CHEMISTRY

BOOKS - CBSE COMPLEMENTARY MATERIAL CHEMISTRY (HINGLISH)

EQUILIBRIUM

Multiple Choice Question Mcq

1. For the hypothetical reactions, the equilibrium constant (k) values are given

$A \Leftrightarrow B : k_1 = 2$

$B \Leftrightarrow C : K_2 = 4$

$C \Leftrightarrow D : K_3 = 8$

The equilibrium constant (K) for the reaction $A \Leftrightarrow D$ is

A. 48

B. 24

C. 12

D. 64

Answer:

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2. The equilibrium constant for the reaction

$SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$ is 5×10^{-2} $\text{atm}^{-1/2}$

The equilibrium constant for the reaction

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

A. 100 atm

B. 25×10^{-4} atm

C. 400 atm

D. 125×19^{-6} $\text{atm}^{-3/2}$

Answer:

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3. $A(g) + 3B(g) \rightarrow 4C(g)$Initially concentration of A is equal to that of B. The equilibrium concentrations of A and C are equal. Kc is :

A. 4

B. $1/8$

C. B

D. 16

Answer:

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4. For the reaction $CO(g) + Cl_2(g) \Leftrightarrow COCl_2(g)$the value of $\left(\frac{K_c}{K_P}\right)$ is equal to :

A. RT

B. RT

C. $1/RT$

D. 1.0

Answer:

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5. At $90^\circ C$ pure water has $K_w = 10^{-12}$. The solution with pH value 6.5 is

A. Acidic

B. Basic

C. Amphoteric

D. Data insufficient

Answer:

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6. 40 ml of 0.1 M ammonia is mixed with 20 ml of $0.1MHCI$. What is the pH of the mixture ? (pK_b of ammonia solution is 4.74.)

A. 4.74

B. 2.26

C. 9.26

D. 5

Answer:

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7. If the pK_a of a weak and acid HA is 4.80 and the pK_b of a weak base BOH is 4.78. Then, the pH of an aqeuous solution of the corresponding salt, BA will be

A. 7.01

B. 4.79

C. 9.22

D. 10.0

Answer:

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8. If 'P' M is the solubility of $KA1(SO_4)_2$, then K_{sp} is equal to

A. p^3

B. $4p^4$

C. p^4

D. $4p^3$

Answer:

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True And False Type Questions

1. Equilibrium state can be achieved if a reversible reaction is carried out in closed or open container.

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2. For a reaction $2A(g) \Leftrightarrow B(g) Q_c > K$ if $'A'$ is added maintaining $Q_c > K$, the reaction will move in backward direction.

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3. For the reaction at equilibrium

$CaCO_3 \Leftrightarrow CaO(s) + CO_2(g)$

What $CaO(s)$ is removed reaction moves in forward direction.

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4. For a reaction $aA + bB \Leftrightarrow cC + dD$ at equilibrium $G^{\theta} = 0$ always .

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5. For a reaction at equilibrium $H_2(g) + Cl_2(g) \Leftrightarrow 2HCl(g)$

$K = 4$, the calue of $\dfrac{K_b[HCl]^2}{K_f[H_2][Cl_2]}$ is 1.

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6. For the electrolyte A_2B if K_{sp} is solubility product then its solubling 'S' M is $[K_{sp}]^{1/2} \div 4$.

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7. HCO_3^- is conjugate base of H_2CO_3.

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8. H_2O can act as acid as well as base.

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9. The pH of buffer solution remain same when any amount of dilution is done.

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10. For a salt $AB_2(s)$ solution if Ionic product (I.P) $> K_{sp}$,then precipitation will take place.

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Fill In The Blanks

1. At equilibrium rate of forward reaction is always equal to .....

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2. $k_P \& k_C$ are ..... for reaction at equilibrium of type $H_2(g) + Br_2(g) \Leftrightarrow 2HBr(g)$.

