

## ADVANCED PLACEMENT PHYSICS 1 TABLE OF INFORMATION

### CONSTANTS AND CONVERSION FACTORS

Universal gravitational constant, $G = 6.67 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2) = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$ 1 atmosphere of pressure, $1 \text{ atm} = 1.0 \times 10^5 \text{ N/m}^2 = 1.0 \times 10^5 \text{ Pa}$	Acceleration due to gravity at Earth's surface, $g = 9.8 \text{ m/s}^2$ Magnitude of the gravitational field strength at the Earth's surface, $g = 9.8 \text{ N/kg}$
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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	$\mu$
$10^{-9}$	nano	n
$10^{-12}$	pico	p

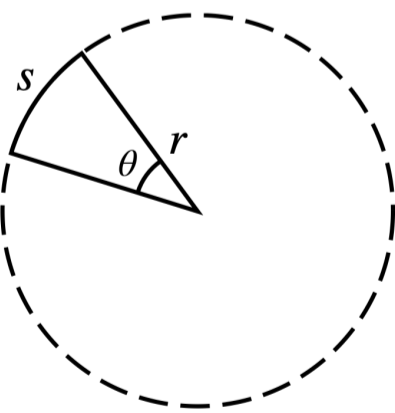
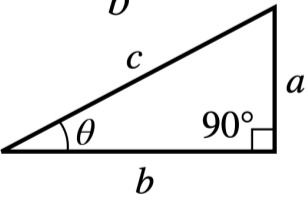
UNIT SYMBOLS	hertz,	Hz	newton,	N
	joule,	J	pascal,	Pa
	kilogram,	kg	second,	s
	meter,	m	watt,	W

VALUES OF TRIGONOMETRIC FUNCTIONS FOR COMMON ANGLES							
$\theta$	$0^\circ$	$30^\circ$	$37^\circ$	$45^\circ$	$53^\circ$	$60^\circ$	$90^\circ$
$\sin \theta$	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	$4/3$	$\sqrt{3}$	$\infty$

The following conventions are used in this exam:

- The frame of reference of any problem is assumed to be inertial unless otherwise stated.
- Air resistance is assumed to be negligible unless otherwise stated.
- Springs and strings are assumed to be ideal unless otherwise stated.
- Fluids are assumed to be ideal, and pipes are assumed to be completely filled by fluid, unless otherwise stated.

### GEOMETRY AND TRIGONOMETRY

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

## Equations

## Units

linear kinematics	$v_x = v_{x0} + a_x t$ $x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$ $v_x^2 = v_{x0}^2 + 2a_x (x - x_0)$	$a$ = acceleration $d$ = distance $E$ = energy $F$ = force $J$ = impulse $k$ = spring constant $K$ = kinetic energy $m$ = mass $p$ = momentum $P$ = power $r$ = radius, distance, or position $t$ = time $U$ = potential energy $v$ = velocity or speed $W$ = work $x$ = position $y$ = height $\theta$ = angle $\mu$ = coefficient of friction	$\text{m/s}^2$ $\text{m}$ $\text{J}$ $\text{N}$ $\text{kg}\cdot\text{m/s} = \text{N}\cdot\text{s}$ $\text{N/m}$ $\text{J}$ $\text{kg}$ $\text{kg}\cdot\text{m/s}$ $\text{W} = \text{J/s} = \text{N}\cdot\text{m/s}$ $\text{m}$ $\text{s}$ $\text{J}$ $\text{m/s}$ $\text{J} = \text{N}\cdot\text{m}$ $\text{m}$ $\text{m}$ $\text{rad or deg}$ (no unit)
center of mass	$\vec{x}_{\text{cm}} = \frac{\sum m_i \vec{x}_i}{\sum m_i}$		
Newton's 2nd law	$\vec{a}_{\text{sys}} = \frac{\sum \vec{F}}{m_{\text{sys}}} = \frac{\vec{F}_{\text{net}}}{m_{\text{sys}}}$		
gravitational force	$ \vec{F}_g  = G \frac{m_1 m_2}{r^2}$		
friction force	$ \vec{F}_f  \leq  \mu \vec{F}_n $		
spring force (Hooke's Law)	$\vec{F}_s = -k \Delta \vec{x}$		
centripetal acceleration	$a_c = \frac{v^2}{r}$		
translational kinetic energy	$K = \frac{1}{2} m v^2$		
work	$W = F_{\parallel} d = F d \cos \theta$		
work-energy theorem	$\Delta K = \sum W_i = \sum F_{\parallel, i} d_i$		
spring potential energy	$\Delta U_s = \frac{1}{2} k (\Delta x)^2$		
gravitational potential energy	$U_G = -\frac{G m_1 m_2}{r}$ $\Delta U_g = m g \Delta y$		
power	$P_{\text{avg}} = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$ $P_{\text{inst}} = F_{\parallel} v = F v \cos \theta$		
linear momentum	$\vec{p} = m \vec{v}$		
impulse	$\vec{F}_{\text{net}} = \frac{\Delta \vec{p}}{\Delta t} = m \frac{\Delta \vec{v}}{\Delta t} = m \vec{a}$ $\vec{J} = \vec{F}_{\text{avg}} \Delta t = \Delta \vec{p}$		
velocity of center of mass	$\vec{v}_{\text{cm}} = \frac{\sum \vec{p}_i}{\sum m_i} = \frac{\sum m_i \vec{v}_i}{\sum m_i}$		

