Table of Information and Equation Tables for TVS AP Physics C Students

The accompanying Table of Information and Equation Tables are similar to those provided to students when they take the AP Physics C Examinations. Therefore, students must **NOT** bring a copy of these tables to the examination room. Students may use these tables to study for the examinations throughout the year in order to become familiar with the contents of the Table of Information and Equation Tables provided during the examinations. This version of the tables is for Trinity Valley School students.

These tables are provided to supplement the tables provided during the examinations. During the preparation period prior to taking the examinations, these tables might provide additional insights about the information, the equations, and the organization of the tables. The added features of this version of the tables are printed in color and thus the entire pamphlet should be printed in color for the students to get the maximum benefit from using it.

Table of Information

For both the AP Physics B and AP Physics C Examinations, the Table of Information is printed near the front cover of the multiple-choice section **AND** on the green insert provided with the free-response section. The Tables of Information for the AP Physics B and AP Physics C examinations are identical, except that Thermodynamics is not part of the AP Physics C examination and therefore a note on the thermodynamic convention concerning work-done on a system is not mentioned in the AP Physics C version of the Table of Information.

Equation Tables

For the AP Physics C Examinations, the Equation Tables for both examinations are printed and available only on the green insert provided with the free-response section. Students may use the Equation Tables when taking the free-response sections of both examinations, but **NOT** when taking the multiple-choice sections.

The equations in the tables express the relationships that are encountered most frequently in AP Physics C Courses and Examinations. However, the tables do not include all equations that might possibly be used. This customized version of the tables includes some additional equations not included in the standard tables provided with the AP Physics C Examination, however, they are highlighted in color to warn students of that difference.

Normally, the tables provided with the AP Physics C Examination do not include equations that may be derived by combining other equations in the tables. Nor do they include equations that are special cases of those that are in the tables. Students are responsible for understanding the physical principles that underlie each equation and for knowing the conditions for which each equation is applicable, however, in this revised addition some of the special cases and derived equations are included, though highlighted.

The equation tables are grouped in sections according to the major content category in which they appear. Within each section, the symbols used for the variables in that section are defined. In some cases the same symbol is used to represent different quantities in different tables. These rare cases should be noted in advance of taking the examinations. It should be mentioned that there is no uniform convention among textbooks, or among physicists generally, for the symbols used in writing equations. The equation tables follow many common conventions, but in some cases consistency is sacrificed for the sake of clarity. For this reason, each student is urged to become familiar with the choices made in these tables for each of the major variables. SI units are assumed throughout the tests.

Further Explanations about the Notation used in the Equations Tables

1. Symbols for physical constants are the same as those in the Table of Information and are defined in the Table of Information rather than in the right-hand column of the tables.
2. Symbols in bold face represent vector quantities.
3. Subscripts on symbols in the equations are used to represent special cases of the variable.
4. The symbol Δ before a variable indicates the change in the variable (final value – initial value).
5. Several different symbols (d, r, s, h, l, ℓ) are used for linear dimensions, such as length, radius, arc length, height, etc.

Table of Information for TVS Students taking AP Physics C

CONSTANTS AND CONVERSION FACTORS

1 unified atomic mass unit	$1\text{u} = 1.66 \times 10^{-27}$ kg
	$= 931$ MeV/c^2
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
Magnitude of electron charge	$e = 1.60 \times 10^{-19}$ C
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
Speed of light	$c = 3.00 \times 10^{8}$ m/s
Planck's Constant	$h = 6.63 \times 10^{-34}$ J•s
	$= 4.14 \times 10^{-15}$ eV•s
	$h\,c = 1.99 \times 10^{-25}$ J•m
	$= 1.24 \times 10^{3}$ eV•nm
Vacuum Permittivity	$\varepsilon_0 = 8.85 \times 10^{-12}$ C^2 / N•m^2
Coulomb's Law Constant	$k = 1/(4\pi\varepsilon_0) = 9.0 \times 10^{9}$ N•m^2/C^2
Vacuum permeability	$\mu_0 = 4\pi \times 10^{-7}$ (T•m)/A
Magnetic Constant	$k' = \mu_0/4\pi = 10^{-7}$ (T•m)/A
Universal gravitational constant	$G = 6.67 \times 10^{-11}$ m^3/kg•s^2
Acceleration due to gravity at the Earth's Surface	$g = 9.8$ m/s^2
1 atmosphere pressure (**Not an SI Unit**)	$1\ \text{atm} = 1.0 \times 10^{5}$ N/m^2 $= 1.0 \times 10^{5}$ Pa
1 electron volt	$1\ \text{eV} = 1.60 \times 10^{-19}$ J

