CHEMISTRY

RESONANCE ENGLISH

CHEMICAL EQUILIBRIUM

PHYSICAL CHMISTRY (CHMICAL EQUILIBRIUM)

1. A sample of mixture of $A(g), B(g)$ and $C(g)$ under equilibrium has mean molecular mass equal to 80. The equilibrium is :

$A(g) \Leftrightarrow B(g) + C(g)$

If initially 4 mole of $'A'$ gas is present then total number of mole at equilibrium is :

$[M_A = 100, M_B = 60, M_C = 40]$

A. 5

B. 2

C. 6

D. 4

Answer: 1

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

At equilibrium in the above case, $'a'$ moles of $CaCO_3$, $'b'$ moles of CaO and $'c'$ moles of CO_2 are found. Then, identify the wrong statement :

A. Moles of $CaCO_3$ will decrease with the addition of inert gas at constant pressure

B. Moles of $CaCO_3$ will remain constant with the increases in volume.

C. If volume of the vessel in halved, then moles of $CaCO_3$ will increases

D. Moles of CaO will decreases with the increases in pressure.

Answer: 2

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3. $N_3 + 3H_2 \Leftrightarrow 2NH_3$ Starting with one mole of nitrogen and 3 moles of hydrogen, at equiliibrium 50% of each had reacted. If the equilibrium pressure is P, the partial pressure of hydrogen at equilibrium would be

A. $P/2$

B. $P/3$

C. $P/4$

D. $P/6$

Answer: 1

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4. For the reaction : $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g), K_p = 1.16 atm$ at $800^\circ C$. If $20g$ of $CaCO_3$ were kept in a 10 litre vessel at $800^\circ C$, the amount of $CaCO_3$ remained at equilibrium is :

A. $34\,\%$

B. $64\,\%$

C. $46\,\%$

D. none

Answer: 1

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5. The degree of dissociation of $N_2O_4(1)$ obeying the equilibrium, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, is approximately related to the pressure at equilibrium by :

A. $\alpha \propto P$

B. $\alpha \propto \frac{1}{\sqrt{P}}$

C. $\alpha \propto \frac{1}{P^2}$

D. $\alpha \propto \frac{1}{P^4}$

Answer: 2

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6. In the following reaction, $3A(g) + B(g) \Leftrightarrow 2C(g) + D(g)$, Initial moles of B is double at A . At equilibrium, moles of A and C are equal. Hence $\%$ dissociation is :

A. $10\ \%$

B. $20\ \%$

C. $40\ \%$

D. $5\ \%$

Answer: 1

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7. The value of K_p for the reaction, $A(g) + 2B(g) \Leftrightarrow C(g)$ is $25 atm^{-2}$ at a certain temperature. The value of K_p for the reaction , $\frac{1}{2}C(g) \Leftrightarrow \frac{1}{2}A(g) + B(g)$ at the same temperature would be :

A. $25 atm^{-1}$

B. $\frac{1}{25} atm^{-1}$

C. $\frac{1}{5} atm$

D. $5 atm$

Answer: 3

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8. For the equilibrium in a closed vessel

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

K_p is found to be double of K_e . This is attained when :

A. $T=2K$

B. $T=12.18K$

C. $T=24.36K$

D. $T=27.3K$

Answer: 3

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9. In the following reaction started only with A_8, $2A_8(g) \Leftrightarrow 3A_2(g)+A_4(g)$ mole fraction of A_2 is found to 0.36 at a total pressure of $100atm$ at equilibrium. The mole fraction of $A_8(g)$ at equlibrium is :

A. 0.28

B. 0.72

C. 0.18

D. None of these

Answer: 1

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10. Which of the following chemical equilibrium is favoured in temperature ?

A. $N_2O_4 \Leftrightarrow 2NO_2 \Delta H = +59kJmol^{-1}$

B. $N_2 + 3H_2 \Leftrightarrow 2NH_3 \Delta H = -22kcalmol^{-1}$

C. $2SO_2 + O_2 \Leftrightarrow 2SO_3 \Delta H = -47kcalmol^{-1}$

D. both 2 and 3

Answer: 1

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11. If 0.5mole H_2 is reacted with 0.5 mole I_2 in a ten $-$ litre container at $444^\circ C$ and at same temperature value of equilibrium constant K_C is 49, the ratio of $[Hl]$ and $[l_2]$ will be :

A. 7

B. $\frac{1}{7}$

C. $\sqrt{\frac{1}{7}}$

D. 49

Answer: 1

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12. 1.50 moles each of hydrogen and iodine were placed in a sealed 10 litre container maintained at 717 K. At equilibrium 1.25 moles each of hydrogen and iodine were left behind. The equilibrium constant, K_c for the reaction , $H_2(g) + I_2(g) \Leftrightarrow 2Hl(g)$ at 717 K is

A. 0.4

B. 0.16

C. 25

D. 50

Answer: 2

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13. If for a particular reversible reaction,

$K_c = 57$ at $355^\circ C$ and $k_c = 68$ at $450^\circ C$ then :

A. $\Delta H < 0$

B. $\Delta H > 0$

C. $\Delta H = 0$

D. ΔH whose sign can be determined

Answer: 2

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14. For which of the following reaction, $\frac{K_p}{K_c}$ ratio is maximum ?

A. $CO(g) + \frac{1}{2}O_2(g) \leftrightarrow CO_2(g)$

B. $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$

C. $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$

D. $7H_2(g) + 2NO_2(g) \leftrightarrow 2NH_2(g) + 4H_2O(g)$

Answer: 3

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15. In which reaction will an increase in the volume of the container favor the formation of products?

A. $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$

B. $H_2O(g) + I_2(g) \Leftrightarrow 2HI(g)$

C. $4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(l)$

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

Answer: 1

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16. In a 1 lit. Container following equilibrium is estabilished with equal moles of $NO_2(g)$ & $N_2O_4(g)$.

$N_2O_4(g) \Leftrightarrow 2NO_2(g) \Leftrightarrow 2NO_2(g)$ at equilibrium $M_{avg.} = \frac{184}{3}$, then ratio of K_c & total initial mole is .

A. 3

B. $3/2$

C. $27/4$

D. 6

Answer: 2

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17. PCl_5 is 10% dissociated at 1 atm. What is % dissociation at 4 atm .

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

A. $40\ \%$

B. $2.5\ \%$

C. $5\ \%$

D. $10\ \%$

Answer: 3

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18. The pressure of iodine gas at $1273K$ is found to be 0.112 atm whereas the expected pressure is 0.074 atm. The increased pressure is due to dissociation $I_2 \Leftrightarrow 2I$. Calculate K_p.

A. 0.074

B. 0.148

C. 0.05

D. None of these

Answer: 2

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19. The ratio of the rate of diffusion of a sample of N_2O_4 partially dissociated in to NO_2 to pure hydrogen was found to be $1:5$. Calculate the degree of dissociation of N_2O_4.

A. 0.84

B. 0.54

C. 0.42

D. 0.64

Answer: 1

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20. For the reaction $4NO_2(g) + O_2(g) \Leftrightarrow 2N_2O_5(g)$, which of the following facts holds good ?

A. $K_p = K_c$

B. $K_p > K_c$

C. $K_p < K_c$

D. K_p and K_c cannot unless pressure of the system is provided.

Answer: C

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21. K_p for equilibrium $N_2O_4 \Leftrightarrow 2NO_2$ is 0.25 at $15^\circ C$. If the system is allowed to expand $\&$ N_2 is added at a constant pressure of 1 atm. What will be the degree when partial of N_2 is 0.6 atm.

A. 0.38

B. 0.23

C. 0.61

D. 0.55

Answer: 1

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22. In an aqueous solution of volume $500ml$ when the reaction $2Ag^{+}(aq) + Cu(s) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$ reached equilibrium, the $[Cu^{2+}]$ was $'a'M$. If $500ml$ water is further added, at the equilibrium $[Cu^{2+}]$ will be :

A. $'a'/2M$

B. $'a'M$

C. between $'a'$ and $'a/2'M$

D. less than $'a/2'$

Answer: 4

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23. K_p for $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ is 0.5 at $1000K$ 2 moles of $CaO(s) \& CO_2(g)$ each at $0.45atm$ introduce in a 16.4 lit. vessel and heated upto $1000K$. The amount of $CaCO_3(s)$ formed will be.

A. 2 mole

B. 0.01 mole

C. 1.9 mole

D. 1 mole

Answer: 3

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24. For the reaction $N_2O(g) \Leftrightarrow 2NO_2(g)$. $\Delta H = 57.49kJ/$ mole, the vapour density of equilibrium mixture .... with increase of temperature.

A. increases

B. decreases

C. Remain same

D. can not be predicted

Answer: 2

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25. $5.1g$ of solid NH_4HS is introduced in a 16.4 lit. vessel & heated upto $500K$ K_B for equilibrium $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ is 0.16. The maximum pressure developed in the vessel will be :

A. $0.8atm$

B. $0.40 atm$

C. $0.5 atm$

D. None of these

Answer: 3

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26. For the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -93.6 kJ mol^{-1}$. The concentration of H_2 at equilibrium will increase if

A. the temperature is lowered

B. the volume of the system is decreased

C. N_2 is added at constant volume

D. NH_3 is added

Answer: 4

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27. For the reaction $2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g) - xkcal$, which is correct?

A. degree of dissociation will increase on decreasing temperature

B. on decreasing the volume of container degree of dissociation will increase.

C. K_c will decrease on increasing temperature.

D. on adding inert gas at constant pressure the amount of ammonia will decrease.

Answer: 4

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28. For a reversible exothermic reaction

$K_c < K_p \& \Delta H = -100kJ$ the reverse reaction is favoured if :

A. Both $P\&T$ are reduced

B. P increased $\&T$ decreased

C. Both $P\&T$ are increased

D. P decreased $\&T$ increased

Answer: 3

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29. In a two step exothermic reaction

$A_2(g) + B_2(g) \Leftrightarrow 3C(g) \Leftrightarrow D(g), \quad \Delta H = -ve$ steps $1\&2$ are favoured respectively by .

A. High pressure, high temperature & low pressure, low temperature

B. Low pressure, low temperature & high pressure, low temperature

C. High pressure, low temperature & low pressure, low temperature

D. Low pressure, high temperature & high pressure, high temperature

Answer: 2

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30. For the reaction $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ the equilibrium amount of CO_2 can be increased by :

A. Adding a suitable catalyst

B. Adding more limestone

C. Increasing volume

D. Adding inert gas at constant volume

Answer: 3

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31. Which one of the following changes would result in a darkening of the colour

$N_2O_4 \Leftrightarrow 2NO_2(g) \Delta H = +ve$

A. Increasing pressure

B. Increase temperature

C. Adding inert gas at constant pressure

D. addition of charcol

Answer: 2

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32. For the following equilibrium, $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ the total equilibrium pressure is P_1. If volume of the system is reduced to $1/2$ of this initial volume then equilibrium is restablished. The new equilibrium total pressure will be :

A. $2P_1$

B. $3P_1$

C. $3.5P_1$

D. less than $2P_1$

Answer: 4

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33. For the reaction : $2A + B \Leftrightarrow 3C$ at $298K$, $K_c = 49$

A $3L$ vessel contains 2,1 and 3 molesof A, B and C respectively.

The reaction at the same temperature

A. must proceed in forward direction

B. must proceed in backward direction

C. must be in equilibrium

D. cannot be predicted

Answer: 1

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34. In a reaction mixture containing H_2, N_2 and NH_3 at partial pressure of 2 atm, 1 atm and 3 atm respectively, the value of K_p at $725K$ is $4.28 \times 10^{-5} atm^{-2}$. In which direction the net reaction will go ?

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

A. Forward

B. Backward

C. No net reaction

D. Direction cannot be predicted

Answer: 2

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35. In the following reaction :

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

the equilibrium is not attained . The rate of forward reaction is greater than that of backward. Thus, which of the following is the correct relation between K_p and Q_p ?

A. $K_p = Q_p$

B. $Q_p > K_p$

C. $Q_p < K_p$

D. $K_p = Q_p = 1$

Answer: 3

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36. The equilibrium constant K_c for the reaction $P_4(g) \Leftrightarrow 2P_2(g)$ is 1.4 at $400^\circ C$. Suppose that 3 moles of $P_4(g)$ and 2 moles of $P_2(g)$ are mixed in 2 litre container at $400^\circ C$. What is the value of reaction quotient (Q) ?

A. $\frac{3}{2}$

B. $\frac{2}{3}$

C. 1

D. None of these

Answer: 2

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37. For the reaction $A(g)+3B(g) \Leftrightarrow 2C(g)$at $27^{\circ} C$, 2 moles of A, 4 moles of B and 6 moles of C are present in 2 litre vessel. If K_c for the reaction is 1.2, the reaction will proceed in :

A. forward direction

B. backward direction

C. neither direction

D. none of these

Answer: 1

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38. When sulphur (in the form of S_B) is heated at temperature T, at equilibrium , the pressure of S_B falls by 30% from $1.0 atm$, because $S_B(g)$ in partially converted into $S_2(g)$.

Find the value of K_P for this reaction.

A. 2.96

B. 6.14

C. 204.8

D. None of these

Answer: 1

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39. In the presence of excess of anhydrous (in torr) of water taken up is governed by $K_p = 10^{12} atm^{-4}$ for the following reaction at $273K$

$SrCl_2.2H_2O(s) + 4H_2O(g) \Leftrightarrow SrCl_2.6H_2O(s)$

What is equilibrium vapour pressure (in torr) of water in a closedvessel that contains $SrCl_2.2H_2O(s)$?

A. 0.001 torr

B. 10^3 torr

C. 0.76 torr

D. 1.31 torr

Answer: 3

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40. At 87° C , the following equilibrium is established .

$H_2(g) + S(s) \Leftrightarrow H_2s(g), K_c = 0.08$

If 0.3 mole hydrogen and 2 mole sulphur are heated to $87^\circ C$ in a 2 L vessel, what will be the concentration of H_2S at equilibrium ?

A. $0.011M$

B. $0.022M$

C. $0.044M$

D. $0.08M$

Answer: 1

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41. At $27^{\circ}C$ and 1 atm pressure ,N_2O_4 is 20% dissociation into $NO_{\circ}$ .What is the density of equilibrium mixture of N_2O_4 and NO_2 at $27^{\circ}C$ and 1 atm?

A. $3.11g/$ litre

B. $2.11g/$ litre

C. $4.5g/$ litre

D. None of these

Answer: 1

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42. $AB_3(g)$is dissociates as $AB_3(g) \Leftrightarrow AB_2(g) + \frac{1}{2}B_2(g)$

When the initial pressure of AB_3 is800 torr and the pressure developed at equilibrium is 900 torr , what fraction of $AB_3(g)$ is dissociated?

A. $10\ \%$

B. $20\ \%$

C. $25\ \%$

D. $30\ \%$

Answer: 3

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43. At a certain temperature the equilibrium constant K_c is 0.25 for the reaction

$A_2(g) + B_2(g) \Leftrightarrow C_2(g) + D_2(g)$

If we take 1 mole of each of the four gases in a 10 litre container ,what would be equilibrium concentration of A_2 (g)?

A. $0.331M$

B. $0.033M$

C. $0.133M$

D. $1.33M$

Answer: 3

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44. A System at equilibrium is described by the equation of fixed temperature T.

$SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$

What effect will be the effect on equilibrium, if total pressure is reducing volume?

A. Concentration of $SO_2Cl_2(g)$ increases

B. Concentration of $SO_2(g)$ increases

C. Concentration of $Cl_2(g)$ increases

D. Concentration of all gases increases

Answer: D

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45. For the reaction at $300K$

$A(g) \Leftrightarrow V(g) + S(g)$

$\Delta_r H^\circ = -30kJ/mol, \Delta_r S^\circ = -0.1kJK^{-1}.mol^{-1}$

What is the value of equilibrium constant ?

A. 0

B. 1

C. 10

D. $+RT$

Answer: 2

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46. Two solid compounds X and Y dissociates at a certain temperature as follows

$X(s) \Leftrightarrow A(g) + 2B(g), K_{p1} = 9 \times 10^{-3} atm^3$

$Y(s) \Leftrightarrow 2B(g) + C(g), K_{p2} = 4.5 \times 10^{-3} atm^3$

The total pressure of gases over a mixture of X and Y is :

A. $4.5 atm$

B. $0.45 atm$

C. $0.6 atm$

D. None of these

Answer: B

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47. Calculate the change in pressure (in atm) when 2 mole of NO and $16gO_2$ in 6.25 litre originally at $27^\circ C$ react to produce the maximum quantity of NO_2 possible according to the equation.

(Take $R = \frac{1}{12}$ ltr. Atm / mol K)

$2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$

A. 1

B. 4

C. 5

D. 2

Answer: 4

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48. n mole of PCl_3 and n mole of Cl_2 are allowed to react at constant temperature T to have a total equilibrium pressure P , as :

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

If y mole of PCl_5 are formed at equilibrium , find K_p for the given reaction .

A. $\frac{(2n-y)y}{(n-y)^2 P}$

B. $\frac{y}{(n-y)^2(2n-y)P}$

C. $\frac{(n-y)^2 . P}{(2n-y)y}$

D. $\frac{(n-y)^2(2n-y)P}{y}$

Answer: 1

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49. At a certain temperature , the equilibrium constant (K_c) is $4/9$ for the reaction :

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

If we take 10 mole of each of the four gases in a one $-$ litre container, what would be the equilibrium mole percent of $H_2(g)$?

A. 20

B. 40

C. 60

D. 80

Answer: 1

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50. For $A(g) \Leftrightarrow 2B(g)$, equilibrium constant at total equilibrium pressure p_1 is

K_{p1}& for $C(g) \Leftrightarrow D(g) + E(g)$.

equilibrium constant at total equilibrium pressure p_2 is K_{p2}. If degree of dissciation of $A \& C$ are same, then the ratio K_{p1} / K_{p2} , if $2p_1 = p_2$, is :

A. 2

B. $1/8$

C. $1/2$

D. 8

Answer: 1

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INORGANIC CHEMISTRY(Metallurgy)

1. If 0.5mole H_2 is reacted with 0.5 mole I_2 in a ten $-$ litre container at $444^\circ C$ and at same temperature value of equilibrium constant K_C is 49, the ratio of $[Hl]$ and $[l_2]$ will be :

A. Hall's process

B. Serpeck's process

C. Baeyer's process

D. Electrolytic reduction.

Answer: 2

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2. 1.50 moles each of hydrogen and iodine were placed in a sealed 10 litre container maintained at 717 K. At equilibrium 1.25 moles each of hydrogen and iodine were left behind. The equilibrium constant, K_c for the reaction , $H_2(g) + I_2(g) \Leftrightarrow 2Hl(g)$ at 717 K is

A. Coke in furnace

B. Coke in upper part and CO in lower part of furnace.

C. CO in most parts of furnace

D. CO in the furnace

Answer: 3

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3. If for a particular reversible reaction,

$K_c = 57$ at $355^\circ C$ and $k_c = 68$ at $450^\circ C$ then :

A. PbO

B. PbO_2

C. PbO and $PbSO_4$

D. PbO_2 and PbO

Answer: 3

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4. For which of the following reaction, $\frac{K_p}{K_c}$ ratio is maximum ?

A. Cuprite, Bauxite

B. Haematite, Cerrusite

C. Argentite, Cassiterite

D. Siderite, Zincite

Answer: A

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5. In which reaction will an increase in the volume of the container favor the formation of products?

A. calamine and siderite are carbonates

B. argentite and cuprite are oxides

C. zinc blende and pyrites are sulphides

D. malachite and azurite are ores of copper

Answer: 5

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6. In a 1 lit. Container following equilibrium is estabilished with equal moles of $NO_2(g)$ & $N_2O_4(g)$.

$N_2O_4(g) \Leftrightarrow 2NO_2(g) \Leftrightarrow 2NO_2(g)$ at equilibrium $M_{avg.} = \frac{184}{3}$, then ratio of K_c & total initial mole is .

A. preferential washing of ores and gangue particles.

B. difference in densities of ore particles and impurities.

C. differnece in chemical properties of ore particles and impurities

D. None of these

Answer: 2

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7. PCl_5 is 10% dissociated at 1 atm. What is % dissociation at 4 atm .

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

A. gravity separation process

B. calcination process

C. leaching process

D. None of these

Answer: 4

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8. The pressure of iodine gas at $1273K$ is found to be 0.112 atm whereas the expected pressure is 0.074 atm. The increased pressure is due to dissociation $I_2 \Leftrightarrow 2I$. Calculate K_p.

A. Sphalerite

B. Argenitite

C. Galena

D. Copper pyrite

Answer: 2

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9. The ratio of the rate of diffusion of a sample of N_2O_4 partially dissociated in to NO_2 to pure hydrogen was found to be $1:5$. Calculate the degree of dissociation of N_2O_4.

A. $Pb(CN)_2$ is precipitated whhile no effect on ZnS.

B. ZnS forms solubel complex $Na_2[Zn(CN)_4]$ while PbS forms froth.

C. PbS froms soluble complex $Na_2[Pb(CN)_4]$ while ZnS forms froth.

D. $NaCN$ is never added in froth floatation process.

Answer: 2

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10. For the reaction $4NO_2(g) + O_2(g) \Leftrightarrow 2N_2O_5(g)$, which of the following facts holds good ?

A. Smelting

B. Calcination

C. Annealing

D. Roasting

Answer: 4

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11. K_p for equilibrium $N_2O_4 \Leftrightarrow 2NO_2$ is 0.25 at $15^\circ C$. If the system is allowed to expand $\&$ N_2 is added at a constant pressure of 1 atm. What will be the degree when partial of N_2 is 0.6 atm.

A. (i), (ii) and (iii) are correct

B. (ii), (iii) and (iv) are correct.

C. (i), (ii) and (iv) are correct.

D. (i), (ii), (iii), (iv) are correct.

Answer: 3

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12. In an aqueous solution of volume $500ml$ when the reaction $2Ag^{+}(aq) + Cu(s) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$ reached equilibrium, the $\left[Cu^{2+}\right]$ was $'a'M$. If $500ml$ water is further added, at the equilibrium $\left[Cu^{2+}\right]$ will be :

A. A

B. B

C. both

D. none

Answer: 2

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13. K_p for $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ is 0.5 at $1000K$ 2 moles of $CaO(s) \& CO_2(g)$ each at $0.45atm$ introduce in a 16.4 lit. vessel and heated upto $1000K$. The amount of $CaCO_3(s)$ formed will be.

A. $Cu_2O + FeO$

B. $FeSiO_3$

C. $FeO + Cu_2O$

D. $Cu_2S + FeO$

Answer: 2

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14. For the reaction $N_2O(g) \Leftrightarrow 2NO_2(g). \Delta H = 57.49 kJ /$ mole, the vapour density of equilibrium mixture .... with increase of temperature.

A. carbon reduction and self reductiion respectively.

B. self reduction and carbon reduction respectively.

C. electrolysis and self reduction respectively.

D. self reduction and electrolysis respectively.

Answer: 2

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15. $5.1g$ of solid NH_4HS is introduced in a 16.4 lit. vessel & heated upto $500K$ K_B for equilibrium $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ is 0.16. The maximum pressure developed in the vessel will be :

A. reduces SnO_2 to Sn.

B. involves the liberation of reducing gases like hydrocarbons.

C. uses poles of freshely cut green wood

D. .all of the above are correct.

Answer: 4

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16. For the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -93.6 kJmol^{-1}$. The concentration of H_2 at equilibrium will increase if

A. $X = [Au(CN)_2]^-, Y = [Zn(CN)_4]^{2-}$

B. $X = [Au(CN)_4]^{3-}, Y = [Zn(CN)_4]^{2-}$

C. $X = [Au(CN)_2]^-, Y = [Zn(CN)_5]^{4-}$

D. $X = [Au(CN)_4]^-, Y = [Zn(CN)_4]^{2-}$

Answer: 1

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17. For the reaction $2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g) - x kcal$, which is correct?

A. anode

B. cathode

C. eletrolytic $-$ tank

D. none

Answer: A

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18. For a reversible exothermic reaction

$K_c < K_p \& \Delta H = -100kJ$ the reverse reaction is favoured if :

A. Maganese

B. Carbon

C. Silicon

D. Phosphorus

Answer: 2

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19. In a two step exothermic reaction

$A_2(g) + B_2(g) \Leftrightarrow 3C(g) \Leftrightarrow D(g), \quad \Delta H = -ve$ steps $1\&2$ are favoured respectively by .

A. Fused salt electrolysis

B. Self reduction

C. Aqueous solution electrolysis

D. Thermite process

Answer: 1

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20. For the reaction $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ the equilibrium amount of CO_2 can be increased by :

A. Mg

B. Au

C. Sn

D. Zn

Answer: 2

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21. Which one of the following changes would result in a darkening of the colour

$N_2O_4 \Leftrightarrow 2NO_2(g)\Delta H = +ve$

A. steel

B. wrought iron

C. pig iron

D. cast iron

Answer: 1

Watch Video Solution

22. For the following equilibrium, $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ the total equilibrium pressure is P_1. If volume of the system is reduced to $1/2$ of this initial volume then equilibrium is restablished. The new equilibrium total pressure will be :

A. silicon

B. germanium

C. gallium

D. all the above

Answer: 4

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23. For the reaction : $2A + B \Leftrightarrow 3C$ at $298K, K_c = 49$

A $3L$ vessel contains 2,1 and 3 molesof A, B and C respectively.

The reaction at the same temperature

A. Entropy change for all oxides is roughly same.

B. Below the boiling point, $'T\Delta S'$ factor decomposes into metal & oxygen.

C. Above $\Delta G = 0$ line, oxide decomposes into metal & oxygen.

D. If randomness increases the slope increases.

Answer: 1

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24. In a reaction mixture containing H_2, N_2 and NH_3 at partial pressure of 2 atm, 1 atm and 3 atm respectively, the value of K_p at $725K$ is $4.28 \times 10^{-5} atm^{-2}$. In which direction the net reaction will go ?

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

A. $TiCl_2 + 2Mg \rightarrow Ti + 2MgCl_2$: Kroll

B. $Ni(CO)_4 \rightarrow Ni + 4CO$: Mond

C. $Ag_2CO_3 \rightarrow 2Ag + CO_2 + \frac{1}{2}O_2$: Van Arkel

D. $ZrI_4 \rightarrow Zr + 2I_2$: Van Arkel

Answer: 3

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25. In the following reaction :

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

the equilibrium is not attained . The rate of forward reaction is greater than that of backward. Thus, which of the following is the correct relation between K_p and Q_p ?

A. In the decomposition of an oxide into oxygen and solid / liquid metal, entropy increases.

B. Decomposition of an oxide is an endothermic change.

C. To make ΔG° negative, temperature should be high enough so that $T\Delta S^\circ > \Delta H^\circ$.

D. All are correct statements.

Answer: 4

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26. The equilibrium constant K_c for the reaction $P_4(g) \Leftrightarrow 2P_2(g)$ is 1.4 at $400^\circ C$. Suppose that 3 moles of $P_4(g)$ and 2 moles of $P_2(g)$ are mixed in 2 litre container at $400^\circ C$. What is the value of reaction quotient (Q) ?

A. (I), (II) and (III)

B. (II), (III) and (I)

C. (III), (I) and (II)

D. (II), (I) and (III)

Answer: 3

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27. For the reaction $A(g)+3B(g) \Leftrightarrow 2C(g)$at $27^{\circ} C$, 2 moles of A, 4 moles of B and 6 moles of C are present in 2 litre vessel. If K_c for the reaction is 1.2, the reaction will proceed in :

A. nitrogen

B. oxygen

C. carbon dioxide

D. argon

Answer: B

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28. When sulphur (in the form of S_B) is heated at temperature T, at equilibrium , the pressure of S_B falls by 30% from $1.0 atm$, because $S_B(g)$ in partially converted into $S_2(g)$.

Find the value of K_P for this reaction.

