PHY1524 - Mécanique

$1D$: $v(t) = v_0 + at$; $(x - x_0) = 1/2(v_0 + v)t$; $(x - x_0) = v_0 t + 1/2at^2$; $v^2 = v_0^2 + 2a(x - x_0)$
$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$; $\vec{v} = \frac{d\vec{r}}{dt} = \dot{\vec{r}}$; $\vec{a} = \frac{d\vec{v}}{dt} = \dot{\vec{v}}$; $\vec{r}\prime = \vec{r} - \vec{u}t$
$\vec{P} = m\vec{g}$; $F_R = -kx$; $\sum \vec{F} = m\vec{a}$; $\vec{F}_{AB} = -\vec{F}_{BA}$
$F_{Fstatique,max} = \mu_{statique} F_N$; $F_{Fcinétique} = \mu_{cinétique} F_N$
$\vec{a}_c = \frac{v^2}{r}\hat{r}$; $F_F = 1/2C\rho Av^2$; $v_{limite} = \sqrt{\frac{2F_g}{C\rho A}}$
$F_g = G\frac{m_1 m_2}{r^2}$; $a_g = \frac{GM}{r^2}$; $U_g(r) = -\frac{GmM}{r}$; $T^2 = \frac{4\pi^2}{GM}r^3$
$W = \vec{F} \cdot \vec{s}$; $\sum W = \sum \vec{F} \cdot \vec{s}$; $\sum W = \Delta K$; $K = 1/2mv^2$
$W_{A\to B} = \int_A^B \vec{F} \cdot d\vec{s}$; $puissance = \frac{dW}{dt}$; $W = -\Delta U$
$\vec{p} = m\vec{v}$; $\vec{F} = \dot{\vec{p}}$
$\Delta E = 0$; $E_{totale} = K + U$; $U_g = mgh$; $U_R = \frac{1}{2}kx^2$; $\Delta\vec{p} = 0$
$v_1\prime = \frac{m_1 - m_2}{m_1 + m_2}v_1 + \frac{2m_2}{m_1 + m_2}v_2$; $v_2\prime = \frac{2m_1}{m_1 + m_2}v_1 + \frac{m_2 - m_1}{m_1 + m_2}v_2$
$M = \sum m_i$; $\vec{r}_{CM} = \frac{1}{M}\sum m_i \vec{r}_i$; $\vec{r}_{CM} = \frac{1}{V}\int \vec{r}dv$
$\vec{F}_{résultante} = M\vec{a}_{CM}$

PHY1524 - Électrostatique

$\vec{F}_C = \frac{1}{4\pi\epsilon_0\epsilon_r}\frac{q_1 q_2}{r^2}\hat{r}$
$\vec{E} = \frac{\vec{F}_C}{q} = \frac{1}{4\pi\epsilon_0\epsilon_r}\frac{q_1}{r^2}\hat{r}$
$\vec{E} = \frac{1}{2\pi\epsilon_0\epsilon_r}\frac{p}{z^3}\hat{z}$
$\vec{\tau} = \vec{p} \times \vec{E}; \vec{p} = Q\vec{d}$
C $= \frac{Q}{V} = \frac{\epsilon_0 A}{s}$
$\Delta U = U_b - U_a = -W$
$\Delta V = V_b - V_a = -\frac{W}{q} = \frac{\Delta U}{q}$
$\Delta U = U_b - U_a = \int_a^b dU = -\int_a^b q_0 \vec{E} \cdot d\vec{\ell}$
$\Delta V = V_b - V_a = \frac{\Delta U}{q_0} = -\int_a^b \vec{E} \cdot d\vec{\ell}$
$V_{ponctuelle} = \frac{q}{4\pi\epsilon_0 r}$
$\vec{E} = -\vec{\nabla}V$
I $= \frac{\Delta Q}{\Delta t} = nqAv_d$
$E_x = \frac{kQx}{(x^2+a^2)^{3/2}}$
$E = \frac{q}{4\pi\epsilon_0 R^3}r$
$dE = \frac{dq}{4\pi\epsilon_0 r^2}$
$\phi = \int_S \vec{E} \cdot d\vec{A} = \int_S \vec{E} \cdot \hat{n}dA$
$\phi_{total} = \oint_S \vec{E} \cdot d\vec{A} = \frac{1}{\epsilon_0}q_{int} = 4\pi k q_{int}$
$V = IR = I\left(\frac{L}{\sigma A}\right) = I\left(\frac{\rho L}{A}\right)$
$V = -2k\lambda \ln\frac{r}{a}$
$R = \frac{L}{\sigma A} = \frac{\rho L}{A}$
$V = IR$

