

ADVANCED PLACEMENT PHYSICS 2 EQUATIONS

MECHANICS

$$v_x = v_{x0} + a_x t$$

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

$$\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{net}}{m}$$

$$|\vec{F}_f| \leq \mu |\vec{F}_n|$$

$$a_c = \frac{v^2}{r}$$

$$\vec{p} = m\vec{v}$$

$$\Delta\vec{p} = \vec{F}\Delta t$$

$$K = \frac{1}{2}mv^2$$

$$\Delta E = W = F_{\parallel}d = Fd \cos \theta$$

$$P = \frac{\Delta E}{\Delta t}$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega = \omega_0 + \alpha t$$

$$x = A \cos(\omega t) = A \cos(2\pi ft)$$

$$x_{cm} = \frac{\sum m_i x_i}{\sum m_i}$$

$$\vec{\alpha} = \frac{\sum \vec{\tau}}{I} = \frac{\vec{\tau}_{net}}{I}$$

$$\tau = r_{\perp} F = rF \sin \theta$$

$$L = I\omega$$

$$\Delta L = \tau \Delta t$$

$$K = \frac{1}{2}I\omega^2$$

$$|\vec{F}_s| = k|\vec{x}|$$

a = acceleration

A = amplitude

d = distance

E = energy

F = force

f = frequency

I = rotational inertia

K = kinetic energy

k = spring constant

L = angular momentum

ℓ = length

m = mass

P = power

p = momentum

r = radius or separation

T = period

t = time

U = potential energy

v = speed

W = work done on a system

x = position

y = height

α = angular acceleration

μ = coefficient of friction

θ = angle

τ = torque

ω = angular speed

$$U_s = \frac{1}{2}kx^2$$

$$\Delta U_g = mg \Delta y$$

$$T = \frac{2\pi}{\omega} = \frac{1}{f}$$

$$T_s = 2\pi\sqrt{\frac{m}{k}}$$

$$T_p = 2\pi\sqrt{\frac{\ell}{g}}$$

$$|\vec{F}_g| = G \frac{m_1 m_2}{r^2}$$

$$\vec{g} = \frac{\vec{F}_g}{m}$$

$$U_G = -\frac{Gm_1 m_2}{r}$$

ELECTRICITY AND MAGNETISM

$$|\vec{F}_E| = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2}$$

$$\vec{E} = \frac{\vec{F}_E}{q}$$

$$|\vec{E}| = \frac{1}{4\pi\epsilon_0} \frac{|q|}{r^2}$$

$$\Delta U_E = q\Delta V$$

$$V = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$$

$$|\vec{E}| = \left| \frac{\Delta V}{\Delta r} \right|$$

$$\Delta V = \frac{Q}{C}$$

$$C = \kappa\epsilon_0 \frac{A}{d}$$

$$E = \frac{Q}{\epsilon_0 A}$$

$$U_C = \frac{1}{2}Q\Delta V = \frac{1}{2}C(\Delta V)^2$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$R = \frac{\rho\ell}{A}$$

$$P = I \Delta V$$

$$I = \frac{\Delta V}{R}$$

$$R_s = \sum_i R_i$$

$$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$$

$$C_p = \sum_i C_i$$

$$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

A = area

B = magnetic field

C = capacitance

d = distance

E = electric field

\mathcal{E} = emf

F = force

I = current

ℓ = length

P = power

Q = charge

q = point charge

R = resistance

r = separation

t = time

U = potential (stored) energy

V = electric potential

v = speed

κ = dielectric constant

ρ = resistivity

θ = angle

Φ = flux

$$\vec{F}_M = q\vec{v} \times \vec{B}$$

$$|\vec{F}_M| = |q\vec{v}||\sin \theta||\vec{B}|$$

$$\vec{F}_M = I\vec{\ell} \times \vec{B}$$

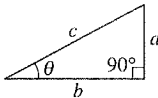
$$|\vec{F}_M| = |I\vec{\ell}||\sin \theta||\vec{B}|$$