A. $Al_2O_3.2H_2O \rightarrow Al$: Leaching, precipitation, calcination and electrolytic reduction (molten state).

B. $Ag_2S \rightarrow Ag$: Leaching and displacement method.

C. $PbS \rightarrow Pb$: Froth flotation process, roasting and self reduction.

D. $KCl.\ MgCl_2.6H_2O \rightarrow Mg$: Dehydration by simple heating electrolytic reduction in aqueous phase.

Answer: 4

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29. In the presence of excess of anhydrous (in torr) of water taken up is governed by $K_p = 10^{12} atm^{-4}$ for the following reaction at $273K$

$SrCl_2.2H_2O(s) + 4H_2O(g) \Leftrightarrow SrCl_2.6H_2O(s)$

What is equilibrium vapour pressure (in torr) of water in a closedvessel that contains $SrCl_2.2H_2O(s)$?

A. reduction

B. oxidation

C. reduction followed by oxidation

D. oxidation followed by reduction.

Answer: 3

Watch Video Solution

30. At 87° C , the following equilibrium is established .

$H_2(g) + S(s) \Leftrightarrow H_2s(g), K_c = 0.08$

If 0.3 mole hydrogen and 2 mole sulphur are heated to $87^\circ C$ in a 2 L vessel, what will be the concentration of H_2S at equilibrium ?

A. Cassiterite is an oxide ore of tin.

B. Tin metal is obtained by the carbon reduction of black tin (purified ore of tin).

C. In the extraction of lead from galena, the roasting and self $-$ reduction are carried out in the same furnace at different temperature.

D. Reducing agent of haematite in blast $-$ furnace is coke in upper part and CO in lower part of furnace.

Answer: 4

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31. At $27^{\circ}C$ and 1 atm pressure ,N_2O_4 is 20% dissociation into $NO_{\circ}$ .What is the density of equilibrium mixture of N_2O_4 and NO_2 at $27^{\circ}C$ and 1 atm?

A. iron

B. lead

C. aluminium

D. zinc

Answer: 3

Watch Video Solution

32. $AB_3(g)$is dissociates as $AB_3(g) \Leftrightarrow AB_2(g) + \frac{1}{2}B_2(g)$

When the initial pressure of AB_3 is800 torr and the pressure developed at equilibrium is 900 torr , what fraction of $AB_3(g)$ is dissociated?

A. pure copper

B. ore of copper

C. alloy of copper

D. impure copper

Answer: 4

Watch Video Solution

33. At a certain temperature the equilibrium constant K_c is 0.25 for the reaction

$A_2(g) + B_2(g) \Leftrightarrow C_2(g) + D_2(g)$

If we take 1 mole of each of the four gases in a 10 litre container ,what would be equilibrium concentration of A_2 (g)?

A. Hoope's process

B. Hall's process

C. Serpeck's process

D. Baeyer's process

Answer: 1

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34. A System at equilibrium is described by the equation of fixed temperature T.

$SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$

What effect will be the effect on equilibrium, if total pressure is reducing volume?

A. adsorption

B. absorption

C. sedimentation

D. coagulation

Answer: 1

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35. For the reaction at $300K$

$A(g) \Leftrightarrow V(g) + S(g)$

$\Delta_r H^\circ = -30kJ/mol, \Delta_r S^\circ = -0.1kJK^{-1}. mol^{-1}$

What is the value of equilibrium constant ?

A. T T T F

B. T F F T

C. F T T T

D. T F T F

Answer: 4

Watch Video Solution

36. Two solid compounds X and Y dissociates at a certain temperature as follows

$X(s) \Leftrightarrow A(g) + 2B(g), K_{p1} = 9 \times 10^{-3} atm^3$

$Y(s) \Leftrightarrow 2B(g) + C(g), K_{p2} = 4.5 \times 10^{-3} atm^3$

The total pressure of gases over a mixture of X and Y is :

A. Fe powder and Al_2O_3

B. Al powder and Fe_2O_3

C. Cu powder and Fe_2O_3

D. Zn powder and Cr_2O_3

Answer: B

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37. Calculate the change in pressure (in atm) when 2 mole of NO and $16 g O_2$ in 6.25 litre originally at $27^\circ C$ react to produce the maximum quantity of NO_2 possible according to the equation.

(Take $R = \frac{1}{12}$ ltr. Atm / mol K)

$2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$

A. Fused mixture of $CaCl_2$ and CaF_2

B. $CaCl_2$ fused salt solution

C. fused mixture of $CaCl_2$ and NaF

D. $Ca_3(PO_4)_2$ fused salt solution

Answer: 1

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38. n mole of PCl_3 and n mole of Cl_2 are allowed to react at constant temperature T to have a total equilibrium pressure P, as :

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

If y mole of PCl_5 are formed at equilibrium , find K_p for the given reaction .

A. The removal of Cu_2O from Cu

B. The removal of Al_2O_3 from Al

C. The removal of Fe_2O_3 from Fe

D. All of these

Answer: 1

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39. At a certain temperature , the equilibrium constant (K_c) is $4/9$ for the reaction :

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

If we take 10 mole of each of the four gases in a one $-$ litre container, what would be the equilibrium mole percent of $H_2(g)$?

A. $\begin{matrix} (a) & (b) & (c) & (d) \\ 4 & 3 & 2 & 1 \end{matrix}$

B. $\begin{matrix} (a) & (b) & (c) & (d) \\ 1 & 2 & 3 & 4 \end{matrix}$

C. $\begin{matrix} (a) & (b) & (c) & (d) \\ 2 & 3 & 4 & 1 \end{matrix}$

D. $\begin{matrix} (a) & (b) & (c) & (d) \\ 3 & 4 & 1 & 2 \end{matrix}$

Answer: 1

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40. For $A(g) \Leftrightarrow 2B(g)$, equilibrium constant at total equilibrium pressure p_1 is

K_{p1}& for $C(g) \Leftrightarrow D(g) + E(g)$.

equilibrium constant at total equilibrium pressure p_2 is K_{p2}. If degree of

dissciation of $A\&C$ are same, then the ratio K_{p1} / K_{p2}, if $2p_1 = p_2$, is :

A. $\begin{matrix} I & II & III & IV \\ a & b & c & d \end{matrix}$

B. $\begin{matrix} I & II & III & IV \\ d & c & b & a \end{matrix}$

C. $\begin{matrix} I & II & III & IV \\ b & a & d & c \end{matrix}$

D. $\begin{matrix} I & II & III & IV \\ d & b & c & a \end{matrix}$

Answer: 2

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ORGANIC CHEMISTRY(Alkyl Halide, Alcohol,Phenol,Ether)

1. A sample of mixture of $A(g), B(g)$ and $C(g)$ under equilibrium has mean molecular mass equal to 80. The equilibrium is :

$A(g) \Leftrightarrow B(g) + C(g)$

If initially 4 mole of $'A'$ gas is present then total number of mole at equilibrium is :

$[M_A = 100, M_B = 60, M_C = 40]$

A. $CH_3 - CH_2 - CH_2OH$

B. $CH_3 - CH_2 - CHO$

C. $CH_3 - CH_2 - COOH$

D. $CH_3 - CH_2 - CH_3$

Answer: C

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

At equilibrium in the above case, $'a'$ moles of $CaCO_3$, $'b'$ moles of CaO and $'c'$ moles of CO_2 are found. Then, identify the wrong statement :

A. Benzene

B. $(CH_3)_3COMgBr$

C. $(CH_3)_3C - Br$

D. All are incorrect.

Answer: C

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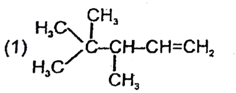
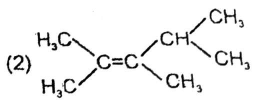
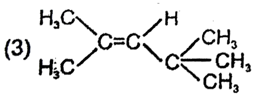
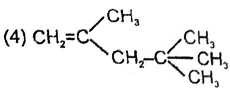
3. $N_3 + 3H_2 \Leftrightarrow 2NH_3$ Starting with one mole of nitrogen and 3 moles of hydrogen, at equiliibrium $50\,\%$ of each had reacted. If the equilibrium pressure is P, the partial pressure of hydrogen at equilibrium would be

A. 

B. 

C. 

D. 

Answer: 4

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4. For the reaction $: CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g), K_p = 1.16 atm$ at $800^\circ C$. If $20g$ of $CaCO_3$ were kept in a 10 litre vessel at $800^\circ C$, the amount of $CaCO_3$ remained at equilibrium is :

A. Nitric acid

B. Picric acid

C. Nitrous acid

D. Acetic acid

Answer: 1

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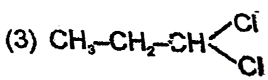
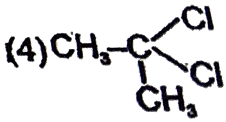
5. The degree of dissociation of $N_2O_4(1)$ obeying the equilibrium, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, is approximately related to the pressure at equilibrium by :

A. $Cl - CH_2 - CH_2 - CH_2 - Cl$

B. $\underset{\displaystyle\overset{|}{Cl}}{CH_3 - CH} - \underset{\displaystyle\overset{|}{Cl}}{CH_2}$

C. 

D. 

Answer: 4

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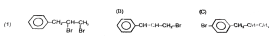
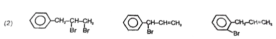
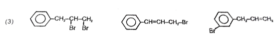
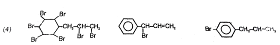
6. In the following reaction, $3A(g) + B(g) \Leftrightarrow 2C(g) + D(g)$, Initial moles of B is double at A . At equilibrium, moles of A and C are equal. Hence $\%$ dissociation is :

A. 

B. 

C. 

D. 

Answer: 1

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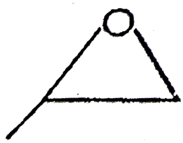
7. The value of K_p for the reaction, $A(g) + 2B(g) \Leftrightarrow C(g)$ is $25 atm^{-2}$ at a certain temperature. The value of K_p for the reaction, $\frac{1}{2}C(g) \Leftrightarrow \frac{1}{2}A(g) + B(g)$ at the same temperature would be :

A. Phenols decolourise Br_2 water due to electrophilic substitution.

B. (2)  is attacked at less sterically hindered carbon by nucleophile in basic medium.

C. Tertiary butyl bromine is more reactive towards hindered both E1 and E2 elimination among its isomers

D. More is Number of $\beta - H$, more is the ease of E2 reaction.

Answer: 4

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8. For the equilibrium in a closed vessel

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

K_p is found to be double of K_e . This is attained when :

A. $CH_3CH_2CH_2OH$

B. $CH_3CH(OH)CH_3$

C. CH_3CH_2OH

D. $CH_3CH_2CH_2CH_2OH$

Answer: 2

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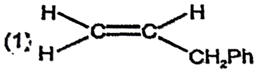
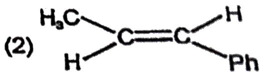
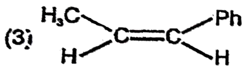
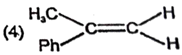
9. In the following reaction started only with A_8, $2A_8(g) \Leftrightarrow 3A_2(g) + A_4(g)$ mole fraction of A_2 is found to 0.36 at a total pressure of $100 atm$ at equilibrium. The mole fraction of $A_8(g)$ at equlibrium is :

A. 

B. 

C. 

D. 

Answer: B

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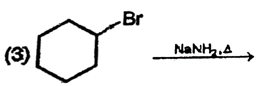
10. Which of the following chemical equilibrium is favoured in temperature ?

A. $CH_3-\underset{\substack{|\\ Cl}}{CH}-CH_2-CH_3 \xrightarrow{alc.KOH,\ \Delta}$

B. $CH_3-\overset{\substack{CH_3\\ |}}{C}H-\underset{\substack{|\\ Br}}{CH}-CH_3 \xrightarrow{(CH_3)_3\overset{\ominus}{C}OK^{\oplus}}$

C. 

D. $CH_3 - \underset{CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}} - CH_2 - Br \xrightarrow[\Delta]{NH_3(l)}$

Answer: 4

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11. If 0.5mole H_2 is reacted with 0.5 mole I_2 in a ten $-$ litre container at $444^\circ C$ and at same temperature value of equilibrium constant K_C is 49, the ratio of $[Hl]$ and $[l_2]$ will be :

A. $(CH_3)_3C - CH_2Br$

B. $(2)\ (CH_3)_2CH-CH\begin{smallmatrix}Br\\ CH_3\end{smallmatrix}$

C. $(CH_3)_3C - CH_2CH_2Br$

D. $(CH_3)_3C - \underset{C(CH_3)_3}{\underset{|}{CH}} - CH_2Br$

Answer: 2

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12. 1.50 moles each of hydrogen and iodine were placed in a sealed 10 litre container maintained at 717 K. At equilibrium 1.25 moles each of hydrogen and iodine were left behind. The equilibrium constant, K_c for the reaction , $H_2(g) + I_2(g) \Leftrightarrow 2Hl(g)$ at 717 K is

A. $HCOOH$

B. $Ph - \underset{\underset{O}{||}}{C} - CH_3$

C. $OHC - \overset{\overset{CH_3}{|}}{C}H - CH_2OH$

D. $OHC - \overset{\overset{CH_3}{|}}{C}H - CHO$

Answer: 4

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13. If for a particular reversible reaction,

$K_c = 57$ at $355^\circ C$ and $k_c = 68$ at $450^\circ C$ then :

A. $KMnO_4 / H^+$

B. $Cu / 300^{\circ} C$

C. Pyridinium chloro chromate (PCC)

D. $(i) MnO_2$. (ii) Ammonical $AgNO_3$, $(iii) H^{+}$

Answer: 4

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14. For which of the following reaction, $\frac{K_p}{K_c}$ ratio is maximum ?

A. an enantiomer of the substrate

B. a product with opposite rotation

C. a mixture of diastereomers

D. A single stereoisomer

Answer: 4

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15. In which reaction will an increase in the volume of the container favor the formation of products?

A. Structural isomers

B. Enantiomers

C. Different compounds

D. Identical compounds

Answer: 4

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16. In a 1 lit. Container following equilibrium is estabilished with equal moles of $NO_2(g)$ & $N_2O_4(g)$.

$N_2O_4(g) \Leftrightarrow 2NO_2(g) \Leftrightarrow 2NO_2(g)$ at equilibrium $M_{avg.} = \frac{184}{3}$, then ratio of K_c & total initial mole is .

A. Eelctrophilic - addition

B. Benzyne intermediate

C. Nucleophilic substitution

D. Electrophilic substitution

Answer: 3

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17. PCl_5 is 10% dissociated at 1 atm. What is % dissociation at 4 atm .

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

A. $CH_3 - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - CH_2 - Cl$

B. $CH_3 - \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - Cl$

C. $CH_3 - \underset{\underset{D}{|}}{\overset{\overset{CH_2CH_3}{|}}{C}} - CH_2 - Cl$

D. $CH_3 - \underset{\underset{H}{|}}{\overset{\overset{CHCH_3}{|}}{C}} - CH_2 - Cl$

Answer: 3

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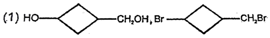
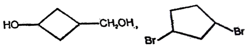
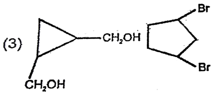
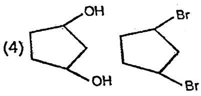
18. The pressure of iodine gas at $1273K$ is found to be 0.112 atm whereas the expected pressure is 0.074 atm. The increased pressure is due to dissociation $I_2 \Leftrightarrow 2I$. Calculate K_p.

A. 

B. 

C. 

D. 

Answer: C

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19. The ratio of the rate of diffusion of a sample of N_2O_4 partially dissociated in to NO_2 to pure hydrogen was found to be $1:5$. Calculate the degree of dissociation of N_2O_4.

A. $2, 1$

B. 4,2

C. 6,3

D. 8,4

Answer: 2

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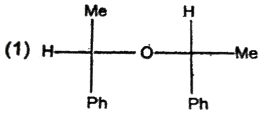
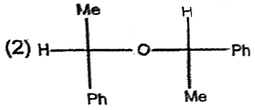
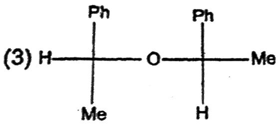
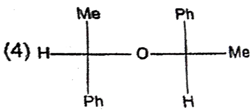
20. For the reaction $4NO_2(g) + O_2(g) \Leftrightarrow 2N_2O_5(g)$, which of the following facts holds good ?

A. 

B. 

C. 

D. 

Answer: 1

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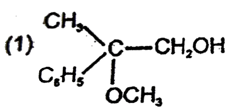
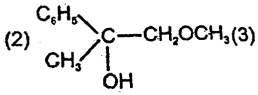
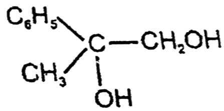
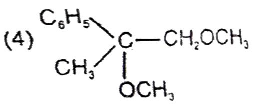
21. K_p for equilibrium $N_2O_4 \Leftrightarrow 2NO_2$ is 0.25 at $15^\circ C$. If the system is allowed to expand $\&$ N_2 is added at a constant pressure of 1 atm. What will be the degree when partial of N_2 is 0.6 atm.

A. 

B. 

C. 

D. 

Answer: B

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22. In an aqueous solution of volume $500ml$ when the reaction $2Ag^{+}(aq)+Cu(s) \Leftrightarrow Cu^{2+}(aq)+2Ag(s)$ reached equilibrium, the $\left[Cu^{2+}\right]$ was $'a'M$. If $500ml$ water is further added, at the equilibrium $\left[Cu^{2+}\right]$ will be :

A. This involves a $1, 2-$ hydride shift

B. This involves a $1, 2-$ methyl shift.

C. This occurs through a S_N1 mechanism

D. This is accompained with formation of alkenes as minor product

Answer: 2

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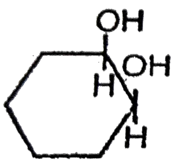
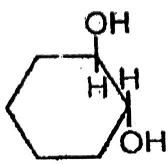
23. K_p for $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ is 0.5 at $1000K$ 2 moles of $CaO(s) \& CO_2(g)$ each at $0.45 atm$ introduce in a 16.4 lit. vessel and heated upto $1000K$. The amount of $CaCO_3(s)$ formed will be.

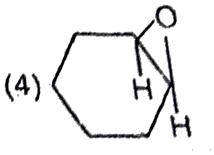
(1) 

A.

(2) 

B.

C. Mixture of (1) and (2)



D.

Answer: 4

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24. For the reaction $N_2O(g) \Leftrightarrow 2NO_2(g)$. $\Delta H = 57.49 kJ /$ mole, the vapour density of equilibrium mixture .... with increase of temperature.

A. $Ph - \underset{\underset{Me}{|}}{C}(OH) - C(NO_3)Me_2$

B. $Ph - \underset{\underset{Me}{|}}{\overset{\overset{OAg}{|}}{C}} - C(NO_3)Me_2$

C. $Ph - CO - CMe_3$

D. $Ph - \underset{\underset{Me}{|}}{\overset{\overset{Me}{|}}{C}} - \underset{\underset{O}{||}}{C} - Me$

Answer: D

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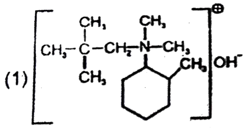
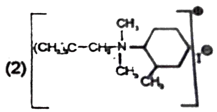
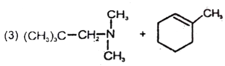
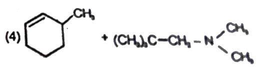
25. $5.1g$ of solid NH_4HS is introduced in a 16.4 lit. vessel & heated upto $500K$ K_B for equilibrium $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ is 0.16. The maximum pressure developed in the vessel will be :

A. 

B. 

C. 

D. 

Answer: 4

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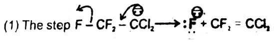
26. For the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -93.6 kJmol^{-1}$. The concentration of H_2 at equilibrium will increase if

A. 

B. $E-1$ reaction can be ragio selective .

C. $S_N2 \& E2$ reactions are stereo specific.

D. In $E1$ and $E2$ reactions inversion of configuration takes place.

Answer: 4

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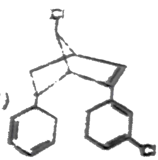
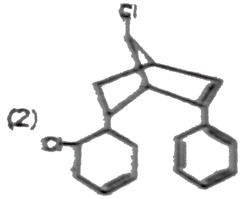
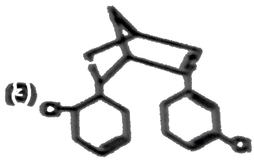
27. For the reaction $2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g) - x kcal$, which is correct?

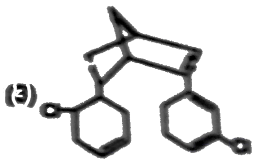
A. (1) 



B.



C.



D.

Answer: 1

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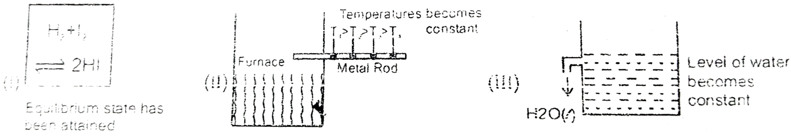
Solved examples

1. (1) Consider the following cases-



The nature of flow of energy in case (I) is same as that in-

(A) II , (B) III , (C) II and III , (D) None

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2. The value of K_P for the reactions $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, is 4.28×10^{-5} at $450^\circ C$. A reaction mixture contains N_2, H_2 and NH_3 at partial pressures of 0.6 atm ,2.5 atm and 0.50 atm respectively . In which direction the reaction will proceed?

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3. The K_P values for three reactions are 10^{-5}, 20 and 300 then what will be the correct order of the percentage composition of the products.

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4. In an experiment starting with 1 mol C_2H_5OH, 1 mol CH_3COOH, and 1 mol of water, the equilibrium mixture mixture of analysis shows that 54.3% of the acid is esterified. Calculate K_c.

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5. Calculate the degree of dissociation and K_P for the following reaction.

$$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)\begin{matrix} t=0 & a & 0 & 0 \\ t=t & a-x & x & x \end{matrix}$$

Since for a mole, x moles are dissociated

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6. The vapoour density of a mixture containing NO_2 and N_2O_4 is 38.3 at 300 K. the number of moles of NO_2 in 100 g of the mixture is approximately

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7. The equilibrium constant of the reaction at $25^\circ C$

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 3H_2O(g)$

is $1.084 \times 10^{-4} atm^2$. Find out under what conditions of relative humidity. $CuSO_4.5H_2O$ will start loosing its water of crystallization according to above reaction. (Vapour pressure of water at $25^\circ C \text{is} 24\ mm$ of Hg).

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8. Variation of equilibrium constan K with temperature is given by van't Hoff equation

$$InK = \frac{\Delta_r S^\circ}{R} - \frac{\Delta_r H^\circ}{RT}$$

for this equation, $(\Delta_r H^\circ)$ can be evaluated if equilibrium constans K_1 and K_2 at two temperature T_1 and T_2 are known.

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta_r H^\circ}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

Variation of $\log_{10}$ K with $\frac{1}{T}$ is shown by the following graph in which straight line is at 45° hence ΔH° is :

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9. $102g$ of solid NH_4HS is taken in the $2L$ evacuated flask at 57°. Following two equilibrium exist simultaneously

$$NH_4(s) \Leftrightarrow NH_3(g) + H_2S(g)$$

$$NH_3(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

one mole of the solid decomposes to maintain both the equilibrium and $0.75 mole$ of H_2 was found at the equilibrium then find the equilibrium concentration of all the species and K_C for the both the reaction.

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(MSPs)

1. An example of a reversible reaction is

A. (A) $Pb(NO_3)_2(aq) + 2Na!(aq) \Leftrightarrow Pbl_2(S) + 2NaNO_2(aq)$

B. (B) $AgNO_3(aq) + HC!(aq) \Leftrightarrow AgCl(S) + HNO_3(aq)$

C. (C) $2Na(S) + H_2O(l) \Leftrightarrow 2NaOH(aq) + H_2(g)$

D. (D) $KNO_3(aq) + NaCl(aq) \Leftrightarrow KCl(aq) + NaNO_3(aq)$

Answer: D

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2. For the reaction , $A + B \Leftrightarrow 3C$, if 'a' mol/litre of each 'A' and 'B' are taken initially then at equilibrium the incorrect relation is :

A. (A) $[A] - [B] = 0$

B. (B) $3[B] + [C] = 3a$

C. (C) $3[A] + [C] = 3a$

D. (D) $[A] + [B] = 3[C]$

Answer: D

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3. The equilibrium constant (K_p) for the decomposition of gaseous

H_2O

$$H_2O(g) \Leftrightarrow H_2(g) + \frac{1}{2}O_2(g)$$

is related to the degree of dissociation α at a total pressure P by

A. (A) $K = \dfrac{\alpha_2 P^{1/2}}{(1+\alpha)(2-\alpha)^{1/2}}$

B. (B)$K = \dfrac{\alpha^{3/2} P^{1/2}}{(1+\alpha)(2+\alpha)^{1/2}}$

C. (C) $K = \dfrac{\alpha^3 P^{1/2}}{\sqrt{2}}$

D. (D) $K = \dfrac{\alpha^3 P^{3/2}}{(1-\alpha)(2+\alpha)^{1/2}}$

Answer: B

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4. The reaction quotient (Q) for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$ The reaction will proceed towards rigt side, if

A. (A) $Q = K_C$

B. (B) $Q < K_C$

C. (C) $Q > K_C$

D. (D) $Q = 0$

Answer: C

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5. $0.96g$ of HI were, heated to attain equilibrium $2HI \Leftrightarrow H_2 + I_2$. The reaction mixture on titration requires $15.7mL$ of $N/10$ hypo solution. Calculate the degree of dissociation of HI.

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6. Would $1\%\ CO_2$ in air be sufficient to prevent any loss in weight when M_2CO_3 is heated at $120^\circ C$?

$M_2CO_3(s) \Leftrightarrow M_2O(s) + CO_2(g)$

$K_p = 0.0095$ atm at $120^\circ C$. How long would the partial pressure of CO_2 have to be to promote this reaction at $120^\circ C$?

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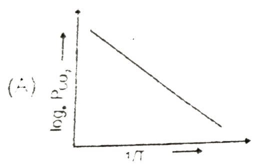
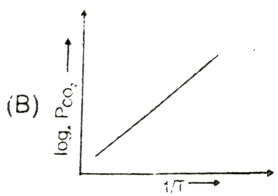
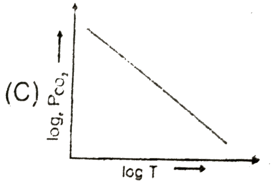
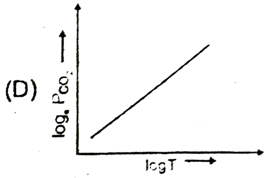
7. For the chemical equilibrium $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g), \Delta_r H^\circ$ can be determined from which one of the following plots?

A. 

B. 

C. 

D. 

Answer: A

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8. In a container of constant volume at a particular temparature N_2 and H_2 are mixed in the molar ratio of $9:13$. The following two equilibria are found o be coexisting in the container

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

$N_2(g) + 2H_2(g) \leftrightarrow N_2H_4(g)$

The total equiibrium pressure is found to be 305 atm while partial pressure of $NH_3(g)$ and $H_2(g)$ are 0.5 atm and 1 atm respectivly. Calculate of equilibrium constants of the two reactions given above.

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Board Level Exercise

1. The equilibrium constant expression for a gas reaction is .

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

Write the balanced chemical equation corresponding to this expression.

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2. For the reaction

$N_2 + 3H_2 \Leftrightarrow 2NH_3$

and $\frac{1}{2}N_2 + \frac{3}{2}H_2 \Leftrightarrow NH_3$

write down the expression for equilibrium constants K_c and K_c'. How is K_c related to K_c'?

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3. Under what condition, a reversible process becomes irreversible?

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4. The numerical value of equilibrium constant depends on

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5. The value of the equilibrium constant is less than zero. What does it indicate ?

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

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7. What are the conditions for getting maximum yield of NH_3 by Haber's process?

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8. Which measurable property becomes constant in water $\Leftrightarrow waterv apour$ equilibrium at constant temperature.

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9. Write expression for $K_p \text{and} K_c$ for the reaction $CaCO_3(S) \leftrightarrow CaO(S) + CO_2(g)$.

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10. Explain the terms:

Law of mass action

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11. What are $K_c \text{and} K_P$?

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12. Define 'Homogeneous Equlibria and Heterogeneous Equilibria'. Give two examples of each of them.

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13. Write the expression for the equilibrium constant, K_c for each of the following reaction :

(i) $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

(ii) $2Cu(NO_3)_2(s) \Leftrightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

(iii) $CH_3COOC_2H_5(aq) + H_2O(l) \Leftrightarrow CH_3COOH(aq) + C_2H_5(aq)$

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

(v) $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

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14. Explain why pure liquids and solids can be ignored while writing the equilibrium constant expression?

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15. What qualitative information can you obtain from the value of the equilibrium constant?

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16. Areaction $A(g) + B(g) \leftrightarrow 2C(g)$ is an equlibrium at a certain temperature. Can we increases the amount of products by (i) adding catayst (ii) increasing pressure?

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17. Why does ice melt slowly at higher altitudes?

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18. The value of K_c for the reaction, $N_2(g) + 2O_2(g) \leftrightarrow 2NO_2(g)$ at a certain temperature is 400. Calculate the value of equilibrium constant for.

(i) $2NO_2(g) \leftrightarrow N_2(g) + 2O_2(g)$, (ii) $1/2N_2(g) + O_2(g) \leftrightarrow NO_2(g)$

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19. If concentration are expressed in moles L^{-1} and pressure in atmospheres, what is the ratio of $K_p \text{to} K_c$ for the reaction, $2SO_2(g) + O_2(g) \leftrightarrow 2SO_3(g)$ at $25^\circ C$?

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20. Describe the effect of :

a) addition of H_2

b) addition of CH_3OH

c) removal of CO

d) removal of CH_3OH

on the equilibrium of the reaction:

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

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21. Discuss the effect of temperature on the equilbrium constant. How does it change for (a) exothermic reaction (b) endothermic reaction (c) reaction having zero heat of reaction?

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22. A sample of $HI(g)$ is placed in flask at at pressure of 0.2 atm . At equilibrium the partial pressure of $HI(g)$ is 0.04atm what is K_p for the given equilibrium ?

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

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23. The following reaction has attained equilibrium

$CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(g). \Delta H^\circ = -92.0 KJmol^{-1}$

What will happen if

(i) Volume of the reaction vessel is suddenly reduced to half?

(ii) the partial pressure of hydrogen is suddenly doubled?

(iii) an inert gas is added to the system at constant volume.

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24. What is K_c for the following equilibrium when the equilibrium concentration of each substance is : $[SO_1] = 0.60M, [O_2] = 0.82M$ and $[SO_3] = 1.90M$?

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

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25. Nitric oxide reacts with Br_2 and gives nitrosul bromide as per reaction given below:

$2NO(g) + Br_2(g) \Leftrightarrow 2NOBr(g)$

When 0.087 mol of NO and 0.0437 mol of Br_2 are mixed in a closed container at constant temperature 0.0518 mol of $NOBr$ is obtained at equilibrium. Calculate equilibrium amount of NO and Br_2.

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26. At $1400K$, $K_c = 2.5 \times 10^{-3}$ for the reaction

$CH_4(g) + 2H_2S(g) \Leftrightarrow CS_2(g) + 4H_2(g)$

A $10L$ reaction vessel at $1400K$ contains $2.0mol$ of CH_4, $4.0mol$ of H_2S, $3.0mol$ of CS_2, $3.0mol$ of H_2. In which direction does the reaction proceed to reach equilibrium?

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27. At $473K$, equilibrium constant K_c for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3} . If decomposition is depicted as,

$PCl_5(g) \Leftrightarrow Pcl_3(g) + Cl_2, \Delta_r H^{\ominus} = 124.0 kJ\text{mol}^{-1}$

a) write an expression for K_c for the reaction.

b) what is the value of K_c for the reverse reaction at the same temperature ?

c) what would be the effect on K_c if (i) more PCl_5 is added (ii) pressure is increased (iii) the temperature is increased ?

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28. At a certain temperature and total pressures of $10^5 Pa$, iodine vapour contains 40% by volume of 1 atoms

$I_2(g) \Leftrightarrow 2I(g)$

Calculate K_p for the equilibrium

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29. Consider the following reaction

$N_2O_4(g) \Leftrightarrow 2NO_2(g)\Delta H = 58.6KJ$

What will be the effect of the following changes on the concentration of N_2O_4 at equilibrium?

(i) Increasing the pressure (ii) Increasing the temperature

(iii) Increasing the volume

(iv) Adding more $NO_2(g)$ to the system without changing temperature and pressure (v) Adding catalyst.

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30. At $523K$, 1 litre of partially dissociated PCI_5 at 1 atm weighs $2.695g$. Calculate the percentage dissociation of $PCI_5\text{at } \ 523K$.

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31. A sample of pure PCl_5 was introduced into aln evacuated vessel at 473 K. After equilibrium was attained, concentration of PCl_5 was found to be $0.5 \times 10^{-1} L^{-1}$. If value of K_c is 8.3×10^{-3}. What are the concentration of PCl_3 and Cl_2 at equilibrium ?

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

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32. At 1127 K and atm pressure, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has 90.55% CO by mass,

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

K_c for this reaction at the above temperature is

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33. Dihydrogen gas used in Haber's process is produced by reacting methane from natural gas with high temperature steam. The first stage of two stage reaction involves the formation of CO and H_2. In second stage, CO formed in first stage is reacted with more steam in water gas shift reaction,

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

If a reaction vessel at $400^{\circ} C$ is charged with an equimolar mixture of CO and steam such that $p_{co} = p_{H_2O} = 4.0$ bar, what will be the partial pressure of H_2 at equilibrium? $K_p = 10.1 at 400^{\circ} C$

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Exercise-1 (Part-1)

1. In a reaction $A + B \Leftrightarrow C + D$ the rate constant of forward reaction & backward reaction is K_1 and K_2 respectively then the equilibrium constant (K_C) for reaction is expressed as

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2. What is the active mass of 5.6 litres of O_2 at S.T.P.?

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3. Write the expressions for equilbrium constant K_c and K_P and classify in Homogeneous and Hetereogeneous equilbrium:

(i) $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

(ii) $3Fe(S) + 4H_2O(g) \Leftrightarrow Fe_3O_4(S) + 4H_2(g)$

(iii) $NH_4HS(S) \Leftrightarrow NH_3(g) + H_2S(g)$

(iv) $CH_3COOH(f) + C_2H_5OH(f) \Leftrightarrow CH_3COOC_2H_5(f) + H_2O(f)$

(V) $MgCO_3(S) \Leftrightarrow MgO(S) + CO_2)g)$

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

(vii) $SO_2(g) + NO_2(g) + NO_2(g) \Leftrightarrow SO_3(g) + NO(g)$

(viii) $NH_4NO_2(S) \Leftrightarrow N_2(g) + 2H_2O(f)$

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4. A mixture of SO_3, SO_2 and O_2 gases is maintained in a $10L$ flask at a temperature at which the equilibrium constant for the reaction is 100:

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

a. If the number of moles of SO_2 and SO_3 in the flask are equal. How many moles of O_2 are present?

b. If the number of moles of SO_3 in flask is twice the number of moles of SO_2, how many moles of oxygen are present?

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5. The equilibrium constant of the reaction

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

at $100^\circ C$ is 50. If a $1L$ flask containing 1 mol of A_2 is connected to a $2L$ flask containing 2 mol of B_2, how many moles of AB will be formed at $373K$?

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6. consider the given reaction, 3A(g) + B(g) hArr 2C(g) at a given temperature if a mixture of 2 mol each of A, B and C exist at equilibrium and $K_c = 9$ then volume of the flask will be

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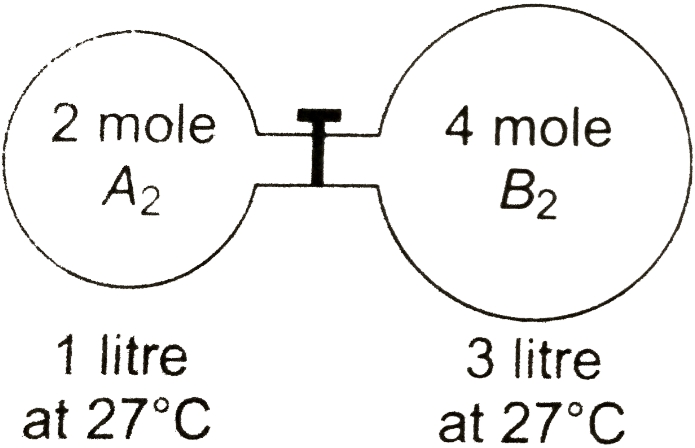

7.

The gas A_2 in the left flask allowed to react with gas B_2 present in right flask as $A_2(g) + B_2(g) \Leftrightarrow 2AB(g), K_c = 4$ at $27^\circ C$. What is the concentration of AB when equilibrium is established ?

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8. n mole each of $H_2O(g), H_2(g) \text{and} O_2(g)$ are mixed at a suitable high temperature to attain the equilibrium $2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g)$. If y and mole of $H_2O(g)$ are the dissociated and the total pressure maintained is P, calculate the K_P.

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9. The partial pressures of $N_2O_4 \text{and} NO_2 \text{at} 40^\circ C$ for the following equilibrium $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ are $0.1 \text{atm and} 0.3$ atm respectively. Find K_P for the reaction.

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10. $1 \text{mole of} N_2$ and 3 moles of H_2 are placed in $1L$ vessel. Find the concentration of NH_3 at equilibrium, if the equilibrium constant (K_c) at $400K \text{is} \frac{4}{27}$

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11. Calculate the expression for $K_C \text{and} K_P$ if initially a moles of $N_2 \text{and} B \text{moles of} H_2$ is taken for the following reaction. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)(\Delta n < 0)$ (P,T,V given)

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12. 1 mole of a gas A is taken in a vessel of volume $1L$. It dissociates according to the reaction

$A(g) \Leftrightarrow B(g) + C(g) \text{at} 27^\circ C$. Forward and backward reaction rate constants for the reaction are $1.5 \times 10^{-2} \text{and} 3 \times 10^{-2}$ respectively. Find the concentrations of $A, B \text{and} C$ at equilibrium.

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13. $0.15 mol$ of CO taken in a $2.5L$ flask is maintained at $750K$ alongwith a catalyst so that the following reaction can take place $CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(g)$. Hydrogen is introduced unit the total pressure of the system is 8.5 atm at equilibrium and 0.08 mol of methanol is formed. Calculate

a. K_p and K_c

b. The final pressure if the same amount of CO and H_2 as brfore is used but no catalyst so that the reaction does not take place.

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14. A mixture of 1.57 mol of N_2, 1.92 mol of H_2 and 8.13 mol of NH_3 is introduced into a $20L$ reaction vessel at $500K$. At this temperature, the equilibrium constant, K_c for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is 1.7×10^2. Is the reaction mixture at equilibrium? If not, what is the direction of the net reaction?

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15. At $460^\circ C, K_C = 81$ for the reaction, $SO_2(g) + NO_2(g) \Leftrightarrow NO(g) + SO_3(g)$

A mixture of these gases has the following concentrations of the reactants and products:

$[SO_2] = 0.04M[NO_2] = 0.04m$

$[NO] - 0.30m[SO] = 0.3m$

Is the system at equilibrium? If not, in which direction must the reaction proceed to reach equilibrium. What will be the molar concentrations of the four gases at equilibrium?

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16. For a reversible reaction, if the concentration of the reactants are doubled, then the equilibrium constant will

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17. The equilibrium constant for the reactions

$N_2 + O_2 \Leftrightarrow 2NO \text{and } \ NO + \frac{1}{2}O_2 \Leftrightarrow NO_2 \text{are} K_1 \text{and} K_2$ respectively, that will be the equilibrium constant for the reaction

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18. Calculate the equilibrium constant for the reaction

$H_2(g) + CO_2(g) \Leftrightarrow H_2O(g) + CO(g)$ at $1395K$

If the equilibrium constants at $1395K$ for the following are:

$2H_2O(g) \Leftrightarrow 2H_2 + O_2(g), K_1 = 2.1 \times 10^{-13}$

$2CO_2(g) \Leftrightarrow 2CO(g) + O_2(g), K_2 = 1.4 \times 10^{-12}$

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19. The homogeneous reversible reaction, $C_2H_5OH + COOH \Leftrightarrow CH_3COOC_2H_5 + H_2O$ is studied at various initial concentrations of the reactants at constant temperature. Calculate K in each case.

	Moles of acid Per litre (initial)	Moles of alcohol Per litre(initial)	Moles of ester Per litre at equilibrium
(i)	1	1	0.637
(ii)	1	4	0.93

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20. The ester ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as

$CH_3COOH(l) + C_2H_5OH(l) \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$

Write the concentration ratio , Q for this reaction. Note that water is not in excess and is not a solvent in this reactions .

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21. N_2O_4 is 25% dissociated at $37^\circ C$ and one atmosphere pressure. Calculate (i) Kp and (ii) the percentage dissociation at 0.1 atm and $37^\circ C$.

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22. At temperature T, a compound $AB_2(g)$ dissociates according to the reaction,

$2AB_2(g) \Leftrightarrow 2AB(g) + B_2(g)$ with a degree of dissociation, 'x' which is small as compared to unity. The expression for K_p in terms of 'x' and total pressure P is

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23. Vapour density of the equilibrium mixture of NO_2 and N_2O_4 is found to be 40 for the equilibrium

$N_2O_4 \Leftrightarrow 2NO_2$

Calculate

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24. When sulphur in the form of S_8 is heated at $900K$, the initial pressure of 1 atm falls by 10% at equilibrium. This is because of conversion of some S_8 to S_2. Find the value of equilibrium constant for this reaction.

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25. In a container $H_2O(g), CO(g) \text{and} H_2(g)$ are present in the molar ration of $1:2:3$ respectively at temperature of $300K$, Find the pressure in the container at which solid carbon (graphile) will star forming in the container given that:

$C(S) + H_2O(G) \Leftrightarrow CO(g) + H_2(g) K_p = 3$ atm

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26. $K_p \text{is} atm^2$ for the reaction: $LiCI.3NH_3(s) \Leftrightarrow LiCI.\, NH_3(s) + 2NH_3(g) \text{at} 40^\circ C$. How many moles of ammonia must be added at this temperature to a 5 litre flask containing 0.1 mole of LiCl. NH_3 in order to completely convert the solid to $LiCI.3NH_3$?

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27. Equilibrium constant for the following equilibrium is given at $0^\circ C$.

$$Na_2HPO_4 \quad . \quad 12H_2O(s) \Leftrightarrow Na_2HPO_4 \quad . \quad 7H_2O(s) + 5H_2O(g)$$

$K_p = 31.25 \times 10^{-13}$. At equilibrium what will be partial pressure of water vapour:

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28. Equilibrium constant for the following equilibrium is given at $0^\circ C$.

$$Na_2HPO_4 \quad . \quad 12H_2O(s) \Leftrightarrow Na_2HPO_4 \quad . \quad 7H_2O(s) + 5H_2O(g)$$

$K_p = 31.25 \times 10^{-13}$. At equilibrium what will be partial pressure of water vapour:

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29. The dissociation pressure of silver oxide at $445^\circ C \text{is} 207$ atm. Calculate ΔG° for the formation of 1 mole $Ag_2O(S)$ from metal and oxygen at this temperature. $(\log 207 = 2.315)$

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30. Given below are the values of $\Delta H^\ominus$ and $\Delta S^\ominus$ for the reaction given below at $27^\circ C$.

$$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g)$$

$$\Delta H^\ominus = -98.32 kJ mol^{-1}, \Delta S^\ominus = -95 J mol^{-1}$$

Find K_p for the reaction

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31. From the following data

i. $H_2(g) + CO_2(g) \Leftrightarrow H_2O(g) + CO(g), K_{2000K} = 4.40$

ii. $2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g), K^I_{2000K} = 5.31 \times 10^{-10}$

iii. $2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g), K_{1000K} = 2.24 \times 10^{22}$

Show whether reaction (iii) is exothermic or endothermic.

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32. Tell whether reaction will get affected by increase of pressure? Also mention, whether change will cause the reaction to go into the right or left direction?

$C_2H_{4(g)} + H_{2(g)} \Leftrightarrow C_2H_{6(g)}$

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33. Using "Le" Chateller's principle, predict the effect of

(i) decreasing the temperature and

(ii) increasing the pressure on each of the following equilibria:

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

(B) $N_2(g) + O_2(g) \Leftrightarrow 2NO(g) + \text{Heat}$

(C) $H_2O(g) + \text{Heat} \Leftrightarrow H_2(g) + \frac{1}{2}O_2(g)$

(D) $2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g) + \text{Heat}$

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34. The decomposition of solid ammonium carbamate, $(NH_4)(NH_2CO_2)$, to gaseous ammonia and carbon dioxide is an endothermic reaction.

$9NH_4)(NH_2CO_2))(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$

(a) When solid $(NH_4)(NH_2CO_2)$ is introduced into and evacuated flask at $25^\circ C$, the total pressure of gas at equilibrium is 0.3 atm. What is the value of $K_p \text{at} 25^\circ C$?

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35. Following equilibrium is established at temperature T.

$A(g) \Leftrightarrow B(g) + C(g)$

at eq. $1M 2M 2M$.

If volume of the vessel is doubled then find the equilibrium concentration of each species. (Given that : $\sqrt{40} = 6.324$)

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36. Two solid compounds A and B dissociate into gaseous products at $20^\circ C$ as

a. $A(s) \Leftrightarrow A'(s) + H_2S(g)$

b. $B(s) \Leftrightarrow B'(g) + H_2S(g)$

At $20^\circ C$ pressure over excess solid A is 50 mm and that over excess solid B is 68 mm. Find:

a. The dissociation constant of A and B

b. Relative number of moles of A' and B' in the vapour phase over a mixture of the solids A and B.

c. Show that the total pressure of gas over the solid mixture would be 84.4 mm.

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37. In a vessel, two equilibrium are simultanceously established at the same temperature as follows:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$.... (1)

$N_2g) + 2H_2(g) hARr N_2H_4(g)$ ....(2)

Initially the vessel contains $N_2 \text{and} H_2$ in the molar ratio of $9:13$. The equilibrium pressure is $7P_0$, in wich pressure due to ammonia is P_o and due to hydrogen is $2P_0$. Find the values of equilibrium constats $(K_p{}'S)$ for both the reactions

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38. When NO and NO_2 are mixed, the following equilibria are readily obtained,

$2NO_2 \Leftrightarrow N_2O_4, K_p = 6.8 atm^{-1}$

$NO + NO_2 \Leftrightarrow N_2O_3$

In an experiment when NO and NO_2 are mixed in the ratio of $1:2$, the final total pressure was 5.05 atm and the partial pressure of N_2O_4 was 1.7 atm. Calculate

a. the equilibrium partial pressure of NO.

b. K_p for $NO + NO_2 \Leftrightarrow N_2O_3$.

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Exercise-1 (Part-2)

1. A reversible reaction is one which :

A. (A) Proceeds in one direction

B. (B) Proceeds in both directions

C. (C) Proceeds spontaneously

D. (D) All the statements are wrong

Answer: B

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2. If a chemical reaction is at equilibrium, it means that:

A. (A) Reactants are completely transformed into products

B. (B) The rates of forward and backward reactions are equal

C. (C) Formation of products is minimised

D. (D) Equal amounts of reactants and products are present

Answer: B

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3. Molar concentration of 96 g of O_2 contained in a 2 L vessel is:

A. (A) $16 mol / litre$

B. (B) $1.5 mol / litre$

C. (C) $4 mol / litre$

D. (D) $24 mol / litre$

Answer: B

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4. Rate of reaction curve for equilibrium can be like: $\left[r_f = \right.$ forward rate, $r_b =$ backward rate]

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5. The active mass of $64g$ of HI in a $2-L$ flask would be

A. (A) 2

B. (B) 1

C. (C) 5

D. (D) 0.25

Answer: D

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6. The active mass of $64g$ of HI in a $2-L$ flask would be

A. (A) $22:3:7$

B. (B) $0.5:3:7$

C. (C) $1:3:1$

D. (D) $1:3:0.5$

Answer: D

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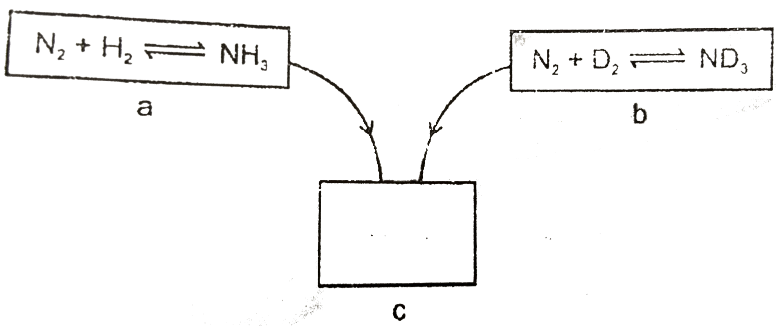
7.



Initially the reactions in the container $a\&b$ are at equilibrium when the products & reactants are put together in a container C then at the equilibrium the total number of different compounds are-

A. (A) 5

B. (B) 7

C. (C) 6

D. (D) 8

Answer: D

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8. Active mass of a 6% solution of a compound is 2 then calculate molar mass of compound.

A. (A) 15

B. (B) 30

C. (C) 60

D. (D) 120

Answer: B

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9. In a reversible reaction $A \underset{K_2}{\overset{K_1}{\Longleftrightarrow}} B$ the initial concentration of A and B are a and b in moles per litre and the equilibrium concentrations are (a-x) and (b+x) respectively, Express x in terms of K_1, K_2, a and b.

A. (A) $\dfrac{K_1a - K_2b}{K_1 + K_2}$

B. (B) $\dfrac{K_1a - K_2b}{K_1 - (K_2)}$

C. (C) $\dfrac{K_1a - K_2b}{K_1K_2}$

D. (D) $\dfrac{K_1a - K_2b}{K_1 + K_2}$

Answer: A

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10. The reaction $A + B \Leftrightarrow C + D$ is studied in a one litre vessel at $250^\circ C$. The initial concentration of A was 3n and that of B was n. When equilibrium was attained, equilibrium concentration of C was found to the equal to the equilibrium concentration of B. What is the concentration of D at equilibrium ?

A. (A) $n/2$

B. (B) $(3n-1/2)$

C. (C) $(n-n/3)$

D. (D) n

Answer: A

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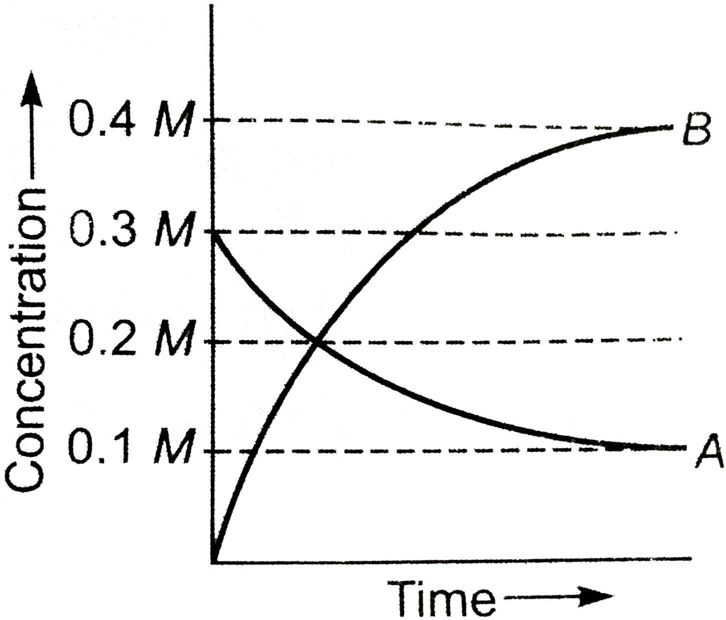
11. The figure shows the change in concentration of species A and B as a function of time.

The equilibrium constant K_c for the reaction $A(g) \Leftrightarrow 2B(g)$ is :



A. (A) $K_c > 1$

B. (B) $K < 1$

C. (C) $K = 1$

D. (D) data insufficient

Answer: A

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12. Using moler concentrations, what is the unit of K_c for the reaction ?

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

A. (A) M^{-1}

B. (B) M^2

C. (C) M^{-1}

D. (D) M

Answer: B

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13. $K_c = 9$ for the reaction, $A + B \Leftrightarrow C + D$. If A and B are taken in equal amounts, then amount of C in equilibrium is:

A. (A) 1

B. (B) 0.25

C. (C) 0.75

D. (D) None of these

Answer: C

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14. The equilibrium $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ is established in a reaction vessel of 2.5 L capacity. The amounts of N_2 and O_2 taken at the start were respectively 2 moles and 4 moles. Half a mole of nitrogen has been used up at equilibrium. The molar concentration of nitric oxide is:

A. (A) 0.2

B. (B) 0.4

C. (C) 0.6

D. (D) 0.1

Answer: B

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15. An equilibrium mixture for the reaction

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

had 1 mole of H_2S, 0.2 mole of H_2 and 0.8 mole of S_2 in a 2 litre flask. The value of K_c in mol L^{-1} is

A. (A) 0.08

B. (B) 0.016

C. (C) 0.004

D. (D) 0.160

Answer: B

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16. What is the unit of K_p for the reaction ?

$CS_2(g) + 4H_2(g) \Leftrightarrow CH_4(g) + 2H_2S(g)$

A. (A) atm

B. (B) atm^{-2}

C. (C) atm^{2}

D. (D) atm^{-1}

Answer: B

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17. N_2 and H_2 are taken in 1:3 molar ratio in a closed vessel to attained the following equilibrium , $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

Find K_p for reaction at total pressure of 2P if P_{N_2} at equilibrium is $\frac{P}{3}$:

A. (A) $\frac{1}{3P^2}$

B. (B) $\frac{4}{3P^2}$

C. (C) $\frac{4P^2}{3}$

D. (D) none

Answer: B

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18. The equilibrium constant, K_p for the reaction

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

is $44.0 atm^{-1} \text{at} 1000K$. What would be the partial pressure of O_2 if at equilibrium the amound of SO_2 and SO_3 is the same?

A. (A) $16.0 atm$

B. (B) $0.023 atm$

C. (C) $1 atm$

D. (D) $0.75 atm$

Answer: B

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19. For the reaction $A_2(g) + 2B_2 \Leftrightarrow 2C_2(g)$ the partial pressure of A_2 and B_2 at equilibrium are 0.80 atm and 0.40 atm respectively.

The pressure of the system is 2.80 atm.

The equilibrium constant K_p will be

A. (A) 20

B. (B) 5.0

C. (C) 0.02

D. (D) 0.02

Answer: A

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20. $PCl_5 \Leftrightarrow PCl_3 + Cl_2$ in the reversible reaction the moles of $PCl_5 .\ PCl_3$ and Cl_2 are a,b and c respectively and total pressure is P then value of K_p will be

A. (A) $\dfrac{bc}{a}.\ RT$

B. (B) $\dfrac{b}{(a+b+c).\ P}$

C. $\dfrac{bc.\ P}{a(a+b+c)}$

D. (D) $\frac{c}{(a+b+c)}.P$

Answer: B::C

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21. At 1000 K , a sample of pure NO_2 gases decomposes as :

$2NO_2(g) \Leftrightarrow 2NO(g) + O_2(g)$

The equilibrium constant K_P is 156.25 atm .Analysis showns that the partial pressure of O_2 is 0.25 atm at equilibrium .The parital pressure o f NO_2 at equilibrium is :

A. (A) 0.03

B. (B) 0.25

C. (C) 0.025

D. (D) 0.04

Answer: C

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22. 10 lt. box contain O_3 and O_2 at equilibrium at 2000 K.The $\Delta G^* = -534.52 kJ$ at 8 atm equilibrium pressure The following equilibrium is present in the container

$2O_3(g) \Leftrightarrow 3O_2(g)$.The partial pressure of O_3 will be (In 10=2.3, R=8.3 J $\text{mole}^{-1} K^{-1}$):

A. (A) 8×10^{-5}

B. (B) 11.3×10^{-7} atm

C. (C) 9.71×10^{-6} atm

D. (D) 9.71×10^{-2} atm

Answer: B

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23. At $527^{\circ} C$, the reaction given below has $K_c = 4$

$$NH_3(g) \Leftrightarrow \frac{1}{2} N_2(g) + \frac{3}{2} H_2(g)$$

what is the K_p for the reaction ?

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

A. (A) $16 \times (800R)^2$

B. (B) $\left(\frac{(800R)^{-2}}{4}\right)$

C. (C) $4 \times 800R$

D. (D) None of these

Answer: C

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24. The value of K_p fot the reaction $2H_2O(g) + 2Cl_2(g) \Leftrightarrow 4HCl(g) + O_2(g)$ is 0.03 and at $427^\circ C$, when the partial pressure are expressed in atmosphere then the value of K_c for the same reaction is:

A. (A) 5.22×10^{-4}

B. (B) 7.34×10^{-4}

C. (C) 3.2×10^{-3}

D. (D) 5.43×10^{-4}

Answer: A

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25. log $\frac{K_p}{K_c}$+log RT=0 is a relationship for the reaction :

A. (A) $PCI_5 \Leftrightarrow PCI_3 + CI_2$

B. (B) $2SO_2 + O_2 \Leftrightarrow 2SO_3$

C. (C) $H_2 + 1_2 \Leftrightarrow 2HI$

D. (D) $N_2 + 3H_2 \Leftrightarrow 2NH_3$

Answer: B

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26. For the following gases equilibrium, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, K_p is found to be equal to K_c. This is attained when:

A. (A) $0^\circ C$

B. (B) $273K$

C. (C) $1K$

D. (D) $12.19K$

Answer: D

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27. consider the following reversible gaseous reaction (at 298 K):

$(A) N_2O_4 \Leftrightarrow 2NO_2$ (B) $2SO_2 + O_2 \Leftrightarrow 2SO_3$

(C) $2HI \Leftrightarrow H_2 + I_2$ (D) $X + Y \Leftrightarrow 4Z$

Highest and lowest value of $\frac{K_p}{K_c}$ will be shown by the equilibrium

A. (A) d,b

B. (B) a,c

C. (C) a,b

D. (D) b,c

Answer: A

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28. 2 moles each of SO_3, CO, SO_2 and CO_2 is taken in a 1 L vessel. If K_C for $SO_3 + CO \Leftrightarrow SO_2 + CO_2$ is $1/9$ then:

A. (A) total no. of moles at equilibrium are less than 8

B. (B) $n(SO_3) + n(CO_2) = 4$

C. (C) $[n(SO_2)/n(CO)] < 1$

D. (D) both (B) and (C).

Answer: D

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29. In a reaction mixture containing H_2, N_2 and NH_3 at partial pressure of 2 atm, 1 atm and 3 atm respectively, the value of K_p at $725K$ is $4.28 \times 10^{-5} atm^{-2}$. In which direction the net reaction will go ?

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

A. (A) Forward

B. (B) Backward

C. (C) No net reaction

D. (D) Direction of reaction cannot be predicted

Answer: B

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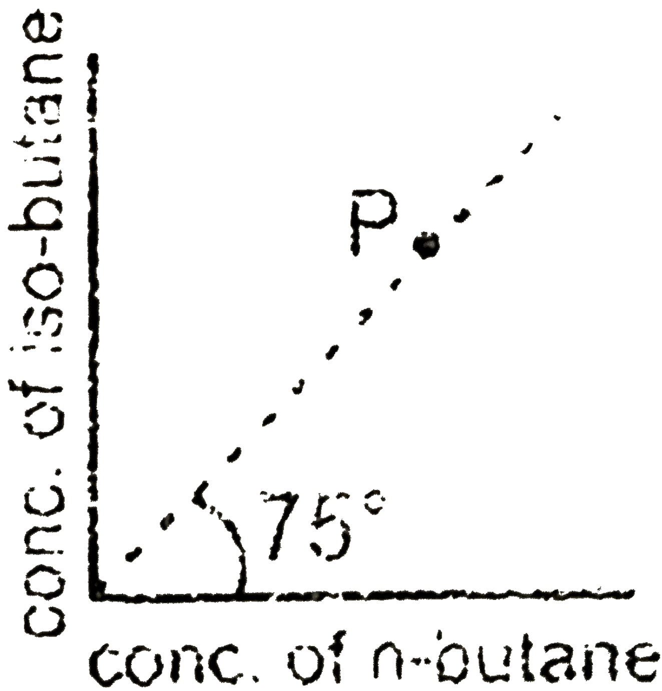
30. For the equilibrium

$CH_3 - CH_2 - CH_2 - CH_3(g) \Leftrightarrow CH_3 - \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3(g)$ equilibrium constant is found to be 1.732 at $298K$. Now if in a vessel at $298K$, a mixture of these two gases be taken as represented by the point P in the figure, predict what will hapen



A. (A) Immediately, above equilibrium will be setup

B. (B) Above reaction will go in the forward direction till it attains equilibrium.

C. (C) Above reaction will go in the backward direction till it attains equilibrium

D. (D) Nothing can be said

Answer: C

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31. The reaction quotient (Q) for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$ The reaction will proceed towards rigt side, if

A. (A) $Q = K_c$

B. (B) $Q < K_c$

C. (C) $Q > K_c$

D. (D) $A = 0$

Answer: C

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32. For the reaction : $2A + B \Leftrightarrow 3C$ at $298K, K_c = 49$

A $3L$ vessel contains 2,1 and 3 molesof A, B and C respectively.

The reaction at the same temperature

A. (A) must proceed in forward direction

B. (B) must proceed in backward direction

C. (C) must be equilibrium

D. (D) can not be predicted

Answer: A

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33. When two reactants A and B are mixed to give products C and D, the reaction quotient Q at the initial stages of the reaction

A. (A) is zero

B. (B) decrease with time

C. (C) is independent of time

D. (D) increases with time

Answer: D

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34. At a certain temperature , the following reactions have the equilibrium constants as shown below:

$S(s) + O_2(g) \Leftrightarrow SO_2(g), K_c = 5 \times 10^{52}$

$2S(s) + 3O_2(g) \Leftrightarrow 2SO_3(g), K_c = 10^{29}$

what is the equilibrium constant $K_c$for the reaction at tahea same temperature?

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

A. 2.5×10^{76}

B. 4×10^{23}

C. 4×10^{-72}

D. None of these

Answer: C

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35. The equilibrium constant of the reaction $SO_2(g) + 1/2O_2(g) \Leftrightarrow SO_3(g)$ is $4 \times 10^{-3} atm^{-1/2}$. The equilibrium constant of the reaction

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

A. $250 atm$

B. $4 \times 10^3 atm$

C. $0.25 \times 10^4 atm$

D. $6.25 \times 10^4 atm$

Answer: D

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36. Equilibrium constant for the reactions,

$2NO + O_2 \Leftrightarrow 2NO_2 \text{is} K_{c1}$,

$NO_2 + SO_2 \Leftrightarrow SO_3 + NO \text{is} L_{C_2}$ and

$2SO_3 \Leftrightarrow 2SO_2 + O_2 \text{is} K_{c3}$ then correct reaction is:

A. $K_{C_3} = K_{C_1} \times K_C(2)$

B. $K_{C_3} \times K_{C_1} \times K_{C_2}^2 = 1$

C. $K_{C_3} \times K_{C_1} \times K_{C_2} = 1$

D. $K_{C_3} \times K_{C_1}^2 \times K_{C_2 = 1}$

Answer: B

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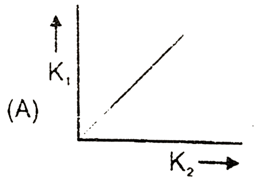
37. For a container contining $A(g), B(g), C(g) \& D(g)$ with rigid walls, an experiment is carried upon. This experiment involves increase in temperature of container in stepsof $1^\circ C$ and system is allowed to attain equilibrium, followed by calculation of $K_1 \& K_2$ at each step, where

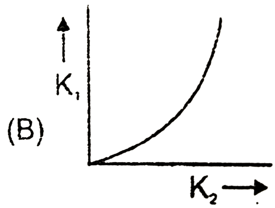
$K_1 \& K_2$ are equilibrium constants for reaction (1) & (2) respectively.

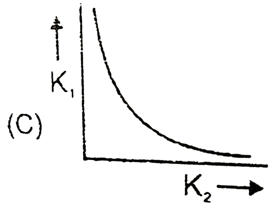
$A(g) + 2B(g) \Leftrightarrow C(g) + D(g)$ ....(1)

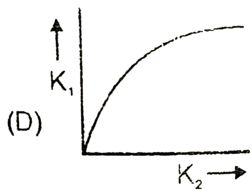
$C(g) + D(g) \Leftrightarrow A(g) + 2B(g)$ .....(2)

Select the graph showing correct relationship-

A. 

B. 

C. 

D. 

Answer: C

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38. The equilibrium constant for $N_2(g) + O_2(g) \Leftrightarrow 2NO \text{is} K_1$ and that for $NO(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ is K_2. $K_1 \text{and} K_2$ will be related as

A. $K_1 = \left(\frac{1}{K_2}\right)^2$

B. $K_1 = K_2^2$

C. $K_2 = \left(\frac{1}{K_1}\right)^2$

D. $K_2 = K_1^2$

Answer: A

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39. When alcohol $(C_2H_5OH(l)) \text{and acetic acid} (CH_3COOH(l))$ are mixed together in equimolar ratio at $27^\circ C, 33\%$ of each is converted into ester. Then the K_c for the equilibrium

$C_2H_5OH(l) + CH_3COOH(l) \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$is:

A. 4

B. $1/4$

C. 9

D. $1/9$

Answer: B

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40. One litre of 2 M acetic acid and one litre of 3 M ethyl alcohol are mixed to form ester according to the given equation: $CH_3COOH + C_2H_5OH \Leftrightarrow CH_3COOC_2H_5 + H_2O$ If each solution is diluted by adding equal volume (1 litre) of water by how many times the initial forward rate has changed?

A. 4 times

B. 2 times

C. 0.5 times

D. 0.25 times

Answer: D

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41. When $\alpha - D$ glucose is dissolved in water, it undergoes a partial converion to $\beta - D$ glucose to exhibit mutarotation. This conversion stops when 63.6% of glucose is in β form. Assuming that equilibrium has been attained, calculate K_c for mutarotation.

A. 1.252

B. 1.747

C. 2.623

D. 1.521

Answer: B

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42. For the dissociation reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the degree of dissociation (α)interms of K_p and total equilibrium pressure P is:

A. $\alpha = \sqrt{\frac{4P + K_P}{K_P}}$

B. $\alpha = \sqrt{\frac{K_P}{4P + K_P}}$

C. $\alpha = \sqrt{\frac{K_P}{4P}}$

D. None of these

Answer: B

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43. The degree of dissociation of SO_3 is α at equilibrium pressure P_0.

K_P for $2SO_3(g) \Leftrightarrow 2SO_2(g) + O_2(g)$is

A. $\left[\left(P_0\alpha^3\right)/2(1-\alpha)^3\right]$

B. $\left[\left(P_0\alpha^3\right)/(2+\alpha)(1-\alpha)^2\right]$

C. $\left[\left(P_0\alpha^2\right)/2(1-\alpha)^2\right]$

D. None of these

Answer: B

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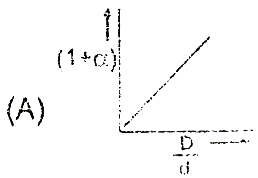
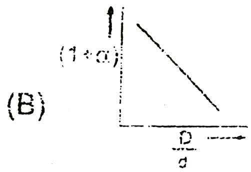
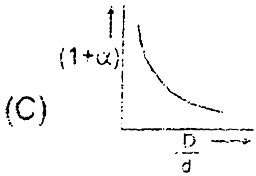
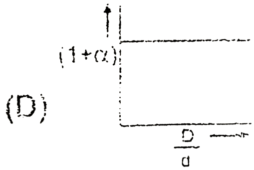
44. In the dissociation of N_2O_4 into NO_2, $(1+\alpha)$ values with the vapour densities ratio $\left(\frac{D}{d}\right)$ is given by: [α degree of dissociation, D-vapour density before dissociation, d-vapour density after dissociation]

A. 

B. 

C. 

D. 

Answer: A

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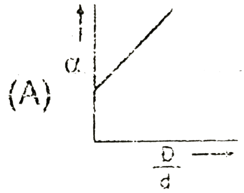
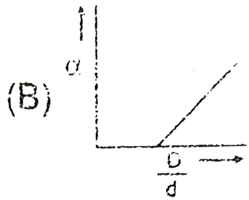
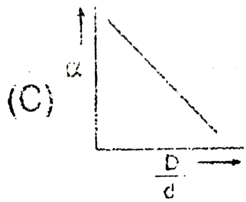
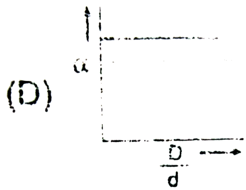
45. $N_2O_4 \rightarrow 2NO_2$

In the above equation, α varies with $\frac{D}{d}$ according to:

A. 

B. 

C. 

D. 

Answer: B

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46. For the reaction $N_2O_4 \Leftrightarrow 2NO_2(g)$, if percentage dissociation of N_2O_4 are 20%, 45%, 65%, 80% then the sequence of observed vapour densities wil be :

A. $d_{20} > d_{45} > d_{65} > d_{80}$

B. $d_{80} > d_{63} > d_{45} > d_{20}$

C. $d_{20} = d_{45} = d_{65} = d_{80}$

D. $d_2 = d_{45} > d_{65} = d_{80}$

Answer: A

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47. At a certain temperature T, a compound $AB_4(g)$ dissociates as

$2AB_4(g) \Leftrightarrow A_2(g) + 4B_2(g)$

with a degree of dissociation α, which compared to unity. The expressio of K_P in terms of α and total pressure P is:

A. $8P^3x^5$

B. $256P^3x^5$

C. $4Px^2$

D. None of these

Answer: A

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48. The degree of dissociation of $PCl_5(g)$ for the equilibrium $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ is approximately releated to the pressure at equilibrium (P) by the relation $[a < \;\; < 1]$

A. $\alpha \propto P$

B. $\alpha \propto \dfrac{1}{\sqrt{P}}$

C. $\alpha \propto \dfrac{1}{P^2}$

D. $\alpha \propto \dfrac{1}{P^4}$

Answer: B

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49. At $727^{\circ} C$ and $1.2 atm$ of total equilibrium pressure, SO_3 is partially dissociated into SO_2 and O_2 as:

$$SO_3(g) \Leftrightarrow SO_2(g) + \frac{1}{2} O_2(g)$$

The density of equilibrium mixture is $0.9 g/L$. The degree of dissociation is:, $[Use R = 0.08 atm L mol^{-1} K^{-1}]$

A. $1/3$

B. $2/3$

C. $1/4$

D. $1/5$

Answer: B

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50. Consider the following hypothetical equilibrium

$2B(g) \Leftrightarrow B_2(g)$

If d is observed vapour density and D is theoretical vapour density, then degree of association (α) will be

A. $\alpha = \left(\frac{D-d}{d}\right)$

B. $\alpha = \frac{2D-d}{D}$

C. $\alpha = 2 - \frac{2D}{d}$

D. $\alpha = \frac{2D}{D-d}$

Answer: C

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51. The vapour density of fully dissociated NH_4Cl would be

A. Slightly less than half of that of ammonium chloride.

B. Half of that of ammonium chloride.

C. Double that of ammonium chloride

D. Determined by the amount of solid ammonium chloride used in the experment.

Answer: B

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52. The degree of dissociation is $0.5 at 800K$ and 2 atm for the gaseous reaction

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

Assuming ideal behaviour of all the gases.

Calculate the density of equilibrium mixture at $800K \text{and} 2$ atm.

A. $4.232g/L$

B. $6.4g/L$

C. $8.4g/L$

D. $2.2g/L$

Answer: A

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53. $SO_3(g) \Leftrightarrow SO_2(g) + \frac{1}{2}O_2(g)$

If observed vapour density of mixture at equilibrium is 35 then find out value of α

A. 0.28

B. 0.38

C. 0.48

D. 0.58

Answer: A

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54. What is the minimum mass of $CaCO_3(s)$, below which it decomposes completely, required to establish equilibrium in a 6.50 litre container for the reaction : $[K^\circ = 0.05$ mole/litre]

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

A. $32.5g$

B. $24.6g$

C. $40.9g$

D. $8.0g$

Answer: A

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55. If 50% of CO_2 converts to CO at the following equilibrium:

$$\frac{1}{2}C(s) + \frac{1}{2}CO_2(g) \Leftrightarrow CO(g)$$

and the equilibrium pressure is 12 atm. Calculate K_P.

A. $12 atm$

B. $16 atm$

C. $20 atm$

D. $24 atm$

Answer: B

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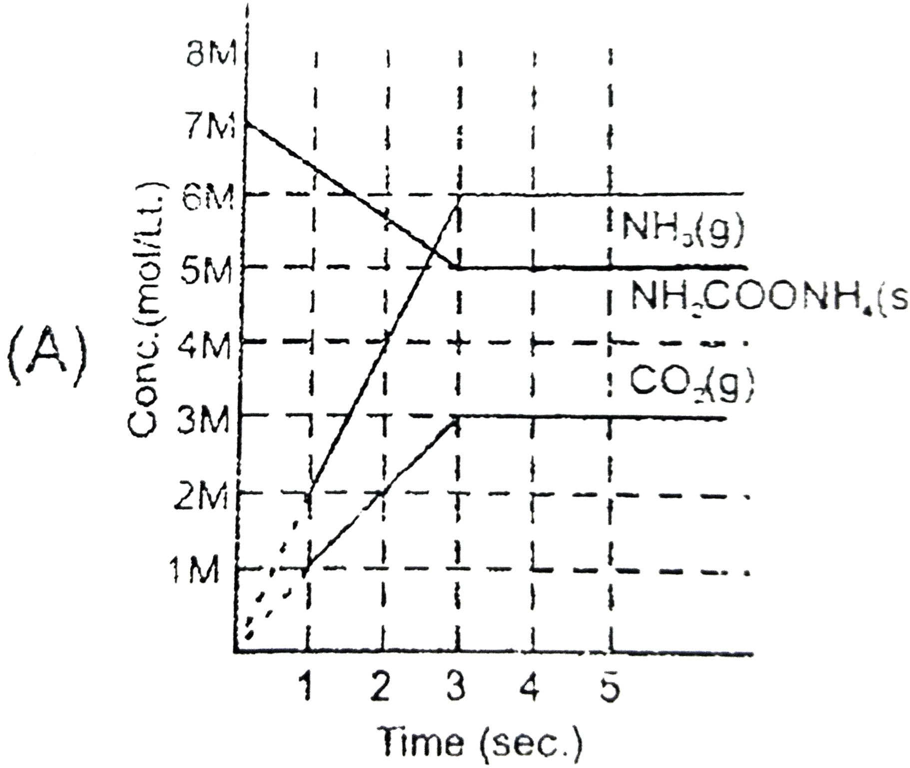
56. Solid ammonium carbamate dissociate to give ammonia and carbon dioxide as follows

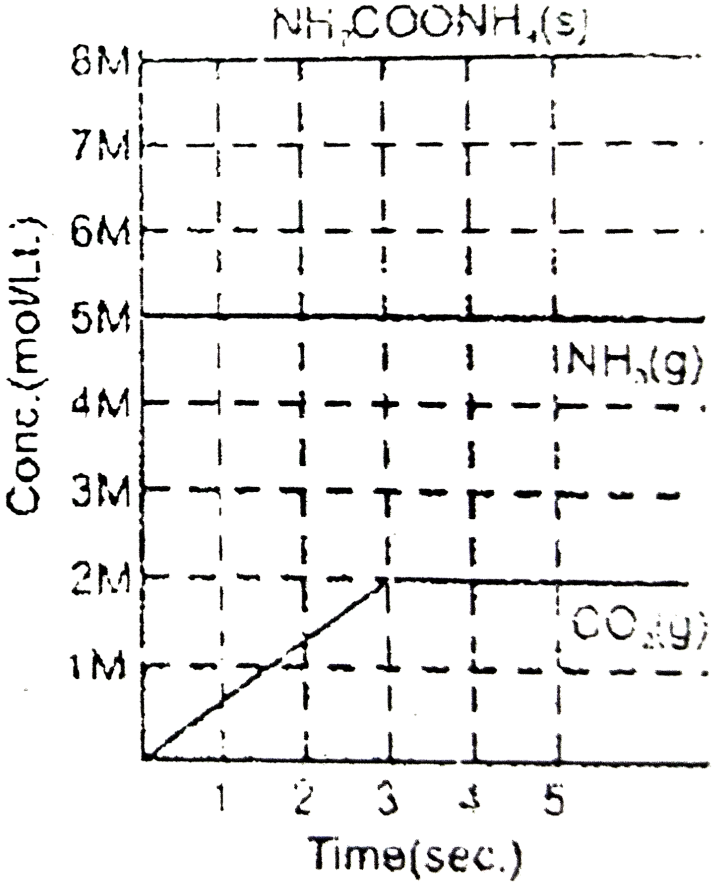
$NH_2COONH_4(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$

which of the following graph correctly represents the equilibrium.


(A)
Conc.(mol/Lt.)
8M
7M
6M
5M
4M
3M
2M
1M
1
2
3
4
5
Time (sec.)
$NH_3(g)$
NH_2COONH_4(s
$CO_2(g)$

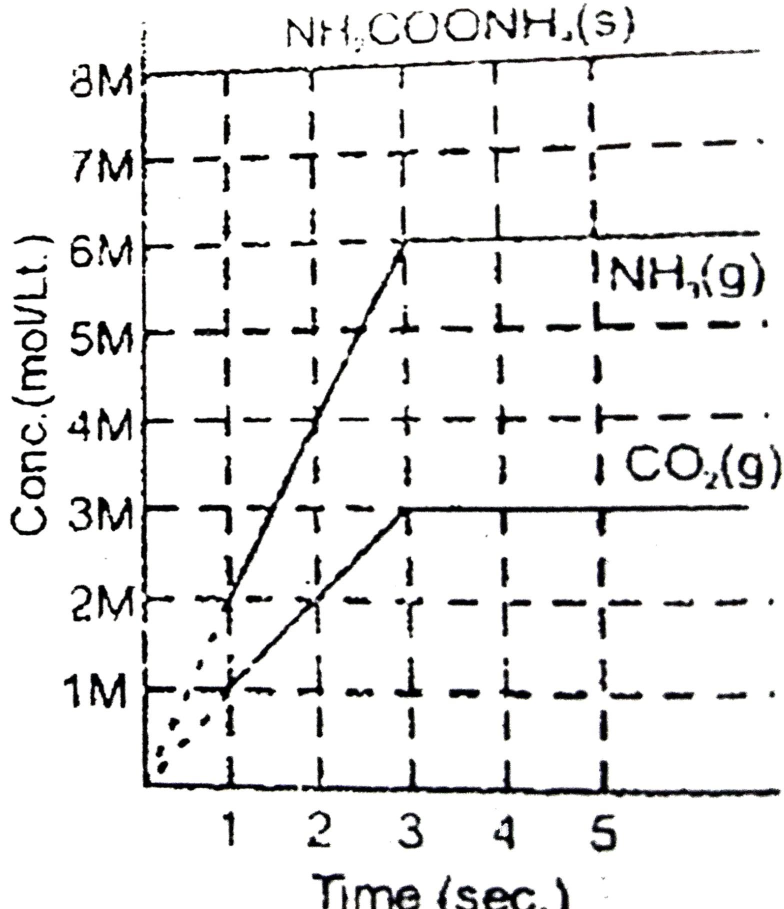
A.

(B)


NH2COONH4(s)
8M
7M
6M
5M
4M
3M
2M
1M
Conc.(mol/L)
NH3(g)
CO2(g)
1
2
3
4
5
Time(sec.)

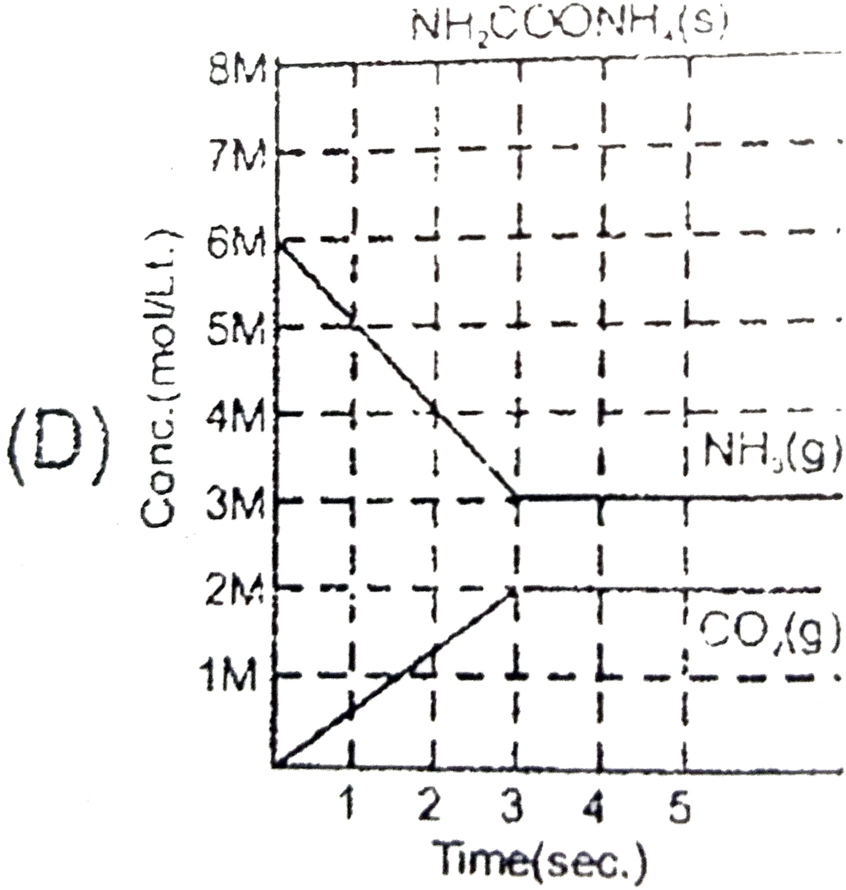
B.

(C)



$NH_2COONH_4(s)$
8M
7M
6M
5M
4M
3M
2M
1M
Conc.(mol/Lt.)
$NH_3(g)$
$CO_2(g)$
1
2
3
4
5
Time (sec.)

c.



D.

Answer: C

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57. For $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ reaction started only with $NH_4HS(s)$, the observed pressure for reaction mixture in equilibrium is

1.2 atm at $106^\circ C$. What is the value of K_p for the reaction?

A. $1.44 atm^2$

B. $0.36 atm^2$

C. $0.16 atm^2$

D. $3.6 atm^2$

Answer: B

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58. Consider the decomposition of solid NH_4HS in a flask containing $NH_3(g)$ at a pressure of 2 atm. What will be the partial pressure of $NH_3(g) \text{and} H_2S(g)$ after the equilibrium has been attained?

K_p for the reaction is 3.

