I. Az „élő” anyag legfontosabb szerkezeti tulajdonságai és szerepük a biológiai funkciókban

$$hf = E_{\mathrm{m}} - E_{\mathrm{i}} \qquad \text{(I.1)}$$

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

$$\Delta M = [Z \cdot m_{\mathrm{p}} + (A - Z) \cdot m_{\mathrm{n}}] - M(A, Z)$$

$$E = mc^2 \qquad \text{(I.19)}$$

$$n_{\mathrm{i}} = n_0 \mathrm{e}^{-\frac{\varepsilon_{\mathrm{i}} - \varepsilon_0}{kT}} \qquad R = N_{\mathrm{A}} k \qquad \text{(I.25)}$$

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

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

II. Sugárzások és kölcsönhatásuk az „élő” anyaggal

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

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

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

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

$$J = J_0 \mathrm{e}^{-\mu x} \qquad \mu = \frac{1}{\delta} \qquad \text{(II.11)}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\lambda T = \ln 2 \qquad \frac{1}{T_{\text{eff}}} = \frac{1}{T_{\text{fiz}}} + \frac{1}{T_{\text{biol}}} \tag{II.98}$$

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

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

$$\mu = \tau + \sigma + \kappa \qquad s = \frac{\Delta E}{\Delta x} \qquad s = s_m \rho \tag{II.102}$$

$$hf = 2m_{\mathrm{e}}c^2 + 2E_{\text{mozgási}} \tag{II.103}$$

$$D = \frac{\Delta E}{\Delta m} \qquad D_{\text{levegő}} = K_\gamma \frac{At}{r^2} \tag{II.105}$$

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

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

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

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

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

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

III. Transzportjelenségek élő rendszerekben

$$I_V = \frac{\Delta V}{\Delta t} = \frac{\Delta \nu}{c \Delta t} \tag{III.1}$$

$$I_V = A\overline{\upsilon} = \text{állandó} \tag{III.4}$$

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

$$F = \eta A \frac{\Delta \upsilon}{\Delta h} \tag{III.6}$$

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

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

$$\upsilon_{\text{krit}} = \mathrm{Re} \frac{\eta}{\rho r} \tag{III.17}$$

$$F = 6\pi\eta r \upsilon \tag{III.18}$$

$$u = \frac{\upsilon}{F} \tag{III.19}$$

$$l = \overline{\upsilon}\tau \tag{III.25}$$

$$\upsilon_{\text{drift}} = \frac{F}{m}\tau \tag{III.26}$$

$$I_N = \frac{\Delta N}{\Delta t} \tag{III.28}$$

$$I_\nu = \frac{\Delta \nu}{\Delta t} \tag{III.29}$$

$$J_\nu = \frac{\Delta I_\nu}{\Delta A} \tag{III.30}$$

$$J_\nu = -D \frac{\Delta c}{\Delta x} \tag{III.31}$$

$$D = \frac{1}{3} \upsilon l = ukT \tag{III.33}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IV. Az érzékszervek biofizikája

$$\Delta\Psi \sim \frac{\Delta\Phi}{\Phi} \qquad \text{(IV.5)}$$

$$\Psi \sim \log\frac{\Phi}{\Phi_0} \qquad \text{(IV.6)}$$

$$\frac{\Delta\Psi}{\Psi} \sim \frac{\Delta\Phi}{\Phi} \qquad \text{(IV.7)}$$

$$\Psi \sim \left(\frac{\Phi}{\Phi_0}\right)^n \qquad \text{(IV.8)}$$

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

$$n = 10\lg\left(\frac{J_1}{J_2}\right) \qquad \text{(IV.25)}$$

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

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

$$H_{\text{phon}} = 10\lg\left(\frac{J}{J_0}\right) \qquad \text{(IV.29)}$$

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

VI. A molekuláris és sejtdiagnosztika fizikai módszerei

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

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

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

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

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

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

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

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

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

VII. Elektromos jelek és módszerek az orvosi gyakorlatban

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

$$X_C = \frac{1}{2\pi fC} \qquad \text{(VII.4)}$$

$$U_{\text{ki}} = U_{\text{be}}\frac{R}{\sqrt{R^2 + X_C^2}} \qquad f_{\text{h}} = \frac{1}{2\pi RC} \qquad \text{(VII.5)}$$

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

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

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

$$n = 10\lg K_P = 20\lg K_U \qquad \text{(VII.10)}$$

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

$$K_{U_{\text{v}}} = \frac{K_U}{1 - K_{\text{v}_U}K_U} \qquad K_{\text{v}_U} = \frac{U_{\text{vissza}}}{U_{\text{ki}}} \qquad \text{(VII.14)}$$

