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CHEMISTRY

BOOKS - SURA CHEMISTRY (TAMIL ENGLISH)

PHYSICAL AND CHEMICAL EQUILIBRIUM

Evaluation Choose The Best Answer

1. If K_b and K_f for a reversible reactions are 0.8×10^{-5} and 1.6×10^{-4} respectively, the value of the equilibrium constant is,

A. 20

B. 0.2×10^{-1}

C. 0.05

D. none of these

Answer: A

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2. At a given temperature and pressure, the equilibrium constant values for the equilibria

$3A_2 + B_2 + 2C \overset{K_1}{\Longleftrightarrow} 2A_3BC$ and

$A_3BC \overset{K_2}{\Longleftrightarrow} \frac{3}{2}[A_2] + \frac{1}{2}B_2 + C$

The relation between K_1 and K_2 is

A. $K_1 = \frac{1}{\sqrt{K_2}}$

B. $K_2 = K_1^{-1/2}$

C. $K_1^2 = 2K_2$

D. $\frac{K_1}{2} = K_2$

Answer: B

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3. The equilibrium constant for a reaction at room temperature is K_1 and that at 700 K is K_2. If $K_1 > K_2$, then

A. The forward reaction is exothermic

B. The forward reaction is endothermic

C. The reaction does not attain equilibrium

D. The reverse reaction is exothermic

Answer: A

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4. The formation of ammonia from $N_{2(g)}$ and $H_{2(g)}$ is a reversible reaction

$$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)} + \text{Heat}$$

What is the effect of increase of temperature on this equilibrium reaction

A. Equilibrium is unalteres

B. formation of ammonia is favoured

C. equilibrium is shifted to the left

D. reaction rate does not change

Answer: C

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5. Solubility of earbon dioxide gas in cold water can be increased by

A. increase in pressure

B. decrease in pressure

C. increase in volume

D. none of these

Answer: A

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6. Which one of the following is incorrect statement ?

A. for a system at equilibrium, Q is always less than the equilibrium constant.

B. equilibrium can be attained from either side of the recation.

C. presence of catelyst affect both the forward reaction and reverse reaction to the same extant.

D. equilibrium constant varied with temperature.

Answer: A

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7. K_1 and K_2 are the equilibrium constants for the recation respectively.

$$N_{2(g)} + O_{2(g)} \overset{K_1}{\Longleftrightarrow} 2NO_{(g)}$$

$$2NO_{(g)} + O_{2(g)} \overset{K_2}{\Longleftrightarrow} 2NO_{2(g)}$$

what is the equilibrium constant for the reaction

$$NO_{2(g)} \Leftrightarrow 1/2N_{2(g)} + O_{2(g)}$$

A. $\frac{1}{\sqrt{K_1K_2}}$

B. $(K_1 = K_2)^{1/2}$

C. $\frac{1}{2K_1K_2}$

D. $\left(\frac{1}{K_1K_2}\right)^{3/2}$

Answer: A

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8. In the equilibrium,

$2A(g) \Leftrightarrow 2B(g) + C_2(g)$

the equilibrium concentrations of A, B and C_2 at 400 K are $1 \times 10^{-4}M, 2.0 \times 10^{-3}M, 1.5 \times 10^{-4}M$ respectively. The value of K_C for the equilibrium at 400 K is

A. 0.06

B. 0.09

C. 0.62

D. 3×10^{-2}

Answer: A

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9. An equilibrium constant of 3.2×10^{-6} for a reaction means, the equilibrium is

A. largely towards forward direction

B. largely towards reverse direction

C. never established

D. none of these

Answer: B

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10. $\frac{K_c}{K_p}$ for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_{3(g)}$ is

A. $\frac{1}{RT}$

B. $\sqrt{RT}$

C. RT

D. $(RT)^2$

Answer: D

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11. For the reaction $AB(g) \Leftrightarrow A(g) + B(g)$, at equilibrium AB is $20\,\%$ dissociated at a total pressure of P, The equilibrium constant K_p is related to tha total pressure by the expression

A. $P = 24K_p$

B. $P = 8K_p$

C. $24P = K_p$

D. none of these

Answer: A

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12. In which of the following equilibrium, K_p and K_c are not equal ?

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

B. $SO_2(g) + NO_2 \Leftrightarrow SO_{3(g)} + NO(g)$

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

D. $PCl_5(g) \Leftrightarrow PCl_3g + Cl_2(g)$

Answer: D

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13. If x is the fraction of PCl_5 dissociated at equilibrium in the reaction

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

then starting with 0.5 mole of PCl_5, the total number of moles of reactants and products at equilibrium is

A. $0.5 - x$

B. $x + 0.5$

C. $2x + 0.5$

D. $x + 1$

Answer: B

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14. The valuse of K_{p_1} and K_{p_2} for the reactions

$X \Leftrightarrow Y + Z$

$A \Leftrightarrow 2B$ are in the ratio $9:1$ if degree of dissociation and initial

concentration of X and A be equal then total pressure at equilibrium P_1, and P_2 are in the ratio

