STATISTICAL PHYSICS PHY - 403

PHYSICAL CONSTANTS

	$\pi = 3.142$	
Charge of an electron	$-e = -1.6 \times 10^{-19}$	C
	$1 \text{ eV} = 1.6 \times 10^{-19}$	J (N·m or W·s)
Permittivity of free space, ϵ_0, gives	$1/4\pi\epsilon_0 = 9 \times 10^9$	F^{-1}·m
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$	H· m^{-1}
	$e^2/4\pi\epsilon_0 = 1.44 \times 10^{-9}$	eV·m
Speed of light in free space	$c = 3.00 \times 10^8$	m·s^{-1}
	$= 1/\sqrt{\mu_0\epsilon_0}$	
Planck's constant	$h = 6.63 \times 10^{-34}$	J·s
	$h/2\pi = \hbar = 1.05 \times 10^{-34}$	J·s
Boltzmann's constant	$k = k_B = 1.38 \times 10^{-23}$	J·K^{-1}
	$= 8.63 \times 10^{-5}$	eV·K^{-1}
Universal Gas constant	$R = N_A \times k_B = 8.31$	J·$K^{-1}$$mol^{-1}$
Molar volume at STP	$= 22.4 \times 10^{-3}$	m^3
Standard Atmosphere	$= 1.01 \times 10^5$	Pa
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8}$	W·m^{-2}·K^{-4}
Wien's displacement constant	$b = 2.9 \times 10^{-3}$	m·K
Gravitational constant	$G = 6.67 \times 10^{-11}$	m^3·kg^{-1}·s^{-2}
Acceleration due to gravity at sea level	$g = 9.81$	m·s^{-2}
Rest mass of an electron	$m_e = 9.11 \times 10^{-31}$	kg
Rest mass of a proton	$m_p = 1.67 \times 10^{-27}$	kg
Avogadro's number	$N_A = 6.02 \times 10^{26}$	$kmol^{-1}$
	$= 6.02 \times 10^{23}$	mol^{-1}
Bohr magneton	$\mu_b = 9.27 \times 10^{-24}$	A·m^2 (or J·T^{-1})
	$= e\hbar/2m_e$	

$$1 \text{ amu} = \tfrac{1}{12} M_{Carbon} = 931.5 \text{ MeV}/c^2 = 1.66 \times 10^{-27} \text{ kg}$$

$1\ \mu\text{m} = 10^{-6}$ m 1 nm $= 10^{-9}$ m 1 Å$= 10^{-10}$ m 1 f $= 10^{-15}$ m

For $|e^a| < 1$, $\sum_{r=0}^{\infty}(e^a)^r = \frac{1}{1-e^a}$.

Stirling's approximation for $N \gg 1$, is $\ln N! \simeq N \ln N - N$, or $N! \simeq \left(\frac{N}{e}\right)^N$, and thus $\frac{d \ln N!}{dx} \simeq \ln N \frac{dN}{dx}$.

For a spinless particle, the number of states with momentum between p and $p + dp$ in a macroscopic volume V is $D(p)dp$ where the density of states $D(p) = \left(\frac{\partial g}{\partial p}\right) = \frac{V}{h^3} 4\pi p^2$.

The 'Thermodynamic Identity' may be stated as $dU = TdS - pdV + \mu dN$, OR (as $F = U - TS$), $dF = -SdT - pdV + \mu dN$.