

Nom :

## Feuille de formule – Ondes et physique moderne

### Constantes :

$g = 9,8 \text{ m/s}^2$	$e = 1,6 \times 10^{-19} \text{ C}$	$v_{\text{son}} = 340 \text{ m/s}$	$c = 3 \times 10^8 \text{ m/s}$
$k = 9 \times 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2$	$\epsilon_0 = 8,85 \times 10^{-12} \text{ C}^2 / (\text{N} \cdot \text{m}^2)$	$\mu_0 = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$	$1 \text{ eV} = 1,6 \times 10^{-19} \text{ J}$
$I_0 = 1 \times 10^{-12} \text{ W/m}^2$	$h = 6,63 \times 10^{-34} \text{ J} \cdot \text{s}$	$\hbar = h / 2\pi$	
$\sigma = 5,67 \times 10^{-8} \text{ W}/(\text{m}^2 \cdot \text{K}^4)$	$k = 1,38 \times 10^{-23} \text{ J/K}$	$w = 0,0029 \text{ m} \cdot \text{K}$	$1 \text{ MeV}/c^2 = 1,7827 \times 10^{-30} \text{ kg}$
$1 \text{ u} = 1,6605 \times 10^{-27} \text{ kg}$	$1 \text{ u} = 931,5 \text{ MeV}$	$1 \text{ MeV}/c^2 = 1,7827 \times 10^{-30} \text{ kg}$	$1 \text{ Ci} = 3,7 \times 10^{10} \text{ Bq}$

#### Électron :

$$m_e = 9,11 \times 10^{-31} \text{ kg}$$

$$q_e = -e$$

#### Proton :

$$m_p = 1,67 \times 10^{-27} \text{ kg}$$

$$q_p = +e$$

#### Neutron :

$$m_n = 1,67 \times 10^{-27} \text{ kg}$$

$$q_n = 0$$

#### Muon :

$$m_\mu = 1,88 \times 10^{-28} \text{ kg}$$

$$q_\mu = -e$$

### Formules :

$$v_x(t) = \frac{dx(t)}{dt}$$

$$a_x(t) = \frac{dv_x(t)}{dt}$$

$$a_c = \frac{v^2}{r}$$

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

$$v_x(t) = v_{x0} + a_x t$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

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

$$a_x = -\omega^2 x$$

$$\omega = \frac{2\pi}{T}$$

$$\omega_0 = \sqrt{\frac{k}{m}}$$

$$\omega_0 = \sqrt{\frac{g}{L}}$$

$$\sum \vec{F} = m\vec{a}$$

$$\vec{F}_g = m\vec{g}$$

$$\vec{F}_r = -k\vec{e}$$

$$f = \mu n$$

$$\vec{F}_e = q\vec{E}$$

$$\vec{F}_m = q\vec{v} \times \vec{B}$$

$$E_f = E_i + W_a$$

$$W = \int \vec{F} \cdot d\vec{s}$$

$$W = \vec{F} \cdot \vec{s}$$

$$E = K + U$$

$$K = \frac{1}{2}mv^2$$

$$U_e = qV$$

$$E = \frac{1}{2}m\omega^2 A^2$$

$$E = \frac{1}{2}kA^2$$

$$E = \frac{1}{2}k(A^2 + e_{\text{eq}}^2)$$

$$U_g = mgy$$

$$U_r = \frac{1}{2}ke^2$$

$$U_{\text{OHS}} = \frac{1}{2}m\omega^2 x^2$$

$$\vec{p}_f = \vec{p}_i + \vec{J}$$

$$\vec{J} = \int \vec{F} dt$$

$$\vec{J} = \vec{F} \Delta t$$

$$\vec{p} = m\vec{v}$$

$$P = \frac{dE}{dt}$$

$$P = \vec{F} \cdot \vec{v}$$

$$y = A \sin(kx \pm \omega t + \phi)$$

$$\lambda = vT$$

$$k = \frac{2\pi}{\lambda}$$

$$v = \sqrt{\frac{F}{\mu}}$$

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

$$f_b = |f_1 - f_2|$$

$$f_N = N \frac{v}{2L}$$

$$f_N = \left(N - \frac{1}{2}\right) \frac{v}{2L}$$

$$f' = \left(\frac{v_s \pm v_r}{v_s \pm v_e}\right) f$$

$$\lambda' = \lambda \pm v_e T$$

$$v' = v \pm v_r$$

$$v_s = v \pm v_{\text{vent}}$$

$$I = \frac{dP}{dA}$$

$$I = \frac{P}{4\pi r^2}$$

$$\beta = 10 \log\left(\frac{I}{I_0}\right)$$

$$\theta' = \theta$$

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

$$n = \frac{c}{v}$$

$$g = \frac{y_i}{y_o}$$

$$G = \frac{\alpha_i}{\alpha_o}$$

$$f = \frac{R}{2}$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$\frac{1}{f} = (n_L - 1) \left( \frac{1}{R_A} - \frac{1}{R_B} \right)$$

