CHEMISTRY

BOOKS - VGS PUBLICATION-BRILLIANT

CHEMICAL EQUILIBRIUM AND ACIDS-BASES

Very Short Answer Questions

1. State law of chemical equilibrium.

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2. Can equilibrium be achieved between water and its vapours in an open vessel? Explain.

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3. Why the concentrations of pure liquids and pure solids are ignored from equilibrium constant expressions?

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4. What is homogeneous equilibrium? Write two homogeneous reactions.

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5. What is heterogenous equilibrium?

Write two heterogeneous reactions.

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6. Write reaction equotient, Q, for each of the following reactions.

a. $3O_2(g) \Leftrightarrow 2O_3(g)$

b. $4NH_3(g) + 7O_2(g) \Leftrightarrow 4NO_2(g) + 6H_2O(g)$

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7. Define equilbrium constant.

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8. The equilibrium constant expression for a gas reaction is

$$K_c = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$$

Write the balanced chemical equation corresponding to this expression.

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9. Write the relation between K_p and K_c

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10. Under what conditions for a reaction K_p and K_c are numerically equal?

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11. Give two chemcial equilibrium reactions for which $K_p = K_c$

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12. Give two chemical equilibrium reactions for which $K_p > K_c$.

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13. Give two chemical equilibrium reactions for which $K_p < K_c$.

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14. Write the equations for the conversion of K_cd to K_p for each of the following reaction.

$CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$

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15. Write the equations for the conversion of K_cd to K_p for each of the following reaction.

$C_3H_8(g) + 5O_2(g) \Leftrightarrow 3CO_2(g) + 4H_2O(g)$

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16. What are the factors which influence the chemical equilibrium?

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17. What is the effect of pressure on gaseous chemical equilibrium?

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18. What is the effect of increase in concentration of reactants of a chemical reaction at equilibrium?

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19. Can catalyst disturb the state of equilibrium?

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20. On which factor, the equilibrium constant value changer?

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21. The equilibrium constants of a reaction at $27^{\circ}C$ and aet $127^{\circ}C$ are 1.6×10^{-3} and 7.6×10^{-2} respectively. Is the reaction exothermic or

endothermic?

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22. What is the effect of temperature on a system at equilibrium?

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23. For an exothermic reaction, what happens to the equilibrium constant if temperature is raised?

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24. What kind of equilibrium constant can be calculated from ΔG° value for a reaction involving only gases?

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25. What is a Bronsted base? Give one example.

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26. What is Lewis acid? Give one example.

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27. What is meant by ionic product of water?

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28. What is the value of K_w ? What are its units?

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29. What is the effect of temperature on ionic product of water?

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30. $H_2O + H_2O \Leftrightarrow H_3O^+ + OH^-$

The ionic product of water is 1×10^{-14} at $25^\circ C$ and 3.0×10^{-14} at $40^\circ C$

is the above process endothermic or exothermic?

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31. All Bronsted bases are Lewis bases? Explain.

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32. All Lewis acids are not Bronsted acids. Why?

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33. What is degree of ionisation?

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34. What is the measure of strength of an acid and base?

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35. Give two examples of salts whose aqueous solutions are basic.

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36. Give two examples of salts whose aqueous salts are acidic.

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37. What equation is used calculating the pH of an acid buffer?

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38. Phosphoric acid (H_3PO_4) have three ionization constants K_{a_1}, K_{a_2} and K_{a_3}. Among these ionization constants which has a lower value ? Give reason for it.

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39. Ice melts slowly at high altitudes. Explain Why?

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Short Answer Questions

1. Write expression for the equilibrium constant, K_c, for each of the following reactions:

(i) $2NOCl_{(g)} \leftrightarrow 2NO_{(g)} + Cl_{2(g)}$

(ii) $2Cu(NO_3)_{2(s)} \Leftrightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

(iii) $CH_3COOC_2H_{5(ag)} + H_2O(I) \Leftrightarrow CH_3COOH_{(aq)} + C_2H_5OH_{(aq)}$

(iv) $Fe^{+3}_{(aq)} + 3OH^{-}_{(aq)} \Leftrightarrow Fe(OH)_{3(S)}$

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2. Derive the relation between K_p and K_c for the equilibrium reaction.