VIII. Képalkotó módszerek

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

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

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

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

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

IX. Terápiás módszerek fizikai alapjai

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

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

Statisztika és informatika

$$g(x) = \frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(x-\mu)^2}{2\sigma^2}} \qquad (1)$$

$$P(n,x) = \frac{n!}{x!(n-x)!}p^x(1-p)^{n-x}$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad (2)$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{Q_x}{n-1}} \qquad (4)$$

$$Q_x \equiv Q_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n} \qquad (6)$$

$$Q_{xy} = \sum_{i=1}^{n} x_i y_i - \frac{\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)}{n}$$

$$s_{\bar{x}} = \frac{s}{\sqrt{n}} \qquad (8)$$

$$Q_h(a,b) = \sum_{i=1}^{n}[y_i - (ax_i + b)]^2 \qquad (16)$$

$$a^* = \frac{Q_{xy}}{Q_{xx}} \qquad (17)$$

$$b^* = \bar{y} - a^*\bar{x} \qquad (18)$$

$$r = \frac{Q_{xy}}{\sqrt{Q_x Q_y}} \qquad (19)$$

$$t_{[n-1]} = \frac{\bar{x} - \mu_0}{s_{\bar{x}}} \qquad (20)$$

$$t_{[n-1]} = \frac{\bar{R} - 0}{s/\sqrt{n}}$$

$$t_{[n_1+n_2-2]} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{Q_1 + Q_2}{n_1 + n_2 - 2}}}\sqrt{\frac{n_1 n_2}{n_1 + n_2}} \qquad (21)$$

$$t_{[n-2]} = r\sqrt{\frac{n-2}{1-r^2}} \qquad (22)$$

$$F = \frac{s^2_\mathrm{nagyobb}}{s^2_\mathrm{kisebb}}$$

$$z = \frac{|x - np| - 1/2}{\sqrt{np(1-p)}}$$

$$\chi^2_{[1]} = \frac{n(ad - bc)^2}{(a+b)(c+d)(a+c)(b+d)} \qquad (23)$$

$$\chi^2 = \sum\left[\frac{(O-E)^2}{E}\right] \tag{24}$$

$$z = \frac{T_1 - n_1(n_1+n_2+1)/2}{\sqrt{n_1 n_2 (n_1+n_2+1)/12}}$$

$$SS_A = \sum_j n_j \left(\bar{x}_j - \bar{x}\right)^2$$

$$MS_A = \frac{SS_A}{j-1}$$

$$SS_E = SS_T - SS_A$$

$$SS_T = \sum_{i,j}\left(x_{i,j} - \bar{x}\right)^2$$

$$MS_E = \frac{SS_E}{N-j}$$

$$F = \frac{MS_A}{MS_E}$$

$$H = \frac{12}{N(N+1)}\sum_i \frac{R_i^2}{n_i} - 3(N+1)$$

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n(n^2-1)} \tag{25}$$

$$RR = \frac{a/(a+b)}{c/(c+d)} = \frac{a(c+d)}{c(a+b)} \tag{26}$$

$$SE(\ln RR) = \sqrt{\frac{1-a/(a+b)}{a} + \frac{1-c/(c+d)}{c}} \tag{27}$$

$$OR = \frac{a/b}{c/d} = \frac{ad}{bc} \tag{28}$$

$$SE(\ln OR) = \sqrt{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}} \tag{29}$$

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

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

$$PPV = \frac{\mathrm{VP}}{\mathrm{VP}+\mathrm{ÁP}}$$

$$NPV = \frac{\mathrm{VN}}{\mathrm{VN}+\mathrm{ÁN}}$$

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

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

$$I = \sum_{k=1}^{m} n_k I_k = -\sum_{k=1}^{m}\left[n_k \cdot \log_2\left(p_k\right)\right]$$

$$H = \bar{I} = -\sum_{k=1}^{m}\left[p_k \cdot \log_2\left(p_k\right)\right]$$

Gyakorlatok

MIKROSZKÓP

$$D = \frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \qquad (2)(\text{II.23})$$

