

ADVANCED PLACEMENT PHYSICS B EQUATIONS DEVELOPED FOR 2012

NEWTONIAN MECHANICS

$$v = v_0 + at$$

$$x = x_0 + v_0t + \frac{1}{2}at^2$$

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

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

$$F_{fric} \leq \mu N$$

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

$$\tau = rF \sin \theta$$

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

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

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

$$\Delta U_g = mgh$$

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

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

$$P = Fv \cos \theta$$

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

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

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

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

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

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

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

a = acceleration
 F = force
 f = frequency
 h = height
 J = impulse
 K = kinetic energy
 k = spring constant
 ℓ = length
 m = mass
 N = normal force
 P = power
 p = momentum
 r = radius or distance
 T = period
 t = time
 U = potential energy
 v = velocity or speed
 W = work done on a system
 x = position
 μ = coefficient of friction
 θ = angle
 τ = torque

ELECTRICITY AND MAGNETISM

$$F = \frac{kq_1q_2}{r^2}$$

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

$$U_E = qV = \frac{kq_1q_2}{r}$$

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

$$V = k\left(\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} + \dots\right)$$

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

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

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

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

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

$$V = IR$$

$$P = IV$$

$$C_p = C_1 + C_2 + C_3 + \dots$$

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$$

$$R_s = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$F_B = qvB \sin \theta$$

$$F_B = BIl \sin \theta$$

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

$$\phi_m = BA \cos \theta$$

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

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

A = area
 B = magnetic field
 C = capacitance
 d = distance
 E = electric field
 \mathcal{E} = emf
 F = force
 I = current
 ℓ = 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
 ρ = resistivity
 θ = angle
 ϕ_m = magnetic flux

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FLUID MECHANICS AND THERMAL PHYSICS

$\rho = m/V$	$A = \text{area}$
$P = P_0 + \rho gh$	$e = \text{efficiency}$
$F_{buoy} = \rho Vg$	$F = \text{force}$
$A_1v_1 = A_2v_2$	$h = \text{depth}$
$P + \rho gy + \frac{1}{2}\rho v^2 = \text{const.}$	$H = \text{rate of heat transfer}$
$\Delta \ell = \alpha \ell_0 \Delta T$	$k = \text{thermal conductivity}$
$H = \frac{kA\Delta T}{L}$	$K_{avg} = \text{average molecular kinetic energy}$
$P = \frac{F}{A}$	$\ell = \text{length}$
$PV = nRT = Nk_B T$	$L = \text{thickness}$
$K_{avg} = \frac{3}{2}k_B T$	$m = \text{mass}$
$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_B T}{\mu}}$	$M = \text{molar mass}$
$W = -P\Delta V$	$n = \text{number of moles}$
$\Delta U = Q + W$	$N = \text{number of molecules}$
$e = \left \frac{W}{Q_H} \right $	$P = \text{pressure}$
$e_c = \frac{T_H - T_C}{T_H}$	$Q = \text{heat transferred to a system}$
	$T = \text{temperature}$
	$U = \text{internal energy}$
	$V = \text{volume}$
	$v = \text{velocity or speed}$
	$v_{rms} = \text{root-mean-square velocity}$
	$W = \text{work done on a system}$
	$y = \text{height}$
	$\alpha = \text{coefficient of linear expansion}$
	$\mu = \text{mass of molecule}$
	$\rho = \text{density}$

ATOMIC AND NUCLEAR PHYSICS

$E = hf = pc$	$E = \text{energy}$
$K_{max} = hf - \phi$	$f = \text{frequency}$
$\lambda = \frac{h}{p}$	$K = \text{kinetic energy}$
$\Delta E = (\Delta m)c^2$	$m = \text{mass}$
	$p = \text{momentum}$
	$\lambda = \text{wavelength}$
	$\phi = \text{work function}$

WAVES AND OPTICS

$v = f\lambda$	$d = \text{separation}$
$n = \frac{c}{v}$	$f = \text{frequency or focal length}$
$n_1 \sin \theta_1 = n_2 \sin \theta_2$	$h = \text{height}$
$\sin \theta_c = \frac{n_2}{n_1}$	$L = \text{distance}$
$\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f}$	$M = \text{magnification}$
$M = \frac{h_i}{h_o} = -\frac{s_i}{s_o}$	$m = \text{an integer}$
$f = \frac{R}{2}$	$n = \text{index of refraction}$
$d \sin \theta = m\lambda$	$R = \text{radius of curvature}$
$x_m \approx \frac{m\lambda L}{d}$	$s = \text{distance}$
	$v = \text{speed}$
	$x = \text{position}$
	$\lambda = \text{wavelength}$
	$\theta = \text{angle}$

GEOMETRY AND TRIGONOMETRY

Rectangle	$A = \text{area}$
$A = bh$	$C = \text{circumference}$
Triangle	$V = \text{volume}$
$A = \frac{1}{2}bh$	$S = \text{surface area}$
Circle	$b = \text{base}$
$A = \pi r^2$	$h = \text{height}$
$C = 2\pi r$	$\ell = \text{length}$
Rectangular Solid	$w = \text{width}$
$V = \ell wh$	$r = \text{radius}$
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

$$a^2 + b^2 = c^2$$

$$\sin \theta = \frac{a}{c}$$

$$\cos \theta = \frac{b}{c}$$

$$\tan \theta = \frac{a}{b}$$