UNITS

Name	Symbol
meter	m
kilogram	Kg
second	s
ampere	A
kelvin	K
mole	mol
hertz	Hz
newton	N
pascal	Pa
joule	J
watt	W
coulomb	C
volt	V
ohm	Ω
henry	H
farad	F
tesla	T
Not an SI Unit	
electron-volt	eV
Not an SI Unit	
degree Celsius	°C

PREFIXES

Factor	Prefix	Symbol
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	sin θ	cos θ	tan θ
0°	0	1	0
30°	1/2	√3/2	√3/3
37°	3/5	4/5	3/4
45°	√2/2	√2/2	1
53°	4/5	3/5	4/3
60°	√3/2	1/2	√3
90°	1	0	∞

The following conventions are used in the AP Physics C examination.

I. Unless otherwise stated, the frame of reference of any problem is assumed to be inertial.

II. The direction of any electric current is the direction of the flow of positive charge (conventional current).

III. For any isolated electric charge, the electric potential is defined as zero at an infinite distance from the charge.

ADVANCED PLACEMENT PHYSICS C EQUATIONS FOR TVS STUDENTS

MECHANICS

$v = v_0 + at$	*(constant a)*
$x = x_0 + v_0 t + \frac{1}{2} at$	*(constant a)*
$v^2 = v_0^2 + 2a(x - x_0)$	*(constant a)*
$\Sigma \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$	*(Newtons 2nd Law)*
$\mathbf{F} = d\mathbf{p}/dt$	*(rate of change of momentum)*
$\mathbf{J} = \int \mathbf{F} \cdot d\mathbf{r}$	*(Impulse of collision, vector dot product)*
$\mathbf{p} = m\mathbf{v}$	*(vectors, momentum)*
$\mathbf{F}_{friction} \le \mu \mathbf{N}$	*(static friction and kinetic friction)*
$\mathbf{W} = \int \mathbf{F} \cdot d\mathbf{r}$	*(Work, dot product)*
$K = \frac{1}{2} mv^2$	*(scalar, kinetic energy)*
$P = dW/dt$	*(rate of change of work)*
$P = \mathbf{F} \cdot \mathbf{v}$	*(vector, dot product, power)*
$\Delta U_g = mgh$	*(gravitational potential energy)*
$a_c = v^2/r = \omega^2 r$	*(centripetal acceleration)*
$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$	*(torque as a vector cross product)*
$\Sigma \boldsymbol{\tau} = \boldsymbol{\tau}_{net} = I\boldsymbol{\alpha}$	*(net torque, Newtons 2nd Law)*
$I = \int r^2 dm = \Sigma mr^2$	*(moment of inertia OR rotational mass)*
$\mathbf{r}_{cm} = \Sigma m\mathbf{r} / \Sigma m$	*(vector to center of mass)*
$v = r\omega$	*(velocity & angular velocity)*
$\mathbf{L} = \mathbf{r} \times \mathbf{p} = I\boldsymbol{\omega}$	
$K = \frac{1}{2} I\omega^2$	*(rotational kinetic energy, in addition to linear KE)*
$\boldsymbol{\omega} = \boldsymbol{\omega}_0 + \boldsymbol{\alpha} t$	*(constant angular acceleration)*
$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$	*(constant angular acceleration)*
$\mathbf{F}_s = -k\mathbf{x}$	*(proportional vectors, negative = restoring force)*
$U_s = \frac{1}{2} k x^2$	*(PE of a spring, 0 PE at x = 0)*
$T = \frac{2\pi}{\omega} = \frac{1}{f}$	*(Period in UCM, components of SHM)*
$T_s = 2\pi\sqrt{\frac{m}{k}}$	*(period of a spring, SHM)*
$\mathbf{F}_G = -G\frac{m_1 m_2}{r^2}$	*(vector, negative = restoring force)*

a = acceleration
F = force
f = frequency
h = height
I = rotational inertia
J = impulse
K = kinetic energy
k = spring constant
ℓ = length
L = angular momentum
m = mass
N = normal force
P = power
p = momentum
r = radius or distance
$\mathbf{r}$ = position vector
T = period
t = time
U = potential energy
v = velocity or speed
W = work done on system
x = position
μ = coefficient of friction
θ = angle
τ = torque
ω = angular speed
α = angular acceleration