A. $P_{NH_3} = 4 \text{atm}, P_{H_2}s = 2$ atm

B. $P_{MH_3} = 1.732 \text{atm}, P_{h_2}s = 1.732$ atm

C. $P_{NH_3} = 3 \text{atm}, P_{H_2}s = 1$ atm

D. $P_{NH_3} = 1 \text{atm}, P_{H_2}s = 1$ atm

Answer: C

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59. What is the relative humidity of air at 1 bar pressure and $313K$ temperature if partial pressure of water is 19.355 mmHg. For any data use the table given below:

(in mmHg)	V.P. of H_2O	25.2	31.8	42.2	55.3	71.9	92.5
(in K)	Temp.	298	303	308	313	318	323

A. $35\ \%$

B. $25\ \%$

C. $75\ \%$

D. $5\ \%$

Answer: A

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60. For the equilibrium

$CuSO_4 \times 5H_2O(s) \Leftrightarrow CuSO_4 \times 3H_2O(s) + 2H_2O(g)$

$K_p = 2.25 \times 10^{-4} atm^2$ and vapour pressure of water is 22.8 torr at 298 K. $CuSO_4 \ . \ 5H_2O(s)$ is efflorescent (i.e., losses water) when relative humidity is :

A. less than $33.3\ \%$

B. less than $50\ \%$

C. less than $66.6\ \%$

D. above $66.6\ \%$

Answer: B

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61. (a)

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 2H_2O(g) K_p = 4 \times 10^{-4} atm^2$

(b)

$Na_2SO_4.10H_2O(s) \Leftrightarrow Na_2SO_4.5H_2O(s) + 5H_2O(g) K_p = 2.43 \times 10^{-8} atm$

(c)

$Na_2S_2O_3.5H_2O(s) \Leftrightarrow Na_2S_2O_3.2H_2O(s) + 3H_2O(g) K_p = 6.4 \times 10^{-5} atm$

What is order of vapour pressure and relative humidity respectively.

A. $c > b > a$ V.P.

$c < b < a R. H.$

B. $c < b < a$ V.P.

$c > b > a R. H.$

C. $a > c > b$ V.P.

$a > c > b R. H.$

D. $a > c > b$ V.P.

$a < c < b R. H.$

Answer: A

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62. For the equilibrium

$CuSO_2.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 2H_2O(g)$

$K_p = 2.25 \times 10^{-4} atm^2$ and vapour pressure of water is

$22.8 \text{Torr at} 298K$.

$CuSO_4.5H_2O(s)$ is efforescent (i.e., loses water) when relative humidity is:

A. 74.46%`

B. $78.46\ \%$

C. $67.85\ \%$

D. $67.85\ \%$

Answer: C

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63.

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.\ 3H_2O(s) + 2H_2O(g), K_p = 4 \times 10^{-4} atm^2$

If the vapour pressure of water is 38 toor then percentage of relatative humidity is :(Assume all data at constant temperture)

A. $> 15.2 mm$

B. $> 15.2 mm$

C. $\leq 15.2 mm$

D. $= 15.2 mm$

Answer: B

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64. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant, K_c is

A. $-\Delta G^{\circ} = RT \text{in} K$

B. $\Delta G = RT \text{In} K$

C. $-\Delta G = RT \text{In} K$

D. $\Delta G^{\circ} = RT\text{In}K$

Answer: A

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65. For the reaction, $H_2(g) + I_2(g) \Leftrightarrow 2HI(g), K_c^{\circ} = 66.9$ at $350^{\circ}C$ and $K_c^{\circ} = 50.0$ at $448^{\circ}C$. The reaction has

A. $\Delta H = +\text{ve}$

B. $\Delta H = -\text{ve}$

C. $\Delta H = \text{zero}$

D. $\Delta H \text{sign can not be determined}$

Answer: B

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66. The equilibrium constants for the reaction $Br_2 \Leftrightarrow 2Br$ at 500 K and 700 K are 1×10^{-10} and 1×10^{-5} respectively. The reaction is:

A. Endothermic

B. Exothermic

C. Fast

D. Slow

Answer: A

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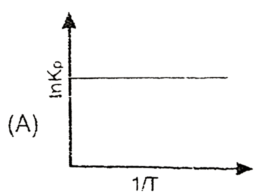
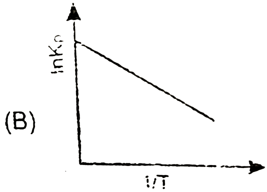
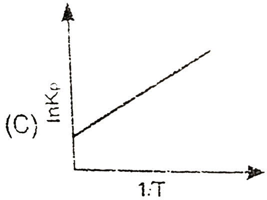
67. An exothermic reaction is represented by the graph :

A. 

B. 

C. 

D. None of these

Answer: C

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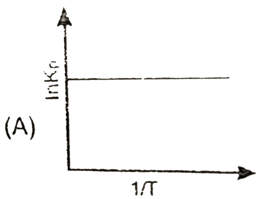
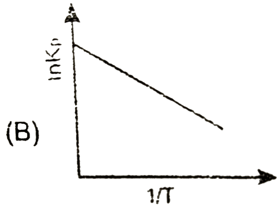
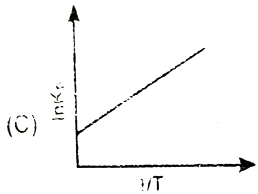
68. An endothermic reaction is represented by the graph:

A. 

B. 

C. 

D. None of these

Answer: B

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69. The value of ΔG° for a reaction in aqueous phase having $K_c = 1$, would be :

A. -1

B. 0

C. $= +RT$

D.

Answer: C

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70. The effect of temperature on equilibrium constant is expressed as $(T_2 > T_1)$

$\log K_2 / K_1 = \frac{-\Delta H}{2.303}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$. For endothermic, false statement is

A. $\left[\frac{1}{T_2} - \frac{1}{T_1}\right] = \text{positive}$

B. $\Delta H = \text{positive}$

C. $\log K_2 > \log K_1$

D. $K_2 > K_1$

Answer: A

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71. For the reaction

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

at a given temperature, the equilibrium amount of $CO_2(g)$ can be increased by

A. adding a suitable catalyst

B. adding an inert gas

C. decreasing the volume of container

D. increasing the amount of $CO(g)$

Answer: D

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72. Given the following reaction at equilibrium $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$. Some inert gas at constant pressure is added to the system. Predict the following facts:

A. More $NH_3(g)$ is produced

B. Less $NH_3(g)$ is produced

C. No affect on the equilibrium

D. K_p of the reaction is decreased

Answer: B

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73. The equilibrium $SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$ is attained at $25^\circ C$ in a closed container and an inert gas, helium, is introduced. Which of the following statement is / are correct?

A. Concentrations of $SO_2, CI_2 \text{and} SO_2CI_2$ are changed

B. NO effect on equilibrium

C. Concentraions of SO_2 is reduced

D. K_p of reaction is increasing

Answer: B

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74. Densities of diamond and graphite are $\frac{3.5g}{mL}$ and $\frac{2.3g}{mL}$.

C (diamond) equilibrium C (graphite)

$\Delta_7 H = -1.9\frac{kJ}{\text{mole}}$

Favourable conditions for formation of diamond are:

A. high pressure and low temperature

B. low pressure and high temperature

C. high pressure and high temperature

D. low pressure and low temperature

Answer: C

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75. Introduction of inert gas (at the same temperature) will affect the equilibrium if :

A. volume is constant and $\Delta n_g \neq 0$

B. pressure is constant and $\Delta n_g \neq 0$

C. volume is constant and $\Delta n_g = 0$

D. pressure is constant and `Deltan_(g)=0

Answer: B

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76. The equilibrium $SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$ is attained at $25^\circ C$ in a closed container and an inert gas, helium, is introduced. Which of the following statement is / are correct?

A. I,II,III

B. II,III,IV

C. III,IV

D. None

Answer: D

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77. An equilibrium mixture in a vessel of capacity 100 litre contain $1 \mathrm{mol} N_2 . 2 \mathrm{mol} O_2 \mathrm{and} 3 \mathrm{mol} NO$. Number of moles of O_2 to be added so that at new equilibrium the conc. Of NO is found to be 0.04 mol//lt.

A. $(101/18)$

B. $(101/9)$

C. $(202/9)$

D. None of these

Answer: A

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78. For an equilibrium $H_2O(s) \Leftrightarrow H_2O(l)$, which of the following statements is ture ?

A. The pressure changes do not affect the equilibrium

B. More of ice melts if pressure on the system is increased

C. More of liquid freezes if pressure on the system is increased

D. The degree of advancement of the reaction do not depend on pressure.

Answer: B

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79. A reaction in equilibrium is respresnt by the following equation $2A_{(s)} + 3B_{(g)} \Leftrightarrow 3C_{(g)} + D_{(g)} + O_{2(g)}$ if the pressure on the system is reduced to half of its original value

A. The amount of C "and D decreases

B. The amounts of C "and" D increases

C. Decreasing the volume of the container

D. Increasing remain constant

Answer: B

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80. For the reaction

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

at a given temperature, the equilibrium amount of $CO_2(g)$ can be increased by

A. Adding a suitable catalyst

B. Adding an inert gas

C. Decreasing the volume of the container

D. Increasing the amount $CO(g)$

Answer: C

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81. The two equilibrium $AB \Leftrightarrow A^{+} + B^{-}$ and $AB + B^{-} \Leftrightarrow AB_2^{-}$ are simultaneously maintained in a solutio with equilibrium constant K_1 and K_2 respectively. The ratio of $[A^{+}]$ to $[AB_2^{-}]$ in the solution is

A. directly proportional to the concentration of $B'(aq.)$.

B. inversely proportional to the concentration of $B'(aq.)$.

C. directly proportional to the square of the concentration of $B'(aq.)$.

D. inversely proportional to the square of the concentration of $B'(aq.)$.

Answer: D

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82. In the preceeding problem, if $\left[A^{+}\right]$ and $\left[AB_2^{-}\right]$ are y and x respectively, under equilibrium produced by adding the substance AB to the solvents, then $\frac{K_1}{K_2}$ is equal to

A. $\frac{y}{x}(y-x)^2$

B. $\frac{y^2(x+y)}{x}$

C. $\frac{y^2(x+y)}{x}$

D. $\frac{y}{x}(x-y)$

Answer: A

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83. The following two reactions:

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

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

are simultaneously in equilibrium in a container at constant volume. A few moles of $CO(g)$ are later introduced into the vessel. After some time, the new equilibrium concentration of

A. PCI_5 will remain unchanged

B. CI_2 will be greater

C. PCI_5 will become less

D. PCI_5 will become greater

Answer: C

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84. $C(s) + CO_2(g) \Leftrightarrow 2CO(g) K_p = 1atm$

$CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(s) K_p = 4 \times 10^{-2}$

Solid

$C, CaO \text{and} CaCO_3 \text{are mixed and allowed to attain equilibrium. Calculate}$

.

A. 0.4atm

B. 0.2 atm

C. 8 atm

D. 0.01 atm

Answer: B

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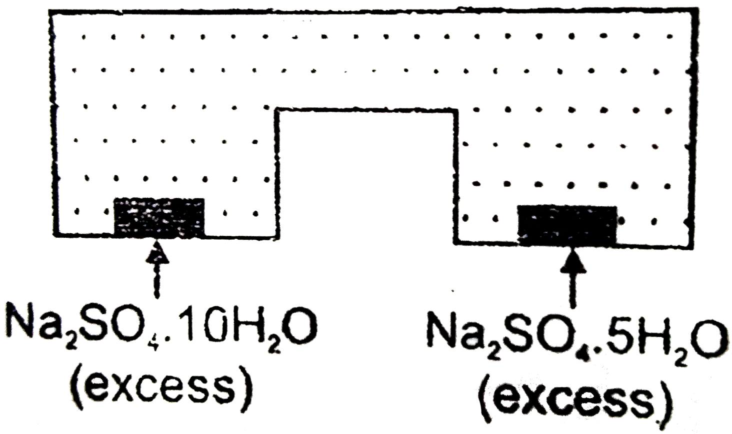

85.

$Na_2SO_4.10H_2O(s) \Leftrightarrow Na_2SO_4.5H_2O(g) K_P = 2.43 \times 10^{-8}$ atm^(5)

incorrect statement is-

A. $CaCI_2(s)$ acts as drying agent under given condition.

B. $CaCI_2(s)$ acts as hydroscopic substance given condition.

C. $CaCI_26H_2O(s)$ acts as efflorescent substance.

D. Mass of $CaCI_2.6H_2O(s)$ increases dueto some reaction.

Answer: C

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86. $A(s) \Leftrightarrow B(g) + C(g) K_{p_1} = 36 atm^2$

$E(s) \Leftrightarrow B(g) + D(g) K_{p_2} = 64 atm^2$

Both solids $A \& E$ were taken in a container of constant volume at a give temperature. Total pressure in the container after equilibrium is

A. 6 atm

B. 5 atn

C. 10 atm

D. 20 atm

Answer: D

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87. In a closed container following equilibrium will be attained-

$A(s) + B(g) \Leftrightarrow AB(g)$

$B(g) + C(g) \Leftrightarrow BC(g)$

On adding He gas (inert) to the above system at constant pressure & temperature

A. Amount of $AB(g)$ will be increased surely

B. Amount of $B(g)$ will be decreased surely

C. Amount of $C(g)$ will be decreased surely.

D. Amount of $BC(g)$ will be decreased surely.

Answer: D

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Exercise-2 (Part-1)

1. The equilibrium constant (K_p) for the reaction $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ is 1.6. If the volume of the container is reduced to one half its original volume, the value of K_p for the reaction at the same temperature will be

A. `32

B. 64

C. 16

D. 4

Answer: C

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2. If K_1, K_2, K_3 are equilibrium constant for formation of AD, AD_2, AD_3 respectively as follows

$A + D \Leftrightarrow D, AD + D \Leftrightarrow AD_2, AD_2 + D \Leftrightarrow AD_3$. Then equilibrium constant $'K'$ for $A + 3D \Leftrightarrow AD_3$ is related as

A. $K_1 + K_2 + K_3 = K$

B. $\log K_1 + \log K_2 + \log K_3 = \log K$

C. $K_1 + K_2 = K_3 + K$

D. $\log K_1 + \log K_2 = \log K_3 + \log K$

Answer: B

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3. In the reaction, $N_2 + O_2 \Leftrightarrow 2NO$, the moles//litre of $N_2, O_2 \text{and} NO$ respectively $0.25, 0.05 \text{and} 1.0$ equilibrium, the initial concentration of $N_2 \text{and} O_2$ will respectively be:

A. $0.75 \text{mol}//\text{litre}, 0.55 \text{mole}//\text{litre}$

B. $0.50 \text{mole}//\text{litre}. 0.75 \text{mole}//\text{litre}$

C. $0.25 \text{mole}//\text{litre}, 0.50 \text{mole}//\text{litre}$

D. $0.25\text{mole}//\text{litre}, 1.0\text{mole}//\text{litre}$

Answer: B

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4. The reaction, $PCI_5 \Leftrightarrow PCI_3 + CI_2$ is started in a five litre container by taking one mole of PCI_5. If 0.3 mol PCI_5 is there at equilibrium, concentration of $PCI_3 \text{and} K_c$ will respectively be:

A. $0.14, \dfrac{49}{150}$

B. $0.12, \dfrac{23}{100}$

C. $0.07, \dfrac{23}{100}$

D. $20, \dfrac{49}{150}$

Answer: A

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5. a' moles of PCI_5, undergoes, thermal dissociation as: $PCI(5) \Leftrightarrow PCI_3 + CI_2$, the mole of PCI_3 equilibrium is 0.25 and the total pressure is 2.0 atmosphere. The partial pressure of CI_2 at equilibrium is:

A. 2.5

B. 1.0

C. 0.5

D. None

Answer: C

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6. For the following gases equilibrium, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, K_p is found to be equal to K_c. This is attained when:

A. $80^\circ C$

B. $273K$

C. $10.5K$

D. $12.19K$

Answer: D

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7. Sulphide ions in alkaline solution react with solid sulphur to form polyvalent sulphide ions. The equilibrium constant for the formation of S_2^{2-} and S_3^{2-} from S and S^{2-} ions is 1.7 and 5.3 respectively. Calculate equilibrium constant for the formation of S_3^{2-} from S_2^{2-} and S.

A. 11

B. 12

C. 132

D. None of these

Answer: A

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8. For which of the reaction, the ratio $\frac{K_P}{K_C}$ is maximum and minimum respectively.

(a) $X(g) \Leftrightarrow 2Y(g)$ (b) $2X(g) \Leftrightarrow Y(g)$

(c) $X(g) \Leftrightarrow 2Y(g) + Z(g)$ (d) $X(s) \Leftrightarrow Y(g)$

A. c,b

B. a,b

C. c,d

D. a,c

Answer: A

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9. If for

$2A_2B(g) \Leftrightarrow 2A_2(g) + B_2(g), K_P = \text{TOTAL PRESSURE(at equilibrium)}$

and starting the dissociation from" 4 "mol of" A_(2)B` then:

A. degree of dissociation of $A_2B \text{will be} (2/3)$

B. total no. of moles at equilibrium will be $(14/3)$.

C. at equilibrium the no. of moles of A_2B are no equal to the no. of moles of B_2

D. at equilibrium the no. of moles of A_2B are equal to the no. of moles of A_2

Answer: A

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10. Ammonia gas at 15 atm is introduced in a rigid vessel at 300 K. At equilibrium the total pressure of the vessel is found to be 40.11 atm at $300^{\circ} C$.The degree of dissociation of NH_3 will be :

A. 0.6

B. 0.4

C. Unpredictable

D. None of these

Answer: B

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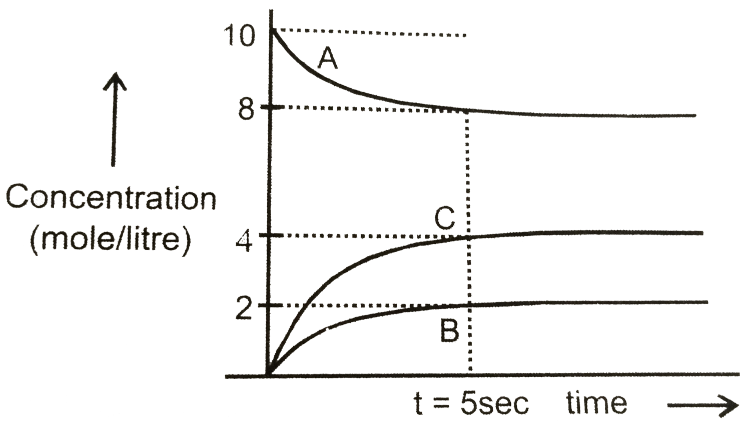
11. Attainment of the equilibrium $A(g) \Leftrightarrow 2C(g) + B(g)$gave the following graph . Find the correct option .

$(\% dissociation = Fractiondissoiatedxx100)$



A. At

$= 5 \text{sec equilibrium has been reached and} K_P = 128(\text{mol}//\text{litre})^2$

B. At

$t = 5 \text{sec equilibrium has been reached and } \% \text{ dissociation of} A \text{is} 60 \%$

C. At

$t = 5 \text{sec equilibrium has been reached and } \% \text{ dissociation of} A \text{is} 40 \%$

D. None of these

Answer: C

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12.

$A 10 L \text{container at} 300 K \text{contains} CO_2 \text{gas at pressure of} 0.2 atm$ and $excesss$

CaO ("neglect the volume of solid" CaO)

$. The volume of conta \in eris now decreased by mov \in g the movab \leq \pi s \to n$

CO_(2)$aa \in sits \max i\mu mvaluegivent$^CaCO_(3)(s)hArrCaO(s)+CO_(2)(g)

K_(P)=0.800 "atm"`

A. $5L$

B. `2.5L

C. $1L$

D. The information is insufficient.

Answer: B

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13. Two solid $A \text{and} B$ are present in two different container having same volume and same temperature following equilibrium are established:

In container $(1) A(s) \Leftrightarrow D(g) + C(g) P_T = 40 \text{atm at equilibrium}$

In container $(2) B(s) \Leftrightarrow E(g) + F(g) P_T = 60 \text{atm at equilibrium}$

If excess of $A \text{and} B$ are added to a third container having double the volume and at same temperature then, the total pressure of this container at equilibrium is:

A. 50 atm

B. 100 atm`

C. 200 atm

D. 70 atm

Answer: B

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14. To the system,

$LaCl_3(s) + H_2O(g) \Leftrightarrow LaClO(s) + 2HCL(g) - \text{Heat}$ already at equilibrium, more water vapour is added without altering temperature or volume of the system. When equilibrium is re-established, the pressure of water vapour is doubled. The pressure of HCl present in the system increases by a factor of

A. 2

B. $\sqrt{2}$

C. $\sqrt{3}$

D. $\sqrt{5}$

Answer: B

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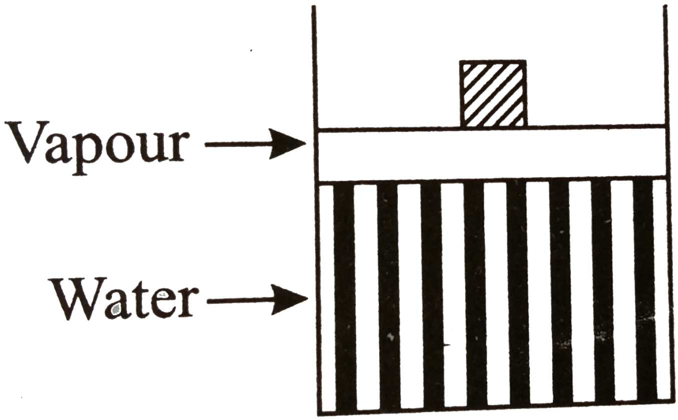
15. Some quantity of water is contained in a container as shown in figure. As neon is added to this system at constant pressure, the amount of liquid water in the vessel



A. Increases

B. decreases

C. remains same

D. changes unpredictably

Answer: B

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16. The equilibrium constant for, $2H_2S(g) \Leftrightarrow 2H_2(g) + S_2(g) \text{is} 0.0118 \text{at} 1300K$ while the heat of dissociation is $597.4KJ$. The standard equilibrium constant of the reaction at $1200K$ is:

A. 1.180×10^{-4}

B. 11.80

C. 118.0

D. cannot be calculated from given data

Answer: A

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17. For reaction, assuming large volume of water.

$H_2O(l) \Leftrightarrow H_2O(g)$, at temp. TK

Choose correct options:

A. On introduction of an inert gas at constant temperature pressure in the container remins same at equilibrium.

B. For this system $\%$ relative humidity always remains 100% at constant temperature at equilibrium

C. If steam at temperature $2T$ is passed into given system. After equilibrium is attained relative humidity changes.

D. This is a special case of equilibrium where pressure of $H_2O(g)$ remains same always due to unique structural feature of H_2O.

Answer: B

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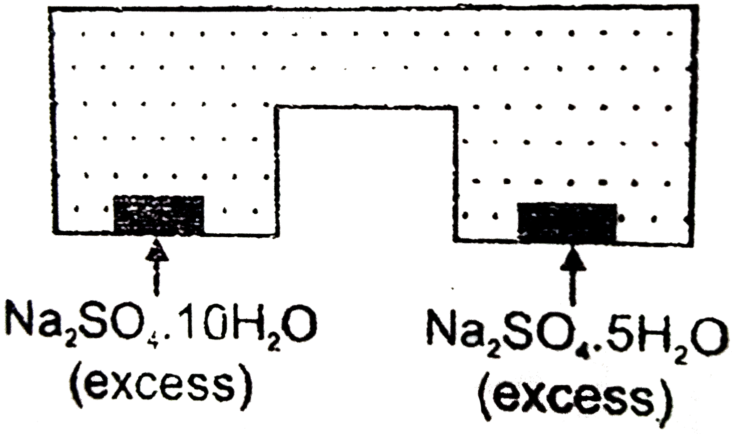
18.



$Na_2SO_4.10H_2O(s) \Leftrightarrow Na_2SO_4.5H_2O(g) K_P = 2.43 \times 10^{-8}$ atm^(5)

incorrect statement is-

A. If partial pressure of H_2O in container is 3.5×10^{-2} atm amount of $Na_2SO_4.5H_2O$ decreases.

B. If $P_{H_2}O = 2.5 \times 10^{-2}$ atm then amount of $Na_2SO_4.5H_2O$ should increases.

C. If $P_{H_2}O = 3 \times 10^{-2}$ atm then both side does not get altered.

D. If $Na_2SO_4.5H_2O$ is completely removed then partial pressure of H_2O increases at equilibrium.

Answer: D

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19. For equilibrium

$ZnSO_4.7H_2O(s) \Leftrightarrow ZnSO_4.2H_2O(s) + 5H_2O(g)K_P = 56.25 \times 10^{-10} atm$

and vapour pressure of water is 22.8 torr at $298K$. $ZnSO_4.7H_2O(s)$ is efflorescent (lose water) when relative humidity is $\left[5\sqrt{56.25} = 2.23\right]$

A. less than $70.620\ \%$

B. less then $74.60\ \%$

C. Above than $74.60\ \%$

D. Above 70.60%`

Answer: B

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20. In the Haber process for the industrial manufacturing of ammonia involving the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at 200 atm pressure in the presence of a catalyst, a temperature of about $500^\circ C$ is used. This considered as optimum temperature for the process because :

A. yield is maximum at this temperature

B. catalyst is active only at this temperature

C. energy needed for the reaction is easily obtained at this temperature

D. rate of the catalytic reaction is fast enough while the yield is also appreciable for this exothermic reaction at this temperature.

Answer: D

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21. Addition of water to which of the following equilibria causes it to shift in the backward direction?

A. $CH_3NH_2(aq) + H_2O(l) \Leftrightarrow CH_3NH_3(aq) + OH^-(aq)$

B. $CH_4 + O_2(g) \Leftrightarrow CO_2 + H_2O$

C. $HCN(aq) + H_2O(l) \Leftrightarrow H_3O^+(aq) + CN^-(aq)$

D.

$$\left[Cr(dien)_2\right]^{3+}(aq) + 3H_2O(l) + 3CI^-(aq) \Leftrightarrow \left[Cr(H_2O)_3CI_3\right](aq)$$

Answer: B

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22. Consider the reactions

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

$(ii) N_2O_4(g) \Leftrightarrow 2NO_2(g)$

The addition of an inert gas at constant volume

A. will increase the dissociation of PCl_5 as well as N_2O_4

B. will reduce the dissociation of PCl_5 aswell as N_2O_4

C. will increase the dissociation of PCl_5 and step up the formation of NO_2

D. will not disturb the equilibrium of the reactions

Answer: D

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23. Solid $A \text{and} B$ are taken in a closed container at a certain temperature. These two solids decompose are following equilibria are established simultaneously

$A(s) \Leftrightarrow X(g) + Y(g) K_{P_1 = 250 atm^2}$

$B(s) \Leftrightarrow Y(g) + Z(g) K_{P_2 = ?}$

If the total pressure developed over the solid mixture is $50 atm$. Then the value of K_P for the 2^{nd} reaction

A. 375

B. 625

C. 225

D. 250

Answer: A

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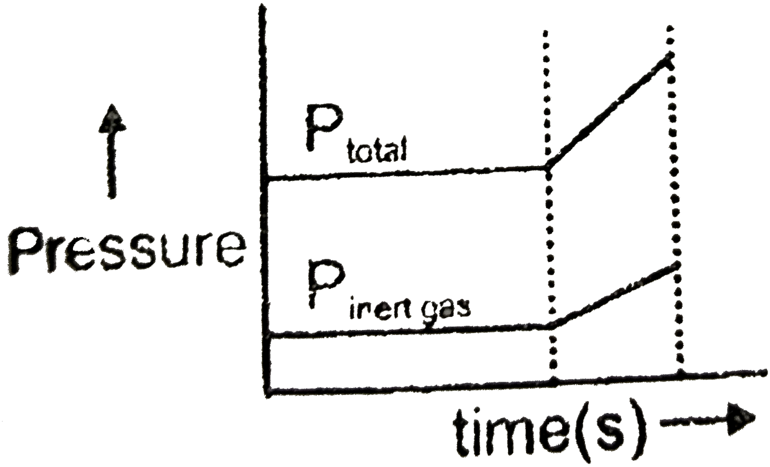
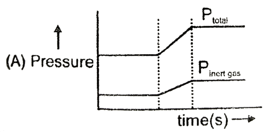
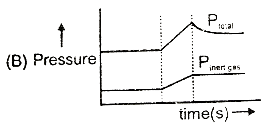
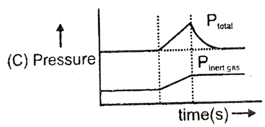
24. For a system at equilibrium some changes are made which is reported by a graph (shown below). Changes has been made at constant temperature.