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3. If K_c for reaction $CH_3COOH(1) + C_2H_5OH \Leftrightarrow CH_3COOC_2H_5(1) + H_2O(1)$ is 4. Then Q_c and $: K_c$ are .....

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4. If $A + B - 70J/mol \Leftrightarrow D$, reaction temperature is increased then reaction moves in ..... direction.

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5. Presence of catalyst will ..... the equilibrium constant.

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6. The conjugate acid of H_2O is .....

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7. On dilution, the degree of dissociation of acetic acid will.....

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8. The presence of NH_4Cl in NH_4OH solution will ..... the degree of dissociation of NH_4OH.

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9. If Ionic product (IP) $< K_{sp}$ for a salt solution of AB, then addition of AB further ..... lead to precipitation initially.

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10. K_p is always equal to K_c ifΔn_g is .....

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Match The Columns

1.

Column-I	Column-II
A) $Na(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; ΔH = - ve	P) K increases with increase in temp
B) $2N_2(g) + 2O_2(g) \rightleftharpoons 4\,NO(g)$: ΔH = +ve	Q) K decreases with increase in temperature
C) $X(g) \rightleftharpoons 2Y(g)$ ΔH = +ve	R) Pressure has no effect
D) $PCl_5(g) \rightleftharpoons PCl_3 + Cl_2$; ΔH = +ve	S) Product moles increases due to addition of inert gast at constant pressure.

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	Coloumn-I		Column-II
A)	Salt of weak acid and weak base	P)	$pH = \frac{1}{2}(pK_w + pK_a + \log_c)$
B)	Salt of weak Acid and strong Base	Q)	$pH = \frac{1}{2}(pK_w + pK_a - pk_h)$
C)	Salt of strong acid and strong base	R)	$pH = \frac{1}{2}(pK_w - pK_b - \log_c)$
D)	Salt of strong acid and weak base	S)	$pH = \frac{1}{2}(pK_w)$

2.

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Assertion Reason Type Question

1. Assertion (A): The endothermic reactions are favoured at lower temperature and the exothermic reactions are favoured at higher temperature.

Reason (R) : when a system in equilibrium is disturbed by changing the temperature, it will tend to adjust itself so as to overcome the effect of the change.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: D

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2. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2(Reason).

Examine the statements carefully and mark the correct answer according to the instruction given below:

STATEMENT-1: The melting point of ice decreases with increase of pressure.

STATEMENT-2: Ice contracts on melting .

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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3. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2(Reason).

Examine the statements carefully and mark the correct answer according to the instruction given below:

STATEMENT-1:The gas phase reaction $PCl_3(g) + Cl_2(g) \Leftrightarrow PCl_5(g)$ shifts to the right on increasing pressure.

STATEMENT-2: When pressure increase, equilibrium shifts towards more number of moles.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: C

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4. Assertion (A) : The equilibrium is not static but a dynamic one.

Reason (R) : The chemical equilibrium is an apparent state of rest in which two opposing reactions are proceeding at the same rate.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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5. Statement-1 : The catalyst does not affect the equilibrium constant.

Statement-2 : Because for the catalysed reaction and uncatalysed reaction ΔH remains same and equilibrium constant depends on ΔH.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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6. Statement-1 : If water is heated to $50^{\circ} C$, the pH will increase.

Statement-2 : K_w increases with increase in temperature.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: D

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7. Statement-1: Addition of $HCl(aq)$. to CH_3COOH (aq). decrease the ionisation of CH_3COOH (aq).

Statement-2 : Due to common ion effect H^+, ionisation of CH_3COOH decreases.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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8. Statement-1: Sparingly soluble salts AB and XY_2 with the same solubility product, will have different solubility.

Statement 2: Solubility of sparingly soluble salts depends upon solubility product.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: B

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9. Statement-1 : The ionisation constants of weak diprotic acid are in the order of $Ka_1 > Ka$.

Statement-2 : Removal of H^+ from anion is difficult as compared to neutral atom.

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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10. Assertion : In a titration of weak monoprotic acid with strong base, the pH at the half equivalent point is pK_a.

