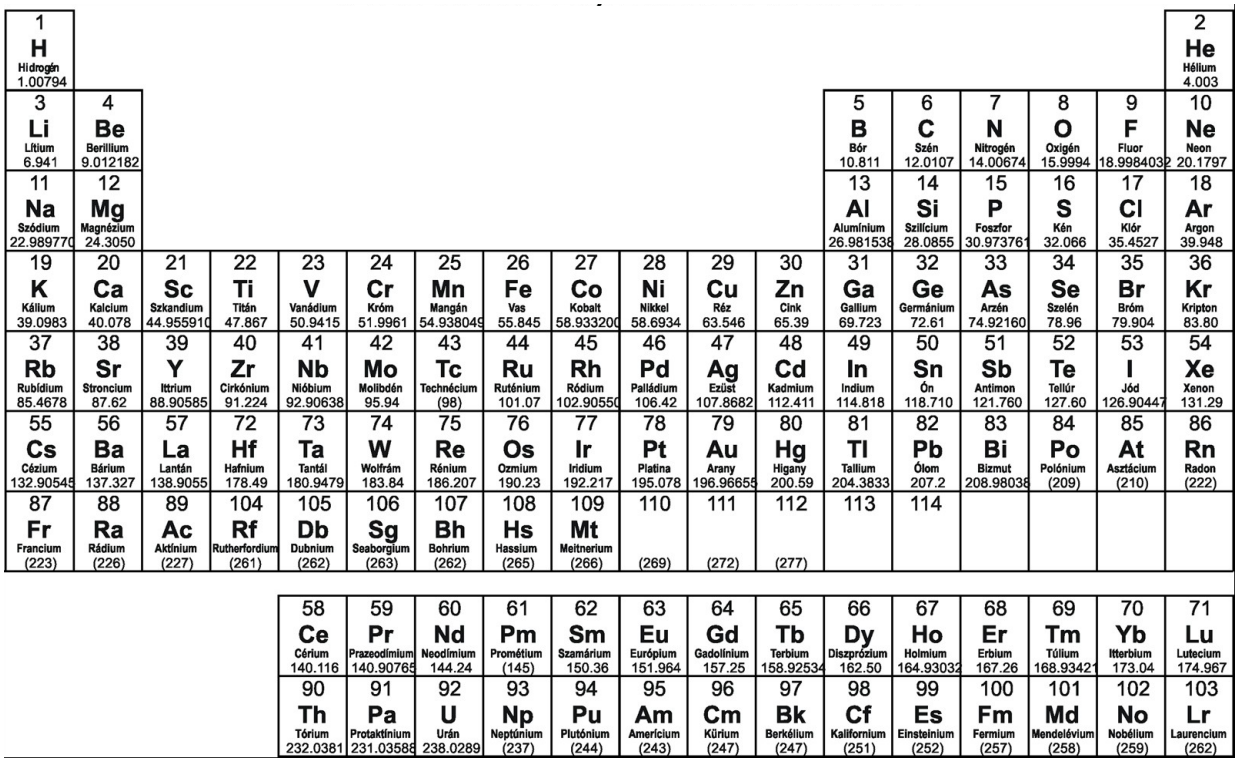
$$\omega_0 = \gamma B_0$$

$$f_{Larmor} = \frac{\gamma}{2\pi}B_0$$

$$\frac{N_\beta}{N_\alpha} = e^{-\frac{\Delta E}{kT}} \qquad \text{(X.31)}$$

egyetemes gázállandó	$R = 8{,}314\ J/(mol \cdot K)$
Avogadro-szám	$N_A = 6 \cdot 10^{23}\ /mol$
Boltzmann-állandó	$k = 1{,}38 \cdot 10^{-23}\ J/K$
Faraday-állandó	$F = 96500\ C/mol$
Planck-állandó	$h = 6{,}626 \cdot 10^{-34}\ J \cdot s$
fénysebesség (vákuumban)	$c = 3 \cdot 10^{8}\ m/s$
elektron töltése (elemi töltés)	$e = 1{,}6 \cdot 10^{-19}\ C$
elektron nyugalmi tömege	$m_e = 9{,}1 \cdot 10^{-31}\ kg$
proton nyugalmi tömege	$m_p = 1{,}673 \cdot 10^{-27}\ kg$
neutron nyugalmi tömege	$m_n = 1{,}675 \cdot 10^{-27}\ kg$
Stefan–Boltzmann-állandó	$\sigma = 5{,}67 \cdot 10^{-8}\ J/(m^2 \cdot K^4 \cdot s)$
Wien-féle eltolódási állandó	$b = 2{,}898 \cdot 10^{-3}\ m \cdot K$
nehézségi gyorsulás (normál érték)	$g = 9{,}81\ m/s^2$
Reynolds-szám (sima falú csövekre)	$Re = 1160$
Röntgenkonstans	$C_{Rtg} = 1{,}1 \cdot 10^{-9}\ V^{-1}$
proton g faktora	$g_p = 5{,}59$
nukleáris magneton	$\mu_N = 5{,}05 \cdot 10^{-27}\ J/T$
Fotoeffektushoz tartozó állandó	$C_{foto} = 6\ cm^2/(g \cdot nm^3)$
Konverziós tényező levegőre	$f_0 = 34\ J/C$
Coulomb-féle arányossági tényező	$k = 9 \cdot 10^9\ Nm^2/C^2$
vákuum dielektromos állandója	$\varepsilon_0 = 8{,}85 \cdot 10^{-12}\ C^2/(Nm^2)$
hallásküszöb (emberi fül, 1kHz)	$10^{-12}\ W/m^2$
képtávolság a redukált szemben	$i = 17\ mm$

AZ ELEMEK PERIÓDUSOS RENDSZERE



SŰRŰSÉG

elemek	ρ (g/cm³)	összetett anyagok	ρ (g/cm³)
alumínium (Al)	2,7	testszövet (lágy)	1,04
réz (Cu)	8,96	vér (átlagos)	1,05
ón (Sn)	5,75	levegő (0°C, 101 kPa)	0,00129
vas (Fe)	7,9	csont (átlagos)	1,7
ezüst (Ag)	10,5	zsírszövet (átlagos)	0,92
higany (Hg)	13,6	izom (átlagos)	1,06
arany (Au)	19,3	víz (4°C)	1,000
ólom (Pb)	11,3	jég (0°C)	0,92
szén (C, grafit)	2,23	etanol	0,8
szén (C, gyémánt)	3,51	cirkónium-dioxid (ZrO_2)	6,0
szén (C, fullerén)	1,65	amalgám (átlagos)	12
titán (Ti)	4,51	Kvarc (SiO_2)	2,65
		PMMA (poli(metil-metakrilát))	1,2

