ADVANCED PLACEMENT PHYSICS 1 TABLE OF INFORMATION

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

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

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							
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:

- 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
$A = bh$

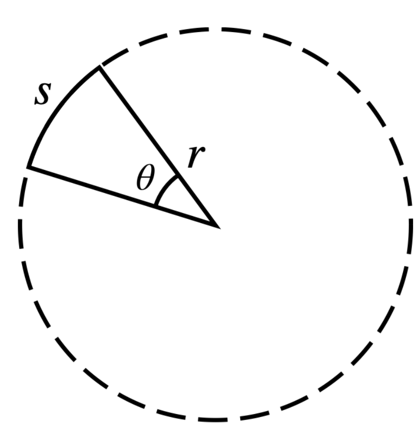
Triangle
$A = \frac{1}{2}bh$

Circle
$A = \pi r^2$
$C = 2\pi r$
$s = r\theta$

Rectangular Solid
$V = \ell wh$

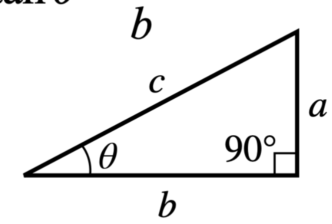
Cylinder
$V = \pi r^2 \ell$
$S = 2\pi r\ell + 2\pi r^2$

Sphere
$V = \frac{4}{3}\pi r^3$
$S = 4\pi r^2$



A = area
b = base
C = circumference
h = height
ℓ = length
r = radius
s = arc length
S = surface area
V = volume
w = width
θ = angle

Right Triangle
$a^2 + b^2 = c^2$
$\sin\theta = \frac{a}{c}$
$\cos\theta = \frac{b}{c}$
$\tan\theta = \frac{a}{b}$



Equations

linear kinematics	$v_x = v_{x0} + a_x t$ $x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$ $v_x^2 = v_{x0}^2 + 2a_x\left(x - x_0\right)$
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	$\left\lvert\vec{F}_g\right\rvert = G\frac{m_1 m_2}{r^2}$
friction force	$\left\lvert\vec{F}_f\right\rvert \le \left\lvert\mu \vec{F}_n\right\rvert$
spring force (Hooke's Law)	$\vec{F}_s = -k\Delta\vec{x}$
centripetal acceleration	$a_c = \frac{v^2}{r}$
translational kinetic energy	$K = \frac{1}{2}mv^2$
work	$W = F_{\parallel}d = Fd\cos\theta$
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	$U_G = -\frac{Gm_1m_2}{r}$ $\Delta U_g = mg\Delta y$
power	$P_{\text{avg}} = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$ $P_{\text{inst}} = F_{\parallel}v = Fv\cos\theta$
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	$\vec{v}_{\text{cm}} = \frac{\sum \vec{p}_i}{\sum m_i} = \frac{\sum m_i\vec{v}_i}{\sum m_i}$

	Units
a = acceleration	m/s²
d = distance	m
E = energy	J
F = force	N
J = impulse	kg·m/s = N·s
k = spring constant	N/m
K = kinetic energy	J
m = mass	kg
p = momentum	kg·m/s
P = power	W = J/s = N·m/s
r = radius, distance, or position	m
t = time	s
U = potential energy	J
v = velocity or speed	m/s
W = work	J = N·m
x = position	m
y = height	m
θ = angle	rad or deg
μ = coefficient of friction	(no unit)

rotational kinematics	$\omega = \omega_0 + \alpha t$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$ $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
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	$I' = I_{cm} + Md^2$
Newton's 2nd law (rotation)	$\alpha_{sys} = \frac{\Sigma\tau}{I_{sys}} = \frac{\tau_{net}}{I_{sys}}$
rotational kinetic energy	$K = \frac{1}{2}I\omega^2$
work (rotation)	$W = \tau\Delta\theta$
angular momentum	$L = I\omega$ $L = rmv\sin\theta$
angular impulse	$\Delta L = \tau\Delta t$
center of mass (rolling)	$\Delta x_{cm} = r\Delta\theta$
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	$P = \frac{F_\perp}{A}$ $P = P_0 + \rho gh$ $P_{gauge} = \rho gh$
buoyant force	$F_b = \rho Vg$
conservation of flow rate	$A_1 v_1 = A_2 v_2$
Bernoulli's equation	$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$

a = acceleration	m/s²
A = amplitude or area	m or m²
d = distance	m
f = frequency	Hz = 1/s
F = force	N
h = height	m
I = rotational inertia	kg·m²
k = spring constant	N/m
K = kinetic energy	J
ℓ = length	m
L = angular momentum	kg·m²/s
m = mass	kg
M = mass	kg
P = pressure	Pa = N/m²
r = radius, distance, or position	m
t = time	s
T = period	s
v = velocity or speed	m/s
V = volume	m³
W = work	J = N·m
x = position	m
y = vertical position	m
α = angular acceleration	rad/s²
θ = angle	rad or deg
ρ = density	kg/m³
τ = torque	N·m
ω = angular speed	rad/s