

ADVANCED PLACEMENT PHYSICS C TABLE OF INFORMATION

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, $G = 6.67 \times 10^{-11} (\text{N}\cdot\text{m}^2)/\text{kg}^2$
Universal gas constant, $R = 8.31 \text{ J}/(\text{mol}\cdot\text{K})$	Acceleration due to gravity at Earth's surface, $g = 9.8 \text{ m/s}^2$
Boltzmann's constant, $k_B = 1.38 \times 10^{-23} \text{ J/K}$	
1 unified atomic mass unit, $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg} = 931 \text{ MeV}/c^2$	
Planck's constant, $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s} = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s}$	
Vacuum permittivity, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{N}\cdot\text{m}^2)$	$hc = 1.99 \times 10^{-25} \text{ J}\cdot\text{m} = 1.24 \times 10^3 \text{ eV}\cdot\text{nm}$
Coulomb's law constant, $k = 1/(4\pi\epsilon_0) = 9.0 \times 10^9 (\text{N}\cdot\text{m}^2)/\text{C}^2$	
Vacuum permeability, $\mu_0 = 4\pi \times 10^{-7} (\text{T}\cdot\text{m})/\text{A}$	
Magnetic constant, $k' = \mu_0/(4\pi) = 1 \times 10^{-7} (\text{T}\cdot\text{m})/\text{A}$	
1 atmosphere pressure, $1 \text{ atm} = 1.0 \times 10^5 \text{ N/m}^2 = 1.0 \times 10^5 \text{ Pa}$	

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 assumptions are used in this exam.

- I. The frame of reference of any problem is inertial unless otherwise stated.
- II. The direction of current is the direction in which positive charges would drift.
- III. The electric potential is zero at an infinite distance from an isolated point charge.
- IV. All batteries and meters are ideal unless otherwise stated.
- V. Edge effects for the electric field of a parallel plate capacitor are negligible unless otherwise stated.

ADVANCED PLACEMENT PHYSICS C EQUATIONS

MECHANICS	ELECTRICITY AND MAGNETISM
$v_x = v_{x0} + a_x t$	$a = \text{acceleration}$
$x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$	$E = \text{energy}$
$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$	$F = \text{force}$
$\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{\text{net}}}{m}$	$f = \text{frequency}$
$\vec{F} = \frac{d\vec{p}}{dt}$	$h = \text{height}$
$\vec{J} = \int \vec{F} dt = \Delta \vec{p}$	$I = \text{rotational inertia}$
$\vec{p} = m\vec{v}$	$J = \text{impulse}$
$ \vec{F}_f \leq \mu \vec{F}_N $	$K = \text{kinetic energy}$
$\Delta E = W = \int \vec{F} \cdot d\vec{r}$	$k = \text{spring constant}$
$K = \frac{1}{2}mv^2$	$\ell = \text{length}$
$P = \frac{dE}{dt}$	$L = \text{angular momentum}$
$P = \vec{F} \cdot \vec{v}$	$m = \text{mass}$
$\Delta U_g = mg\Delta h$	$P = \text{power}$
$a_c = \frac{v^2}{r} = \omega^2 r$	$P = \text{power}$
$\vec{\tau} = \vec{r} \times \vec{F}$	$Q = \text{charge}$
$\vec{\alpha} = \frac{\sum \vec{\tau}}{I} = \frac{\vec{\tau}_{\text{net}}}{I}$	$q = \text{point charge}$
$I = \int r^2 dm = \sum mr^2$	$R = \text{resistance}$
$x_{cm} = \frac{\sum m_i x_i}{\sum m_i}$	$r = \text{radius or distance}$
$v = r\omega$	$t = \text{time}$
$\vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}$	$U = \text{potential or stored energy}$
$K = \frac{1}{2}I\omega^2$	$V = \text{electric potential}$
$\omega = \omega_0 + \alpha t$	$v = \text{velocity or speed}$
$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$	$\rho = \text{resistivity}$
	$\Phi = \text{flux}$
	$\kappa = \text{dielectric constant}$
	$\vec{F}_M = q\vec{v} \times \vec{B}$
	$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$
	$d\vec{B} = \frac{\mu_0}{4\pi} \frac{Id\vec{l} \times \hat{r}}{r^2}$
	$\vec{F} = \int I d\vec{l} \times \vec{B}$
	$B_s = \mu_0 nI$
	$\Phi_B = \int \vec{B} \cdot d\vec{A}$
	$\boldsymbol{\epsilon} = \oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$
	$\boldsymbol{\epsilon} = -L \frac{dI}{dt}$
	$U_L = \frac{1}{2}LI^2$
	$P = I\Delta V$

ADVANCED PLACEMENT PHYSICS C EQUATIONS

GEOMETRY AND TRIGONOMETRY

Rectangle

$$A = bh$$

Triangle

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

Circle

$$A = \pi r^2$$

$$C = 2\pi r$$

$$s = r\theta$$

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

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

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

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

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

A = area

C = circumference

V = volume

S = surface area

b = base

h = height

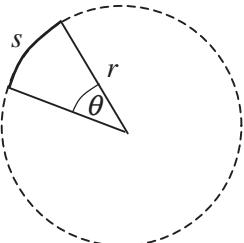
ℓ = length

w = width

r = radius

s = arc length

θ = angle



CALCULUS

$$\frac{df}{dx} = \frac{df}{du} \frac{du}{dx}$$

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

$$\frac{d}{dx}(e^{ax}) = ae^{ax}$$

$$\frac{d}{dx}(\ln ax) = \frac{1}{x}$$

$$\frac{d}{dx}[\sin(ax)] = a\cos(ax)$$

$$\frac{d}{dx}[\cos(ax)] = -a\sin(ax)$$

$$\int x^n dx = \frac{1}{n+1} x^{n+1}, n \neq -1$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax}$$

$$\int \frac{dx}{x+a} = \ln|x+a|$$

$$\int \cos(ax) dx = \frac{1}{a} \sin(ax)$$

$$\int \sin(ax) dx = -\frac{1}{a} \cos(ax)$$

VECTOR PRODUCTS

$$\vec{A} \cdot \vec{B} = AB \cos \theta$$

$$|\vec{A} \times \vec{B}| = AB \sin \theta$$

