

## ADVANCED PLACEMENT PHYSICS 1 EQUATIONS, EFFECTIVE 2015

### CONSTANTS AND CONVERSION FACTORS

Proton mass, $m_p = 1.67 \times 10^{-27}$ kg Neutron mass, $m_n = 1.67 \times 10^{-27}$ kg Electron mass, $m_e = 9.11 \times 10^{-31}$ kg Speed of light, $c = 3.00 \times 10^8$ m/s	Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C Coulomb's law constant, $k = 1/4\pi\epsilon_0 = 9.0 \times 10^9$ N·m <sup>2</sup> /C <sup>2</sup> Universal gravitational constant, $G = 6.67 \times 10^{-11}$ m <sup>3</sup> /kg·s <sup>2</sup> Acceleration due to gravity at Earth's surface, $g = 9.8$ m/s <sup>2</sup>
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UNIT SYMBOLS	meter, m	kelvin, K	watt, W	degree Celsius, °C
	kilogram, kg	hertz, Hz	coulomb, C	
	second, s	newton, N	volt, V	
	ampere, A	joule, J	ohm, Ω	

PREFIXES		
Factor	Prefix	Symbol
$10^{12}$	tera	T
$10^9$	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. The frame of reference of any problem is assumed to be inertial unless otherwise stated.
- II. Assume air resistance is negligible unless otherwise stated.
- III. In all situations, positive work is defined as work done on a system.
- IV. The direction of current is conventional current: the direction in which positive charge would drift.
- V. Assume all batteries and meters are ideal unless otherwise stated.

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**MECHANICS**

$v_x = v_{x0} + a_x t$	$a =$ acceleration
$x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$	$A =$ amplitude
$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$	$d =$ distance
$\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{net}}{m}$	$E =$ energy
$ \vec{F}_f  \leq \mu  \vec{F}_n $	$f =$ frequency
$a_c = \frac{v^2}{r}$	$F =$ force
$\vec{p} = m\vec{v}$	$I =$ rotational inertia
$\Delta\vec{p} = \vec{F} \Delta t$	$K =$ kinetic energy
$K = \frac{1}{2} m v^2$	$k =$ spring constant
$\Delta E = W = F_{\parallel} d = F d \cos \theta$	$L =$ angular momentum
$P = \frac{\Delta E}{\Delta t}$	$\ell =$ length
$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$	$m =$ mass
$\omega = \omega_0 + \alpha t$	$P =$ power
$x = A \cos(2\pi f t)$	$p =$ momentum
$\vec{\alpha} = \frac{\sum \vec{\tau}}{I} = \frac{\vec{\tau}_{net}}{I}$	$r =$ radius or separation
$\tau = r_{\perp} F = r F \sin \theta$	$T =$ period
$L = I \omega$	$t =$ time
$\Delta L = \tau \Delta t$	$U =$ potential energy
$K = \frac{1}{2} I \omega^2$	$V =$ volume
$ \vec{F}_s  = k  \vec{x} $	$v =$ speed
$U_s = \frac{1}{2} k x^2$	$W =$ work done on a system
$\rho = \frac{m}{V}$	$x =$ position
	$y =$ height
	$\alpha =$ angular acceleration
	$\mu =$ coefficient of friction
	$\theta =$ angle
	$\rho =$ density
	$\tau =$ torque
	$\omega =$ angular speed
	$\Delta U_g = m g \Delta y$
	$T = \frac{2\pi}{\omega} = \frac{1}{f}$
	$T_s = 2\pi \sqrt{\frac{m}{k}}$
	$T_p = 2\pi \sqrt{\frac{\ell}{g}}$
	$ \vec{F}_g  = G \frac{m_1 m_2}{r^2}$
	$\vec{g} = \frac{\vec{F}_g}{m}$
	$U_G = -\frac{G m_1 m_2}{r}$

**ELECTRICITY**

$ \vec{F}_E  = k \left  \frac{q_1 q_2}{r^2} \right $	$A =$ area
$I = \frac{\Delta q}{\Delta t}$	$F =$ force
$R = \frac{\rho \ell}{A}$	$I =$ current
$I = \frac{\Delta V}{R}$	$\ell =$ length
$P = I \Delta V$	$P =$ power
$R_s = \sum_i R_i$	$q =$ charge
$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$	$R =$ resistance
	$r =$ separation
	$t =$ time
	$V =$ electric potential
	$\rho =$ resistivity

**WAVES**

$\lambda = \frac{v}{f}$	$f =$ frequency
	$v =$ speed
	$\lambda =$ wavelength

**GEOMETRY AND TRIGONOMETRY**

Rectangle	$A =$ area
$A = bh$	$C =$ circumference
Triangle	$V =$ volume
$A = \frac{1}{2} bh$	$S =$ surface area
Circle	$b =$ base
$A = \pi r^2$	$h =$ height
$C = 2\pi r$	$\ell =$ length
Rectangular solid	$w =$ width
$V = \ell wh$	$r =$ radius
Cylinder	Right triangle
$V = \pi r^2 \ell$	$c^2 = a^2 + b^2$
$S = 2\pi r \ell + 2\pi r^2$	$\sin \theta = \frac{a}{c}$
Sphere	$\cos \theta = \frac{b}{c}$
$V = \frac{4}{3} \pi r^3$	$\tan \theta = \frac{a}{b}$
$S = 4\pi r^2$	