A. $36:1$

B. $1:1$

C. $3:1$

D. $1:9$

Answer: A

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15. In the reaction,

$Fe(OH)_3(s) \Leftrightarrow Fe^{3+}(aq) + 3OH^-(aq)$

if the concentration of OH^- ions is decreased by $1/4$ times , then the equilibrium concentration of Fe^{3+} will

A. not changed

B. also decreased by $1/4$ times

C. increase by 4 times

D. increase by 64 time

Answer: D

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16. Consider the reaction where $K_p = 0.5$ at a particular temperature

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

If the three gases are mixed in a container so that the partial pressure of each gas is initially 1 atm, then which one of the following is true

A. more PCl_3 will be produced

B. more Cl_2 will be produced

C. more PCl_5 will be produced

D. none of these

Answer: C

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17. Equimolar concentration of H_2 and I_2 are heated to equilibrium ina 1 liter flask. What percentage of initial concentration of H_2 has reacted at equilibrium, the rate constant for the forward reaction is 25×10^2 and the equilibrum constant is 50. The rate constant for the reverse reaction is,

A. $33\ \%$

B. $66\ \%$

C. $(33)^2\ \%$

D. $16.5\ \%$

Answer: A

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18. In a chemical equilibrium, the rate constant for the forward reaction is 2.5×10^2 and the equilibrium constant of 50. The rate constant for the revese reaction is.

A. 11.5

B. 5

C. 2×10^2

D. 2×10^{-3}

Answer: B

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19. Which of the following is not a general characteristic of equilibrium involving physical process

A. Equilibrium is possible only in a closed system at a given temperature.

B. The opposing processes occur at the same rate and there is a dynamic but stable condition.

C. All the physical processes stop at equilibrium.

D. All measurable properties of the system remains constant.

Answer: C

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20. For the formation of two moles of $SO_3(g)$ from SO_2 and O_2, the equalibrium constant is K_1. The equilibrium constant for the dissociation of one mole of SO_3 into SO_2 and O_2 is

A. $\frac{1}{K_1}$

B. K_1^2

C. $\left(\frac{1}{K_1}\right)^{1/2}$

D. $\frac{K_1}{2}$

Answer: C

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21. Match the equilibria with the corresponding conditions,

i) Liquid $\Leftrightarrow$ Vapour

ii) Solid $\Leftrightarrow$ Liquid

iii) Solid $\Leftrightarrow$ Vapour

iv) Solute(s) $\Leftrightarrow$ Solute (Solution)

1) Melting point

2) Saturated solution

3) Boiling point

4) Sublimation point

5) Unsaturated solution

A. $\begin{matrix}(\mathrm{i}) & (\mathrm{ii}) & (\mathrm{iii}) & (\mathrm{iv}) \\ 1 & 2 & 3 & 4\end{matrix}$

B. $\begin{matrix}(\mathrm{i}) & (\mathrm{ii}) & (\mathrm{iii}) & (\mathrm{iv}) \\ 3 & 1 & 4 & 2\end{matrix}$

C. $\begin{matrix}(\mathrm{i}) & (\mathrm{ii}) & (\mathrm{iii}) & (\mathrm{iv}) \\ 2 & 1 & 3 & 4\end{matrix}$

D.

(i)	(ii)	(iii)	(iv)
3	2	4	5

Answer: B

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22. Consider the following reversible reaction at equilibrium, $A + B \Leftrightarrow C$. If the concentration of the reactants A and B are doubled, then the equilibrium constant will

A. be doubled

B. become one fourth

C. be halved

D. remain the same

Answer: D

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23.

$[Co(H_2O)_6]^{2+}(aq)(\text{pink}) + 4Cl^-(aq) \Leftrightarrow [CoCl_4]^{2+}(aq)(\text{blue}) + 6H_2O(l)$

In the above reaction at equilibrium, the reaction mixture is blue in colour at room temperature. On cooling this mixture, it becomes pink in colour On the basis of this information, which one the following is true ?

A. $\Delta H > 0$ for the forward reaction

B. $\Delta H = 0$ for the reverse reaction

C. $\Delta H < 0$ for the forward reaction

D. Sign of the ΔH cannot be predicted bassed on this information.

Answer: A

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24. The equilibrium constants of the following reactions are :

$N_2 + 3H_2 \Leftrightarrow 2NH_3 \quad , \quad K_1$

$N_2 + O_2 \Leftrightarrow 2NO \quad , \quad K_2$

$H_2 + 1/2O_2 \Leftrightarrow H_2O \quad , \quad K_3$

The equilibrium constant (K) for the reaction ,

$2NH_3 + \frac{5}{2}O_2 \overset{K}{\Longleftrightarrow} 2NO + 3H_2O$, will be

A. $K_2^3 \frac{K_3}{K_1}$

B. $K_1 \frac{K_3^3}{K_2}$

C. $K_2 \frac{K_3^3}{K_1}$

D. $K_2 \frac{K_3}{K_1}$

Answer: C

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25. A 20 liter container at 400 contains $CO_2(g)$ at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains Its maximum value will be :

Given that : $SrCO_3(S) \Leftrightarrow SrO(S) + CO_2(g)$

$K_p = 1.6$ atm

A. 2 litre

B. 5 litre

C. 10 litre

D. 4 litre

Answer: B

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Evaluation Write Brief Answer To The Following Questions

1. If there is no change in concentration, why is the equilibrium state considered dynamic ?

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2. For a given reaction, at a particular temperature, the equilibrium constant has value. Is the value of Q also constant ? Explain.

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3. What is the relation between K_P and K_C, Give one example for which K_P is equal to K_C,

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4. For a gaseous homogeneous reaction at equilibrium, number of moles of products are greater than the number of moles of reactants. Is K_C is larger or smaller than K_P ,

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5. When the numerical value of the reaction quotient (Q) is greter than the equilibrium constant (K) in which direction does the reaction proceed to reach equilibrium ?

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6. For the reaction

$A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$, ΔH is-ve

the following molecular scenes represent different reaction mixture (A-green, B-blue)

i) Calculate the equilibrium constant K_P and (K_C).

ii) For the reaction mixture represented by scene (x), (y) reaction proceed in which directions ?

iii) What is the effect of increase in pressure for the mixture at equilibrium ?

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7. State Le-Chatelier principle.

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8. Consider the following reactions,

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

In each of the above reaction find out whether you have to increase (or) decrease the volume to increase the yield of the product.

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9. Consider the following reactions,

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

In each of the above reaction find out whether you have to increase (or) decrease the volume to increase the yield of the product.

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10. Consider the following reactions,

$S(s) + 3F_2(g) \Leftrightarrow SF_6(g)$

In each of the above reaction find out whether you have to increase (or) decrease the volume to increase the yield of the product.

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11. State law of mass action.

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12. Explain how will you predict the direction of a equilibrium reaction.

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13. Derive a general expression for the equilibrium constant K_P and K_C for the reaction.

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

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14. Write a balanced chemical equation for a equilibrium reaction for which the equilibrium constant is given by expression.

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

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15. What is the effect of added inert gas on the reaction at equilibrium at constant volume.

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16. Derive the relation between K_P and $K_{C'}$.

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17. One mole of PCl_5 is heated in one litre closed container. If 0.6 mole of chlorine is found at equilibrium, calculate the value of equilibrium

constant.

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18. For the reaction

$SrCO_3(s) \Leftrightarrow SrO(s) + CO_2(g)$,

the value of equilibrium constant $K_P = 2.2 \times 10^{-4}$ at 1002 K. Calculate K_C for the reaction.

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19. To study the decomposition of hydrogen iodide, a student fills an evacuated 3 litre flask with 0.3 mol of HI gas and allows the reaction to proceed at $500^\circ C$. At eauilibrium he found the concentration of HI which is equal to 0.05 M. Calculate K_C and K_P for this reaction.

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20. Oxidation of nitrogen monoxide was studied at $200^{\circ}C$ with initial pressures of 1 atm NO and 1 atm of O_2. At equilibrium partial pressure of oxygen is found to be 0.52 atm calculate K_P value.

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21. 1 mol of CH_4, 1 mole of CS_2 and 2 mol of H_2S are 2 mol of H_2 are mixed in a 500 ml flask The equilibrium constant for the reaction $K_C = 4 \times 10^{-2} \text{mol}^2 \text{ lit}^{-2}$. In which direcition will the reaction proceed to reach equilibrium ?

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22. At particular temperature $K_C = 4 \times 10^{-2}$ for the reaction

$H_2S(g) \Leftrightarrow H_2(g) + 1/2S_2(g)$

Calculate K_C for each of the following reaction.

i) $2H_2S(g) \Leftrightarrow 2H_2(g) + S_2(g)$

ii) $3H_2(g) \Leftrightarrow 3H_2(g) + \frac{3}{2}S_2(g)$

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23. 28 g of nitrogen and 6 g of hydrogen were mixed in a 1 litre closed container. At equilibrium 17 g NH_3 was produced. Calculate the weight of nitrogen, hydrogen at equilibrium.

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24. The equilibrium for the dissociation of XY_2 is given as,

$2XY_2(g) \Leftrightarrow 2XY(g) + Y_2(g)$

if the degree of dissociation x is so small compared to one. Show that $2K_p = PX^3$ where P is the total pressure and K_P is the dissociation equilibrium constant of XY_2.

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25. A sealed container was filled with 1 mol of $A_2(g)$ 1 mol $B_2(g)$ at 800 K and total pressure 1.00 bar. Calculate the amounts of the components in

the mixture at equilibrium given that $K = 1$ for the reaction

$A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$

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26. Deduce the Vant Hoff equation.

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27. The equilibrium constant K_P for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is 8.19×10^2 at 298K and 4.6×10^{-1} at 498 K. Calculate ΔH° fror the reaction.

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28. The partial pressure of carbon dioxide in the reaction

$CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ is 1.017×10^{-3} atm at $500^\circ C$.