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

SPECIÁLIS MIKROSZKÓPOK

$$\Delta s = d \sin \alpha_{\text{k}} = \text{k}\lambda \qquad (1)(\text{VI.24})$$

$$\delta = 0{,}61\frac{\lambda}{n \sin \omega} \qquad (3)(\text{VI.28})$$

REFRAKTOMÉTER

$$\frac{1}{\sin \beta_{\text{h}}} = \frac{n_2}{n_1} = n_{21} \qquad (5)$$

$$n = n_0 + Kc \qquad (7)$$

FÉNYEMISSZIÓ

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

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

FÉNYABSZORPCIÓ

$$T = \frac{J}{J_0}(100\%) \qquad (2)$$

$$A = \lg\left(\frac{J_0}{J}\right) = \varepsilon(\lambda) c x \qquad (7)(\text{VI.34})$$

A SZEM OPTIKÁJA

$$D = \frac{n}{t} + \frac{n'}{k} \qquad (1)(\text{II.18})$$

$$\Delta D = D_{\text{p}} - D_{\text{r}} = \frac{1}{t_{\text{p}}} - \frac{1}{t_{\text{r}}} \qquad (4)$$

$$\text{látásélesség (visus)} = \frac{1(')}{\alpha(')}100\% \qquad (6)$$

$$\alpha(') \approx \frac{a}{x}(\text{rad})\frac{360(^\circ)}{2\pi(\text{rad})}60\left(\frac{'}{^\circ}\right) \qquad (7)$$

$$a' = \frac{17a}{x}(\text{mm}) \qquad (8)$$

$$\text{receptorsűrűség} \approx \frac{1}{(a')^2}\left(\frac{1}{\text{mm}^2}\right) \qquad (9)$$

$$d'_1 = 17\frac{d}{x_1}(\text{mm}) \qquad d'_2 = 17\frac{d}{x_2}(\text{mm}) \qquad (11)$$

NUKLEÁRIS MÉRÉSTECHNIKA

$$N_{\text{j}} = N_{\text{j+z}} - N_{\text{z}} \qquad (2)$$

GAMMA ABSZORPCIÓ

$$\frac{J}{J_0} = \frac{1}{2} = e^{-\mu D} \qquad (2)$$

$$x_{1/10} = 3{,}33D \qquad (5)$$

$$\mu = \frac{\ln 2}{D} \qquad (\text{II.13})(3)$$

$$\mu = \mu_m \rho \qquad D_m = \rho D \qquad (\text{II.85})$$

$$\mu_m = \tau_m + \sigma_m + \kappa_m \qquad (10)$$

GAMMA ENERGIA

$$\frac{\varepsilon_1}{\varepsilon_2} = \frac{U_1}{U_2} \qquad (1)$$

IZOTÓPDIAGNOSZTIKA

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

RÖNTGEN – CT

$$D_i = \lg\frac{J_{\text{i}_0}}{J_{\text{i}}} = \lg \text{e} \cdot \sum_{\text{j=1}}^{\text{n}} \mu_{\text{ij}} \Delta x \qquad (6)$$

DOZIMETRIA

$$D = \frac{\Delta E}{\Delta m} \qquad (1\,\text{rad} = 0{,}01\,\text{J/kg}) \qquad (1)$$

$$X = \frac{\Delta q}{\Delta m} \qquad (1\,\text{R} = 2{,}6 \cdot 10^{-4}\,\text{C/kg}) \qquad (2)$$

$$D_{\text{levegő}} = f_0 X \qquad (3)(\text{II}.107)$$

$$D_{\text{levegő}} = K_\gamma \frac{At}{r^2} \qquad (8)$$

$$U = \frac{Q}{C} \sim X \qquad (10)$$

$$U = IR = \frac{Q}{t} R \sim \frac{X}{t} \qquad (11)$$

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

UV-DOZIMETRIA

$$E_{\text{be}} = \frac{\Delta P}{\Delta A} \qquad (1)(\text{II}.3)$$

$$H = SEt \qquad (2)$$

$$A(t) = A_\infty + (A_0 - A_\infty) e^{-H_{\text{U}}} \qquad (5)$$

$$H_{\text{U}} = \ln \frac{A_0 - A_\infty}{A(t) - A_\infty} \qquad (6)$$

OSZCILLOSZKÓP

$$U_{\text{pp}} = 2U_{\text{max}} = 2\sqrt{2} U_{\text{eff}} \qquad (5)$$

ERŐSÍTŐ

$$K_U = \frac{U_{\text{ki}}}{U_{\text{be}}} \qquad K_P = \frac{P_{\text{ki}}}{P_{\text{be}}} \qquad (3)(\text{VII}.6)$$

$$n = 20 \lg K_U + 10 \lg \frac{R_{\text{be}}}{R_{\text{ki}}} \quad (\text{dB}) \qquad (6)$$

