Cheatography

# 313 Exam 3 Cheat Sheet

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## Laws

Zeroth Law: If system x = system y & system y = system z, then system x = system z. (Transitive)

First Law: Internal energy($\Delta U$) of an isolated system is constant. No heat lost, only transferred.

Second Law: The entropy of any isolated system always increases.

Third Law: The entropy of a system approaches a constant value as the temperature approaches absolute zero.

Cyclic Rule: $(dP/dT)_V(dT/dV)_P(dV/dP)_T = -1$

## Definitions

Adiabatic: No transfer of heat or matter

Diathermal: Heat allowed to transfer, no matter transfer. Can transfer energy in the form of work

Enthalpy($\Delta H$): Amount of heat content used or released in a system at constant pressure

Irreversible: A process that cannot return both the system and the surroundings to their original conditions.

## Exam 2

$\Delta U = m_s/M_s \, \Delta U_{comb} + m_{H2O}/M_{H2O} \, C_{v,m}(H2O)\Delta T + \Delta T C_{calorimeter}$

$\Delta H^o = m_{salt}/M_{salt} \, \Delta H^o_{solution} + m_{H2O}/M_{H2O} \, C_{p,m}(H2O)\Delta T + \Delta T C_{calorimeter}$

$S = k \ln(W)$ W=#of states

Efficiency = $1-|q_{cd}|/|q_{ab}| < 1$

$\Delta H^o_{rt} = \Delta H^o_{298} + \int \Delta C_p(T)\, dT$ from 298 to T

$\Delta H_{combustion} = \Delta U_{combustion} + \Delta(PV)$

For Solids & Liquids: $\Delta H \sim= \Delta U$

$\Delta s = -nR\ln(P_f/P_i) + \int nC_{pm}/T \, dT$ for $P_i$ to $P_f$

$\Delta s = nR\ln(V_f/V_i) + \int nC_{vm}/T \, dT$ for $V_i$ to $V_f$

Isolated System: $\Delta S = q_p(1/T_1 - 1/T_2)$

Isothermal, Ideal: $\Delta S = nR\ln(V_f/V_i)$

$\Delta S_{total} = \Delta S + \Delta S_{surroundings}$

$\Delta G = nRT \, \Sigma \, x_i \ln(x_i)$ $x_i$ is mole fraction

$\Delta G = T\Delta S_{total}$

## Internal Energy ($\Delta U$)

| | |
|---|---|
| General | $\Delta U = q + w$ |
| Constant Volume | $\Delta U = C_v\Delta T = q_v$ |
| Adiabatic, Reversible | $\Delta U = w = n(C_{pm} - R)\Delta T = nC_{vm}\Delta T$ |
| Ideal | $\Delta U = nC_{vm}\Delta T$ |

## Enthalpy ($\Delta H$) (State Fxn)

| | |
|---|---|
| General | $\Delta H = \Delta U + \Delta(PV) = \Delta U + nR\Delta T$ |
| Constant Pressure | $\Delta H = C_p\Delta T$ |
| Ideal | $\Delta H = q_p$ |
| Constant Volume | $\Delta H = nC_{pm}\Delta T + V\Delta P$ |
| Even More General | $dH = (dH/dP)_T \, dT + (dH/dT)_P \, dP$ |
| Liquids & Solids | $(dH/dP)_T = V(1 - T\beta)$ |
| Constant Pressure, closed system | $\Delta H = (U_f + P_f V_f) - (U_i + P_i V_i)$ |
| Isobaric | $\Delta H = n\int C_{pm}(T)\, dT = nC_{pm}\Delta T$ |

## Exam 2 Material

$S_m(T) = S_m(0^o k) + \int C_{pm}/T \, dT$(solid 0-$T_f$) $+ \Delta H_{fus}/T_f + \int C_{pm}/T \, dT$(liquid $T_f$-$T_b$) $+ \Delta H_{vap}/T_b \int C_{pm}/T \, dT$(gas $T_b$-T) `

For Ideal Gases: $\Delta S_m = R\ln(V_f/V_i) = -R\ln(P_f/P_i)$

$\Delta G(T_2)/T_2 = \Delta G(T_1)/T_1 + \Delta H(T_1)(1/T_2 - 1/T_1)$

Max Work: Reversible, adiabatic, isothermal

Hess's Law: Total Enthalpy change is independent of # of steps(path-independent).

$\Delta A = \Delta U - T\Delta S = \Delta H - nRT$ (Hemholtz)

for $\Delta G^o_r$ only include non-pure substances.

## Exam 3

$\Delta G_R = \Delta G^\circ_R + RT \ln(Q_P)$

$\ln(K_P) = -\Delta G^\circ_R/RT$

$K_x = K_P(P/P^\circ)^{-\Delta V}$

$dA = \gamma\, d\sigma$ gamma is surface tension

Work = 8pi$\gamma$r dr

Force = 8pi$\gamma$r

h(capillary rise/depression) = $2\gamma/\rho gr$

$u_B = u^\circ_B + RT\ln(\gamma[B])$ gamma is activity coefficient

$\Delta G_R = \Delta G^\circ_R - 2.303vRT(pH)$

$q_x = kA(T_{si} - T_{so})/L$

$q''_x = -k\, dT/dx = q_x/A$

$\dot{E}_{in} + \dot{E}_g - \dot{E}_{out} = \dot{E}_{internal}$

$q_{12} = \varepsilon\sigma A(T_1^4 - T_2^4)$ - Heat xchange via radiation b/t 2 surfaces

$q''_s = h(T_s - T_\infty)$ - Newton's Law of Cooling