Calculate K_P at $600^\circ c$ C for the reaction. ΔH for the reaction is 181 kJ mol^{-1} and does not change in the given range pf temperature.

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Additional Questions Choose The Correct Answer

1. The K_c for given reaction will be

$$A_{2(g)} + 2B_{(g)} \Leftrightarrow C_{(g)} + 2D_{(g)}$$

A. $K_c = \dfrac{[C][D]^2}{[A_2][B]^2}$

B. $K_c = \dfrac{[C]}{[A_2][B]^2}$

C. $K_c = \dfrac{[A_2][B]^2}{[C][D]^2}$

D. $K_c = \dfrac{[A_2][B]^2}{[C]}$

Answer: B

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2. For which of the following reaction, the degree of dissociation (α) and equilibrium constant (K_p) are related as $K_p = \frac{4\alpha^2 P}{(1-\alpha)}$?

A. $N_{2O_{4(g)}} \Leftrightarrow 2NO_2(g)$

B. $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI(g)$

C. $N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$

D. $PCl_{3(g)} + Cl_{2(g)} \Leftrightarrow PCl_{5(g)}$

Answer: A

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3. In which of the following does the reaction go almost to completion ?

A. $K_c = 10^3$

B. $K_c = 10^2$

C. $K_c = 10^{-2}$

D. $K_c = 10^{-3}$

Answer: A

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4. Hydrogen (a moles) and iodine (b moles) react to give 2x moles of the HI at equilibrium. The total number of moles at equilibrium is

A. $a + b + 2x$

B. $(a - b) + (6 - 2x)$

C. $(a + b)$

D. $a + b - x$

Answer: C

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5. K_p is how many times equal to K_c for the given reaction ?

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$

A. $\frac{1}{R^2T^2}$

B. R^2T^2

C. $\frac{R}{T}$

D. RT

Answer: A

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6. $A + B \Leftrightarrow C + D$, K_c for this reaction is 10. If 1,2,3,4 mole/litre of A,B,C and D respectively are present in a container at $25^\circ C$, the direction of reaction will be

A. From left to right

B. From right to left

C. Reaction is at equilibrium

D. Unpredictable

Answer: A

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7. 4g H_2, $32g$ O_2, 14 g N_2 and 11g CO_2 are taken in a bulb of 500ml. Which one of these has maximum active mass ?

A. H_2

B. O_2

C. N_2

D. CO_2

Answer: A

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8. For reaction, $2A + B \Leftrightarrow 2C, K = x.$ Equilibrium constant for $C \Leftrightarrow A + 1/2B$ will be

A. x

B. $\frac{x}{2}$

C. $\frac{1}{\sqrt{x}}$

D. $\sqrt{x}$

Answer: C

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9. XY_2 dissociates as, $XY_{2(g)} \Leftrightarrow XY_{(g)} + Y_{(g)}$ Initial pressure of XY_2 is 600mm Hg. The total pressure at equilibrium is 800mm Hg. Assuming volume of system to remain constant, the value of K_p is

A. 50

B. 100

C. 400

D. 20

Answer: B

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10. In which of the following equilibrium, change in pressure will not affect the equilibrium ?

A. $N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$

B. $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

C. $PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$

D. $N_2O_{4(g)} \Leftrightarrow 2NO_{2(g)}$

Answer: B

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11. In melting of ice, which one of the conditions will be more favorable ?

A. high temperature and high pressure

B. low temperature and low pressure

C. low temperature and high pressure

D. high temperature and low pressure

Answer: A

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12. Two moles of N_2 and two moles of H_2 are taken in a closed vessel of 5 litre capacity and suitable conditions are provided for the reaction. When the equilibrium is reached, it is found that a half mole of N_2 is used up. The equilibrium concentration of NH_3 is

A. 0.2

B. 0.4

C. 0.3

D. 0.1

Answer: A

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13. The active mass of 7.0 g of nitrojan in a 2.0 L container would be

A. 0.25

B. 0.125

C. 0.5

D. 14

Answer: B

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14. At 700K, the equilibrium constant K_p, for the reaction $2SO_{3(g)} \Leftrightarrow 2SO_{2(g)} + O_{2(g)}$ is 1.8×10^{-3} atm. The value of K_c for the above reaction at the same temperature in moles per litre would be

A. 1.1×10^{7}

B. 6.2×10^{-7}

C. 3.1×10^{-5}

D. 9.3×10^{-7}

Answer: C

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15. $C_{(s)} + H_2O_{(g)} \Leftrightarrow CO_{(g)} + H_{2(g)} : \Delta H < O$

The above equilibrium will proceed in forward direction when

A. It is subjected to high pressure

B. It is subjected to high temperature

C. Inert gas (argon) is added at constant pressure

D. Carbon (solid) is added

Answer: C

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16. A state of equilibrium is reached when

A. The rate of forward reaction is greater than the rate of the reverse reaction

B. The concentration of the products and reactants are equal

C. More product is present than reactant

D. The concentration of the products and reactants have reached constant value

Answer: D

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17. Le-Chateller's principle is not applicable to

A. $Fe_{(s)} + S_{(s)} \Leftrightarrow FeS_{(s)}$

B. $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

C. $N_{2(g)} + O_{2(g)} \Leftrightarrow 2NO_{(g)}$

D. $N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$

Answer: A

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18. Following three gaseous equilibrium reactions are occurring at $27^\circ C$.