Reason : At half equivalence point, it will form acidic buffer at its maximum capacity where [acid] $=$ [salt].

A. If both the statements are true and statement -2 is the correct explanation of statement-I

B. If both the statements are true but statement-2 is not the correct explanation of statement-I

C. If statement-I is true and statement-2 is false

D. If statement-I is false and statement-2 is true.

Answer: A

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One Word Answer Type Questions

1. What is sum of $pH + pOH$ at $25^{\circ} C$?

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2. Write the Henderson Hasselbalch equation for acidic buffer

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3. How is degree of dissociation related with concentration terms and Ka, for weak electrolyte.

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4. How NH_3 is defined as Lewis base?

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5. How are K_p and K_c related ?

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6. How does K affected for endothermic reaction if temperature is increased?

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7. What is the effect of catalyst on K?

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8. How is pH scale affected by increasing temperature?

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9. What is the conjugate base of HCO_3^- ?

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10. What is the nature of CH_3COOH in conc. HCl solution ?

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1 Mark Questions

1. Define physical equilibrium. Give an example also.

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2. Why is there a fizz when a soda water bottle is opened?

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3. In a reversible reaction, two substances are in equilibrium. If the concentration of each one is reduced to half, the equilibrium constant will be

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4. Write the expression for equilibrium constant K_p for the reaction,

$3Fe(s) + 4H_2O(g) \Leftrightarrow Fe_3O_4(s) + 4H_2(g).$

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5. Classify the equilibrium as homogeneous or heterogeneous :

$CH_3COOC_2H_5(aq). + H_2O(1) \Leftrightarrow CH_3COOH(aq). + C_2H_5OH(aq).$

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6. Discuss the position of equilibrium if the following reaction is carried out in the presence of catalyst.

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

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7. pH of black coffee is $5.0 \text{at} \quad 25^\circ C$. Is black coffee acidic or basic ?

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8. Arrange the following in increasing acidic strength

HCl, HBr, HF, HI

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9. Arrange the following in increasing Lewis base strange

$NH_3, BiH_3, PH_3, AsH_3, SbH_3$

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10. Arrange following in increasing pH value

$0.1MCH_3COOH, 0.1MNaCl, 0.1MHCl, 0.1MNaOH, 0.1MNH_4OH$

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11. Arrange following in increasing order of degree of hydrolysis.

$0.1MNH_4OH, 0.01MNH_4OH, 10^{-5}MNH_4OH, 10^{-3}MNH4OH, 10^{-6}M$

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12. Arrange following in increasing order of acidic strengh

$CH_3COOH, HCOOH, CH_3CH_2COOH, C_6H_5COOH, CH_2COOH$

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13. Arrange following in increasing order of basic strength in gas phase

$NH_3, (CH_3)_2NH, (CH_3)_3N, CH_3NH_2$

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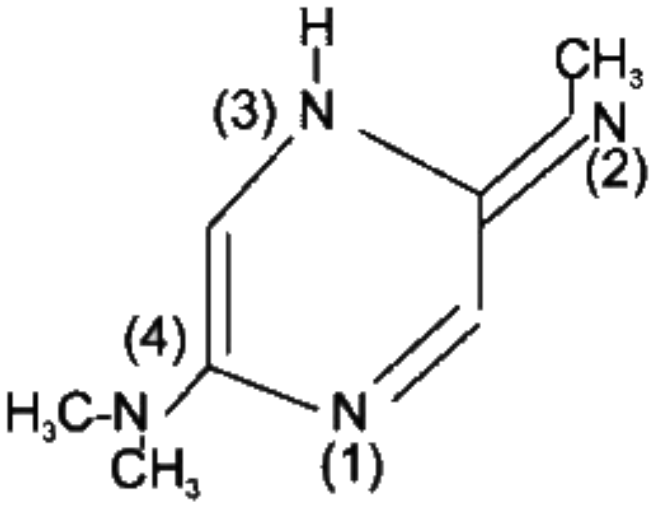
14. Arrange the following pkb in increasing order



