STEM Center (BLRC 200)
Academic Success Center
HCC Brandon Campus

Useful Formulae for Physics I

$v_f = v_i + at$ | $A_x = A\cos\theta$ | $\sum \mathbf{F} = m\mathbf{a}$ | $\mathbf{A}\cdot\mathbf{B} = AB\cos\theta$ | $v = mg/b(1 - e^{-bt/m})$

$\Delta x = v_i t + 1/2at^2$ | $A_y = A\sin\theta$ | $W = mg$ | $W = \int \mathbf{F}\cdot d\mathbf{x}$ | $\tau = m/b$

$\Delta x = 1/2(v_f + v_i)t$ | $\theta = \tan^{-1}(A_y/A_x)$ | $F_N = mg\cos\theta$ | $W = \Delta E$ | $R = 1/2D\rho Av^2$

$v_f^2 = v_i^2 + 2a\Delta x$ | $A = (A_x^2 + A_y^2)^{1/2}$ | $F_D = mg\sin\theta$ | $U_G = mgh$

$\rho = $ mass/volume | $a_C = v^2/r$ | $F_k = \mu_K F_N$ | $K = 1/2mv^2$

$R = v_i^2\sin(2\theta_i)/g$ | $a_T = \Delta v/\Delta t$ | $F_s \le \mu_S F_N$ | $U_S = 1/2kx^2$

$y_{max} = v_i^2\sin^2(\theta_i)/2g$ | $a = (a_C^2 + a_T^2)^{1/2}$ | $F_C = mv^2/r$ | $P = dW/dt$

$t_{up} = v_i\sin(\theta_i)/g$ | $F = -kx$ | $P_{Avg} = \Delta E/\Delta t$ | $eff = (P_{useful}/P_{in})$

$(U_S + U_G + K)_i + \sum W_{ext} - F_k d = (U_S + U_G + K)_f$

$\mathbf{p} = m\mathbf{v}$ | $\sum \mathbf{F} = d\mathbf{p}/dt$ | $\mathbf{p}_i = \mathbf{p}_f (\text{if} \sum \mathbf{F} = 0)$ | $\mathbf{I} = \int \mathbf{F}\,dt = \Delta\mathbf{p} (\text{if} \sum \mathbf{F} \ne 0)$

$s = r\theta$ | $\omega_f = \omega_i + \alpha t$ | $\sum \boldsymbol{\tau} = I\boldsymbol{\alpha}$ | $W = \int \boldsymbol{\tau}\, d\boldsymbol{\theta}$ | $\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$

$v = r\omega$ | $\Delta\theta = \omega_i t + 1/2\alpha t^2$ | $I = \sum m_i r_i^2$ | $W = \Delta E$ | $P = dW/dt$

$a_T = r\alpha$ | $\Delta\theta = 1/2(\omega_i + \omega_f)t$ | $I = \int r^2\, dm$ | $K_R = 1/2I\omega^2$ | $\mathbf{L} = I\boldsymbol{\omega}$

$a_C = r\omega^2$ | $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ | $I = I_{CM} + MD^2$ | $\Delta K_R = \sum W - \tau_f\theta$ | $\sum \boldsymbol{\tau} = d\mathbf{L}/dt$

$\mathbf{L}_i = \mathbf{L}_f (\text{if} \sum \boldsymbol{\tau} = 0)$ | $\mathbf{I} = \int \boldsymbol{\tau}\, dt = \Delta\mathbf{L} (\text{if} \sum \boldsymbol{\tau} \ne 0)$

$\mathbf{A} \times \mathbf{B} = (A_y B_z - A_z B_y)\mathbf{i} - (A_x B_z - A_z B_x)\mathbf{j} + (A_x B_y - A_y B_x)\mathbf{k}$ | $|\mathbf{A} \times \mathbf{B}| = Ab\sin\varphi$

$\mathbf{r}_{CM} = (1/M)\int \mathbf{r}\, dm$ | $x_{CM} = (1/M)\sum m_i x_i$ | $x_{CM} = (1/M)\int x\, dm$ | $y_{CM} = (1/M)\sum m_i y_i$ | $y_{CM} = (1/M)\int y\, dm$

$P = F/A$ | $F_2 = F_1(A_2/A_1)$ | $Y = (F/A)/(\Delta L/L_i)$ | $F_G = Gm_1 m_2/r^2$

$P_{abs} = P_G + P_{atm}$ | $d_2 = d_1(A_1/A_2)$ | $S = (F/A)/(\Delta x/h)$ | $g = Gm/(r+h)^2$