SZINUSZOSZCILLÁTOR

$$K_{U_{\text{v}}} = \frac{K_U}{1 - K_{\text{v}} K_U} \qquad f_0 = \frac{1}{2\pi\sqrt{LC}} \qquad (3)(\text{VII}.14)$$

$$Q = \sigma E^2 V t \qquad (4)$$

$$R = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2} \right)^2 \qquad Z = c\rho \qquad (5)(\text{II}.77)$$

IMPULZUSGENERÁTOR

$$T = \tau_1 + \tau_2 \qquad (2)$$

$$\text{kitöltési tényező} = \frac{\tau_1}{\tau_1 + \tau_2} 100\% \qquad (3)$$

COULTER SZÁMLÁLÓ

$$h = \frac{c_{\text{megadott}}}{c_{\text{mért}}} \qquad (1)$$

BŐRIMPEDANCIA

$$Z = \frac{U_{\text{eff}}}{I_{\text{eff}}} \qquad (13)$$

$$\rho^* = RA \qquad (14)$$

$$C = \frac{1}{2\pi f Z} \qquad (15)$$

$$\gamma^* = \frac{C}{A} \qquad (16)$$

AUDIOMETRIA

$$J = \eta \frac{U_{\text{eff}}{}^2}{R} \qquad (1)$$

$$J_{\text{saját}} = AU^2 \qquad (2)$$

$$n = 10 \lg \left(\frac{J}{J_0} \right) \qquad (5)$$

SZENZOR

$$\Psi \sim \left(\frac{\Phi}{\Phi_0} \right)^n \qquad (\text{IV}.8)$$

EKG

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

$$U_{\text{I}} = \varphi_{\text{L}} - \varphi_{\text{R}}$$

$$U_{\mathrm{II}} = \varphi_{\mathrm{F}} - \varphi_{\mathrm{R}}$$

$$U_{\mathrm{III}} = \varphi_{\mathrm{F}} - \varphi_{\mathrm{L}}$$

ÁRAMLÁS

$$\frac{\Delta V}{\Delta t} = I_V = -\frac{\pi}{8\eta} R^4 \frac{\Delta p}{\Delta l} \qquad (3)(\mathrm{III}.12)$$

$$\eta = \frac{\pi}{8} \frac{R^4}{\Delta V} \frac{\overline{\Delta h} \rho g}{l} \Delta t \qquad (11)$$

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

$$R_{\mathrm{cső}} = 8\pi\eta \frac{l}{A^2} \qquad (6)$$

$$R_{\mathrm{párhuzamos\ eredő}} = \frac{R}{n} \qquad (7)$$

DIFFÚZIÓ

$$D\Delta t \frac{\Delta\left(\frac{\Delta c}{\Delta x}\right)}{\Delta x} + c(t) = c(t + \Delta t) \qquad (4)$$

$$\nu = K\nu_0 \mathrm{e}^{-\frac{t}{\tau}} \qquad (T = \ln 2 \cdot \tau) \qquad (5)$$

