AP B Physics Equation Sheet

You may use this equation sheet on tests and quizzes unless told otherwise by the teacher. Try not to use it as a crutch but rather as an occasional jog for your memory. You have to know what the symbols mean, when you can use the equations, and what methods to apply.

Equations on this sheet may be used as starting equations for solving problems. If the equation you want to use isn't on this sheet, you're not allowed to use it as a starting point.

1-Dimensional Kinematics

$$v_{av} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \qquad a_{av} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} \qquad v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} \qquad a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$$

$$v_{av} = \tfrac{1}{2}(v_o + v) \qquad v = v_o + at \qquad x = x_o + \tfrac{1}{2}(v_o + v)t$$

$$x = x_o + v_o t + \tfrac{1}{2}at^2 \qquad v^2 = v_o^2 + 2a(x - x_o) \qquad x = x_o + vt - \tfrac{1}{2}at^2$$

Math

$$\cos\theta = \frac{side\,adjacent}{hypotenuse} \qquad \sin\theta = \frac{side\,opposite}{hypotenuse} \qquad \tan\theta = \frac{side\,opposite}{side\,adjacent} = \frac{\sin\theta}{\cos\theta}$$

$$\sin^2\theta + \cos^2\theta = 1 \qquad \cos(\theta + 90°) = \sin\theta \qquad \cos(90° - \theta) = \sin\theta$$

$$a^2 + b^2 = c^2 \qquad C = 2\pi r \qquad A = \pi r^2$$

$$\sin 30° = \cos 60° = 0.5 \qquad \sin 60° = \cos 30° = \sqrt{3}/2 \qquad \sin 45° = \cos 45° = \sqrt{2}/2$$

Constants

$g = 9.81\ m/s^2$

2-Dimensional Kinematics

No new equations are needed for 2-dimensional motion. The 1-dimensional equations given above are applied individually to horizontal and vertical dimensions. One simply inserts distinguishing x and y subscripts. The usual simplification for projectiles is that the horizontal acceleration is zero.

Equations such as 4-9 and 4-12 in the text may not be used as starting points in solving problems. You must start with the usual dvats.

Forces

$$\vec{a} = \frac{\sum \vec{F}}{m} \quad \text{or} \quad \vec{F}_{net} = m\vec{a} \qquad W = mg$$

In component form, $\vec{a}_x = \frac{\sum \vec{F}_x}{m}$ $\quad \vec{a}_y = \frac{\sum \vec{F}_y}{m}$, or $F_{net,x} = ma_x$ $\quad F_{net,y} = ma_y$

$$f_S <= \mu_S N \qquad f_k = \mu_k N \qquad F = kx \text{ (magnitude)} \qquad a = v^2/r \qquad v = 2\pi R/T$$

Work and Energy

$$K = \tfrac{1}{2} mv^2 \qquad \Delta U = -W_c \qquad W_{net} = \Delta K \qquad P = W/t = Fv$$

$$E = U + K \qquad W_{ext} = \Delta E_{sys} \qquad U_s = \tfrac{1}{2}kx^2 \qquad U_g = mgy$$

Momentum and Collisions

$\vec{p} = m\vec{v}$ $\quad \vec{F}_{net} = \frac{\Delta\vec{p}}{\Delta t}$ $\quad \vec{I} = \Delta\vec{p}$ $\quad \vec{P}_{tot} = \vec{p}_1 + \vec{p}_2 + \vec{p}_3 + \ldots$ $\quad \vec{P}_i = \vec{P}_f$

Rotational Kinematics

$f = 1/T$ $\quad \omega_{av} = \frac{\Delta\theta}{\Delta t}$ $\quad \alpha_{av} = \frac{\Delta\omega}{\Delta t}$ $\quad T = \frac{2\pi}{\omega}$ $\quad v = R\omega$ $\quad a_t = R\alpha_t$ $\quad a_{cp} = R\varpi^2$ $\quad \tau = r_\perp F$

Gravitation

$F_g = \frac{Gm_1m_2}{r^2}$ $\quad G = 6.67 \times 10^{-11}$ Nm²/kg² $\quad g = \frac{GM}{R^2}$ $\quad U = -\frac{GmM}{R}$ $\quad T = \left(\frac{2\pi}{\sqrt{GM}}\right)R^{3/2}$

Oscillations

$x = A\cos(\omega t + \phi)$ $\quad T = 2\pi\sqrt{\frac{m}{k}}$ $\quad T = 2\pi\sqrt{\frac{L}{g}}$