rotational kinematics	$\omega = \omega_0 + \alpha t$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$ $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$	$a = \text{acceleration}$ $A = \text{amplitude or area}$ $d = \text{distance}$ $f = \text{frequency}$ $F = \text{force}$ $h = \text{height}$ $I = \text{rotational inertia}$ $k = \text{spring constant}$ $K = \text{kinetic energy}$ $\ell = \text{length}$ $L = \text{angular momentum}$ $m = \text{mass}$ $M = \text{mass}$ $P = \text{pressure}$ $r = \text{radius, distance, or position}$ $t = \text{time}$ $T = \text{period}$ $v = \text{velocity or speed}$ $V = \text{volume}$ $W = \text{work}$ $x = \text{position}$ $y = \text{vertical position}$ $\alpha = \text{angular acceleration}$ $\theta = \text{angle}$ $\rho = \text{density}$ $\tau = \text{torque}$ $\omega = \text{angular speed}$	$\text{m/s}^2$ $\text{m or m}^2$ $\text{m}$ $\text{Hz} = 1/\text{s}$ $\text{N}$ $\text{m}$ $\text{kg}\cdot\text{m}^2$ $\text{N/m}$ $\text{J}$ $\text{m}$ $\text{kg}\cdot\text{m}^2/\text{s}$ $\text{kg}$ $\text{kg}$ $\text{Pa} = \text{N/m}^2$ $\text{m}$ $\text{s}$ $\text{s}$ $\text{m/s}$ $\text{m}^3$ $\text{J} = \text{N}\cdot\text{m}$ $\text{m}$ $\text{m}$ $\text{rad/s}^2$ $\text{rad or deg}$ $\text{kg/m}^3$ $\text{N}\cdot\text{m}$ $\text{rad/s}$
linear / rotational kinematics	$v = r\omega$ $a_T = r\alpha$		
torque	$\tau = r_{\perp} F = rF \sin \theta$		
rotational inertia	$I = \sum m_i r_i^2$		
parallel axis theorem	$I' = I_{\text{cm}} + Md^2$		
Newton's 2nd law (rotation)	$\alpha_{\text{sys}} = \frac{\sum \tau}{I_{\text{sys}}} = \frac{\tau_{\text{net}}}{I_{\text{sys}}}$		
rotational kinetic energy	$K = \frac{1}{2} I \omega^2$		
work (rotation)	$W = \tau \Delta \theta$		
angular momentum	$L = I \omega$ $L = r m v \sin \theta$		
angular impulse	$\Delta L = \tau \Delta t$		
center of mass (rolling)	$\Delta x_{\text{cm}} = r \Delta \theta$		
period	$T = \frac{1}{f}$		
mass-spring period	$T_s = 2\pi \sqrt{\frac{m}{k}}$		
pendulum period	$T_p = 2\pi \sqrt{\frac{\ell}{g}}$		
simple harmonic motion	$x = A \cos(2\pi ft)$ $x = A \sin(2\pi ft)$		
density	$\rho = \frac{m}{V}$		
pressure	$P = \frac{F_{\perp}}{A}$ $P = P_0 + \rho gh$ $P_{\text{gauge}} = \rho gh$		
buoyant force	$F_b = \rho V g$		
conservation of flow rate	$A_1 v_1 = A_2 v_2$		
Bernoulli's equation	$P_1 + \rho g y_1 + \frac{1}{2} \rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2} \rho v_2^2$		