(A) $2CO + O_2 \Leftrightarrow 2CO_2$

(B) $PCl_5 \Leftrightarrow PCl_3 + Cl_2$

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

The correct order of K_p / K_c for the following reaction is

A. $A < B < C$

B. $C < B < A$

C. $A < C < B$

D. $B < A < C$

Answer: C

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19. If the equilibrium constant for

$N_{2(g)} + O_{2(g)} \Leftrightarrow 2NO_{(g)}$ is K, the equilibrium constant for $\frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)} \Leftrightarrow NO_{(g)}$ will be

A. K

B. K^2

C. $K^{1/2}$

D. $\frac{1}{2}K$

Answer: C

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20. In a closed system : $A_{(s)} \Leftrightarrow 2B_{(g)} + 3C_{(g)}$ if the partial pressure of C is doubled then partial pressure of B will be

A. Twicw the orignal pressure

B. Half of its orignal pressure

C. $\frac{1}{2\sqrt{2}}$ times, the original pressure

D. $2\sqrt{2}$ times its original pressure

Answer: C

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21. In which of the following cases, the reaction goes farthest to completion ?

A. $A \Leftrightarrow B\left(K = 10^{3}\right)$

B. $P \Leftrightarrow Q\left(K = 10^{-2}\right)$

C. $A + B \Leftrightarrow C + D(K = 10)$

D. $X + Y \Leftrightarrow XY_2 \left(K = 10^{-1}\right)$

Answer: A

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22. The ratio of K_p / K_c for reaction

$CO_{(g)} + \frac{1}{2} O_{2(g)} \Leftrightarrow CO_{2(g)}$ is

A. $\frac{R}{T}$

B. RT

C. $(RT)^{1/2}$

D. $(RT)^{-1/2}$

Answer: D

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23. For the reversible reaction

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)} + \text{Heat.}$

The equilibrium shifts in forward direction.

A. by increasing the concentration of $NH_{3(g)}$

B. by increasing the pressure and decreasing the temperature.

C. by decreasing the pressure and decreasing the temperature

D. by decreasing the concentration of $N_{2(g)}$ and $H_{2(g)}$.

Answer: B

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24. The value of ΔH for the reaction

$X_{2(g)} + 4Y_{2(g)} \Leftrightarrow 2XY_{4(g)}$ is less than zero.

Formation of $XY_{4(g)}$ will be favoured at :

A. High pressure and low temperature.

B. Low pressure and low temperature.

C. High temperature and high pressure.

D. high temperature and low pressure

Answer: A

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25. Ice and water are placed in a closed container at a pressure of 1 atm and 273.15 K temperature. If pressure of the system is increased by 2 atm keeping temperature constant the correct observation would be

A. The amount of ice increases

B. Volume of the system increases

C. The liquid phase disappears completely

D. The solid phase (ice) disappears completely

Answer: D

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26. $2H_{2(g)} + CO_{2(g)} \Leftrightarrow CH_3OH_{(g)}, \Delta H = -92.2kJ.$

Which of the following condition will shift the equilibrium in the forward direction ?

A. Temperature of the system is increased

B. CO is removed

C. CH_3OH is added

D. The pressure of the system is increased

Answer: D

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27. The value of equilibrium constant of reaction $HI_{(g)} \Leftrightarrow \frac{1}{2}H_{2(g)} + \frac{1}{2}I_{2(g)}$ is 8.0. The equilibrium constant of the reaction , $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$ will be

A. $\frac{1}{8}$

B. $\frac{1}{16}$

C. 16

D. $\frac{1}{64}$

Answer: D

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28. For the reaction, $CaCO_{3(g)} \Leftrightarrow CaO_{(s)} + CO_{2(g)}$ K_p is equal to

A. K_c

B. K_cRT

C. $K_c(RT)^2$

D. $K_c(RT)^-$

Answer: B

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29. The favourable conditions for melting of ice is

A. Low pressure

B. High pressure

C. Low temperature

D. Absence of catalyst

Answer: B

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30. In the manufacture of NH_3 by Haber's process involving the reaction.