FELÜLETI FESZÜLTSÉG

anyag	σ (mJ/m^2)
víz	73
higany	486
etilalkohol	22

FAJLAGOS HŐKAPACITÁS

anyag	c (kJ/(kg·K))
volfrám (W)	0,132
víz	4,18
jég	2,094
etanol	2,4
izom	3,76
vér	3,9
tömör csont (átlagos)	1,3
zsírszövet	3
testszövet (átlagos)	3,5
oxigén (C_v)	0,65
oxigén (C_p)	0,92

ÁTALAKULÁSI HŐ

anyag	q (kJ/kg)
jég (olvadáshő)	334,4
víz (párolgáshő (100°C, 101 kPa))	2257
víz (párolgáshő (30°C, 101 kPa))	2400

FAJLAGOS VEZETŐKÉPESSÉG

anyag	σ(S/m)
izomszövet	0,8

LINEÁRIS HŐTÁGULÁSI EGYÜTTHATÓ

anyag	α (10^{-6} 1/K)
alumínium	24
acél	12
amalgám	25
jég	51
teflon	200

ABSZOLÚT TÖRÉSMUTATÓ

anyag	n (589 nm, 20°C)
levegő	1
víz	1,333
cédrusolaj	1,505
gyémánt	2,417
üveg	1,5
flintüveg	1,6
prizma (refraktométerben)	1,739

FAJLAGOS FORGATÓKÉPESSÉG

anyag	$[\alpha]_D^{20}\left(\frac{^\circ \cdot \mathrm{cm}^3}{\mathrm{g} \cdot \mathrm{dm}}\right)$
D-glükóz (dextróz)	+52,7
D-szacharóz	+66,5
D-galaktóz	+80,2
D-laktóz	+55,3
D-fruktóz (levulóz)	−93,8
D-maltóz	+137,5

HANGSEBESSÉG

anyag	c (m/s)
levegő	330
hélium	970
víz	1500
testszövet (lágy)	1600
csont	3600

TÖMEGGYENGÍTÉSI EGYÜTTHATÓ

anyag	μ_m (cm^2/g)
ólom (^{24}Na, γ sugárzás)	0,05

VISZKOZITÁS

anyag	η (mPa·s)
víz (20°C)	1
víz (25°C)	0,85
vér (37°C, aortában)	4,5
levegő	0,02
éter	0,23
higany	1,55
glicerin	1500

TESTSZÖVETI SÚLYTÉNYEZŐK (W_T)

szövetek	w_T
vörös csontvelő	0,12
vastagbél	0,12
tüdő	0,12
gyomor	0,12
emlő	0,12
gonádok	0,08
húgyhólyag	0,04
máj	0,04
nyelőcső	0,04
pajzsmirigy	0,04
bőr	0,01
csontfelszín	0,01
nyálmirigyek	0,01
agy	0,01
egyéb	0,12

SUGÁRZÁSI SÚLYTÉNYEZŐK (W_R)

sugárzás és energiatartomány	w_R
Fotonok	1
Elektronok	1
Neutronok	5-20
Protonok, E_p > 2 MeV	5
α részecskék, nehéz magok	20

