|  |  |
| --- | --- |
| Division | 11th |
| Subject | Chemistry |
| Chapter | Equilbrium |
| Author | Ruhani Kashni |
| Category | 04 |

|  |
| --- |
| For a reaction at equilibrium  the relation between dissociation constant , degree of dissociation and equilibrium pressure(p) is given by :  (2022) |
|  |
|  |
|  |
|  |
| B |
|  |
| Now, equilibrium pressure , |
| Equilibrium in physical processes |

|  |
| --- |
| 4.0 moles of argon and 5.0 moles of are introduced into an evacuated flask of 100 litre capacity at . The system is allowed to equilibrate. At equilibrium, the total pressure of mixture was found to be . The for the reaction is [Given : atm  (2022) |
| 2.25 |
| 6.24 |
| 12.13 |
| 15.24 |
| A |
|  |
| mole  mole |
| Equilibrium in physical processes |

|  |
| --- |
| Consider the following equation:  The number of factors which will increase the yield of at equilibrium from the following is  (2023) |
| Increasing temperature |
| Increasing pressure |
| Adding more |
| Addition of catalyst |
| c |
| Increasing the reactant concentration which can favour the forward reaction |
| If you add more SO2 to the reaction mixture while keeping the amounts of O2 and SO3 constant, it would increase the concentration of SO2. By adding more SO2, you are effectively increasing the reactant concentration which can Favor the forward reaction to produce more SO3 and potentially increase the yield of SO3 at equilibrium. |
| Equilibrium in chemical processes |

|  |
| --- |
| The effect of addition of helium gas to the following reaction in equilibrium state, is :  (2023) |
| The equilibrium will shift in the forward direction and more of and gases will be produced. |
| The equilibrium will go backward due to suppression of dissociation of . |
| Helium will deactivate and reaction will stop. |
| Addition of helium will affect the equilibrium. |
| a |
|  |
| According to Le Chatelier's principle, when a system at equilibrium is subjected to a change in conditions, the system will adjust itself to counteract that change.  Case 1 : At constant - volume will increase so reaction will shift in forward direction.  Case 2 : At constant volume no change in active mass so reaction will not shift in any direction then  When helium gas is added to the reaction mixture, it does not participate in the chemical reaction itself. Since helium is an inert gas and does not affect the concentrations of reactants or products, it does not impact the equilibrium position based on concentrations. |
| Equilibrium in chemical processes |

|  |
| --- |
| (i)  (ii)  If the degree of dissociation and initial concentration of both the reactants and are equal, then the ratio of the total pressure at is equilibrium equal to . The value of is  (2023) |
| 14 |
| 11 |
| 12 |
| 16 |
| C |
|  |
| Initial mole  at equilibrium |
| Dynamic nature of equilibrium |

|  |
| --- |
| For independent process at .  The number of non-spontaneous process from the following is    (2023) |
| 1 |
| 2 |
| 3 |
| 4 |
| b |
|  |
| The number of non-spontaneous process is 2 .  A :  B :  Processes C and D are non-spontaneous. |
| Law of mass action |

|  |
| --- |
| Water decomposes at  The percent of water decomposing at and is (Nearest integer).  Equilibrium constant for the reaction is at  (2023) |
| 2 |
| 3 |
| 4 |
| 5 |
| a |
|  |
|  |
| Law of mass action |

|  |
| --- |
| Consider the following reaction approaching equilibrium at and 1 atm pressure    The standard Gibb's energy change at is  (2023) |
| 2.3 |
| 6 |
| 4 |
| 1.5 |
| b |
|  |
| Given : and )  and  mole (nearest integer) |
| Equilibrium constant |

|  |
| --- |
| At  Based on above equilibria, the equilibrium constant of the reaction,  is (Nearest integer)  (2023) |
| 2×103 |
| 4×10-33 |
| 6×10-31 |
| 1×103 |
| b |
|  |
| (ii) (iii) - (i) |
| Factors affecting equilibrium |

|  |
| --- |
| At , the enthalpy of the following processes are given:  What would be the value of for the following reaction?  (2023) |
| 623 |
| 455 |
| 278 |
| 499 |
| d |
|  |
|  |
| Factors affecting equilibrium |

|  |
| --- |
| The percentage of pyridine that forms pyridinium ion in a aqueous pyridine solution for is  (2015) |
|  |
|  |
|  |
|  |
| c |
|  |
| The percentage of pyridine can be equal to the percentage of dissociation of pyridinium ion and pyridine solution as shown below |
| Postulates of Le Chatelier’s principle |

|  |
| --- |
| The solubility of in water is at . The value of its solubility product will be  (Given molar mass of )  (2018) |
|  |
|  |
|  |
|  |
| c |
|  |
|  |
| Postulates of Le Chatelier’s principle |

|  |
| --- |
| The solubility of with solubility product in solution would be  (2016) |
|  |
|  |
|  |
| zero |
| b |
|  |
| is asked in solution, so in the calculation, solubility of (from ) must be added to the solubility of (from ).  Let s be the solubility of and in before the addition of . |
| Ionic equilibrium |

|  |
| --- |
| and, two nearly insoluble salts, have the same values of at room temperature. Which statement would be true regarding and ?  (2016) |
| The molar solubility of MY in water is less than |
| The salts and are more soluble in than in pure water |
| The addition of the salt of to solution of and will have no effect on their solubilities |
| The molar solubilities of and in water are identical |
| a |
|  |
| For MY, MY  where, solubility and solubility product.  Similarly, for  Therefore, molar solubility of MY in water is less than that of. |
| Ionic equilibrium |

|  |
| --- |
| The of and are respectively, , . Which one of the following salts will precipitate last if solution is added to the solution containing equal moles of , Nal and  (2020) |
|  |
|  |
|  |
|  |
| b |
|  |
| Solubility product  (given)      Solubility of is highest. |
| Ionization of acids and bases |

|  |
| --- |
| gas when passed through a solution of cations containing precipitates the cations of second group in qualitative analysis but not those belonging to the fourth group. It is because.  (2014) |
| presence of decreases the sulphide ion concentration |
| presence of increases the sulphide ion concentration |
| solubility product of group II sulphides is more than that of group IV sulphides |
| sulphides of group IV cations are unstable in |
| a |
| gas is passed in presence of , therefore due to common ion effect, lower concentration of sulphide ions is obtained which is sufficient for the precipitation of second group cations. |
| In qualitative analysis of cations of second group gas is passed in presence of , therefore due to common ion effect, lower concentration of sulphide ions is obtained which is sufficient for the precipitation of second group cations in the form of their sulphides due to lower value of their solubility product . Here, fourth group cations are not precipitated because it require more sulphide ions for exceeding their ionic product to their solubility products which is not obtained here due to common ion effect. |
| Differences between strong and weak electrolytes |

|  |
| --- |
| dissociates as  5 moles of are placed in a 200-litre vessel which contains 2 moles of and is maintained at . The equilibrium pressure is . The equilibrium constant for the dissociation of is . (Nearest integer)  (Given: : Assume ideal gas behaviour)  (2022) |
| 1107×10-3 |
| 1274×10-4 |
| 1105×10-3 |
| 1306×10-4 |
| a |
|  |
|  |
| Degree of ionization |

|  |
| --- |
| The standard free energy change for dissociation of into at and 1 atm pressure is . The value of is . (Nearest Integer)  [Given:  (2022) |
| 310 |
| 212 |
| 710 |
| 113 |
| c |
|  |
| . |
| Degree of ionization |

|  |
| --- |
| The solubility product of a sparingly soluble salt is . Its solubility (in mol/L) is  (2021) |
|  |
|  |
|  |
|  |
| c |
|  |
| is ionised as follows  Solubility product of ,  Solubility |
| Ionization of poly basic acids |

|  |
| --- |
| Which of the following is most soluble?  (2007) |
|  |
|  |
|  |
|  |
| B |
| Higher the value of solubility product, higher is its solubility. |
| Higher the value of solubility product, higher is its solubility. In all these compounds the MnS is most soluble because its solubility product is maximum. The solubility product constant (Ksp) is a measure of the extent to which a solid compound dissolves in water to form its constituent ions. The solubility of a compound is directly proportional to the concentration of its constituent ions in solution. As the solubility product constant increases, the concentration of ions in solution increases as well, leading to higher solubility. |
| Ionization of poly basic acid |

|  |
| --- |
| In an experiment, 2.0 moles of was placed in a one-litre flask and the concentration of NO after equilibrium established, was found to be 0.4 . The equilibrium constant at is ………..  (2023) |
| 126 |
| 125 |
| 127 |
| 128 |
| b |
|  |
|  |
| Acid strength |

|  |
| --- |
| A box contains of liquid water in equilibrium with water vapour at . The equilibrium vapour pressure of water at Torr. When the volume of the box is increased, some of the liquid water evaporates to maintain the equilibrium pressure. If all the liquid water evaporates, then the volume of the box must be m\_ litre. [nearest integer]  (Given: )  (2023) |
| 29.21 |
| 43.51 |
| 11.81 |
| 36.61 |
| a |
|  |
| n=0.90, R= 0.082 , T= 27+273=300  32 tor= 32/760=p  Weight of water vapour= 0.9 g  Mole of water vapour= 0.9/18 |
| Acid strength |

|  |
| --- |
| The concentration of and concentration of of a aqueous solution of ionised weak monobasic acid is …[ionic product of water  (2021) |
| Mand |
| and |
| and |
| and |
| b |
|  |
| in monobasic acid molarity degree of ionisation  ionisation constant of water |
| Concept of pH |

|  |
| --- |
| Solution of and has 9.25, then find out of .  (2012) |
| 9.25 |
| 4.75 |
| 3.75 |
| 8.25 |
| B |
|  |
| Solution of and acts as a basic buffer solution. For basic buffer solution |
| Concept of pH |

|  |
| --- |
| The ionisation constant of ammonium hydroxide is at 298 K. Hydrolysis constant of ammonium chloride is  (2011) |
|  |
|  |
|  |
|  |
| A |
|  |
| Hydrolysis of takes place as,  or  From Eqs. (i), (ii) and (iii) |
| Hydrolysis of salts |

|  |
| --- |
| The compound that is not a Lewis acid is  (2013) |
|  |
|  |
|  |
|  |
| c |
| The compound that exist in polymeric forms. |
| exist in polymeric forms and has no electron deficiency, not a Lewis acid. |
| Buffer solution |

|  |
| --- |
| The conjugate acid of is  (2009) |
|  |
|  |
|  |
|  |
| A |
| When a base accepts a proton (H+) conjugate form. |
| A conjugate acid is formed when a base accepts a proton (H+). NH2- is a base as it can accept a proton to form its conjugate acid. |
| Buffer solution |

|  |
| --- |
| An aqueous solution contains an unknown concentration of . When of a solution of is added, just begins to precipitate. The final volume is . The solubility product of is . What is the original concentration of ?  (2018) |
|  |
|  |
|  |
|  |
| C |
|  |
| Its given that the final volume is and this final volume was arrived when of was added to unknown solution.  So, we can interpret the volume of unknown solution as i.e.  From this we can calculate the concentration of ion in the solution via  Now for just precipitation,  Ionic product Solubility product  i.e. of  Given of  So,  or  Remember This is the concentration of ions in final solution. Hence, for calculating the in original solution we have to use |
| Henderson Equation |

|  |
| --- |
| For the reaction,  and . Which of the following statement is incorrect?  (2021) |
| The equilibrium constant decreases as the temperature increases |
| The addition of inert gas at constant volume will not affect the equilibrium constant |
| The equilibrium will shift in forward direction as the pressure increases |
| The equilibrium constant is large suggestive of reaction going to completion and so no catalyst is required. |
| D |
| the equilibrium constant will decrease with increase in temperature and the equilibrium will shift in the backward direction. |
| The explanation of given statements are as follows:  1. For the given equilibrium, is negative, so the equilibrium constant will decrease with increase in temperature and the equilibrium will shift in the backward direction.  Thus, statement The equilibrium constant decreases as the temperature increases is correct  2. When inert gas is added at constant volume and constant temperature, an equilibrium remains undisturbed.  3. For the equilibrium,  So, increase in pressure will shift the equilibrium in the forward direction.  4. The equilibrium constant is large suggestive of reaction going to completion and so no catalyst is required. this is incorrect statement The reaction takes place in the presence of a catalyst which is in contact process or in chamber process |
| Solubility product |

|  |
| --- |
| In a chemical reaction, , the initial concentration of was 1.5 times of the concentration of , but the equilibrium concentrations of and were found to be equal. The equilibrium constant for the aforesaid chemical reaction is  (2021) |
|  |
| 16 |
| 1 |
| 4 |
| d |
|  |
|  |
| Solubility product |

|  |
| --- |
| When two reactants, and are mixed to give products, and , the reaction quotient, at the initial stages of the reaction  (2004) |
| is zero |
| decreases with time |
| is independent of time |
| increases with time |
| d |
| The relative concentrations of reactants and products, will be small at the beginning |
| A  As time passes, amount of products '' and D ' increases, hence increases.  The reaction quotient (Q), which measures the relative concentrations of reactants and products, will be small at the beginning. However, as the reaction proceeds, the concentrations of products increase and reactants decrease, causing Q to increase. This indicates that the reaction is progressing towards product formation. |
| Common ion effect |

|  |
| --- |
| Consider the reaction,  The equilibrium constant of the above reaction is . If pure ammonia is left to dissociate, the partial pressure of ammonia at equilibrium is given by (Assume that at equilibrium)  (2020) |
|  |
|  |
|  |
|  |
| a |
|  |
|  |
| Common ion effect |