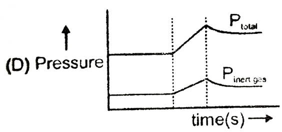


Choose the correct options:

A. 

B. 

C. 

D. 

Answer: B

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25. In one experiment, certain amount of $NH_4I(s)$ was heated rapidly in a closed container at $357^\circ C$. The following equilibrium was established:

$NH_4I(s) \Leftrightarrow NH_3(g) + HI(g)$

but the pressure gradually increases further (when the excess solid residue remains in the vessel) owing to the dissociation of HI. Calculate the final pressure developed at equilibrium. . 2HI(g)rarrH_(2)(g)+I_(2)(g) K_(C)=0.065 at 357 ∘ C.

A. $331 mm \text{of} Hg$

B. $335 mm \text{of} Hg$

C. $369 mm \text{of} Hg$

D. $151 mm \text{of} Hg$

Answer: A

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26. $A(s) \Leftrightarrow B(g) + C(g) K_P = 40 atm^2$

$X(s) \Leftrightarrow B(g) + E(g)$

Above equilibrium is allowed to attain in a closed container and pressure of B was found to be 10 atm. Calculate standard Gibb's free energy change for $X(s) \Leftrightarrow B(g) + E(g) \text{at} 300K$ (take $R = 2 cal / k / mol$)

A. $3.5 Kcal / mol$

B. $3 Kcal / mol$

C. $2.5 Kcal / mol$

D. $2 Kcal / mol$

Answer: C

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27. $X(s) \Leftrightarrow Y(g) + 2Z(g)$

$A(s) \Leftrightarrow Y(g) + B(g)$

Consider both these equilibrium to be established simultaneously in a closed container.

At equilibrium, pressure of $Z \text{and} B$ were found to be same and sum of pressure of $Z \& B$ is $10 atm$ more than that of species Y. Find ratio of standard gibb's energy of two reactions.

A. 20

B. $2.303 \log_{10} 20$

C. $\log_{10} 3\sqrt{144}$

D. $\dfrac{3+\log 12}{2+\log 6}$

Answer: D

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28. 1-butyne and 1, 3-butadiene are :

A. 1.80moles 3.60moles 3.60moles

B. 3.60moles 6.60moles 1.80moles

C. 1.80moles 6.6moles` 3.60moles

D. 3.60moles 1.80moles 6.60moles

Answer: A

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Exercise-2 (Part-2)

1. How many of the following reactions are homogenous equilibrium reactions?

(1) $CH_3COOH(l) + C_2H_5OH(l) \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$

(2) $C(s) + CO_2(g) \Leftrightarrow CO(g) + H_2O(g)$

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

(4) $CO(g) + CI_2(g) \Leftrightarrow COCI_2(g)$

(5) $NH_4HS_{(s)} \Leftrightarrow NH_3(g) + H_2S(g)$

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

(7) $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$

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

(9) $SO_2(g) + NO_2(g) \Leftrightarrow SO_3(g) + NO(g)$

(10) $NO(g) + \frac{1}{2}Br_2(l) \Leftrightarrow 2NOBr(g)$

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2. The equilibrium $SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$ is established in a container of $4L$ at a particular temperature. If the number of moles of $SO_2, O_2 \text{and} SO_3$ at equilibrium are $2, 1 \text{and} 4$ respectively then find the value of equilibrium constant.

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3. $A(G) + B(g) \Leftrightarrow C(g) + D(g)$

Above equilibrium is established by taking A& B in a closed container. Initial concentration of A is twice of the initial concentration of B. At equilibrium concentraons of B and C are equal. Then find the equilibrium constant for the reaction, $C(g) + D(g) \Leftrightarrow A(g) + B(g)$.

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4. In a reversible reaction, the forward reaction was 3 times faster than that of reverse reaction. The reaction quotient is.....

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5. If the equilibrium constant of the reaction

$2HI(g) \Leftrightarrow H_2(g) + I_2(g)$ is 0.25, find the equilibrium constant of the reaction.

$\frac{1}{2}H_2 + \frac{1}{2}I_2 \Leftrightarrow HI(g)$

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6. In an experiment starting with 1 mol $C_2H_5OH, 1$ mol CH_3COOH, and 1 mol of water, the equilibrium mixture mixture of analysis shows that 54.3% of the acid is esterified. Calculate K_c.

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7. For the reaction:

$N_2O_5(g) \rightarrow 2NO_2(g) + 0.5O_2(g)$

Calculate the mole fraction of $N_2O_5(g)$ decomposed at constant volume and temperature, if the initial pressure is $600 mmHg$ and the pressure at any time is $960 mmHg$.

Assume ideal behaviour.

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8. Consider the equilibrium

$Ni(s) + 4CO(g) \Leftrightarrow Ni(CO)_4(g), K_p = 0.125 atm^{-3}$

If equal number of moles of $CO \text{ and } Ni(CO)_4$ (ideal gases) are mixed in a small container fitted with a piston, find the maximum total pressure (in atm) to which this mixture must be brough in order to just precipitate out metallic Ni?

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9. For the equilibrium system

$FeO(s)CO(g) \Leftrightarrow Fe(s) + CO_2(g)$(Exothermic)

How many of the following changes in condition will cause the equilibrium to shift to the right?

(1) Add CO_2 (2) Add FeO (3) Add CO

(4) Add positive catalyst (5) Increase temperature

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10. Consider the reaction, $2CI_2(g) + 2H_2O(g) \Leftrightarrow 4HCI(g) + P_2(g)\Delta H^\circ = +113KJ$

The four gases, CI_2, H_2O, $HCI \text{and} O_2$, are mixed and the reaction is allowed to come to equilibrium. Each operation is to be considered separately. Temperature and volume are constant unless stted otherwise. Report the number of operations in the left column which lead to increase in the equilibrium value of the quantity in the right column.

(a) Increasing the volume of the container Number of moles of H_2O

(b) Adding O_2 Number of moles of H_2O

(c) Adding O_2 Number of moles of HCI

(d) Decreasing the volume of the container Number of moles of CI_2

(e) Decreasing the vollume of the container Partial pressure of CI_2

(f) Decreasing the volume of the container K_(C)

$(g) Rai \sin gthetemperatureConcentrationofHCI$

(i) Adding He Number of moles of HCI

(j) Adding catalyst Number of moles of HCI

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11. For given simultaneous reaction :

$X(s) \Leftrightarrow A(g) + B(s) + C(g) K_{P_1} = 500$ atm

$Y(s) \Leftrightarrow D(g) + A(g) + E(s) K_{P_2} = 2000$ atm

If total pressure =x , then write your answer after dividing by 25.

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12. If a mixture 0.4 mole H_2 and 0.2 mole Br_2 is heated at 700 K at equilibrium, the value of equilibrium constant is 0.25×10^{10} then find out the ratio of concentrations of (Br_2) and (HBr) (Report your answer as $\frac{Br_2}{HBr} \times 10^{11}$)

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13. 2 mole of PCI_5 were heated in a 5 litre vessel. It dissociated. 80% at equilibrium find out the value of equilibrium constatn. Report your answer as $K_C \times 50$.

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14. $A_2(g)$ and $B_2(g)$ having partial pressures $60mm$ of Hg & $45mm$ of Hg respectively, are present in a closed uessel. At equilibrium, partial pressure of $AB(g)$ is $28mm$ of Hg. If all measurements are made under similar condition, then calculate percentage of dissociation of $AB(g)$.

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15. When C_2H_5OH and CH_3COOH are mixed in equivalent proportion, equilibrium is reached when $2/3$ of acid and alcohol are used. How much ester will be present when $2g$ "mole"cule of acid were to react with $2g$ "mole"cule of alcohol.

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16. In reaction $N_2O_4(g) \rightarrow 2NO_2(g)$, The observed molecular weight 80 gmol^{-1} at 350 K. The percentage dissociation of $N_2O_4(g)$ at 350 K is

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17. The vapour density of N_2O_4 at a certain temperature is 30. Calculate the percentage dissociation of N_2O_4 this temperature.

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18. Solid Ammonium carbamate dissociates as:

$NH_2COONH_4(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$.

In a closed vessel, solid ammonium carbamate is in equilibrium with its dissociation products. At equilibrium, ammonia is added such that the partial pressure of NH_3 at new equilibrium now equals the original total pressure. Calculate the ratio of total pressure at new equilibrium to that of original total pressure.

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19. If 50% of CO_2 converts to CO at the following equilibrium:

$\frac{1}{2}C(s) + \frac{1}{2}CO_2(g) \Leftrightarrow CO(g)$

and the equilibrium pressure is 12 atm. Calculate K_P.

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20. Two solids A and D dissociates into gaseous products as follows

$C(s) \Leftrightarrow B(g) + C(g), K_{P_1} = 300, D(s) \Leftrightarrow E(g) + C(g) K_{P_2 = 600}$

at $27^{\circ} C$, then find the total pressure of the solid mixture.

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21. Consider

(i) $C(s) + O_2 \Leftrightarrow CO_2(g) K_{P_2 = \frac{7}{8}}$

(ii) $2C(s) + O_2 \Leftrightarrow 2CO(g) K_{P_2 = 12.5 atm}$

As $100L$ of air ($80\% N_2$, $20\% O_2$ by volume) is pased over excess heated coke to establish these equilibrium the equilibrium mixture is found to measure $105L$ at constnat temperature & pressure ($105 atm$). Assuming no other reaction, find the sum of partial pressure of $CO \text{and} CO_2$ in the final equilibrium mixture.

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22. Two solid compounds $A \text{and} C$ dissociate into gaseous product at temperature T as follows:

(i) $A(s) \Leftrightarrow B(g) + D(g) K_{P_1} = 25(atm)^2$

(ii) $C(s) \Leftrightarrow E(g) + D(g) K_{P_2} = 975(atm)^2$

Both solid are present in same container then calculate total pressure over the solid mixture.

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Exercise-2 (Part-3)

1. Which of the following is correct about the chemical equilibrium ?

A. $(\Delta G)_{T.P} = 0$

B. Equilibrium constant is independent of initial concentration of reactants

C. Catalyst has no effect on equilibrium state

D. Reaction stops at equilibrium

Answer: A::B::C

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2. For a reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$, the value of K_C does not depends upon:

A. Initial concentration of the reactants

B. pressure

C. Temperature

D. catalyst

Answer: A::B::D

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3. Which of the following statements is/are correct.:

A. At equilibrium, vapour pressure of solution and refractive index of eq. mixture becomes constant.

B. Equilibrium can be attained in both homogenous and heterogenous reaction.

C. Approach to the equilibrium is fast in initial state but gradually it decreases.

D. Equilibrium is dynamic in nature

Answer: A::B::C::D

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4. $64gm$ of CH_4 and $68gm \text{of} H_2S$ was placed in an close container and heated up to $727^\circ C$ following equilibrium is established in gaseous phase reaction is:

$CH_4(g) + 2H_2S(g) \Leftrightarrow CS_2(g) + 4H_2(g)$

The total pressure at equilibrium is 1.6 atm and partial pressure of $H_2 \text{is} 0.8$ atm, then

A. Total moles at equilibrium 4.8

B. $K_P = K_C(RT)^2$

C. Mole fraction H_2 at equilibrium $= 0.5$

D. On increasing moles of H_2S equilibrium constant increases.

Answer: A::B::C::D

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

a. K_c

A. Ratio of concentration of $A \text{and} B$ at new equilibrium is 3/4

B. Value of equilibrium constant for both cases are same

C. Concentration of C at new equilibrium become half

D. Equilibrium concentration of C at new equilibrium $\dfrac{10\sqrt{20}}{\sqrt{20}-\sqrt{15}}$

Answer: A::B::D

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6. Consider the following gases equilibrium given below:

(i) $N_2 + 3H_2 \Leftrightarrow 2NH_3, \text{Eqm.Constant} = K_1$

(ii)$N_2 + O_2 \Leftrightarrow 2NO, Eqm.\ cons\tan t = K_2$

(III) $H_2 + \frac{1}{2}O_2 \Leftrightarrow H_2O, Eqm.\ cons\tan t = K_3$

The equilibrium constant for the reaction , $2NH_3 + \frac{5}{2}O_2 \Leftrightarrow 3H_2O \text{in terms of} K_1, K_2 \text{ and } K_3$ will be :

A. $K_1 = K_2 \times \frac{K_3^3}{K_4}$

B. $K_4 = K_1 \times K_2 / (K_3)^3$

C. $K_2 = \left(K_4 \times \frac{K_1}{(K_3)^3}\right.$

D. $K_4 = \left(K_2 \times \frac{K_3^3}{K_1}\right.$

Answer: A::C::D

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7. (i) $N_2(g) + O_2(g) \Leftrightarrow 2NO(g), K_1$

(ii) $\left(\frac{1}{2}\right)N_2(g) + \left(\frac{1}{2}\right)O_2(g) \Leftrightarrow NO(g), K_2$

(iii) $2NO(g) \Leftrightarrow N_2(g) + O_2(g), K_3$

(iv) $No(g) \Leftrightarrow \left(\frac{1}{2}\right)N_2(g) + \left(\frac{1}{2}\right)O_2(g), K_4$

Correct relation between $K_1, K_2, K_3 \text{and} K_4$ is//are:

A. $K_1 \times K_3 = 1$

B. $\sqrt{K}_1 \times K_4 = 1$

C. $\sqrt{K}_3 \times K_2 = 1$

D. None

Answer: A::B::C

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8. If $\frac{\log(K_C)}{K_P} - \log\left[\frac{1}{RT}\right] = 0$, then above is true for the following equilibrium reaction

A. $NH_2(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$

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

C. $2NO_2(g) \Leftrightarrow N_2O_4(g)$

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

Answer: A::B

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9. The reaction for which $K_P = K_C$ is satisfied

A. $A(g) + 2B(g) \Leftrightarrow 3C(g)$

B. $A(s) \Leftrightarrow B(g)$

C. $2A(g) \Leftrightarrow B(g) + C(g)$

D. $A(s) + B(g) \rightarrow C(s) + 2D(g)$

Answer: A::C

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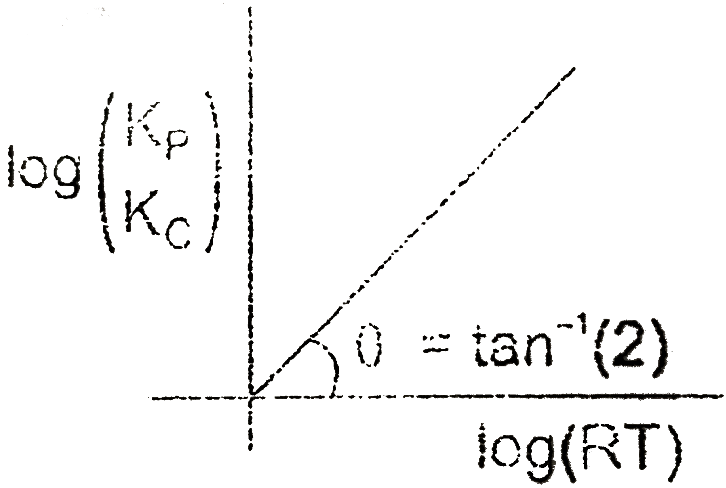
10. At $300K$, the reactions satisfying the following graph is:



A. $A(s) \Leftrightarrow 2B(g)$

B. $2A(g) \Leftrightarrow B(g) + 3C(g)$

C. $A(s) \Leftrightarrow B(g) + C(g)$

D. $2A(g) \Leftrightarrow B(g)$

Answer: A::B::C

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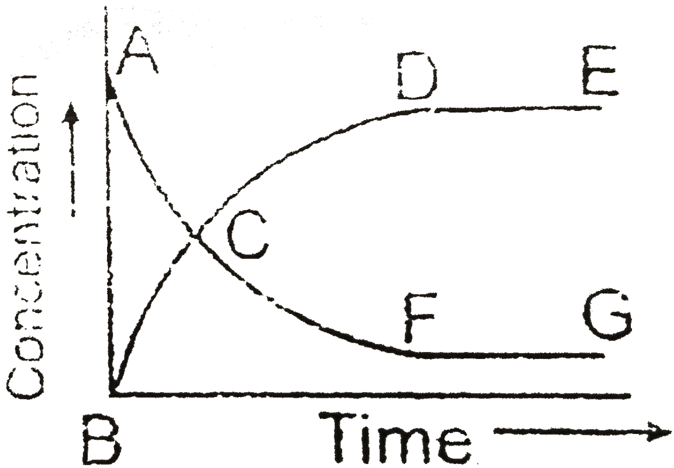
11. $N_2O_4(g) \Leftrightarrow 2NO_2(g), K_C = 4$. This reversible reaction is studied graphically as shown in figure. Select the correct statements.



A. Reaction quotient has maximum value at point A

B. Reaction proceeds left to riht at a point when $[N_2O_4] = [NO_2] = 0.1M$

C. $K_C = Q$ when point D or F is reached:

D. None of these

Answer: B::C

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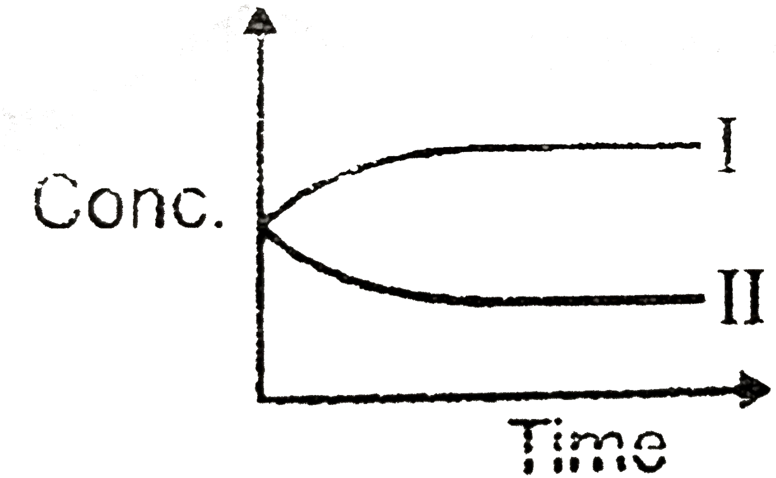
12. $A2$ lit vessel is filled by 1 mole of each gas $A \& B$. If K_C for reaction $A(g) \Leftrightarrow B(g)$ is 1.5 at temp. T. [Atomic mass of A is 40 & $B \text{is} 20$].



A. $[A]$ vs time is graph I

B. $[B]$ vs time is graph I

C. $[A]$ vs time is graph II

D. $[B]$ vs time is grap II

Answer: B::C

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13. The equilibrium constant for some reactions are given below against each of the reaction

(i) $2N_2 + 5O_2 \Leftrightarrow 2N_2O_5, K = 5 \times 10^{-27}$

(ii) $N_2 + O + (2) \Leftrightarrow 2NO, K = 2 \times 10^{-15}$

(iii) N_(2)+2O_(2)hArr2NO_(2) , K=1.5xx10^(-29)`

Which of the following statement is correct

A. The least stable oxide is NO_2

B. The most stable oxide is NO

C. The stability order is $N_2O_5 > NO_2 > NO$

D. The stablity order is $NO_2 > NO > N_2O_5$

Answer: A::B

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14. For the reaction, $SnO_2(s) + 2H_2(g) \Leftrightarrow Sn(l) + 2H_2O(g)$ the equilibrium mixture of steam and hydrogen contained 45% and 24% H_2 at $900K$ and $1100K$ respectively. Calculate K_p at both the temperature.

A. Reaction is endothermic in nature

B. At higher temperature, the efficiency of reduction of tin oxide will increase

C. Reaction is exothermic in nature

D. At lower temperature, the efficiency of reduction of tin oxide decreases.

Answer: A::B

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15. The equation $\alpha = \dfrac{D-d}{(n-1)d}$ is correctly matched for: (α is the degree of dissociation, D and d are the vapour densities before and after dissociation, respectively).

A. $A(g) \Leftrightarrow (n/2)B(g) + 9n/3)0C(g)$

B. $A(g) \Leftrightarrow (n/3)B(g) + (2n/3)C(g)$

C. $A(g) \Leftrightarrow (n/2)B(g) + (n/4)C(g)$

D. $A(g) \Leftrightarrow (n/2)B(g) + C(g)$

Answer: A::C::D

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16. If reaction $A + B \Leftrightarrow C + D$, taken place in 5 liter close vessel, the rate constant of forward reaction is nine times of rate of backward reaction.

If initially one mole of each reactant present in the container, then find the correct option//is.

A. $\frac{[C]}{[B]} = \frac{3}{1}$

B. $\log K_P = \log K_C$

C. $[D]_{eq} = 15 \times 10^{-2} \text{mole} L - 1$

D. $K_{eq} = 9$

Answer: A::B::C::D

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17. Consider equilibrium $H_2O(l) \Leftrightarrow H_2O(g)$. Choose the correct direction of shifting of equilibrium with relative humidity.

A. $R.\ H.\ > 1$,rightward

B. $R.\ H.\ < 1$, rightward

C. $R.\ H.\ > 1$, leftward

D. $R.\ H.\ < 1$, leftward

Answer: B::C

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18. Consider the following equilibrium

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

The vapour density of the equilibrium mixture does not depend upon

A. Temperature

B. Initial concentration

C. Volume of contain

D. Pressure of equilibrium mixture

Answer: A::B::C::D

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19. Vapour density of equilibrium $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$ is decreased by

A. increasing temperature

B. decreasing pressure

C. increasing pressure

D. decreasing temperature

Answer: A::B

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20.

$CuSO_4, 5H_2O(s) \Leftrightarrow CuSO_4(s) + 5H_2O(g) K_P = 10^{-10}$moles of$CuSO_4.5$

is taken in a $2.5L$ container at $27^\circ C$ then at equilibrium [Take: $R = \frac{1}{12}$

litre atm $mol^{-1}K^{-1}$]

A. Moles of $CuSO_4.5H_2O$ left in the container is 9×10^{-3}

B. Moles of $CuSO_4.5H_2O$ left in the container is 9.8×10^{-3}

C. Moles of $CuSO_4$ Left in the container is 10^{-3}

D. Moles of $CuSO_4$ left in the container is 2×10^{-4}

Answer: B::D

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21.

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 2H_2O(s)K_P = 0.4 \times 10^{-3}atm^2$

Which of following sttement are correct:

A. $\Delta G^\circ = -RT\ln P_{H_2o}$ where $P_{H_2o = \text{Partial pressure of} H_2O}$ at equilibrium.

B. At vapour pressure of $H_2O = 15.2$ torr relative humidity of $CuSO_4.5H_2O\text{is}100\%$

C. In presence of aqueous tension of 24 torr, $CuSO_4.5H_2O$ can not loss molisture.

D. In presence of dry atmosphere in open container $CuSO_4.5H_2O$ will completely convert into $CuSO_4.3H_2O$

Answer: B::C::D

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22. 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 equilibrium constant of the exothermic reaction at high temperature decreases.

STATEMENT-2: Since In $\frac{K_2}{K_1} = \frac{\Delta H^\circ}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ and for exothermic reaction ,

ΔH° = -ve and thereby, $\frac{K_2}{K_1} < 1$

A. $K_2 > K_1 \text{if} T_2 > T_1$ for an endothermic change

B. $K_2 < K_1 \text{if} T_2 > T_1$ for an endothermic change

C. $K_2 > K_1 \text{if} T_2 > T_1$ for an endothermic change

D. $K_2 > K_1 \text{if} T_2 > T_1$ for an endothermic change

Answer: A::D

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23. 1 mole each of $H_2(g)\text{and}I_2(g)$ are introduced in a $1L$ evacuated vessel at $523K$ and equilibrium$H_2(g) + I_2(g) \Leftrightarrow 2Hi(g)$ is established. The concentration of $HI(g)$ at equilibrium:

A. Changes on changing pressure.

B. Changes on changing temperature.

C. Changes on changing volume of the vessel

D. Is same even if only 2 mol of $HI(g)$ were introduced in the vessel in the beginning.

Is same even when a platinum gauze is introduced to catalyst the reaction.

Answer: A::B::C::D

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24. For the reaction $PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$, the forward reaction at constant temperature is favoured by

A. introducing chlorine gas at constant volume

B. introducing an inert gas at constant pressure

C. increasing the volume of the container

D. introducing PCl_5 at constant volume

Answer: B::C::D

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25. Which of the following reaction will shift in forward direction. When the respective change is made at equilibrium

A. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ increase in pressure at eq.

B. $H_2O(s) \Leftrightarrow H_2O(l)$ addition of inert gas at constant volume

C. $PCI_5(g) \Leftrightarrow PCI_3(g) + CI_2(g)$ addition of inert gas at constant pressure

D. $H_2 + I_2 \Leftrightarrow 2Hi$ increase in temperature

Answer: A::B::C

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26. Which of the following will not affect the value of equilibrium constant of a reaction?

A. Change in temperature

B. Addtion of catalyst

C. Change in concentration of the reactants

D. Change in pressure

Answer: B::C::D

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27. If the volume of the racion flask is reduced to half of its initial value and temperature is kept constant the in which of the following cases the position of equilibrium will not shift?

A. $CO(g) + H_2O(g) \Leftrightarrow CO(2)(g) + H_2(g)$

B. $I_2(g) \Leftrightarrow 2I(g)$

C. $NH_4HS_s \Leftrightarrow NH_3(g) + H_2S(g)$

D. $2NOCI(g) \Leftrightarrow 2NO(g) + CI_2(g)$

Answer: B::C::D

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28. $2CaSO_4(s) \Leftrightarrow 2CaO(s) + 2SO_2(g) + O_2(g), \Delta H > 0$

Above equilibrium is establised by taking some amount of $CaSO_4(s)$ in a closed container at 1600 K. Then which of the following may be correct options ?

A. Moles of $CaO(s)$ will increase with the increase in temperature

B. If the voulme of the container is doubled at equilibrium then partial pressure of $SO_2(g)$ will change at new equilibrium

C. If the volume of the container is halved partial pressure of $O_2(g)$ at new equilibrium will remain same

D. If two moles of the He gas is added at constant pressure then the moles of $CaO(s)$ will increase.

Answer: A::C::D

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29. An industrial fuel, 'water gas', which consists of a mixture of $H_2 \text{and} CO$ can be made by passing steam over red-hot carbon. The reaction is

$C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g), \Delta H = +131KJ$

The yield of $CO \text{and} H_2$ at equilibrium would be shifted to the product side by,

A. raising the relative pressure of the steam

B. adding hot carbon

C. raising the temperature

D. reducing the volume of the system

Answer: A::C

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30. The dissociation of phosgene, which occurs according to the reaction $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

Is an endothermic process. Which of the following will increase the degree of dissociation of $COCl_2$?

A. adding Cl_2 to the system

B. Adding helium to the system at constant pressure

C. Decreasing the temperature of the system

D. Reducing the total pressure

Answer: B::D

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31. If two gases AB_2 and B_2C are mixed, following equilibria are readily established:

$AB_2(g) + B_2C(g) \rightarrow AB_3(g) + BC(g)$,

$BC(g) + B_2C(g) \rightarrow B_3C_2(g)$

If the reaction started only with AB_2 with B_2C, then which of the following is necessarily true at equilibrium?

