BUB ćwiczenia

$\delta X = X - X_0$	$X_0 \in \langle X - \Delta X, X + \Delta X \rangle$	$\bar{T} = \frac{T_1 + T_2 + T_3 + \ldots\ldots + T_n}{n}$	$s_T = \sqrt{\frac{(T_1 - \bar{T})^2 + (T_2 - \bar{T})^2 + \cdots + (T_n - \bar{T})^2}{n-1}}$
$s_{\bar{T}} = \frac{s_T}{\sqrt{n}}$	$F = const \cdot A^a \cdot B^b \cdot C^c \cdot \ldots$	$\Delta F = \pm F \cdot \left[\left\lvert a \cdot \frac{\Delta A}{A} \right\rvert + \left\lvert b \cdot \frac{\Delta B}{B} \right\rvert + \left\lvert c \cdot \frac{\Delta C}{C} \right\rvert + \ldots \right]$	
	$F = A \pm B \Rightarrow \Delta F = \Delta A + \Delta B$		

$F = \eta \cdot S \cdot \frac{\Delta v}{\Delta x}$	$\eta_{wł} = \frac{\eta}{\eta_0} - 1$	$[\eta] = \lim_{c \to 0} \left(\frac{\eta_{wł}}{c} \right)$	$\Delta V = \frac{\pi \cdot r^4 \cdot \Delta t}{8 \cdot l \cdot \eta} \cdot \Delta p$
$R = 6 \cdot \pi \cdot r \cdot v \cdot \eta$	$\eta = \frac{2 \cdot r^2 \cdot g \cdot (\rho - \rho_c)}{9 \cdot v}$	$\frac{\eta}{\eta_0} = \frac{t}{t_0} \cdot \frac{\rho}{\rho_0}$	$\Phi = \frac{V_c}{V_r}$
$\frac{\eta}{\eta_0} = 1 + 2{,}5 \cdot \Phi$	$[\eta] = 2{,}5 \cdot \frac{N_A}{M} \cdot v_{cz}$	$r = \sqrt[3]{\frac{3 \cdot M}{10 \cdot \pi \cdot N_A} \cdot [\eta]}$	$\frac{\rho}{\rho_0} = 1 + 0{,}23 \cdot c$

$\sigma_p = \frac{F}{l}$	$\sigma_p = \sigma_0 - \sigma$	$\sigma_p \cdot S_w = n_{cz} \cdot k_B \cdot T$	$S_w = n_{cz} \cdot s_0$		
$V_w = \frac{c \cdot V_k}{\rho}$	$s_{cz} = \frac{S_w}{n_{cz}} = \frac{S_w \cdot M}{c \cdot V_k \cdot N_A}$	$d_{cz} = \sqrt{\frac{4 \cdot s_{cz}}{\pi}}$	$l_{cz} = \frac{c \cdot V_k}{\rho \cdot S_w}$		
$W = \sigma \cdot \Delta S$	$\sigma = \frac{F}{l}$	$\Delta p = \frac{2 \cdot \sigma}{R}$	$\frac{\sigma}{\sigma_0} = \frac{n_0 \cdot \rho}{n \cdot \rho_0}$	$\sigma = \frac{r \cdot h \cdot \rho \cdot g}{2 \cdot \cos(\alpha)}$	$\sigma = \frac{\rho \cdot V \cdot g}{2 \cdot \pi \cdot r \cdot n}$

$\frac{\mathrm{d}n}{\mathrm{d}t} = -D \cdot S \cdot \frac{\mathrm{d}c}{\mathrm{d}x}$	$D = \frac{k \cdot T}{6 \cdot \pi \cdot r \cdot \eta}$	$\overline{\Delta x^2} = 2 \cdot D \cdot t$	$P = \frac{D}{\mathrm{d}x}$
$\frac{\mathrm{d}n}{\mathrm{d}t} = P \cdot S \cdot (c_1 - c_2)$	$c_2 = \frac{c_0}{2} \cdot (1 - e^{-C \cdot D \cdot t})$	$C = \frac{2 \cdot A}{V \cdot \mathrm{d}x}$	$\ln \left(\frac{c_0}{c_0 - 2 \cdot c_2} \right) = C \cdot D \cdot t$
$\frac{c_0}{2} = c_0 \cdot \mathrm{e}^{-\kappa_E \cdot t_{1/2}}$	$c = c_0 \cdot \mathrm{e}^{-\kappa_D \cdot t}$	$c = c_0 \cdot \mathrm{e}^{-\kappa_E \cdot t}$	$\kappa_E = \frac{\ln(2)}{t_{1/2}} \approx \frac{0{,}693}{t_{1/2}}$

