Final Exam Equations, Constants and Data

$g = 9.81\ m/s^2$
$R = 8.314\ J\ mol^{-1}\ K^{-1} = 0.08206\ L\ atm\ mol^{-1}\ K^{-1}$
$1\ a.m.u. = 1.67 \times 10^{-27}\ kg$
$electron\ mass = 9.31 \times 10^{-31}\ kg$
$\sigma = 5.67 \times 10^{-8}\ W/m^2/K^4$
$Electron\ charge = 1.62 \times 10^{-19}\ C$
$The\ Rydberg\ constant = 13.6\ eV = 109690\ cm^{-1}$
$1\ Debye = 3.33 \times 10^{-30}\ Cm$
$1\ atm = 1.0133 \times 10^{5}\ Nm^{-2} = 760\ Torr$
$F = 96{,}450\ C/mol$
$h = 6.626 \times 10^{-34}\ Js$
$c = 2.99 \times 10^{8}\ m/s$
$k_B = 1.38 \times 10\text{-}23\ J/K = 0.697\ cm^{-1}/K$

$$P_2 = P_1 + \frac{\Delta_{trs}H_m}{\Delta_{trs}V_m}\ln\left(\frac{T_2}{T_1}\right) \quad , \quad \ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta_{trs}H_m}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln\left(\frac{K_2}{K_1}\right) = \frac{\Delta H_m}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \ , \ \ln\left(\frac{k_2}{k_1}\right) = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln a_2 = \frac{\Delta H_{fusion}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \ , \ \mu_i = \mu_i^* + RT\ln x_i \ , \ \Delta S = nC_p\ln\left(\frac{T_2}{T_1}\right)$$

$$\Delta S = -R\sum_{i=1}^{N} x_i \ln x_i \ , \ \Delta S = k_B \ln W \ , \ \Delta S = nR\ln\left(\frac{V_2}{V_1}\right)$$

$$\rho = mgh \quad , \quad P = \rho gh \quad , \quad dS \geq \frac{\delta q}{T} \quad , \quad dw = -PdV$$

$$dH = dU + PdV + VdP \ , \ dG = dH - TdS - SdT$$

$$C_p = C_v + nR \ , \ U = \frac{3}{2}nRT \ , \ dU = TdS - PdV$$

$$\omega = \sqrt{\frac{k}{\mu}} \ , \ \dot{B} = \frac{h}{8\pi^2 c\mu R^2} \ , \mu = \frac{m_1 m_2}{m_1 + m_2} \ , \lambda = \frac{h}{p} \ , \ \left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{R/C_V} \ ,$$

$$E_n = -\frac{ZR}{n^2} \ , \ -\frac{\hbar^2}{2\mu}\frac{\partial^2}{\partial x^2}\Psi = E\Psi \ , \ E_n = \frac{n^2 h^2}{8mL^2} \ , \ \mu = ezd$$

$$U = -\mu F\cos\theta \ , U = \frac{q_1 q_2}{4\pi\varepsilon_0 r} \ , \ u(r) = 4\varepsilon\left\{\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right\} \ ,$$

$$W = \sigma T^4 \ , \ \lambda_{max} T = 2.88 \ x \ 10^6 \ nm\text{–}K \ , \ E_v = (v + \frac{1}{2})h\nu \ , \ E = \frac{\hbar^2}{2\mu R^2} J(J+1)$$

$$\varepsilon^* = \frac{(\varepsilon - \lambda)^2}{4\lambda} \ , \ k = \frac{2\pi}{\hbar}\frac{V^2}{\sqrt{4\pi\lambda kT}}\exp\left\{\frac{\varepsilon^*}{kT}\right\} \ , P = P_0 \exp\left\{-\frac{Mgh}{RT}\right\}$$

$$a = \omega^2 x \ , s = \frac{m(1 - v_2\rho)}{f} \ , D = kT/f \ , \ f = 6\pi\eta r \ , M = \frac{RTs}{D(1 - v_2\rho)}$$

$$\Delta E = \frac{RT}{nF}\ln\left(\frac{c_o}{c_i}\right) \ , \ \Delta G^o = -nF\Delta E \ , \ \Pi = cRT \ , \ P_i = K_{H,i} x_i$$

$$P_i = K_{H,i} c_i \ , \ a_i = \gamma_i x_i \ , \ P_i = x_i P_i^* \ , \ P_i = y_i P_{total} \ , \ \sqrt{<d^2>} = L\sqrt{N}$$

$$\frac{P_2}{P_1} = e^{-\Delta E/kT} \ , \ P_{in} = P_{out} + \frac{2\gamma}{r} \ , \ k = Ae^{-E_a/RT} \ , \ k = \frac{k_B T}{h} e^{-\Delta G^*/RT}$$

Surface Tension Data

Substance	Surface tension (mN/m)	Temperature (^{o}C)
Water	72	25
Water	59	100
Benzene	29	25
Acetone	24	25

Water Phase Data

Point	Pressure (atm)	Temperature (K)
Triple Point	0.006	273.16
Normal Boiling Point	1	373.15
Critical Point	218.3	647.4

For H_2O: $V_m = 0.018$ L/mol (liquid)
$\rho = 1.00$ g/cm^3 (liquid)
$\Delta H_{fus} = 6.0$ kJ/mol
$\Delta H_{vap} = 40.65$ kJ/mol