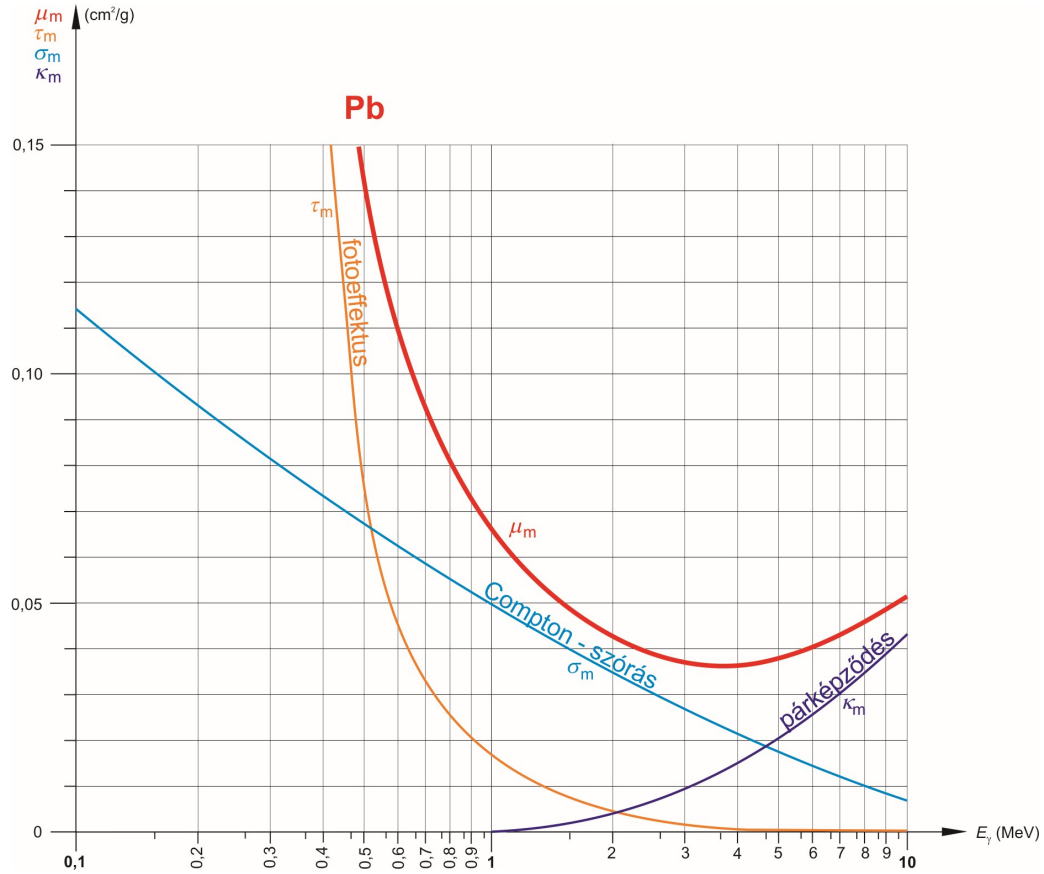
OZMOTIKUS EGYÜTTHATÓ

anyag	φ
NaCl	0,92
$CaCl_2$	0,85
glükóz	1,00
KCl	0,92
Na-laktát	0,98

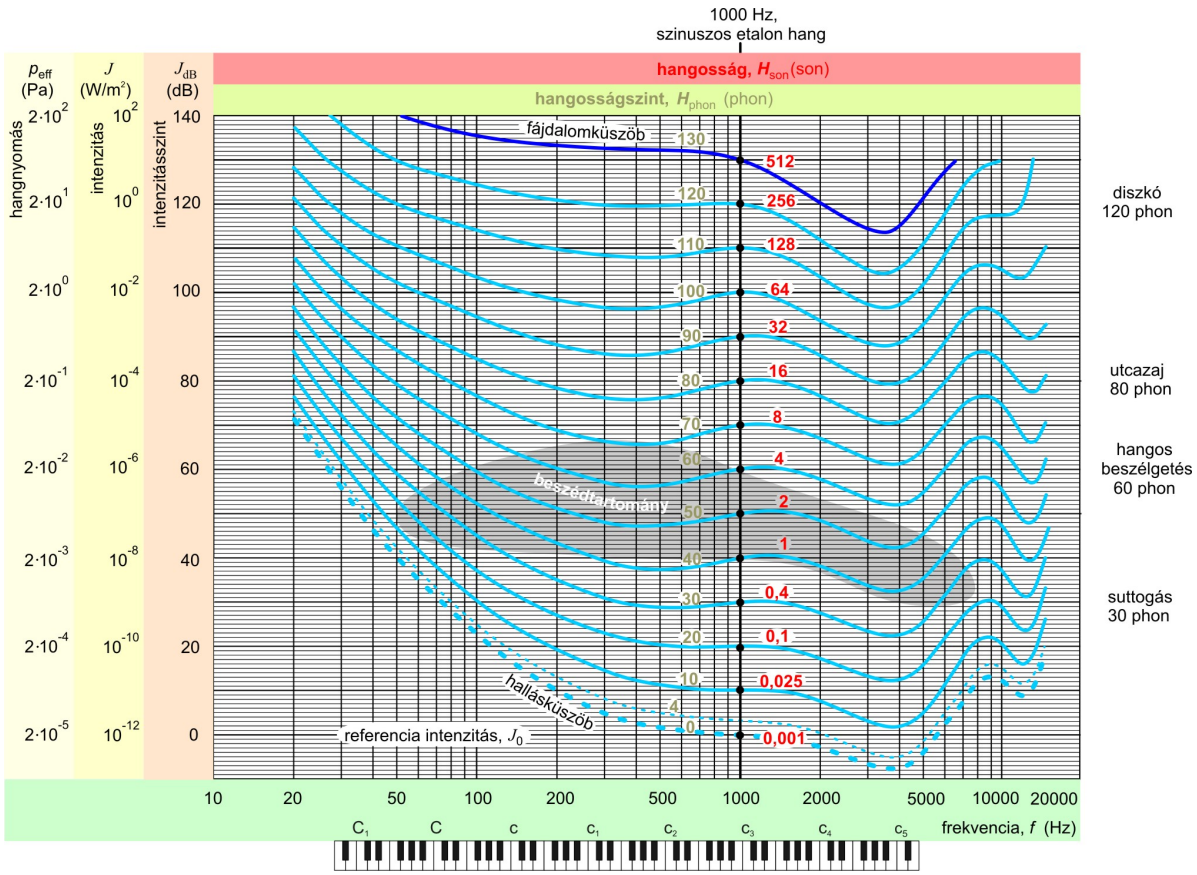
A FONTOSABB RADIOAKTÍV IZOTÓPOK JELLEMZŐ ADATAI

kémiai elem és rendszáma		**izotóp**	**felezési idő**	**bomlás módja**	**maximális részecske energiák** (MeV)	**γ-energia** (MeV)	***K*γ dózis-konstans** $\left(\frac{\mu Gy_{lev} \cdot m^2}{GBq \cdot h}\right)$
hidrogén	1	^{3}H	12,33 év	β^-	0,0186	–	
szén	6	^{11}C ^{14}C	20,4 perc 5760 év	β^+ β^-	0,96 0,155	–	
nitrogén	7	^{13}N	10 perc	β^+	1,19	–	
oxigén	8	^{15}O	2 perc	β^+	1,73	–	
fluor	9	^{18}F	109,8 perc	β^+	0,633	–	
nátrium	11	^{24}Na	15,02 óra	β^-, γ	1,392	2,754 1,369	444
foszfor	15	^{32}P	14,28 nap	β^-	1,710	–	
kén	16	^{35}S	87,2 nap	β^-	0,167	–	
kálium	19	^{40}K ^{42}K	$1{,}28 \cdot 10^9$ év 12,36 óra	β^-, K (10%) β^-, γ	1,31 3,52 (75%) 1,99 (25%)	1,46 K után 1,525	
kalcium	20	^{45}Ca	163 nap	β^-	0,257	–	
króm	24	^{51}Cr	27,7 nap	K, e^-, γ	0,315 (e^-)	0,320	
vas	26	^{52}Fe ^{59}Fe	8,2 óra 44,6 nap	β^+, γ β^-, γ	0,8 1,566	0,5 1,30 1,10	160
kobalt	27	^{60}Co	5,272 év	β^-, γ	0,318	1,33 1,17	305
réz	29	^{64}Cu	12,74 óra	β^- (39%) β^+ (19%) K (42%) γ (1%)	0,575 0,656	 1,34	
kripton	36	^{85}Kr	10,73 év	β^-, γ	0,687	0,514	
rubídium	37	^{81}Rb ^{86}Rb	4,7 óra 18,65 nap	β^+, γ β^-, γ	0,99 1,78	1,93 0,95 1,078	
stroncium	38	^{90}Sr	29 év	β^-	0,546	–	
ittrium	39	^{90}Y	64 óra	β^-, γ(0,4%)	2,29	1,761	
technécium	43	$^{99}Tc^m$	6,02 óra	γ	–	0,140	
indium	49	$^{113}In^m$	1,658 óra	γ	–	0,391	
jód	53	^{123}I ^{125}I ^{131}I	13,3 óra 59,7 nap 8,04 nap	K, γ K, γ β^-, γ	– – 0,606 0,25 0,81	0,16 0,0355 0,364 0,080 0,723	54
xenon	54	^{133}Xe	5,29 nap	β^-, γ	0,346	0,081	
cézium	55	^{137}Cs	30,1 év	β^-, γ	0,512 (92,6%) 1,173 (7,4%)	0,661	80
arany	79	^{198}Au	2,695 nap	β^-, γ	0,961	0,411	
higany	80	^{203}Hg	46,6 nap	β^-, γ	0,212	0,279	
radon	86	^{222}Rn	3,824 nap	α	5,489	–	
rádium	88	^{226}Ra	1600 év	α, γ(6%)	4,784 4,598	0,186 0,260 0,609	
urán	92	^{238}U	$4{,}47 \cdot 10^9$ év	α, γ	4,2	0,048	