$N_{2(g)} + 3H_{2(g)} \overset{[Fe_2O_2]}{\Longleftrightarrow} 2NH_{3(g)}, \Delta H = -22.08 \text{ kcal.}$ The favourable conditions are

A. High pressure and low temperature.

B. High pressure and high temperature

C. Low pressure and high temperature

D. Low pressure and low temperature

Answer: A

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31. If K_1 is equilibrium constant at temperature T_1 and K_2 is the equilibrium constant at temperature T_2, and if $T_2 > T_1$ and reaction is endothermic then

A. $K_2 > K_1$

B. $K_2 < K_1$

C. $K_2 = K_1$

D. All of these

Answer: A

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32. Sulphide Ion reacts with solid sulphur

$S^{2-}_{(aq)} + S_{(s)} \Leftrightarrow S^{2-}_{2(aq)}, \quad K_1 = 10$

$S^{2-}_{(aq)} + 2S_{(s)} \Leftrightarrow S^{2-}_{3(aq)}, \quad K_2 = 130$

The equilibrium constant for the formation of $S_3^{2-}(aq)$ from $S_2^{2-}(aq)$ and sulphur is

A. 10

B. 13

C. 130

D. 1300

Answer: B

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33. $CH_{4(g)} + 2O_{2(g)} \Leftrightarrow CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H = -170.8 \text{ kJ mol}^{-1}$ which of the following statement is not true

?

A. At equilibrium, the concentration of $CO_{2(g)}$ and $H_2O_{(l)}$ are not equal

B. The equilibrium constant for the reaction is given by $K_p = \frac{[CO_2]}{[CH_4][O_2]}$

C. Addition of $CH_{4(g)}$ or $O_{2(g)}$ at equilibrium will cause a shift to the right.

D. The reaction is exothermic.

Answer: B

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34. For the system $3A + 2B \Leftrightarrow C$, the expression for equilibrium constant K is

A. $\frac{[3A] \times [2B]}{[C]}$

B. $\frac{[A]^3 \times [B]}{[C]}$

C. $\frac{[C]}{[A]^3 \times [B]^2}$

D. $\frac{[C]}{[3A] \times [2B]}$

Answer: C

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35. Equilibrium constant K_p for following reaction

$$MgCO_{3(s)} \Leftrightarrow MgO_{(s)} + CO_{2(g)}$$

A. $K_p = P_{CO_2}$

B. $K_p = \frac{P_{CO_3} \times P_{CO_2} \times P_{\text{Mgo}}}{P_{\text{Mg } CO_3}}$

C. $K_p = \frac{P_{\text{Mg}}CO_3}{P_{CO_2} \cdot P_{\text{MgO}}}$

D. $K_p = \frac{P_{CO_3} \cdot P_{\text{MgO}}}{P_{\text{Mg}}CO_3}$

Answer: A

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36. A cyllnder filled with a movable piston contains liquid water in equilibrium with water vapour at $25^{\circ}C$. Which one of the following operations results in a decrease In the equilibrium vapour pressure ?

A. Moving piston downward a short distance

B. Removing a small amount of the liquid water

C. Dissolving salt in the water

D. Removing a small amount of vapour

Answer: C

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37. The oxisation of SO_2 and O_2 to SO_3 is an exothermic reaction. The yield of SO_3 will be maximum if

A. Temperature and pressure both are increased

B. Temperature decreased, pressure increased

C. Temperature increased, pressure constant

D. Temperature and pressure both decreased

Answer: B

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38. For the reaction $CO_{(g)} + 2H_{2(g)} \Leftrightarrow CH_3OH_{(g)}$. If active mass of CO is kept constant and active mass of H_2 is tripied, the rate of forward reaction will become

A. Three times

B. Six times

C. Eight time

D. Nine times

Answer: D

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39. For the homogeneous are reaction at 600 K,

$4NH_{3(g)} + 5O_{2(g)} \Leftrightarrow 4NO_{(g)} + 6H_2O_{(g)}$. The equilibrium K_c has the unit.

A. $\left(\text{mol dm}^{-3}\right)^{-1}$

B. $\left(\text{mol dm}^{-3}\right)^{1}$

C. $\left(\text{mol dm}^{-3}\right)^{10}$

D. $\left(\text{mol dm}^{-3}\right)^{-9}$

Answer: B

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40. The equilibrium $A_{(g)} + 4B_{(g)} \Leftrightarrow AB_{4(g)}$ is attained by mixing equal moles of A and B in a one litre vessel. Then at moles of A and B in a one litre vessel. Then at equilibrium

A. $[A] = [B]$

B. $[A] > [B]$

C. $[A] < [B]$

D. $[AB_4] > [A]$

Answer: B

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41. If Ar is added to the equilibrium

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_3$ at constant volume, then equilibrium will

A. Shift in forward direction

B. Not shift in any direction

C. Shift in reverse direction

D. All are incorrect

Answer: B

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42. The transport of oxygen by hemoglobin in our body as an illustration for a _____ change.

A. Reversible

B. Irreversible

C. Thermodynamic

D. Kinetic

Answer: A

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43. In reversible reaction, initilly the reaction proceed towards the _____ .

A. Formation of the product

B. Formation of reactions

C. Decompose of product

D. Equilibrium state

Answer: A

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44. What is the temperature and pressure in a thermos flask ?

A. 298 k, 1 atm

B. 273 k, 2 atm

C. 298 k, 2 atm

D. 273 k, 2 atm

Answer: B

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45. Rate of melting of ice is equal to _____ .

A. rate of freezing of ice

B. rate of melting of ice

C. rate of freezing water

D. rate of melting of water

Answer: C

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46. Assertion (A) : A pure solid always has the same concentration at a given temperature.