Fluids

$\rho = M/V$ $\quad P = F/A$ $\quad P_{gauge} = P - P_{atm}$ $\quad P_2 = P_1 + \rho gh$ $\quad \rho_1 A_1 v_1 = \rho_2 A_2 v_2$

$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$ $\quad v = (2gh)^{1/2}$ (Torricelli's Law) $\quad$ 1 atm = 1.01×10^5 Pa

Temperature, Heat, and Gases

$T_C = (5/9)(T_F - 32)$ $\quad T = T_C + 273.15$ $\quad \Delta L = \alpha L_o \Delta T$ $\quad$ 1 kC = 4186 J $\quad C = Q/\Delta T$

$c = Q/m\Delta T$ $\quad Q = kA(\Delta T/L)t$ $\quad PV = NkT = nRT$ $\quad N_A = 6.022 \times 10^{23}$ $\quad R = 8.31$ J/(mol·K)

$k = 1.38 \times 10^{-23}$ J/K $\quad M = N_A m$ $\quad (\frac{1}{2}mv^2)_{av} = 3kT/2$ $\quad U = 3nRT/2$ $\quad \Delta U = Q - W$

$W = nRT\ln(V_f/V_i)$ $\quad Q = P_{ave}\Delta V$ $\quad e = W/Q_h$ $\quad e = 1 - T_c/T_h$ (Carnot) $\quad COP = Q_c/W$ or Q_h/W

Electrostatics

$F_{el} = k\frac{|q_1||q_2|}{r^2}$ $\quad \vec{E} = \vec{F}_{el}/q$ $\quad k = 8.99 \times 10^9$ Nm²/C² $\quad e = 1.6 \times 10^{-19}$ C

$\Delta V = \Delta U/q_o$ $\quad E = -\Delta V/\Delta s$ $\quad V = kq/r$ $\quad U = kqq_o/r$ $\quad C = Q/V$

$C = \varepsilon_o A/d$ $\quad U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}Q^2/C$

Circuits

$I = \Delta Q/\Delta t$ $\quad R = V/I$ $\quad R = \rho\frac{L}{A}$ $\quad P = IV = I^2R = V^2/R$

$R_{eq} = \sum_{j=1}^{n} R_j$ $\quad \frac{1}{R_{eq}} = \sum_{j=1}^{n}\frac{1}{R_j}$ $\quad C_{eq} = \sum_{j=1}^{n} C_j$ $\quad \frac{1}{C_{eq}} = \sum_{j=1}^{n}\frac{1}{C_j}$

Magnetism

$F_{mag} = |q|vB\sin\theta$ $\quad F_{mag} = ILB\sin\theta$ $\quad \tau = NIAB\sin\theta$ $\quad \mu_o = 4\pi \times 10^{-7}$ Tm/A

$$B=\frac{\mu_o I}{2\pi r} \qquad F=\frac{\mu_o I_1 I_2}{2\pi d}L \qquad B=\frac{N\mu_o I}{2R} \qquad B=\mu_o nI,\ \ n=N/L$$

$$\Phi=BA\cos\theta \qquad emf=-N\frac{\Delta\Phi}{\Delta t} \qquad |emf|=Bvl \qquad \frac{I_s}{I_p}=\frac{V_p}{V_s}=\frac{N_p}{N_s}$$

Waves

$$v=f\lambda \qquad v=\sqrt{F/\mu} \qquad y(t)=A\cos\left(\frac{2\pi}{T}t\right) \qquad y(x,t)=A\cos\left(\frac{2\pi}{\lambda}x-\frac{2\pi}{T}t\right)$$

$$I=P/A \qquad I=P/4\pi r^2 \qquad \beta=10\log(I/I_o) \qquad f_{beat}=|f_i-f_2|$$

$$f'=(1\pm u/v)f\ \ (moving\ observer) \qquad f'=\left(\frac{1}{1\pm u/v}\right)f\ \ (moving\ source)$$

Optics

$$v=c/n \qquad n_1\sin\theta_1=n_2\sin\theta_2 \qquad f=½R \qquad \frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f} \qquad m=-\frac{d_i}{d_o}$$

$$d\sin\theta=m\lambda\ \ or\ \ (m-½)\lambda \qquad W\sin\theta=m\lambda \qquad \sin\theta=1.22\lambda/D$$