$$\Phi_B = \vec{B} \cdot \vec{A}$$

$$\Phi_B = |\vec{B}|\cos \theta||\vec{A}|$$

$$\mathcal{E} = -\frac{\Delta\Phi_B}{\Delta t}$$

$$\mathcal{E} = B\ell v$$

$P = P_0 + \rho gh$ $F_b = \rho Vg$ $A_1 v_1 = A_2 v_2$ $P_1 + \rho gy_1 + \frac{1}{2} \rho v_1^2 = P_2 + \rho gy_2 + \frac{1}{2} \rho v_2^2$ $\frac{Q}{\Delta t} = \frac{kA \Delta T}{L}$ $PV = nRT = Nk_B T$ $K = \frac{3}{2} k_B T$ $W = -P \Delta V$ $\Delta U = Q + W$	$L =$ thickness $m =$ mass $n =$ number of moles $N =$ number of molecules $P =$ pressure $Q =$ energy transferred to a system by heating $T =$ temperature $t =$ time $U =$ internal energy $V =$ volume $v =$ speed $W =$ work done on a system $y =$ height $\rho =$ density	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f}$ $ M = \left \frac{h_i}{h_o} \right = \left \frac{s_i}{s_o} \right $ $\Delta L = m\lambda$ $d \sin \theta = m\lambda$	$M =$ magnification $m =$ an integer $n =$ index of refraction $s =$ distance $v =$ speed $\lambda =$ wavelength $\theta =$ angle
MODERN PHYSICS		GEOMETRY AND TRIGONOMETRY	
$E = hf$ $K_{\max} = hf - \phi$ $\lambda = \frac{h}{p}$ $E = mc^2$	$E =$ energy $f =$ frequency $K =$ kinetic energy $m =$ mass $p =$ momentum $\lambda =$ wavelength $\phi =$ work function	Rectangle $A = bh$ Triangle $A = \frac{1}{2} bh$ Circle $A = \pi r^2$ $C = 2\pi r$ 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 $C =$ circumference $V =$ volume $S =$ surface area $b =$ base $h =$ height $\ell =$ length $w =$ width $r =$ radius Right triangle $c^2 = a^2 + b^2$ $\sin \theta = \frac{a}{c}$ $\cos \theta = \frac{b}{c}$ $\tan \theta = \frac{a}{b}$
			

ADVANCED PLACEMENT PHYSICS 2 TABLE OF INFORMATION

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 Avogadro's number, $N_0 = 6.02 \times 10^{23}$ mol ⁻¹ Universal gas constant, $R = 8.31$ J/(mol.K) Boltzmann's constant, $k_B = 1.38 \times 10^{-23}$ J/K	Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C 1 electron volt, $1 \text{ eV} = 1.60 \times 10^{-19}$ J Speed of light, $c = 3.00 \times 10^8$ m/s Universal gravitational constant, $G = 6.67 \times 10^{-11}$ m ³ /kg.s ² Acceleration due to gravity at Earth's surface, $g = 9.8$ m/s ²
1 unified atomic mass unit, Planck's constant, Vacuum permittivity, Coulomb's law constant, $k = 1/4\pi\epsilon_0 = 9.0 \times 10^9$ N.m ² /C ² Vacuum permeability, Magnetic constant, $k' = \mu_0/4\pi = 1 \times 10^{-7}$ (T.m)/A 1 atmosphere pressure,	$1 \text{ u} = 1.66 \times 10^{-27}$ kg = 931 MeV/c ² $h = 6.63 \times 10^{-34}$ J.s = 4.14×10^{-15} eV.s $hc = 1.99 \times 10^{-25}$ J.m = 1.24×10^3 eV.nm $\epsilon_0 = 8.85 \times 10^{-12}$ C ² /N.m ² $\mu_0 = 4\pi \times 10^{-7}$ (T.m)/A $1 \text{ atm} = 1.0 \times 10^5$ N/m ² = 1.0×10^5 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 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 θ	0	1/2	3/5	√2/2	4/5	√3/2	1
cos θ	1	√3/2	4/5	√2/2	3/5	1/2	0
tan θ	0	√3/3	3/4	1	4/3	√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. In all situations, positive work is defined as work done on a system.
 - III. The direction of current is conventional current: the direction in which positive charge would drift.
 - IV. Assume all batteries and meters are ideal unless otherwise stated.
 - V. Assume edge effects for the electric field of a parallel plate capacitor unless otherwise stated.
 - VI. For any isolated electrically charged object, the electric potential is defined as zero at infinite distance from the charged object.