PHY1524 – Magnétisme

$d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\hat{u}_r}{r^2}$; $\vec{B} = \int_L \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\hat{u}_r}{r^2}$
$B = \frac{\mu_0 I}{2\pi a}$
$B = -\frac{\mu_0 I}{4\pi a}(cos(\theta_2) - cos(\theta_1))$
$B = \frac{\mu_0 NI}{l}$
$B = \frac{\mu_0 I}{2R}$
$B_x = \frac{\mu_0 IR^2}{2(x^2+R^2)^{3/2}}$
$\oint \vec{B} \cdot d\vec{l} = \mu_o I_{total}$
$\Phi_m = \int_S \vec{B} \cdot d\vec{a}$
$\vec{\tau} = I\vec{A} \times \vec{B}$
$\mathcal{E} = -\frac{d\Phi_m}{dt}$
$\mathcal{E} = -L\frac{dI}{dt}$
$\vec{F} = q\vec{v} \times \vec{B}$
$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$
$\vec{F} = I\vec{l} \times \vec{B}$
$r = \frac{|\vec{p}|}{q|\vec{B}|}$

PHY1524 - Relativité

Pour $S \to S'$ $(\vec{v} = v\hat{x})$:
$x' = \gamma(x - vt)$; $y' = y$; $z' = z$; $t' = \gamma[t - (v/c^2)x]$ $u'_x = \frac{u_x - v}{1 - u_x v/c^2}$; $u'_y = \frac{u_y}{\gamma(1 - vu_x/c^2)}$; $u'_z = \frac{u_z}{\gamma(1 - vu_x/c^2)}$
Pour $S' \to S$ $(\vec{v} = v\hat{x})$:
$x = \gamma(x' + vt')$; $y = y'$; $z = z'$; $t = \gamma[t' + (v/c^2)x']$ $u_x = \frac{u'_x + v}{1 + u'_x v/c^2}$; $u_y = \frac{u'_y}{\gamma(1 + vu'_x/c^2)}$; $u_z = \frac{u'_z}{\gamma(1 + vu'_x/c^2)}$;
$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}$
$T = \gamma T_0$; $L = L_0/\gamma$
$p = mv$; $m = \gamma m_0$; $E = m_0 c^2$
$K = E - m_0 c^2 = m_0 c^2(\gamma - 1)$; $E^2 = p^2c^2 + m_0^2 c^4$

PHY1524 - Autres formules

PHY1524 - Mathématiques

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$
$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$
$\vec{A} \cdot \vec{B} = AB\cos\theta = A_x B_x + A_y B_y + A_z B_z$
$\vec{A}X\vec{B} = AB\sin\theta\,\hat{u}$
$(1 + x)^n \approx 1 + nx$, $x \ll 1$;
$\rho = 2\pi r$; $A_{sphere} = 4\pi r^2$; $V_{sphere} = \frac{4}{3}\pi r^3$
$d(ax^n)/dx = nax^{n-1}$; $d(e^{ax})/dx = ae^{ax}$
$d\sin(ax)/dx = a\cos(ax)$; $d\cos(ax)/dx = -a\sin(ax)$
$d(ln(ax)/dx) = ax$
$\int x^n dx = \frac{x^{n+1}}{n+1}$; $n \neq -1$; $\int x^{-1}dx = ln(x)$; $\int e^{ax}dx = \frac{1}{a}e^{ax}$
$\int \cos x\, dx = sinx$; $\int \sin x\, dx = -cosx$
$\int \frac{dx}{(x^2+a^2)^{3/2}} = \frac{x}{a^2(x^2+a^2)^{1/2}}$; $\int \frac{xdx}{(x^2+a^2)^{3/2}} = \frac{-1}{(x^2+a^2)^{1/2}}$
$\int \frac{xdx}{x+a} = x - a\,ln(x + a)$; $\int \frac{dx}{\sqrt{a^2+x^2}} = ln(x + \sqrt{a^2 + x^2})$
$\int \frac{dx}{(a+bx)^2} = -\frac{1}{b(a+bx)}$;$\int \frac{xdx}{\sqrt{(x^2 \pm a^2)}} = \sqrt{x^2 \pm a^2}$

PHY1524 - Données et constantes

e = 1,602 x$10^{-19}C$; $g = 9,807\,m/s^2$
ϵ_0 = 8,854 x $10^{-12}C^2/(N \cdot m^2)$; k = 8,99 x $10^9 N \cdot m^2/C^2$
$\mu_0 = 4\pi$ x 10^{-7} T· m/A
R = 8,314 J/(K· mole)
N_A = 6,022 x 10^{23} $mole^{-1}$
m_e = 9,101 x 10^{-31}kg; m_p = 1,672 x 10^{-27}kg
k_B = 1,381 x 10^{-23} J/K
h = 6,626 x 10^{-34} $J \cdot s$; c = 2,998 x 10^8 m/s
1 atm = 1,013 x 10^5 Pa
Vitesse du son dans l'air = 343,4 m/s
$T(K) = 273,15 + T(°C)$
R_{Terre} = 6,371 x 10^6 m
ρ_{air} (à 20°C et 1 atm) = 1,21 kg/m^3
$\rho_{eau} = 10^3$ kg/m^3; ρ_{Terre} = 4,3 x 10^3 kg/m^3