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

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3. Define equilibrium constant. Write the equilibrium constant expression for the reaction of

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$

and its reverse reaction. How are the two equilibrium constants related?

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4. How does the values of equilibrium constant predict the extent of reaction?

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5. State law of chemical equilibrium? What is K_c for the following equilibrium when the equilibrium concentration of each substance is $[SO_2] = 0.60M$, $[O_2] = 0.82M$ and $[SO_3] = 1.90M$

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

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6. Why sealed soda water bottle on opening shows the evolution of gas with effervescence?

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7. Explain the significance of : a value of K of about 1.0

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8. Explain the significance of : a very small value of K

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9. Explain the significance of : a value of K of about 1.0

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10. Why is it useful to compare Q with K?

What is the situation when

a. $Q = K$ b. $Q < K$ c.$Q > K$?

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11. For the reaction

$Cl_2(g) + F_2(g) \Leftrightarrow ClF(g), K_c = 19.9$ What will happen in a mixture originally containing $[Cl_2] = 0.04 \text{mol} L^-$,

$[F_2] = 0.2 \text{mol} L^{-1}$ and $[ClF] = 7.3 \text{mol} L^-$?

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12. Predict which of the following reactionn will have appreciable concentration of reactants and products:

$Cl_2(g) \Leftrightarrow 2Cl(g), K_c = 5 \times 10^{-39}$

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13. Predict which of the following reactionn will have appreciable concentration of reactants and products:

$Cl_2(g) + 2NO(g) \Leftrightarrow 2BNOCl(g), K_c = 3.7 \times 10^8$

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14. Predict which of the following reactionn will have appreciable concentration of reactants and products:

$Cl_2(g) + 2NO_2(g) \Leftrightarrow 2NO_2Cl(g), K_c = 1.8$

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15. How to recognise the conditions under which changes in pressure would effect system in equilibrium.

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16. What property of a reaction can be used to predict the effect of a change in temperature on the magnitude of an equilibrium constant?

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17. Does the number of moles of reaction products increase, decrease, or remains same when each of the following equilibrium is subjected to a decrease in pressure by increasing the volume?

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

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18. Does the number of moles of reaction products increase, decrease, or remains same when each of the following equilibrium is subjected to a decrease in pressure by increasing the volume?

$Cao(s) + CO(\_2)(g) \Leftrightarrow CaCO_3(s)$

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19. Which of the following reactions will get affected by increasing the pressure? Also mention whether chasnge will cause the reaction to go into forward or backward direction.

(i) $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

(ii) $CH_4(g) + 2S_2(g) \Leftrightarrow CS_2(g) + 2H_2S(g)$

(iii) $CO_2(g) + C(s) \Leftrightarrow 2CO(g)$

(iv) $4NH_3 + (g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$

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20. How will an increase in pressure and affect each of the following equilibria? An increase in temperature

(i) $2NH_3(g) \Leftrightarrow N_2(g) + 3H_g \Delta H = 932kJ$

(ii) $N_2(g) + O(2)(g) \Leftrightarrow 2NO(g) \Delta H = 181kJ$

(iii) $2O_3(g) \Leftrightarrow 3O_2(g) \Delta H = -285kJ$

(iv) $CaO(s) + CO_2(g) \Leftrightarrow CaCO_3(s) \Delta H = -176kJ$

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21. The dissociatiion of HI is independent of pressure, while the dissociation of PCl_3 depends upon the pressure applied explain.

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22. Explain the term: Electrolyle

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23. Explain the term: Non-electrolyte

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24. Explain the term: Strong and weak electrolytes

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25. Explain the term: Ionic equilibrium

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26. Explain the terms: extent of ionization and on what factors it depends

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27. Explain the terms: dissociation

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28. Explain the terms:ionization

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29. Explain the Arrhenius concept of acids and bases.

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30. What is a conjugate acid base pair? Illustration with examples.

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31. Acetic acid is a weak acid. List in order of descending concentration all of the ionic and molecular species present in 1M aqueous solution of acetic acid.

