Information for the Quiz on Ch. T7 and T8

Things You Must Know

(1) 0th Law of Thermodynamics
(2) 1st Law of Thermodynamics
(3) 2nd Law of Thermodynamics
(4) Gas processes
(5) Definitions of microstate, macrostate, and macropartition
(6) The fundamental assumption of statistical mechanics

Potential Useful Information

$dU = mc\,dT$ $\qquad$ $PV = Nk_BT$ $\qquad$ $U = \frac{f}{2}Nk_BT$

$K_{avg} = \frac{1}{2}m\left[v^2\right]_{avg} = \frac{3}{2}k_BT$ $\qquad$ $v_{rms} = \sqrt{\left[v^2\right]_{avg}}$

$dW = -PdV$

adiabatic: $\qquad$ $TV^{\gamma-1} = \text{constant}$ $\qquad$ $PV^{\gamma} = \text{constant}$

$\Omega(N,U) = \frac{(q+3N-1)!}{q!(3N-1)!}$ $\qquad$ $q = U/\varepsilon$

$S = k_B \ln\Omega$ $\qquad$ $S_{AB} = S_A + S_B$ $\qquad$ $\frac{1}{T} = \frac{dS}{dU}$

$\Pr(E) = \frac{1}{Z}e^{-E/k_BT}$ $\qquad$ $Z = \sum_{\text{all states}} e^{-E_i/k_BT}$ $\qquad$ $E_{avg} = \sum E_n\left(\frac{e^{-E_n/k_BT}}{Z}\right)$

$v_p = \sqrt{\frac{2k_BT}{m}}$ $\qquad$ $D(v) = \frac{4}{\sqrt{\pi}}\left(\frac{v}{v_p}\right)^2 e^{-(v/v_p)^2}$ $\qquad$ $\Pr(v_1 < v < v_2) = \int_{v_1}^{v_2} D(v)\frac{dv}{v_p}$

$dS = \frac{dQ}{T}$ $\qquad$ $Q = mL$

Physical Constants and Data

$k_B = 1.38 \times 10^{-23}$ J/K $= 8.62 \times 10^{-5}$ eV/K $\qquad$ 1 eV = 1.602×10^{-19} J

$N_A = 6.02 \times 10^{23}$ molecules/mole $\qquad$ $m_{\text{proton}} \approx m_{neutron} \approx 1.7 \times 10^{-27}$ kg

Avogadro's number of nucleons (protons and/or neutrons) has a mass of about 1 g

$\gamma = 5/3$ (for monatomic gas) $\qquad$ $\gamma = 7/5$ (for diatomic gas)

a monatomic gas has 3 degrees of freedom; $\qquad$ a monatomic gas has 5 degrees of freedom

specific heat of water = 4186 J/(kg·K) $\qquad$ latent heat of melting ice = 333 kJ/kg