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15. Arrange the basic strength of following

$F^-, Br^-, C1^-, I^-$

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16. Arrange the following in increasing base strength

$CH_3^-, NH_2^+, OH^-, F^-$

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2 Mark Questions

1. The standard Gibbs energy change at 300 k for the reaction $2A \Leftrightarrow B + C$ is $2494.2J$. At a given temperature, and time. the composition of the reaction mixture is $[A] = 1/2, [B] = 2, [C] = 1/2$. The reaction proceed in the

$(R = 8.314\text{J/K mol}, = 2.718)$

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2. The equilibrium constant for

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ is K, then calculate equilibrium constant for

$1/2N_2(g) + 1/2O_2(g) \Leftrightarrow NO(g)$.

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3. For the reversible reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at $500^\circ C$, the value of Kp is 1.44×10^{-5} atm^{-2}. Find the K_c value.

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4. The equilibrium constant at 298 K for the reaction $A + B \Leftrightarrow C + D$is 100 If the initial concentration of all the four species were 1M each, then equilibrium concentration of D will be

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5. For the reaction

$NH_4COONH_2(g) \Leftrightarrow 2NH_3(g) + CO_2(g)$

If equilibrium pressure is 3 atm. Find the value of Kp

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6. A buffer solution with pH 9 is to be prepared by mixing NH_4Cl that should be added to one litre of

$1.0mNH_4OHkb1.8 \times 10^{-5}$

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7. Calculate the solubility of silver chloride in water at room temperature if the K_{sp} of $AgCl$ is 1.6×10^{-10}

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8. Calculate the molar solubility of $Ni(OH)_2$ in $0.10mNaOH$. The ionic product of $Ni(OH)_2$ is 2.0×10^{-15}.

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9. Calculate the pH of 10^{-8} M HCl solution.

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10. How many grams of NaOH must be dissolved in IL of the solution to give it a pH value of L^2 ?

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3 Mark Questions

1. The equilibrium constant for the reaction $H_2(g) + Br_2(g) \Leftrightarrow 2HBr(g)$at $1024K$ is 1.6×10^5. Find the equilibrium pressure of all gases if 10.0bar of HBr is introduced into a sealed container at 1024K.

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2. For the reaction $2BrCl \Leftrightarrow Br_2(g) + Cl_2(g) K_c$ is 32 at $500K$. If initially pure BrCl is present at a concentration of 3.30×10^{-3}, M, what is its molar concentration in the mixture at equilibrium?

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3. What is the equilibrium constantK_p and K_c for the reaction $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ if the pressure is 1.0 atm in $8.0L$ container at equilibrium.

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4. The K_p for the reaction, $N_2O_4(g) \Leftrightarrow NO_2(g)$ is 640 mm at $775K$. Calculate the percentage dissociation of N_2O_4 at equilibrium pressure of 160mm. At what pressure the dissociation will be 50%.

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5. Show that degree of dissociation (α) for the dissociation of PCl_5 into PCl_3 and Cl_2 at pressure P is given by $\alpha = \left[\frac{kp}{P+kp}\right]^{1/2}$

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6. How much of $0.3MNH_4$ should be mixed with 30 mL of NH_4Cl to give a buffer solution of $pH10$. pk_b for $NH_4OH$is 4.75.

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7. Predict whether a precipitate will be formed or not on mixing 20 mL of $20mL$ of $0.001NNaCl$ solution with 80 mL of $0.01MAgNO_3$ solution. K_{sp} for $AgCl$ is 1.5×10^{-10}.

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8. The values of Ksp of two sparingly soluble salts $Ni(OH)_2$ and $AgCN$ are 2.0×10^{-15} and 6.0×10^{-17} respectively. Which salt is more soluble. Explain

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9. The ionization constant of propanoic acid is 1.32×10^{-15}. Calculate the degree of ionization if its solution is 0.05 M. What will be its degree of ionization if the solution is0.01 M in HCl solution.

