CHEMISTRY

BOOKS - JEEVITH PUBLICATIONS CHEMISTRY (KANNADA ENGLISH)

CHEMICAL EQUILIBRIUM

One Mark Questions And Answers

1. Mention the factors affecting rate (velocity) of a reaction.

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2. Define Law of mass action.

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3. Define equilibrium constant of reaction.

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4. Write the expressions for K_c and K_p for the reaction,

$$2A + 3B \underset{V_b}{\overset{V_f}{\rightleftharpoons}} 4C + 5D$$

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5. Write the relationship between K_p and K_c.

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6. Define Le-Chatelier's principle.

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7. What is active mass?

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8. What happens when the temperature of a reversible reaction at equilibrium is increased, if enthalpy change is positive?

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9. Give an example for a reversible reaction in which $K_p = K_c RT$.

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10. Write an expression for K_p for the following reaction: $A + B \Leftrightarrow C + 2D$

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11. How are K_p and K_c related? Mention the condition under which $K_p = K_c$.

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12. Give an example of a reaction where $K_p \neq K_c$.

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13. How does a catalyst influence the equilibrium constant of a reversible reaction?

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14. Define physical equilibrium.

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15. Define chemical equilibrium.

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16. What is the unit of equilibrium constant?

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17. What is reaction quotient (Q).

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18. Explain effect of catalyst of Le-Chatelier's principle.

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19. Define pH.

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20. Define pH scale.

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21. What is the law which gives the relationship between the degree of dissociation of a weak electrolyte and its concentration in the solution?

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22. Write the expression for the comparison of the relative strengths of two weak acids in terms of their ionization constants.

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23. What do you mean by reversible process?

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24. Define equilibrium.

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25. What is hydrolysis of a salt?

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26. Give two examples of Acidic buffers.

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27. Write the expression of K_c for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$. Give units of K.

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28. What is the condition of precipitation using solubility product principle?

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29. State Henry's law.

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30. What is the effect of temperature of the reactions?

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

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

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31. What is the effect of temperature on the reactions?

(i) $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) + \text{Heat}$

(ii) $N_2(g) + O_2(g) \Leftrightarrow 2NO_3(g) - \text{Heat}$

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32. Write the expression of K_p for the reaction.

$N_2O(g) \Leftrightarrow 2NO_2(g)$

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33. Write the equilibrium expression and equilibrium constant for the given reverse reaction.

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34. Define degree of ionization or dissociation.

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35. Define ionic equilibrium.

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36. Under what conditions can a weak electrolyte have a high degree of ionization?

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37. What is the effect of temperature on degree of dissociation?

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38. What is the relationship between pK_a and pK_b values where K_a and K_b represent ionization constants of the acid and its conjugate base respectively?

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39. What is the relationship between pH and pOH?

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40. Write the demerits of Brownsted-Lowry theory.

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41. What do you mean by buffer solution?

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42. Define buffer action.

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43. Mention the types of buffer solutions.

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44. Mention the uses of buffer solutions.

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45. What is meant by ionic product of water (K_w)?

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Two Mark Questions And Answers

1. Explain rate of reaction with its mathematical forms.

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2. Define Rate equation with an example.

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3. Define Irreversible reaction with an example.

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4. Define Reversible reaction with an example.

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5. Define Chemical Equilibrium with an example.

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6. Chemical equilibrium is dynamic. Justify.

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7. Write the characteristics of chemical equilibrium.

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8. Explain with an example equilibrium involving dissolution of solids in liquids.

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9. Define Arrhenius acid-base theory with one example.

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10. Define Bronsted Lowry theorey or Protonic theory with one example.

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11. What are amphoteric substances? Give examples.

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12. What are conjugate acid-base pairs? Give one example.

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13. Explain Lewis electron acid - base concept with an example.

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14. Explain with an example equilibrium involving dissolution of solids in liquids.

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15. Mention any three applications of equilibrium constant.

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16. Explain Homogeneous equilibria.

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17. Explain Heterogeneous equilibria.

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18. Give one example for the relation between K_p and K_c for a reaction, if $\Delta n = 0$.

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19. Predict the spontaneity of a forward (or) a reverse reaction based on ΔG of a reversible reaction.

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20. Explain factors affecting equilibria.

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21. Explain briefly the effect of temperature on Le-Chatelier's principle.

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22. Briefly explain the effect of pressure on Le-Chatelier's principle.

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23. Write a note on the effect of concentration on Le-Chatelier's principle.

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24. Briefly explain the effect of addition of inert gas on Le-Chatelier's principle.

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25. All Bronsted bases are also lewis bases, but all bronsted acids are not lewis acids. Why?

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26. Exaplain ionisation of acids and bases.

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27. Explain degree of dissociation.

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28. Prove that $pH + pOH = pK_w$ at 298 K.

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29. Define pH of a solution.

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30. Define pOH of a solution.

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31. What is dissociation constant of a weak acid (K_a).

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32. What is dissociation constant of a weak base (K_b).

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33. Define pK_a for weak acids.

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34. Define pK_b for a weak base.

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35. What is the relationship between K_w and pK_w.

