PH2033 Equation Sheet

$\epsilon_0 = 8.85 \times 10^{-12} C^2/N.m^2$	$\mu_0 = 4\pi \times 10^{-7} \mathrm{T \cdot m/A}$	R = 8.314 J/mol.K = 0.082 L atm/mol.K	$k_B = 1.38 \times 10^{-23}$ J/K
$v_{\text{sound}} = 343$ m/s	$I_0 = 10^{-12}$ W/m^2	$\mathrm{N}_A = 6.02 \times 10^{23}$ mol^{-1}	1L $= 10^{-3}$ m^3
$c = 3.00 \times 10^8$ m/s	$P_{\text{atm}} = 1.013 \times 10^5$ Pa		

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\begin{aligned}
A &= \sqrt{A_x^2 + A_y^2 + A_z^2} \\
\mathbf{A} &= A_x\hat{\imath} + A_y\hat{\jmath} + A_z\hat{k} \\
\mathbf{r} &= x\hat{\imath} + y\hat{\jmath} + z\hat{k} \\
\mathbf{A}\cdot\mathbf{B} &= AB\cos\theta = A_xB_x + A_yB_y + A_zB_z \\
F_{sx} &= -kx \\
U_s &= \frac{1}{2}kx^2 \\
T = \frac{1}{f} &= \frac{2\pi}{\omega} \\
\omega^2 &= \frac{k}{m} \\
\omega^2 &= \frac{g}{l} \\
x &= A\cos(\omega t + \phi) \\
x &= Ae^{-\frac{b}{2m}t}\cos(\omega t + \phi) \\
E &= \frac{1}{2}kA^2 \\
y &= A\sin(kx \pm \omega t) \\
v &= \omega/k \\
k &= 2\pi/\lambda, \quad \omega = 2\pi f \\
v &= \sqrt{\frac{F_T}{\mu}} \\
\mathcal{P} &= \frac{1}{2}\mu\omega^2 A^2 v \\
f_1 &= \frac{v}{2L}, \frac{v}{4L} \\
\beta &= 10\log\left(\frac{I}{I_0}\right) \\
I &= \frac{1}{2}\rho\omega^2 A^2 v \\
f' &= f\left(\frac{v_{\text{snd}} \pm v_{\text{obs}}}{v_{\text{snd}} \mp v_{\text{src}}}\right) \\
E &= cB \\
u_E &= \frac{1}{2}\epsilon_0 E^2 \\
u_B &= \frac{B^2}{2\mu_0} \\
u_{\text{av}} &= \frac{1}{2}\epsilon_0 E_0^2 \\
I &= u_{\text{av}}c \\
P_r &= \frac{I}{c}, \frac{2I}{c} \\
I &= P/A \\
\frac{1}{d_o} + \frac{1}{d_i} &= \frac{1}{f} = \frac{2}{r} \\
m &= -d_i/d_o = h_i/h_o
\end{aligned}
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\begin{aligned}
\frac{1}{f} &= (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \\
n_1\sin\theta_1 &= n_2\sin\theta_2 \\
I &= I_0\cos^2\theta \\
d\sin\theta &= m\lambda \\
y_m &= m\frac{\lambda L}{d} \\
D\sin\theta &= m\lambda \\
\sin\theta &= 1.22\frac{\lambda}{D} \\
2t &= m\frac{\lambda}{n} \\
2t &= \left(m + \frac{1}{2}\right)\frac{\lambda}{n} \\
T_K &= T_C + 273 \\
\Delta l &= \alpha l_0 \Delta T \\
\Delta V &= 3\alpha V_0 \Delta T \\
PV &= nRT = Nk_BT \\
Q &= mc\Delta T \\
Q &= mL \\
W &= \int P\,dV \\
Q &= \Delta U + W \\
\Delta E_{\text{int}} &= nC_V\Delta T \\
K &= \frac{3}{2}k_BT \\
W &= nRT\ln\frac{V_2}{V_1} \\
PV^\gamma &= \text{const.} \\
\gamma &= C_P/C_V \\
C_P - C_V &= R \\
C_V &= \frac{3}{2}R,\ \frac{5}{2}R \\
v_{rms} &= \sqrt{\frac{3RT}{M}} \\
\frac{dQ}{dt} &= -kA\frac{\Delta T}{\Delta x} \\
W &= Q_H - |Q_C| \\
e &= \frac{W}{Q_H} \\
e_{\text{ideal}} &= 1 - \frac{T_L}{T_H} \\
\Delta S &= \int\frac{dQ}{T}
\end{aligned}
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