$P = P_0 + \rho gh$ | $B = -(\Delta F/A)/(\Delta V/V_i)$ | $T^2 = (4\pi^2/GM_S)a^3$

$VFR = A_1 v_1 = A_2 v_2$ | $P + 1/2\rho v^2 + \rho gh = const$ | $= -\Delta P/(\Delta V/V_i)$ | $U_s = -Gm_1 m_2/r$

$F = (9/5)C + 32$ | $\Delta E = mc\Delta T$ | $\Delta L = L_i\alpha\,\Delta T$ | $W = -\int P dV$

$K = C + 273.15$ | $\Delta E = mL_F$ | $\Delta V = V_i\beta\,\Delta T$ | $PV = nRT$ or $PV = Nk_B T$

$R = F + 459.67$ | $\Delta E = mL_V$ | $\Delta V = V_i 3\alpha\,\Delta T$ | $P = kA|dT/dx|$

$P = A\,\Delta T/\sum R$

Intensity = Power/Area | (R units = ft^2 hr °F/Btu)

1 mile = 1609 m | $1 m^3 = 1000$ liter | 1 HP = 746 W | $k_B = 1.38 \times 10^{-23}$ J/K

1 meter = 3.281 ft. | 1 gallon = 3.786 liter | 1 Joule = 0.738 ft. lbs. | $G = 6.673 \times 10^{-11}\ Nm^2/kg^2$

1 inch = 2.54 cm | $\rho_{water} = 1000\ kg/m^3$ | 1 Btu = 1054 J | $g = 9.8\ m/s^2$

1 lb = 4.448 N | 1 cal = 4.186 J | $A_{SPH} = 4\pi r^2$

R = 8.314 J/mol K = 0.08214 L atm/mol K

1 ATM = 101.3 kPa = 14.7 PSI = 29.92 in(Hg) = 760 mm(Hg)

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Useful Formulae for Physics II

$\omega = \sqrt{(k/m)}$
$x = A\cos(\omega t + \varphi)$
$\omega = \sqrt{(k/m) - (b/2m)^2}$
$x = Ae^{-bt/2m}\cos(\omega t + \varphi)$
$T = 2\pi\sqrt{(L/g)}$

$v = \lambda f$
$f = 1/T$
$y = A\sin(kx - \omega t)$
$k = 2\pi/\lambda$
$v = \sqrt{(T/\mu)}$

$v = \sqrt{(B/\rho)}$
$\Delta P_{max} = \rho v \omega s_{max}$
$I = \text{Power/Area}$
$I = \Delta P_{max}^2/2\rho v$
$f_n = (n/2L)\sqrt{(T/u)}$

$f' = f(v + v_O)/(v - v_S)$
$dB = 10\log(I/I_0)$
$I_0 = 1 \times 10^{-12}\,W/m^2$
$f_0 = nv/2L\ (n = 1, 2, 3, \ldots)$
$f_c = nv/4L\ (n = 1, 3, 5, \ldots)$

$F_E = (k_E\, q_1\, q_2)/r^2$
$\mathbf{E} = \mathbf{F}_E/q_0$
$\mathbf{a} = q\mathbf{E}/m$
$\Phi_E = \int \mathbf{E} \cdot \mathbf{dA} = q_{in}/\varepsilon_0$
$\Delta V = \Delta U/q_0 = -\int \mathbf{E} \cdot \mathbf{ds}$
$\Delta V = -Ed$
$k_E = 1/(4\pi\varepsilon_0)$

$C = Q/V$
$C = (\kappa\varepsilon_0\, A)/d$
$\text{Energy} = 1/2CV^2$
$\mu_E = 1/2\varepsilon_0 E^2$
$V_C = V_{APP}(1 - e^{-t/\tau})$
$\tau = RC$

$\mathbf{J} = n\, q\, v_d = \sigma\mathbf{E}$
$I = dQ/dt$
$I = V/R$
$R = \rho L/A$
$\rho = \rho_0[1 + \alpha(T - T_0)]$
$P = IV = V^2/R = I^2R$