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10. Calculate the pH of a solution obtained by mixing 50ml of0.2M HCl with 49.9 mL of 0.2m NaOH solution.

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Hots Questions

1. The molar solubility of $Cd(OH)_2$ is $1.84 \times 10^{-5}M$. Calculate the expected solubility of $Cd(OH)_2$in a buffer solution of pH = 12.

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2. An aqueous solution contains an unknown concentration of Ba^{2+}. When 50 ml of a 1M solution of Na_2SO_4 is added. $BaSO_4$just begins to precipitate. The final volume is 500ml. The solubility product of $BaSO_4$ is 1×10^{-10} Find the original concentration.

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3. An aqueous solution contains0.10 M H2S and 0.20M HCl. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from $4S^-$ ions is 1.2×10^{-13}, then find the concentration of S^{-2} ions in aqueous solution

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4. How many litres of water must be added to 1 litre of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2?

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5. A certain buffer solution contains equal concentration of X^- and HX.The K_b for X^- is 10^{-10}. Find the pH of the buffer .

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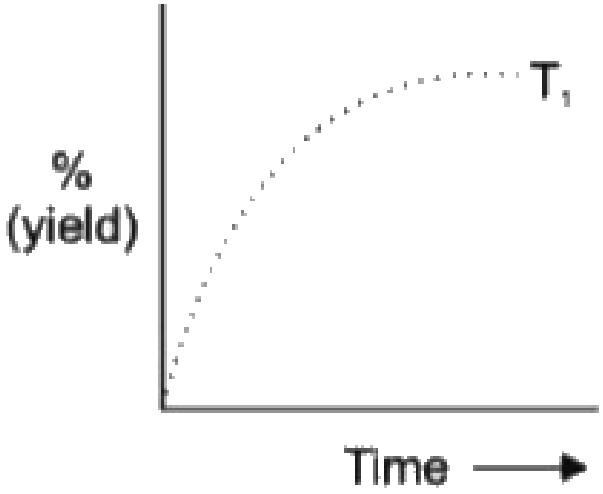
6. The % yield of Ammonia as a function of time in the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H < O$ at (P, T) is given below:



If this reaction is conducted at $T_2 > T_1$, then plot the % yield of NH_3 as a function of time on same graph

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7. Consider the reaction $NH_4COONH_2(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$ at a certain temperature, the equilibrium pressure of the system is 0.318 atm. Find K_p of the decomposition of ammonium carbonate.

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8. The equilibrium constant for the reaction $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$ is 5. How many moles of CO_2 must be added to 1 litre container already containing 3 moles each of CO and H_2O to make 2M equilibrium concentration of CO?

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9. At constant temperature, the equilibrium constant K_p

$N_2O_4 \Leftrightarrow 2NO_2$ is given by

$k_p = \frac{4x^2P}{1-x}$ were ,P = Pressure and X= Extent of reaction

How does the value of K_p change on following changes

(a) 'P' increases

(b) X changes

(c) 'P' decreases

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10. When two reactants A and B are mixed to give product 'c' and 'p' the reaction quotient 'Q' at the initial stages of the reaction will be?

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Unit Test

1. What is the $pH10^{-3}$ M HCl solution ?

A. 1

B. 11

C. 3

D. 14

Answer: C

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2. Write the conjugate base of $CH_3COOH + H_2O$.

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3. What is the nature of following reaction

Exothermic or endothermic

$A + B - 70J \rightarrow C$

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4. The pKa of CH_3COOH and pKb of NH_4OH are 4.76 and 4.75 5 respectively. Calculate the pH of CH_3COONH_4.

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5. Calculate the molar solubility of $Ni(OH)_2$ in 0.1 M KOH solution . The K_{sp} for $Ni(OH)_2$ is 2.0×10^{-15}.

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6. Ionization constant of Benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. How many times is silver benzoate more soluble in buffer of $pH 3.19$ compared to its solubility in pure water $\left[H^{+}\right] = 6.46 \times 10^{-4}$

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