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32. Show by suitable equations that each of the following species can act as a Bronsted base: H_2O

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33. Show by suitable equations that each of the following species can act as a Bronsted base: OH^-

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34. Show by suitable equations that each of the following species can act as a Bronsted base: C_2H_5OH

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35. Show by suitable equations that each of the following species can act as a Bronsted base: HPO_4^{-2}

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36. The species H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and base. Give the corresponding conjugate acid and base for each of them.

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37. Write equation that showss $H_2PO_4^-$ acting both as an acid and as a base.

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38. Write the conjuate acid and conjuate base of each of the following:

OH^-

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39. Write the conjuate acid and conjuate base of each of the following:

H_2O

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40. Write the conjuate acid and conjuate base of each of the following:

HCO_3^-

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41. Write the conjuate acid and conjuate base of each of the following:

H_2O_2

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42. Identity and label the Bronsted acid and its conjugate base,te Bronsted base and its conjugate acid in each of the following equations.

$H_2SO_4 + Cl^{-1} \rightarrow HCl + HSO_4^-$

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43. Identity and label the Bronsted acid and its conjugate base,te Bronsted base and its conjugate acid in each of the following equations.

$H_2S + NH_2^- \rightarrow HS^- + NH_3$

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44. Identity and label the Bronsted acid and its conjugate base,te Bronsted base and its conjugate acid in each of the following equations.

$CN^- + H_2O \rightarrow HCN + OH^-$

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45. Identity and label the Bronsted acid and its conjugate base,the Bronsted base and its conjugate acid in each of the following equations.

$O_{2\_} + H_2O \rightarrow 2OH^-$

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46. Classify the species $AlCl_3$, NY_3, Mg^{+2} and H_2O into Lewis acids and Lewis bases and justify your answer?

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47. What are the strengths of conjuate bases of a strong acid and a weak acid?

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48. What are the strengths of conjuate acids of a strong base and weak base?

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49. Define ionic product of water. What is the value at room temperature?

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50. Define pH. pH cannot be calculated directly from the molar concentration of a weak acid or weak base. Why? Derive an equation for the pH of a weak acid.

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51. Write equations to show the step wise ionization of the polyprotic acids H_2SO_4 and H_3PO_4.

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52. Explain how acid strength changes among

i. the hydrides of the group elements and

(ii) the hydrides in the same row of the periodic.

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53. Justifyi the statement that water behaves like an acid an also like base on the basis of protonic concept.

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54. What is common ion effect? Illustrate.

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55. Define solubility product. Write solubility product expressiions for the following:

$Ag_2Cr_2O_7$

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56. Define solubility product. Write solubility product expressions for the following:

$Zr_3(PO_4)_4$

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57. Give the classification of salts. What types of salts undergo hydrolysis?

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58. What must be true of value of ΔG° for a reaction if

$K > 1$

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59. What must be true of value of ΔG° for a reaction if

$K = 1$

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60. What must be true of value of ΔG° for a reaction if

$K < 1$

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61. Aqueous solution of NH_4Cl is acidic. Explain.

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62. Aqueous solution of CH_3COONa is basic. Explain

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63. Give reason that acetic acid is less acidic in sodium acetate solution than in sodium chloride solution.

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64. $AgCl$ is less soluble in $AgNO_3$ solution than in pure water. Explain.

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65. Predict whether the following reaction will proceed from left to the right to any measurable extent:

$CH_3COOH(aq) + Cl^-(aq) \rightarrow$

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66. Aqueous solution of H_2S contains $H_2S, HS^-, S^{2-}, H_3O^+, OH^-$ and H_2O in varying concentrations. Which of these species can act only as a base? Which can act only as an acid? Which can act both as an acid and as a base?

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Long Answer Questions

1. What are equilibrium processes? Explain equilibrium in Physical and Chemical processes with examples.

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2. What is meant by dynamic equilibrium?

Explain with suiitable examples.

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3. Give the general characteristics of equilibrium involving physical processes.

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4. What are the important features of equilibrium constant? Discuss any two applications of equilibrium constant.

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5. What is Le Chatelier's principle? Discuss breifly the factors which can influcence the equilibrium.

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6. Discuss the application of LE Chatellier's principle for the industrial synthesis of Ammonia and sulphur trioxide.

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7. Dihydrogen gas is obtained from natural gas by partial oxidation with stream as per the following endothermic reaction.

