THERMODYNAMICS AND EQUILIBRIUM C07 : DH

1. Among them intensive property is

1) mass 2) volume 3) surface tension 4) enthalpy

Ans. 3

1. The exothermic reaction is one in which reacting substances

1) have less energy than the products 2) more energy than the products

3) same energy as products 4) are at higher temp than products

Ans. 2, since heat is released

1. Calculate the standard entropy change for the reaction A ↔ B if the value of

ΔH° = 28.40 kJ/mol and equilibrium constant is 1.8 x 10-7 at 298K.

1) -57.48 2) -33.78 3) -86.57 4) -45.56

Ans. 2,ΔG°= -2.303 RT log Kc

= -2.303 x 8.31 J/K/mol x 298 log 1.8 x 10 -7

= 38466 J/mol

ΔS = ΔH° - ΔG°/ T = (28400 -38466)/ 298 = -33.78 J/K/mol

1. On the basis of thermo chemical equations (1), (2) and (3), find out which of the algebraic relationships given in options (a) to (d) is correct.

1) C (graphite) + O2(g) → CO2(g); ΔrH = x kJ /mol

2) C(graphite) + 1/2 O2(g) → CO (g); ΔrH = y kJ /mol

3) CO(g) + 1/2 O2(g) → CO2(g); ΔrH = z kJ /mol

1) z = x + y 2) x = y - z 3) x = y + z 4) y = 2z – x

Ans. 3,For, C (graphite) + O2(g) → CO2(g); on adding equation 2 and 3 we get equation 1 hence

x= y + z

1. Which of the following are not state functions?

I) q+ w II) q III) w IV) H- TS

1) (I) and (IV) 2) II), (III) and (IV) 3) (I), (II) and (III) 4) (II) and (III)

Ans.4,We know that heat (q) and Work (W) are not state functions but (q + w) is a state function. H-TS (i.e G) is also a state function. Thus II and III are not state functions so the correct answer is option (d).

1. For which of the following process ΔS is negative?

1) H2(g) → 2H(g) 2) N2 (g) (1atm) → N2 (g) (8atm)

3) 2SO3 (g) → 2 SO2 (g) + O2(g) 4) C(diamond) → C(graphite)

Ans.2,High pressure reduces volume, decreases entropy, hence ΔS negative.

1. The standard enthalpy of formation of NH3 is - 46kJ/mol. If the enthalpy of formation of H2 from its atoms is -436 kJ/mol and that of N2 is -712 kJ /mol, the average bond enthalpy of

N- H bond in NH3 is:

1) + 1056 kJ /mol 2) -1102 kJ /mol 3) -964 kJ /mol 4) +352 kJ /mol

Ans.4,let B. E of (N-H) = x kJ/mol

ΔH = ∑B.E (r) - ∑B.E (p)

- 46 = 1/2(712) + 3/2(436) -3x

x = 352 kJ/mol

1. Which of the following reactions defines ΔH ᵒf?

1) C(diamond) + O2 (g) → CO2 (g) 2) ½ H2(g) + ½ F2(g) → HF(g)

3) N2(g) + 3H2(g) → 2NH3(g) 4) CO(g) + ½ O2(g) → CO2(g)

Ans. 2,As one mole of the substance formed from its stable elements

1. What is the value of internal energy change (ΔU) at 27°C of a gaseous reaction

2A2 (g ) + 5B2 (g ) ----> 2A2 B5 (g) (Whose heat change at constant pressure is -50700 J)?

(R = 8.314 J/K/mol)

1) -50700 J 2) -63171 J 3) -38229 J 4) +38229 J

Ans.3,ΔH = ΔU+ ΔngRT

-50700 = ΔU + (-5) x 8.314 x 300

ΔU = -38229 J

1. The species which by definition has Zero standard molar enthalpy of formation at 298 K is:

1) Br2 (g) 2) Cl2(g) 3) H2O(g) 4) CH4 (g)

Ans.2,H°= zero in most stable form of element

H°Cl2 (g)  = 0H°Br2 (l) = 0

1. 4.48 L of an ideal gas at S.T.P requires 12 calories to raise its temperature by 15°C at constant volume. The Cp of the gas is:

1) 3 cal 2) 4 cal 3) 7 cal 4) 6 cal

Ans. 4, C v =Δ U/nΔT , n =4.48L/22.4L = 0.2

= 12/(0.2 x 15) = 4 cal

Cp= Cv+R =4+2= 6cal

1. Spontaneous adsorption of a gas on a solid surface is exothermic process because

1) enthalpy of the system increases. 2) entropy decreases.

3) entropy increases. 4) free energy change increases.