Reason (R) : It does not expand to fill its container.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true and (R) is not the correct explanation of (A).

C. (A) true but (R) false.

D. Both (A) and (R) are false.

Answer: A

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47. Assertion (A) : The concentration terms of pure liquids can also be excluded from the expression of the equilibrium constant.

Reason (R) : The active mass concentration of the pure liquid does not charge at a given temperature.

A. Both (A) and (R) are true and (R) is the correct explanation of (A).

B. Both (A) and (R) are true and (R) is not the correct explanation of (A).

C. (A) true but (R) false.

D. Both (A) and (R) are false.

Answer: A

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48. Equilibrium constant value depends on _____ .

A. Temperature

B. Volume

C. Pressure

D. Catalyst

Answer: A

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49. Which of the following is correct about equilibrium constant ?

A. Unpredict the direction in which the 'net reaction will take place.

B. Unpredict the extent of the reaction.

C. Cannot calculate the equilibrium concentrations of the reactants and products

D. These constants do not provide any information regrading the rates of the forward or information regarding the rates of the forward or reverse reaction.

Answer: D

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50. Which equation gives the quantitative temperature dependence of equilibrium constant ?

A. Hess law

B. Graham's diffusion

C. Van't Hoff

D. Van dae Waals

Answer: C

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51. Which of the following is incorrect ?

A. Kc indicates how far the reaction has proceeded

B. A large value of Kc indicates that the reaction reaches equilibrium with high product yeid.

C. A low value of Kc indicates that the the rection reaches equilibrium with low product form.

D. Unpreidt the direction in which the net reaction will take place.

Answer: D

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52. What is the relation between standard free energy change and equilibrium constant ?

A. $\Delta G^{\circ} = + \mathrm{RT} \ln \mathrm{k}$

B. $k = - \Delta G^{\circ} RT$

C. $\Delta G^{\circ} = - \ln k$

D. $k = RT \Delta G$

Answer: A

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53. Catalyst speeds up the attainment of equilibrium by providing a new pathway having a _____ .

A. lower activation energy

B. higher activation energy

C. more activation energy

D. no activation energy

Answer: A

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Very Short Answer Question

1. Ice melts showly at altitudes Explain why ?

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2. Predict which of the following reaction will have appreciable concentration of reactants and products ?

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

(ii) $Cl_{2(g)} + 2NO_{(g)} \Leftrightarrow 2NOCl_{(g)}, K_c = 3.7 \times 10^{-8}$

(iii) $Cl_{2(g)} + 2NO_{2(g)} \Leftrightarrow 2NO_2Cl_{(g)}, K_c = 1.8$

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3. The following concentration were obtained for the formation of NH_3 from N_2 and H_2 at equilibrium for the reaction

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$

$[N_2] = 1.5 \times 10^{-2} M, [H_2] = 3.0 \times 10^{-2} M, [NH_3] = 1.2 \times 10^{-2} M$

Calculate the equilibrium constant.

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4. Which of the following reactions involve homogeneous equilibrium and which involve heterogeneous equilibrium ?

$Ag_2O_{(s)} + 2HNO_{3(aq)} \Leftrightarrow 2AgNO_{3(aq)} + H_2O_{(l)}$

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5. Which of the following reactions involve homogeneous equilibrium and which involve heterogeneous equilibrium ?

$C_{(s)} + CO_{2(g)} \Leftrightarrow 2CO_{(g)}$

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6. Which of the following reactions involve homogeneous equilibrium and which involve heterogeneous equilibrium ?

$CH_3COOC_{2(g)}H_{5(aq)} + H_2O_{(l)} \Leftrightarrow CH_3COOH_{(aq)} + C_2H_5OH_{(aq)}$

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7. Which of the following reactions involve homogeneous equilibrium and which involve heterogeneous equilibrium ?

$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$

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8. Write the relationship between equilibrium constant and enthapy.

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9. Explain the state of equilibrium based on the following illustration.

See-saw

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10. Explain the state of equilibrium based on the following illustration.

Tug of war

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11. why are reversible process non-static ?

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12. 'Rate of Melting = Rate of freezing"

When is the above condition achieved ? Explain with an example.

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13. When does the rate of backward reaction increase ? What is its consequence ?

$A + B \Leftrightarrow C + D$

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14. Distinguish between homogeneous and hetergeneous equilibrium reaction.

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15. Define equilibrium constant.

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16. Write the expressions of equilibrium constants in terms of partial pressure and active masses for

$2BrCl_{(g)} \Leftrightarrow Br_{2(g)} + Cl_{2(g)}$

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17. Define reaction quotient.

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18. Explain the diagrammatic expression expression about the direction of reaction.

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Short Answer Question

1. Find out the Δng values and write the K_c and K_p relation for the equilibrium reactions

Decomposition of ammonia

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2. Find out the Δng values and write the K_c and K_p relation for the equilibrium reactions

Formation of NO

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3. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.

What is the initial effect of change on vapour pressure ?