$\mathbf{F}_B = q\mathbf{v} \times \mathbf{B}$
$\mathbf{F}_B = I\mathbf{L} \times \mathbf{B}$(long I − carrying wire)
$F_B/L = \mu_0\, I_1 I_2/2\pi a$(parallel wires)
$B = \mu_0 I/2\Pi a$(long wire)
$B = (\mu_0 I/4\pi R)\theta$ (circular section)
$B = \mu_0 NI/L = \mu_0 nI$ (solenoid)
$B = \mu_0 NI/2\Pi r$ (toroid)
$\mu_N = \mu_0(1 + \chi)$
$\boldsymbol{\tau} = I\,\mathbf{A} \times \mathbf{B}$
$\boldsymbol{\mu} = I\,\mathbf{A}$
$\boldsymbol{\tau} = \boldsymbol{\mu} \times \mathbf{B}$
$U = -\boldsymbol{\mu} \cdot \mathbf{B}$
$\mu_B = 1/2B^2/\mu_0$

$E_L = -L\, dI/dt$
$L = N\Phi_B/I$
$\text{Energy} = 1/2\, LI^2$

$I = I_0 e^{-t/\tau}$
$I_0 = V/R$
$\tau = L/R$

$M_{12} = N_2\, \Phi_{12}/I_1$
$E_2 = -M_{12}\, dI_1/dt$

$r = mv/qB$
$\omega = v/r = qB/m$
$T = 2\pi/\omega = 2\pi m/qB$

$\Phi_B = \int \mathbf{B} \cdot \mathbf{dA}$
$EMF = -N\, d\Phi_B/dt$
$EMF = -BLv$

Series Resistors	Parallel Resistors	Series Capacitors	Parallel Capacitors
$V_T = V1 + V2 + \cdots$	$V_T = V1 = V2 = \cdots$	$V_T = V1 + V2 + \cdots$	$V_T = V1 = V2 = \cdots$
$R_T = R1 + R2 + \cdots$	$1\backslash R_T = 1/R_1 + 1/R_2 + \cdots$	$1\backslash C_T = 1/C_1 + 1/C_2 + \cdots$	$C_T = C1 + C2 + \cdots$
$I_T = I_1 = I_2 = \cdots$	$I_T = I_1 + I_2 + \cdots$	$Q_T = Q1 = Q2 = \cdots$	$Q_T = Q1 + Q2 + \cdots$

Series and parallel combinations of inductors follow the same rules as resistors.

$V_{RMS} = 0.707\, V_{MAX}$
$I_{RMS} = 0.707\, I_{RMS}$

$X_L = \omega L$
$X_C = 1/\omega C$

$Z = (R^2 + (X_L - X_C)^2)^{1/2}$
$I_{RMS} = V_{RMS}/Z$

$P_{AV} = I_{RMS} V_{RMS} \cos\varphi$
$\varphi = \tan^{-1}((X_L - X_C)/R)$

$\text{Intensity} = \text{Power/Area} = S_{AV} = (E_{MAX}\ B_{MAX})/(2\mu_0) = E_{MAX}^2/(2\mu_0 c) = (c\, B_{MAX}^2)/(2\mu_0)$

$\mathbf{S} = (1/\mu_0)\, \mathbf{E} \times \mathbf{B}$
$c = 1/\sqrt{(\mu_0\varepsilon_0)}$
$S/c \le \text{Pressure} \le 2S/c$

$v = f\lambda$
$v = c/n$
$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$\sin\theta_C = n_2/n_1$

$1/f = 1/p + 1/q$
$1/f = (n - 1)(1/R_1 - 1/R_2)$
$M = h_i/h_o = -q/p$

$m\lambda = d\sin\theta_{Br}$
$(m + 1/2)\lambda = d\sin\theta_{Dk}$
$* \; 2nt = (m + 1/2)\lambda_{Br}$
$* \; 2nt = m\,\lambda_{Dk}$

$\theta_{min} = 1.22\lambda/D$

$c = 3 \times 10^8\ m/s$
$k_E = 8.987 \times 10^9\ Nm^2/C^2$
$\varepsilon_0 = 8.854 \times 10^{-12}\ C^2/Nm^2$
$\mu_0 = 4\pi \times 10^{-7}\ Tm/A$
$q_e = 1.6 \times 10^{-19}\ C$

$m_n = 1.675 \times 10^{-27}\ kg$
$m_p = 1.673 \times 10^{-27}\ kg$
$m_e = 9.1 \times 10^{-31}\ kg$
$1eV = 1.6 \times 10^{-19}\ J$

$v_{Sound} = 331.5 + 0.6T_c\ m/s$
1 meter = 3.281 ft
1 mile = 1609 m
$1m^3 = 1000$ liter

$A_{sph} = 4\,\pi\, r^2$

* = These formulae assume $n_1 < n_2 > n_3$