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36. Explain common ion effect taking place in $CH_3COOH + CH_3COONa$ and $NH_4OH + NH_4Cl$.

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37. Write the relationship between K_{sp} and S for an AB type of salt.

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38. Write the relationship between K_{sp} and S of an A_2B type of salt.

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39. Write the relationship between K_{sp} and S of an AB_2 type of salt.

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40. Write the relatioship between K_{sp} and S of $BaSO_4$ and AgCl.

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41. Write the relationship between K_{sp} and S of Ag_2CrO_4.

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42. Write the relationship between K_{sp} and S of PbI_2.

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43. Write a general expression for a A_xB_y type electrolyte.

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44. Give any two differences between strong and weak electrolytes.

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45. What is common ion effect? Give an example.

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46. Calculate the pH of 0.01 M HCl.

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47. Calculate the pH of 0.0001 M of HNO_3.

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48. Calculate the pH of 0.00025 M HNO_3.

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49. Calculate the pH of 0.1 M of H_2SO_4 (concentration of hydrogen = $0.1 \times 2 = 0.2$).

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50. Calculate pH of 0.005 M H_2SO_4.

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51. Calculate pH of 3×10^{-9} M NaOH.

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52. Calculate $\left[OH^-\right]$ if pOH = 8.3.

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53. Calculate $\left[H^{+}\right]$ if pOH = 9.23.

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54. Calculate $\left[OH^{-}\right]$ if pH = 5.284.

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55. What is the pH of a 0.05 M solution of formic acid? $\left(K_a = 1.8 \times 10^{-4}\right)$

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56. Calculate the $\left[OH^{-}\right]$ of a solution whose pH is 9.62.

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57. The pOH of a solution is 5.725. Calculate the $\left[H^{+}\right]$.

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58. Calculate the pH of 0.125M of H_2SO_4.

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59. Solubility product of barium sulphide $(BaSO_4)$ is 2.4×10^{-9}. Calculate it's solubility.

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60. If the solubility product of silver chloride is 1.8×10^{-10}. What is the solubility of silver ion if concentration of Cl^{-} is 0.01 molar.

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Three Mark Questions And Answers

1. Derive the relatioshhip between K_p and K_c

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2. Explain equilibrium constant (or) equilibrium law.

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3. How to predict the extent of a reaction.

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4. Explain direction of reaction by reaction quotient - Q_c.

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5. Discuse common ion effect on the solubility of an ionic salt.

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6. Define pH of a solution.

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7. Explain polybasic acids and polyacidic bases with examples.

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8. Derive ionic product of water. Also find its value at $25^{\circ} C$.

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9. How do you apply law of mass action to a gaseous reversible reaction?

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10. Write the conjugate acid for the following $(a) Cl^{-}, (b) NO_3^{-}, (c) HSO_4^{-}, (d) HCO_3^{-}, (e) SO_4^{2-}, (f) CO_3^{2-}, (g) NH^{2-},$

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11. Deduce Handerson's equation for a basic buffer.

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12. Deduce Hendersons equation for an acidic buffer.

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13. Explain Mechanism or working of an acid buffer:

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14. Explain the Mechanism or working of a basic buffer.

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Numerical Problems

1. The solubility product of AgCl is 2.8×10^{-10} at 298 K. Calculate the solubility of AgCl in (i) pure water (ii) 0.1M $AgNO_3$ solution, and (iii) 0.1M HCl solution.

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2. Calculate the volume of 0.1 M acetic acid solution to be mixed with $50cm^3$ of 0.2M sodium acetate solution, in order to prepare a standard buffer of pH 4.94 (pK_a of acetic acid = 4.74).

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3. The solubility of Ag_2CrO_4 at $25^\circ C$ is $0.0332 gdm^{-3}$. Calculate its solubility product.

(At. Masses : Ag = 108, Cr = 52, O = 16).

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4. The solubility product of AgCl at a particular temperature is $1.08 \times 10^{-10} mol^2 dm^{-6}$. Calculate its solubility in 0.01 M HCl.

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5. When the temperature of a reversible rection is increased from 327 to $427^\circ C$, the equilibrium constant K_p is decreased by four times. Find the enthalpy of the reaction in this temperature range.

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6. For a reaction whose standrad enthalpy change is -100 kJ, what final temperature is needed to double the equilibrium constant from its value at 298 K?

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7. The equilibrium constant for the Haber process $\frac{3}{2}H_2 + \frac{1}{2}N_2 \Leftrightarrow NH_3$ is 668 at 300 K and 6.04 at 400 K. What is the average of the reaction for the process in that temperature range?

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8. Calculate the pH of a buffer mixture of 0.05 M NH_4Cl and 0.12 M NH_4OH at 298 K. (Dissociation constant of ammonium hydroxide at 298 K is 1.8×10^{-5}).

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9. What is the pH of a buffer solution prepared by dissolving 0.1 mole of sodium acetate and 0.2 mole of acetic acid in enough water to make a dm^3 of solution? (K_a of acetic acid = 1.8×10^{-5}).