Ans.2

1. Standard entropies of X2, Y2 and XY3 are 60, 40 and 50 J/K/mol respectively. For the reaction

½ X2 + 3/2 Y2 → XY3, ΔH = -kJ

to be at equilibrium, the temperature should be:

1) 750K 2) 1000K 3) 1250K 4) 500K

Ans.1,Δ S for the reaction ½ X2 + 3/2 Y2 ↔ XY3

ΔS = 50 - (30+60) = - 40J

For equilibrium ΔG =0= ΔH - TΔS

T = ΔH /ΔS = -30000/-40 = 750K

1. At 27 ᵒC 1 mol of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10atm. The value of Δ E and q are ( R = 2)

1) 0, -965cal 2) -965cal, +965cal 3) +565cal, -565cal 4) -565cal, -565cal

Ans. 1 w= + 2.303nRTlogP2/P1 = 965 at const Temp E=0

E= q+w, q= -w = -965cal

1. For an endothermic reaction , energy of activation and enthalpy of reaction is ΔH , minimum value of Ea is

1) equal to ΔH 2) less than ΔH 3) equal to zero 4) more than ΔH

Ans. 4, since H p > Hr

1. The volume of gas is reduced to half from its original volume. The specific heat will be

1) reduce to half 2) be double

3) remain constant 4) increase 4 times

Ans 3, specific heat is an intensive property depends only on the nature of the gas

1. H2(g) +I2 (g) 🡪 2HI(g) , H =51.9 kJ According to this ,heat of formation of HI is
   * 1. kJ 2)-51.9 kJ 3)-25.95kJ 4)25.95 kJ

Ans. 4 ,Hint: Heat of formation 1 mole of HI =

1. The entropy change for the conversion of 1 mol of α- tin (at 13º C,1 atm) to 1 mol of β-tin (at 13º C,1 atm ) if the enthalpy of transition is 2.095 K J mol-1

1)7.32 mol-1K-1 2)14.62 J K mol-1 3)56. J mol-1K-1 4)0

Ans. 1,Hint: S = = 7.32J/mol/K

1. For the reaction, 2HgO(s) 🡪 2Hg(l) + O2(g)

H > 0& S <0 H >0& S >0

H <0 & S<0 H<0& HS>0

Ans. 2, Hint:solid states posses minimum randomness randomness order solid<liquid<gas

1. Which among the following are necessary and sufficient conditions for spontaneous Reaction

S, ∆H = -ve only 2)S = + ve only

3)Both H = -ve and s = +Ve 4) G =+ve

Ans 3, Hint: G = H - TS or G = H- TS

1. A gas expands from 1.5 to 6.5 L against a constant pressure of 0.5 atn during this the Process the gas also absorbs 100J of heat the change in the internal energy of the gas is

1)153.3J 2)353.3J 3)-153.3J 4)-353.3J

Ans. 3,Hint: U = Q+W

= 100J – (0.5atm) (6.5 l -1.5L)

= 100J - (2.5atm L)(8.314J/0.082atm L)

=-153.3J

1. The standard heat of formation values of SF6(g),S(g) and F(g) are -1100, 275 and 80J mol-1 respectively . the energy of S-F bond in SF6

1)309.2kJ 2)378.2 kJ 3)284.6 kJ 4)261.88 kJ

Ans. 1, Hint: H= ( HS +6 HF)- HSF6

=275 + (6 X 80)-(-1100) = 1855

Average bond energy = 1855/6 =309.2 kJ

1. Entropy of a perfect crystalline solid at absolute Zero is

1)Zero 2)Less than Zero

3)Greater than Zero 4)Depends upon nature of the solid

Ans. 1, Hint: III law

1. For a given exothermic reaction Kp and Kp1 are the equilibrium constants at temperatures T1 and T2, respectively. Assuming that heat of reaction is constant in temperature range between T1 and T2, it is readily observed that

1) Kp > Kp1 2) Kp < Kp1 3) Kp = Kp1 4)

Ans: 1

1. If solubility product of Zr3(PO4)4 is denoted by Ksp and its molar solubility is denoted by S, then which of the following relation between S and Ksp is correct?

1) 2)  3)  4) 

Ans. Ans: 4



1. Which will make basic buffer?

1) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH3COOH

2) 100 mL of 0.1 M CH3COOH+ 100 mL of 0.1 M NaOH

3) 100 mL of 0.1 M HCl+ 200 mL of 0.1 M NH4OH

4) 100 mL of 0.1 M HCl+ 100 mL of 0.1 M NaOH

Ans. 3



Hence its basic buffer.

1. 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction

A + B → C + D , 2 moles of C and D are formed. The equilibrium constant for the reaction will be

1) 2)  3) 1 4) 4

Ans. Ans: 3



1. Which of the following molecule acts as a Lewis acid?

1)(CH3)2O 2) (CH3)3P 3) (CH3)3N 4) (CH3)3B

Ans:4

(CH3)3B is electron deficient

1. In a buffer solution, pH= pKa when the solution contains

1)[salt] = [acid] 2) [salt] > [acid]

3) [salt] < [acid] 4) [salt] +[acid] has a maximum value

Ans: 1

For an acidic buffer solution



1. Which of the following solutions will have highest value of pH?

1)0.1 M HCl 2) 0.1 M H2SO4

3)0.1 M CH3COOH 4)0.1 M in each of HCl and H2SO4

Ans: 3

0.1M CH3COOH will have minimum[H3O+] and hence its pH will be maximum.