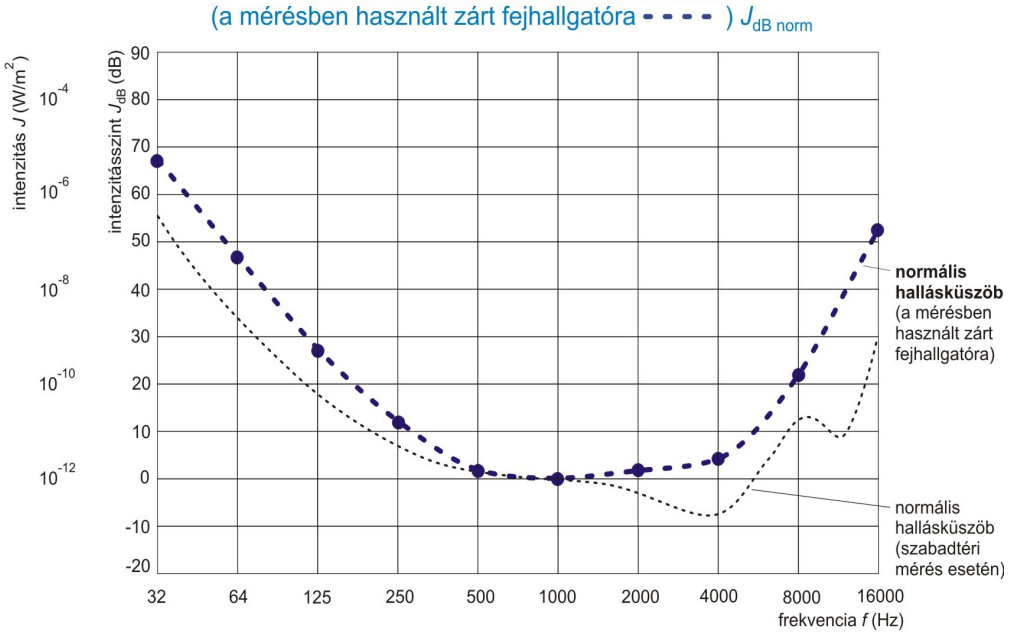
AZ ÓLOM TÖMEGGYENGÍTÉSI EGYÜTTHATÓJÁNAK ÖSSZETEVŐI

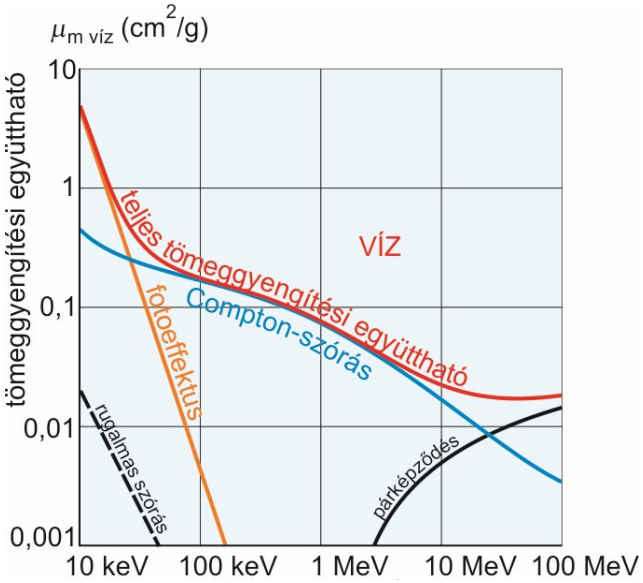


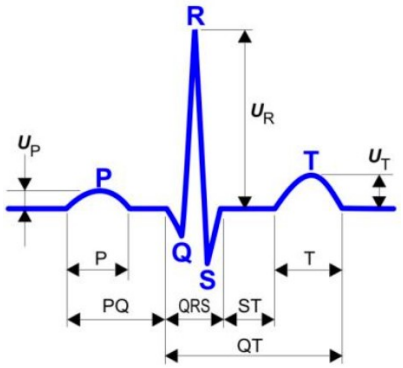
EGYENLŐ HANGOSSÁGSZINTŰ GÖRBÉK



Megújított gyakorlatokhoz kapcsolódó képletek, adatok







I.	II.	III.	IV.	V.
Szabályozott üreg	Érzékelt üreg	Érzékelésre adott válasz	Ritmus moduláció	Többhelyes ritmus-szabályozás
0 = Nincs	0 = Nincs	0 = Nincs	0 = Nincs	0 = Nincs
A = Pitvar	A = Pitvar	I = Nincs inger	R = Ritmus moduláció	A = Pitvar
V = Kamra	V = Kamra	T = Inger		V = Kamra
D = Duális (A+V)	D = Duális (A+V)	D = Duális (I+T)		D = Duális (A+V)