$CH_4(g) + H_2O(g) \Leftrightarrow CO(g) + 3H_2(g)$

a. Write an expression for K_p for the above reaction.

b. How will the values o K_p and composition of equilibrium mixture be affected by

(i) increasxing the pressure (ii) increasing the temperature (iii) using a catalyst?

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8. Describe the effect of:

a. addition of H_2

b. addition of CH_3OH

c. removal of CO

d. removal of CH_3OH on the equilibrium of the reaction.

$2H_2(g) + CO(g) \Leftrightarrow CH_3OH(g)$

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9. At 473K, equilibrium constant K_C for the decompositioni of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If the decomposition is depicted as:

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g) \Delta H = 124.0 kJ \text{mol}^{-1}$

a. Write an expression of K_c for the reaction.

b. What is the value of K_c for the reverse reaction at the same temperature?

c. What would be effect on K_c if

(i) more PCl_5 is added (ii) pressure is increased (iii) the temperature in increased.

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10. Explain the concept of Bronsted acids and Bronsted bases. Illustrate the answer with suitable examples.

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11. Explain Lewis acid base theory with suitable example. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base.

a. OH^- b. F^- c. H^+ d. BCl_3

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12. What is degree of ionization is respect of weak acids and weak bases? Derive the relationship between degree of ionization (α) and ionization constant (K_a) for thke weak acid HX.

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13. Define pH. What is buffer solution? Derive Henderson-Hasselbalch equation for calculating the pH of an acid buffer solution.

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14. Explain the term Hydrolysis of salts with examples. Discuss the pH of the following types of salt solutions.

(i) Salts of weak acid and strong base.

(ii) Salts of strong acid and weak base.

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15. What is solubilityy product? Explain the common ion effect on solubility of ionic salts.

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16. Write notes on

(i) Common ion effect

(ii) The relation between K_{sp} and solubility (S) of a sparingly soluble salt $BaSO_4$.

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Numerical Problems

1. Mole of PCl_5 is heated in a closed vessel of 1 litre capacity. At equilibrium 0.4 moles of chlorine is found. Calculate the equilibrium constant.

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2. Nitrogen dioxide froms dinitrogen tetroxide according to the equation $2NO_2(g) \Leftrightarrow N_2O_4$ (g) when 0.1 mole of NO_2 is added to a 1 litre flask at $25^\circ C$, the concentration changes so that at equilibrium $[NO_2] = 0.016M$ and $[N_2O_4] = 0.042M$.

a. What is the value of the reaction Quotient before any reaction occurs.

b. What is the value of the equilibrium constant for the reaction.

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3. The equilibrium constant for the reaction:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at $725K$

is 6.0×10^{-2}. At equilibrium $[H_2] = 0.25\text{mol}L^{-1}$ and $[NO_3] = 0.06\text{mol}L^{-1}$

Calculate the equilirbium concentration of N_2.

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4. At certain temperature K_c for the reactioni.

$SO_2(g) + NO_2(g) \Leftrightarrow SO_3(g) + NO(g)$ is 16. If initiallyone mole each of all the four gases are taken in one litre vessel, what are the equilibrium concentrations of NO and NO_2?

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5. Under certain conditions, the equilibrium constant for the decomposition of $PCl_5(g)$ into $PCl_3(g)$ and $Cl_2(g)$ is $0.0211 \text{mol} L^{-1}$. What are the equilibrium concentrations of PCl_5, $PCl_3 d$ and Cl_2 if the initial concentration of PCl_5 was $1.00 M$?

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6. For the reactions $A + B \Leftrightarrow 3C$ at $25^\circ C$, a 3 litre vessel contains 1,2,4 mole of A, B and C respectively predict the direction of reaction if

a. K_c for the reaction is 10

b. K_c for the reaction is 15

c. K_c for the reaction is 10.66

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7. A mixture of H_2, N_2 and NH_3 with molar concentration $5.0 \times 10^{-3} \text{mol} L^{-1}, 4.0 \times 10^{-3} \text{mol} L^{-1}$ and $2.0 \times 10^{-3} \text{mol} L^{-1}$ respectively was prepared and heated to $500K$. The value of K_c for the reaction:

$3H_2(g) + N_2(g) \Leftrightarrow 2NH_3(g)$ at this temperature is 60. Predict whether ammonia tends to form or decompose at this stage of concenration.

