**Chemistry 232 Physical Constants, Conversion Factors and Equations** (final exam)

**Physical Constants and Conversion Factors**

*R* = 8.3145 J K−1 mol−1 = 0.083145 L bar K−1 mol−1 = 0.082058 L atm K−1 mol−1 *T*/K = *t*/oC + 273.15

*N*A = 6.0221 × 1023 mol−1 *k* = *k*B = *R*/*N*A= 1.3806 × 10−23 J K−1  *F* = 96485 C mol−1

1 bar = 105 Pa 1 atm = 1.01325 bar 1 mm Hg = 133.32 Pa

1 L bar = 100 J 1 m3 = 1000 L 1 L = 1000 cm3

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**solutions**

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*F* = *C* + 2 − *P* *F′* (const. *T* ) = *C* + 1 − *P* *F′* (const. *p*) = *C* + 1 − *P* *n*liquid(*Z*1 − *x*1) = *n*vapor (*y*1 – *Z*1)

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**ideal solutions** Δ*U*mix= 0 Δ*H*mix= 0 Δ*G*mix= *n*1*RT* ln*x*1 + *n*2*RT* ln*x*2 Δ*S*mix= −*n*1*R*ln*x*1 − *n*2*R*ln*x*2

*pi* = *yi p* *μi*(g) = *μi*o(g, *p*o) + *RT* ln(*pi* /*p*o) *pi* = *xi pi*\* *μi*(*l*) = *μi*\*(pure liquid) + *RT* ln*xi*

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 *p* = *p*1 + *p*2

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**colligative properties** (dilute ideal solutions assumed, *x*1 ≈ 1)

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**activities and activity coefficients for nonideal solutions**

**Raoult’s Law** ( *pi* → *xi pi*\* as  *xi* → 1 ):

*ai*RL *= pi*RL */pi\** = *γi*RL *xi*  *γi*RL *= pi /*(*xi pi\**) *γi*RL→ 1 as *xi* → 1 *μi* = *μi*\*(pure liquid) + *RT* ln(*γi*RL *xi* )

**Henry’s Law** ( *pi* → *xi ki* as  *xi* → 0 ):

*ai*HL *= pi /ki* = *γi*HL *xi*  *γi*HL *= pi /*(*xi ki*) *γi*HL→ 1 as *xi* → 0 *μi* = *μi*\*HL + *RT* ln(*γi*HL *xi* )

(*pi* /*xi*) → *ki* as *xi* → 0 *μi*\*HL = *μi*\*(pure liquid) + *RT* ln(*ki* /*pi*\*)

**Electrolytes**

*a*C*v*+A*v*− = (*a*+)*v*+(*a*−)*v*− = (*γ*+*m*+)*v*+(*γ*−*m*−)*v*− = *γ*±*vm*±*v* **=** *a*±*v* (*a*C*v*+A*v*− = *m*+*v*+*m*−*v*− if ideal) *v* = *v*+ + *v*−

*γ*± = (*γ*+*v*+*γ*−*v*−)1/*v* *m*± = (*m*+*v*+*m*−*v*−)1/*v* *m*+ = *v*+*m* *m*− = *v*−*m* *μ* = *μ*o + *RT* ln[(*a*+)*v*+(*a*−)*v*−] = *μ*o + *RT* ln(*γ*± *vm*± *v*)

*γ*+, *γ*−, *γ*± → 1 as *m* → 0 Δ*H*fmo(H+, aq) = 0 Δ*G*fmo(H+, aq) = 0 *S*mo(H+, aq) = 0

*μi*(total)= *μi*(chemical)+ *μi*(electrical) = *μ*o + *RT* ln(*γimi*) + *ziFφ* *μi*(electrical) = *ziFφ* pH = −log10*a*H+



d*GT*,*p* ≤ *w*e Δ*GT*,*p* = *w*e,rev = −*nFE* Δ*G* = Δ*G*o + *RT* ln*Q* *E* = *E*o − (*RT/nF*) ln*Q*

Δ*G* = Δ*H* − *T*Δ*S* Δ*S* = *nF*(∂*E*/∂*T*)*p* Δ*H* = −*nF*[∂(*E/T*)/∂(1/*T*)]*p*

Zn(s) + 2 MnO2(s) + H2O(*l*) → Zn2+(aq) + Mn2O3(s) + 2 OH−(aq) 2 H2O(*l*) → 2 H2(g) + O2(g)

Zn(s) + 2 MnO2(s) + H2O(*l*) → Zn(OH)2(s) + Mn2O3(s) LiCoO2(s) + C(s) → Li1−*x*CoO2(s) + Li*x*C(s)

Zn(s) + Ag2O(s) → ZnO(s) + 2 Ag(s) PbO2(s) + Pb(s) + 2 H2SO4 (aq) → 2 PbSO4(s) + 2 H2O(*l*)

2 Cl−(aq) + 2H2O(*l*) → Cl2(g) + H2(g) + 2 OH−(aq) 2 Al2O3(melt) + 3 C(s) → 4 Al(*l*) + 3 CO2(g)

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**Kinetic Theory**

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**Transport Properties**







**Transport Properties (cont.)**





*η* = *K*viscometer *ρ t*













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**Chemical Kinetics**





A + A → P: A + B → P:









A→I→P:



A→B:

A→C:



A ↔ B:



H2O ↔ H+ + OH−: