## ADVANCED PLACEMENT PHYSICS B EQUATIONS FOR 2006 and 2007

### NEWTONIAN MECHANICS

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

$v^2 = v_0^2 + 2a(x - x_0)$

$\Sigma \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$

$F_{fric} \leq \mu N$

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

$\tau = rF \sin\theta$

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

$\mathbf{J} = \mathbf{F}\Delta t = \Delta\mathbf{p}$

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

$\Delta U_g = mgh$

$W = F\Delta r \cos\theta$

$P_{avg} = \frac{W}{\Delta t}$

$P = Fv\cos\theta$

$\mathbf{F}_s = -k\mathbf{x}$

$U_s = \frac{1}{2}kx^2$

$T_s = 2\pi\sqrt{\frac{m}{k}}$

$T_p = 2\pi\sqrt{\frac{\ell}{g}}$

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

$F_G = -\frac{Gm_1m_2}{r^2}$

$U_G = -\frac{Gm_1m_2}{r}$

$a$ = acceleration
$F$ = force
$f$ = frequency
$h$ = height
$J$ = impulse
$K$ = kinetic energy
$k$ = spring constant
$\ell$ = length
$m$ = mass
$N$ = normal force
$P$ = power
$p$ = momentum
$r$ = radius or distance
$\mathbf{r}$ = position vector
$T$ = period
$t$ = time
$U$ = potential energy
$v$ = velocity or speed
$W$ = work done on a system
$x$ = position
$\mu$ = coefficient of friction
$\theta$ = angle
$\tau$ = torque

### ELECTRICITY AND MAGNETISM

$F = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r^2}$

$\mathbf{E} = \frac{\mathbf{F}}{q}$

$U_E = qV = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r}$

$E_{avg} = -\frac{V}{d}$

$V = \frac{1}{4\pi\epsilon_0}\sum_i \frac{q_i}{r_i}$

$C = \frac{Q}{V}$

$C = \frac{\epsilon_0 A}{d}$

$U_c = \frac{1}{2}QV = \frac{1}{2}CV^2$

$I_{avg} = \frac{\Delta Q}{\Delta t}$

$R = \frac{\rho\ell}{A}$

$V = IR$

$P = IV$

$C_p = \sum_i C_i$

$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$

$R_s = \sum_i R_i$

$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$

$F_B = qvB\sin\theta$

$F_B = BI\ell\sin\theta$

$B = \frac{\mu_0}{2\pi}\frac{I}{r}$

$\phi_m = BA\cos\theta$

$\mathcal{E}_{avg} = -\frac{\Delta\phi_m}{\Delta t}$

$\mathcal{E} = B\ell v$

$A$ = area
$B$ = magnetic field
$C$ = capacitance
$d$ = distance
$E$ = electric field
$\mathcal{E}$ = emf
$F$ = force
$I$ = current
$\ell$ = length
$P$ = power
$Q$ = charge
$q$ = point charge
$R$ = resistance
$r$ = distance
$t$ = time
$U$ = potential (stored) energy
$V$ = electric potential or potential difference
$v$ = velocity or speed
$\rho$ = resistivity
$\phi_m$ = magnetic flux

# ADVANCED PLACEMENT PHYSICS B EQUATIONS FOR 2006 and 2007

## FLUID MECHANICS AND THERMAL PHYSICS

$P = P_0 + \rho gh$

$F_{buoy} = \rho Vg$

$A_1 v_1 = A_2 v_2$

$P + \rho gy + \frac{1}{2}\rho v^2 = \text{const.}$

$\Delta \ell = \alpha \ell_0 \Delta T$

$H = \frac{kA\Delta T}{L}$

$P = \frac{F}{A}$

$PV = nRT = Nk_BT$

$K_{avg} = \frac{3}{2}k_BT$

$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{\mu}}$

$W = -P\Delta V$

$\Delta U = Q + W$

$e = \left|\frac{W}{Q_H}\right|$

$e_c = \frac{T_H - T_C}{T_H}$

$A$ = area
$e$ = efficiency
$F$ = force
$h$ = depth
$H$ = rate of heat transfer
$k$ = thermal conductivity
$K_{avg}$ = average molecular kinetic energy
$\ell$ = length
$L$ = thickness
$M$ = molar mass
$n$ = number of moles
$N$ = number of molecules
$P$ = pressure
$Q$ = heat transferred to a system
$T$ = temperature
$U$ = internal energy
$V$ = volume
$v$ = velocity or speed
$v_{rms}$ = root-mean-square velocity
$W$ = work done on a system
$y$ = height
$\alpha$ = coefficient of linear expansion
$\mu$ = mass of molecule
$\rho$ = density

## ATOMIC AND NUCLEAR PHYSICS

$E = hf = pc$

$K_{\max} = hf - \phi$

$\lambda = \frac{h}{p}$

$\Delta E = (\Delta m)c^2$

$E$ = energy
$f$ = frequency
$K$ = kinetic energy
$m$ = mass
$p$ = momentum
$\lambda$ = wavelength
$\phi$ = work function

## WAVES AND OPTICS

$v = f\lambda$

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

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

$\sin\theta_c = \frac{n_2}{n_1}$

$\frac{1}{s_i} + \frac{1}{s_0} = \frac{1}{f}$

$M = \frac{h_i}{h_0} = -\frac{s_i}{s_0}$

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

$d\sin\theta = m\lambda$

$x_m \sim \frac{m\lambda L}{d}$

$d$ = separation
$f$ = frequency or focal length
$h$ = height
$L$ = distance
$M$ = magnification
$m$ = an integer
$n$ = index of refraction
$R$ = radius of curvature
$s$ = distance
$v$ = speed
$x$ = position
$\lambda$ = wavelength
$\theta$ = angle

## GEOMETRY AND TRIGONOMETRY

Rectangle
$A = bh$
Triangle
$A = \frac{1}{2}bh$
Circle
$A = \pi r^2$
$C = 2\pi r$
Parallelepiped
$V = \ell wh$
Cylinder
$V = \pi r^2 \ell$
$S = 2\pi r\ell + 2\pi r^2$
Sphere
$V = \frac{4}{3}\pi r^3$
$S = 4\pi r^2$
Right Triangle
$a^2 + b^2 = c^2$
$\sin\theta = \frac{a}{c}$
$\cos\theta = \frac{b}{c}$
$\tan\theta = \frac{a}{b}$

$A$ = area
$C$ = circumference
$V$ = volume
$S$ = surface area
$b$ = base
$h$ = height
$\ell$ = length
$w$ = width
$r$ = radius