1. Which of the following order regarding basic strength of the given Bronsted bases in aqueous medium is correct?

1) 2) 

3)  4) 

Ans: 4

The order of the conjugate acids is HNO2 > CH3COOH >H2CO3. The base

strength follows the reverse order, i.e. 

1. The conjugate acid  (azide) ion is

1) NH3 2)HN3 3) 4) 

Ans: 2



1. In an exothermic reaction, high yield of the product is obtained at

1) High temperature 2) Low temperature

3) Low concentration 4) None of these

Ans: 2

1. The dissociation constant of a substituted benzoic acid at 25°C is 1.0 x 10-4. The pH of

0.01 M solution of its sodium salt is

1) 5 2) 3 3) 8 4) 1

Ans.3, Sodium benzoate (C6H5COONa) is a salt of weak acid and strong base.

pH =7 + ½ [pKa + log c]

= 7 + ½ [-log10-4 + log 10-2]

= 7 + ½ (4-2) = 7+1 = 8

1. The pH of 0.05 M aqueous solution of diethylamine is 12. Its Kb is:

1) 3.5 x 10 -3 2) 2.5 x 10 -3 3) 4.5 x 10 -3 4) 1.5 x 10 -3

Ans.2, pH+ pOH = 14

pOH= 14-12-=2; [OH-]= 10-2

(C2H5)2 NH + H2O (C2H5)2 NH2+ + OH-

0.05-0.01 0.01 0.01

Kb = ( 0.01 x 0.01) / 0.04 = 2.5 x 10 -3

1. For a reaction N2 + 3H2 → 2NH3; ΔH = -22kcal. If energy of activation for this reaction is 70 kcal, the energy of activation for backward reaction is:

1) 70 kcal 2) 92 kcal 3) 48 kcal 4) none of these

Ans.2, Ea(forward) - Ea(backward) = ΔH

Ea(backward) = Ea(forward) - ΔH = 70 - ( -22) = 92 kcal

1. For the chemical reaction : 3X(g)+ Y(g) ↔ X3Y(g) ; the amount of X 3Y at equilibrium is affected by

1) temperature and pressure 2) temperature only

3) pressure only 4) temperature, pressure and catalyst

Ans.1, Conceptual

1. For the reaction  , if

Kp = Kc(RT)X where the symbols have usual meaning then the value X is (assuming ideality)

1) 2)1 3) −1 4) 

Ans: 4

For reaction



∆ng = = X

1. The degree of dissociation of 10−3M ammonium hydroxide (Kb0=1.8×10−5)solution is about

1)0.25 2)0.20 3)0.13 4)0.09

Ans: 3



1. The pH of a dilute solution of acetic acid was found to be 4.3. the addition of a small crystal of sodium acetate will cause pH to

1) becomes less than 4.3 2) Become more than 4.3

3) Remain equal to 4.3 4) UnpredictableAns: 2

Ans. 2, 

Due to common ion ( CH3COO- ) , the suppression of ionisation of CH3COOH takes place, so the concentration of H+ decreases, so pH increases. So pH must be more than 4.3

1. In a buffer solution, pH= pKa when the solution contains

1)[salt] = [acid] 2) [salt] > [acid] 3) [salt] < [acid] 4) [salt] +[acid]

has a maximum value

Ans: 1

For an acidic buffer solution



1. If pKa=4.76 and pKb= 4.75 calculate pH

1) 5 2) 9 3) 2 4) 7.005

Ans: 4 

1. Why only As+ gets precipitated as As2S3 and not Zn+ as ZnS when H2S is passed through an acidic solution containing As3+ and Zn+2?

1) Solubility product of As2S3 is less than that of ZnS

2) Enough As3+ are present in acidic medium

3) Zinc salt does not ionise in acidic medium

4) Solubility product changes in presence of an acid

Ans. 1, Ksp of AS2S3 is less than ZnS. In acid medium ionisation of H2S is suppresed (common ion effect) and Ksp of ZnS does not exceed.

1. 1 M NaCl and 1 M HCl are present in an aqueous solution. The solution is

1) not a buffer solution with pH < 7 2) not a buffer solution with pH > 7

3) a buffer solution with pH < 7 4) a buffer solution with pH > 7.

Ans. 1, A buffer is a solution of weak acid and its strong base and vice versa. HCl is strong acid

NaCl is its salt with strong base. pH is less than to HCl

1. The indicator used for titration of weak base and stong acid is

1)Thymol blue 2) methyl orange 3)phenolphthalein 4)fluorescein

Ans. 2