A. $[AB_3]_{eq} = [BC]_{eq}$

B. $[AB_2]_{eq} = [B_2C]_{eq}$

C. $[AB_3]_{eq} > [B_3C_2]_{eq}$

D. $[AB_3]_{eq} > [BC]_{eq}$

Answer: C::D

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32. Consider the following two equilibria simultaneously established in a rigid vessel at a particular temperature

$NH_2COOMH_4(s) \Leftrightarrow 2NH_3 + CO_2(g)$

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

Now, on adding some amout of NH_3 to the reaction vessel, the orignal equilibrium is disturbed and a new equilibrium state is obtained. On comparing the following at the initial & final equilibrium states, select the INCORRECT statement (s):

A. Nothing can be said about the number of moles of CO_2 gas in reaction vessel.

B. Nothing can be said about the number of moles of NH_3 gas in reaction vessel.

C. Number of moles of NH_3 gas would have definitely increased.

D. Number of moles of $CaCO_3$ solid gas would have definitely decreased.

Answer: A::B::C

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

$CO_2(g) \Leftrightarrow CO(g) + \frac{1}{2}O_2(g)$

For above simultaneous equilibrium if CO_2 is added from out side at equilibrium then:

A. P_{CO_2} will increase

B. P_{CO_2} will decrease

C. No shift in 2^{nd} equilibrium

D. Backward shift in 1^{st} equilibrium

Answer: C::D

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Exercise-2 (Part-4)

1. Le Chatelier's Principle

If a system at equilibrium is subjected to a change of any one of the factors such as concentration, pressure or temperature, the system adjusts itself in such a way as to nullify the effect of that change.

Change of pressure : If a system consists of gases, then the concentration of all the components can be alterd by changing the pressure. To increase the pressure on the system,the volume has to be decreased proportionally. The total number of mols per unit volume will now be more and the equilibrium will shift in the direction in which there is a decrease in number of moles i,e. towards the direction in which there can be decrease in pressure.

Effect of pressure on melting point : There are two types of solids:

(a) Solids whose volume decreases on melting e.g., ice,diamond carborundum magnesium nitride and quratz.

Solids (higher volume) $\Leftrightarrow$ Liquid (lower volume) The process of melting is facilitated at high pressure, thus, melting point is lowerd.

(b) Solids whose volume increase on melting e.g.,Fe,Cu,Ag,Au,etc.

Solid (lower volume) $\Leftrightarrow$ Liquid (higher volume) In this case the process of melting become difficult at high pressure, thus melting point becomes high.

(c) Solubility of substances : When solid substances are dissolved in water, either heat is evolved (exothermic) or heat is absorbed (endothermic).

$$KCI + aq \Leftrightarrow KCI(aq) - heat$$

In such cases, solubility increase with increase in temperature. Consider the case of KOH, when this is dissolved,heat is evolved.

$$KOH + aq \Leftrightarrow KOH(aq) + heat$$

In such cases, solubility decrease with increase in temperature.

(d) Solubility of gases in liquids : When a gas dissolves in liquid,there is decrease in volume. Thus increase of pressure will favour the dissolution of gas in liquid.

A gas 'X' when dissolved in water,heat is evolved. Then solubility of 'X' will increase:

A. Low pressure, high temperature

B. Low pressure, low temperature

C. high pressure, high temperature

D. high pressure, low temperature

Answer: D

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Au(s) $\Leftrightarrow$ Au(l)

Above equsilibrium is favoured at :

A. High pressure low temperature

B. High pressure high temperature

C. Low pressure, high temperature

D. Low pressure, low temperature

Answer: C

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3. For the reaction

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

If pressure id increased by reducing the volume of the container then :

A. Total pressure at equilibrium will change.

B. Concentration of all the component at equilibrium will change.

C. Concentration of all the component at equilibrium will remain same

D. Equilibrium will shift in the forward direction

Answer: A::B

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4. Effect of temperature on the equilibrium process analysed by using the thermodynamics

From the thermodynamics reaction

$\Delta G^\circ = -2.30RT \log k$

ΔG° : Standing free energy change

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ ...(ii)

ΔH° : Standard heat of the reaction gt

From eqns.(i) and(ii)

$-2RT \log k = \Delta H^\circ = T\Delta S^\circ$

ΔS° : standard entropy change

$$\Rightarrow \quad \log K = -\frac{\Delta H^\circ}{2.3RT} + \frac{\Delta S^\circ}{2.3R}$$

Clearly, if a plot of k vs 1/T is made then it is a straight lone having slope $= \frac{-\Delta H^\circ}{2.3R}$ amd y intercept $= \frac{\Delta S^\circ}{2.3R}$

If at temperature T_1 equilibrium constant be k_1 and at temperature T_2 equilibrium constant be k_2 then :

$$\Rightarrow \quad \log K_1 = -\frac{\Delta H^\circ}{2.3RT_1} + \frac{\Delta S^\circ}{2.3R} \text{..(iv)}$$

$$\Rightarrow \quad \log K_2 = -\frac{\Delta H^\circ}{2.3RT_2} + \frac{\Delta S^\circ}{2.3R} \text{...(v)}$$

Substracting e.q (iv) from (v), we get

from the relation we can conclude that the of equilibrium constant increase in temperature for endothermic reaction eith but value of equilibrium constant decrease with the increase in temperature for exothermic reaction

If statndard heat of dissociation of PCl_5 is 230 cal then slope of the graph of log vs $\frac{1}{T}$ is :

A. $+50$

B. -50

C. 10

D. None

Answer: B

Watch Video Solution

5. Effect of temperature on the equilibrium process analysed by using the thermodynamics

From the thermodynamics reaction

$\Delta G^\circ = -2.30 RT \log k$

$\Delta G^\circ :$ Standing free energy change

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ ...(ii)

ΔH° : Standard heat of the reaction gt

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If at temperature T_1 equilibrium constant be k_1 and at temperature T_2 equilibrium constant be k_2 then :

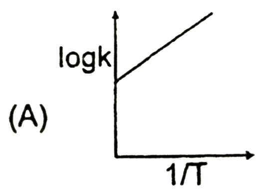
$$\Rightarrow \quad \log K_1 = -\frac{\Delta H^\circ}{2.3RT_1} + \frac{\Delta S^\circ}{2.3R} \text{..(iv)}$$

$$\Rightarrow \quad \log K_2 = -\frac{\Delta H^\circ}{2.3RT_2} + \frac{\Delta S^\circ}{2.3R} \text{...(v)}$$

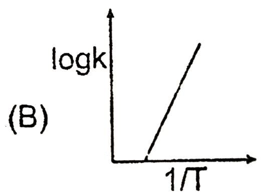
Substracting e.q (iv) from (v), we get

from the relation we can conclude that the of equilibrium constant increase in temperature for endothermic reaction eith but value of equilibrium constant decrease with the increase in temperature for exothermic reaction

For exothermic reaction if $\Delta S^\circ < 0$ then the sketch of log k vs $\frac{1}{T}$ may be



A.



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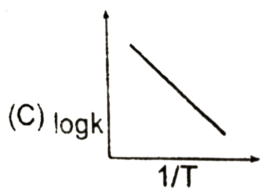
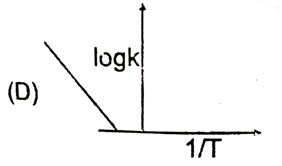


C.

D. 

Answer: B

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ΔG° : Standing free energy change

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ ...(ii)

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Clearly, if a plot of k vs 1/T is made then it is a straight lone having slope $= \frac{-\Delta H^\circ}{2.3R}$ amd y intercept $= \frac{\Delta S^\circ}{2.3R}$

If at temperature T_1 equilibrium constant be k_1 and at temperature T_2 equilibrium constant be k_2 then :

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$$\Rightarrow \quad \log K_2 = -\frac{\Delta H^\circ}{2.3RT_2} + \frac{\Delta S^\circ}{2.3R} \text{...(v)}$$

Substracting e.q (iv) from (v), we get

from the relation we can conclude that the of equilibrium constant increase in temperature for endothermic reaction eith but value of equilibrium constant decrease with the increase in temperature for exothermic reaction

If for a particular reversible reaction

$K_C = 57$ abd $355^\circ C$ and $K_C = 69$ at $450^\circ C$ then

A. $\Delta H < 0$

B. $\Delta H > 0$

C. $\Delta H = 0$

D. ΔH whose sign can't be determined

Answer: B

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Exercise-3 (Part-1)

1. At constant temperature , the equilibrium constant (K_P) for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2,$ is expressed by $K_p = \dfrac{(4x^2p)}{(1 - x^2)}$

where p= pressure ,x = extent of decomposition .which one of the following statements is true?

A. K_P increases with increase of P

B. K_P increases with increase of x

C. K_P increases with decrease of x

D. K_P remains constant with change in $P \text{and} x$

Answer: D

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2. Consider the following equilibrium in a closed container,

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

At a fixed temperature, the volume of the reaction container is halved. For this change which of the following statements holds true regarding the equilibrium constant (K_p) and degree of dissociation (α)?

A. neither K_P nor α changes

B. both K_P and α change

C. K_P changes, but α does not change

D. K_P does not change but α changes

Answer: D

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3. $N_2 + 3H_2 \Leftrightarrow 2NH_3$, $K = 4 \times 10^6 \text{at} 298K$ and $K = 41 \text{at} 400K$

Which statement is correct?

A. If N_2 is added at equilibrium condition, the equilibrium will shift to the forward direction because according to II^{nd} law of thermodynamics the entropy must increases in the direction of spontaneous reaction.

B. The condition for equilibrium is $2\Delta G_{NH_3} = 3\Delta G_{H_2 + \Delta G_{N_2}}$ where G gibbs free energy per mole of the gaseous species measured at that partial pressure.

C. Addition of catalyst does not change K_P but changes ΔH.

D. At $400K$ addition of catalyst will increase forward reaction by 2 times while reverse reaction rate will be changed by 1.7 times.

Answer: B

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4. The value of $1og_{10}$ K for a reaction $A \Leftrightarrow B$ is:

(Given, $\Delta_r H^{\circ}_{298K} = -54.07kJ \quad mol^{-1}, \Delta_r S^{\circ}_{298K} = 10JK^{-1} \quad mol^{-1}$

and

R=8.314JK^(-1)mol^{-1}, $2.303 \times 8.314 \times 298 = 5705$)

A. 5

B. 10

C. 95

D. 100

Answer: B

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5. Assertion (A): For every chemical reaction at equilibrium, standard Gibbs enegry of the reaction is zero.

Reason (R) : At constant temperature and pressure chemical reactions are spontaneous in the direction of the decreasing Gibbs energy.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True. Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Staement-1 is False, Statement-2 is True.

Answer: D

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6. The thermal dissociation of equilibrium of $CaCO_3$(s) is studied under different conditions

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

For this equilibrium, the correct statement(s) is:

A. ΔH is dependent on T

B. K is independent of the initial amount of $CaCO_3$

C. K is dependent on the pressure of CO_2 at a given T

D. ΔH is independent of the catalyst, if any

Answer: A::B::D

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Exercise-3 (Part-2)

1. In which of the following equilibrium ,change in volume of the system does not alter the number of moles:

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

B. $PCI_3(g) \Leftrightarrow PCI_3(g) + CI_2(g)$

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

D. $SO_2CI_2(g) \Leftrightarrow SO_2(g) + CI_2(g)$

Answer: A

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2. In which of following reactions, increase in the volume at constant temperature does not affect the number of moles of at equilibrium?

A. $2NH_3 \Leftrightarrow N_2 + 3H_2$

B. $C(g) + (1/2)O_2(g) \Leftrightarrow CO(g)$

C. $H_2(g) + O_2(g) \Leftrightarrow H_2O_2(g)$

D. None of these

Answer: D

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3. Consider the reaction equilibrium,

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), \Delta H^\circ = -198kJ$

On the basic of Le - Chatelier's principle, the condition favourable for the forward reaction is

A. lowering of temperature as well as pressure

B. increasing temperature as well ass pressure

C. lowering the temperature and increasing the pressure

D. any value of temperature and pressure.

Answer: C

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4. For the reaction, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the concentration of an equilibrium mixture at $298K$ is $N_2O_4 = 4.50 \times 10^{-2} molL^{-1}$ and $NO_2 = 1.61 \times 10^{-2} molL^{-1}$. What is the value of equilibrium constant?

A. $3.3 \times 10^2 \text{mol} L^{-1}$

B. $3 \times 10^{-1} \text{mol} L^{-1}$

C. $3 \times 10^{-3} \text{mol} L^{-1}$

D. $3 \times 10^3 \text{mol} L^{-1}$

Answer: C

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5. The equilibrium constant for the following reaction will be

$P_{4(s)} + 5O_{2(g)} \Leftrightarrow P_4O_{10(s)}$

A. $K_C = [P_4O_{10}] / [P_4][O_2]^5$

B. $K_C = 1 / [O_2]^5$

C. $K_C = [O_2]^5$

D. $K_C = [P_4O_{10}] / 5[P_4][O_2]$

Answer: B

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6. 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. $1/RT$

B. 1.0

C. $\sqrt{RT}$

D. RT

Answer: A

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7. The equilibrium constant for the reacction $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ at temperature (T) 4×10^{-4} The value of K_c for the reaction $NO(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) at the same temperature?$ (1)/(2)F_(2)(g)hArrF(g)`

A. 2.5×10^2

B. 0.02

C. 4×10^{-4}

D. 50

Answer: D

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8. For the reaction,

$$2NO_2(g) \Leftrightarrow 2NO(g) + O_2(g),$$

$$\left(K_c = 1.8 \times 10^{-6} at 184^\circ C\right)$$

$$(R = 0.0083 kJ) / (\text{ mol K })$$

When K_p and K_c are compared at $184^\circ C$ it is found that

A. Whether K_P is greater than, less than or equal to K_C depedns upon the total gas pressure

B. $K_P = K_C$

C. K_P is less than K_C

D. K_P is greater than K_C

Answer: D

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9. The exothermic formation of ClF_3 is represented by thr equation:

$Cl_2(g) + 3F_2(g) \Leftrightarrow 2ClF_3(g), \Delta H = -329kJ$

Which of the following will increase the quantity of ClF_3 in an equilibrium mixture of Cl_2, F_2, and ClF_3?

A. Adding F_2

B. Increasing the volume of container

C. Removing CI_2

D. Increasing the temperature

Answer: A

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10. An amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure . Ammonium hydrogen sulphide decomposses to yield NH_3 and H_2S

gases in the flask. When the decomposition reaction reaches equilibrium , the total pressure in the flask rises to 0.84 atm. The equilibrium constant for NH_4HS decomposition at this temperature is

A. 0.11

B. 0.17

C. 0.18

D. 0.30

Answer: A

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11. Phosphorus pentachloride dissociates as follows in a closed reaction vessel

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

If total pressure at equilibrium of the reaction mixture is P and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be.

A. $\left(\frac{x}{x+1}\right)P$

B. $\left(\frac{2x}{1-x}\right)P$

C. $\left(\frac{x}{x+1}\right)P$

D. $\left(\frac{x}{1-x}\right)P$

Answer: A

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12. The equilibrium constant for the given reaction:

$SO_{3(g)} \Leftrightarrow SO_{2(g)} + 1/2O_{2(g)}, (K_c = 4.9 \times 10^{-2})$

The value of K_c for the reaction:

$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$, will be :

A. 416

B. 2.40×10^{-3}

C. 9.8×10^{-2}

D. 4.9×10^{-2}

Answer: B

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13. For the following three reaction I, II and III, equilibrium contants are given

1. `CO(g) + H_(2)O (g) 2. `CH_(4)(g) + H_(2)O(g) 3. `CH_(4)(g) + 2H_(2)O(g)

Which of the following relations is correct?

A. $K_2K_3 = K_1$

B. $K_3 = K_1K_2$

C. $K_3K_2^3 = K_1^2$

D. $K_1\sqrt{K_2} = K_3$

Answer: B

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14. The equilibrium constant K_{p_1} and K_{p_2} for the reactions $X \Leftrightarrow 2Y$ and $Z \Leftrightarrow P + Q$, respectively are in the ratio of $1:9$ .If the degree of the dissociation of X and Z be equal , then the ratio of the total pressure at these equlibria is

A. $1:1$

B. $1:3$

C. $1:9$

D. $1:36$

Answer: D

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15. If $10^{-4} dm^3$ of water is introduced into a $1.0 dm^3$ flask at 300 K, how many moles of water are in the vapour phase when equilibrium is established?

(Given : Vapour pressure of H_2O at 300K is 3170 Pa, $R = 8.314 JK^{-1} mol^{-1}$)

A. $5.56 \times 10^{-3} mol$

B. $1.56 \times 10^{-2} mol$

C. $4.46 \times 10^{-2} mol$

D. $1.27 \times 10^{-3} mol$

Answer: D

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16. A vessel at $1000 K$ contains carbon dioxide with a pressure of $0.5 atm$. Some of the carbon dioxide is converted to carbon monoxide on addition of graphite. Calculate the value of K_p if total pressure at equilibrium is $0.8 atm$.

A. 1.8 atm

B. 3 atm

C. 0.3 atm

D. 0.18

Answer: A

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17. For the reaction $SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$, if $K_P = K_C(RT)^x$ where the symbols have usual meaning then the value of x is :

(assuming ideality)

A. -1

B. $-\frac{1}{2}$

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

D. 1

Answer: B

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Advanced Level Problems (Part-1)

1. The standard Gibbs energy change at 300 K for the reaction $2A \Leftrightarrow B + C$ is $2494.2J$. At a given time, the composition of the reaction mixture is $[A] = \frac{1}{2}, [B] = 2$ and $[C] = \frac{1}{2}$. The reaction proceeds in the :

$[R = 8.314J/K/mol, e = 2.718]$

A. forward direction because $Q > K_C$

B. reverse direction because $Q > K_C$

C. forward direction because $Q < K_C$

D. reverse direction because $Q < K_C$

Answer: B

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2. 1 mol of N_2 and 2 mol of H_2 are allowed to react in a 1 dm^3 vessel. At equilibrium, 0.8 mol of NH_3 is formed. The concentration of H_2 in the vessel is

A. 0.6 mole

B. 0.8 mole

C. 0.2 mole

D. 0.4 mole

Answer: B

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3. For the following mechanism, $P + Q \underset{K_B}{\overset{K_A}{\Longleftrightarrow}} PQ \underset{K_D}{\overset{K_C}{\Longleftrightarrow}}$ R at equilibrium $\frac{[R]}{[P][Q]}$ is: [K represents rate constant]

A. $\frac{K_A . K_B}{K_C . K_D}$

B. $\frac{K_A . K_D}{K_B . K_C}$

C. $\dfrac{K_B.\,K_D}{K_A.\,K_C}$

D. $\dfrac{K_A.\,K_C}{K_BK_D}$

Answer: D

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4. Select the reaction for which the equilibrium constant is written as $[MX_3]^2 = K_{eq}[MX_2]^2[X_2]$

A. $MX_3 \Leftrightarrow MX_2 + \dfrac{1}{2}X_2$

B. $2MX_3 \Leftrightarrow 2MX_2 + X_2$

C. $2MX_{2+X_2} \Leftrightarrow 2MX_3$

D. $MX_2 + \dfrac{1}{2}X_2 \Leftrightarrow MX_3.$

Answer: C

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5. What should be the value of K_c for the reaction $2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$. If the amount are $SO_3 = 48g$. $SO_2 = 12.8 \text{and} O_2 = 9.6$ at equilibrium and the volume of the container is one litre?

A. 64

B. 30

C. 42

D. 8.5

Answer: B

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6. If 0.5mole H_2 is reacted with 0.5 mole I_2 in a ten $-$ litre container at $444^\circ C$ and at same temperature value of equilibrium constant K_C is 49, the ratio of $[HI]$ and $[I_2]$ will be :

A. 7

B. $\frac{1}{7}$

C. $\sqrt{\frac{1}{7}}$

D. 49

Answer: A

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7. 4.5 moles each of hydrogen and iodine heated in a sealed ten litre vessel. At equilibrium, 3 moles of HI were found. The equilibrium, 3 moles of HI were found. The equilibrium constant for $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is

A. 1

B. 10

C. 5

D. 0.33

Answer: A

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8. In a 20 litre vessel initially each have $1 - 1$ mole. CO, H_2OCO_2 is present, then for the equilibrium of $CO + H_2O \Leftrightarrow CO_2 + H_2$ following is true:

A. H_2, more then 1 mole

B. $CO,\ H_2O,\ H_2$ less then 1 mole

C. $CO_2 \& H_2O$ both more then 1 mole

D. All of these

Answer: B

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9. At 1000 K, the value of K_p for the reaction: $A(g) + 2B(g) \Leftrightarrow 3C(g) + D(g)$ is 0.05 atmosphere. The value of K_c in terms of R would be:

A. $20000R$

B. $0.02R$

C. $5 \times 10^{-6}R$

D. $5 \times 10^{-5} \times R^{-1}$

Answer: D

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10. In which of the following reactions is $K_p < K_c$?

A. $CO_g + CI_2(g) \Leftrightarrow COCI_2(g)$

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

C. $2BrCI(g) \Leftrightarrow CI_2(g) + Br_2(g)$

D. $I_2(g) \Leftrightarrow 2I(g)$

Answer: A

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11. K for the synthesis of HI is 50. K for dissociation of HI is

A. 50

B. 5

C. 0.2

D. 0.02

Answer: D

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12. The K_c for $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_g$ is 64. If the volume of the container is reduced to one-half of its original volume, the value of the equilibrium constant will be

A. 16

B. 32

C. 64

D. 128

Answer: C

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13. In equilibrium $CH_3COOH + H_2O \Leftrightarrow CH_3COO^- + H_3O^+$

The equilibrium constant may change when

A. CH_3COO^- is added

B. CH_3COOH is added

C. Catalyst is added

D. Mixture is heated

Answer: D

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14. In the esterification

$C_2H_5OH(l) + CH_3COOH(l) \text{ an } \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$

equimolar mixture of alcohol and acid taken initially yields under equilibrium, the water with mole fraction $= 0.333$. The equilibrium constant. Is

A. 1 mole of ethyl acetate is formed

B. 2 mole of ethyl acetate are formed

C. $1/2$ moles of ethyl acetate is formed

D. $2/3$ moles of ethyl acetate is formed

Answer: D

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15. In the following reaction started only with $A_8, 2A_8(g) \Leftrightarrow 3A_2(g) + A_4(g)$ mole fraction of A_2 is found to 0.36 at a total pressure of $100 atm$ at equilibrium. The mole fraction of $A_8(g)$ at equlibrium is :

A. 0.28

B. 0.72

C. 0.18

D. None of these

Answer: A

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16. Ina 0.25 litre tube dissociation of 4 moles of NO takes place. If its degree of dissociation is 10%. The value of K_p for reaction

$2NO \Leftrightarrow N_2 + O_2$ is:

A. $\frac{1}{(18)^2}$

B. $\frac{1}{(8)^2}$

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

D. $\frac{1}{32}$

Answer: A

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17. For the given reaction at constant pressure,

$$\begin{array}{lll} & nA(g) \Leftrightarrow & A_n(g) \\ \text{Initial moles} & 1 & 0 \\ \text{Final moles} & 1-\alpha & \frac{\alpha}{n} \end{array}$$

Then the correct relation between initial density (d_i) and final density (d_f) of the system is :

A. $\left[\frac{n-1}{n}\right]\left[\frac{d_f - d_i}{d_f}\right] = \alpha$

B. $\frac{n}{n-1}\frac{[d_f - d_i]}{d_f} = \alpha$

C. $\left[\frac{n-1}{n}\right]\left[\frac{d_i-d_f}{d_i}\right]=\alpha$

D. $\frac{1}{(n-1)}\left[\frac{d_i-d_f}{d_i}\right]=\alpha$

Answer: B

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18. On decomposition of NH_4HS , the following equilibrium is estabilished: $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$ If the total pressure is P atm, then the equilibrium constant K_p is equal to

A. P atm

B. P^2atm

C. $P^2 / 4atm^2$

D. $2P$ atm

Answer: C

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19. At room temperature, the equilibrium constant for the reaction P + Q $\Leftrightarrow$ R + S was calculated to be 4.32 . At $425^{\circ} C$ the equilibrium constant became 1.24×10^{-2} . This indicates that the reaction

A. is exothermic

B. is endothermic

C. is difficult to predict

D. no relation between $\Delta H \text{and} K$

Answer: A

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20. Calculate $\Delta, G^{\ominus}$ for conversion of oxygen to ozone, 3/2 $O_2(g) \rightarrow O_3(g)$ at 298 K. If K_p for this conversion in 2.47×10^{-29}

A. $163 Kjmol^{-1}$

B. $2.4 \times 10^2 Kjmol^{-1}$

C. $1.63 KJmol^{-1}$

D. $2.38 \times 10^6 Kjmol^{-1}$

Answer: A

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21. For the reaction, $4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6 H_2O(l), \Delta H =$ positive. At equilibrium the factor that will not affect the concentration of NH_3 is:

A. change in pressure

B. change in volume

C. catalyst

D. None of these

Answer: C

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22. The effect of adding krypton (Kr) gas on position of equilibrium, keeping the volume of the system constant is

A. If $\Delta n = 0$, backward reaction is favoured.

B. If,$\Delta n = +ve,$ forward reaction is favoured

C. If $\Delta n = -ve,$ forward reaction is favoured

D. No effect watever be the value of Δn

Answer: D

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23. Le-Chatelier's principle is applicable only to a

A. System in equilibrium

B. Irreversible reaction

C. Homogeneous reaction

D. Heterogeneous reaction

Answer: A

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24. Two solid comp0ounds X and Y dissociates at a ceritain temperature as follows

$X(s) \Leftrightarrow A(g) + 2B(g), K_{P1} = 9 \times 10^{-3} atm^3$

$Y(s) \Leftrightarrow 2B(g) + C(g), K_{P2} = 4.5 \times 10^{-3} atm^3$

The total pressurre of gases over a mixture of X and T is :

A. 4.5` atm

B. 0.45 atm

C. 0.6 atm

D. None of these

Answer: B

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25. The value of ΔG° for the phosphorylation of glucose in glycolysis is $15KJ/mol$. Find the value of K_{eq}at$300K$.

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26. Which of the following statements is correct for a reversible process in a state of equilibrium ?

A. $\Delta G = 2.30RT\log K$

B. $\Delta G^{\circ} = -2.30RT\log K$

C. $\Delta G^{\circ} = 2.30RT\log K$

D. $\Delta G = -2.30RT\log K$

Answer: B

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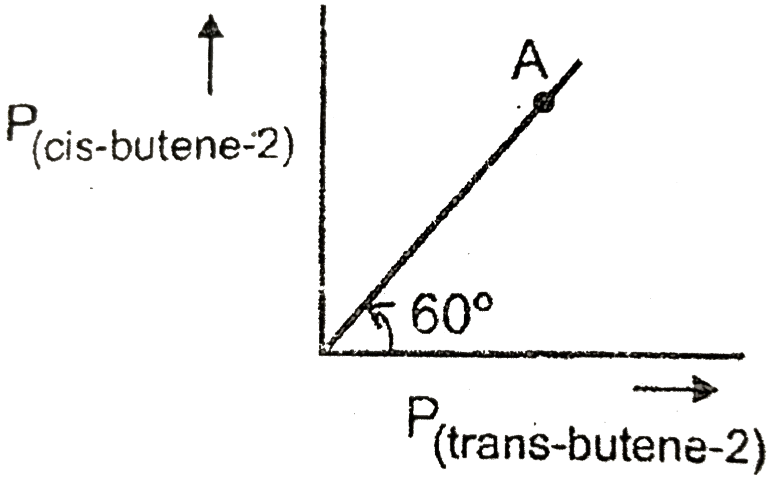
27. For the following isomerisation reaction

cis-butene-2 $\Leftrightarrow$ $trans$ $-$ butene-2 $K_p = 1.732$



Which of the following statement is true at point A?

