Nom :

Feuille de formule – Ondes et physique moderne

Constantes :

$g = 9{,}8\ \ \mathrm{m/s^2}$	$e = 1{,}6\times10^{-19}\,\mathrm{C}$	$v_{\mathrm{son}} = 340\ \ \mathrm{m/s}$	$c = 3\times10^{8}\ \ \mathrm{m/s}$
$k = 9\times10^{9}\,\mathrm{N\cdot m^2/C^2}$	$\varepsilon_0 = 8{,}85\times10^{-12}\,\mathrm{C^2/(N\cdot m^2)}$	$\mu_0 = 4\pi\times10^{-7}\,\mathrm{T\cdot m/A}$	$1\ \ \mathrm{eV} = 1{,}6\times10^{-19}\,\mathrm{J}$
$I_0 = 1\times10^{-12}\ \mathrm{W/m^2}$	$h = 6{,}63\times10^{-34}\,\mathrm{J\cdot s}$	$\hbar = h/2\pi$	$S = 1{,}36\ \ \mathrm{kW/m^2}$
$\sigma = 5{,}67\times10^{-8}\,\mathrm{W/(m^2\cdot K^4)}$	$k_{\mathrm{B}} = 1{,}38\times10^{-23}\,\mathrm{J/K}$	$w = 0{,}0029\ \ \mathrm{m\cdot K}$	$1\ \ \mathrm{MeV/c^2} = 1{,}7827\times10^{-30}\,\mathrm{kg}$
$1\ \ \mathrm{u} = 1{,}6605\times10^{-27}\,\mathrm{kg}$	$1\ \ \mathrm{u} = 931{,}5\ \ \mathrm{MeV}$	$1\ \ \mathrm{MeV/c^2} = 1{,}7827\times10^{-30}\,\mathrm{kg}$	$1\ \ \mathrm{Ci} = 3{,}7\times10^{10}\,\mathrm{Bq}$
$E_1 = 13{,}6\,\mathrm{eV}$	$r_1 = 5{,}292^{-11}\,\mathrm{m}$		

Électron :	Proton :	Neutron :	Muon :
$m_{\mathrm{e}} = 9{,}11\times10^{-31}\ \ \mathrm{kg}$	$m_{\mathrm{p}} = 1{,}67\times10^{-27}\ \ \mathrm{kg}$	$m_{\mathrm{n}} = 1{,}67\times10^{-27}\ \ \mathrm{kg}$	$m_{\mu} = 1{,}88\times10^{-28}\ \ \mathrm{kg}$
$q_{\mathrm{e}} = -e$	$q_{\mathrm{p}} = +e$	$q_{\mathrm{n}} = 0$	$q_{\mu} = -e$

Formules :

$$v_x(t) = \frac{\mathrm{d}x(t)}{\mathrm{d}t} \qquad a_x(t) = \frac{\mathrm{d}v_x(t)}{\mathrm{d}t} \qquad a_{\mathrm{C}} = \frac{v^2}{r}$$

$$x(t) = x_0 + v_{x0}t + \frac{1}{2}a_x t^2 \qquad v_x(t) = v_{x0} + a_x t \qquad {v_x}^2 = {v_{x0}}^2 + 2a_x(x - x_0)$$

$$x = A\sin(\omega t + \phi) \qquad a_x = -\omega^2 x \qquad \omega = \frac{2\pi}{T} \qquad \omega_0 = \sqrt{\frac{k}{m}} \qquad \omega_0 = \sqrt{\frac{g}{L}}$$

$$\sum\vec{F} = m\vec{a} \qquad \vec{F}_g = m\vec{g} \qquad \vec{F}_r = -k\vec{e} \qquad f = \mu n \qquad \vec{F}_{\mathrm{e}} = q\vec{E} \qquad \vec{F}_{\mathrm{m}} = q\,\vec{v}\times\vec{B}$$

$$E_f = E_i + W_a \qquad W = \int\vec{F}\cdot\mathrm{d}\vec{s} \qquad W = \vec{F}\cdot\vec{s} \qquad E = K + U \qquad K = \frac{1}{2}mv^2 \qquad U_{\mathrm{e}} = qV$$

$$E = \frac{1}{2}m\omega^2 A^2 \qquad E = \frac{1}{2}kA^2 \qquad E = \frac{1}{2}k\left(A^2 + {e_{\mathrm{eq}}}^2\right) \qquad U_g = mgy \qquad U_r = \frac{1}{2}ke^2 \qquad U_{\mathrm{OHS}} = \frac{1}{2}m\omega^2 x^2$$

$$\vec{p}_f = \vec{p}_i + \vec{J} \qquad \vec{J} = \int\vec{F}\,\mathrm{d}t \qquad \vec{J} = \vec{F}\,\Delta t \qquad \vec{p} = m\vec{v} \qquad P = \frac{\mathrm{d}E}{\mathrm{d}t} \qquad P = \vec{F}\cdot\vec{v}$$