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8. At $500K$, K_p value for the reaction

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ is 2.5×10^{10}.

Find the value of K_p for each of followign reactions at the same temperature.

a. $SO_2(g) + 1/2O_2(g) \Leftrightarrow SO_3(g)$

b. $SO_3(g) \Leftrightarrow SO_2(g) + 1/2O_2(g)$

c. $3SO_2(g) + 3/2O_2(g) \Leftrightarrow 3SO_3(g)$

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9. K_c for the reaction $N_2O(g) \Leftrightarrow 2NO_2(g)$ is 4.63×10^{-3} at 25^2C.

a. What is the value of K_p at this temperature?

b. At $25^\circ C$, if the partial pressure of $N_2O_4(g)$ at equilibrium is 0.2 atm, calculate equilibrium pressure of $NO_2(g)$

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10. At $27^\circ C$, K_p value for the reversible reaction $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ is 0.65, calculate K_c.

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11. K_c for the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2N_3(g)$ is 0.5 at $400K$ find K_p

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12. 1 mole of A and 1 mol3 of B are taken in a 5 litre flask, 0.5 mole of c is formed in the equilibrium of

$A + B \Leftrightarrow C + D$

What is molar concentration of each species if the reaction is carried with 2 mole A, 1 mole of B in a 5 litre flask at the same temperature.

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13. For the following reaction

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g) 0.4$ mole of Cl_2 are taken in a 1 litre flask. If $K_c = 0.2$ predict the direction in which reaction proceeds.

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14. In an equilibrium $A + B \Leftrightarrow C + D$, A and B are mixed in a vessel at temperature T. The initial concentration of A was twice the initial concentration of B. After the attainment of equilibrium, concentration of C was thrice concentration of B, calculate K_c.

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15. A mixture of SO_2, SO_3 and O_2 gases are maintained at equilibrium in 10 litre flask at a temperature at which K_c for the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ is 100. At equilibrium.

a. If no of moles of SO_3 and SO_2 is flask are same, how many moles of O_2 are present.

b. If no. of moles of SO_3 in flask is twice the no. of moles SO_2 how many moles of O_2 are present.

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16. For $A + B \Leftrightarrow C$, the equilibrium concentrations of A and B at a temperature are $15 \text{mol} L^{-1}$. When volume is doubled the reaction has equilibrium concentration of A is $10 \text{mol} L^{-1}$. Calculate

a. K_c

b concentration of C in original equilibrium.

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17. A vessel at $100K$ contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on addition of graphite. Calculate the value of K if total pressure at equilibrium is 0.8 atm.

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18. The K_p values for the reaction

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ at $460^\circ C$ is 49. If the initial pressure of H_2 and I_2 are 0.5 atm respectively, determine the partial pressure of each gases at equilibrium.

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19. 0.5 mol of H_2 and 0.5 mole of I_2 react in 10 litre flast at $448^\circ C$. The equilibrium constant K_c is 50 for

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$

a. What is the value of K_p

b. Calculate mole of I_2 at equilibrium.

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20. How much PCl_5 must be added to a one little vessel at $250^\circ C$ in order to obtain a concentration of 0.1 mole of Cl_2 at equilibrium. K_c for $PCl(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ is $0.0414M$

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21. K_p for the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at 400^2C is 1.64×10^{-4}

a. Calculate K_cd

b. Calculate ΔG° value of K_c value.

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22. Calculate pH of

a. $10^{-3}MHCl$

b. $10^{-3}MH_2HO_4$

c. $10^{-6}MHNO_3$

d. $0.02MH_2SO_4$

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23. Calculate the pH for

a. $0.001MNaOH$

b. $0.01MCa(OH)_2$

c. $0.0008MBa(OH)_2$

d. $0.004MNaOH$

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24. The pH of a solution is 3.6. Calculate H_3O^+ ion concentration.

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25. The pH of a solution is 8.6. Calculate the OH^- ion concentration

$pH = 8.6$

$pOH = 5.4$

$-\log[OH^-] = 10^{-5.4}$

$[OH^-] = 10^{-6} \times 10^{0.6} = 10^{-6} \times$ anto log 0.6

$[OH^-] = 3.98 \times 10^{-6}$

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26. What is $[H^+]$ for a solution in which

a. $pH = 3$ b. $pH = 4.75$ c. $pH = 4.4$?

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27. A solutioin of 0.005 MH_2SO_4 is diluted 100 times. Calculate the pH of diluted solution.

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28. A solution of HCl has a $pH = 3$. If one ml of it is diluted to 1 litre, what will be the pH of the resulting solution?

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29. What is the pH of $10^{-H}MCl$?

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30. Calculate the pH of the following basic solutions

a. $\left[OH^-\right] = 0.05M$ b. $\left[OH^-\right] = 2 \times 10^{-4}M$

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31. 2g of $NaOH$ is dissolved in water to give 1 litre solutioin. What is the pH of the solution?

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32. Calculate the pH of the following solutions.

a. 0.37g fo $Ca(OH)_2$ dissolved in water to give 500 ml solution

b. 0.3 g of NaOH dissolved in water to give 200 ml solution

c. 0.1825% HCl aqueous solution

d. 1 ml of 13.6 M HCl is diluted with water to give 1 litre solution.

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33. How many grams of NaOH are present in 100 ml solution if pH of the solution is 10?

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34. The value of K_w is 9.55×10^{-14} at certain temperature. Calculate the pH of water at this temperature.

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35. Caculate the pH of $10^{-8} mNaOH$

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36. 150 ml of 0.5 HCl and 100 ml of 0.2 M HCl are mixed. Find the pH of the resulting solution.

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37. Calculate the p of solution obtained by mixign 10 ml fo 0.1 M HCl and 40 ml off $0.2 M H_2SO_4$.

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38. 100 ml of $pH = 4$ solution is mixed with 100 ml of $pH = 6$ solution. What is the pH of resulting solution?

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39. Equal volumes of M NaOH and 0.3 M KOH are mixed in an experiment. Find the POH and pH of the resulting solution.

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40. 60 ml of 1 M HCl is mixed with 40 ml of 1M NaOH. What is the pHH of resultant solution?

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41. Calculate the pH of a solution which contains 100 ml of 0.1 H HCl and 9.9 ml of 1.0 M NaOH.

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42. What will be the resultant pH when 200 ml of an aqueous solution of HCl having $pH = 2$ is mixed with 300 ml of a aqueous solution of NaOH having $pH = 12$?

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43. 50 ml of 0.2 M HCl is added to 30 ml of 0.1 MKOH solution. Find the pH of the solution.

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44. 40 ml of $0.2MHNO_3$ when reacted with 60 ml of $0.3MNaOH$ gave a mixed solution. What is the pH of the resulting solution?

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45. 50 ml of $0.1MH_2SO_4$ were added to 100 ml of $0.2MHNO_3$. Then the solution is diluted to 300 ml. What is the pH of the solution?

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46. What is the K_w value in the aqueous solution of $pK_w = 13.725$?

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47. The ionic product of water at $80^\circ C$ is 2.44×10^{-13}. What are the concentrations of hydronium ion and the hydroxide in pure water at $80^\circ C$?

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48. The ionization constnat for water is 2.9×10^{-14} at $40^{\circ} C$. Calculate $\left[H_3O^+\right]$, $[OH]$, pH and pOH for pure water at $40^{\circ} C$.

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49. Calculate the pH of

a. 0.002 M acetic acid having 2.3% dissociation.

b. 0.002MNH_4OH having 2.3% dissociation.

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50. Calculate Ka of acetic acid from equilibrium concentration given below:

$\left[H_3O^+\right] = \left[CH_3COO^-\right] = 1.34 \times 10^{-3} M, [CH_3COOH] = 9.866 \times 10^{-2}$

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51. Calculate pH of 0.1 M acetic acid having $K_a = 1.8 \times 10^{-5}$

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52. The pH of 0.1 M solution of weak mono protic acid is 4.0. Calculate its $\left[H^+\right]$ and Ka.