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10. A buffer solution contains 2 moles of ammonium hydroxide and 0.25 mole of ammonium chloride per dm^3 of the solution. (K_b for ammonium hydroxide = 1.8×10^{-5}). Calculate the pH of the buffer solution.

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11. Calculate the mole ratio in which salt and acid are to be mixed in order to get a buffer solution of 5? [pK_a of acid = 4].

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12. What should be the ratio of concentration of acetic acid to sodium acetate while preparing an acid buffer mixture with pH = 5.7? (K_a for acetic acid is 1.8×10^{-5})

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13. 1 mole of PCl_5 is placed in a closed vessel at 523K. At equilibrium, if it dissociates to an extent of 35%, calculate K_p for $PCl_5 \Leftrightarrow PCl_3 + Cl_2$. Equilibrium pressure is found to be 5×10^5 Pa.

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14. Hydrogen ion concentration of a solution is $2.5 \times 10^{-4} \text{mol } dm^{-3}$ at $25^\circ C$. Calculate its OH^- ion concentration.

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15. Calculate the H^+ ion concentration in 0.05M formic acid at 298K. $\left(K_a = 1.8 \times 10^{-4}\right.$ for HCOOH).

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16. Calculate the OH^- ion concentration of 0.005 M solution of a weak base BOH if the degree of dissociation is 0.02.

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17. Calculate OH^- ion concentration in 0.08M solution of it.

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18. 1 mole of N_2 and 3 mole of H_2 are mixed in a closed vessel of 1 dm^3 capacity. At equilibrium if the vessel contains a total of 2.4 moles, calculate equilibrium constant K_c for $N_2 + 3H_2 \Leftrightarrow 2NH_3$.

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19. A mixture of 1 mole of N_2 and 3 moles of H_2 is allowed to react at a constant pressure of 100 bar. At equilibrium, 0.6 mole of ammonia is formed. Calculate the equilibrium constant for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$.

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20. For the reaction $A + B \Leftrightarrow C + D$, the equilibrium constant is 0.05 at 300K. Calculate the equilibrium constant for $C + D \Leftrightarrow A + B$ at the same temperature.

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21. In a reversible reaction the rate constants of the forward and the backward reactions are $4.8 \times 10^{-5} s^{-1}$ and $1.2 \times 10^{-4} s^{-1}$ respectively. Calculate the equilibrium constant.

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22. For the reaction $A + B \Leftrightarrow C + D$, the equilibrium constant is 0.05 at 300K. Calculate the equilibrium constant for $C + D \Leftrightarrow A + B$ at the same temperature.

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23. For $2HI \Leftrightarrow H_2 + I_2$, the equilibrium constant is K. What is the equilibrium constant for $HI \Leftrightarrow \frac{1}{2}H_2 + \frac{1}{2}I_2$ at the same temperature?

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24. For the reaction, $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$ the value of $K_c = 3.75 \times 10^{-6}$ at 1069K. Calculate K_p.

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25. In the following system at equilibrium, $N_2 + 3H_2 \Leftrightarrow 2NH_3$, the reaction mixture contains 0.005 mol of N_2, 0.012 mol of H_2 and 0.002 mol of NH_3 in a 2 litre vessel. Calculate K_c.

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26. For $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, show that $K_c = K_p(RT)^2$.

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27. For the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ at 773K, the value of $K_p = 1.4 \times 10^{-15}$. Calculate K_c (Given R = 8.314 $JK^{-1}mol^{-1}$).

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28. K_c for $CS_2(g) + 4H_2(g) \Leftrightarrow CH_4(g) + 2H_2S(g)$ is 0.28 at 900K. Calculate K_p. (R = 8.314 $JK^{-1}mol^{-1}$).

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29. PCl_3, Cl_2, PCl_5 are in equilibrium in a closed vessel at 500K. The equilibrium concentration are 1.6 mol L^{-1}, $1.6\text{mol}L^{-1}$ and $1.4\text{mol}L^{-1}$ respectively. Calculate K_c and K_p for $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$.

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30. A mixture of N_2 and H_2 in the ratio 1 : 3 is allowed to attain equilibrium. At equilibrium, the total pressure is $5 \times 10^{-5} Nm^{-2}$ and the mixture contains 40% by volume of NH_3. Calculate K_p.

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31. The pK_a value of acetic acid is 4.7447 at $25^\circ C$. How would you obtain a buffer of acetic acid and sodium acetate with pH = 4?

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32. A buffer solution of pH = 4.7 is prepared from CH_3COONa and CH_3COOH. Dissociation constant of acetic acid is 1.75×10^{-5}. Calculate the mole proportion of sodium acetate and acetic acid.

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33. A buffer solution of pH 8.3 is prepared from ammonium chloride and ammonium hydroxide. Dissociation constant of ammonium hydroxide is 1.8×10^{-5}. What is the mole proportion of ammonium chloride and ammonium hydroxide?

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34. 3.0 g of pure acetic acid and 4.1 g of anhydrous sodium acetate are dissolved together in water and the solution is made up to 500 ml. Calculate the pH of the solution. Given K_a of acetic acid is 1.75×10^{-5}.

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