$$y = A\sin(kx \pm \omega t + \phi) \qquad \lambda = vT \qquad k = \frac{2\pi}{\lambda} \qquad v = \sqrt{\frac{F}{\mu}} \qquad v = \sqrt{\frac{\gamma P}{\rho}} \qquad f_{\mathrm{b}} = |f_1 - f_2|$$

$$f_N = N\frac{v}{2L} \qquad f_N = \left(N - \frac{1}{2}\right)\frac{v}{2L} \qquad f' = \left(\frac{v_s \pm v_r}{v_s \pm v_e}\right)f \qquad \lambda' = \lambda \pm v_e T \qquad v' = v \pm v_r \qquad v_s = v \pm v_{\mathrm{vent}}$$

$$I = \frac{\mathrm{d}P}{\mathrm{d}A} \qquad I = \frac{P}{4\pi r^2} \qquad \beta = 10\log\left(\frac{I}{I_0}\right)$$

$$\theta' = \theta \qquad n_1\sin(\theta_1) = n_2\sin(\theta_2) \qquad \theta_c = \arcsin(n_2/n_1) \qquad n = \frac{c}{v} \qquad g = \frac{y_{\mathrm{i}}}{y_{\mathrm{o}}} \qquad G = \frac{\alpha_{\mathrm{i}}}{\alpha_{\mathrm{o}}}$$

$$f = \frac{R}{2} \qquad \frac{1}{p} + \frac{1}{q} = \frac{1}{f} \qquad \frac{1}{f} = (n_{\mathrm{L}} - 1)\left(\frac{1}{R_{\mathrm{A}}} - \frac{1}{R_{\mathrm{B}}}\right) \qquad g = -\frac{q}{p} \qquad A_{\mathrm{acc}} = n_{\mathrm{ext}}\left(\frac{1}{d_{\mathrm{PP}}} - \frac{1}{d_{\mathrm{PR}}}\right) \qquad A_{\mathrm{acc}} = V_{\max} - V_{\min}$$

$$V = \frac{1}{f} \qquad \frac{n_1}{p} + \frac{n_2}{q} = V \qquad V = \frac{n_{\mathrm{L}} - n_1}{R_{\mathrm{A}}} - \frac{n_{\mathrm{L}} - n_2}{R_{\mathrm{B}}} \qquad g = -\frac{n_1}{n_2}\frac{q}{p} \qquad \frac{n_1}{p} + \frac{n_2}{q} = \frac{n_2 - n_1}{R}$$

$$\delta_{\max} = m\lambda \qquad \delta_{\min} = \left(m + \frac{1}{2}\right)\lambda \qquad \delta = |r_2 - r_1| \qquad \delta \approx d\sin(\theta) \qquad \delta \approx a\sin(\theta) \qquad \delta = \delta_{\mathrm{e}} + \delta_{\mathrm{r}}$$

$$\delta_{\min 1} = \lambda \qquad \delta_{\min 2} = 2\lambda \qquad \delta_{\min 3} = 3\lambda \qquad \delta_{\min 1} \approx 1{,}22\lambda \qquad \delta_{\min 2} \approx 2{,}23\lambda \qquad \delta_{\min 3} \approx 3{,}24\lambda$$

$$\Delta\phi = 2\pi\left(\frac{\delta}{\lambda}\right) \qquad \alpha_{\lim} = \frac{\lambda}{a} \qquad \alpha_{\lim} = 1{,}22\frac{\lambda}{D} \qquad \lambda_1 n_1 = \lambda_2 n_2 \qquad I' = I\cos^2(\theta)$$

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$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} \qquad T = \gamma T_0 \qquad L = \frac{L_0}{\gamma} \qquad \tau = \frac{L_0}{c}\frac{v}{c}$$

$$\Delta x_B = \gamma_{AB}\left(\Delta x_A + v_{xAB}\Delta t_A\right) \qquad \Delta t_B = \gamma_{AB}\left(\Delta t_A + \frac{\Delta x_A v_{xAB}}{c^2}\right) \qquad v_{xAR} = \frac{v_{xAB} + v_{xBR}}{1 + \left(\frac{v_{xAB}}{c}\right)\left(\frac{v_{xBR}}{c}\right)} \qquad f_B = \frac{\sqrt{c \pm v}}{\sqrt{c \mp v}} f_A$$

$$\vec{p} = \gamma m \vec{v} \qquad F_x = \gamma_x^{\,3} m a_x \qquad F_y = \gamma_x m a_y$$

$$K = (\gamma - 1)mc^2 \qquad E_0 = mc^2 \qquad E = \gamma mc^2 \qquad E^2 = p^2c^2 + m^2c^4$$

$$E = hf \qquad E = pc \qquad \lambda_f - \lambda_i = \frac{h}{m_e c}\left(1 - \cos(\theta)\right) \qquad \lambda = \frac{h}{p}$$