STATISZTIKA

$$\bar{x} = \frac{x_1 + x_2 + \ldots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$\bar{x} = \frac{\sum_{i=1}^{n} n_i x_i}{n}$$

$$s_{x,n-1} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{Q_{xx}}{n-1}}$$

$$s_{\bar{x}} = \frac{s_x}{\sqrt{n}}$$

$$z = \frac{x - \mu}{\sigma}$$

$$\bar{x} \pm t_{\%} s_{\bar{x}}$$

$$\bar{x} \pm t_{\%} s_x$$

$$t_{[n-1]} = \frac{\bar{x}}{s_{\bar{x}}}$$

$$t_{[n-1]} = \frac{\bar{x} - \mu_0}{s_{\bar{x}}}$$

$$t_{[n_1+n_2-2]} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{Q_1 + Q_2}{n_1 + n_2 - 2}}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$Q_1 = \sum_{i=1}^{n_1}(x_{1i} - \bar{x}_1)^2 \quad \text{és} \quad Q_2 = \sum_{i=1}^{n_2}(x_{2i} - \bar{x}_2)^2$$

$$F_{[n_1-1;n_2-1]} = \frac{s^2_{\text{nagyobb}}}{s^2_{\text{kisebb}}}$$

$$s_g^2 = \frac{\sum_{j=1}^{h} n_j \left(\bar{x}_j - \bar{\bar{x}}\right)^2}{h-1} = \frac{Q_g}{h-1}$$

$$s_i^2 = \frac{\sum_{j=1}^{h} Q_j}{N-h} = \frac{\sum_{j=1}^{h}\sum_{i=1}^{n_j}(x_{ij} - \bar{x}_j)^2}{N-h} = \frac{Q_i}{N-h}$$

$$t_{[n-1]} = \frac{\bar{R}}{\frac{s}{\sqrt{n}}}$$

$$Q(a,b) = \sum_{i=1}^{n}[y_i - (ax_i + b)]^2$$

$$a^* = \frac{Q_{xy}}{Q_{xx}} = \frac{s_{xy}^2}{s_x^2}$$

$$Q_{xy} = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

$$Q_{xx} = \sum_{i=1}^{n} (x_i - \bar{x})^2$$

$$s_{xy}^2 = \frac{Q_{xy}}{n-1}$$

$$b^* = \bar{y} - a^* \bar{x}$$

$$r = \frac{Q_{xy}}{\sqrt{Q_{xx} Q_{yy}}} = \frac{s_{xy}^2}{s_x s_y}$$

$$t_{[n-2]} = r \sqrt{\frac{n-2}{1-r^2}}$$

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i}$$

$$\chi_{[1]}^2 = \frac{n(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

$$\log(a \cdot b) = \log a + \log b$$

$$\log\left(\frac{a}{b}\right) = \log a - \log b$$

$$\log a^b = b \cdot \log a$$

$$H = p \log_2\left(\frac{1}{p}\right)$$

$$I = \log_2\left(\frac{1}{p}\right)$$

$$p(A) = \frac{k}{n}$$

$$p(AvagyB) = p(A) + p(B) - p(AésB)$$

$$p(A|B) = \frac{p(AésB)}{p(B)}$$

$$odds = \frac{p}{1-p} = \frac{p}{q}$$

$$p = \frac{odds}{1+odds}$$

logit (A)=ln(odds(A))

logit(nem A)=-logit(A)

odds(A)=$e^{\text{logit(A)}}$

$$odds(\text{nem A}) = \frac{1}{odds(A)}$$

$$\text{RR} = \frac{p(B_+|R_+)}{p(B_+|R_-)} = \frac{\frac{a}{a+b}}{\frac{c}{c+d}} = \frac{a(c+d)}{c(a+b)}$$

$$\text{OR} = \frac{\frac{p(B_+|R_+)}{p(B_-|\text{R}_+)}}{\frac{p(B_+|R_-)}{p(B_-|R_-)}} = \frac{ad}{bc}$$

$$\mu = E(\xi) = \sum_i x_i p_i$$

$$\sigma^2 = D^2(\xi) = E[(\xi - E(\xi))^2] = \sum_i \left((x_i - \mu)^2 \cdot p(x_i)\right)$$

$$\eta = \xi + k \rightarrow E(\eta) = E(\xi) + k\,; Var(\eta) = Var(\xi)$$

$$\eta = \xi \cdot k \rightarrow E(\eta) = E(\xi) \cdot k\,; Var(\eta) = Var(\xi) \cdot k^2$$

$$\eta = \xi_{norm} \cdot \omega_{norm} \rightarrow E(\eta) = E(\xi) \cdot E(\omega)$$

$$\eta = \xi + \omega \rightarrow E(\eta) = E(\xi) + E(\omega); Var(\eta) = Var(\xi) + Var(\omega)$$

, ha függetlenek

$$\eta_{E=0;Var=1} = (\xi - E(\xi)) * \frac{1}{\sqrt{Var(\xi)}} = \frac{(\xi - E(\xi))}{\sqrt{Var(\xi)}}$$

$$p(x_i) = \frac{1}{n} \quad \mu = \frac{n+1}{2} \quad \sigma^2 = \frac{n^2-1}{12}$$

$$f(x) = \begin{cases} \frac{1}{b-a}, & \text{ha } a \le x \le b \\ 0, & \text{egyébként} \end{cases}$$

$$\mu = \frac{a+b}{2} \quad \sigma^2 = \frac{(b-a)^2}{12}$$

$$p_k = \binom{n}{k} p^k (1-p)^{n-k}$$

$$\mu = np \qquad \sigma^2 = np(1-p)$$

$$p_k = \frac{\lambda^k}{k!} e^{-\lambda} \qquad \mu = \lambda \qquad \sigma^2 = \lambda$$