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4. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.

How do rates evaporation and condensation change initially ?

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5. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.

What happens when equilibrium is restored finally and what will be the final vapour pressure ?

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6. Find out the value of K_c for each of the following equilibria from the value of K_p

$2NOCl_{(g)} \Leftrightarrow 2NO_{(g)} + Cl_{2(g)}$,

$K_p = 2.1 \times 10^{-2}$ at $500\,\mathrm{K}$

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7. Find out the value of K_c for each of the following equilibria from the value of K_p

$CaCO_{3(s)} \Leftrightarrow CaO_{(s)} + CO_{2(g)}$,

$K_p = 165 \text{ at } 1073 \text{ K}.$

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8. List out few examples in irreversible reactions (changes) taking place in our daily life activity.

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9. Write a note biochemical reversible change

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10. State whether the existence of equilibrium is possible in our lungs or not. Give reason.

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11. Discuss the equilibrium involving dissolution of solids or gases in liquids.

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12. Give the relationship between K_p and K_c for the following cases with example.

$\Delta n_g = +\text{ve}$

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13. Give the relationship between K_p and K_c for the following cases with example.

$\Delta n_g = -\text{ve}$

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14. Give the relationship between K_p and K_c for the following cases with example.

$\Delta n_g = 0$

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15. Consider the equations given below

$\text{Ca CO}_{3(s)} \Leftrightarrow CaC_{(s)} + CO_{2(g)}$

$CO_{2(g)} + H_2O_{(e)} \Leftrightarrow H^+_{(aq)} + HCO^-_{3(aq)}$

Write the equilibrium constant for these equations and give reason for the exception of concentration of specific compounds.

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16. List down the applications of equilibrium constant.

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17. What happens when the concentration of H_2 and I_2 are increased in the reaction $H_2 + I_2 \Leftrightarrow 2HI$?

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18. What inferences do you observe by the values of Q and K_C ?

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19. Discuss the changes you observe in the reaction of synthesis of ammonia with preference to effect of pressure.

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20. Write a note on Haber's process emphasizing the idea of a catalyst in an equilibrium reaction.

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Long Answers Questions

1. Explain the following with relevant examples.

Solid-liquid equilibrium

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2. Explain the following with relevant examples.

Liquid-vapour equilibrium

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3. Explain the following with relevant examples.

Solid-vapour equilibrium

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4. Derive the K_P and K_c for the following equilibrium reaction.

$H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

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5. Derive the value of K_C and K_P for the synthesis of HI.

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6. Arrive at the expressions of K_P and K_C for the dissociation of PCl_5.

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7. Equilibrium constant K_C for the reaction,

$N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$ at 500K is 0.061.

At particular time, the analysis shows that the composition of the reaction mixture is $3.0 \ \text{mol L}^{-1}$ of N_2, $2.0 \ \text{mol L}^{-10}$ of H_2, $0.50 \ \text{mol L}^{-1}$ of NH_3. is the reaction at equilibrium ?

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8. Explain K How does the extent of reaction depend on K_C ?

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9. Explain the effect of concentration, pressure, temperature, catalyst and inert gas on equilibrium.

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Creative Questions Hots

1. How will you arrive at the unit of equilibrium constant ?

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2. $2NO_{(g)} + O_{2(g)} \Leftrightarrow 2NO_{2(g)}, \Delta H = -117 \text{ kJ}.$

Predict the effect of an increase in concentration of NO.

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3. $2NO_{(g)} + O_{2(g)} \Leftrightarrow 2NO_{2(g)}, \Delta H = -117 \text{ kJ}.$

Predict the effect of pressure decrease as a result of increased volume on the equilibrium concentration of NO_2.

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4. Following data is given for the reacson,

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(s)}$

$\Delta_f H^\circ \left[CaO_{(s)}\right] = -650.0 \text{ kJ mol}^{-1}$

$\Delta_f H^\circ \left[CO_{2(g)}\right] = -395.9 \text{ kJ mol}^{-1}$

$\Delta_f H^\circ \left[CaCO_{3(s)}\right] = -1206.9 \text{ kJ mol}^{-1}$

Predict the effect of temperature on the equilibrium constant of the above reaction.

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5. write a relation between ΔG and Q and define the meaning of each term and answer the following

Why a reaction proceeds forward when $Q < K$ and no net reaction occurs when $Q = K$?

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6. write a relation between ΔG and Q and define the meaning of each term and answer the following

Explain the effect of increase in pressure in terms of reaction quotient Q.

For the reaction,

$CO_{(g)} + 3H_{2(g)} \rightarrow CH_{4(g)} + H_2O_{(g)}$

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7. Describe the effect of

addition of H_2

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8. Describe the effect of

addition of CH_3OH

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9. Describe the effect of

removal of CO

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10. Describe the effect of

removal of CH_3OH on the equilibrium of the reaction, $2H_{2(g)} + CO_{(g)} \Leftrightarrow CH_3OH_{(g)}$

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11. What happens to an wquilibrium in a reversible reaction if a catalyst is added to it ?

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