$$I_\lambda = \frac{2\pi hc^2}{\lambda^5\left(e^{\frac{hc}{\lambda k_B T}} - 1\right)} \qquad \lambda_{\max} = \frac{w}{T} \qquad I = \sigma T^4 \qquad T(\mathrm{K}) = T(^\circ\mathrm{C}) + 273{,}15 \qquad PV = Nk_B T$$

$$E_n = -\frac{E_1}{n^2} \qquad r_n = r_1 n^2 \qquad L_z = n\hbar \qquad 2\pi r = n\lambda$$

$$E_L = \Delta mc^2 \qquad Q = \left(\sum m_i - \sum m_f\right)c^2$$

$$R = -\frac{\mathrm{d}N}{\mathrm{d}t} \qquad R = \lambda N \qquad N = N_0 e^{-\lambda t} \qquad T_{1/2} = \frac{\ln(2)}{\lambda} \qquad Q = mC\Delta T$$

$$S = \frac{L_{\text{É}}}{4\pi D_{\text{É-P}}^{\;2}} \qquad \bar{I}_{\text{inc}} = \frac{\Phi_\gamma}{A_{\text{tot}}} \qquad \bar{I}_{\text{inc}} = \frac{S}{4} \qquad \bar{I}_{\text{abs}} = (1 - \alpha)\bar{I}_{\text{inc}} \qquad \bar{I}_{\text{réfl}} = \alpha \bar{I}_{\text{inc}} \qquad \bar{I}_{\text{CN}} = \sigma T_{\text{CN}}^4$$

Mathématique :

$$\vec{A} = (A_x, A_y, A_z) = A_x\vec{i} + A_y\vec{j} + A_z\vec{k} \qquad \vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos(\theta) = A_xB_x + A_yB_y + A_zB_z$$

$$A = |\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2} \qquad \vec{A}\times\vec{B} = |\vec{A}||\vec{B}|\sin(\theta)\hat{n} = (A_yB_z - A_zB_y)\vec{i} - (A_xB_z - A_zB_x)\vec{j} + (A_xB_y - A_yB_x)\vec{k}$$

$$ax^2 + bx + c = 0 \quad \Rightarrow \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad C = 2\pi r, \quad A = \pi r^2, \quad A = 4\pi r^2, \quad V = 4\pi r^3/3$$

$$\sin^2(\theta) + \cos^2(\theta) = 1 \qquad 2\cos\theta\sin\theta = \sin(2\theta) \qquad \sin a + \sin b = 2\cos\left(\frac{a-b}{2}\right)\sin\left(\frac{a+b}{2}\right)$$

$$\ln(A) + \ln(B) = \ln(AB) \qquad \ln(A) - \ln(B) = \ln\left(\frac{A}{B}\right)$$

Table de dérivée et d'intégrale :

$$\frac{\mathrm{d}x^n}{\mathrm{d}x} = nx^{n-1} \qquad \frac{\mathrm{d}e^{Ax}}{\mathrm{d}x} = Ae^{Ax} \qquad \frac{\mathrm{d}\ln x}{\mathrm{d}x} = \frac{1}{x} \qquad \frac{\mathrm{d}\cos x}{\mathrm{d}x} = -\sin x \qquad \frac{\mathrm{d}\sin x}{\mathrm{d}x} = \cos x \qquad \frac{\mathrm{d}\tan x}{\mathrm{d}x} = \sec^2 x$$

$$\int x^n \mathrm{d}x = \frac{x^{n+1}}{n+1} + C \qquad \int e^{Ax}\mathrm{d}x = \frac{e^{Ax}}{A} + C \qquad \int \frac{1}{x}\mathrm{d}x = \ln|x| + C$$

$$\int \cos(x)\mathrm{d}x = \sin(x) + C \qquad \int \sin(x)\mathrm{d}x = -\cos(x) + C \qquad \int \tan(x)\mathrm{d}x = \ln|\sec(x)| + C$$

$$\int \frac{1}{A^2 + x^2}\mathrm{d}x = \frac{1}{A}\arctan\left(\frac{x}{A}\right) + C \qquad \int \frac{x}{\left(A^2 + x^2\right)^{3/2}}\mathrm{d}x = \frac{-1}{\sqrt{A^2 + x^2}} + C \qquad \int \frac{1}{\left(A^2 + x^2\right)^{3/2}}\mathrm{d}x = \frac{x}{A^2\sqrt{A^2 + x^2}} + C$$

Dérivée en chaîne :

$$\frac{\mathrm{d}}{\mathrm{d}x} f(y(x)) = \frac{\mathrm{d}f}{\mathrm{d}y}\frac{\mathrm{d}y}{\mathrm{d}x}$$

Dérivée d'un produit :

$$\frac{\mathrm{d}}{\mathrm{d}x} f(x)\cdot g(x) = \frac{\mathrm{d}f(x)}{\mathrm{d}x}g(x) + f(x)\frac{\mathrm{d}g(x)}{\mathrm{d}x}$$

Intégrale par parties :

$$\int u\,\mathrm{d}v = uv - \int v\,\mathrm{d}u$$