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} = N(\mu, \sigma)$$

$$\sum \frac{(x_i)^k}{n}$$

$$\sum \frac{(x_i - \mu)^k}{n}$$

$$w = \frac{beteg}{összes} = \frac{ÁN + VP}{VN + ÁP + ÁN + VP}$$

$$se = \frac{VP}{beteg} = \frac{VP}{ÁN + VP}$$

$$sp = \frac{VN}{egészséges} = \frac{VN}{VN + ÁP}$$

$$1 - se = \frac{ÁN}{beteg} = \frac{ÁN}{ÁN + VP}$$

$$1 - sp = \frac{ÁP}{egészséges} = \frac{ÁP}{VN + ÁP}$$

$$PPV = \frac{VP}{összes\ pozitív} = \frac{VP}{ÁP + VP}$$

$$NPV = \frac{VN}{összes\ negatív} = \frac{VN}{ÁN + VN}$$

$$1 - PPV = \frac{ÁP}{összes\ pozitív} = \frac{ÁP}{ÁP + VP}$$

$$1 - NPV = \frac{ÁN}{összes\ negatív} = \frac{ÁN}{ÁN + VN}$$

$$de = \frac{VP + VN}{összes} = \frac{VP + VN}{VP + ÁN + VN + ÁP}$$

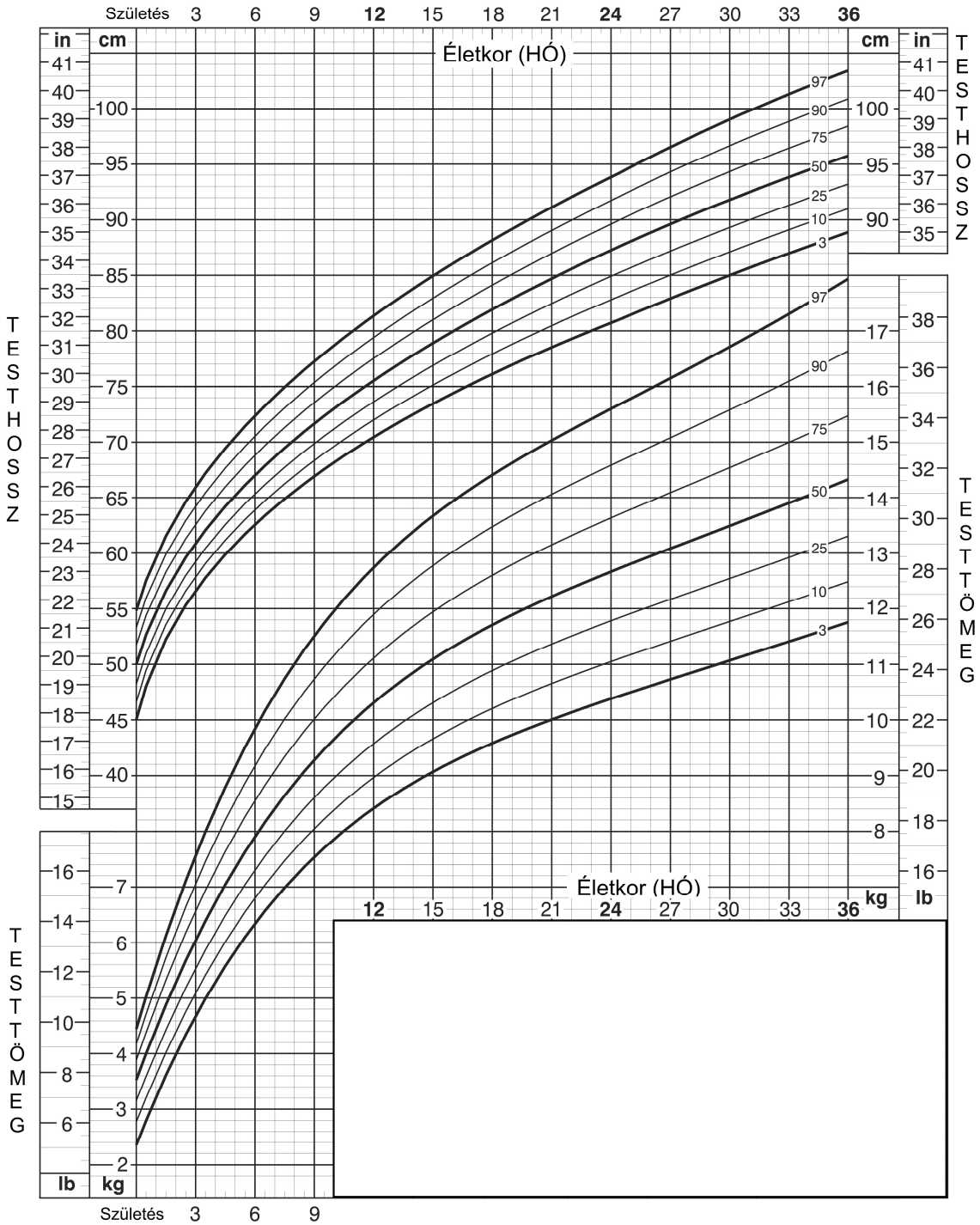
T-ELOSZLÁS

szabadságfok	*p* (valószínűség, kétszélű)							
	0,5	0,2	0,1	0,05	0,02	0,01	0,002	0,001
1	1,00	3,08	6,31	12,7	31,8	63,7	318,3	636,6
2	0,82	1,89	2,92	4,30	6,96	9,92	22,3	31,6
3	0,76	1,64	2,35	3,18	4,54	5,84	10,2	12,9
4	0,74	1,53	2,13	2,78	3,75	4,60	7,17	8,61
5	0,73	1,48	2,02	2,57	3,37	4,03	5,89	6,87
6	0,72	1,44	1,94	2,45	3,14	3,71	5,21	5,96
7	0,71	1,41	1,89	2,36	3,00	3,50	4,79	5,41
8	0,71	1,40	1,86	2,31	2,90	3,36	4,50	5,04
9	0,70	1,38	1,83	2,26	2,82	3,25	4,30	4,78
10	0,70	1,37	1,81	2,23	2,76	3,17	4,14	4,59
11	0,70	1,36	1,80	2,20	2,72	3,11	4,02	4,44
12	0,70	1,36	1,78	2,18	2,68	3,05	3,93	4,32
13	0,69	1,35	1,77	2,16	2,65	3,01	3,85	4,22
14	0,69	1,35	1,76	2,14	2,62	2,98	3,79	4,14
15	0,69	1,34	1,75	2,13	2,60	2,95	3,73	4,07
16	0,69	1,34	1,75	2,12	2,58	2,92	3,69	4,01
17	0,69	1,33	1,74	2,11	2,57	2,90	3,65	3,97
18	0,69	1,33	1,73	2,10	2,55	2,88	3,61	3,92
19	0,69	1,33	1,73	2,09	2,54	2,86	3,58	3,88
20	0,69	1,33	1,72	2,09	2,53	2,85	3,55	3,85
21	0,69	1,32	1,72	2,08	2,52	2,83	3,53	3,82
22	0,69	1,32	1,72	2,07	2,51	2,82	3,51	3,79
23	0,69	1,32	1,71	2,07	2,50	2,81	3,49	3,77
24	0,68	1,32	1,71	2,06	2,49	2,80	3,47	3,75
25	0,68	1,32	1,71	2,06	2,49	2,79	3,45	3,73
30	0,68	1,31	1,70	2,04	2,46	2,75	3,39	3,65
40	0,68	1,30	1,68	2,02	2,42	2,70	3,31	3,55
60	0,68	1,30	1,67	2,00	2,39	2,66	3,23	3,46
120	0,68	1,30	1,66	1,98	2,36	2,62	3,16	3,37
∞	0,68	1,29	1,64	1,96	2,33	2,58	3,09	3,29