$$D = 0{,}12 \frac{r^2}{T} \qquad (8)$$

$$\sigma_{\mathrm{elektrolit}} = \frac{1}{R} \hat{C} \qquad (12)$$

A korábbi tanulmányokból ismertnek vélt összefüggések

$$E_{\mathrm{magassági}} = mgh$$

$$E_{\mathrm{mozgási}} = \frac{1}{2} m\upsilon^2$$

$$E_{\mathrm{kondenzátor}} = \frac{1}{2} CU^2$$

$$\varepsilon = hf$$

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

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

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

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

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

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

$$X_L = 2\pi f L$$

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

$$C = \varepsilon_0 \varepsilon \frac{A}{d}$$

$$P_{\mathrm{elektromos}} = UI$$

$$Q = cm\Delta t$$

Statisztikai táblázatok

t-eloszlás

szabadságfok	*p* (valószínűség, kétoldalú próba)							
	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
26	0,68	1,31	1,71	2,06	2,48	2,78	3,44	3,71
27	0,68	1,31	1,70	2,05	2,47	2,77	3,42	3,69
28	0,68	1,31	1,70	2,05	2,47	2,76	3,41	3,67
29	0,68	1,31	1,70	2,05	2,46	2,76	3,40	3,66
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)						
	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
2	0,0201	0,0506	0,103	5,99	7,88	9,21	13,82
3	0,115	0,216	0,352	7,81	9,35	11,34	16,27
4	0,297	0,484	0,711	9,49	11,14	13,28	18,47
5	0,554	0,831	1,15	11,07	12,83	15,09	20,51
6	0,872	1,24	1,64	12,59	14,45	16,81	22,46
7	1,24	1,69	2,17	14,07	16,01	18,47	24,32
8	1,65	2,18	2,73	15,51	17,53	20,09	26,13
9	2,09	2,70	3,33	16,92	19,02	21,67	27,88
10	2,56	3,25	3,94	18,31	20,48	23,21	29,59
11	3,05	3,61	4,57	19,68	21,92	24,72	31,26
12	3,57	4,40	5,23	21,03	23,34	26,22	32,91
13	4,11	5,01	5,89	22,36	24,74	27,69	34,53
14	4,66	5,63	6,57	23,68	26,12	29,14	36,12
15	5,23	6,26	7,26	25,00	27,49	30,58	37,70
16	5,81	6,91	7,96	26,33	28,85	32,00	39,25
17	6,41	7,56	8,67	27,59	30,19	33,41	40,79
18	7,01	8,23	9,39	28,87	31,53	34,81	42,31
19	7,63	8,91	10,12	30,14	32,85	36,19	43,82
20	8,26	9,59	10,85	31,41	34,17	37,57	45,31
21	8,90	10,28	11,59	32,67	35,48	38,93	46,80
22	9,54	10,98	12,34	33,92	36,78	40,29	48,27
23	10,20	11,69	13,09	35,17	38,08	41,64	49,73
24	10,86	12,40	13,85	36,42	39,36	42,98	51,18
25	11,52	13,12	14,61	37,65	40,65	44,31	52,62
26	12,20	13,84	15,38	38,89	41,92	45,64	54,05
27	12,88	14,57	16,15	40,11	43,19	46,96	55,48
28	13,56	15,31	16,93	41,34	44,46	48,28	56,89
29	14,26	16,05	17,71	42,56	45,72	49,59	58,30
30	14,95	16,79	18,49	43,77	46,98	50,89	59,70
40	22,16	24,43	26,51	55,76	59,34	63,69	73,40
50	29,71	32,36	34,76	67,51	71,42	76,15	86,66
60	37,48	40,48	43,19	79,08	83,30	88,38	99,61
100	70,06	74,22	77,93	124,3	129,5	135,8	149,4

Állandók és adatok

egyetemes gázállandó	$R = 8{,}31$ J/(mol·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	$h = 6{,}6 \cdot 10^{-34}$ J·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	$\sigma = 5{,}7 \cdot 10^{-8}$ J/(m^2·K^4·s)
Reynolds-szám (sima falú csővekre)	$Re = 1160$
c_{Rtg}	$1{,}1 \cdot 10^{-9}$ V^{-1}
C_{foto}	6 cm^2/(g·nm^3)
f_0	34 J/C

relatív atomtömeg	
nitrogén:	14
oxigén:	16
sűrűség [kg/m^3]	
alumínium (Al):	$2{,}7 \cdot 10^3$
vas (Fe)	$7{,}9 \cdot 10^3$
ólom (Pb):	$11{,}3 \cdot 10^3$
testszövet (lágy):	$1{,}04 \cdot 10^3$
vér (átlagos):	$1{,}05 \cdot 10^3$
levegő (0°C, 101 kPa):	1,29
csont:	$1{,}7 \cdot 10^3$
zsírszövet:	$0{,}92 \cdot 10^3$
viszkozitás [mPa·s]	
víz (27°C-on):	0,85
vér (37°C-on):	4,5
fajhő [kJ/(kg·K)]	
víz:	4,18
izom:	3,76
vér:	3,9
tömör csont:	1,3
zsírszövet:	3
testszövet (átlagos)	3,5

fajhő [kJ/(kg·K)]	
oxigén: c_v	0,65
oxigén: c_p	0,92
olvadáshő [kJ/kg]	
jég:	334,4
párolgáshő [kJ/kg]	
víz (100°C, 101 kPa):	2257
standard kémiai potenciál [kJ/mol]	
glükóz:	–902,5
törésmutató	
levegő:	1
víz:	1,333
cédrusolaj:	1,505
tömeggyengítési együttható [cm^2/g]	
μ_m (^{24}Na, ólom absz.):	$5 \cdot 10^{-2}$
hallásküszöb [W/m^2]	
emberi fül (1 kHz-en):	10^{-12}
hangsebesség [m/s]	
testszövet (lágy):	1600
csont:	3600
fajlagos vezetőképesség [S/m]	
izomszövet:	0,8

A fontosabb radioaktív izotópok jellemző adatai:

kémiai elem és rendszáma		izotóp	felezési idő	bomlás módja	maximális részecske energiák (MeV)	γ-energia (MeV)	$K\gamma$ 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	