

## 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>
---	--

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.

**ADVANCED PLACEMENT PHYSICS 1 EQUATIONS, EFFECTIVE 2015**

<b>MECHANICS</b>		<b>ELECTRICITY</b>	
$v_x = v_{x0} + a_x t$ $x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$ $v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$ $\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{net}}{m}$ $ \vec{F}_f  \leq \mu  \vec{F}_n $ $a_c = \frac{v^2}{r}$ $\vec{p} = m\vec{v}$ $\Delta \vec{p} = \vec{F} \Delta t$ $K = \frac{1}{2} m v^2$ $\Delta E = W = F_{\parallel} d = F d \cos \theta$ $P = \frac{\Delta E}{\Delta t}$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$ $\omega = \omega_0 + \alpha t$ $x = A \cos(2\pi f t)$ $\vec{\alpha} = \frac{\sum \vec{\tau}}{I} = \frac{\vec{\tau}_{net}}{I}$ $\tau = r_{\perp} F = r F \sin \theta$ $L = I \omega$ $\Delta L = \tau \Delta t$ $K = \frac{1}{2} I \omega^2$ $ \vec{F}_s  = k  \vec{x} $ $U_s = \frac{1}{2} k x^2$ $\rho = \frac{m}{V}$	<p><i>a</i> = acceleration  <i>A</i> = amplitude  <i>d</i> = distance  <i>E</i> = energy  <i>f</i> = frequency  <i>F</i> = force  <i>I</i> = rotational inertia  <i>K</i> = kinetic energy  <i>k</i> = spring constant  <i>L</i> = angular momentum  <i>ℓ</i> = length  <i>m</i> = mass  <i>P</i> = power  <i>p</i> = momentum  <i>r</i> = radius or separation  <i>T</i> = period  <i>t</i> = time  <i>U</i> = potential energy  <i>V</i> = volume  <i>v</i> = speed  <i>W</i> = work done on a system  <i>x</i> = position  <i>y</i> = height  <i>α</i> = angular acceleration  <i>μ</i> = coefficient of friction  <i>θ</i> = angle  <i>ρ</i> = density  <i>τ</i> = torque  <i>ω</i> = angular speed</p> $\Delta U_g = mg \Delta y$ $T = \frac{2\pi}{\omega} = \frac{1}{f}$ $T_s = 2\pi \sqrt{\frac{m}{k}}$ $T_p = 2\pi \sqrt{\frac{\ell}{g}}$ $ \vec{F}_g  = G \frac{m_1 m_2}{r^2}$ $\vec{g} = \frac{\vec{F}_g}{m}$ $U_G = -\frac{G m_1 m_2}{r}$	$ \vec{F}_E  = k \left  \frac{q_1 q_2}{r^2} \right $ $I = \frac{\Delta q}{\Delta t}$ $R = \frac{\rho \ell}{A}$ $I = \frac{\Delta V}{R}$ $P = I \Delta V$ $R_s = \sum_i R_i$ $\frac{1}{R_p} = \sum_i \frac{1}{R_i}$	<p><i>A</i> = area  <i>F</i> = force  <i>I</i> = current  <i>ℓ</i> = length  <i>P</i> = power  <i>q</i> = charge  <i>R</i> = resistance  <i>r</i> = separation  <i>t</i> = time  <i>V</i> = electric potential  <i>ρ</i> = resistivity</p>
		<b>WAVES</b>	
		$\lambda = \frac{v}{f}$	<p><i>f</i> = frequency  <i>v</i> = speed  <i>λ</i> = wavelength</p>
		<b>GEOMETRY AND TRIGONOMETRY</b>	
		<p>Rectangle  <math>A = bh</math></p> <p>Triangle  <math>A = \frac{1}{2} bh</math></p> <p>Circle  <math>A = \pi r^2</math>  <math>C = 2\pi r</math></p> <p>Rectangular solid  <math>V = \ell wh</math></p> <p>Cylinder  <math>V = \pi r^2 \ell</math>  <math>S = 2\pi r \ell + 2\pi r^2</math></p> <p>Sphere  <math>V = \frac{4}{3} \pi r^3</math>  <math>S = 4\pi r^2</math></p>	<p><i>A</i> = area  <i>C</i> = circumference  <i>V</i> = volume  <i>S</i> = surface area  <i>b</i> = base  <i>h</i> = height  <i>ℓ</i> = length  <i>w</i> = width  <i>r</i> = radius</p> <p>Right triangle  <math>c^2 = a^2 + b^2</math>  <math>\sin \theta = \frac{a}{c}</math>  <math>\cos \theta = \frac{b}{c}</math>  <math>\tan \theta = \frac{a}{b}</math></p>
			