ELECTRICITY AND MAGNETISM

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{r^2}$$
$$\mathbf{E} = \frac{\mathbf{F}}{q}$$
$$\oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q}{\varepsilon_0}$$
$$E = -\frac{dV}{dr}$$
$$V = \frac{1}{4\pi\varepsilon_0} \sum_i \frac{q_i}{r_i}$$
$$U_E = qV = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{r}$$
$$C = \frac{Q}{V}$$
$$C = \frac{\varepsilon_0 A}{d}$$
$$C_p = \sum_i C_i$$
$$\frac{1}{C_s} = \sum_i \frac{1}{C_i}$$
$$I = \frac{dQ}{dt}$$
$$U_C = \tfrac{1}{2} QV = \tfrac{1}{2} CV^2$$
$$R = \frac{\rho\ell}{A}$$
$$V = IR$$
$$R_s = \sum_i R_i$$
$$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$$
$$P = IV$$
$$\mathbf{F}_M = q\mathbf{v} \times \mathbf{B}$$
$$\oint \mathbf{B} \cdot d\boldsymbol{\ell} = \mu_0 I$$
$$F = \int I d\boldsymbol{\ell} \times B$$
$$B_S = \mu_0 nI$$
$$\phi_m = \int \mathbf{B} \cdot d\mathbf{A}$$
$$\mathcal{E} = -d\phi_m/dt$$
$$\mathcal{E} = -L\, dI/dt$$
$$U_L = \tfrac{1}{2} L I^2$$

A = area
B = magnetic field
C = capacitance
d = distance
E = electric field
$\mathcal{E}$ = emf
F = force
I = current
L = inductance
ℓ = length
n = number of loops of wire per unit length
P = power
Q = charge
q = point charge
R = resistance
r = distance
t = time
U = potential energy or stored energy
V = electric potential
v = velocity or speed
ρ = resistivity
ϕ_m = magnetic flux
κ = dielectric constant

For study purposes, only. These are not the official Equation Tables available from AP Central. They are modeled on those tables and supplemented as needed. 30 Mar 2007

$$T_P = 2\pi\sqrt{\frac{\ell}{g}}$$ *(period of a pendulum, SHM)*

$$U_G = -G\frac{m_1 m_2}{r}$$ *(gravitational PE, 0 PE at r = infinity)*

ADVANCED PLACEMENT PHYSICS C EQUATIONS FOR TVS STUDENTS

GEOMETRY AND TRIGONOMETRY

Rectangle

$A = bh$ *(area)*

Triangle

$A = \frac{1}{2} bh$ *(area)*

Circle

$A = \pi r^2$ *(area)*

$C = 2\pi r$ *(circumference)*

A = area
C = circumference
V = volume
S = Surface area
b = base
h = height
ℓ = length
w = width
r = radius

Ellipse or oval

$A = \pi ab$ *(a = semi-major axis, and b = semi-minor axes)*

$C \approx \pi(a+b)[1 + h/8]^2$ *The circumference formulae for the ellipse are often written in terms of the quantity, $h = (a-b)^2/(a+b)^2$*

Circumference formulae for an ellipse are always approximate or require that you evaluate the sum of an infinite series.

Parallelepiped

$V = \ell wh$ *(volume)*

Cylinder

$V = \pi r^2 \ell$ *(volume)*

$S = 4\pi r^2$ *(surface area)*

Sphere

$V = {}^4/_3\, \pi r^3$ *(volume)*

$S = 4\pi r^2$ *(surface area)*

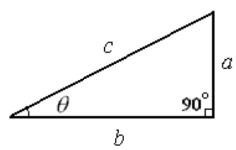
Right Triangle

$a^2 + b^2 = c^2$ *(Pythagorean Theorem)*

$\sin\theta = \frac{a}{c}$ *(definition of sine)*

$\cos\theta = \frac{b}{c}$ *(definition of cosine)*

$\tan\theta = \frac{a}{b}$ *(definition of tangent)*



Law of Sines – Any Triangle

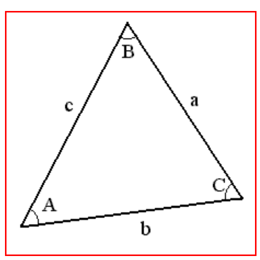
$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Law of Cosines – Any Triangle

$c^2 = a^2 + b^2 - 2ab \cos C$

$a^2 = b^2 + c^2 - 2bc \cos A$

$b^2 = c^2 + a^2 - 2ca \cos B$



CALCULUS

$$\frac{df}{dx} = \frac{df}{du}\frac{du}{dx}$$

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(\ln x) = \frac{1}{x}$$

$$\frac{d}{dx}(\sin x) = \cos x$$

$$\frac{d}{dx}(\cos x) = -\sin x$$

$$\int x^n dx = \frac{1}{n+1}x^{n+1}, n \neq -1$$

$$\int e^x dx = e^x$$

$$\int \frac{dx}{x} = \ln|x|$$

$$\int \cos x dx = \sin x$$

$$\int \sin x dx = -\cos x$$