$$g = -\frac{q}{p}$$

$$A_{\text{acc}} = \frac{1}{d_{\text{pp}}} - \frac{1}{d_{\text{PR}}}$$

$$A_{\text{acc}} = V_{\text{max}} - V_{\text{min}}$$

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

$$\frac{n_1}{p} + \frac{n_2}{q} = V$$

$$V = \frac{n_L - n_1}{R_A} - \frac{n_L - n_2}{R_B}$$

$$g = -\frac{n_1 q}{n_2 p}$$

$$\frac{n_1}{p} + \frac{n_2}{q} = \frac{n_2 - n_1}{R}$$

$$\delta_{\text{max}} = m\lambda$$

$$\delta_{\text{min}} = \left(m + \frac{1}{2}\right)\lambda$$

$$\delta = |r_2 - r_1|$$

$$\delta \approx d \sin(\theta)$$

$$\delta \approx a \sin(\theta)$$

$$\delta = \delta_e + \delta_r$$

$$\delta_{\text{min1}} = \lambda$$

$$\delta_{\text{min2}} = 2\lambda$$

$$\delta_{\text{min3}} = 3\lambda$$

$$\delta_{\text{min1}} \approx 1,22\lambda$$

$$\delta_{\text{min2}} \approx 2,23\lambda$$

$$\delta_{\text{min3}} \approx 3,24\lambda$$

$$\Delta\phi = 2\pi \left(\frac{\delta}{\lambda}\right)$$

$$\alpha_{\text{lim}} = \frac{\lambda}{a}$$

$$\alpha_{\text{lim}} = 1,22 \frac{\lambda}{D}$$

$$\lambda_1 n_1 = \lambda_2 n_2$$

$$I' = I \cos^2(\theta)$$

# Feuille de formule – Ondes et physique moderne

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

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

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

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

$$E = h f \quad E = p c \quad \lambda_f - \lambda_i = \frac{h}{m_e c} (1 - \cos(\theta)) \quad \lambda = \frac{h}{p}$$

$$I_\lambda = \frac{2 \pi h c^2}{\lambda^5 (e^{hc/\lambda kT} - 1)} \quad \lambda_{\max} = \frac{w}{T} \quad I = \sigma T^4 \quad T(K) = T(^{\circ}C) + 273,15$$

$$2 \pi r = n \lambda \quad L_z = n \hbar$$

$$E_n = -\frac{E_1}{n^2} \quad E_1 = 13,6 \text{ eV} \quad r_n = r_1 n^2 \quad r_1 = 5,292^{-11} \text{ m}$$

$$E_L = \Delta m c^2 \quad Q = (\sum m_i - \sum m_f) c^2$$

$$R = -\frac{dN}{dt} \quad R = \lambda N \quad N = N_0 e^{-\lambda t} \quad T_{1/2} = \frac{\ln(2)}{\lambda}$$

## Mathématique :

$$\vec{A} = (A_x, A_y, A_z) = A_x \vec{i} + A_y \vec{j} + A_z \vec{k}$$

$$A = |\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos(\theta) = A_x B_x + A_y B_y + A_z B_z$$

$$\vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin(\theta) \hat{n} = (A_y B_z - A_z B_y) \vec{i} - (A_x B_z - A_z B_x) \vec{j} + (A_x B_y - A_y B_x) \vec{k}$$

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$C = 2\pi r, \quad A = \pi r^2, \quad A = 4\pi r^2, \quad V = 4\pi r^3 / 3$$

$$\sin^2(\theta) + \cos^2(\theta) = 1$$

$$2 \cos \theta \sin \theta = \sin(2\theta)$$

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

$$\ln(A) + \ln(B) = \ln(AB)$$

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

## Table de dérivée et d'intégrale :

$$\frac{d x^n}{d x} = n x^{n-1}$$

$$\frac{d e^{Ax}}{d x} = A e^{Ax}$$

$$\frac{d \ln x}{d x} = \frac{1}{x}$$

$$\frac{d \cos x}{d x} = -\sin x$$

$$\frac{d \sin x}{d x} = \cos x$$

$$\frac{d \tan x}{d x} = \sec^2 x$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C$$

$$\int e^{Ax} dx = \frac{e^{Ax}}{A} + C$$

$$\int \frac{1}{x} dx = \ln|x| + C$$

$$\int \cos(x) dx = \sin(x) + C$$

$$\int \sin(x) dx = -\cos(x) + C$$

$$\int \tan(x) dx = \ln|\sec(x)| + C$$

$$\int \frac{1}{A^2 + x^2} dx = \frac{1}{A} \arctan\left(\frac{x}{A}\right) + C$$

$$\int \frac{x}{(A^2 + x^2)^{3/2}} dx = \frac{-1}{\sqrt{A^2 + x^2}} + C$$

$$\int \frac{1}{(A^2 + x^2)^{3/2}} dx = \frac{x}{A^2 \sqrt{A^2 + x^2}} + C$$

## Dérivée en chaîne :

$$\frac{d}{dx} f(y(x)) = \frac{df}{dy} \frac{dy}{dx}$$

## Dérivée d'un produit :

$$\frac{d}{dx} f(x) \cdot g(x) = \frac{df(x)}{dx} g(x) + f(x) \frac{dg(x)}{dx}$$

## Intégrale par parties :

$$\int u dv = uv - \int v du$$