A. $Q > K_p$

B. $Q < K_p$

C. $Q = K = 1$

D. $Q = K = 1.732$

Answer: D

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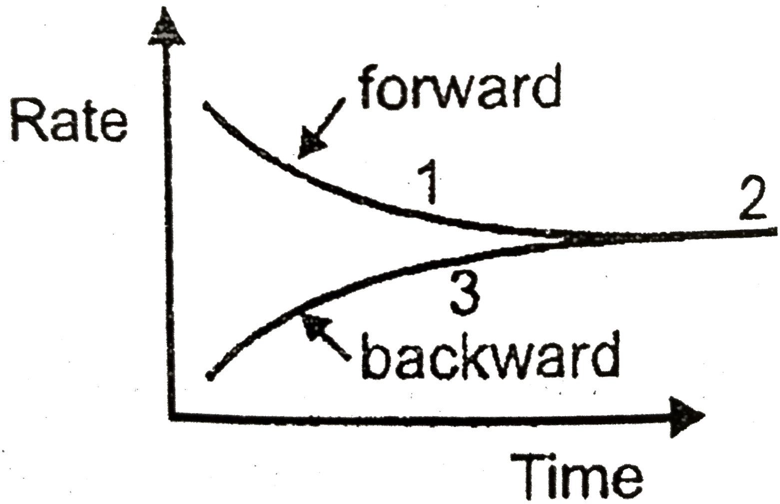
28. In the reaction

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

a graph in plotted to show the variation of rate of forward and backward reactions against time. Which of the following is correct?



$Q > K$ $Q = K$ $Q < K$

A. 321

B. 123

C. 231

D. 213

Answer: A

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29. For the reaction $PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$, the forward reaction at constant temperature is favoured by

A. introducing chlorine gas at constant volume

B. introducing an inert gas at constant pressure

C. increasing the volume of the container

D. introducing PCl_5 at constant volume

Answer: A

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30. Find out InK_{eq} for the formation of NO_2 from NO and O_2 at $298K$

$$NO_g + \frac{1}{2}O_2 \Leftrightarrow NO_2g$$

Given: $\Delta G_f^\circ(NO_2) = 52.0 KJ/mole$

$\Delta_f^\circ(NO) = 87.0 KJ/mole$

$\Delta_f^\circ(O_2) = 0 KJ/mole$

A. $\dfrac{35 \times 10^3}{8.314 \times 298}$

B. $-\dfrac{35 \times 10^3}{8.314 \times 298}$

C. $\dfrac{35 \times 10^3}{2.303 \times 8.314 \times 298}$

D. $\dfrac{35 \times 10^3}{2 \times 298}$

Answer: A

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31. If a reaction vessel at $400^\circ C$ is charged with equimolar mixture of CO and steam such that $P_{CO} = P_{H_2O} = 4$ bar what will be that partial pressure of H_2 at equilibrium if $K_P = 9$

$CO + H_2O \Leftrightarrow CO_2 + H_2$

A. 3 bar

B. 4 bar

C. 2 bar

D. 1 bar

Answer: A

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Advanced Level Problems (Part-2)(Section-1)

1. Write the equilibrium constant of the reaction

$C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$

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2. For the reaction $PCl_5 \Leftrightarrow PCl_3 + Cl_2$, Supposing at constant temperature, if the volume is increased 16 times the initial volume, the degree of dissociation for this reaction will becomes:

A. 4 times

B. $\frac{1}{4}$ times

C. 2 times

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

Answer: A::B::D

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3. A vessel of $10L$ was filled with 6 mole of Sb_2S_3 and 6 mole of H_2 to attain the equilibrium at $440^\circ C$ as:

$Sb_2S_3(s) + 3H_2(g) \Leftrightarrow 2Sb(s) + 3H_2S(g)$

After equilibrium the H_2S formed was analysed by dissolving it in water and treating with excess of Pb^{2+} to give $708 g \text{of} PbS$ as precipitate. What is value of K_c of the reaction at $440^\circ C$?(At. weight of $Pb = 206$).

A. 0.08

B. 0.8

C. 0.4

D. 0.04

Answer: A::B::D

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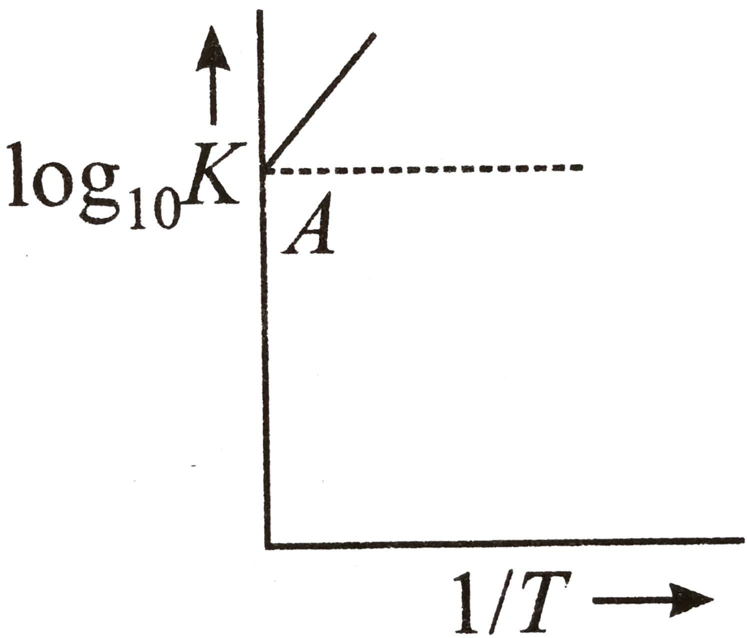
4. Variation of $\log_{10} K$ with $\frac{1}{T}$ is shown by the following graph in which straight line is at 45°, hence ΔH° is:



A. $+4.606 cal$

B. $-4.606 cal$

C. $2 cal$

D. $-2 cal$

Answer: B

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5. $aA + bB \Leftrightarrow cC + dD$

In above reaction low pressure and high temperature, conditions are shift equilibrium in back direction so correct set:

A. $(a+b) > (c+d), \Delta H > 0$

B. $(a+b) < (c+d), \Delta H > 0$

C. $(a+b) < (c+d), \Delta H < 0$

D. $(a+B) > (c+d), \Delta H < 0$

Answer: D

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6. The value of K_p for the reaction at $27^{\circ} C$

$Br_2(l) + CI_2(g) \Leftrightarrow 2BrCI(g)$

is $1 atm$. At equilibrium in a closed container partial pressure of $BrCI$ gas $0.1 atm$ and at this temperature the vapour pressure of $Br_2(l)$ is also 0.1atm. Then what will be minimum moles of $Br_2(l)$ to be added to 1 mole of CI_2, initially, to get above equilibrium stiuation,

A. $\frac{10}{6} moles$

B. $\frac{5}{6} moles$

C. $\frac{15}{6} moles$

D. $2 moles$

Answer: C

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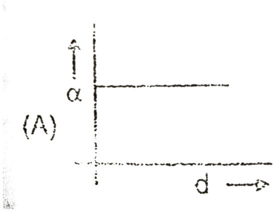
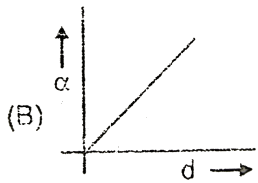
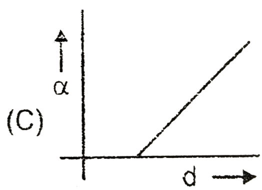
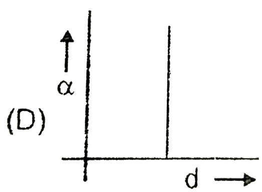
7. $C(s) \Leftrightarrow 2A(g) + B(s)$

If the dissociation of $C(s)$ is α and d is the density of the gaseous mixture in the container. Initially container have only $C(s)$ and the reaction is carried at constant temperature and pressure.

A. 

B. 

C. 

D. 

Answer: D

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Advanced Level Problems (Part-2)(Section-2)

1. For which reaction at $298K$, the value of $\frac{K_p}{K_c}$ is maximum and minimum respectively:

A. $N_2O_4 \Leftrightarrow 2No_2$

B. $2SO_2 + O_2 \Leftrightarrow 2SO_3$

C. $X + Y \Leftrightarrow 4Z$

D. $A + 3B \Leftrightarrow 7C$

Answer: B::D

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2. For the equilibrium $2SO_2(g) + O_2(g)2SO_3(g), \Delta H = -198KJ$, the equilibrium concentration of SO_3 will be affected by

A. doubling the volume of the reaction vessel

B. increasing the temperature at constant volume

C. adding more oxygen to the reaction vessel

D. adding helium to the reaction vessel at constant volume

Answer: A::B::C

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3. $AB(s) \Leftrightarrow A(g) + B(g)K_p = 4, \Delta H = +ve$

In a container,A(g) "and" B(g) are filled to partial pressure of 1 atm each. Now $AB(s)$ is added (in excess quantity). Which of the following is CORRECT? (No other gas is present in container):

A. At equilibrium, the total pressure in the container is 4 atm.

B. Equilibrium pressure decreases uniformly on increasing the volume by container.

C. At equilibrium, the total pressure in the container is more than 4 atm, if temperature is increased.

D. None of these

Answer: A::C::D

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4.

$CuSO_4.5H_2O(s) \Leftrightarrow CuSO_4.3H_2O(s) + 2H_2O(s) K_P = 0.4 \times 10^{-3} atm^2$

Which of following sttement are correct:

A. $\Delta G^\circ = -RT\ln P_{H_2O}$ where $P_{H_2O} = \text{partial pressure of} H_2O$ at equilibrium.

B. At vapour pressure of $H_2O = 15.2$ torr relative humidity of $CuSO_4.5H_2O \text{is} 100\%$

C. In pressure of aqueous tension of 24 torr, $CuSO_4.5H_2O$ can not loss moisture.

D. In presence of dry atmosphere in open container $CuSO_4.5H_2O$ will completely convert into $CuSO_4.3H_2O$

Answer: B::C::D

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5. 05 moles of $NH_4HS(s)$ are taken in a container having air at 1 atm. On warming the closed container to $50^\circ C$ the pressure attained a constant value of 1.5 atm, with some $NH_4HS(s)$ remaining unreacted. The K_p of reaction

$NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)\text{at}50^\circ)C$ is:

A. 0.25

B. 0.625

C. 0.025

D. 0.0625

Answer: D

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6. How many moles of water are in vapour phase present inside the vessel containing $1L$ water after sufficient time? (Vapour pressure of water at $27^{\circ}C = 3000Pa, R = \frac{25}{3}J/mol - K$)

A. 5×10^{-4}

B. 120

C. 1.2×10^{-3}

D. None of these

Answer: A

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Advanced Level Problems (Part-2)(Section-3)

1. If 1 mole of CH_3COOH and 1 mole of C_2H_5OH are taken in 1 litre flask, 50% of CH_3COOH is converted into ester as,

$CH_3COOH_{(l)} + C_2H_5OH_{(l)} \Leftrightarrow CH_3COOC_2H_5(l) + H_2O_{(l)}$

There is 33% conversion of CH_3COOH into ester, if $CH_3COOH \text{and} C_2H_5OH$ have been taken initially in molar ratio $x:1$, find x.

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2. Solid ammonium carbamate NH_2COONH_4 was taken in excess in closed container according to the following reaction

$NH_2COONH_4(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$. If equilibrium pressure is 4 atm, it's equilibrium constnat K_P is ?

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3. Find the percentage dissociation of ammonia into N_2 and $'H_2$ if the dissociation is carried out at constant pressure and the volume at equilibrium is 20% greater than initial volume. (Initially. Equal moles of $NH_3 \text{and} N_2$ are present with no hydrogen)

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4. $A_2B_{(g)}$ is introduced in a vessel at $1000K$. If partial pressure of $A_2B(g) \text{is} 1$ atm initially and K_P for reaction $A_2B_{(g)} \Leftrightarrow 2A(g) + B(g) \text{is} 81 \times 10^{-6}$ then calculate percentage of dissociation of A_2B.

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5. Consider the following two equilibrium established together in a closed container

$A(s) \Leftrightarrow 2B(g) + 3C(g), K_{P_1}$

$A(s) \Leftrightarrow 3D(g), K_{P_2}$

Starting with only $A(s)$, molar ratio of $B(g)$ & $D(g)$ at equilibrium is found to be in a ratio $1:6$ determine $\frac{K_{P_2}}{8K_{P_1}}$

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6. 0.1 mol each of ethyl alcohol and acetic acid are allowed to react and at equilibrium, the acid was exactly neutralised by $100mL$ of $0.85NNaOH$. If no hydrolysis of ester is supposed to have undergo, find K_c.

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Advanced Level Problems (Part-3)(Stage-1)

1. If the equilibrium constant for the reaction 0.125.

$P_{4(g)} + 6Cl_{2(g)} \Leftrightarrow 4PCl_{3(g)}$

The value of equilibrium constant for this reaction

$4PCl_{3(g)} \Leftrightarrow P_{4(g)} + 6Cl_{2(g)}$

A. 0.25

B. 8

C. 0.125

D. 6

Answer: B

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2. The free energy change for a reversible reaction at equilibrium is:

zero

small positive

small negative

large positive.

A. very large positive

B. positive

C. zero

D. negative

Answer: C

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3. Pure ammonia is placed in a vessel at a temperature where its dissociation constant (α) is appreciable. At equilibrium,

A. concentration of ammonia does not change with pressure.

B. its degree of dissociation, a does not change with pressure

C. K_p does not change significantly with pressure.

D. concentration of hydrogen is less than that of nitrogen.

Answer: C

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4. For a spontaneous process :-

A. zero

B. negative

C. positive

D. very large positive

Answer: B

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5. For a given reversible reaction at a fixed temperature, equilibrium constants K_p and K_c are related by ....

A. $K_p = K_c. R(T)^{\Delta n}$

B. $K_c = K_p. (RT)^{\Delta n}$

C. $K_p = K_c. (RT)^{\Delta n}$

D. $mol. dm^{-3}$

Answer: C

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6. In the gaseous phase reaction

$C_2H_4 + H_2 \Leftrightarrow C_2H_6$, the equilibrium constant can be expressed in the units to :

A. $mol^2 dm^{-3}$

B. $dm^3 mol^{-1}$

C. $dm^3 mol^{-1}$

D. $mol. dm^{-3}$

Answer: B

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7. The equilibrium constant for the reaction $H_2 + Br_2 \Leftrightarrow 2HBr$ is 67.8 at $300K$. The equilibrium constant for the dissociation of HBr is:

A. 0.0147

B. 67.80

C. 33.90

D. 8.349

Answer: A

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8. The equilibrium constant (K) for the reaction. $A + 2B \Leftrightarrow 2C + D$ is:

A. $\dfrac{[C]^2[D]}{[A][2B]}$,

B. $\dfrac{[2C][D]}{[A][2B]}$

C. $\dfrac{[C][D]}{[A][B]}$

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

Answer: D

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9. A solid mixture(5.000 g) consisting of lead nitrate and sodium nitrate was heated below 600°C until the weight of the residue was constant. If the loss in weight is 28%, find the amount of lead nitrate and sodium nitrate in the mixture.

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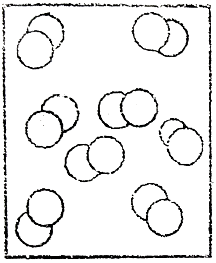
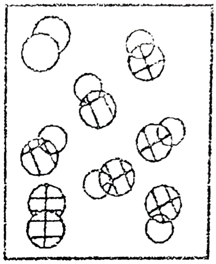
10. The following pictures represents the equilibrium state for three different reactions of the type

$A_2 + X_2 \Leftrightarrow 2AX \ (X = B, C \text{or} D)$

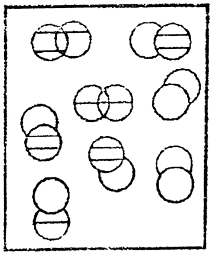
$A_2 + X_2 \rightleftharpoons 2AX$ (X = B, C or D)



$[A_2 + B_2 \rightleftharpoons 2AB]$



$[A_2 + C_2 \rightleftharpoons 2AC]$



$[A_2 + D_2 \rightleftharpoons 2AD]$

Which reaction has the largest equilibrium constant?

A. $A_2 + B_2 \Leftrightarrow 2AB$

B. $A_2 + C_2 \Leftrightarrow 2AC$

C. $A_2 + D_2 \Leftrightarrow 2AD$

D. None of these

Answer: B

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11. Methanol (CH_3OH) is manufactured by reaction of carbon monoxide with hydrogen in the presence of ZnO/Cr_2O_3 catalyst.

$CO + 2H_{2(g)}, [\Delta H^\circ = -91KJ]$

What happens to the amount of methanol when an equilibrium mixture of reactants and products is subjected to rise in temperature?

A. Amount of methanol will increase

B. Amount of methanol will decrease

C. Amount of methanol remain the same

D. None of these

Answer: B

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12. For the reversible reaction,$A + B \Leftrightarrow C$, the specific reaction rates for forward and reverse reactions are $1.25 \times 10^3 \text{and} 2.75 \times 10^4$ respectively. The equilibrium constant for the reaction is:

A. 0.0454

B. 0.022

C. 2.20

D. 0.4545

Answer: A

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13. The equilibrium constant for the gaseous reaction $H_2 + Cl_2 \Leftrightarrow 2HCl$ is given by

A. $\dfrac{[H_2][Cl_2]}{[HCl]^2}$

B. $\dfrac{[H_2][Cl_2]}{2[HCl]}$

C. $\dfrac{[HCl]^2}{[H_2][Cl_2]}$

D. 2[HCl]) / ([H_(2)][Cl_(2)])`

Answer: C

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14. Given the equilibrium system

$NH_4Cl(s) \Leftrightarrow NH_4^+(aq) + Cl^-(aq)(\Delta H = +3.5 \text{ kcal/mol})$.

What change will shift the equilibrium to the right?

A. decrease in temperature

B. increase in temperature

C. addition of NH_4Cl crystals to the reaction mixture

D. addition of NH_4OH solution to the reaction mixture.

Answer: B

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15. A catalyst increases the

A. rate of forward reaction only

B. free energy change in the reaction

C. rates of both forward and reverse reactions

D. equilibrium constant of the reaction.

Answer: C

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16. For the reaction, $N_2 + 3H_2 \Leftrightarrow 2NH_3$, the units of $K_c \text{and} K_p$ respectively are:

A. $mol^{-2}L^2 \text{and} bar^{-2}$

B. $mol^{-2}L^2 \text{and} Bar^{-1}$

C. $mol^{-1}L \text{and} bar^{-2}$

D. $mol^{-1}L^{-1} \text{and} bar^{-1}$

Answer: A

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17. A 0.20 M solution of methanoic acid has degree of ionization of 0.032. Its dissociation constant would be

A. $2.1 \times 10 - 2$

B. $2.1 \times 10 - 4$

C. $1.1 \times 10 - 6$

D. $1.6 \times 10 - 8$

Answer: A::B

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18. The equilibrium constant for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ is 70 at a certain temperature. Hence, equilibrium constant for the reaction $NH_3 \Leftrightarrow \frac{1}{2}N_2 + \frac{3}{2}H_2$ of the same temperature will be approximately

A. 1.4×10^{-2}

B. 1.2×10^{-1}

C. 2.0×10^{-4}

D. 2.9×10^{-2}

Answer: B

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19. For the reaction:

$4NH_3(g) + 7O_{2(g)} \Leftrightarrow 4NO_{2(g)} + 6H_2O_g$. K_p is related to K_c by

A. $K_p = K_c(RT)$

B. $K_p = K_c$

C. $K_p = K_c(RT)^3$

D. $K_p = K_c \mid (RT)$.

Answer: D

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20. When $K_c > 1$ for a chemical reaction,

A. the equilibrium would be achieved rapidly

B. the equilibrium would be achieved slowly

C. product concentrations would be much greater than reactant concentrations at equilibrium

D. reactant concentraions would be much greater then product concentraions at equilibrium.

Answer: C

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21. What will be the effect to increased pressure in the following equilibrium reaction ?

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

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

(iii) $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

A. form more ammonia gas

B. produce more $N_2(g) \text{and} H_2(g)$

C. Keep the conversion to ammonia unaltered

D. produce more $H_2(g)$.

Answer: A

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22. In which reaction will an increase in the volume of the container favor the formation of products?

A. $C_{(s)} + H_2O_{(g)} \Leftrightarrow CO_{(g)} + H_{2((g))}$

B. $H_{2(g)} + l_{2(g)} \text{and} H_{2(g)}$

C. $4NH_{3(g)} + 5O_{2(g)} \Leftrightarrow 4NO((g)) + 6H_2O$

D. $3O_{2((g))} \Leftrightarrow 2O_{3((g))}$.

Answer: A

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23. Which of the following changes the value of the equilibrium constant ?

A. change in concentration

B. change in pressure

C. change in volume

D. None of these

Answer: D

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24. Consider the equilibrium reaction:

$$4NH_{3((g))} + 3O_{2((g))} \Leftrightarrow 2N_{2((g))} + 6H_2O_{(g)}$$

$$(\Delta H = -1268KJ)$$

Which change will cause the reaction to shift to the right?

A. Increase the temperature

B. Decrease the volume of the container.

C. Add a catalyst to speed up the reaction.

D. None of these

Answer: D

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25. Equilibrium constants K_1 and K_2 for the following equilibria

$NO(g) + 1/2O_2(g) \overset{K_1}{\Longleftrightarrow} NO_2(g)$ and

$2NO_2(g) \overset{K_2}{\Longleftrightarrow} 2NO(g) + O_2(g)$

are related as

A. $K_1 = 2K_2$

B. $K_1 = 1/K_2$

C. $K_1 = \sqrt{K_2}$

D. $K_1 = \sqrt{1}K_2$

Answer: D

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26. A catalyst speeds up a chemical reraction by

A. shifting the equilibrium

B. increasing the activation energy

C. initiating the reaction

D. decreasing energy of activation

Answer: D

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27. For the reaction $2HI \Leftrightarrow H_2(g) + I_2(g)$

A. $K_p = K_c$

B. $K_p > K_c$

C. $K_p < L_c$

D. $L_c = \sqrt{K}_P$

Answer: A

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28. consider the following gaseous equilibrium with equilibrium constant K_1 and K_2 respectively

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

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

The equilibrium constants are related as

A. $K_2 = (K_1)^{-1}$

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

C. $K_2 = \left(\frac{1}{K_1}\right)^2$

D. $\sqrt{K_1}$

Answer: C

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29. The equilibrium constant K_c for the reaction,

$2NaHCO_3(s) \Leftrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$

A. `

B.

C.

D.

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30. For the following reaction, the value of K change with

$N_2(g) + O_2(g) < \; < 2NO(g), \Delta H = \; + 180 kJmol^{-1}$

A. change in pressure

B. change in concentration of oxygen

C. introduction of $NO(g)$

D. change in temperature

Answer: D

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31. For the reaction $PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g), K_c$ is 26 at $250^\circ C$. K_p at the same temperature is $(R = 8.314 JK^{-1} mol^{-1})$

A. 4.6×10^3

B. 5.7×10^3

C. 6.0×10^{-3}

D. 8.3×10^{-3}

Answer: C

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32. At $445^\circ C$, K_c for the following reaction is 0.020.

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

A mixture of H_2, I_2 and HI in a vessel at $445^\circ C$ has the following concentration: $[HI] = 2.0M, [H_2] = 0.50M$ and $[I_2] = 0.10M$. The statement that is true concerning the reaction quotient, Q_c is:

A. $Q_cK_c,$ the system is at equilibrium

B. Q_c less than $K_c,$ more $H_2 \text{and} I_2$ will be produced

C. Q_c less than $K_c,$ more HI will be produced

D. Q_c is greater than $K_c,$ more $H_2 \text{and} I_2$ will be produced

Answer: B

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33. A catalyst accelerates a reaction primarily by stablizing the

A. substrate

B. product

C. intermediate

D. transition state

Answer: D

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34. The oxidation of SO_2 to SO_3 is an exothermic reaction. The yield of SO_3 will be maximum if :

A. temperature is increased and pressure is kept constant

B. temperature is decreased and pressure is increased

C. both temperature and pressure are increased

D. both temperature and pressure are decreased

Answer: B

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35. In which of the following reaction $K_p > K_c$?

A. $H_2 + l_2 \rightarrow 2HI$

B. $N_2 + 3H_2 \rightarrow 2NH_3$

C. $2SO_3 \rightarrow 2SO_2 + O_2$

D. $PCl_3 + Cl_2 \rightarrow PCl_5$

Answer: C

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36. The K_p / K_c ratio for the reaction:

$4NH_3(g) + 7O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$, at,127$^\circ C$ is

A. 0.0304

B. 0.0831

C. 1.0001

D. 33.26

Answer: A

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37. K_p for the reaction given below is $1.36 \text{at} 499K$. Which of the following equations can be used to calculate K_c for this reaction?

$N_2O_{5(g)} \rightarrow NO_{2(g)} + NO_{3(g)}$

A. $K_C = \dfrac{[(0.0821) \times (499)]}{[1.36]}$

B. $K_C = \frac{[(1.36) \times (0.0821)]}{[499]}$

C. $K_C = \frac{[1.36]}{[(0.0821) \times (499)]}$

D. $K_C = \frac{[(1.36) \times (499)]}{[0.0821]}$

Answer: C

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38. At $700K$, for the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ the $K_p \text{is} 3.2 \times 10^4$. At the same temperature the K_p for the reaction $SO_3(g) \Leftrightarrow SO_2(g) + 0.50 O_2(g)$ is:

A. $3.125 \times^{-5}$

B. 5.59×10^{-3}

C. 1.79×10^4

D. 1.79×10^{-2}

Answer: B

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Advanced Level Problems (Part-3)(Stage-2)

1. Reaction stoichiometry, kinetics and thermodynamics that of Nitrosyl chloride $(NOCl)$, is a yellow gas that is most commonly encountered as a decomposition product of aqua regia. It is toxic and irritating to the lungs. On heating $NOCl$ decomposes as

$2NOCl \rightarrow 2NO + Cl_2$.

The enthalpy change (ΔH) for the formation of 1 mole of Cl_2 by the decomposition of $NOCl$ is $75.3KJ$ between $100. K \text{to} 600K$. The standard entropies $(S^\circ\_(298K))$ of different species are as given below:

Substance	$NOCl$	NO	Cl_2
S°_{298K}	264	211	223

Calculate G of the above decomposition reaction at $298K$.

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2. Reaction stoichiometry, kinetics and thermodynamics ltbgt Nitrosyl chloride $(NOCl)$, is a yellow gas that is most commonly encountered as a decomposition product of aqua regia. It is toxic and irritating to the lungs. On heating $NOCl$ decomposes as

$2NOCl \rightarrow 2NO + Cl_2$.

The enthalpy change (ΔH) for the formation of 1 mole of Cl_2 by the decomposition of $NOCl$ is $75.3KJ$ between $100. K\text{to}600K$. The standard entropies $(S^\circ\_(298K))$ of different species are as given below:

Substance	$NOCl$	NO	Cl_2
S°_{298K}	264	211	223

Calculate the temperature at which K_p will be double the value at $298K$.

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3. Reaction stoichiometry, kinetics and thermodynamics that of Nitrosyl chloride $(NOCl)$, is a yellow gas that is most commonly encountered as a decomposition product of aqua regia. It is toxic and irritating to the lungs. On heating $NOCl$ decomposes as

$2NOCl \rightarrow 2NO + Cl_2$.

The enthalpy change (ΔH) for the formation of 1 mole of Cl_2 by the decomposition of $NOCl$ is $75.3KJ$ between $100. K \text{to} 600K$. The standard entropies $(S^\circ\_(298K))$ of different species are as given below:

Substance	$NOCl$	NO	Cl_2
S°_{298K}	264	211	223

Calculate the temperature above which the reaction will become non-spontaneous.

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Advanced Level Problems (Part-3)(Stage-5)

1. An alloy consists of rubidium and one of the other alkali metals. A sample of $4.6g$ of the alloy when allowed to react with water, liberates $2.241dm^3$ of hydrogen at STP.

Relative atomic masses: $A_T(Li) = 7, A_T(Na) = 23, A_T(K) = 39, A_T(Rb) = 85.5, A_T(Cs) = 1.33$

Which alkali metal is the component of the alloy?

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2. An alloy consists of rubidium and one of the other alkali metals. A sample of $4.6g$ of the alloy when allowed to react with water, liberates $2.241dm^3$ of hydrogen at STP.

Relative atomic masses: $A_T(Li) = 7, A_T(Na) = 23, A_T(K) = 39, A_T(Rb) = 85.5, A_T(Cs) = 1.33$

What composition in $\%$ by mass has the alloy?

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