χ^2 (KHI-NÉGYZET)-ELOSZLÁS

szabadságfok	*p* (valószínűség, jobbszélű)						
	0,99	0,975	0,95	0,05	0,025	0,01	0,001
1	0,0000157	0,0000982	0,000393	3,84	5,02	6,63	10,83

TESTHOSSZ- ÉS TESTTÖMEG – ÉLETKOR PERCENTILISEK; FIÚK



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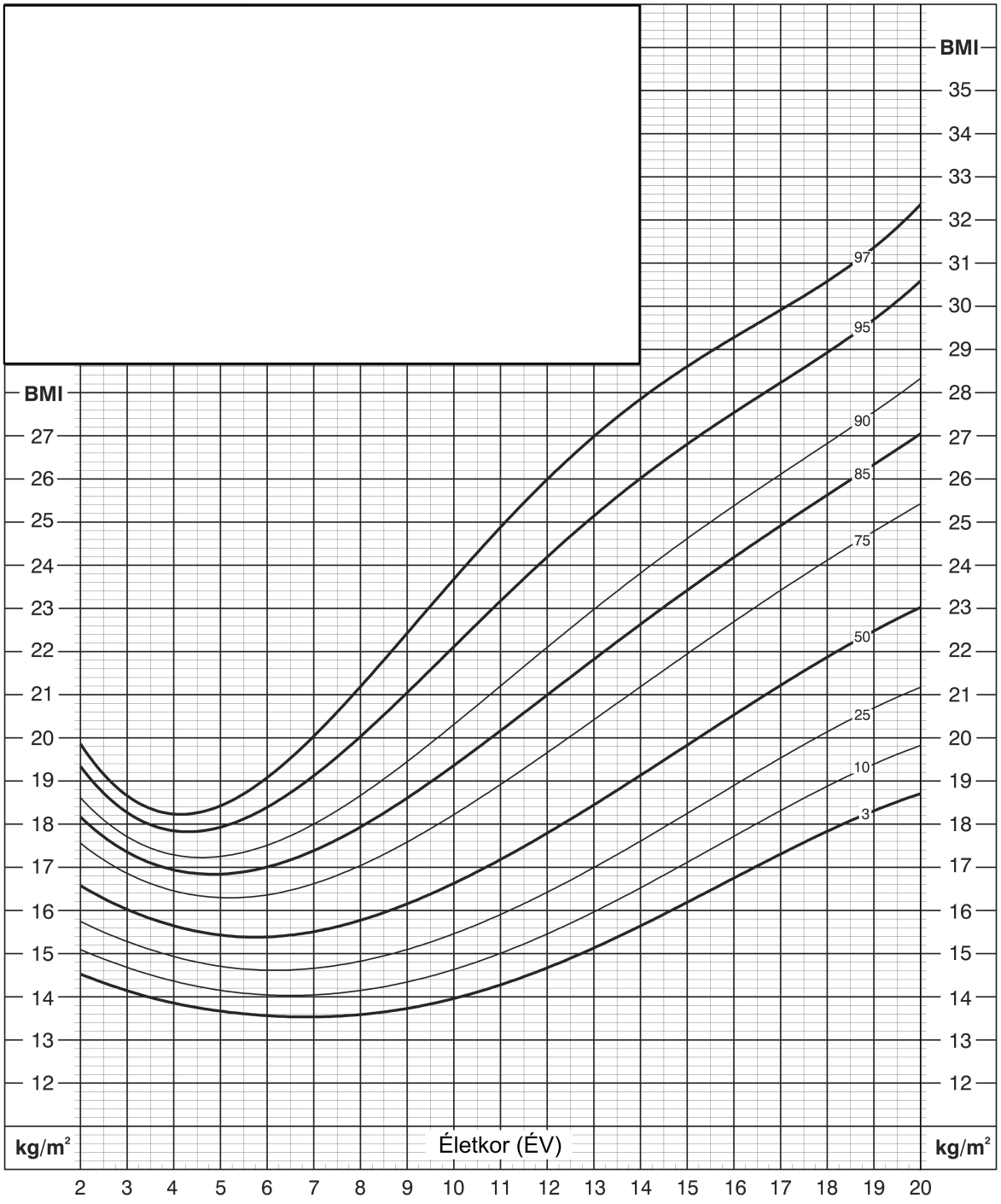
BMI – ÉLETKOR PERCENTILISEK; FIÚK