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53. K_a of $0.02MCH^3COOH$ is 1.8×10^{-5} Calculate

a. $\left[H_3O^+\right]$ b. % ionization c. pH

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54. Calculate the pH of 0.01 M solution of $CH_3COOH. K_a$ for CH_3COOH at $298K$ is 1.8×10^{-5}

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55. The pH of 0.1 M solution of an organic acid is 4.0. Calculate the dissociation constant of the acid.

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56. The ionization constants of $HF, HCOOH$ and HCN at 298 K are $6.8x10^{-4}, 1.8 \times 10^{-4}$ and 4.7×10^{-9} respectively. Calculate the ionization constants of the corresponding conjugate base.

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57. Find the concentration of hydroxide ion in a 0.25 M solution of trimethylamine, a weak base.

$(CH_3)_3N + H_2O \Leftrightarrow (CH_3)_3 + OH^-, K_b = 7.4 \times 10^{-5}$

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58. The 0.005 M monobasic acid has a pH of 5. What is the extent of ionization?

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59. 50 ml of $0.1MNH_4OH$, 25 ml of $2MNH_4Cl$ were used to make a buffer. What is the pH if pK_a is 4.8?

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60. The pH of a buffer prepared by mixing 50 ml of $0.2MCH_3COOH$ and 25 ml of CH_3COONa is 4.8. If the pK_a is 4.8, what is the strength of CH_3COONa?

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61. 50 ml o 0.1 M sodium acetate, 25 ml of 0.2 M acetic acid were added together to form the buffer solution. pK_a of CH_3COOH is 4.8. Find the

pH of the solution.

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62. When 20 ml of 0.1 MNH_4OH are added to 20 ml of MNH_4Cl solution, the pH of the buffer formed is 8.2. What is the pK_b of NH_4OH?

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63. One litre of buffer solution contains 0.1 mole of acetic acid add 1 mole of sodium acetate. Find its pH if pK_a of CH_3COOH is 4.8.

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64. 50 ml of $1MCH_3COOH$ solutioin, when added to 50 ml of 0.5 M NaOH gives a solution with a pH value 'X'. Find the valuer of $'X'$, pK_a of acetic acid is 4.8.

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65. The solibility product of Ag cl is $1.6 \times 10^{-10} \text{mol}^2 / L^2$. What is its solubility?

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66. The solubility product of $Zr(OH)_2$ is $4.5 \times 10^{-17} \text{mol}^3 L^{-3}$. What is solubility?

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67. The solubility of Ag_2CrO_4 is $1.3 \times 10^{-4} \text{mol} L^{-1}$. What is the solubility product?

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68. The solubility of $A_2B = 2 \times 10^{-3} \text{mol} L^{-1}$. What is solubility product?

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69. The solubility product of a salt $AB = 10^{-10} \text{mol}^2 L^{-2}$. What is the solubility?

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70. PQ and RS_2 are two sparingly soluble salts. Their solubility prodcts are equal and each equal to 4.0×10^{-18}. Which salt is more soluble?

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71. In a 0.1 solution, acetic acid is 1.34% ionized. Calculate $\left[H^+\right]$, $\left[CH_3COO^-\right]$ and $[CH_3COOH]$ in the solution and calculate K_a

of acetic acid.

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Additional Questions Answers

1. PCl_5, PCl_3 and Cl_2 are at equilibrium at $500K$ and having concentration $1.59MPCl_3$, $1.59MCL_2$ and $1.41MPCl_5$. Calculate K_c for the reaction $PCl_5 \Leftrightarrow PCl_3 + Cl_2$

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2. The value of ΔG^{Θ} for the phosphorylation of glucose in glycolysis is 13.8 kJ/mol. Find the value of Kc at 298 K.

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3. What will be the conjugate bases of the following Bronsted acids: HF, H_2SO_4 and HCO_3^-?

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4. Write the conjugate acids for the following Bronsted bases: NH_2^-, NH_3 and $HCOO^-$:

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5. The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

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6. The concentration of hydrogen ion in a sample of soft drink is $3.8 \times 10^{-3} M$. What is its pH?

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7. Calculate pH of a 1.0×10^{-8} M solution of HCl.

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8. Calculate the solubility of A_2X_3 is pure water, assuming that neither kind of ion racts with water. The solubility product of A_2X_3, $K_{sp} = 1.1 \times 10^{-23}$

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