

TABLE OF INFORMATION DEVELOPED FOR 2012 (see note on cover page)

CONSTANTS AND CONVERSION FACTORS	
Proton mass, $m_p = 1.67 \times 10^{-27}$ kg	Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C
Neutron mass, $m_n = 1.67 \times 10^{-27}$ kg	1 electron volt, $1 \text{ eV} = 1.60 \times 10^{-19}$ J
Electron mass, $m_e = 9.11 \times 10^{-31}$ kg	Speed of light, $c = 3.00 \times 10^8$ m/s
Avogadro's number, $N_0 = 6.02 \times 10^{23}$ mol ⁻¹	Universal gravitational constant, $G = 6.67 \times 10^{-11}$ m ³ /kg·s ²
Universal gas constant, $R = 8.31$ J/(mol·K)	Acceleration due to gravity at Earth's surface, $g = 9.8$ m/s ²
Boltzmann's constant, $k_B = 1.38 \times 10^{-23}$ J/K	
1 unified atomic mass unit,	$1 \text{ u} = 1.66 \times 10^{-27}$ kg = 931 MeV/c ²
Planck's constant,	$h = 6.63 \times 10^{-34}$ J·s = 4.14×10^{-15} eV·s
	$hc = 1.99 \times 10^{-25}$ J·m = 1.24×10^3 eV·nm
Vacuum permittivity,	$\epsilon_0 = 8.85 \times 10^{-12}$ C ² /N·m ²
Coulomb's law constant, $k = 1/4\pi\epsilon_0 = 9.0 \times 10^9$ N·m ² /C ²	
Vacuum permeability,	$\mu_0 = 4\pi \times 10^{-7}$ (T·m)/A
Magnetic constant, $k' = \mu_0/4\pi = 1 \times 10^{-7}$ (T·m)/A	
1 atmosphere pressure,	$1 \text{ atm} = 1.0 \times 10^5$ N/m ² = 1.0×10^5 Pa

UNIT SYMBOLS	meter,	m	mole,	mol	watt,	W	farad,	F
	kilogram,	kg	hertz,	Hz	coulomb,	C	tesla,	T
	second,	s	newton,	N	volt,	V	degree Celsius,	°C
	ampere,	A	pascal,	Pa	ohm,	Ω	electron-volt,	eV
	kelvin,	K	joule,	J	henry,	H		

PREFIXES		
Factor	Prefix	Symbol
10 ⁹	giga	G
10 ⁶	mega	M
10 ³	kilo	k
10 ⁻²	centi	c
10 ⁻³	milli	m
10 ⁻⁶	micro	μ
10 ⁻⁹	nano	n
10 ⁻¹²	pico	p

VALUES OF TRIGONOMETRIC FUNCTIONS FOR COMMON ANGLES							
θ	0°	30°	37°	45°	53°	60°	90°
$\sin \theta$	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1
$\cos \theta$	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0
$\tan \theta$	0	$\sqrt{3}/3$	3/4	1	4/3	$\sqrt{3}$	∞

The following conventions are used in this exam.

- I. Unless otherwise stated, the frame of reference of any problem is assumed to be inertial.
- II. The direction of any electric current is the direction of flow of positive charge (conventional current).
- III. For any isolated electric charge, the electric potential is defined as zero at an infinite distance from the charge.
- *IV. For mechanics and thermodynamics equations, W represents the work done on a system.

*Not on the Table of Information for Physics C, since Thermodynamics is not a Physics C topic.

ADVANCED PLACEMENT PHYSICS B EQUATIONS DEVELOPED FOR 2012

NEWTONIAN MECHANICS	ELECTRICITY AND MAGNETISM
$v = v_0 + at$ $x = x_0 + v_0t + \frac{1}{2}at^2$ $v^2 = v_0^2 + 2a(x - x_0)$ $\Sigma \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$ $F_{fric} \leq \mu N$ $a_c = \frac{v^2}{r}$ $\tau = rF \sin \theta$ $\mathbf{p} = m\mathbf{v}$ $\mathbf{J} = \mathbf{F}\Delta t = \Delta \mathbf{p}$ $K = \frac{1}{2}mv^2$ $\Delta U_g = mgh$ $W = F\Delta r \cos \theta$ $P_{avg} = \frac{W}{\Delta t}$ $P = Fv \cos \theta$ $\mathbf{F}_s = -k\mathbf{x}$ $U_s = \frac{1}{2}kx^2$ $T_s = 2\pi\sqrt{\frac{m}{k}}$ $T_p = 2\pi\sqrt{\frac{\ell}{g}}$ $T = \frac{1}{f}$ $F_G = -\frac{Gm_1m_2}{r^2}$ $U_G = -\frac{Gm_1m_2}{r}$	$F = \frac{kq_1q_2}{r^2}$ $\mathbf{E} = \frac{\mathbf{F}}{q}$ $U_E = qV = \frac{kq_1q_2}{r}$ $E_{avg} = -\frac{V}{d}$ $V = k\left(\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} + \dots\right)$ $C = \frac{Q}{V}$ $C = \frac{\epsilon_0 A}{d}$ $U_c = \frac{1}{2}QV = \frac{1}{2}CV^2$ $I_{avg} = \frac{\Delta Q}{\Delta t}$ $R = \frac{\rho \ell}{A}$ $V = IR$ $P = IV$ $C_p = C_1 + C_2 + C_3 + \dots$ $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$ $R_s = R_1 + R_2 + R_3 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$ $F_B = qvB \sin \theta$ $F_B = BI\ell \sin \theta$ $B = \frac{\mu_0 I}{2\pi r}$ $\phi_m = BA \cos \theta$ $\mathcal{E}_{avg} = -\frac{\Delta \phi_m}{\Delta t}$ $\mathcal{E} = B\ell v$
$a =$ 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 $T =$ 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	$A =$ 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 $\theta =$ angle $\phi_m =$ magnetic flux

ADVANCED PLACEMENT PHYSICS B EQUATIONS DEVELOPED FOR 2012

FLUID MECHANICS AND THERMAL PHYSICS

$$\rho = m/V$$

$$P = P_0 + \rho gh$$

$$F_{buoy} = \rho Vg$$

$$A_1 v_1 = A_2 v_2$$

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

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

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

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

$$PV = nRT = Nk_B T$$

$$K_{avg} = \frac{3}{2} k_B T$$

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

$$W = -P\Delta V$$

$$\Delta U = Q + W$$

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

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

A = area

e = efficiency

F = force

h = depth

H = rate of heat transfer

k = thermal conductivity

K_{avg} = average molecular kinetic energy

ℓ = length

L = thickness

m = mass

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

α = coefficient of linear expansion

μ = mass of molecule

ρ = 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

λ = wavelength

ϕ = work function

WAVES AND OPTICS

$$v = f\lambda$$

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

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

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

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

$$M = \frac{h_i}{h_o} = -\frac{s_i}{s_o}$$

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

$$d \sin \theta = m\lambda$$

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

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

λ = wavelength

θ = angle

GEOMETRY AND TRIGONOMETRY

Rectangle

$$A = bh$$

Triangle

$$A = \frac{1}{2}bh$$

Circle

$$A = \pi r^2$$

$$C = 2\pi r$$

Rectangular Solid

$$V = \ell wh$$

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

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

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

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

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