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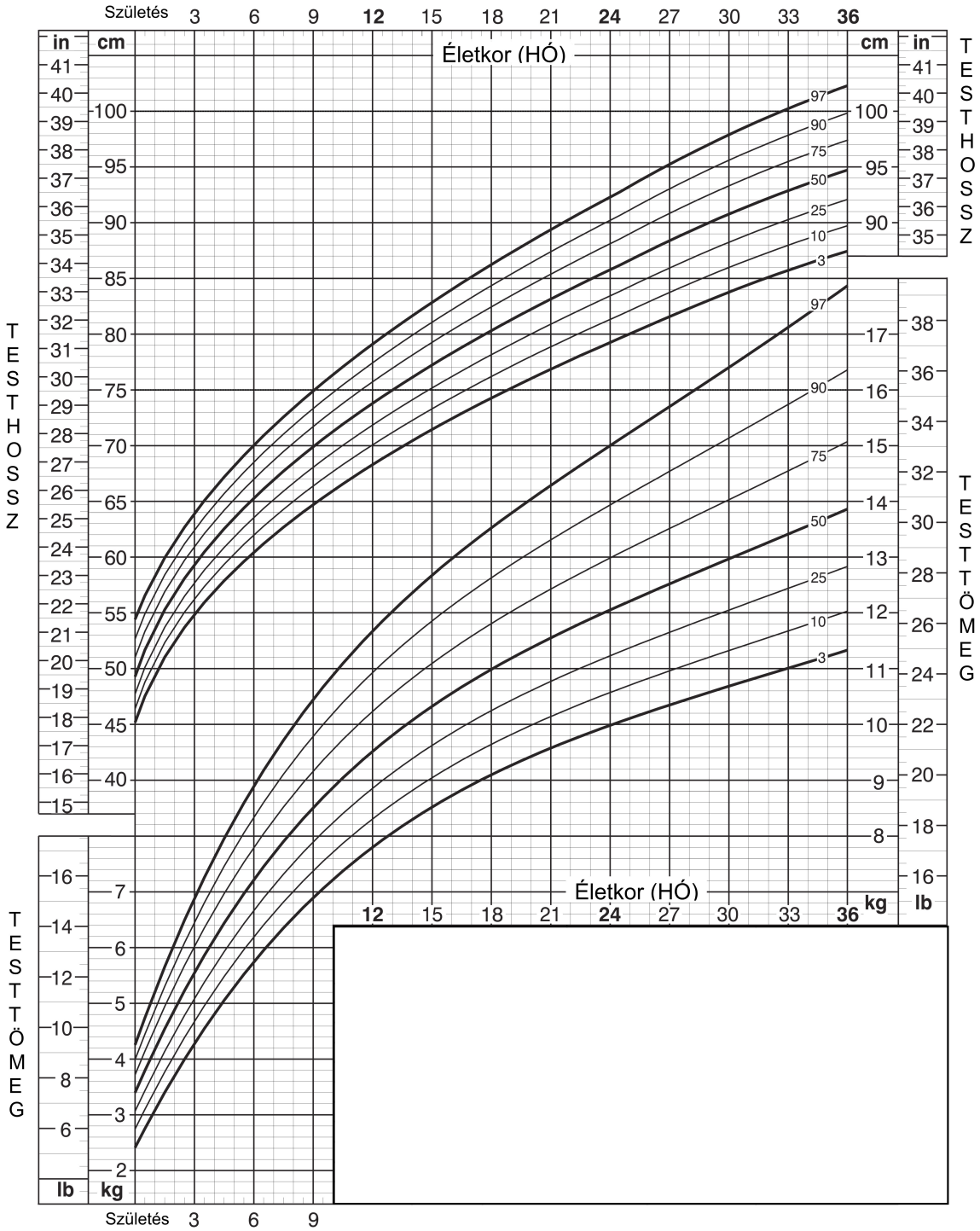
TESTHOSSZ- ÉS TESTTÖMEG – ÉLETKOR PERCENTILISEK; LÁNYOK



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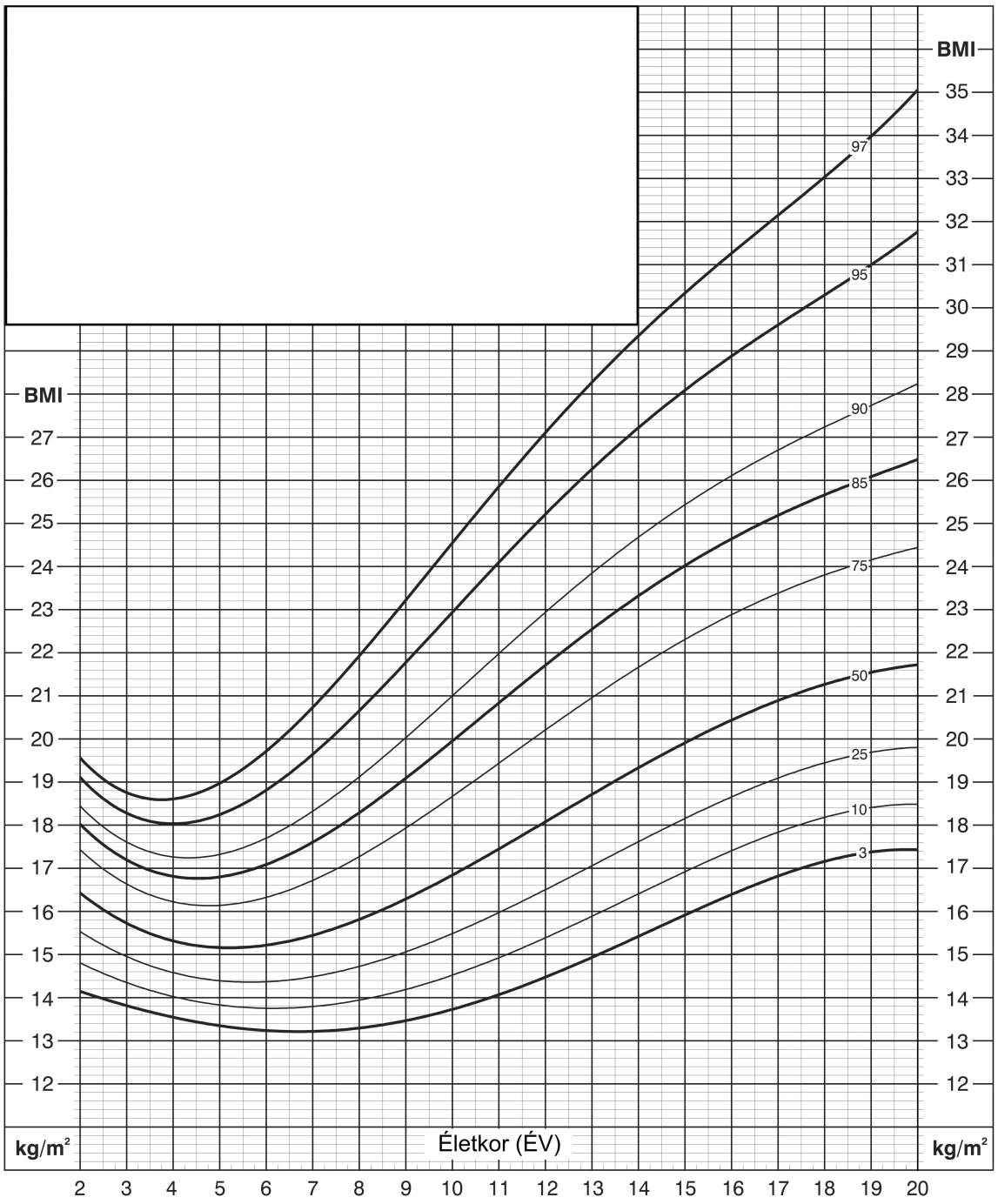

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