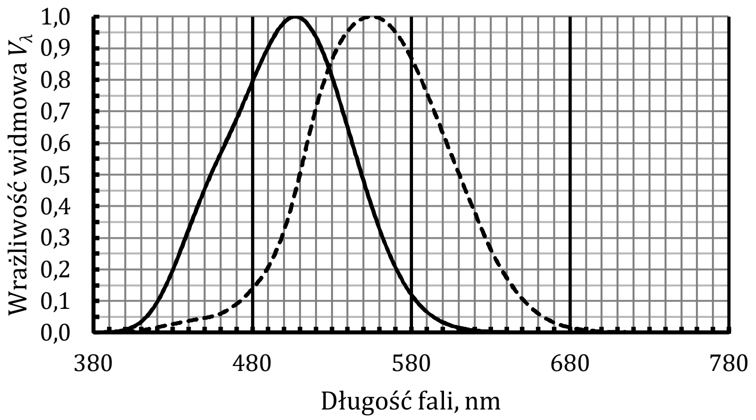
$\mu_i = \left(\frac{\partial G_i}{\partial n_i} \right)_{T, p, n_j \, dla \, j \neq i}$	$\mu_i = \mu_{ic}^0 + R \cdot T \cdot \ln(c_i)$	$\tilde{\mu}_i = \mu_i + \varphi \cdot F \cdot z$	
$Me \rightleftharpoons Me^{z+} + z \cdot e^-$	$\Delta V_e = V_e - V_r = \Delta V_0 + \left(\frac{R \cdot T}{z \cdot F} \right) \cdot \ln(c_j)$	$\Delta V_d = V_2 - V_1 = \left(\frac{u^+ - u^-}{u^+ + u^-} \right) \cdot \left(\frac{R \cdot T}{z \cdot F} \right) \cdot \ln \left(\frac{c_1}{c_2} \right)$	
$u = \frac{v}{E}$	$E = \left(\frac{R \cdot T}{z \cdot F} \right) \cdot \ln \left(\frac{c_1}{c_2} \right)$	$E = \Delta V_{e1} - \Delta V_{e2}$	$W = q \cdot U$

$J = \frac{I}{S}$	$J \cdot \Delta t = \frac{I \cdot \Delta t}{S} = \frac{\Delta Q}{S}$	$I_p = (CH \cdot R) \cdot \frac{1}{\Delta t} + R$

$Q = \frac{\Delta V}{\Delta t}$	$S_1 \cdot v_1 = S_2 \cdot v_2 = const$	$p_{S1} + \rho \cdot g \cdot h_1 + \frac{1}{2} \cdot \rho \cdot v_1^2 = p_{S2} + \rho \cdot g \cdot h_2 + \frac{1}{2} \cdot \rho \cdot v_2^2 = const.$		
$Q = \frac{\pi \cdot r^4}{8 \cdot l \cdot \eta} \cdot \Delta p$	$Q = \frac{1}{R_N} \cdot \Delta p$	$N_R = \frac{2 \cdot r \cdot v \cdot \rho}{\eta}$		
$v = \sqrt{\frac{K}{\rho}}$	$K = \frac{\Delta p}{\frac{\Delta V}{V}}$	$v_t = F \cdot \sqrt{\frac{E \cdot d}{2 \cdot R \cdot \rho_c}}$	$v_p = \frac{\Delta V}{S \cdot \Delta t}$	$v_t = \frac{l_{AB}}{\Delta t}$

$D = D_1 + D_2 - \frac{d}{n} \cdot D_1 \cdot D_2$	$R = \frac{1}{s_D}$	$D_{kom} = \frac{1}{L}$	$R = D - D_{kom}$	$A = \frac{1}{s_D} - \frac{1}{s_B}$
$\frac{\sin(\alpha)}{\sin(\beta)} = \frac{v_\alpha}{v_\beta} = \frac{\lambda_\alpha}{\lambda_\beta} = \frac{n_\beta}{n_\alpha} = n_{\beta/\alpha}$	$n_\alpha = \frac{c}{v_\alpha}$	$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f'}$	$D = \frac{1}{f'} = \left(\frac{n_{socz}}{n_{ot}} - 1 \right) \cdot \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$	

$\Omega = \frac{S}{R^2}$	$I_E \stackrel{\text{def}}{=} \frac{\Phi_E}{\Omega} \Rightarrow [I_E] = \frac{\text{W}}{\text{sr}}$	$I_V = \frac{\Phi_V}{\Omega} \Rightarrow [I_V] = \text{cd} = \frac{\text{lm}}{\text{sr}}$
$\Phi_V = I_V \cdot \Omega \Rightarrow [\Phi_V] = \text{lm} = \text{cd} \cdot \text{sr}$	$P = \Phi_E \stackrel{\text{def}}{=} \frac{Q_E}{t} \Rightarrow [\Phi_E] = W$	$\Phi_V = \left(683\ \frac{\text{lm}}{\text{W}}\right) \cdot V_\lambda \cdot \Phi_E$
$E_V \stackrel{\text{def}}{=} \frac{\Phi_V}{S} \Rightarrow [E_V] = 1\ \text{lx} = \frac{1\ \text{lm}}{1\ \text{m}^2}$	$E_V = \frac{I_V}{r^2} \cdot \cos(\alpha)$	$L_V = \frac{I_V}{S \cdot \cos(\alpha)} \Rightarrow [L_V] = \frac{\text{cd}}{\text{m}^2}$
$I_V(\alpha) = I_{V\perp} \cdot \cos(\alpha)$	$L_V = \frac{\Phi_V}{S \cdot \cos(\alpha) \cdot \Omega}$	



$p = \rho \cdot c \cdot v$	$I = \frac{\Delta E}{\Delta t \cdot S} = \frac{P}{S}$	$I = \frac{1}{2} \cdot \frac{{p_0}^2}{\rho \cdot c}$	$L = \log_{10}\left(\frac{I}{I_0}\right)$	$L_p = 2 \cdot \log_{10}\left(\frac{p}{p_0}\right)$

$L = 10 \cdot \log_{10}\left(\frac{I}{I_0}\right) = 20 \cdot \log_{10}\left(\frac{U}{U_0}\right)$	$\frac{\Delta I}{I} = const$	$\frac{\Delta f}{f} = 0{,}3\%$	$Z_W = \rho \cdot c = \sqrt{\rho \cdot E}$	$R = \frac{I_R}{I_I} = \left(\frac{Z_1 - Z_2}{Z_1 + Z_2}\right)^2$

Krzywe izofoniczne „normalnego" ucha według Fletchera i Munsona: