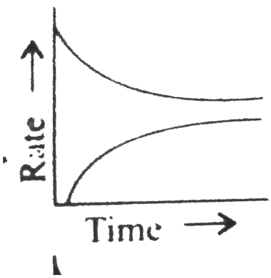
CHEMISTRY

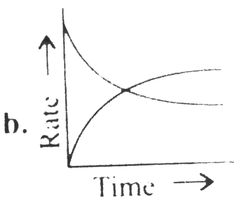
BOOKS - CENGAGE CHEMISTRY (HINGLISH)

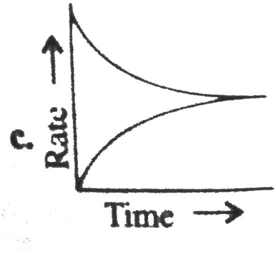
CHEMICAL EQUILIBRIUM

Solved Example

1. Which graph will show equilibrium condition?

A. 

B. 

C. 

D. None of these

Answer: C

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2. For $A + B \Leftrightarrow C + D$, the equilibrium constant is K_1 and for $C + DhArA + B$, the equilibrium constant is K_2. The correct relation between K_1 and K_2 is

A. $K_1 \times K_2 = 1$

B. $K_1 \times \left(K_2 - 1\right) = 0$

C. $K_1 / K_2 = 1$

D. All of these

Answer: A

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3. For the reactions,

$A \Leftrightarrow B, K_c = 1, B = \ \Leftrightarrow C, K_c = 3, C \Leftrightarrow D, K_c = 5.$ K_c for the reaction $A \Leftrightarrow D$ is

A. 15

B. 5

C. 3

D. 1

Answer: A

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4. The law of mass action was proposed by

A. Guldberg and Waage

B. Le Chatelier and Braun

C. Kossel and Lewis

D. vant Hoff

Answer: A

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5. The equilibrium constant of the reactions

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

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

are K_1 and K_2 respectively. The relationship between K_1 and K_2 is

A. $K_1 = K_2$

B. $K_2^2 = K_1$

C. $K_1^2 = K_2$

D. $K_2 = \sqrt{K_1}$

Answer: C

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6. When $4mol$ of A is mixed with $4mol$ of B, $4mol$ of C and D are formed at equilibrium, according to the reaction

$A + B \Leftrightarrow C + D$

the equilibrium constant is

A. $\sqrt{2}$

B. 2

C. 1

D. 4

Answer: C

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7. The rate at which a substance reacts, depends on its:

A. Active mass

B. molecular mass

C. Equivalent mass

D. Total volume

Answer: A

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8. The state of equilibrium refers to

A. State of rest

B. Dynamic state

C. Stationary state

D. State of inertness

Answer: B

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9. For the reaction, $A + 2B \Leftrightarrow C$, the expession for equilibrium constant is

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

B. $\frac{[A][B]}{[C]}$

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

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

Answer: C

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10. For the reaction:

$2A(g) + B(g) \Leftrightarrow 3C(g) + D(g)$

Two moles each of A and B were taken into a flask. The following must always be true when the system attained equilibrium

A. $[A] = [B]$

B. $[A] < [B]$

C. $[B] = [C]$

D. $[A] > [B]$

Answer: B

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11. In a reversible chemical reaction, equilibrium is said to have been established when the

A. Concentrations of reactants and products are equal

B. Opposing reactions cease

C. Speeds of opposing reactions become equal

D. Temperature of opposing reactions are equal

Answer: C

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12. Active mass is defined as

A. Number of g equivalent per unit volume

B. Number of g mol per L

C. Amount of substance in g per unit volume

D. Number of g mol in $100L$

Answer: B

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13. 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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14. The equilibrium constant for the reaction

$N_2 + 2O_2 \Leftrightarrow 2NO_2$

at a particular temperature is 100. Write down the equilibrium law equations for the following reaction and determine the values of equilibrium constants.

$2NO_2 \Leftrightarrow N_2 + 2O_2$

$NO_2 \Leftrightarrow 1/2N_2 + O_2$

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15. Determine K_c for the reaction

$$\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) + \frac{1}{2}Br_2(g)H + \Leftrightarrow NOBr(g)$$

from the following data at $298K$.

The equilibrium constants for the following reaction

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

and $NO(g) + \frac{1}{2}Br_2(g) \Leftrightarrow NOBr(g)$

are 2.4×10^{30} and 1.4, respectively.

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16. For the hypothetical reactions, the equilibrium constant (K) value are given

$A \Leftrightarrow B, K_1 = 2, B \Leftrightarrow C, K_2 = 4,$

$C \Leftrightarrow D, K_3 = 3$

The equilibrium constant (K) for the reaction

$A \Leftrightarrow D$ is

A. 48

B. 6

C. 27

D. 24

Answer: D

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17. Given

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), K_1$

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g), K_2$

$H_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow H_2O(g), K_3$

The equilibrium constant for

$2NH_3(g) + \frac{5}{2}O_2(g) \Leftrightarrow 2NO(g) + 3H_2O(g)$

will be

A. $K_1K_2K_3$

B. $\frac{K_1K_2}{K_3}$

C. $\frac{K_1K_3^2}{K_2}$

D. $\frac{K_2K_3^3}{K_1}$

Answer: D

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18. In areversible reaction, study of its mechanism says that both the forward and reverse reaction follows first-order kinetics. If the halflife of forward reaction $\left(t_{1/2}\right)_f$ is $400s$ and that of reverse reaction $\left(t_{1/2}\right)_b$ is $250s$, the equilibrium of the reaction is

A. 1.6

B. 0.433

C. 0.625

D. 1.109

Answer: C

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19. A vessel at $1000K$ contains carbon dioxide with a pressure of $0.5atm$. 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 $0.8atm$.

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20. A sample of $CaCO_3(s)$ is introduced into a sealed container of volume $0.654L$ and heated to $1000K$ until equilibrium is reached. The equilibrium constant for the reaction

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

is 3.9×10^{-2} atm at this temperature. Calculate the mass of CaO present at equilibrium.

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21. Form the given data of equilibrium constants of the following reactions:

$CuO(s) + H_2(g) \Leftrightarrow Cu(s) + H_2O(g), K = 67$

$CuO(s) + CO(g) \Leftrightarrow Cu(s) + CO_2(g), K = 490$

Calculate the equilibrium constant of the reaction,

$CO_2(g) + H_2(g) \Leftrightarrow Cu(s) + CO_2(g) + H_2O(g)$

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22. Given that at $1000K$

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), K = 261$

Calculate K for the following equations: ltgbrgt a. 2SO_(3)(g)hArr2SO_(2)(g)+O_(2)(g)b. SO_(3)(g)hArrSO_(2)(g)+(1)/(2)O_(2)(g)c. SO_(2)(g)+(1)/(2)(g)+(1)/(2)O_(2)(g)hArrSO_(3)(g)`

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23. If $N_2 + 3H_2 \overset{K}{\Leftrightarrow} 2NH_3$ then $2N_2 + 6H_2 \overset{K}{\Leftrightarrow} 4NH_3$ - K' is equal to

A. K^2

B. $(K)^{1/3}$

C. $1/\sqrt{K}$

D. $1/K^2$

Answer: A

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24. Equilibrium constants for four different reaction are given as $K_1 = 10^6, K_2 = 10^{-4}, K_3 = 10,$ and $K_4 = 1.$ Which reaction will take maximum time to attain equilibrium?

A. $K_1 = 10^2$

B. $K_2 = 10^{-4}$

C. $K_3 = 10$

D. $K_4 = 20$

Answer: B

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25. For the rections $A \Leftrightarrow B, B \Leftrightarrow C, C \Leftrightarrow D,$, equilibrium constants are K_1, K_2 and K_3 respectively. What is the value of equilibrium constant for $A \Leftrightarrow D$?

A. $K_1 + K_2 + K_3$

B. $K_1 \times K_2 \times K_3$

C. $K_1K_2/3$

D. None

Answer: B

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Exercise 7.26 $AO \rightleftharpoons \left(\frac{1}{2}\right)A_2 + \left(\frac{1}{2}\right)O_2; K = 5 \times 10^5$

$$BO \rightleftharpoons \left(\frac{1}{2}\right)B_2 + \left(\frac{1}{2}\right)O_2; K = 1.10 \times 10^{12}$$

$$CO \rightleftharpoons \left(\frac{1}{2}\right)C_2 + \left(\frac{1}{2}\right)O_2; K = 2.3 \times 10^{18}$$

$$DO \rightleftharpoons \left(\frac{1}{2}\right)D_2 + \left(\frac{1}{2}\right)O_2; K = 1.4 \times 10^{21}$$

26.

Which oxide is most stable?

A. AO

B. BO

C. CO

D. DO

Answer: A

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27. Theory of 'active mass' indicates that the rate of a chemical reaction is directly proportional to the

A. Equilibrium constant

B. Properties of reactants

C. Volume of apparents

D. Concentration of reactants

Answer: D

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28. For a system, $a + 2B \Leftrightarrow C$, the equilibrium comcentrations are $[A] = 0.06, [B] = 0.12$, and $[C] = 0.216$. The K_c for the reaction is

A. 120

B. 400

C. 4×10^{-3}

D. 250

Answer: D

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29. Equilibrium constants (K) for the reaction $2NO(g) + Cl_2(g) \Leftrightarrow 2NOCl(g)$ is correctly given by the expression

A. $\frac{[NOCl]^2}{[NO]^2\left[Cl_2\right]}$

B. $\frac{[2NOCl]}{[2NO]\left[Cl_2\right]}$

C. $\frac{[NO]^2 + \left[Cl_2\right]}{[NOCl]}$

D. $\frac{[NO]^2\left[Cl_2\right]}{[NOCl]^2}$

Answer: A

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30. Consider the following equilibrium:

$$SO_2(g) + \frac{1}{2}O_2(g) \overset{K_1}{\Leftrightarrow} SO_3(g),$$

$$2SO_3(g) \overset{K_2}{\Leftrightarrow}$$

What is the relation between K_1 and K_2?

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

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

C. $K_1 = K_2$

D. $K_1 = \frac{1}{K_2^2}$

Answer: B

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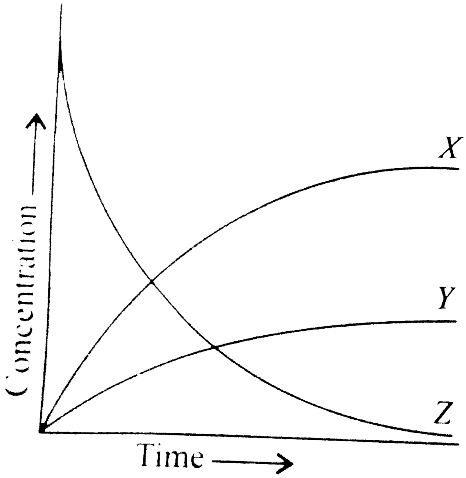
31. Consider the following reaction:

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

In the figure below, identify the curves $X, Y,$ and Z associated with the three species in the reaction



A. $X = NO, Y = O_2, Z = NO_2$

B. $X = O_2, Y = NO, Z = NO_2$

C. $X = NO_2, Y = NO, Z = O_2$

D. $X = O_2, Y = NO_2, Z = NO$

Answer: A

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32. Two equilibrium $AB \Leftrightarrow A^{\oplus} + B^{\ominus}$ and $AB + B^{\ominus} \Leftrightarrow AB_2^{\ominus}$ are simultaneously maintained in a solution with equilibrium constants K_1 and k_2, respectively. Ratio of $\left[A^{\oplus}\right]$ to $\left[AB_2^{\ominus}\right]$ in the solution is

A. Direclty proportional to $\left[B^{\ominus}\right]$

B. Inversely proportional to $\left[B^{\ominus}\right]$

C. Directly proportional to $\left[B^{\ominus}\right]^2$

D. Inversely proportional to $\left[B^{\ominus}\right]^2$

Answer: D

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33. 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, $3.0mol$ of CS_2, $3.0mol$ of H_2S. In which direction does the reaction proceed to reach equilibrium?

A. Forward

B. Backward

C. May be forward or backward

D. Reaction is in equilibrium

Answer: B

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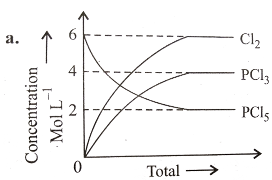
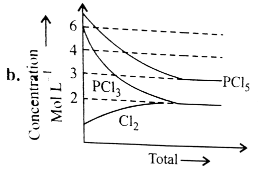
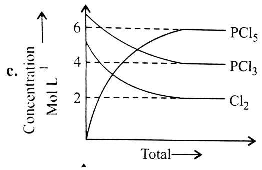
34. For the reaction

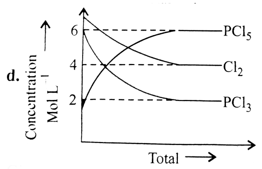
$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

Which of the following sketches may represent above equilibrium? Assume equilibrium can be achieved from either side and by taking any one or more components initially. Give K_c for the reaction < 2?

A. 

B. 

C. 

D. 

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35. a. For which of the following reactions, K_p is equal to K_c ?

i. $H_2 + I_2 \Leftrightarrow 2HI$

ii. $N_2 + 3H_2 \Leftrightarrow 2NH_3$

iii. $PCl_5 \Leftrightarrow PCl_3 + Cl_2$

b. For which of the following cases does the reaction go garthest to completion:

$K = 1, K = 10^{10}, K = 10^{-10}$?

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36. Both matels Mg and Fe can reduce copper metal from a solution having copper ions $\left(Cu^{2+}\right)$. According to the equilibria:

$Mg(s) + Cu^{2+} \Leftrightarrow Mg^{2+} + Cu(s), K_1 = 6 \times 10^{90}$

$Fe(s) + Cu^{2+} \Leftrightarrow Fe^{2+} + Cu(s), K_2 = 3 \times 10^{26}$

Which metal will remove cupric ion from the solution to a greater extent?

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37. The equilibrium constant of the reaction

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

at $426\,^\circ C$ is 55.3, what will be the value of equilibrium constant

a. if the reaction is reversed and

b. if the given reaction is represented as

$3H_2 + 3I_2 \Leftrightarrow 6HI$?

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38. What will be the effect on the equilibrium constant for the reaction

$N_2 + 3H_2 \Leftrightarrow 2NH_3$,

$\Delta H =$ - 22.4 kcal, when

a. Pressure is increased

b. Concentration of N_2 is increased and

c. Temperature is raised at equilibrium ?

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39. From equation (i) and (ii),

$Co \Leftrightarrow CO + \frac{1}{2}O_2\left[K_{c1} = 9.0 \times 10^{-12} \text{ at } 1000^\circ C\right]$ (i)

$H_2O \Leftrightarrow H_2 + \frac{1}{2}O_2\left[K_{c2} = 7.0 \times 10^{-12} \text{ at } 1000^\circ C\right]$ (ii)

the equilibrium for the reaction

$CO_2 + H_2 \Leftrightarrow CO + H_2O$

at the same temperature is

A. 0.78

B. 2.0

C. 16.2

D. 1.28

Answer: B

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40. For a reversible reaction

$A + B \Leftrightarrow C$

$\left(\frac{dx}{dt}\right) = 2.0 \times 10^{3} L mol^{-1} s^{-1} [A][B] - 1.0 \times 10^{2} s^{-1} [C]$ where x is the amount of 'A' dissociated. The value of equilibrium constant $\left(K_{eq}\right)$ is

A. 10

B. 0.05

C. 20

D. Cannot be calculated

Answer: C

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41. The formation of amoonia from nitrogen and hydrogen gases can be written by the following two equations:

a. $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) < \; < NH_3(g)$

b. $\frac{1}{3}N_2(g) + H_2(g) < \; < \frac{2}{3}NH_3(g)$

The two equations have equilibrium constants K_1 and K_2 respectively. The relationship between the equilibrium constant is

A. $K_1 = K_2^2$

B. $K_1^3 = K_2^2$

C. $K_1^{2/3} = K_2$

D. $K_1 = K_2^{3/2}$

Answer: C::D

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42. The following concentrations were obtained for the formation of NH_3 from N_2 and H_2 at equilibrium at $500K$. $\left[N_2\right] = 1.5 \times 10^{-2}M$, $\left[H_2\right] = 3.0 \times 10^{-2}M$, and $\left[NH_3\right] = 1.2 \times 10^{-2}M$. Calculate the equilibrium constant.

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43. At equilibrium, the concentrations of $N_2 = 3.0 \times 10^{-3}M, O_2 = 4.2 \times 10^{-3}M$, and $NO = 2.8 \times 10^{-3}M$ in a sealed vessel at $800K$. What will be K_c for the reaction

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

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44. In the reaction,

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

The concentration of H_2, I_2, and HI at equilibrium are $8.0, 3.0$ and 28.0 mol per L respectively. Determine the equilibrium constant.

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45. 40% of a mixture of 2.0 mol of N_2 and 0.6 mol of H_2 reacts to give NH_3 according to the equation:

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

at constant temperature and pressure. Then the ratio of the final volume to the initial volume of gases are

A. $4:5$

B. $5:4$

C. $7:10$

D. $8:5$

Answer: A

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46. Arrange the following in order of increasing tendency of the forward reactions to proceed towards completion at $298K$ and one atmospheric pressure :

a. $H_2O(g) \Leftrightarrow H_2O(l), K_c = 782$

b. $F_2(g) \Leftrightarrow 2F(g), K_c = 4.9 \times 10^{-21}$

c. $C_{\text{graphite}} + O_2(g) \Leftrightarrow CO_2(g), K_c = 1.3 \times 10^{69}$

d. $N_2O_4(g) \Leftrightarrow 2NO_2(g), K_c = 4.6 \times 10^{-3}$

e. $H_2(g) + C_2H_4(g) \Leftrightarrow C_2H_6(g), K_c = 9.8 \times 10^{18}$

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47. The equilibrium constant of the dissocition of various of an element A are given at constant temperature:

a.
a. $2A_2O(g) \rightleftharpoons 2A_2(g) + O_2(g); K_c = 4.0 \times 10^{30}$
b. $2AO(g) \rightleftharpoons A_2(g) + O_2(g); K_c = 2.0 \times 10^{27}$
c. $2AO_2(g) \rightleftharpoons A_2(g) + 2O_2(g); K_c = 7.0 \times 10^{13}$
d. $2A_2O_5(g) \rightleftharpoons 2A_2(g) + 5O_2(g); K_c = 1.0 \times 10^{31}$

Write the stability of these oxides in increasing order.

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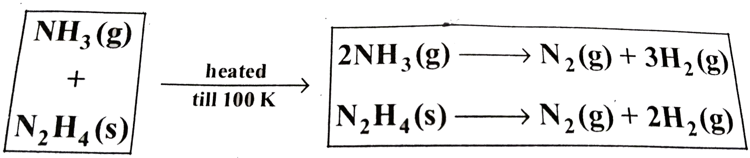
48. At



Assuming complete decomposition of NH_3 and $N(2)H_4$

$P = 0.3atm, P = 2.7atm$

$T = 300K, T = 200K$

VL, VL

mole % of NH_3 in original mixture is (assume both concentration same volume)

A. 25 %

B. 20 %

C. 75 %

D. 37.5 %

Answer: C

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49. Write the expression for equilibrium constant for the following reactions. If the concentrations are expressed in $molL^{-1}$, give the units in each case.

a. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

b. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

c. $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$

d. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

e. $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

f. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

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

h. $2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$

a.

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50. At a certain temperature, the equilibrium constant (K_c) is 16 for the reaction:

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

If we take one mole of each of the equilibrium concentration of NO and NO_2?

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51. 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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52. The value of K_c for the reaction

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

is 0.50 at $400\ ^{\circ}C$. Find the value of K_p at $400\ ^{\circ}C$ when concentrations are expressed in mol L^{-1} and pressure in atm.

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53. For an ideal gas reaction

$2A + B \Leftrightarrow C + D$

the value of K_p will be:

A. $K_p = \frac{n_C n_D}{n_A^2 n_B} \cdot \frac{V}{RT^2}$

B. $K_p = \frac{n_C n_D}{n_A^2 n_B} \cdot \frac{V}{RT}$

C. $K_p = \frac{n_C n_D}{n_A^2 n_B} \cdot \frac{RT}{V}$

D. $K_p = \frac{n_C n_D}{4n_A^2 n_B} \cdot \frac{V}{RT}$

Answer: B

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54. For a reaction

$aA(g) \Leftrightarrow bB(g)$

at equilibrium, the heat of reaction at constant volume is 1500 cal more than at constant pressure. If the temperature is $27^{\circ}C$ then

A. $K_p = K_c$

B. $K_p > K_c$

C. $K_p < K_c$

D. None of these

Answer: B

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55. Given that K_c for equation (i) given below has a value of 256 at $1000K$. Calculate the numerical values of K_c for other reactions (ii), (iii), and (iv).

i. $2A_2(g) + B_2(g) \rightleftharpoons 2A_2B(g)$

ii. $2A_2B(g) \rightleftharpoons 2A_2(g) + B_2(g)$

iii. $A_2(g) + 1/2B_2(g) \rightleftharpoons A_2B(g)$

iv. $A_2B(g) \rightleftharpoons A_2(g) + 1/2B_2(g)$

i.

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56. When $3.06g$ of solid NH_4HS is introduced into a two-litre evacuated flask at $27^\circ C$, 30% of the solid decomposes into gaseous ammonia and hydrogen sulphide. (i) Calculate K_c and K_p for the reaction at $27^\circ C$. (ii) What would happen to the equilibrium when more solid NH_4HS is introduced into the flask?

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57. At $540K$, $0.10mol$ of PCl_5 is heated in a $8L$ flask. The pressure of equilibrium mixture is found to be $1.0atm$. Calculate K_p and K_c for the reaction.

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58. Prove that the pressure necessary to obtain 50% dissociation of PCl_5 at $250^\circ C$ is numerically three times of K_p.

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59. For the reaction

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

Hydrogen gas is introduced into a five-litre flask at $327^\circ C$, containing 0.2 mol of $CO(g)$ and a catalyst, untill the pressure is $4.92 atm$. At this point, 0.1 mol of $CH_3OH(g)$ is formed. Calculate the equilibrium constants K_p and K_c.

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60. 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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61. Two solid X and Y dissociate into gaseous products at a certain temperature as followas:

$X(s) \Leftrightarrow A(g) + C(g)$, and $Y(s) \Leftrightarrow B(g) + C(g)$

At a given temperature, the pressure over excess solid X is $40mm$ and total pressure over solid Y is $80mm$. Calculate

a. The value of K_p for two reactions.

b. The ratio of moles of A and B in the vapour state over a mixture of X and Y.

c. The total pressure of gases over a mixture of X and Y.

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62. For a homogenous gaseous reaction

$X(g) + 2Y)g) \Leftrightarrow Z(g)$,

at $473K$, the value of $K_c = 0.35$ concentration units. When 2 moles of Y are mixed with 1 mole of X, at what pressure 60% of X is converted to Z?

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63. Solid $NH_4HS(s)$ (ammonium hydrogen sulphate) dissociates to give $NH_3(g)$ and $H_2S(g)$ and is allowed to attain equilibrium at $100\,^\circ C$. If the value of K_p for its dissociation is found to be 0.34, find the total pressure at equilibrium at $100\,^\circ C$. If the value of K_p for its dissociation is found to be 0.34, find the total pressure at equilibrium and partical pressure of each component.

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64. At $700K$, the equilibrium constant K_p for the reaction

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

is $1.80 \times 10^{-3} kPa$. What is the numerical value of K_c in moles per litre for this reaction at the same temperature?

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65. The equilibrium of formation of phosgene is represented as :

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

The reaction is carried out in a $500 mL$ flask. At equilibrium, 0.3 mol of phosgene, $0.1 mol$ of CO, and 0.1 mol of Cl_2 are present.

The equilibrium constant of the reaction is

A. 30

B. 15

C. 5

D. 25

Answer: B

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66. Which of the following relation(s) hold(s) good for gaseous and reversible reactions?

A. $\frac{K_p}{K_c} = (RT)^{(\Delta n)_g}$

B. $\frac{K_p}{K_x} = (P)^{(\Delta n)_g}$

C. $\frac{K_c}{K_x} = \left(\frac{p}{RT}\right)^{(\Delta n)_g}$

D. $\frac{K_c}{K_x} = (P)^{-(\Delta n)_g}$

Answer: A::B

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67. 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 is started only with AB_2 with B_2C, then which of the following us necessarily true at equilibrium?

A. $\left[AB_3\right]_{eq} = [BC]_{eq}$

B. $\left[AB_2\right]_{eq} = \left[B_2C\right]_{eq}$

C. $\left[AB_3\right]_{eq} > \left[B_3C_2\right]_{eq}$

D. $\left[AB_3\right]_{eq} > [BC]_{eq}$

Answer: C::D

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68. The degree of dissociation of HI at a particualr temperature is 0.8. Calculate the volume of $2MNa_2S_2O_3$ solution required to neutralise the iodine present in an equilibrium mixture of a reaction when 2 mol each of H_2 and I_2 are heated in a closed vessel of $2L$ capacity and the equilibrium mixture is freezed.

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69. At $1000K$, the pressure of iodine gas is found to be $0.1atm$ due to partial dissociation of $I_2(g)$ into $I(g)$. Had there been no dissociation, the pressure would have been $0.07atm$. Calculate the value of K_p for the reaction:

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

Watch Video Solution

70. Calculate the precentage dissociation of $H_2S(g)$ if 0.1 mol of H_2S is kept in a $0.5L$ vessel at $1000K$. The value of K_c for the reaction

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

is 1.0×10^{-7}.

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71. For the reaction

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

The degree of dissociation (α) of $HI(g)$ is related to equilibrium constant

K_p by the expression

a. $\frac{1+2\sqrt{K_p}}{2}$, b. $\sqrt{\frac{1+2K_p}{2}}$

c. $\sqrt{\frac{2K_p}{1+2K_p}}$, d. $\frac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$

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

$2AB_2(g) \Leftrightarrow 2AB(g) + B_2(g)$

with degree of dissociation α, which is small compared with unity. The expression for K_p in terms of α and the total pressure P_T is

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73. For the dissociation reaction

$N_2O \Leftrightarrow 2NO_2(g)$,

the equilibrium constant K_P is 0.120 atm at $298K$ and total pressure of system is 2 atm. Calculate the degree of dissociation of N_2O_4.

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74. A sample of air consisting of N_2 and O_2 was heated to $2500K$ until the equilibrium

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

was established with an equlibrium constant, $K_c = 2.1 \times 10^{-3}$. At equilibrium, the mole % of NO was 1.8. Eatimate the initial composition of air in mole fraction of N_2 and O_2.

Watch Video Solution

75. PCl_5 dissociates into PCl_3 and Cl_2, thus

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

If the total pressure of the system in equilibrium is P at a density ρ and temperature T, show that the degree of dissociation $\alpha = \frac{PM}{\rho RT} - 1$, where

M is the relative molar mass of PCl_5. If the vapour density of the gas mixture at equilibrium has the value of 62 when the temperature is $230\,^{\circ}C$, what is the value of P/ρ?

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76. The equilibrium constant K_p for the reaction

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

at $497\,^{\circ}C$ is found to be $636mmHg$. If the pressure of the gas mixture is $182mm$, calculate the presentage dissociation of N_2O_4. At what pressure will it be dissociated?

Watch Video Solution

77. For the reaction

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

The degree of dissociation (α) of $AB(g)$ is related to equilibrium constant K_p by the expression

A. $\dfrac{1+2\sqrt{K_p}}{2\sqrt{K_p}}$

B. $\sqrt{\dfrac{1+2K_p}{2}}$

C. $\sqrt{\dfrac{2K_p}{1+2K_p}}$

D. $\dfrac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$

Answer: D

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78. At a given temperature and a total pressure of 1.0 atm for the homogenous gaseous reaction

$N_{2\_}(4) \Leftrightarrow 2NO_2(g)$,

the partial pressure of NO_2 is $0.5atm$.

a. Find the value of K_p.

b. If the volume of the vessel is decreased to half of its original volume, at constant temperature, what are the partial pressure of the components of the equilibrium mixture?

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79. In which of the folowing reactions, the system will shift towards the forward reaction by adding inert gas at constant pressure?

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80. N_2O_4 dissociates as

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

At $40^{\circ}C$ and one atmosphere $\%$ decomposition of N_2O_4 is 50.3%. At what pressure and same temperature, the equilibrium mixture has the ratio of $N_2O_4 : NO_2$ as $1:8$?

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81. At $627^{\circ} C$ and 1 atm SO_3 is partially dissociated into SO_2 and O_2 by the reaction

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

The density of the equilibrium mixture is $0.925 gL^{-1}$. What is the degree of dissociation?

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82. Density of equilibrium mixture of N_2O_4 and NO_2 at $1 atm$ and $384K$ is $1.84 gdm^{-3}$. Calculate the equilibrium constant of the reaction.

$$N_2O_4 \Leftrightarrow 2NO_2$$

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83. For the reaction

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

Show that the degree of dissociation of NH_3 is given as

$$\alpha = \left[1 + \frac{3\sqrt{3}}{4}\frac{p}{K_p}\right]^{-1/2}$$

where p is equilibrium pressure. If K_p of the above reaction is $78.1 atm$ at $400\ ^\circ C$, calculate K_c.

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84. 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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85. $3g$ mol of phosphorus is heated in a flask of $4L$ volume. At equilibrium, it dissociates to give $40\ \%$ of phosphorus trichloride and chlorine. Calculate the equilibrium constant.

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86. N_2O_4 is 25% dissociated at $37\ ^\circ C$ and $1 atm$. Calculate (i) K_p and (ii) the percentage dissociation at 0.1 atm and $37\ ^\circ C$.

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87. 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. 

B. 

C. 

D. 

Answer: B

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88. The vapour density of the equilibrium mixture of the reaction:

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

is 50. The percent dissociation of SO_2Cl_2 is

A. 33.00

B. 35.0

C. 30.0

D. 66.00

Answer: B

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89. 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 $\left(K_p\right)$ and the degree of dissociation (α)?

A. Neither K_p nor alpha changes

B. Both K_p and alpha change

C. K_p does not change but alpha changes

D. K_p changes, but alpha does not change

Answer: C

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90. 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. $256P^3\alpha^5$

B. $4P\alpha^2$

C. $8P^3\alpha^5$

D. None of these

Answer: C

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91. The following reaction occurs at $700K$. Arrange them in the order of increasing tendency to proceed to completion.

I. $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g); K_p = 1.7 \times 10^{-2}$

II. $N_2O_4(g) \rightleftharpoons 2NO_2(g); K_p = 1.5 \times 10^3$

III. $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g); K_p = 1.3 \times 10^{-5}$

IV. $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g); K_p = 5.9 \times 10^{-5}$

I.

A. $II < I < IV < III$

B. $III < IV < I < II$

C. $I < III < IV < II$

D. $IV < III < I < II$

Answer: B

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92. 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:, $\left[Use R = 0.08 atm L mol^{-1} K^{-1}\right]$

A. $\frac{1}{3}$

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

C. $\frac{1}{4}$

D. $\frac{1}{4}$

Answer: B

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93. K_p for the reaction

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

at $250^{\circ}C$ is 0.82. Calculate the degree of dissociation at given temperature under a total pressure of $5atm$. What will be the degree of dissociation if the equilibrium pressure is $10atm$, at same temperature.

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94. In reaction:

$CH_3COCH_3(g) \Leftrightarrow CH_3CH_3(g) + CO(g)$,

if the initial pressure of $CH_3COCH_3(g)$ is $150mm$ and at equilibrium the mole fraction of $CO(g)$ is $\frac{1}{3}$, then the value K_P is

A. $50mm$

B. $100mm$

C. $33.3mm$

D. $75mm$

Answer: A

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95. When PCl_5 is heated, it dissociates into PCl_3 and Cl_2. The vapour density of the gas mixture at $200^\circ C$ and at $250^\circ C$ is 70 and 58, respectively. Find the degree dissociation at two temperatures.

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96. 0.25 mol of CO taken in a $1.5L$ flask is maintained at $500K$ along with a catalyst so that the following reaction can take place:

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

Hydrogen is introduced until the total pressure of the system is $8.2atm$, at equilibrium, and $0.1mol$ 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 before are used but no catalyst so that the reaction does take place.

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97. Ammonia under a pressure of $15 atm$, at $27 ^\circ C$ is heated to $327 ^\circ C$ in a vessel in the pressure of catalyst. Under these conditions, NH_3 partially decomposes to H_2 and N_2. The vessel is such that the volume remains effectively constant, whereas the pressure increases to $50 atm$. Calculate the precentage of NH_3 actually decomposed.

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98. Solid Ammonium carbamate dissociates as:

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

In a closed vessel, solid ammonium carbonate 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. Also find the partial pressure of ammonia gas added.

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99. The degree of dissociation of I_2 molecule at $1000\ ^\circ C$ and under $1.0atm$ is $40\ \%$ by volume. If the dissociation is reduced to $20\ \%$ at the same temperature, the total equilibrium pressure on the gas will be:

A. $1.57atm$

B. $2.57atm$

C. $3.57atm$

D. $4.57atm$

Answer: D

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100. $I_2 + I^{\ominus} \Leftrightarrow I_3^{\ominus}$

This reaction is set-up in aqueous medium. We start with 1 mol of I_2 and 0.5 mol of $I^{\ominus}$ in $1L$ flask. After equilibrium reached, excess of $AgNO_3$ gave 0.25 mol of yellow precipitate. Equilibrium constant is

A. 1.33

B. 2.66

C. 2.00

D. 3.00

Answer: A

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101. At $25^\circ C$ and 1 atm, N_2O_4 dissociates the reaction

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

If it is 35% dissociated at given condition, find the volume of above mixture will difuse if $20mL$ of pure O_2 diffuse10 minutes at same yemperature and pressure.

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102. For the reaction

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

Show that the degree of dissociation of NH_3 is given as

$\alpha = \left[1 + \frac{3\sqrt{3}}{4}\frac{P}{K_p}\right]^{-1/2}$, where P is the equilibrium pressure and α is the degree of dissociation. If K_p of the above reaction is 82.1 atm at $727\,^\circ C$, determine the value of K_c.

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103. For the formation of ammonia the equilibrium constant data at $673K$ and $773K$, respectively, are 1.64×10^{-4} and 1.44×10^{-5} respectively. Calculate heat of reaction $\left(R = 8.314JK^{-1}mol^{-1}\right)$

Watch Video Solution

104. For the reaction

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

K is 0.63 at $700\ ^{\circ}C$ and 1.66 at $1000\ ^{\circ}C$.

a. What is the average $\Delta H^{\ominus}$ for the temperature range considered?

b. What is the value of K at $800\ ^{\circ}C$?

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105. The value of K for the reaction

$O_3(g) + OH(g) \Leftrightarrow H(g) + 2O_2(g)$

Changed from 0.096 at $298K$ to 1.4 at $373K$. Above what temperature will the reaction become thermodynamically spontaneous in the forward direction assuming that $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ values for the reaction do not change with change in temperature? Given that $\Delta S^{\ominus}_{298} = 10.296JK^{-1}$.

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106. Which of the following graph represents an exothermix reaction?

A.

B.

C.

D.

Answer: D

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107. A reversible reaction is endothermic in forward direction. Then which of the following is (are) correct?

A. ln K vs $1/T$ will be a straight line with negative slope

B. $\frac{d}{dT}\ln K > 0$

C. A plot of d ln K against $1/T^2$ will have positive slope

D. An increase in temperature will shift the reaction in the forward direction.

Answer: A::B::C

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108. The activation energy of

$H_2 + I_2 \Leftrightarrow 2HI(g)$ in equilibrium for the forward reaction is $167 kJmol^{-1}$ whereas for the reverse reaction is $180 kJmol^{-1}$. The presence of catalyst lowers the activation energy by $80 kJmol^{-1}$. Assuming that the reactions are made at $27\,^{\circ}C$ and the frequency factor for forwatd and backward reactions are 4×10^{-4} and 2×10^{-3} respectively, calculate K_c.

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109. Variation of K with temperature as given by van't Hoff equation can be written as

A. $\log\frac{K_2}{K_1} = -\frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

B. $\log\frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$

C. $\log\frac{K_2}{K_1} = -\frac{\Delta H}{2.303R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$

D. None of the above

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110. It is known that the heat is needed to dissociate ammonia into N_2 and H_2. For the reaction $N_2 + 3H_3 \Leftrightarrow 2NH_3$, K_f is the velocity constant for forward reaction and K_b is velocity constant for backward reaction, K_c is equilibrium constant for the reaction shown. Then $\frac{dk_f}{dT}$ (where T is symbol for absolute temp.):

A. Is greater than dk_b/dT

B. Is less than dk_b/dT

C. Is equal to dk_b/dT

D. Cannot be compared with dk_b/dT

Answer: B

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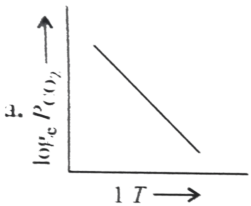
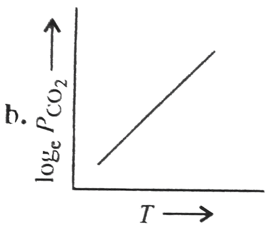
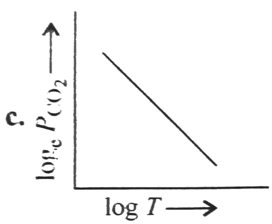
111. For the chemical equilibrium,

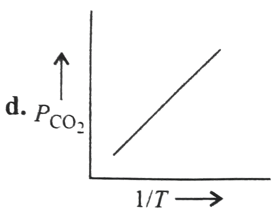
$CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$

$\Delta_r H^{\ominus}$ can be determined from which one of the following plots?

A. 

B. 

C. 

D. 

Answer: A

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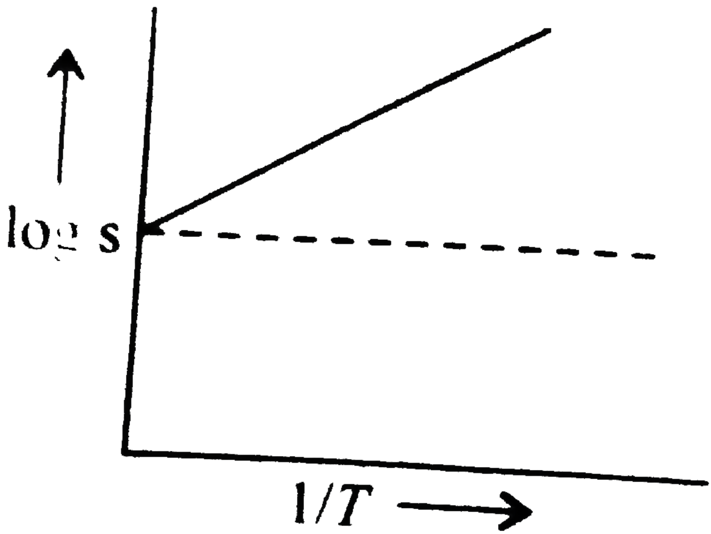
112. Solubility of a solute in water is dependent on temperature as given by

$S = Ae^{-\Delta H/RT}$, where ΔH=heat of solution

Solute+$H_2O(l) \Leftrightarrow$ Solution, $\Delta H = \pm x$

For given solution, variation of log S with temperature is shown graphically. Hence, solution is



A. $CuSO_4.5H_2O$

B. NaCl

C. Sucrose

D. CaO

Answer: D

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113. In the preparation of CaO from $CaCO_3$ using the equilibrium,

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

K_p is expressed as

$$\log K_p = 7.282 - \frac{8500}{T}$$

For complete decomposition of $CaCO_3$, the temperature in celsius to be used is:

A. 1167

B. 894

C. 8500

D. 850

Answer: B

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114. The partial pressure of CO_2 in the reaction

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

Is 0.773 mm at $500\,^{\circ}C$. Calculate K_p at $600\,^{\circ}C$ for the above reaction, ΔH of the reaction is 43.2 kcal per mole and does not change in the given range of temperature.

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115. For the reaction $Br_2 \Leftrightarrow 2Br$, the equilibrium constants at $327\,^{\circ}C$ and $527\,^{\circ}C$ are, respectively, 6.1×10^{-12} and 1.0×10^{-7}. What is the nature of the reaction?

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116. 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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117. The equilibrium constant K_p for the reaction,

$N_2 + 3H_2 \Leftrightarrow 2NH_3$

is 1.64×10^{-4} at $400\,^{\circ}C$ and 0.144×10^{-4} at $500\,^{\circ}C$. Calculate the mean heat of formation of 1 mol of NH_3 from its elements in this temperature range.

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118. For the reaction $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$, the equilibrium constant is 2.8×10^{-5} at $300K$ and 7.0×10^{-1} at $400K$. What is the activation energy for the reaction?

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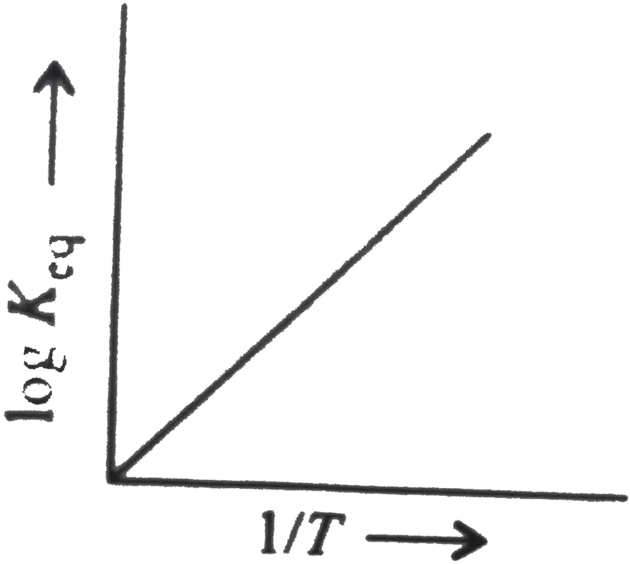
119. A schematic plot of log K_{eq} vs inverse of temperature for a reaction is shown in the figure. The reaction must be:



A. Exothermic

B. Endothermic

C. One with negligible enthalpy change

D. Highly spontaneous at ordinary temperature

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120. For the reaction

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

K is 0.63 at $727\,^\circ C$ and 1.26 at $927\,^\circ C$.

a. What is the average ΔH for the temperature range considered? [Use log 2=0.3]

b. What is the value of K at $1227\,^\circ C$?

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121. The equilibrium constant K_p, for the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is 1.6×10^{-4} at $400\,^\circ C$. What will be the equilibrium constant at $500\,^\circ C$ if the heat of reaction in this temperature range is -25.14 kcal?

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122. The equilibrium constant for the reaction

$H_2(g) + S(s) \Leftrightarrow H_2S(g)$

is 18.5 at $925K$ and 9.25 at $1000K$, respectively. Calculate the enthalpy of the reaction.

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123. Consider the reaction

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

at $375\,^{\circ}C$, the value of equilibrium constant for the reaction is 0.0032. It was observed that the concentration of the three species is $0.050 mol L^{-1}$ each at a certain instant. Discuss what will happen in the reaction vessel?

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124. Consider the reaction

$X(g) \Leftrightarrow Y(g) + Z(g)$

When the system is at equilibrium at $100\,^{\circ}$, the concentrations are found to be $[X] = 0.2M$, $[Y] = [Z] = 0.4M$

a. If the pressure of the container is suddenly halved at $100\,^{\circ}C$, find equilibrium concentration.

b. If the pressure of the container is suddenly doubled at $100\,^{\circ}C$, find the equilibrium concentration

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125. The value of K_c for the reaction $2A \Leftrightarrow B + C$ is 2.0×10^{-3}. At a given time, the composition of reaction mixture is $[A] = [B] = [C] = 3 \times 10^{-4}M$. In which direction the reaction will proceed?

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126. The value of K_c for the reaction:

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

at $100\,^{\circ}C$ is 49. If $1.0L$ flask containing one mole of A_2 is connected with a $2.0L$ flask containing one mole of B_2, how many moles of AB will be formed at $100\,^{\circ}C$?

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127. The value of K_c for the reaction

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

is 64 at $773K$. If one "mole" of H_2, one mole of I_2, and three moles of HI are taken in a $1L$ flask, find the concentrations of I_2 and HI at equilibrium at $773K$.

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128. In a $1.0L$ aqueous solution when the reaction

$2Ag^{\oplus}(aq) + Cu(s) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$

reaches equilibrium, $\left[Cu^{2+}\right] = Cu(s) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$

reaches equilibrium, $\left[Cu^{2+}\right] = xM$ and $\left[Ag^{\oplus}\right] = yM$.

If the volume of solution is doubled by adding water, then at equilibrium:

A. $\left[Cu^{2+}\right] = \frac{x}{2}M, \left[Ag^{\oplus}\right] = \frac{y}{2}M$

B. $\left[Cu^{2+}\right] > \frac{x}{2}M, \left[Ag^{\oplus}\right] > \frac{y}{2}M$

C. $\left[Cu^{2+}\right] < \frac{x}{2}M, \left[Ag^{\oplus}\right] > \frac{y}{2}M$

D. $\left[Cu^{2+}\right] < \frac{x}{2}M, \left[Ag^{\oplus}\right] < \frac{y}{2}M$

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129. H_2 and I_2 are mixed at $400\,^\circ C$ in a $1.0L$ container, and when equilibrium is established, the following concentrations are present: $[HI] = 0.8M$, $\left[H_2\right] = 0.08M$, and $\left[I_2\right] = 0.08M$. If now an additional 0.4 mol of HI is added, what are the new equilibrium concentrations, when the new equilibrium $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is re-established?

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130. At $448\,^\circ C$, the equilibrium constant $\left(K_c\right)$ for the reaction

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

is 50.5. Presict the direction in which the reaction will proceed to reach equilibrium at $448\,^\circ C$, if we start with 2.0×10^{-2} mol of HI, 1.0×10^{-2} mol of H_2 and 3.0×10^{-2} mol of I_2 in a $2.0L$ constainer.

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131. The value of $\Delta G^{\ominus}$ for the phosphorylation of glucose in glycolysis is $13.8kJmol^{-1}$. Find the value of K_c at $298K$

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132. Hydrolysis of sucrose gives

$\text{Sucrose}+H_2O \Leftrightarrow \text{Glucose} + \text{Fructose}$

Equilibrium constant K_c for the reaction is 2×10^{13} at $300K$. Calculate $\Delta G^{\ominus}$ at $300K$.

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133. If K_c is not numerically equal to K_p, how can both of the following equations be valid?

$\Delta G^{\ominus} = -2.303RT\log K_c, \Delta G^{\ominus} = -2.303RT\log K_p$

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134. The value of K_p at $298K$ for the reaction

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

is found to be 826.0, partial pressure being measured atmospheric units.

Calculate $\Delta G^{\ominus}$ at $298K$.

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135. For the reaction,

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

Calculate the standard equilibrium constant at $298K$. Given that the value of $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ of the reaction at $298K$ are $77.2kJmol^{-1}$ and $122JK^{-1}mol^{-1}$.

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136. $\Delta G^{\ominus}$ for $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \Leftrightarrow NH_3(g)$ is $-16.5kJmol^{-1}$. Find out K_p for the reaction at $25\,^{\circ}C$. Also report K_p and $\Delta G^{\ominus}$ for $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at $25\,^{\circ}C$.

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137. In the reaction equilibrium

$N_2O_4 \Leftrightarrow 2NO_2(g)$

When 5 mol of each is taken and the temperature is kept at $298K$, the total pressure was found to be 20 bar.

Given : $\Delta_f G^{\ominus}_{n_2O_4} = 100kJ, \Delta_f G^{\ominus}_{NO_2} = 50KJ$

a. Find ΔG of the reaction at $298K$.

b. Find the direction of the reaction.

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138. A large positive value of $\Delta G^{\ominus}$ corresponds to which of these?

A. Small positive K

B. Small negative K

C. Large positive K

D. Large negative K

Answer: A

Watch Video Solution

139. For the reaction

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

in a closed flask, the equilibrium pressure is P atm. The standard free energy of the reaction would be:

A. $-RT\ln p$

B. $-RT(\ln p - \ln 2)$

C. $-2RT\ln p$

D. $-2RT(\ln p - \ln 2)$

Answer: D

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140. $\Delta G^{\ominus}$ for the reaction $X + Y \Leftrightarrow C$ is -$4.606 kcal at$1000 K`. The equilibrium constant for the reverse mode of the reaction will be:

A. 100

B. 10

C. 0.01

D. 0.1

Answer: D

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141. For the following reaction: $K = 1.7 \times 10^7$ at $25\,^{\circ}C$

$Ag^{\oplus}(aq) + 2NH_3(aq) \Leftrightarrow \left[Ag\left(NH_3\right)_2\right]^{\oplus}$

What is the value of $\Delta G^{\ominus}$ in kJ?

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142. In an equilibrium reaction for which $\Delta G^{\ominus} = 0$, the equilibrium constant K should be equal to :

A. Zero

B. 10

C. 1

D. 2

Answer: C

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143. What is $\Delta G^{\ominus}$ for the following reaction?

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \Leftrightarrow NH_3(g), K_p = 4.42 \times 10^4$ at $25^\circ C$

A. $-26.5 kJmol^{-1}$

B. $11.5 kJmol^{-1}$

C. $-2.2 kJmol^{-1}$

D. $-0.97 kJmol^{-1}$

Answer: A

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144. If the E° for a given reaction has a negative value, then which of the following gives the correct relationship for the of ΔG° and k_{aq}?

A. $\Delta G^{\ominus} > 0, K_{eq} < 1$

B. $\Delta G^{\ominus} > 0, K_{eq} > 1$

C. $\Delta G^{\ominus} < 0, K_{eq} > 1$

D. $\Delta G^{\ominus} < 0, K_{eq} < 1$

Answer: A

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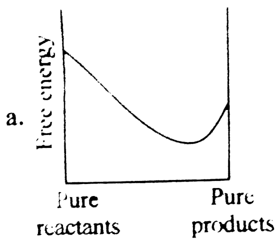
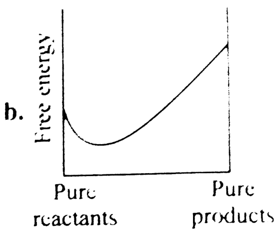
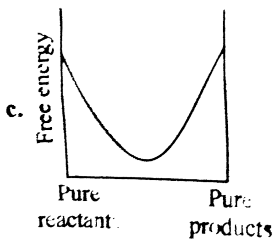
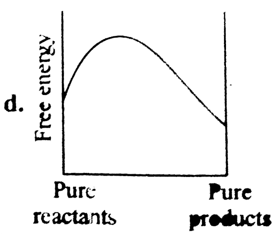
145. Which of the following graph correctly represent for equilibrium reaction whose $K_p > 1$?

A. 

B. 

C. 

D. 

Answer: A

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146. The equilibrium constant K_p for the homogeneous reaction is 10^{-3}. The standard Gibbs free energy change $\Delta G^{\ominus}$ for the reaction at $27^{\circ}C\left(\text{using} R = 2calK^{-1}mol^{-1}\right)$ is

A. Zero

B. $-1.8kcal$

C. $-4.154kal$

D. $+4.154kcal$

Answer: D

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147. The free energy of formation of NO is $78kJmol^{-1}$ at the temperature of an authomobile engine $(1000K)$. What is the equilibrium constant for this reaction at $1000K$?

$$\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow NO(g)$$

A. 8.4×10^{-5}

B. 7.1×10^{-9}

C. 4.2×10^{-10}

D. 1.7×10^{-19}

Answer: A

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148. The densities of graphite and diamond are 22.5 and 3.51 gm cm^{-3}. The $\Delta_f G^\ominus$ values are $0Jmol^{-1}$ and $2900Jmol^{-1}$ for graphite and diamond, respectively. Calculate the equilibrium pressure for the conversion of graphite into diamond at $298K$.

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149. Calculate the pressure of CO_2 gas at $700K$ in the heterogenous equilibrium reaction $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$, if $\Delta G^{\ominus}$ for this reaction is $130.2kJmol^{-1}$.

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150. For the equilibrium

$NiO(s) + CO(g) \Leftrightarrow Ni(s) + CO_2(g)$

$\Delta G^{\ominus}\left(Jmol^{-1}\right) = -20700 - 11.97T$. Calculate the temperature at which the product gases at equilibrium at 1 atm will contain 400 ppm of carbon monoxide.

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151. K_c for the reaction $N_2O_4 \Leftrightarrow 2NO_2$ in chloroform at $291K$ is 1.14. Calculate the free energy change of the reaction when the concentration of the two gases are 0.5 mol dm^{-3} each at the same temperature. $\left(R = 0.082 LatmK^{-1}mol^{-1}\right)$

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152. A reaction mixture containing H_2, N_2 and NH_3 has partial pressures 2 atm, 1 atm, and 3 at,. Respectively, at $725K$. If the value of K_p for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is $4.28 \times 10^{-5} atm^{-2}$ at $725K$, in which direction the net reaction will go?

A. Forward

B. Backward

C. No net reaction

D. Direction of reaction cannot be predicted.

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153. i. The initial pressure of PCl_5 present in one litre vessel at $200K$ is 2 atm. At equilibrium the pressure increases to 3 atm with temperature increasing to 250. The percentage dissociation of PCl_5 at equilibrium is

A. $30\ \%$

B. $60\ \%$

C. $0.2\ \%$

D. $20\ \%$

Answer: D

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154. ii. One mole of $N_2O_4(g)$ at $100K$ is kept in a closed container at 1.0 atm pressure. It is heated to $300K$, where $30\ \%$ by mass of $N_2O_4(g)$ decomposes to $NO_2(g)$. The resultant pressure will be

A. $3.9 atm$

B. $1.95 atm$

C. $1.0 atm$

D. $3.0 atm$

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155. The density of an equilibrium mixture of N_2O_4 and NO_2 at 1 atm is $3.62 gL^{-1}$ at $288K$ and $1.84 gL^{-1}$ at $348K$. Calculate the entropy change during the reaction at $348K$.

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156. Which of the following conditions help melting of ice?

A. High pressure, temperature below $0^{\circ} C$

B. High pressure, temperature above $0^{\circ} C$

C. Low pressure, temperature above $0^{\circ} C$

D. Low pressure, temperature below $0^{\circ} C$

Answer: B

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157. Densities of diamond and graphite are 3.5 and $2.3 gmL^{-1}$, respectively.

The increase of pressure on the equilibrium $C_{\text{diamond}} \Leftrightarrow C_{\text{graphite}}$

A. Favours backward reaction

B. Fovours forward reaction

C. Have no effect

D. Increases the reaction rate

Answer: C

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158. K_p for an endothermic chemical reaction is 10 atm. Then backward reaction is favoured at

A. High pressure, high temperature

B. High pressure, low temperature

C. Low pressure, high temperature

D. Low pressure, low temperature

Answer: C

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159. For the following reaction, the value of K change with

$N_2(g) + O_2(g) < \; < 2NO(g), \Delta H = \; + 180kJmol^{-1}$

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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160. Which among the following reactions is favoured in forward direction by increase of temperature?

A. $N_2(g)3H_2(g) \Leftrightarrow 2NH_3(g) + 22.9kcal$

B. $N_2(g) + O_2(g) \Leftrightarrow 2NO(g) - 42.8kcal$

C. $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g) + 45.3kcal$

D. $H_2(g) + Cl_2(g) - 44kcal \Leftrightarrow 2HCl(g)$

Answer: B

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161. 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. Increasing the temperature

B. Removing Cl_2

C. Increasing the volume of the container

D. Adding F_2

Answer: D

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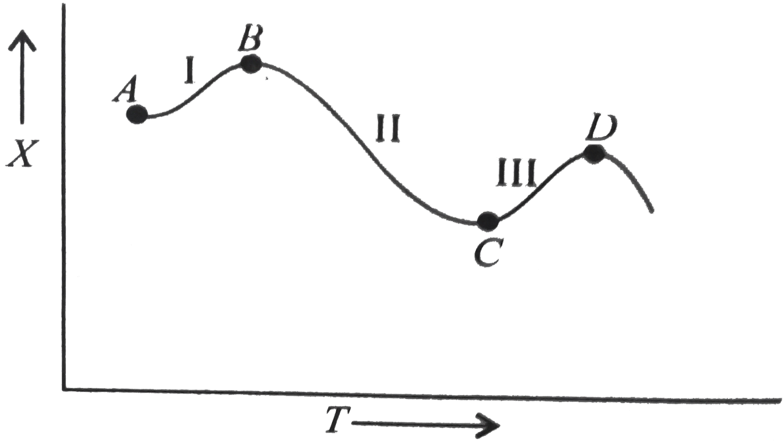
162. For the following reaction through stages I, II and III

$$A \xrightarrow{I} B \xrightarrow{II} C \xrightarrow{III} D$$

quantity of the product formed (x) varies with temperature (T) as given.

Select the correct statement.



A. Stages I and III are endothermic but II is exothermic.

B. Stages I and III are exothermic but II is endothermic

C. Stages II and III are exothermic but I is endothermic

D. Stage I is exothermic but stages II and III are endothermic.

Answer: A

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163. Which among the following reactions will be favoured at low pressure?

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

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

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

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

Answer: C

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164. Consider the following reversible reactionat equilibrium:

$2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g), \Delta H = \ + 24.7kJ$

Which one of the following changes in conditions will lead to maximum decomposition of $H_2O(g)$?

A. Increasing both temperature and pressure

B. Decreasing temperature and increasing pressure

C. Increasing temperature and decreasing pressure

D. Increasing temperature at constant pressure

Answer: C

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165. A gas X when dissolved in water, heat is evolved. Then solubility of X will increases at

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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166. $Au(s) \Leftrightarrow Au(l)$

above mentioned equilibrium is fovoured at

A. High pressure, lowtemperature

B. High pressure, high temperature

C. Low pressure, high temperature

D. Low pressure, low temperature

Answer: C

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167. What is the direction of a reversoble reaction when one of the products of the reaction is removed?

A. The reaction moves towards right hand side.

B. The reaction moves towards left hand side

C. The reaction moves towards both hand side

D. The reaction stops.

Answer: A

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168. According to le-Chatelier's principle, adding heat to a solid and liquid in equilibrium will cause the

A. Amount of solid to decrease

B. Amount of liuid to decrease

C. Temperature to rise

D. Temperature to fall

Answer: A

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169. The equilibrium constant for the reaction, $A + B \Leftrightarrow C + D$ is 2.85 at room temperature and 1.4×10^{-2} at $698K$. This shows that the forward reaction is

A. Exothermic

B. Endothermic

C. Unpredictable

D. There is no relationship between ΔH and K.

Answer: A

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170. Le Chatelier's principle is applicable to:

A. Only homogeneous chemical reversible reactions

B. Only heterogeneous chemical reversible reactions

C. Only physical equilibria

D. All system, chemical or physical, in equilibrium

Answer: D

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171. Solubility of a gas in liquid increases on

A. Addition of a catalyst

B. Decreaseing of pressure

C. Increasing of pressure

D. Increasing of temperature

Answer: C

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172. When any system in equilibrium is subjected to a change in pressure, concentration, or temperature, the equilibrium is shifted in the direaction which tends to undo the effect of the change. This statement is known as

A. First law of thermodynamics

B. Le Chatelier's principle

C. Hess's law

D. Ostwald/s law

Answer: B

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173. The equilibrium constant for the reaction $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ is 4.0×10^{-4} at $2000K$. In the presence of a catalyst, the equilibrium is attained 10 times faster. Therefore, the equilibrium constant in presence of the catalyst at $2000K$ is

A. 4×10^{-4}

B. 40×10^{-4}

C. 4×10^{-2}

D. Difficult to compute without more data

Answer: A

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174. When KOH is dissolved in water, heat is evolved. If the temperature is raised, the solunility of KOH

A. Increases

B. Decreases

C. Remains the same

D. Cannot be predicted

Answer: B

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175. Le Chatelier's principle is not applicable to

A. $Fe(s) + S(s) \Leftrightarrow FeS(s)$

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

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

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

Answer: A

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176. Consider the reaction

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

in closed container at equilibrium. What would be the effect of addition of $CaCO_3$ on the equilibrium concentration of CO_2?

A. Increase

B. Decreases

C. Remains unaffected

D. Data is not sufficient to predict it

Answer: C

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177. The equilibrium constant for a reaction $A + B \Leftrightarrow C + D$ is 1×10^{-2} at $298K$ and is 2 at $273K$. The chemical process resulting in the formation of C and D is

A. Exothermic

B. Endothermic

C. Unpredictable

D. There is no relationship between ΔH and K.

Answer: A

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178. In a flask, colourless N_2O_4 is in equilibrium with brown-coloured NO_2. At equilibrium, when the flask is heated to $100\,^\circ C$ the brown colour deepens and on cooling, the brown colour became less coloured. The change in enthalpy ΔH for the ayatem is

A. Nagative

B. Positive

C. Zero

D. Not defined

Answer: A

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179. Consider the following equilibria:

$I.\ A(s) \Leftrightarrow B(s), II.\ A(s) \Leftrightarrow B(l)$

$III.\ A(l) \Leftrightarrow B(l), IV.\ A(g) \Leftrightarrow B(g)$

Which of the above will be disturbed by an increase in pressure?

A. II

B. I, II

C. I, II, III,

D. None of these

Answer: D

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180. 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. PCl_5 will remain unchanged

B. Cl_2 will be greater

C. PCl_5 will become greater

D. PCl_5 will become less

Answer: D

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181. The oxidation of SO_2 by O_2 to SO_3 is an exothermic process. The yield of SO_3 is maximum if

i. Temperature is increased and pressure is kept constant

ii. Temperature is reduced and pressure is kept constant

iii. Pressure is increased

iv. Temperature and pressure both are increased

The correct option is:

A. I, ii

B. i, iii

C. ii, iii

D. ii, iii, ive

Answer: C

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182. The position of equilibrium will shift, by the addition of inert gas at constant pressure condition, in the following case(s):

a. $N_2(g) + 3F^2(g) \Leftrightarrow 2NF_2(g)$, forward direction

b. $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$, forward direction

c. $CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(g)$, backward direction

d. $2C(s) + O_2(g) \Leftrightarrow 2CO(g)$, forward direction

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183. $COCl_2$ gas decomposes as:

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

If one mole of He gas is added in the vessel at equilibrium at constant pressure then

A. $\left[COCl_2\right]$ increases.

B. "moles" of CO will increases.

C. The reaction goes in forward goes in forward direction.

D. $K_c = 1$

Answer: B::C

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184. What would be the effect of increasing the volume of each of the following system at equilibrium?

a. $2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g)$

b. $NI(s) + 4CO(g) \Leftrightarrow NI(CO)_4(g)$

c. $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

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185. What happens when an inert gas is added to

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

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

at equilibrium at : (a) constant pressure and temperature and temperature, and (b) at constant volume and temperature.

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186. What is the effect of temperature and pressure on the yields of products?

a. $N_2(s) + 3H_2(g) \Leftrightarrow 2NH_3 + xcal$

b. $N_2(g) + O_2(g) \Leftrightarrow 2NO(g) - ycal$

c. $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g) + 46.9kcal$

d. $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g) - 15.0kcal$

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187. What would happen to a reversible reaction at equilibrium, when

a. The temperature is raised, given that its ΔH is positive.

b. The temperature is lowered, given that its ΔH is positive.

c. The temperature is lowered, given that its ΔH is negative.

The prssure is lowered, given that Δn is negative.

e. The pressure is incteased, given Δn is negative.

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188. Which of the following factors will increase the solubility of NH_3 gas in H_2O?

a. Increase in pressure

b. Addition of water

c. Increase in temperature

d. Decrease in pressure

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189. An aqueous solution of hydrogen sulphide shows the equilibrium:

$H_2S \Leftrightarrow H^{\oplus} + HS^{\ominus}$

If dilute hydrochloric acid is added to an aqueous solution of H_2S, without any change in temperature, the

a. The equilibrium constant will change.

b. The concentration $HS^{\ominus}$ will increase.

c. The concentration of un-dissociated hydogen sulphide will decrease.

d. The concentration of $HS^{\ominus}$ will decrease.

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190. Consider the equilibrium

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

How would the following affect the position of equilibrium?

a. Addition of PCl_3

b. Addition of Cl_2

c. Removal of PCl_5

e. Addition of He without a change in volume

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191. The reaction between H_2 and CO_2 to form CO and H_2O in the gas phase is exothermic. Predict the changes that take place when the system originally at equilibrium is stressed in each of the following wats

a. CO_2 is removed.

b. CO is reamoved.

c. The temperature is decreased.

d. The pressure of the system is increased.

e. The volume of the system is increased.

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192. State which one is homogeneous or heterogeneous?

a. $S_{\text{Rhombus}} \Leftrightarrow S_{\text{Monoclinic}}$

b. $H_2O(l) \Leftrightarrow H_2O(g)$

c. $H_2O(s) \Leftrightarrow H_2O(l)$

d. $C_{\text{Diamond}} \Leftrightarrow C_{\text{Amorphous}}$

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

f. $CuSO_4(s) + 3NH_3(g) \Leftrightarrow CuSO_4.3NH_3(l)$

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

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193. If a mixture of 3 mol of H_2 and 1mole of N_2 is completely converted into NH_3, what would be the ratio of the initial and final volume at same temperature and pressure?

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194. 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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195. For the reaction, $A + B \Leftrightarrow 2C$, 2 mol of A and 3 mol of B are allowed to react. If the equilibrium constant is 4 at $400\,^{\circ}C$, what will be the moles of C at equilibrium?

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196. In which case does the reaction go farthest to completion: $K = 1, K = 10^{-10}$, and why?

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197. One mole of H_2 two moles of I_2 and three moles of HI are injected in one litre flask. What will be the concentration of H_2, I_2 and HI at equilibrium at $500\,^{\circ}C$. K_c for reaction $H_2 + I_2 \Leftrightarrow 2HI$ is 45.9.

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198. $0.5 mol$ of H_2 and 0.5 mol of I_2 react in $10L$ flask at $448\,^{\circ}C$. The equilibrium constant $\left(K_c\right)$ is 50 for

$H_2 + I_2 \Leftrightarrow 2HI$

a. What is the value of K_p?

b. Calculate the moles of I_2 at equilibrium.

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199. The activation energy of $H_2 + I_2 \Leftrightarrow 2HI$ in equilibrium for the forward reaction is $167 kJmol^{-1}$ whereas for the reverse reaction is $180 kJmol^{-1}$. The presence if catalyst lowers the activation energy by $80 kJmol^{-1}$. Assuming that the reaction are made at $27\,^{\circ}C$ and the frequency factorr for the forward and backward reactions are 6×10^{-4} and 3×10^{-3}, respectively, calculate K_c.

Watch Video Solution

200. K_c for $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$ at $986\ ^\circ C$ is 0.63. A mixture of 1 mol $H_2O(g)$ and 3 mol $CO_2(g)$ is allowed to react to come to an equilibrium. The equilibrium pressure is 2.0 atm.

a. Hoe many moles of H_2 are present at equilibrium ?

b. Calculate partial pressure of each gas at equilibrium.

Watch Video Solution

201. At $700K$, CO_2 and H_2 react to form CO and H_2O. For this purpose, K_c is 0.11. If a mixture of 0.45 mol of CO_2 and 0.45 mol of H_2 is heated to $700K$.

(a) Find out amount of each gas at equilibrium.

(b) When equilibrium has been reached, another 0.34 mol of CO_2 and

0.34 mol of H_2 are added to the reaction mixture. Find the composition of of mixture at new equilibrium.

Watch Video Solution

202. The degree of dissociation of N_2O_4 into NO_2 at 1 atm $40^\circ C$ is 0.310. Calculate its K_p at $40^\circ C$. Also report the degree of dissociation at 10 atm pressure at same temperature.

Watch Video Solution

203. N_2O_4 dissociates as

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

At $40^\circ C$ and one atmosphere % decomposition of N_2O_4 is 50.3%. At what pressure and same temperature, the equilibrium mixture has the ratio of $N_2O_4 : NO_2$ as $1:8$?

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204. An equilibrium mixture at $300K$ contains N_2O_4 and NO_2 at 0.28 and $1.1atm$, respectively. If the volume of container is doubles, calculate the new equilibrium pressure of two gases.

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205. At $25^\circ C$ and $1atm$ pressure, the partial pressure in equilibrium mixture of N_2O_4 and NO_2, are 0.7 and $0.3atm$, respectively. Calculate the partial pressures of these gases when they are in equilibrium at $25^\circ C$ and a total pressure of $10atm$.

Watch Video Solution

206. Prove $\alpha = \sqrt{\left(\frac{K_p}{P + K_p}\right)}$ for

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

where α is the degree of dissociation at temperature when equilibrium constant is K_p.

Watch Video Solution

207. At some temperature and under a pressure of 4 atm, PCl_5 is 10% dissociated. Calculated the pressure at which PCl_5 will be 20% dissociated temperature remaining same.

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208. 1mol of Cl_2 and 3 mol of PCl_5 are placed in a $100L$ vessel heated to $227^\circ C$. The equilibrium pressure is 2.05 atm. Assuming ideal behaviour, calculate the degree of dissociation for PCl_5 and K_p for the reaction.

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

Watch Video Solution

209. One "mole" of N_2 is mixed with three moles of H_2 in a $4L$ vessel. If 0.25% N_2 is coverted into NH_3 by the reaction

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, calculate K_c. Also report K_c for

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

Watch Video Solution

210. NH_3 is heated at 15 at, from $25^\circ C$ to $347^\circ C$ assuming volume constant. The new pressure becomes 50 atm at equilibrium of the reaction $2NH_3 \Leftrightarrow N_2 + 3H_2$. Calculate % moles of NH_3 actually decomposed.

Watch Video Solution

211. What is the % dissociation of H_2S if 1 "mole" of H_2S is introduced into a $1.10L$ vessel at $1000K$? K_c for the reaction

$2H_2S(g) \Leftrightarrow 2H_2(g) + S_2(g)$ is 1×10^{-6}

Watch Video Solution

212. Some solid NH_4HS is placed in flask containing 0.5 atm of NH_3. What would be the pressure of NH_3 and H_2S when equilibrium is reached.

$NH_4HS(g) \Leftrightarrow NH_3(g) + H_2S(g), K_p = 0.11$

Watch Video Solution

213. 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 showa that 54.3% of the acid is eaterified. Calculate K_c.

Watch Video Solution

214. 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.

Watch Video Solution

215. When α - D glucose is dissolved in water, it undergoes a partial converion to β - 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.

Watch Video Solution

216. Calculate K_c for the reaction $KI_{I\_}(2) \Leftrightarrow KI_3$. Given that initial weight of KI is $1.326g$ weight of KI_3 is $0.105g$ and number of moles of free I_2 is 0.0025 at equilibrium the volume of solution is 1 - L.

Watch Video Solution

217. 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.

Watch Video Solution

Watch Video Solution

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

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

$NO + NO_2 \Leftrightarrow N_2O_3$

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 $NO + NO_2 \Leftrightarrow N_2O_3$.

Watch Video Solution

219. N_2 and O_2 combine at a given temperature to produce NO. At equilibrium the yield of NO is 'x' precent by volume. If $x = \sqrt{Ka.b} - \frac{K(a+b)}{4}$, where K is the equilibrium constant of the given reaction at the given temperature and a and b are the volume percentage of N_2 and O_2, respectively, in the initial state. Report. Report the maximum value of K at which X is maximum

Watch Video Solution

220. A vessel at $1000K$ contains carbon dioxide with a pressure of $0.5atm$. 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 $0.8atm$.

Watch Video Solution

221. The equilibrium constant K_p of the reaction: $2SO_2 + O_2 \Leftrightarrow 2SO_3$ is $900atm^{-1}$ at $800K$. A mixture constaining SO_3 and O_2 having initial pressure of 1 atm and 2 atm respectively, is heated at constant volume to equilibriate. Calculate the partial pressure of each gas at $800K$ at equilibrium.

Watch Video Solution

222. When 0.15 mol of CO taken in a $2.5L$ flask is maintained at $750K$ along with a catalyst, the following reaction takes place

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

Hydrogen is introduced until 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 before are used, but with no catalyst so that the reaction does not take place.

Watch Video Solution

223. For the reaction

$Ag(CN)_2^{\ominus} \Leftrightarrow Ag^{\oplus} + 2CN^{\ominus}$, the K_c at $25\,^{\circ}C$ is 4×10^{-19} Calculate $\left[Ag^{\oplus}\right]$ in solution which was originally $0.1M$ in KCN and $0.03M$ in $AgNO_3$.

Watch Video Solution

224. $\Delta G^{\ominus} = 77.77 kJmol^{-1}$ at $1000K$ for the reaction $1/2N_2(g) + 1/2O_2(g) \Leftrightarrow NO(g)$. What is the partial pressure of NO under equilibrium at $1000K$ for air at $1atm$ pressure containing $80\% N_2$ and $20\% O_2$ volume.

Watch Video Solution

225. A saturated aqueous dolution of $Mg(OH)_2$ has a vapour pressure of $759.5mm$ at $373K$. Calculate the solubility product of $Mg(OH)_2$. (Assume molarity equals molality).

Watch Video Solution

226. For the reaction $CaCO_3(s) \Leftrightarrow CaO(s)\ K_p = 1.16$ atm at $800\ ^{\circ}C$.

If $20g$ of $CaCO_3$ was put in to $10L$ container and heated to $800\ ^{\circ}C$, what percentage of the $CaCO_3$ would remain unreacted at equilibrium.

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227. Consider the reaction:

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

When the system is at equilibrium at $200^{\circ} C$, the concentrations are found to be:

$[A] = 0.20M, [B] = 0.30M, [C] = 0.30M$

a. If the volume of the container is suddenly doubled at $200^{\circ} C$, find the equilibrium concentrations.

b. If the volume of the container is suddenly halved (instead of being doubled in part (i) at $200^{\circ} C$, find the equilibrium concentrations.

Watch Video Solution

228. 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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229. Calculate the total pressure developed in a vessel containing a mixture of three parts H_2 and one part of N_2 to give a mixture containing 10% ammonia (by moles) at equilibrium at $450\ ^{\circ}C$.

K_p for $N_2 + 3H_2 \rightarrow 2NH_3$ is $1.6 \times 10^{-4} atm$ units at $450\ ^{\circ}C$

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230. A container of volume VL contains an equilibrium mixture that consists of 2 mol each of gaseous PCl_5, Pcl_3 and Cl_2 at 3 atm TK. Some Cl_2 is added unitl the volume is double keeping P and T constant. Calculate moles of Cl_2 added and K_p for $PCl_5 \rightarrow PCl_3 + Cl_2$

Watch Video Solution

231. Consider the following equilibrium:

$SO_3 \rightarrow SO_2 + O_2$

$8.0g$ of SO_3 are put in a container at $600\ ^{\circ}C$. The equilibrium pressure and density are 1.8 atm and $1.6gL^{-1}$, respectively

a. Find the value of K_p.

b. Also find the moles of helium that is to be added at equilibrium to double the pressure at constant temperature.

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232. When $N_2O_5(g)$ is heated it dissociates to give N_2O_3 and O_2. K_c for $N_2O_5 \rightarrow N_2O_3 + O_2$ is 7.75 and K_c for $N_2O_3 \rightarrow N_2O + O_2$ is $4.0 molL^{-1}$. (both K_c are at same temperature) 4 mol N_2O_5 in $1.0L$ vessel is kept at a certain temperature. the concentration of O_2 was $4.5 molL^{-1}$. Find the concentration of N_2O_5, N_2O_3, and N_2O at equilibrium.

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233. For a reversible reaction: $X + 2Y \rightarrow 2Z$, the equilibrium concentrations of X, Y and Z are $0.32, 0.40$ and 0.35 moles L^{-1} respectively at $25^\circ C$.

a. If unitially the system contained only X and Y and then reached the state of equilibrium, what were the initial concentrations of X and Y.

b. If at the start only X and Z were present, what were the initial concentrations?

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234. Under what pressure conditions $CuSO_4.\ 5H_2O$ be efforscent at $35\ ^\circ C$. How good a drying agent is $CuSO_4.3H_2O$ at the same temperature? Given

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

$K_p = 1.268 \times 10^{-3} atm^2$ at $35\ ^\circ C$. Vapoure pressure of water at $35\ ^\circ C$ is $25.0 mmHg$.

Watch Video Solution

235. Under what pressure conditions $CuSO_4.5H_2O$ be efforescent at $25\ ^\circ C$. How good a drying agent is $CuSO_4.3H_2O$ at the same temperature? Given

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

$K_p = 1.086 \times 10^{-4} atm^2$ at $25^\circ C$. Vapour pressure of water at $25^\circ C$ is 23.8 mm of Hg.

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236. From the data given below derive which of the following reactant is most effective drying agent at $0^\circ C$. Given $P^\circ_{H_2O} = 4.58 mm$ at $0^\circ C$.

i. $SrCl_2.6H_2O(s) \Leftrightarrow SrCl_2.2H_2O(s) + 4H_1O(g), K_p = 6.9 \times 10^{-12} atm^4$

ii. $Na_2SO_4.10H_2O(s) \Leftrightarrow Na_2SO_4(s) + 10H_2O(g), K_p = 4.08 \times 10^{-25} atm^{10}$

iii.

$Na_2HPO_4.\ 12H_2O(s) \Leftrightarrow Na_2HPO_4.\ 7H_2O(s) + 5H_2O(g), K_p = 5.525 \times 10^{-13} atm^5$

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237. Following two equilibria are established on mixing two gases A_2 and C.

i. $3A_2(g) \Leftrightarrow A_6(g) \quad K_p = 1.6 atm^{-2}$

ii. $A_2(g) + C(g) \Leftrightarrow A_2C(g)$

If A_2 and C mixed in $2:1$ molar, ratio calculate the equilibrium partial pressure of A_2, C, A_2C and K_p for the reaction (ii). Given that the total pressure to be 1.4 atm and partial pressure of A_6 to be 0.2 atm at equilibrium

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238. 1 mol of A in 1 litre vessel maintained at constant T shows the equilibrium

$A(g) \Leftrightarrow B(g) + 2C(g) \quad K_{C_1}$

$C(g) \Leftrightarrow 2D(g) + 3B(g) \quad K_{C_2}$

If the equilibrium pressure is $\frac{13}{6}$ times of initial pressure and $[C]_{eq} = \frac{4}{9}[A]_{eq}$, Calculate K_{C_1} and K_{C_2}.

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239. One "mole" of $N_2O_4(g)$ at $100K$ is kept in a closed container at 1.0 atm pressure. It is heated to $400K$, where 30% by mass of $N_2O_4(g)$ decomposes to $NO_2(g)$. The resultant pressure will be

A. 4.2

B. 5.2

C. 3.2

D. 6.2

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Concept Applicationexercise 7.1

1. In a reaction between hydrogen and iodine $6.84 mol$ of hydrogen and 4.02 mol of iodine are found to be in equilibrium with 42.85 mol of hydrogen iodide at $350\,^{\circ}C$. Calculate the equilibrium constant.

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2. Calculate the equilibrium constant K_p and K_c for the reaction: $CO(g) + 1/2O_2(g) \Leftrightarrow CO_2(g)$. Given that the partial pressure at equilibrium in a vessel at $3000K$ are $p_{CO} = 0.4atm, p_{CO_2} = 0.2atm$

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3. The equilibrium composition for the reaction is

PCl_3	+ Cl_2	$\Leftrightarrow$	PCl_5
0.20	0.10		$0.40molL^{-1}$

What will be the equilibrium concentration of PCl_5 on adding $0.10mol$ of Cl_2 at the same temperature?

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4. For the reaction

$Cu(s) + 2Ag^{\oplus}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$

Fill in the blanks in the following table for the three solution at equilibrium.

Solution	$[Cu^{2+}(aq)]$	$[Ag^{\oplus}(aq)]$	KL^{-1}
	$molL^{-1}$	$molL^{-1}$	$molL^{-1}$
1.	(a)	1.0×10^{-9}	2.0×10^{15}
2.	2.0×10^{-7}	1.0×10^{-11}	(b)
3.	2.0×10^{-2}	(c)	2.0×10^{15}

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5. The value of K_c for the reaction:

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

at $100\,^{\circ}C$ is 49. If $1.0L$ flask containing one mole of A_2 is connected with a $2.0L$ flask containing one mole of B_2, how many moles of AB will be formed at $100\,^{\circ}C$?

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6. At $440\,^{\circ}C$, the equilibrium constant (K) for the following reaction is 49.5, $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$. If 0.2 mol of H_2 and 0.2 mol of I_2 are placed in a 10 - L vessel and permitted to react at this temperature, what will be the concentration of each substance at equilibrium?

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7. When 0.15 mol of CO taken in a $2.5L$ flask is maintained at $750K$ along with a catalyst, the following reaction takes place

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

Hydrogen is introduced until 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 before are used, but with no catalyst so that the reaction does not take place.

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8. A vessel at $1000K$ contains carbon dioxide with a pressure of $0.5atm$. 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 $0.8atm$.

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9. 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?

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10. For an equilibrium reaction, the rate constants for the forward and the backward reaction are 2.38×10^{-4} and 8.15×10^{-5}, respectively. Calculate the equilibrium constant for the reaction.

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11. In a reaction between H_2 and I_2 at a certain temperature, the amounts of H_2, I_2 and HI at equilibrium were found to be 0.45 mol, 0.39 mol, and 3.0 mol respectively. Calculate the equilibrium constant for the reaction at the given temperature.

Watch Video Solution

12. At $700K$, the equilibrium constant K_p for the reaction

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

is $1.80 \times 10^{-3} kPa$. What is the numerical value of K_c in moles per litre for this reaction at the same temperature?

Watch Video Solution

13. Two moles of PCl_5 were heated to $327\,^{\circ}C$ in a closed two-litre vessel, and when equilibrium was achieved, PCl_5 was found to be $40\,\%$ dissociated into PCl_3 and Cl_2. Calculate the equilibrium constant K_p and K_c for this reaction.

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14. For the reaction,

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

the partial pressure of N_2 and H_2 are 0.80 and 0.40 atmosphere, respectively, at equilibrium. The total pressure of the system is 2.80 atm. What is K_p for the above reaction?

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15. The equilibrium constant at $278K$ for $Cu(s) + 2Ag^{\oplus}(aq) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$ is 2.0×10^{15}. In a solution in which copper has displaced, some silver ions from the solution, the concentration of Cu^{2+} ions from the solution, the concentration of Cu^{2+} ions is $1.8 \times 10^{-2} molL^{-1}$ and the concentration of $Ag^{\oplus}$ ions is $3.0 \times 10^{-9} molL^{-1}$. Is the system at equilibrium?

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16. AB_2 dissociates as

$AB_2(g) \Leftrightarrow AB(g) + B(g)$. If the initial pressure is 500 mm of Hg and the total pressure at equilibrium is 700 mm of Hg. Calculate K_p for the reaction.

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17. Under what pressure must an equimolar mixture of PCl_5 and Cl_2 be placed at $250^{\circ} C$ in order to obtain PCl_5 at 1 atm? $\left(K_p \text{for dissociation of} PCl_5 = 1.78\right)$.

Watch Video Solution

18. XY_2 dissociates $XY_2(g) \Leftrightarrow XY(g) + Y(g)$. When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K for the reaction Assuming that the volume of the system remains unchanged.

A. 50

B. 100

C. 200

D. 400

Answer: A

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19. K_p for the reaction $SO_2 + \frac{1}{2}O_2 \Leftrightarrow SO_3$ at $600\,^{\circ}C$ is 61.7. Claculate K_p. What is the unit of K_p for the above equilibrium? $\left(R = 0.0821L\text{ - atm deg}^{-1}mol^{-1}\right)$

Watch Video Solution

20. 1 mol of H_2, 2 mol of I_2 and 3 mol of HI were taken in a $1 - L$ flask. If the value of K_c for the equation $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is 50 at $440\,^{\circ}C$, what will be the concentration of each specie at equilibrium?

Watch Video Solution

21. For $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$, K_c is equal to ....

A. $K_c = \frac{1}{[CO_2]}$

B. $K_c = [CO_2]$

C. $K_c = \frac{[CaO][CO_2]}{[CaCO_3]}$

D. $K_c = \frac{[CaCO_3]}{[CaO][CO_2]}$

Answer: B

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22. For the reaction $C(s) + CO_2(g) \Leftrightarrow 2CO(g)$, the partial pressure of CO_2 and CO is 2.0 and 4.0 atm, respectively, at equilibrium. The K_p of the reaction is

A. 0.5

B. 5.0

C. 30.0

D. 8.0

Answer: D

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23. In a chemical equilibrium, $K_c = K_p$ when

A. The number of molecules entering into a reaction is more than the number of molecules produced.

B. The number of molecules entering into the reaction is equal to the number of molecules produced.

C. the number of molecules entering into the reaction is less to the number of moleculed produced.

D. None of the above

Answer: B

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24. In a general reaction $A + B \Leftrightarrow AB$, which value of equilibrium constant most favours the production of AB?

A. 9.0×10^{-3}

B. 3.0×10^{-3}

C. 9.0×10^{-7}

D. 9.0×10^{-12}

Answer: A::B::C

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25. During thermal dissociation of a gas, the vapour density.

A. Remains the same

B. Increases

C. Decreases

D. Increases in some cases and decreases in others

Answer: C

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26. The vapour density of fully dissociated NH_4Cl would be

A. Less than half of the vapour density of pure NH_4Cl

B. Double of the vapour density of pure NH_4Cl

C. Half of the vapour density of pure NH_4Cl

D. One-third of the vapour density of pure NH_4Cl

Answer: C

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27. In the reversible reaction, $2HI(g) \Leftrightarrow H_2(g) + I_2(g), K_p$ is

A. Greater than K_c

B. Less than K_c

C. Equal to K_c

D. Zero

Answer: C

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28. At $500K$, the equilibrium constant for reaction $cis - C_2H_2Cl_2 \Leftrightarrow transa - C_2H_2Cl_2$ is 0.6. At the same temperature, the equilibrium constant for the reaction $trans\text{-}C_2H_2Cl_2 \Leftrightarrow cis\text{-}C_2H_2Cl_2$ will be

A. 1.67

B. 1.65

C. 1.06

D. 1.60

Answer: A::B::C

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29. 2 mol of N_2 is mixed with 6 mol of H_2 in a closed vessel of one litre capacity. If 50% N_2 is converted into NH_3 at equilibrium, the value of K_c for the reaction

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

A. $4/27$

B. $27/4$

C. $2/27$

D. 20

Answer: A::B::C

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30. For the reaction, $H_2(g) + CO_2(g) \Leftrightarrow CO(g) + H_2O(g)$, if the initial concentration of $\left[H_2\right] = \left[CO_2\right]$ and x mol L^1 of H_2 is consumed at equilibrium, the correct expression of K_p is:

A. $\dfrac{x^2}{(1 - x)^2}$

B. $\dfrac{(1 + x)^2}{(1 - x)^2}$

C. $\dfrac{1 + x^2}{(2 + x)^2}$

D. $\dfrac{x^2}{1 + x^2}$

Answer: A::B::C

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31. Partial pressure of O_2 in the reaction

$2Ag_2O(s) \Leftrightarrow 4Ag(s) + O_2(g)$ is

A. K_p

B. $\sqrt{K_p}$

C. $\sqrt[3]{K_p}$

D. $(K_p)^2$

Answer: A::B::C

Watch Video Solution

32. Two moles of PCl_5 were heated to $327^\circ C$ in a closed two-litre vessel, and when equilibrium was achieved, PCl_5 was found to be 40% dissociated into PCl_3 and Cl_2. Calculate the equilibrium constant K_p and K_c for this reaction.

A. 0.530

B. 0.266

C. 0.130

D. 0.170

Answer: B

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33. For the reaction:

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

$K_c = 1.8 \times 10^{-6}$ at $184^\circ C$

$R = 0.0831 kJK^{-1}mol^{-1}$

when K_p and K_c are compared at $184^\circ C$, it is found that

A. K_p is greater than K_c

B. K_p is less than K_c

C. $K_p = K_c$

D. None of the above

Answer: A

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34. $NH_4COONH_2(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$ If equilibrium pressure is 3 atm for the above reaction, then K_p for the reaction is

A. 4

B. 20

C. 25

D. 15

Answer: A::B::C

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35. For the reaction $A + B \Leftrightarrow C + D$, the initial concentrations of A and B are equal. The equilibrium concentration of C is two times the equilibrium concentration of A. The value of equilibrium constant is ....

A. 1

B. 2

C. 3

D. 4

Answer: D

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36. 15 mol of H_2 and 5.2 moles of I_2 are mixed and allowed to attain eqilibrium at $500\ ^\circ C$ At equilibrium, the concentration of HI is founf to be 10 mol. The equilibrium constant for the formation of HI is.

A. 50

B. 25

C. 200

D. 15

Answer: A

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37. For the reaction: $NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g), K_c$ at $427\,^{\circ}C$ is $3 \times 10^6 Lmol^{-1}$. The value of K_p is

A. 7.5

B. 2.5×10^{-5}

C. 2.0×10^{-4}

D. 1.75×10^{-4}

Answer: D

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38. For the reaction

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

Which one is the correct representation?

A. $K_p = \left[p_{H_2O}\right]^2$

B. $K_c = \left[H_2O\right]^2$

C. $K_p = K_c(RT)^2$

D. All

Answer: D

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39. Which one is the correct representation for the reaction

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

A. $K_p = \frac{\left[p_{SO_3}\right]^2}{\left[p_{SO_2}\right]^2\left[p_{O_2}\right]}$

B. $K_c = \frac{\left[SO_3\right]^2}{\left[SO_2\right]^2\left[O_2\right]}$

C. $K_p = \frac{\left[n_{SO_3}\right]^2}{\left[n_{SO_2}\right]^2\left[n_{O_2}\right]} \times \left[\frac{P}{\text{Total mole}}\right]^{-1}$

D. All the above

Answer: D

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40. For the reaction

$CO(g) + CI_2(g) \Leftrightarrow COCI_2(g)$

K_p/K_c is equal to

A. $1/RT$

B. Rt

C. $\sqrt{RT}$

D. $(RT)^2$

Answer: A

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41. The equilibrium constant for the reaction

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

at temperature T is 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 is

A. 25×10^2

B. 50

C. 4×10^{-4}

D. 10.00

Answer: B

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42. K_p/K_c for the reaction

$CO(g) + \frac{1}{2}O_2(g) \Leftrightarrow CO_2(g)$ is

A. RT

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

C. $\frac{1}{(RT)^3}$

D. $\frac{1}{\sqrt{RT}}$

Answer: D

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43. The unit of equilibrium constant K_c for the reaction $A + B \Leftrightarrow C$ would be

A. $mol^{-1}L$

B. $molL^{-1}$

C. $molL$

D. No unit

Answer: A

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44. For which of the following reaction does the equilibrium constant depend on the units of concentration?

A. $NO(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$

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

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

D. $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

Answer: D

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45. To the system,

$LaCl_3(s) + H_2O(g) \Leftrightarrow LaClO(s) + 2HCL(g)$ - 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. $2^{1/2}$

C. $2^{1/3}$

D. 2^2

Answer: B

Watch Video Solution

46. For the reaction, $A(g) + 2B(g) \Leftrightarrow 2C(g)$, the rate constant for forward and the reverse reactions are 1×10^{-4} and 2.5×10^{-2} respectively. The value of equilibrium constant, K for the reaction would be

A. 2×10^{-4}

B. 3×10^{-2}

C. 4×10^{-3}

D. 3×10^{2}

Answer: C

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47. The equilibrium constant for the reaction

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

is 20 at $500K$. The equilibrium constant for the reaction $2AB(g) \Leftrightarrow A_2(g) + B_2(g)$ would be

A. 20

B. 0.5

C. 0.05

D. 10

Answer: C

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48. For the reaction

$Ag(CN)_2^{\ominus} \Leftrightarrow Ag^{\oplus} + 2CN^{\ominus}$, the K_c at $25\,^{\circ}C$ is 4×10^{-19} Calculate $\left[Ag^{\oplus}\right]$ in solution which was originally $0.1M$ in KCN and $0.03M$ in $AgNO_3$.

Watch Video Solution

49. At a certain temperature, K_c for

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

is 16. If we take one mole of each of all the equilibrium concentration of NO and NO_2?

A. $1.6 mol L^{-1}$

B. $0.8 mol L^{-1}$

C. $0.4 mol L^{-1}$

D. $0.6 mol L^{-1}$

Answer: C

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50. HI was heated in a sealed tube at $400^{\circ} C$ till the equilibrium was reached. HI was found to be 22% decomposed. The equilibrium constant for dissociation is

A. 1.99

B. 0.0199

C. 0.0796

D. 0.282

Answer: B

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51. For the equilibrium $AB(g) \Leftrightarrow A(g) + B(g)$ at a given temperature, the pressure at which one-third of AB is dissociated is numerically equal to

A. 8 times K_p

B. 16 times K_p

C. 4 times K_p

D. 9 times K_p

Answer: A

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52. In a reversible reaction, if the concentration of reactants are doubles, the equilibrium constant K will:

A. change to $1/4K$

B. change to $1/2K$

C. change to $2K$

D. remain the same

Answer: D

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53. For the equilibrium $AB(g) \Leftrightarrow A(g) + B(g). K_p$ is equal to four times the total pressure. Calculate the number moles of A formed if one mol of AB is taken initially.

A. 0.45

B. 0.30

C. 0.60

D. 0.90

Answer: D

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Ex 7.2

1. $1.5mol$ of PCl_5 are heated at constant temperature in a closed vessel of $4L$ capacity. At the equilibrium point, PCl_5 is 35% dissociated into PCl_3 and Cl_2. Calculate the equilibrium constant.

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2. Calculate the degree of dissociation of HI at $450^\circ C$ if the equilibrium constant for the dissociation reaction is 0.263.

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3. Calculate the percent dissociation of $H_2S(g)$ if $0.1 mol$ of H_2S is kept in $0.4L$ vessel at $1000K$. For the reaction:

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

The value of K_c is 1.0×10^{-6}

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4. One mole of H_2 two moles of I_2 and three moles of HI are injected in one litre flask. What will be the concentration of H_2, I_2 and HI at equilibrium at $500\ ^{\circ} C$. K_c for reaction $H_2 + I_2 \Leftrightarrow 2HI$ is 45.9.

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5. At $700K$, hydrogen and bromine react to form hydrogen bromine. The value of equilibrium constant for this reaction is 5×10^8. Calculate the amount of the H_2, Br_2 and HBr at equilibrium if a mixture of $0.6 mol$ of H_2 and $0.2 mol$ of Br_2 is heated to $700K$.

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6. At some temperature and under a pressure of 4 atm, PCl_5 is 10% dissociated. Calculated the pressure at which PCl_5 will be 20% dissociated temperature remaining same.

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7. $20\% N_2O_4$ molecules are dissociated in a sample of gas at $27^\circ C$ and 760 torr. Calculate the density of the equilibrium mixture.

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8. $0.1 mol$ of PCl_5 is vaporised in a litre vessel at $260^\circ C$. Calculate the concentration of Cl_2 at equilibrium, if the equilibrium constant for the dissociation of PCl_5 is 0.0414.

Watch Video Solution

9. The equilibrium constant for the reaction

$CH_3COOH + C_2H_5OH \Leftrightarrow CH_3COOC_2H_5 + H_2O$

is 4.0 at $25\,^{\circ}C$. Calculate the weight of ethyl acetate that will be obtained when $120g$ of acetic acid are reacted with $92g$ of alcohol.

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10. The vapour density of PCl_5 at $43K$ is is found to be 70.2. Find the degree of dissociation of PCl_5 at this temperature.

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11. For the equilibrium $AB(g) \Leftrightarrow A(g) + B(g)$. K_p is equal to four times the total pressure. Calculate the number moles of A formed if one mol of AB is taken initially.

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12. The vapour density of a mixture containing NO_2 and N_2O_4 is $38.3 at 27^{\circ} C$. Calculate the mole of NO_2 in $100g$ mixture.

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13. NH_3 is heated at 15 at, from $25^{\circ} C$ to $347^{\circ} C$ assuming volume constant. The new pressure becomes 50 atm at equilibrium of the reaction $2NH_3 \Leftrightarrow N_2 + 3H_2$. Calculate % moles of NH_3 actually decomposed.

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14. 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.

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15. K_c for $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ is 0.00466 at $298K$. If a $1 - L$ container initially contained 0.8 mol of N_2O_4, what would be the concentrations of N_2O_4 and NO_2 at equilibrium? Also calculate the equilibrium concentration of N_2O_4 and NO_2 if the volume is halved at the same temperature.

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16. At a certain temperature , K_p for dissociation of solid $CaCO_3$ is 4×10^{-2} atm and for the reaction, $C(s) + CO_2 \Leftrightarrow 2CO$ is 2.0 atm, respectively. Calculate the pressure of CO at this temperature when solid $C, CaO, CaCO_3$ are mixed and allowed to attain equilibrium.

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

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

$\Delta H^{\ominus} = -98.32 kJmol^{-1}, \Delta S^{\ominus} = -95 kJmol^{-1}$

Find K_p for the reaction

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18. The yield of product in the reaction,

$A_2(g) + 2B(g) \Leftrightarrow C(g) + QKJ$

would be higher at:

A. Low temperature and high pressure

B. High temperature and high pressure

C. Low temperature and low pressure

D. High temperature and low pressure

Answer: A

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19. Manufacture of ammonia from the elements is represented by

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) + 22.4 kcal$

The maximum yield of ammonia will be obtained when the process is made to take place

A. At low pressure and high temperature

B. At low pressure and low temperature

C. At high pressure and high temperature

D. At high pressure and low temperature

Answer: D

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20. In the reaction, $2SO_2(s) + O_2(g) \Leftrightarrow 2SO_3(g) + X cal$, most favourable conditions of temperature and pressure for greater yield of SO_3 are

A. Low temperature and low pressure

B. High temperature and low pressure

C. High temperature and high pressure

D. Low temperature and high pressure

Answer: D

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21. In which of the following equilibrium, change in the volume of the system does not alter the number of moles?

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

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

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

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

Answer: A

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22. In the dissociation of $2HI \Leftrightarrow H_2 + I_2$, the degree of dissociation will be affected by

A. Increase of temperature

B. Addition of an inert gas

C. Addition of H_2 and I_2

D. Increase of pressure

Answer: A

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23. In line kilns, the following reaction,

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

proceeds to completion because of

A. High temperature

B. CO_2 escapes

C. Low temperature and low pressure

D. molecular mass of CaO is less than that of $CaCO_3$

Answer: B

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24. Which of the following reaction will be favoured at low pressure?

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

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

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

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

Answer: C

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25. If E_f and E_r are the activation energies of forward and backward reactions and the reaction is known to be exothermic, then

A. $E_f > E_r$

B. $E_f < E_r$

C. $E_f = E_r$

D. No relation can be given between E_f and E_r

Answer: B

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26. K_p for a reaction at $25\ ^\circ C$ is 10 atm. The activation energy for forward and reverse reactions are 12 and $20 kJmol^{-1}$ respectively. The K_c for the reaction at $40\ ^\circ C$ will be:

A. $4.33 \times 10^{-1} M$

B. $3.33 \times 10^{-2} M$

C. $3.33 \times 10^{-1} M$

D. $4.33 \times 10^{-2} M$

Answer: C

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27. Concentration of pure solid and liquid is not included in the expression of equilibrium constant because

A. Solid and liquid concentrations are independent of their quantities

B. Solid and liquid react slowly

C. Solid and liquids at equilibrium do not interact with gaseous phase

D. The molecules of solids and liquid cannot migrate to the gaseous phase

Answer: A

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28. For an equilibrium reaction involving gases, the forward reaction is first order while the reverse reaction is second order. The unit of K_p for forward equilibrium is

A. atm

B. atm^2

C. atm^{-1}

D. atm^{-2}

Answer: A

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29. For the reaction, $PCl_3(g) + Cl_2(g) \Leftrightarrow PCl_5(g)$, the position of equilibrium can be shifted to the right by:

A. Doubling the volume

B. Increasing the temperature

C. Addition of equimolar quantities of PCl_3 and PCl_5

D. Addition of Cl_2 at constant volume

Answer: D

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30. High pressure and low temperature are favourable conditions for the synthesis of ammonia.

A. High temperature and high pressure

B. Low temperature and low pressure

C. High temperature and low pressure

D. Low temperature and high pressure

Answer: D

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31. Which of the following change will shift the reaction in forward direction?

$I_2(g) \Leftrightarrow 2I(g), \Delta H^{\ominus} = +150kJ$

A. Increase in total pressure

B. Increase in temperature

C. Increse in concentration of I

D. Decrease in concentration of I_2

Answer: B

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32. In a vessel containing SO_3, SO_2 and O_2 at equilibrium, some helium gas is introduced so that total pressure increases while temperature and volume and volume remain the same. According to Le Chatelier's principle, the dissociation of SO_3:

A. Increases

B. Decreases

C. Remains unaltered

D. Changes unpredictably

Answer: C

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33. 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

A. abnormal molecular weight

B. degree of dissociation

C. percentage of NO_2 in the mixture

D. N/A

Answer: B

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34. Calculate the pressure of CO_2 gas at $700K$ in the hetrogeneous equilibrium reaction $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$, if $\Delta G^{\ominus}$ for this reaction is $130.2kJmol^{-1}$.

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35. The equilibrium constant K_{p_2} and K_{p_2} for the reactions $A \Leftrightarrow 2B$ and $P \Leftrightarrow Q + R$, respectively, are in the ratio of $2:3$. If the degree of dissociation of A and P are equal, the ratio of the total pressure at equilibrium is,

A. $1:36$

B. $1:1$

C. $1:3$

D. $1:9$

Answer: A::C

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36. For $I_2(g) \Leftrightarrow 2I(g), K_p = 1.79 \times 10^{-10}$. The partial pressure of $I_2 = 1.0$ atm and $I = 0.5 \times 10^{-6}$ atm after 50 min . Comment on the status of equilibrium process.

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37. Calculate the volume percent of chlorine gas at equilibrium in the dissociation of $PCl_5(g)$ under a total pressure of 1.5 atm. The K_p for its dissociation $= 0.3.$

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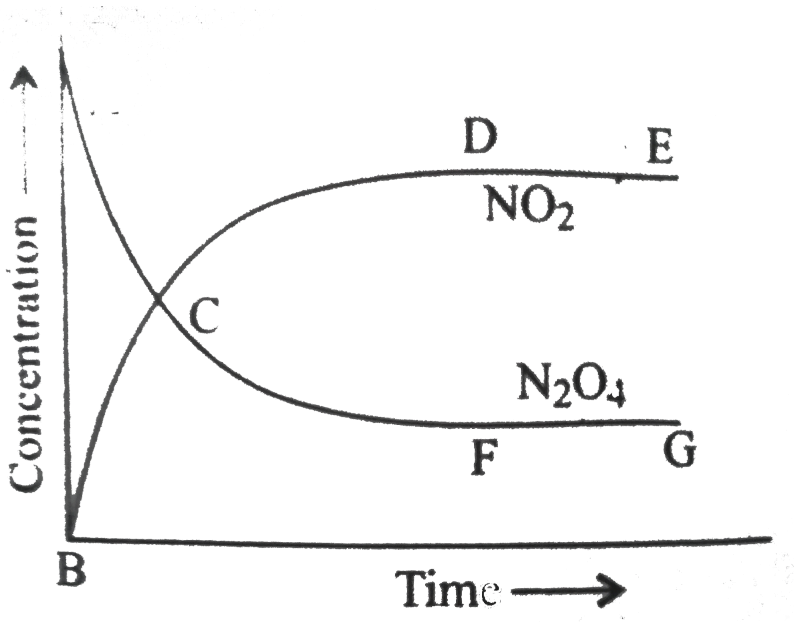
38. $N_2O_4 \Leftrightarrow 2NO_2, K_c = 4$. This reversible reaction is studied graphically as shown in the figure. Select the correct statement out of I, II and III.

I : Reaction quotient has maximum value at point A

II : Reaction proceeds left to right at a point when $[N_2O_2] = [NO_2] = 0.1M$

III : $K = Q$ when point D or F is reached:



A. I, II

B. II, III

C. II

D. I, II, III

Answer: B

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39. The equilibrium:

$P_4(g) + 6Cl_2(g) \Leftrightarrow 4PCl_3(g)$

is attained by mixing equal moles of P_4 and Cl_2 in an evacuated vessel.

Then at equilibrium:

A. $[Cl_2] > [PCl_3]$

B. $[Cl_2] > [P_4]$

C. $[P_4] > [Cl_2]$

D. $[PCl_3] > [P_4]$

Answer: C

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40. $N_2O_4(g)$ is dissociated to an extent of 20% at equilibrium pressure of 1.0 atm and $57^\circ C$. Find the percentage of N_2O_4 at 0.2 atm and $57^\circ C$.

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Exercises (Subjective)

1. The equilibrium pressure of $NH_4CN(s) \Leftrightarrow NH_3(g) + HCN(g)$ is 2.98 atm. Calculate K_p. If $NH_4CN(s)$ is allowed to decompose in presence of NH_3 at 0.25 atm, calculate partial pressure of HCN at equilibrium.

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2. To $500 mL$ of $0.150 M AgNO_3$ solution were added $500 mL$ of $1.09 M Fe^{2+}$ solution and the reaction is allowed to reach an equilibrium at $25^\circ C$

$Ag^{\oplus}(aq) + Fe^{2+}(aq) \Leftrightarrow Fe^{3+}(aq) + Ag(s)$

For 25 mL of the solution, $30 mL$ of $0.0832 M KMnO_4$ was required for oxidation. Calculate the equilibrium constant for the the reaction $25 ^{\circ} C$.

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3. For the equilibrium:

$LiC1.3NH(3)(s) \Leftrightarrow LiCl.NH_3(s) + 2NH_3$

$K_p = 9 atm^2$ at $40 ^{\circ} C$. A 5 - L vessel contains 0.1 "mole" of $LiCl.NH_3$. How many moles of NH_3 should be added to the flask at this temperature to derive the backward reaction for completion?

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4. The equilibrium constant of the reaction,

$SO_3(g) \Leftrightarrow SO_2(g) + 1/2O_2(g)$

is 0.15 at $900K$. Calculate the equilibrium constant for

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

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5. K_c for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ is $0.5 mol^{-2}L^2$ at $400K$. Find K_p.

Given $R = 0.082L$ - atm $\deg^{-1} mol^{-1}$

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6. The equilibrium constant K_c for $A(g) \Leftrightarrow B(g)$ is 1.1. Which gas has a molar concentration greater than 1.

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7. In an equilibrium $A + B \Leftrightarrow C + D$, A and B are mixed in vessel at temperature T. The initial concentration of A was twice the initial concentration of B. After the equilibrium has reaches, concentration of C was thrice the equilibrium concentration of B. Calculate K_c.

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8. For a gaseous phase reaction $A + 2B \Leftrightarrow AB_2, K_c = 0.3475L^2\text{mole}^{-2}$ at $200\,^\circ C$. When 2 moles of B are mixed with one "mole" of A, what total pressure is required to convert $60\,\%$ of A in AB_2?

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9. For a reaction $2HI \Leftrightarrow H_2 + I_2$, at equilibrium $7.8g$, $203.2g$, and $1638.4g$ of H_2, I_2, and HI, respectively were found. Calculate K_c.

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10. $60mL$ of H_2 and 42 mL of I_2 are heated in a closed vessel. At equilibrium, the vessel contains $20mLHI$. Calculate degree of dissociation of HI.

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11. In the dissociation of HI, 20% of HI is dissociated at equilibrium. Calculate K_p for

$HI(g) \Leftrightarrow 1/2H_2(g) + 1/2I_2(g)$

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12. The value of K_p for dissociation of $2HI \Leftrightarrow H_2 + I_2$ is 1.84×10^{-2}. If the equilibrium concentration of H_2 is 0.4789 mol L^{-1}, calculate the concentration of HI at equilibrium.

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13. $0.96g$ 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.

View Text Solution

14. An equilibrium mixture

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

present in a vessel of one litre capacity at $815^\circ C$ was found by analysis to contain 0.4 mol of CO, 0.3 mol of H_2O, 0.2 mol of CO_2 and 0.6 mol of H_2.

a. Calculate K_c

b. If it is derived to increase the concentration of CO to 0.6 mol by adding CO_2 to the vessel, how many moles must be addes into equilibrium mixture at constant temperature in order to get this change?

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15. A mixture of one mole of CO_2 and "mole" of H_2 attains equilibrium at a temperature of $250^\circ C$ and a total pressure of 0.1 atm for the change $CO_2(g) + H_2(g) \Leftrightarrow CO(g) + H_2O(g)$. Calculate K_p if the analysis of final reaction mixture shows 0.16 volume percent of CO.

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16. At a certain temperature, K_c for

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

is 16. If we take one mole of each of all the equilibrium concentration of NO and NO_2?

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17. The equilibrium mixture for

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

present in $1L$ vessel at $600\,^\circ C$ contains $0.50, 0.12$, and 5.0 moles of SO_2, O_2, and SO_3 respectively.

a. Calculate K_c for the given change at $600\,^\circ C$.

b. Also calculate K_p.

c. How many moles of O_2 must be forced into the equilibrium vessel at $600\,^\circ C$ in order to increase the concentration of SO_3 to 5.2 mol?

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18. At $273K$ and 1 atm aL of N_2O_4 decomposes to NO_2 according to equation $N_2O_4(g) \Leftrightarrow 2NO_2(g)$. To what extent ha the decomposition proceeded when the original volume is 25% less than that of exisiting volume?

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19. At $340K$ and 1 atm pressure, N_2O_4 is 66% into NO_2. What volume of $10gN_2O_4$ ocuupy under these conditions?

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20. How much PCl_5 must be added to a one litre vessel at $250\ ^\circ C$ in order to obtain a 35 concentration of 0.1 mol of Cl_2? K_c for $PCl_5 \Leftrightarrow PCl_3 + Cl_2$ is $0.0414molL^{-1}$

View Text Solution

21. The degree of dissociation of PCl_5 at 1 atm pressure is 0.2. Calculate the pressure at which PCl_5 is dissociated to $50\ \%$?

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22. At $473K$, partially dissociated vapours of PCl_5 are 62 times as heavy as H_2. Calculate the degree of dissociation of PCl_5.

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23. In a mixture of N_2 and H_2 in the ratio $1:3$ at 30 atm and $300\ ^\circ C$, the $\%$ of NH_3 at equilibrium is 17.8. Calculate K_p for $N_2 + 3H_2 \Leftrightarrow 2NH_3$.

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24. A reaction carried out by 1 mol of N_2 and 3 mol of H_2 shows at equilibrium the mole fraction of NH_3 as 0.012 at $500\ ^\circ C$ and 10 atm pressure. Calculate K_p Also report the pressure at which "mole" % of NH_3 in equilibrium mixture is increased to 10.4.

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25. K_p for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ is $1.6 \times 10^{-4} atm^{-2}$ at $400\ ^\circ C$. What will be K_p at $500\ ^\circ C$? The heat of reaction on this temperature is -25.14 kcal?

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26. What concentration of CO_2 be in equilibrium with $2.5 \times 10^{-2} molL^{-1}$ of CO at $100\ ^\circ C$ for the reaction:

$FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2(g), K_c = 5.0$

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27. Calculate K_c for the reaction:

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

if 1.58 mol H_2S, 1.27 mol H_2 and 2.78×10^{-6} mol of S_2 are in equilibrium in a flask of capacity $180L$ at $750\,^{\circ}C$.

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28. For $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$, the observed, pressure for reaction mixture in equilibrium is 1.12 atm at $106\,^{\circ}C$. What is the value of K_p for the reaction?

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29. In the reaction $C(s) + CO_2(g) \Leftrightarrow 2CO(g)$, the equilibrium pressure is 12 atm. If $50\,\%$ of CO_2 reacts, calculate K_p.

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30. For gasesous reaction $A + B \Leftrightarrow C$, the equilibrium concentration of A and B at a temperature are $15 mollitre^{-1}$. When volume is doubled the reaction has equilibrium concentration of A as $10 mollitre^{-1}$. Calculate:

(i) K_c

(ii) Concentration of C in originl equilibrium.

Watch Video Solution

31. 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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32. At a certain temperature, K_p for dissociation of solid $CaCO_3$ is 4×10^{-2} atm and for the reaction, $C(s) + CO_2 \Leftrightarrow 2CO$ is 2.0 atm, respectively. Calculate the pressure of CO at this temperature when solid $C, CaO, CaCO_3$ are mixed and allowed to attain equilibrium.

Watch Video Solution

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

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

$K_p = 0.0095$ 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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34. Under what pressure conditions $CuSO_4.5H_2O$ be efforescent at $25\,^\circ C$. How good a drying agent is $CuSO_4.3H_2O$ at the same temperature? Given

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

$K_p = 1.086 \times 10^{-4} atm^2$ at $25\,^\circ C$. Vapour pressure of water at $25\,^\circ C$ is 23.8 mm of Hg.

Watch Video Solution

35. 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. Generally should it be higher or lower temperatures for better reduction of SnO_2?

Watch Video Solution

36. For the reaction:

$2Fe^{3+}(aq) + \left(Hg_2\right)^{2+}(aq) \Leftrightarrow 2Fe^{2+}(aq)$

$K_c = 9.14 \times 10^{-6}$ at $25\,^\circ C$. If the initial concentration of the ions are

$Fe^{3+} = 0.5M$, $(Hg_2)^{2+} = 0.5M$, $Fe^{2+} = 0.03M$ and $Hg^{2+} = 0.03M$, what will be the concentration of ions at equilibrium.

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37. 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, finf K_c.

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38. At $450^\circ C$ the equilibrium constant K_p for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ was found to be 1.6×10^{-5} at a pressure of 200 atm. If N_2 and H_2 are taken in $1:3$ ratio. What is $\%$ of NH_3 formed at this temperature?

Watch Video Solution

39. K_p for the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ at $400\ ^\circ C$ is 1.64×10^{-4}. Find K_c. Also find $\Delta G^{\ominus}$ using K_p and K_c values and interprest the difference.

Watch Video Solution

40. Equilibrium constant K_p for

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

is 0.0118 atm at $1065\ ^\circ C$ and heat of dissociation is 42.4 Kcal. Find equilibrium constant at $1132\ ^\circ C$.

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41. K_p for $3/2H_2 + 1/2N_2 \Leftrightarrow NH_3$ are 0.0266 and $0.0129 atm^{-1}$, respectively, at $350\ ^\circ C$ and $400\ ^\circ C$. Calculate the heat of formation of NH_3.

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42. In a reaction at equilibrium, X moles of the reactant A decomposes to give 1 mole each of C and D. It has been found that the fraction of A decomposed at equilibrium is independent of initial concentration of A. Calculate X.

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43. For the reaction $A + B \Leftrightarrow 3.C$ at $25\,^{\circ}C$, a $3L$ vessel contains 1, 2, and 4 moles of A, B and C respectively. Predict the direction of reaction if:

a. K_c for the reaction is $10.$

b. K_c for the reaction is $15.$

c. K_c for the reaction is 10.66

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44. $CO + 2H_2 \rightarrow CH_3OH$ (all gases). An equilibrium mixture consists of 2.0 atm $CH_3OH, 1$ atm CO and 0.1 atm H_2. The volume, at same T. Find new equilibrium pressures.

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45. NO and Br_2 at initial pressures of 98.4 and 41.3 torr respectively were allowed react at $300K$. At equilibrium the total pressure was 110.5 torr. Calculate the value of equilibrium constant, K_p and the standard free energy change at $300K$ for the reaction:

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

Watch Video Solution

46. In the reaction equilibrium

$N_2O_4 \Leftrightarrow 2NO_2(g)$

When 5 mol of each is taken and the temperature is kept at $298K$, the total pressure was found to be 20 bar.

Given : $\Delta_f G^{\ominus}_{n_2O_4} = 100kJ, \Delta_f G^{\ominus}_{NO_2} = 50KJ$

a. Find ΔG of the reaction at $298K$.

b. Find the direction of the reaction.

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Exercises (Linked Comprehensive)

1. Physical and chemical equilibrium can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium we have a principle named Le Chatelier principle. According to this principle, even if we make some changes in equilibrium, then also the system even re-establishes the equilibrium by undoing the effect.

Consider the following equilibrium:

$2NO_2 \Leftrightarrow 2NO_3, \Delta H = -ve,$

If O_2 is added and volume of the reaction vessel is reduced, the equilibrium

A. Shift in the product side

B. Shifts in the reactant side

C. Cannot be predicted

D. Remains unchanged

Answer: A

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2. Physical and chemical equilibrium can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium we have a principle named Le Chatelier principle. According to this principle, even if we make some changes in equilibrium, then also the system even re-establishes the equilibrium by undoing the effect.

If we add SO_4^{2-} ion to a saturated solution of Ag_2SO_4, it will result in a//an

A. Increase in $Ag^{\oplus}$ concentration.

B. Decrease in $Ag^{\oplus}$ concentration

C. It will shift $Ag^{\oplus}$ ions from solid ag_2SO_4 into solution.

D. It will decrease the SO_4^{2-} ion concentration in the solution.

Answer: B

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3. Physical and chemical equilibrium can respond to a change in their pressure, temperature, and concentration of reactants and products. To describe the change in the equilibrium we have a principle named Le Chatelier principle. According to this principle, even if we make some changes in equilibrium, then also the system even re-establishes the equilibrium by undoing the effect.

In the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$. If we increase the pressure of the system, the equilibrium is

A. Shifts in the product side

B. Shift un reactant side

C. Remains unchanged

D. Cannot be predicted

Answer: A

Watch Video Solution

4. Consider the chemical reaction:

$$Ni^{2+}(aq)\text{(Green solution)} + 6NH_3(aq) \Leftrightarrow \left[Ni\left(NH_3\right)_6\right]^{2+}\text{(Blue solution)}(aq)$$

When $H^{\oplus}(aq)$ is added, the colour green is favoured. Use one or more of the following interpretations to answer the questions:

i. Some unreacted $Ni^{2+}(aq)$ is present in the solution at equilibrium

ii. Some unreacted $NH_3(aq)$ is present in the solution at equilibrium

iii. The colour change indicates new equilibrium conditions with reduced $\left[Ni\left(NH_3\right)_6\right]^{2+}(aq)$

iv. The colour change indicates new equilibrium conditions with increased $\left[Ni\left(NH_3\right)_6\right]^{2+}(aq)$.

The deepening of blue colour on dissolving more $Ni\left(NO_3\right)_2$ supports interpretation (s).

A. i only

B. i and iv only

C. ii and iv only

D. i and ii only

Answer: B

Watch Video Solution

5. Consider the chemical reaction:

$Ni^{2+}(aq)(\text{Green solution}) + 6NH_3(aq) \Leftrightarrow \left[Ni\left(NH_3\right)_6\right]^{2+}(\text{Blue solution})(aq)$

When $H^{\oplus}(aq)$ is added, the colour green is favoured. Use one or more of the following interpretations to answer the questions:

i. Some unreacted $Ni^{2+}(aq)$ is present in the solution at equilibrium

ii. Some unreacted $NH_3(aq)$ is present in the solution at equilibrium

iii. The colour change indicates new equilibrium conditions with reduced $\left[Ni\left(NH_3\right)_6\right]^{2+}(aq)$

iv. The colour change indicates new equilibrium conditions with increased

$\left[Ni\left(NH_3\right)_6\right]^{2+}(aq)$.

The deepening of blue colour on addition of more $NH_3(aq)$ supports interpretation(s).

A. i only

B. i and iv only

C. i and ii only

D. ii and iv only

Answer: D

Watch Video Solution

6. One "mole" of $NH_4HS(s)$ was allowed to decompose in a 1 - L container at $200\ ^{\circ}C$. It decomposes reversibly to $NH_3(g)$ and $H_2S(g)$. $NH_3(g)$ further undergoes decomposition to form $N_2(g)$ and $H_2(g)$. Finally, when equilibrium was set up, the ratio between the number of moles of $NH_3(g)$ and $H_2(g)$ was found to be 3.

$NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g), K_c = 8.91 \times 10^{-2} M^2$

$2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g), K_c = 3 \times 10^{-4} M^2$

Answer the following:

What is the "mole" fraction of hydrogen gas in the equilibrium mixture in the gas phase?

A. $1/4$

B. $3/4$

C. $1/8$

D. 4

Answer: B

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7. One "mole" of $NH_4HS(s)$ was allowed to decompose in a $1 - L$ container at $200\,^\circ C$. It decomposes reversibly to $NH_3(g)$ and $H_2S(g)$. $NH_3(g)$ further undergoes decomposition to form $N_2(g)$ and $H_2(g)$. Finally, when equilibrium was set up, the ratio between the number of moles of $NH_3(g)$

and $H_2(g)$ was found to be 3.

$NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g), K_c = 8.91 \times 10^{-2}M^2$

$2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g), K_c = 3 \times 10^{-4}M^2$

Answer the following:

To attain equilibrium, how much % by weight of folid NH_4HS got dissociated?

A. 19 %

B. 30 %

C. 33 %

D. 15 %

Answer: C

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8. One "mole" of $NH_4HS(s)$ was allowed to decompose in a 1 - L container at 200 $^\circ C$. It decomposes reversibly to $NH_3(g)$ and $H_2S(g)$. $NH_3(g)$ further undergoes decomposition to form $N_2(g)$ and $H_2(g)$. Finally, when equilibrium was set up, the ratio between the number of moles of $NH_3(g)$ and $H_2(g)$ was found to be 3.

$NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g), K_c = 8.91 \times 10^{-2}M^2$

$2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g), K_c = 3 \times 10^{-4}M^2$

Answer the following:

Assuming the volume due to solid NH_4HS is negligible what will be the density of the gaseous mixture in the above equilibrium system?

A. $16.83gL^{-1}$

B. $16.83gmL^{-1}$

C. $18.415gL^{-1}$

D. $14.83gL^{-1}$

Answer: A

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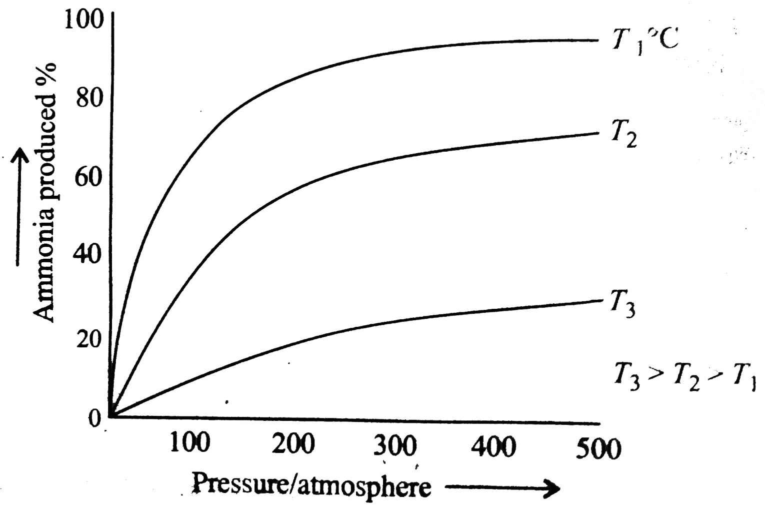
9. The persentage of ammonia produced from nitrogen and hydrogen under conditions of temperature and pressure is given in the graph



Use the graph answering the following questions:

What happens to the percentage of ammonia produced when the temperature is increased

A. The % is decreased

B. The % is increased

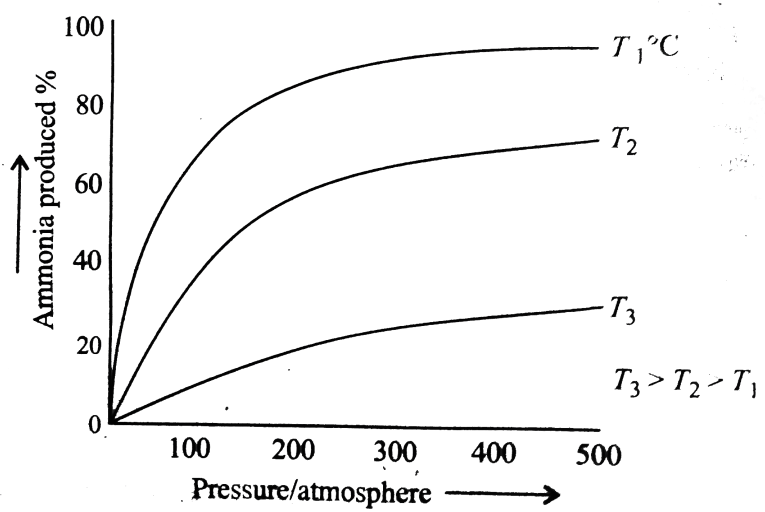
C. No effect

D. Cannot be predicted

Answer: A

Watch Video Solution

10. The persentage of ammonia produced from nitrogen and hydrogen under conditions of temperature and pressure is given in the graph



Use the graph answering the following questions:

What happens to the percentage of ammonia produced when the pressure is increased?

A. The % is decreased

B. The % is increased

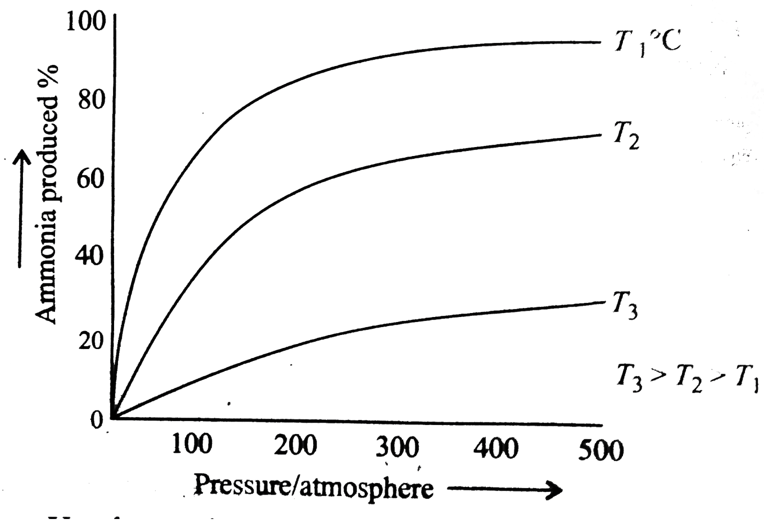
C. No effect

D. Cannot be predicted

Answer: B

Watch Video Solution

11. The persentage of ammonia produced from nitrogen and hydrogen under conditions of temperature and pressure is given in the graph



Use the graph answering the following questions:

What conditions of pressure produce the highest percentage of ammonia?

A. At least 50 atm

B. At least 150 atm

C. At least 300 atm

D. At least 100 atm

Answer: C

Watch Video Solution

12. The synthesis of ammonia is given as:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -92.6 kJmol^{-1}$ given $K_c = 1.2$ and temperature $(T) = 375\,^{\circ}C$

The expression of equilibrium constant is

A. $K_c = \dfrac{[N_2][H_2]^3}{[NH_3]^2}$

B. $K_c = \dfrac{[N_2][H_2]}{[NH_3]}$

C. $K_c = \dfrac{[NH_3]}{[N_2][H_2]^3}$

D. $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

Answer: D

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13. The synthesis of ammonia is given as:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -92.6 kJmol^{-1}$ given $K_c = 1.2$ and temperature $(T) = 375^{\circ}C$

On increasing the temperature, the value of equilibrium constant K_c

A. Increases

B. Decreases

C. Remain unchanged

D. Cannot be predicted

Answer: B

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14. The synthesis of ammonia is given as:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -92.6kJmol^{-1}$ given $K_c = 1.2$ and temperature $(T) = 375^{\circ}C$

The relationship between K_p and K_c for this reaction is

A. $K_c = K_p(RT)^2$

B. $K_p = K_c(RT)^{-1}$

C. $K_p = K_c(RT)^2$

D. $K_p = K_c(RT)^4$

Answer: A

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15. The synthesis of ammonia is given as:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -92.6kJmol^{-1}$ given $K_c = 1.2$ and temperature $(T) = 375^{\circ}C$

Which of the following factors does not increase the yield of NH_3 at equilibrium?

A. Catalyst

B. Increase in pressure

C. Increase in temperature

D. Decrease in pressure

Answer: A

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16. The synthesis of ammonia is given as:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -92.6 kJmol^{-1}$ given $K_c = 1.2$ and temperature $(T) = 375^{\circ}C$

Starting with 2 mol of each $\left(N_2, H_2 \text{and} NH_3\right)$ in $5.0L$ reaction vessel at $375^{\circ}C$, predict what is true for the reaction?

A. The reaction is at equilibrium

B. The reaction proceed in forward direction.

C. The reaction proceed in backward direction

D. Q_c for the reaction is less then K_c

Answer: C

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17. Phosphorous pentachloride when heated in a sealed tube at $700K$ it undergoes decomposition as

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 38$ atm

Vapour density of the mixture is 74.25.

The reaction is

A. Endothermic

B. Exothermic

C. May be endothermic or exothermic

D. Unpredictable

Answer: A

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18. Phosphorous pentachloride when heated in a sealed tube at $700K$ it undergoes decomposition as

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 38$ atm

Vapour density of the mixture is 74.25.

Percentage dissociation of PCl_5 may be given as

A. 4.04

B. 40.4

C. 44.0

D. 0.404

Answer: B

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19. Phosphorous pentachloride when heated in a sealed tube at $700K$ it undergoes decomposition as

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 38$ atm

Vapour density of the mixture is 74.25.

Equilibrium constant K_c for the reaction will be

A. $0.66M$

B. $0.56M$

C. $0.46M$

D. $0.36M$

Answer: A

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20. Phosphorous pentachloride when heated in a sealed tube at $700K$ it undergoes decomposition as

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 38$ atm

Vapour density of the mixture is 74.25.

If pressure is increased then the equilibrium will

A. Be unaffected

B. Shift in backward direction

C. Shift in forward direction

D. Cannot be predicted

Answer: B

Watch Video Solution

21. Phosphorous pentachloride when heated in a sealed tube at $700K$ it undergoes decomposition as

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 38$ atm

Vapour density of the mixture is 74.25.

When an inert gas is added to the given reversible process, then the equilibrium will.

A. Be unaffected

B. Shift in backward direction

C. Shift in forward direction

D. Cannot be predicted

Answer: C

View Text Solution

22. Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as:

$NH_4Cl(s) \Leftrightarrow NH_3(g) + HCl(g)$

A $6.250g$ sample of NH_4Cl os placed in an evacuated $4.0L$ container at $27\,^{\circ}C$. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container. Answer the followings

The value of K_p for the reaction at $300K$ is

A. 16.2

B. 0.168

C. 1.68

D. 32.4

Answer: B

Watch Video Solution

23. Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as:

$NH_4Cl(s) \Leftrightarrow NH_3(g) + HCl(g)$

A $6.250g$ sample of NH_4Cl os placed in an evacuated $4.0L$ container at $27^\circ C$. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container. Answer the followings

The amount of solid NH_4Cl left behind in the container at equilibrium is

A. 2.856

B. 28.56

C. 0.2856

D. 1.320

Answer: A

Watch Video Solution

24. Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as:

$NH_4Cl(s) \Leftrightarrow NH_3(g) + HCl(g)$

A $6.250g$ sample of NH_4Cl os placed in an evacuated $4.0L$ container at $27^\circ C$. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container. Answer the followings

If the volume of container were doubled at constant temperature, then what would happen to the amount of solid in the container.

A. Decrease

B. Increases

C. Remain unchanged

D. None

Answer: A

Watch Video Solution

25. Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as:

$NH_4Cl(s) \Leftrightarrow NH_3(g) + HCl(g)$

A $6.250g$ sample of NH_4Cl os placed in an evacuated $4.0L$ container at $27\,^{\circ}C$. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container. Answer the followings

The extent of decomposition can be increased by

A. Increasing the temperature

B. Decreasing the temperature

C. Adding more NH_4Cl

D. Removing HCl(g)

Answer: A

Watch Video Solution

26. Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as:

$NH_4Cl(s) \Leftrightarrow NH_3(g) + HCl(g)$

A $6.250g$ sample of NH_4Cl os placed in an evacuated $4.0L$ container at $27^\circ C$. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container. Answer the followings

The value of K_p for the reaction decreases with

A. Increase in volume

B. Decrease in temperature

C. Decrease in pressure

D. Increase in temperature

Answer: B

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27. K_p and K_c are inter related as

$K_p = K_c(RT)^{\Delta n}$

Answer the following questions:

Which of the following have K_p - K_c?

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

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

C. $2NO(g) + Cl_2(g) \leftrightarrow 2NOCl(g)$

D. $2SO_2(g) + O_2(g) \leftrightarrow 2SO_3(g)$

Answer: A::B

Watch Video Solution

28. K_p and K_c are inter related as

$K_p = K_c(RT)^{\Delta n}$

Answer the following questions:

Which of the following have same units K_p ?

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

B. $AB_2(g) \Leftrightarrow AB(g) + B(g)$

C. $NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g)$

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

Answer: A::B

Watch Video Solution

29. K_p and K_c are inter related as

$K_p = K_c(RT)^{\Delta n}$

Answer the following questions:

In which of the following equilibria K_p is less than K_c?

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

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

C. $H_2(g) + Cl_2(g) \Leftrightarrow 2HCl(g)$

D. $2H_2O(l) \Leftrightarrow 2H_2(g) + O_2(g)$

Answer: B

Watch Video Solution

30. K_p and K_c are inter related as

$K_p = K_c(RT)^{\Delta n}$

Answer the following questions:

For $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, K_p/K_c is equal to:

A. RT^3

B. $1/RT$

C. $(RT)^4$

D. $1/(RT)^2$

Answer: D

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31. K_p and K_c are inter related as

$K_p = K_c(RT)^{\Delta n}$

Answer the following questions:

The unit of equilibrium constant for

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

A. mol L^{-2}

B. mol^2L^{-2}

C. $Lmol^{-2}$

D. None of these

Answer: D

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32. The relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$ unit of $K_p = (atm)^{\Delta n}$, unit of $K_c = \left(molL^{-1}\right)^{\Delta n}$

Consider the following reactions:

i. $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g), K_1$

ii. $CH_4(g) + H_2O(g) \Leftrightarrow CO(g) + 3H_2(g), K_2$

iii. $CH_4(g) + 2H_2O(g) \Leftrightarrow CO_2(g) + 4H_2(g), K_3$

Which of the following is correct?

A. $K_3 = K_1/K_2$

B. $K_3 = K_1^2/K_2^3$

C. $K_3 = K_1 \times K_2$

D. $K_3 = K_1\sqrt{K_2}$

Answer: C

Watch Video Solution

33. The relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$ unit of $K_p = (atm)^{\Delta n}$, unit of $K_c = \left(molL^{-1}\right)^{\Delta n}$

The equilibrium constant of the following reactions at $400K$ are given:

$2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g), K_1 = 3.0 \times 10^{-13}$

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

Then, the equilibrium constant K for the reaction

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

is

A. 2.04

B. 20.5

C. 0.85

D. 1.4

Answer: D

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34. The relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$ unit of $K_p = (atm)^{\Delta n}$, unit of $K_c = \left(molL^{-1}\right)^{\Delta n}$

Given: $2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g), K_1$

$2NO_2(g) \Leftrightarrow N_2O_4(g), K_2$

$2NO(g) + O_2(g) \Leftrightarrow N_2O_4(g), K_3$

Which of the following relations is correct?

A. $K_3 = K_1/K_2$

B. $K_3 = K_1 \times K_2$

C. $K_3 = K_1 + K_2$

D. $K_3 = K_1/\sqrt{K_2}$

Answer: B

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35. The relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$ unit of $K_p = (atm)^{\Delta n}$, unit of $K_c = \left(molL^{-1}\right)^{\Delta n}$

H_3ClO_4 is a tribasic acid, it undergoes ionisation as

$H_3ClO_4 \Leftrightarrow H^{\oplus} + H_2ClO_4^-, K_1$

$H_2ClO_4^- \Leftrightarrow H^{\oplus} + HClO_4^{2-}, K_2$

$HClO_4^{2-} \Leftrightarrow H^{\oplus} + ClO_4^{3-}, K_3$

Then, equilibrium constant for the following reaction will be:

$H_3ClO_4 \Leftrightarrow 3H^{\oplus} + ClO_4^{3-}$

A. $K_1K_2K_3$

B. $\frac{(K_1K_3)^2}{K_2}$

C. $\frac{K_1}{K_2}$

D. $\frac{K_1K_2}{K_3^2}$

Answer: A

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36. The relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$ unit of $K_p = (atm)^{\Delta n}$, unit of $K_c = \left(molL^{-1}\right)^{\Delta n}$

Consider the two reaction:

$XeF_6(g) + H_2O(g) \Leftrightarrow XeO_3F_4(g) + 2HF(g), K_1$

$XeO_4(g) + XeF_6(g) \Leftrightarrow XeOF_4(g) + XeO_3F_2(g), K_2$

Then the equilibrium constant for the following reaction

$XeO_4(g) + 2HF(g) \Leftrightarrow XeO_3F_2(g)$

is given by:

A. K_1/K_2^2

B. $\left(K_1/K_2\right)^{1/2}$

C. K_1^2/K_2^3

D. K_2/K_1

Answer: D

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37. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -22.4kJ$

The pressure inside the chamber is 100 atm and temperature at $300K$

If K_p for the given reaction is 1.44×10^{-5}, then the value of K_c will be:

A. $\dfrac{1.44 \times 10^{-5}}{(0.082 \times 500)^{-2}} molL^{-1}$

B. $\dfrac{1.44 \times 10^{-5}}{(8.314 \times 200)^{-2}} molL^{-1}$

C. $\dfrac{1.44 \times 10^{-5}}{(0.082 \times 700)^{2}} molL^{-1}$

D. $\dfrac{1.44 \times 10^{-5}}{(0.082 \times 300)^{-2}} molL^{-1}$

Answer: A::B::D

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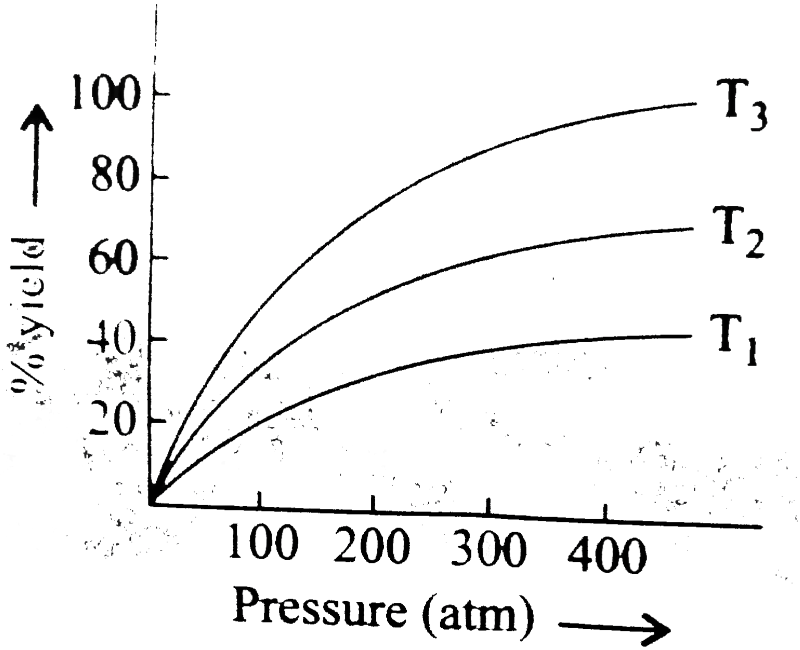
38. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -22.4kJ$

The pressure inside the chamber is 100 atm and temperature at $300K$

The preparation of ammonia by Haber's process is an exothermic reaction. If the preparation follows the following temperature-pressure relationship for its % yield. Then for temperature T_1, T_2 and T_3 the correct option is:



A. $T_3 > T_2 > T_1$

B. $T_1 > T_2 > T_3$

C. $T_3 < T_2 < T_3$

D. $T_1 = T_2 = T_3$

Answer: B

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39. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -22.4kJ$

The pressure inside the chamber is 100 atm and temperature at $300K$

On adding catalyst the equilibrium of reaction:

A. Shift in backward direction

B. Shift in forward direction

C. Does not affect the equilibrium

D. Cannot predict.

Answer: C

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40. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -22.4kJ$

The pressure inside the chamber is 100 atm and temperature at $300K$

If K_p for the reaction is 1.44×10^{-5}, then the value of K_p for the decomposition of NH_3

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

will be:

A. $\sqrt{1.44 \times 10^{-5}}$

B. $\left(1.44 \times 10^{-5}\right)^4$

C. $\dfrac{1}{1.44 \times 10^{-5}}$

D. 1.00×10^{-3}

Answer: C

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41. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H^{\ominus} = -22.4kJ$

The pressure inside the chamber is 100 atm and temperature at $300K$ $30LH_2(g)$ and $30LN_2(g)$ were taken for the reaction in Haber's process which yields only 50% of the expected ammonia due to reversibility of the reaction. What will be the composition of reaction mixture under the given condition?

A. $NH_3 = 20L, N_2 = 20L, H_2 = 20L$

B. $NH_3 = 10L, N_2 = 25L, H_2 = 15L$

C. $NH_3 = 20L, N_2 = 10L, H_2 = 30L$

D. $NH_3 = 20L, N_2 = 25L, H_2 = 15L$

Answer: B

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42. Mass action rato or reaction quotient Q for a reaction can be calculate using the law of masss action

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

$$Q = \frac{[C][D]}{[A][B]}$$

The value of Q decides whether the reaction is at equilibrium or not.

At equilibrium, $Q = K$

For an equilibrium process, $Q \neq K$

when $Q > K$, reaction will favour backward direction and when $Q < K$, it will favour direction.

Answer the following questions:

The reaction quotient Q for:

$O_2(g) + 2H_2(g) \Leftrightarrow 2H_2O(g)$

is given by $Q = \frac{[H_2O]^2}{[O_2][H_2]^2}$. The reaction will proceed in backward direction, when

A. $Q = K_c$

B. $Q < K_c$

C. $Q > K_c$

D. $Q = 0$

Answer: C

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43. Mass action rato or reaction quotient Q for a reaction can be calculate using the law of masss action

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

$Q = \frac{[C][D]}{[A][B]}$

The value of Q decides whether the reaction is at equilibrium or not.

At equilibrium, $Q = K$

For an equilibrium process, $Q \neq K$

when $Q > K$, reaction will favour backward direction and when $Q < K$, it will favour direction.

Answer the following questions:

For the reaction:

$2A + B \Leftrightarrow 3C$ at $298K, K_c = 40$

A $4L$ vessel contains $2, 1,$ and 4 mol of 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: A

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44. Mass action rato or reaction quotient Q for a reaction can be calculate using the law of masss action

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

$Q = \frac{[C][D]}{[A][B]}$

The value of Q decides whether the reaction is at equilibrium or not.

At equilibrium, $Q = K$

For an equilibrium process, $Q \neq K$

when $Q > K$, reaction will favour backward direction and when $Q < K$, it will favour direction.

Answer the following questions:

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 $700K$ is $4.00 \times 10^{-5} atm^{-2}$. In which direction the net reaction will go?

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

A. Forward

B. Backward

C. No reaction

D. Cannot be predicted

Answer: B

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45. Mass action rato or reaction quotient Q for a reaction can be calculate using the law of masss action

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

$$Q = \frac{[C][D]}{[A][B]}$$

The value of Q decides whether the reaction is at equilibrium or not.

At equilibrium, $Q = K$

For an equilibrium process, $Q \neq K$

when $Q > K$, reaction will favour backward direction and when $Q < K$, it will favour direction.

Answer the following questions:

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 reaction. 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: C

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46. Mass action rato or reaction quotient Q for a reaction can be calculate using the law of masss action

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

$$Q = \frac{[C][D]}{[A][B]}$$

The value of Q decides whether the reaction is at equilibrium or not.

At equilibrium, $Q = K$

For an equilibrium process, $Q \neq K$

when $Q > K$, reaction will favour backward direction and when $Q < K$, it will favour direction.

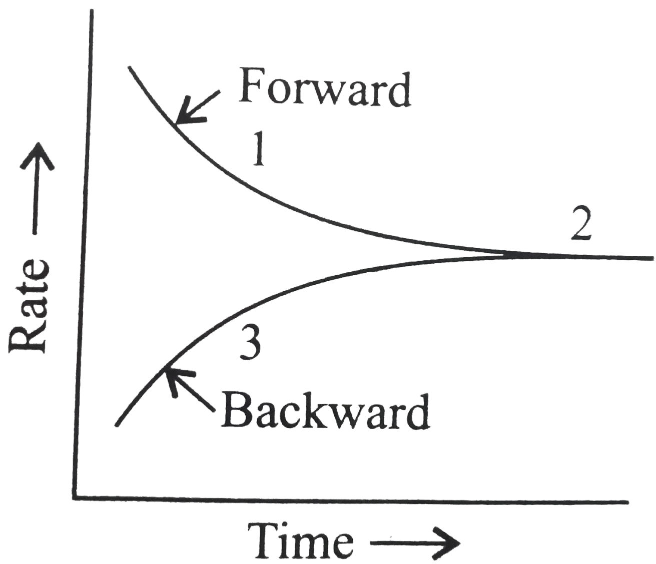
Answer the following questions:

In the reaction:

$NH_4Cl(g) \Leftrightarrow NH_3(g) + HCl(g)$

a graph is plotted to show that the variation or the rate of forward and backward reaction against time.

Which of following is correct?



A. $Q > K = 3, Q = K = 2, Q < K = 1$

B. $Q > K = 2, Q = K = 3, Q < K = 1$

C. $Q > K = 1, Q = K = 2, Q < K = 3$

D. $Q > K = 2, Q = K = 1, Q < K = 3$

Answer: A

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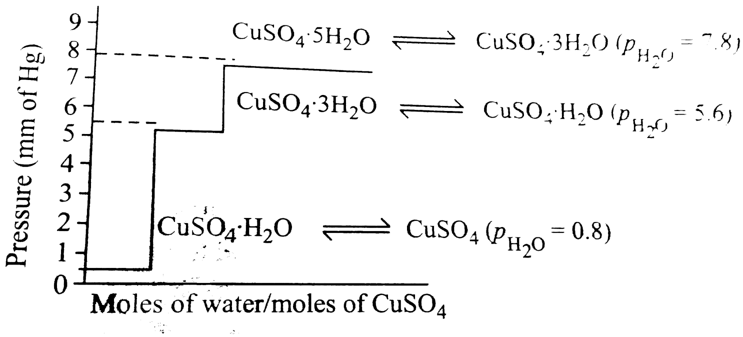
47. Dehydration of salts is an important class of heterogeneous reactions. The salt hydrates during dehydration often dissociate in steps to form a number of intermediate hydrates according to the prevailing pressure of moisture in contact with the solid hydrates. Thus, copper sulphate pentahydrate on dissociation yield trihydrates, monohydrates and then the anhydrous salt in the above order as follows:



The equilibrium constant K_p for the equilibrium between pentahydrate and trihydrate is:

A. 7.8

B. 60.84

C. 31.36

D. 5.6

Answer: B

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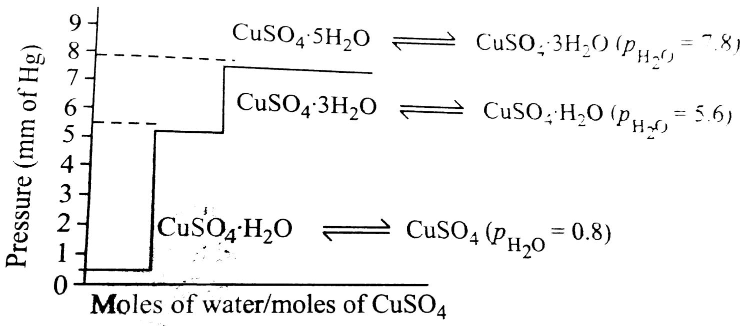
48. Dehydration of salts is an important class of heterogeneous reactions. The salt hydrates during dehydration often dissociate in steps to form a number of intermediate hydrates according to the prevailing pressure of moisture in contact with the solid hydrates. Thus, copper sulphate pentahydrate on dissociation yield trihydrates, monohydrates and then the anhydrous salt in the above order as follows:



The ratio of equilibrium constant between pentahydrate and trihydrate and equilibrium between trihydrate and monohydrate is

A. 1.9

B. 2.9

C. 8.6

D. 5.6

Answer: A

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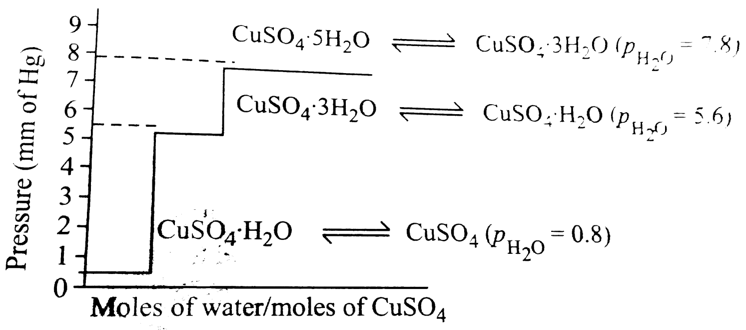
49. Dehydration of salts is an important class of heterogeneous reactions. The salt hydrates during dehydration often dissociate in steps to form a number of intermediate hydrates according to the prevailing pressure of moisture in contact with the solid hydrates. Thus, copper sulphate pentahydrate on dissociation yield trihydrates, monohydrates and then the anhydrous salt in the above order as follows:



Which of the following conditions is favourable for dehydration of $CuCO_4 .\ 5H_2O$?

i. Low humidty in air

ii. High temperature

iii. p_{H_2O} increases

The correct option is:

A. i

B. i, ii

C. ii, iii

D. i, ii, iii

Answer: B

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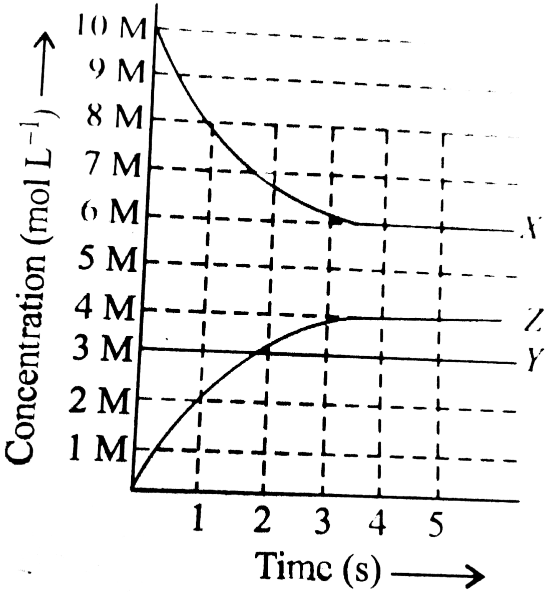
50. X, Y and Z react in the $1:1:1$ stoichiometric ratio.

The concentration of X, Y and Z we are found to vary with time as shown in the figure below:



Which of the following equilibrium reaction represents the correct variation of concentration with time?

A. $X(g) + Y(g) \Leftrightarrow Z(g)$

B. $X(g) + Y(s) \Leftrightarrow Z(g)$

C. $Z(g) + Y(g) \Leftrightarrow X(g)$

D. $Z(g) + X(g) \Leftrightarrow Y(g)$

Answer: C

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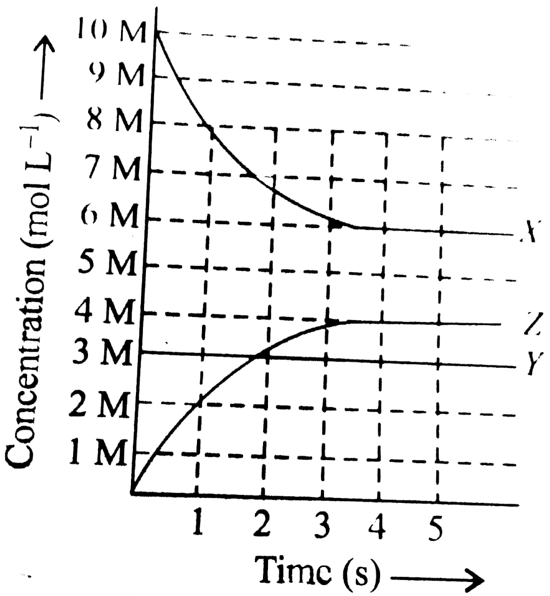
51. X, Y and Z react in the $1:1:1$ stoichiometric ratio.

The concentration of X, Y and Z we are found to vary with time as shown in the figure below:



The value of the equilibrium constant $\left(K_c\right)$ for the equilibrium represented the in above sketch will be

A. $\frac{9}{2}$

B. $\frac{11}{4}$

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

D. $\frac{10}{7}$

Answer: C

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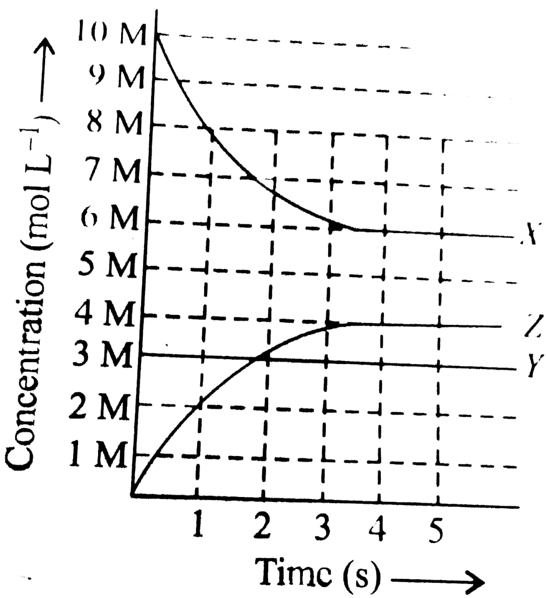
52. X, Y and Z react in the $1:1:1$ stoichiometric ratio.

The concentration of X, Y and Z we are found to vary with time as shown in the figure below:



If the above equilibrium is established in a $2.0L$ container by taking reactants in sufficient amount then how many moles of components Y must have reacted to establish the equilibrium?

A. 0

B. 6

C. 12

D. 8

Answer: D

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53. Two solids X and Y dissociate into gaseous products at a certain temperature as follows:

i. $X(s) \Leftrightarrow A(g) + C(g)$ and

ii. $Y(s) \Leftrightarrow B(g) + C(g)$

At a given temperature, pressure over excess solid 'X' is 40 mm of Hg and total pressure over solid 'Y(s)' is 60 mm of Hg.

Now, answer the following questions:

Ratio of K_p for reaction (i) to that of reaction (ii), is:

A. $4:9$

B. $2:3$

C. $4:9$

D. $2:1$

Answer: A

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54. Two solids X and Y dissociate into gaseous products at a certain temperature as follows:

i. $X(s) \Leftrightarrow A(g) + C(g)$ and

ii. $Y(s) \Leftrightarrow B(g) + C(g)$

At a given temperature, pressure over excess solid 'X' is 40 mm of Hg and total pressure over solid 'Y(s)' is 60 mm of Hg.

Now, answer the following questions:

The ratio of moles of A and B in the vapour state over a mixture of solids X and Y, is:

A. $2:3$

B. $2:5$

C. $4:9$

D. $1:1$

Answer: C

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55. Two solids X and Y dissociate into gaseous products at a certain temperature as follows:

i. $X(s) \Leftrightarrow A(g) + C(g)$ and

ii. $Y(s) \Leftrightarrow B(g) + C(g)$

At a given temperature, pressure over excess solid 'X' is 40 mm of Hg and total pressure over solid 'Y(s)' is 60 mm of Hg.

Now, answer the following questions:

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

A. 100 mm

B. 74.84 mm

C. 50 mm

D. 120.74 mm

Answer: B

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Exercises (Multiple Correct)

1. For the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, which of the following factors will have no effect on the value of equilibrium constant?

A. Temperature

B. Initial concentration of N_2O_4

C. Pressure of catalyst

D. Pressure

Answer: B::C::D

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2. For the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, the equilibrium can be shifted in favour of product by

A. Increasing the $[H_2]$

B. Increasing the pressure

C. Increasing the $[I_2]$

D. By using the catalyst

Answer: A::B

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3. A reaction $S_8(g) \Leftrightarrow 4S_2(g)$ is carried out by taking 2 mol of $S_8(g)$ and 0.2 mol of $S_2(g)$ is a reaction vessel of $1L$. Which one is not correct if $K_c = 6.30 \times 10^{-6}$

A. Reaction qutient is 8×10^{-4}

B. Reaction proceed in backward direction.

C. Reaction proceed is forward direction

D. $K_p = 2.55atm^3$

Answer: A::B::D

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4. For the equilibrium at $298K, N_2O_4(g) \Leftrightarrow 2NO_2(g), G^{\ominus}_{N_2O_4} = 100kJmol^{-1}$ and $G^{\ominus}_{NO_2} = 50kJmol^{-1}$. If 5 mol of N_2O_4 and 2 moles of NO_2 are taken initially in one litre container than which statement are correct.

A. reaction proceeds in forward direction

B. $K_c = 1$

C. $\Delta G = -0.55 KJ, \Delta G^{\ominus} = 0$

D. At equilibrium $\left[N_2O_4\right] = 4.84M$ and $\left[NO_2\right] = 0.212M$

Answer: A::B::C::D

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5. Which are true for the reaction: $A_2 \Leftrightarrow 2C + D$?

A. if $\Delta H = 0, K_p$ and increases with temperature and dissociation.

B. if $\Delta H = +ve, K_p$ increases with temperature and dissociation of A_2 increases.

C. if $\Delta H = -ve, K_p$ decreases with temperature and dissociation of A_2 increases.

D. $K_p = 4\alpha^3\left[\frac{P}{1+2\alpha}\right]^2$

Answer: A::B::C::D

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6. van't Hoff equation is

A. $(d/dT)\ln K = -\Delta H/RT^2$

B. $d/dT(\ln K) = +\Delta H/RT^2$

C. $(d/dT)\ln K = -\Delta H/RT$

D. $K = Ae^{-\Delta H/RT}$

Answer: B::D

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7. For given two equilibria attained in a container which are correct if degree of dissociation of A and A' are α and α' .

$A(s) \Leftrightarrow 2B(g) + C(g), K_{p_1} = 8 \times 10^{-2}$

$A'(s) \Leftrightarrow 2B(g) + D(g), K_{P_2} = 2 \times 10^{-2}$

A. $\frac{K_{p_1}}{K_{p_2}} = \left[\frac{(3\alpha' + 2\alpha)}{(3\alpha + 2\alpha')}\right]^3 \times \frac{\alpha}{\alpha'}$

B. $P'_C / P'_D = 4$

C. $P'_B = 2P'_C + 2P'_D$

D. $\alpha > \alpha'$

Answer: A::B::C::D

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8. In a reaction $A_2(g) + 4B_2(g) \Leftrightarrow 2AB_4(g), \Delta H < 0$. The formation of AB_4 is not favoured by

A. Low temperature and higher pressure

B. High temperature and low pressure

C. Low temperature and low pressure

D. High temperature and high pressure

Answer: B::C::D

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9. The reaction which proceeds in the backward direction is

A. $Fe_3O_4 + 6HCl = 2FeCl_3 + 3H_2O$

B. $NH_3 + H_2O + NaCl = NH_4Cl + NaOH$

C. $SnCl_4 + Hg_2Cl_2 = SnCl_2 + 2HgCl_2$

D. $2CuI + I_2 + 4K^{\oplus} = 2Cu^{2+} + 4KI$

Answer: B::C::D

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10. For which of the following reaction, $K_p \neq K_c$?

A. $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

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

C. $H_2(g) + Cl_2(g) \Leftrightarrow 2HCl(g)$

D. $2N_2O_4(g) \Leftrightarrow 2NO_2(g)$

Answer: A::B

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11. Select the incorrect statements:

A. K_p or K_c are dimenensionless if pressure or concentration are expressed in standard state.

B. The neumerical value of K_p changes with experimental conditions, i.e., P, T, and C at which equilibrium is attained.

C. Active mass of reactant = concentration of reactant

D. Dissolution of NH_3 in water increases with increasing pressure.

Answer: A::B::C::D

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12. For the chemical reaction

$3X(g) + Y(g) \Leftrightarrow X_3Y(g)$,

the amount of X_3Y at equilibrium is affected by

A. Temperature and pressure

B. Temperature only

C. Pressure only

D. Temperature, pressure, and catalyst

Answer: B::C::D

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13. 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. Is zero

B. Decreases with time

C. Is independent of time

D. Increases with time

Answer: A

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14. At constant temperature, the equilibrium constant (K_p) for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2$

is expressed by $K_p = 4x^2p/(1 - x^2)$, where p=pressure x= extent of decomposition. Which of the following statements is true?

A. K_p increases with increase of P.

B. K_p increases with increases of x.

C. K_p increase with decrease of x.

D. K_p remains constant with change in p and x

Answer: D

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15. 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. neigher K_p no α changes

B. Both K_p and α change

C. K_p changes but α does not change

D. K_p does not chamge but α changes

Answer: B::C::D

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16. Which of the following do not change the value of K for a reaction?

A. Addition of catalyst

B. Increase in temperature

C. Increase in pressure

D. Removal of one of the products

Answer: A::C::D

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17. For which of the following reactions at equilibrium at constant temperature, doubling the volume will cause a shift to the right?

A. $N_2O_4(g) \Leftrightarrow 2NO_2(g)$

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

C. $2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g)$

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

Answer: A::B

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18. Unit of equilibrium constant is:

A. $\left(molL^{-1}\right)^{1-n}$

B. $\left(molL^{-1}\right)^{\Delta n}$

C. $(atm)^{\Delta n}$

D. All

Answer: B::C

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19. Which is/are correct?

A. $2.303\log K = -\Delta H^{\ominus}/RT + \Delta S^{\ominus}/R$

B. $\Delta G^{\ominus} = -2.303RT\log K$

C. $-2.303\log K = -\Delta H^{\ominus}/RT^2 + \Delta S^{\ominus}/R$

D. $2.303\log K = (1/RT)\left(\Delta H^{\ominus} + \Delta S^{\ominus}\right)$

Answer: A::B

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20. For the reaction, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$, which is the correct representation?

A. $K_p = \left(p_{CO_2}\right)$

B. $K_p = K_c(RT)$

C. $K_p = \left(CO_2\right)/1$

D. None

Answer: A::B::C

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21. $N_2O_2 \Leftrightarrow 2NO, K_1,$

$$\left(\frac{1}{2}\right)N_2 + \left(\frac{1}{2}\right)O_2 \Leftrightarrow NO, K_2,$$

$2NO \Leftrightarrow N_2 + O_2, K_3,$

$$NO \Leftrightarrow \left(\frac{1}{2}\right)N_2 + \left(\frac{1}{2}\right)O_2, K_4$$

Correct relaton(s) between K_1, K_2, K_3 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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22. The rate of disappearance of A at two temperature is given by $A \Leftrightarrow B$

i. $\frac{-d[A]}{dt} = 2 \times 10^{-2}[A] - 4 \times 10^{-3}[B]$ at $300K$

ii. $\frac{-d[A]}{dt} = 4 \times 10^{-2}[A] - 16 \times 10^{-4}[B]$ at $400K$

From the given values of heat of reaction which are incorrect.

A. $3.86kcal$

B. $6.93kcal$

C. $1.68kcal$

D. $1.68 \times 10^{-2}kcal$

Answer: B::C::D

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23. Which of the following will favour the formation of NH_3 by Haner's prodess?

A. Increase in temperature

B. Increase in pressure

C. Addition of catalyst

D. Addition of promoter

Answer: B::C::D

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24. Which of the following will not affect the value of equilibrium constant of a reaction?

A. Change in the concentration of the reactants

B. Change in temperature

C. Change in pressure

D. Addition of catalyst

Answer: A::C::D

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25. Which of the following statement is/are wrong?

A. At equilibrium, concentrations of reactants and products become constant because the reaction stops.

B. Addition of catalyst speeds up the forward reaction more than the backward reaction.

C. Equilibrium constant of an exothermic reaction decreases with increase of temperature.

D. K_p is always greater than K.

Answer: A::B::D

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26. When $NaNO_3$ is heated in a closed vessel, oxygen is liberated and $NaNO_2$ is left behind. At equilibrium, which are correct

A. Addition of $NaNO_2$ favours reverse reactions.

B. Addition of $NaNO_2$ favours forward reactions.

C. Increasing temperature favours forward reaction

D. Increasing pressure reverse reaction.

Answer: C::D

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Exercises (Single Correct)

1. In the dissociation of PCl_5 as

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

If the degree of dissociation is α at equilibrium pressure P, then the equilibrium constant for the reaction is

A. $K_p = \dfrac{\alpha^2}{1 + \alpha^2 P}$

B. $K_p = \dfrac{\alpha^2 P^2}{1 - \alpha^2}$

C. $K_p = \frac{P^2}{1 - \alpha^2}$

D. $K_p = \frac{\alpha^2 P}{1 - \alpha^2}$

Answer: D

Watch Video Solution

2. For a hypothetical reaction of kind.

$AB_2(g) + \frac{1}{2}B_2(g) \Leftrightarrow AB_3(g), \Delta H = -xkJ$

More AB_3 could be produceed at equilibrium by

A. Using a catalyst

B. Removing some of B_2

C. Increasing the temperature

D. Increasing the pressure

Answer: D

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3. The equilibrium constant for a reaction

$A + B \Leftrightarrow C + D$ is 1.0×10^{-2} at 298 and is 2.0 at $373K$. The chemical process resulting in the foemation of C and D is

A. Exothermic

B. Endothermic

C. Unpredictable

D. None

Answer: B

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4. The solubility of CO_2 in water increases with

A. Increasing in temperature

B. Reduction of gas pressure

C. Increasing in gas pressure

D. Increasing in volume

Answer: C

Watch Video Solution

5. The equilibrium constant for a reaction

$A + 2B \Leftrightarrow 2C$ is 40. The equilibrium constant for reaction $C \Leftrightarrow B + 1/2A$ is

A. $1/40$

B. $(1/40)^{1/2}$

C. $(1/40)^{2}$

D. 40

Answer: B

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6. Inert gas has been added to the following equilibrium system at constant volume

$SO_2(g) + 1/2O_2(g) \Leftrightarrow SO_3(g)$

To which direction will the equilibrium shift?

A. Forward

B. Backward

C. No effect

D. Unpredictable

Answer: C

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7. The equilibrium constant K for the reaction $2HI(g) \Leftrightarrow H_2(g) + I_2(g)$ at room temperature is 2.85 and that at $698K$ is 1.4×10^{-2}. This implies

A. Exothermic

B. Endothermic

C. Exergonic

D. Unpredictable

Answer: A

Watch Video Solution

8. The decomposition of N_2O_4 to NO_2 is carried out at $280\,^{\circ}C$ in chloroform. When equilibrium is reached, 0.2 mol of N_2O_4 and 2×10^{-3} mol of NO_2 are present in a $2L$ solution. The equilibrium constant for the reaction

$N_2O_4 \Leftrightarrow 2NO_2$ is

A. 1×10^{-2}

B. 2×10^{-3}

C. 1×10^{-5}

D. 2×10^{-5}

Answer: C

Watch Video Solution

9. For the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the degree of dissociation at equilibrium is 0.2 at 1 atm pressure. The equilibrium constant K_p will be

A. $1/2$

B. $1/4$

C. $1/6$

D. $1/8$

Answer: C

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10. 4 mol of carbon dioxide was heated in $1dm^3$ vessel under conditions which produced at equilibrium 25% dissociation into carbon monoxide and oxygen. The number of moles of carbon monoxide produced

A. 0.5

B. 1.0

C. 2.0

D. 4.0

Answer: B

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11. 1 mol of N_2 is mixed with 3 mol of H_2 in a litre container. If 50 % of N_2 is converted into ammonia by the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, then the total number of moles of gas at the equilibrium are

A. 1.5

B. 4.5

C. 3.0

D. 6.0

Answer: C

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12. The equilibrium constant of a reaction is 300, if the volume of the reaction flask is tripled, the equilibrium constant will be

A. 100

B. 300

C. 250

D. 150

Answer: B

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13. For reaction : $H_2(h) + I_2(g) \Leftrightarrow 2HI(g)$ at certain temperature, the value of equilibrium constant is 50. If the volume of the vessel is reduced to half of its original volume, the value of new equilibrium constant will be

A. 25

B. 50

C. 100

D. Unpredictable

Answer: B

Watch Video Solution

14. The system $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ attains equilibrium. If the equilibrium concentration of $PCl_3(g)$ is doubled, the concentration of $Cl_2(g)$ would become

A. $1/4$ its original value

B. $1/2$ its original value

C. Twice its original value

D. Unpredictable

Answer: D

Watch Video Solution

15. XY_2 dissociates $XY_2(g) \Leftrightarrow XY(g) + Y(g)$. When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K for the reaction Assuming that the volume of the system remains unchanged.

A. 50.0

B. 100.0

C. 166.6

D. 400.0

Answer: B

Watch Video Solution

16. Consider the reaction

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

Which occurs in one step. The specific rate constant are 0.25 and 5000 for the forward and reverse reaction, respectively. The equilibrium constant is

A. 2.0×10^{-4}

B. 4.0×10^{2}

C. 5.0×10^{-5}

D. 2.5×10^{-6}

Answer: C

Watch Video Solution

17. For the equilibrium system

$2HX(g) \Leftrightarrow H_2(g) + X_2(g)$

the equilibrium constant is 1.0×10^{-5}. What is the concentration of HX if the equilibrium concentration of H_2 and X_2 are 1.2×10^{-3} M, and 1.2×10^{-4} M respectively?

A. $12 \times 10^{-4} M$

B. $12 \times 10^{-3} M$

C. $12 \times 10^{-2} M$

D. $12 \times 10^{-1} M$

Answer: C

Watch Video Solution

18. In alkaline solution, the following equilibria exist

a. $S^{2-} + S \rightarrow S_2^{2-}$ equilibrium constant K_1

b. $S_2^{2-} + S \rightarrow S_3^{2-}$ equilibrium constant K_2

K_1 and K_2 have values 12 and 11, respectively.

$S_3^{2-} \rightarrow S^{2-} + 2S$. What is equilibrium constant for the reaction

A. 132

B. 7.58×10^{-3}

C. 1.09

D. 0.918

Answer: B

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19. Given the equilibrium constants

$HgCl^{\oplus} + Cl^{\ominus} \rightarrow HgCl_2, K_1 = 3 \times 10^6$

$HgCl_2 + Cl^{\ominus} \rightarrow HgCl_3^{\ominus}, K_2 = 8.9$

The equilibrium constant for the disproportionation equilibrium

$2HgCl_2 \rightarrow HgCl^{\oplus} + HgCl_3^{\ominus}$ is

A. -3.3×10^5

B. 3×10^{-5}

C. 3.3×10^{5}

D. 3×10^{-6}

Answer: D

Watch Video Solution

20. When the reaction, $2NO_2(g) \Leftrightarrow N_2O_4(g)$ reaches equilibrium at $298K$. The partial pressure of NO_2 and N_2O_4 are $0.2Kpa$ and $0.4Kpa$, respectively. What is the equilibrium constant K_p of the above reaction at $298K$?

A. 0.1

B. 0.5

C. 1.0

D. 10

Answer: D

Watch Video Solution

21. The vapour density of mixture consisting of NO_2 and N_2O_4 is 38.3 at $26.7\,^{\circ}C$. Calculate the number of moles of NO_2 I $100g$ of the mixture.

A. 0.2

B. 0.4

C. 0.8

D. 1.6

Answer: B

Watch Video Solution

22. In the problem number 21, the number of mole of N_2O_4 in $100g$ of the mixture is:

A. 0.43

B. 0.86

C. 0.57

D. 0.2

Answer: B

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23. One mole of SO_3 was placed in a litre reaction flask at a given temperature when the reaction equilibrium was established in the reaction.

$2SO_3 \Leftrightarrow 2SO_2 + O_2$ the vessel was found to contain 0.6 mol of SO_2. The value of the equilibrium constant is

A. 0.36

B. 0.675

C. 0.45

D. 0.54

Answer: B

Watch Video Solution

24. The equilibrium constant for the reaction $w + x \Leftrightarrow y + z$ is 9. If one mole of each of w and x are mixed and there is no change in volume, the number of moles of y for formed is

A. 0.10

B. 0.50

C. 0.75

D. 0.54

Answer: C

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25. In the gaseous equilibrium

$A + 2B \Leftrightarrow C + \text{Heat}$, the forward reaction is favoured:

A. Low P, High T

B. Low P, Low T

C. High P, Low T

D. High P, High T

Answer: C

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

A. 2

B. 1

C. 5

D. 0.25

Answer: D

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27. For $N_2 + 3H_3 \Leftrightarrow 2NH_3 + \text{Heat}$

A. $K_p = K_c$

B. $K_p = K_cRT$

C. $K_p = K_c(RT)^{-2}$

D. $K_p = K_c(RT)^{-1}$

Answer: C

Watch Video Solution

28. For the reaction

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

The equilibrium constant K_p changes with

A. Total pressure

B. Catalyst

C. The amounts of H_2 and I_2 present

D. Temperature

Answer: D

Watch Video Solution

29. The equilibrium constant K for the reaction $2HI(g) \Leftrightarrow H_2(g) + I_2(g)$ at room temperature is 2.85 and that at $698K$ is 1.4×10^{-2}. This implies

A. HI is exothermic compound

B. HI is very stable at room temperature

C. HI is relatively less stable than H_2 and I_2 at room temperature

D. HI is resonance stablised

Answer: C

Watch Video Solution

30. K_1 and K_2 are equilibrium constants for reaction (i) and (ii)

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

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

then,

A. $K_1 = \left(1/K_2\right)^2$

B. $K_1 = K_2^2$

C. $K_1 = 1/K_2$

D. $K_1 = \left(K_2\right)^{\circ}$

Answer: A

Watch Video Solution

31. The equilibrium constant K_p for a homogeneous gaseous reaction is 10^{-8}. The standard Gibbs free energy change $\Delta G^{\ominus}$ for the reaction

$\left(\text{using} R = 2 cal K^{-1} mol^{-1}\right)$ is

A. $10.98 kcal$

B. $-1.9 kcal$

C. $-4.1454 kcal$

D. $+4.1454 kcal$

Answer: A

Watch Video Solution

32. Which of the following will not change the concentration of ammonia in the equilibrium

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -xkJ$

A. increase of temperature

B. increase of volume

C. decrease of volume

D. addition of catalyst

Answer: D

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33. In a chemical reaction, equilibrium is said to have been established when the

A. Concentrations of reactants and products are equal

B. Opposing reactions ceases

C. Velocities of opposing reaction become equal

D. Temperature of opposing reactions are equal

Answer: C

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34. In a chemical reaction

$N_2 + 3H_2 \Leftrightarrow 2NH_3$, at equilibrium point

A. Equal volumes of N_2 and H_2 are reacting

B. Equal masses of N_2 and H_2 are reacting

C. The reaction has stopped

D. The same amount of ammonia is formed as is decomposed into N_2 and H_2

Answer: D

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35. The equilibrium constant in a reversible reaction at a given temperature which

A. Depends on initial concentration, of the reactants.

B. Depends on the concentration of the products at equilibrium.

C. Does not depend on the initial concentration.

D. It is not characteristic of the reaction

Answer: C

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36. According to le-Chatelier's principle, adding heat to a solid and liquid in equilibrium will cause the

A. Amount of solid to decrease

B. Amount of liuid to decrease

C. Temperature to rise

D. Temperature to fall

Answer: A

Watch Video Solution

37. In the formation of nitric acid, N_2 and O_2 are made to combine. Thus, $N_2 + O_2 \Leftrightarrow 2NO + \text{Heat}$ which of the following condition will favour the formation of NO?

A. low temperature

B. high temperature

C. freezing point

D. all are favourable

Answer: A

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38. Which of the following factors will favour the reverse reaction in a chemical equilibrium?

A. increase in concentration of one of the reactants

B. increase in concentration of one of the products

C. removal of one of the products regularly

D. None of these

Answer: B

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39. For the system $A(g) + 2B(g) \Leftrightarrow C(g)$ the equilibrium concentration is

$A = 0.06molL^{-1}, B = 0.12molL^{-1}$

$C = 0.216molL^{-1}$ The K_{eq} for the reaction is

A. 250

B. 416

C. 4×10^{-3}

D. 125

Answer: A

Watch Video Solution

40. 4 moles of A are mixed with 4 moles of B, when 2 moles of C are formed at equilibrium according to the reaction $A + B \Leftrightarrow C + D$.

The value of equilibrium constant is

A. 4

B. 1

C. 1/2

D. 1/4

Answer: B

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41. $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$ in closed container at equilibrium. What would be the effect of addition of $CaCO_3$ on the equilibrium concentration of CO_2.

A. Increases

B. Decreases

C. Data is not sufficient

D. Remains unaffected

Answer: D

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42. The equilibrium constant for a reacton $N_2(g) + O_2(g) = 2NO(g)$ is 4×10^{-4} at $2000K$. In the presence of catalyst, the equilibrium constant is attained 10 times faster. The equilibrium constant in the presence of catalyst, at $2000K$ is

A. 40×10^{-4}

B. 4×10^{-4}

C. 4×10^{-2}

D. incomplete data

Answer: B

Watch Video Solution

43. In which of the following reaction, the yield of the products does not increase by increase in thepressure?

A. $N_2(g) + O_2(g) = 2NO(g)$

B. $2SO_2(g) + O_2(g) = 2SO_3(g)$

C. $N_2(g) + 3H_2(g) = 2NH_3(g)$

D. $PCl_3(g) + Cl_2(g) = PCl_5(g)$

Answer: A

Watch Video Solution

44. At certain temperature 50% of HI is dissociated into H_2 and I_2 the equilibrium constant is

A. 1.0

B. 3.0

C. 0.5

D. 0.25

Answer: D

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45. For a reaction $A(g) \Leftrightarrow B(g) + C(g)$. K_p at $400\,^\circ C$ is 1.5×10^{-4} and K_p at $600\,^\circ C$ is 6×10^{-3}. Which statement is incorrect?

A. The reaction is exothermic

B. Increase in temperature increases the formation of B

C. Increase in pressure increases the formation of A

D. Decrease in temperature and increase in pressure shift the equilibrium towards left

Answer: A

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46. 8 mol of gas AB_3 are introduced into a $1.0 dm^3$ vessel. It dissociates as

$2AB_3(g) \Leftrightarrow A_2(g) + 3B_2(g)$

At equilibrium, 2 mol of A_2 is found to be present. The equilibrium constant for the reaction is

A. $2 mol^2 L^{-2}$

B. $3 mol^2 L^{-2}$

C. $27 mol^2 L^{-2}$

D. $36 mol^2 L^{-2}$

Answer: C

Watch Video Solution

47. 1 mol of $XY(g)$ and 0.2 mol of $Y(g)$ are mixed in 1 L vessel. At equilibrium, 0.6 mol of $Y(g)$ is present. The value of K for the reaction

$XY(g) \Leftrightarrow X(g) + Y(g)$ is

A. $0.04 mol L^{-1}$

B. $0.06 mol L^{-1}$

C. $0.36 mol L^{-1}$

D. $0.40 mol L^{-1}$

Answer: D

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48. How will the lowering of temperature affect the chemical equilibrium in the system

$2NO + O_2 \Leftrightarrow 2NO_2, \Delta H < 0$

A. Relative concentration of products and reactants does not change.

B. Relative concentration of products and reactants change.

C. Equilibrium is shift to the left.

D. Equilibrium is shift to the right.

Answer: B::D

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49. For the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, the value of K_p is 1.7×10^3 at $500K$ and 1.7×10^4 at $600K$. Which of the following is/are correct ?

A. The proportions of NO_2 in the equilibrium mixture is increased by decrease in pressure.

B. The standard enthalpy change for the forward reaction is negative

C. Units of K_p are atm^{-1}

D. At $500K$ the degree of dissociation of N_2O_4 decreases by 50% by increasing the pressure by 100%

Answer: A

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50. At equilibrium $X + Y \Leftrightarrow 3Z$, 1 mol of X, 2 mol of Y and 4 mol of Z are contained in a 3 - L vessel. Among the given values of reaction coefficient Q, given at three different instants, which value refers to system at equilibrium?

A. 10

B. 15

C. 10.67

D. N/A

Answer: C

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51. What concentration of CO_2 be in equilibrium with $0.025M$ CO at $120\,^{\circ}C$ for the reaction

$FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2(g)$

if the value of $K_c = 5.0$?

A. $0.125M$

B. $0.0125M$

C. $1.25M$

D. $12.5M$

Answer: A

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52. Which of the following reactions will not be affected by increasing the pressure?

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

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

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

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

Answer: B::D

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53. 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 of $CO(g)$

Answer: D

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54. For the chemical reaction

$3X(g) + Y(g) \Leftrightarrow X_3Y(g)$,

the amount of X_3Y at equilibrium is affected by

A. Temperature and pressure

B. Temperature only

C. Pressure only

D. Temperature, pressure, and catalyst

Answer: A

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55. 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. Is zero

B. Decreases with time

C. Is independent of time

D. Increases with time

Answer: D

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56. At constant temperature, the equilibrium constant $\left(K_p\right)$ for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2$

is expressed by $K_p = 4x^2p/\left(1 - x^2\right)$, where p=pressure x= extent of decomposition. Which of the following statements is true?

A. K_p increase with increase in p

B. K_p increases with increase in x

C. K_p increases with decrease in x.

D. K_p remains constant with change in p and x

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57. The equilibrium constant K_{p_2} and K_{p_2} for the reactions $A \Leftrightarrow 2B$ and $P \Leftrightarrow Q + R$, respectively, are in the ratio of $2:3$. If the degree of dissociation of A and P are equal, the ratio of the total pressure at equilibrium is,

A. $1:36$

B. $1:9$

C. $1:6$

D. $1:4$

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58. For the reaction $X \Leftrightarrow 2Y$ and $Z \Leftrightarrow P + Q$ occuring at two different pressure P_1 and P_2, respectively. The ratio of the two pressure is $1:3$. What will be the ratio of equilibrium constant, if degree of dissociation of X and Z are equal.

A. $1:36$

B. $1:12$

C. $1:9$

D. $2:3$

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Exercises (Assertion-Reasoning)

1. Assertion (A) : K_p can be equal to or less than or even greater than value of K_c

Reason (R) : $K_p = K_c(RT)^{\Delta n}$

Relation between K_p and K_c depends on the change in the number of moles of gaseous reactants and products.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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2. Assertion (A) : For $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, the equilibrium constant is K. The for $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \Leftrightarrow NH_3(g)$, the equilibrium constant will be $\sqrt{K}$.

Reason (R) : If concentrations are changed to half, the equilibrium constants will be halved.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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3. Assertion (A) : The equilibrium constant is fixed and characteristic for any given chemical reaction at a specified temperature.

Reason (R) : The composition of the final equilibrium mixture at a particular temperature depends upon the starting amount of reactants.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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4. Assertion (A) : K_p is always greater than K_c.

Reason (R) : The effect of pressure is greater on the rate of reaction than the effect of concentration.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If both (A) and (R) are incorrect.

Answer: D

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5. Assertion (A) : A catalyst does not influences the values of equilibrium constant

Reason (R) : Catalyst influences the rate of both forward and backward reactions equally.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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6. Assertion (A) : Equilibrium constant of a reaction increases if temperature is increased

Reason (R) : The forward reaction becomes faster with increase of temperature.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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7. Assertion (A) : The active mass of pure solid and pure liquid is taken unity.

Reason (R) : The active mass of pure solids and liquids depends on the density and molecular mass. The density and molecular of a mass of pure liquids and solids are constant.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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8. Assertion (A) : For $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$, if more Cl_2 is added the equilibrium will shift in backward direction. Hence, equilibrium constant will decrease.

Reason (R) : Addition of inert gas to the equilibrium mixture at constant volume does not alter the equilibrium.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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9. Assertion (A) : Adding inert gas to dissociation equilibrium of N_2O_4 at constant pressure and temperature increases the dissociation.

Reason (R) : molar concentration of the reactants and products decreases.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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10. Assertion (A) : The value of K for a reaction may increase or decrease with increase in temperature depending upon whether the reaction is exothermic or endothermic.

Reason (R) : With increase in temperature, the axtent of reaction increases.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: B

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11. Assertion (A) : When a catalyst is added to a reaction mixture in equilibrium the amount of the products increases.

Reason (R) : The forward reaction becomes faster on adding the catalyst.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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12. Assertion (A) : For the reaction

$H_2 + I_2 \Leftrightarrow 2HI, K_p = K_c$

Reason (R) : In this reaction, the sum of stoichiometric coefficient of reactants is equal to the sum of stoichiometric coefficients of products.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: A

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13. Assertion (A) : A change of pressure has no effect in case of the equilibrium,

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

Reason (R) : The reaction,

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ is highly exothermic reaction

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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14. Assertion (A) : The value of K increases with increase in temperature in case of endothermic reaction

Reason (R) : The increase in temperature shifts the equilibrium in the backward direction in case of exothermic reaction.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: D

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15. Assertion (A) : Greater the value of K, more is the fraction of initial concentration of reactants converted to products at equilibrium.

Reason (R) : The value of K depends on the initial concentration of reactants.

A. If both (A) and (R) are correct, and (R) is the correct explanation for (A)

B. If both (A) and (R) are correct, but (R) is not the correct explanation of (A)

C. If (A) is correct, but (R) is incorrect

D. If (A) is incorrect, but (R) is correct.

Answer: C

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Exercises (Integer)

1. A reaction attains equilibrium, when the free energy change is

A. 1

B. 2

C. 3

D. 0

Answer: D

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2. For a homogeneous chemical reaction, K_p - K_c when

A. $\Delta n = 0$

B. $\Delta n = 1$

C. $\Delta n = 2$

D. $\Delta n = \infty$

Answer: A

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3. For the reaction $A + B \Leftrightarrow C$, the rate constants for the forward and the reverse reactions are 4×10^2 and 2×10^2 respectively. The value of equilibrium constant K for the reaction would be

A. 1

B. 2

C. 3

D. 4

Answer: B

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4. The equilibrium constant for the reactions

$A + B \Leftrightarrow AB$ is 0.5 at $200K$. The equilibrium constant for the reaction $AB \Leftrightarrow A + B$ would be

A. 1

B. 2

C. 3

D. 4

Answer: B

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5. One mole of ethanol is treated with one mole of ethanoic acid at $25^{\circ} C$. Half of the acid changes into ester at equilibrium. The equilibrium constant for the reaction will be

A. 1

B. 2

C. 3

D. 4

Answer: A

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6. In the reaction $A + B \Leftrightarrow AB$, if the concentration of A and B is increased by a factor of 2, it will cause the equilibrium concentration of AB to change to

A. Two times to original value

B. Three times to original value

C. Same

D. Zero

Answer: A

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7. At equilibrium, the value of equilibrium constant K is

A. 1

B. 2

C. 3

D. 0

Answer: A

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Exercises (Fill In The Blanks)

1. At equilibrium stage, the rate of forward reaction is .... To the rate of backward reaction.

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2. The equilibrium constant does not depends on the initial concentrations of the reactants but depends on .... of various reactants and products at ....

Watch Video Solution

3. In the reaction $2NO(g) \Leftrightarrow N_2(g) + O_2(g)$, the values of K_c and K_p are .... at a given temperature.

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4. Number of moles when divided by the total volume in litre gives .... of the respective species.

Watch Video Solution

5. The equilibrium state is attained when the reversible reaction is carried out in .... space.

Watch Video Solution

6. The chemical equilibrium is .... in nature.

Watch Video Solution

7. A catalyst .... the equilibrium state but helps to attain in lesser time.

Watch Video Solution

8. The equilibrium concentration of x, y and z are $4, 2$ and 2 mol L^{-1}, respectively, at equilibrium of the reaction $2x + y \Leftrightarrow z$. The value of K_c is ....

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9. At equilibrium , the amount of each constituent of reaction mixture becomes ....

Watch Video Solution

10. The equilibrium constant has no unit if Δn= ....

Watch Video Solution

11. The relation between K_p and K_c of a reversible reaction at constant temperature is K_p=..............

Watch Video Solution

12. For the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, the units of K_p are ....

Watch Video Solution

13. In the reaction $A + B \Leftrightarrow C + D$, the value of equilibrium constant is 10. If the rate constant of forward reaction is 80, the rate constant of backward reaction is ....

Watch Video Solution

14. A tenfold increase in pressure on the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at equilibrium result in .... in K_p.

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15. The equilibrium constant for the reaction $2A + 2B \Leftrightarrow 2C + 2D$ is 200. The equilibrium constant for the reaction $A + B \Leftrightarrow C + D$, at the same temperature is ....

Watch Video Solution

16. If the activation energies of the forward and backward reactions of a reversible reaction are $E_a(f)$ and $E_a(b)$, respectively. The ΔE of the reaction is ....

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17. If the value of equilibrium constant is large, ... Are more stable.

Watch Video Solution

18. The magnitude of equilibrium constant is a measure of .... to which the reversible reaction proceeds in a particular direction at a given ....

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19. Le Chatelier's principle is applicable to both .... and .... equilibria.

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20. Low temperature is favourable for .... reactions.

Watch Video Solution

21. Low pressure is favourable for those reversible reactions in which there is .... in the number of molecules.

Watch Video Solution

22. If the temperature of the system at equilibrium is increased, the equilibrium will shift in the direction which .... heat.

Watch Video Solution

23. An endothermic reaction which proceeds with decrease in volume will give maximum yield of the products at .... and ....

Watch Video Solution

24. The formation of ammonia by Haber's process is favoured by .... pressure.

Watch Video Solution

25. Low pressure favoures those reactions which occur with .... in the number of molecule.

Watch Video Solution

26. For a system of gases A, B, C, and D at equilibrium $A+2B \Leftrightarrow C+3D$, the partial pressures are found to be $A=2.0, B=2.0, C=3.0,$ and

$D = 5.0$ atm. The value of equilibrium constant is ....

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27. For the reaction $A + B \Leftrightarrow C + D$, the initial concentrations of A and B are equal. The equilibrium concentration of C is two times the equilibrium concentration of A. The value of equilibrium constant is ....

Watch Video Solution

28. For reaction $PCl_3(g) + Cl_2(g) \Leftrightarrow PCl_5(g)$, K_c is 30 at $300K$. The value of K_p at $300K$ is ....

Watch Video Solution

29. For $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$, K_c is equal to ....

Watch Video Solution

30. The vapour density of Pcl_5 is 104.16 but when heated to $230\,^\circ C$, its vapour density is reduced to 62. The degree of dissociation of PCl_5 at $230\,^\circ C$ is ....

Watch Video Solution

31. In line kilns, the following reaction,

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

proceeds to completion because of

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32. The degree of dissociation of PCl_5 will be more at .... pressure.

Watch Video Solution

33. When the system $2HI(g) \Leftrightarrow H_2(g) + I_2(g)$ is at equilibrium, inert gas is introduced. Dissociation of HI is ....

Watch Video Solution

34. When a product is removed from the system which is at equilibrium .... reaction is favoured.

Watch Video Solution

35. The melting of ice is favoured by .... pressure and .... temperature.

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Exercises (True/False)

1. The dissociation of $CaCO_3$ is suppressed at high pressure

Watch Video Solution

2. More of SO_3 decompose at loe temperature.

Watch Video Solution

3. Addition of inert gas to system at equilibrium changes only K_p not K_c.

Watch Video Solution

4. The melting of ice in water decreases with increase in pressure.

Watch Video Solution

5. The evaporation of liquid with increase in pressure.

Watch Video Solution

6. If equilibrium constant for the reaction

$A_2 + B_2 \Leftrightarrow 2AB$ is k, then for the backward reaction $AB \Leftrightarrow 1/2A_2 + 1/2B_2$

the equilibrium constant k' is $1/K$.

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7. K_p is equal to K_c if Δn is positive.

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8. The value K_c of a reaction has a higher value at higher temperature. The reaction is axothermic in nature.

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9. The reaction having higher value of equilibrium constant is faster than the reaction having lower value of equilibrium constant.

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10. Ammonium chloride dissociates as,

$NH_4Cl(g) \Leftrightarrow NH_3(g) + HCl(g)$

The vapour density becomes half the initial value when degree of dissociation is 0.5.

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11. The low of mass action applicable to heterogenous equilibria.

Watch Video Solution

12. Equilibrium can be achieved only in open vessel.

Watch Video Solution

13. The solubility of sodium hydroxide increases with increase of temperature.

Watch Video Solution

14. The degree of dissociation of PCl_5 decreases with increase in pressure.

Watch Video Solution

15. High pressure and low temperature are favourable conditions for the synthesis of ammonia.

Watch Video Solution

16. An endothermic reaction proceeds faster in the forward reaction with decrease in temperature.

Watch Video Solution

17. A catalyst increases the rate of forward reaction and decrease the rate of backwark reaction.

Watch Video Solution

18. The value of K does not depends upon pressure.

Watch Video Solution

19. For any reaction, greater the value of equilibrium constant greater is the extent of reaction.

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20. Solid $\Leftrightarrow$ liquid equilibrium can be achieved only at melting point of the substance.

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21. Addition of an inert gas at constant volume to the equilibrium mixture does not affect the position of equilibrium.

Watch Video Solution

22. For a reversible system at a constant temperature, the value of K_c increases if the concentrations are changed at equilibrium.

Watch Video Solution

23. The equilibrium constant is 10 at $100K$. Hence, ΔG will be negative.

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24. Unit of K_p is $(atm)^{\Delta n}$

Watch Video Solution

25. The value of equilibrium constant is independent of the speed with which the equilibirum is attained.

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26. In Haber's process, once the equilibrium is established, addition of nitrogen decreases the yield of ammonia.

Watch Video Solution

27. When the equilibrium is attained, the concentration of each of the reactants and products becomes equal.

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28. The equilibrium state can be attained from both sides of the chemical reaction.

Watch Video Solution

29. A reaction continues even after the attainment of equilibrium.

Watch Video Solution

30. The equilibrium can be attained at a faster rate if one of the products is allowed to escape from the reaction mixture.

Watch Video Solution

Archives (Multiple Correct)

1. For the gas phase reaction

$C_2H_4 + H_2 \Leftrightarrow C_2H_6 (\Delta H = -32.7 \text{kcal})$

carried out in a vessel, the equilibrium concentration of C_2H_4 can be increased by

A. Increasing the temperature

B. Decreasing the temperature

C. Removing some H_2

D. Adding some C_2H_6

Answer: A::C::D

Watch Video Solution

2. When $NaNO_3$ is heated in a closed vessel, oxygen is liberated and $NaNO_3$ is left behind. At equilibrium,

A. Addition of $NaNO_2$ favours reverse reaction.

B. Addition of $NaNO_3$ fovours forward reaction

C. Increasing the temperature favours forward reaction.

D. Increasing the pressure favours reverse reaction.

Answer: C::D

Watch Video Solution

3. 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. The concentrations of SO_2, Cl_2 and SO_2Cl_2 change.

B. More chlorine is formed.

C. The concentration of SO_2 is reduced.

D. All are incorrect.

Answer: D

Watch Video Solution

4. For the reaction

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl\_(2)(g)$

The forward reaction at constant temperature is favoured by

A. Introducing an inert gas at constant volume.

B. Introducing chlorine gas at constant volume,

C. Introducing an inert gas at constant pressure

D. Increasing the volume of the container.

Answer: C::D

Watch Video Solution

5. 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 of $CO(g)$

Answer: D

Watch Video Solution

6. The equilibrium $2CuI \Leftrightarrow Cu + Cu^{II}$

In aqueous medium at $25\,^{\circ}C$ shifts towards the left in the presence of

A. $NO_3^{\ominus}$

B. $Cl^{\ominus}$

C. $SCN^{\ominus}$

D. $CN^{\ominus}$

Answer: B::C::D

Watch Video Solution

Archives (Single Correct)

1. For the reaction

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

The equilibrium constant K_p changes with

A. Total pressure

B. Catalyst

C. The amounts of H_2 and I_2 present

D. Temperature

Answer: D

Watch Video Solution

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2. Pure ammonia is placed in a vessel at a temperature where its dissociation constant (α) is appreciable. At equilibrium,

A. K_p does not change significantly with pressure

B. α does not change with pressure

C. The concentration of NH_3 does not change with pressure.

D. The concentration of hydrogen is less than that of nitrogen.

Answer: A

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3. An example of a reversible reaction is

A. $Pb\left(NO_3\right)_2(aq) + 2NaI(aq) \rightarrow PbI_2(s) + 2NaNO_3(aq)$

B. $AgNO(3)(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

C. $2Na(s) + H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

D. $KNO_3(aq) + NaCl(aq) \rightarrow Kcl(aq) + NaNO_3(aq)$

Answer: D

Watch Video Solution

4. One mole of $N_{20O_4(g)}$ at 300K is kept in a closed container under one atmosphere. It is heated to 600K when 20% of $N_2O_4(g)$ is converted to $NO_2(g)$

$N_2O_4 \Leftrightarrow 2NO_2(g)$ Hence resultant pressure is :

A. 1.2 atm

B. 2.4 atm

C. 2.0 atm

D. 1.0 atm

Answer: B

Watch Video Solution

5. For the chemical reaction,

$3x(g) + Y(g) \Leftrightarrow X_3Y(g)$

the amount of X_3Y at equilibrium is affected by

A. Temperature and pressure

B. Temperature only

C. Pressure only

D. Temperature, pressure, and catalyst

Answer: A

Watch Video Solution

6. For the reversible reaction

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

at $500\,^\circ C$, the value of K_p is 1.44×10^{-5} when the partial pressure is measured in atmophere. The corresponding value of K_c with concentration in mol L^{-1} is

A. $\frac{1.44 \times 10^{-5}}{(0.082 \times 500)^{-2}}$

B. $\frac{1.44 \times 10^{-5}}{(8.314 \times 773)^{-2}}$

C. $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{2}}$

D. $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

Answer: D

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7. When two reactants A and B are mixed to give producys C and D, the reaction quotient (Q) at the initial stages of the reaction

A. Is zero

B. Decreases with time

C. Is independent of time

D. Increases with time

Answer: D

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8. At constant temperature, the equilibrium constant (K_p) for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2$

is expressed by $K_p = 4x^2p/(1-x^2)$, where p=pressure x= extent of decomposition. Which of the following statements is true?

A. K_p increases with increase in p.

B. K_p increases with increase in x.

C. K_p increases with decrease in x.

D. K_p remains constant with change in p and x

Answer: D

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Watch Video Solution

9. 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 statement holds true regarding the equilibrium constant $\left(K_p\right)$ and the degree of diffociation (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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Archives (Fill In The Blanks)

1. For a given reversible reaction at a fixed temperature, equilibrium constants K_p and K_c are related by ....

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2. A 10-fold increase in pressure on the reaction

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

at equilibrium results in .... in K_p.

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3. For a gaseous reaction $2B \rightarrow A$, the equilibrium constant K_p is .... to/ than K_c.

Watch Video Solution

Archives (True/False)

1. When a liquid and its vapour are at equilibrium and the pressure is suddenly decreased, cooling occurs.

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2. If the equilibrium constant for the reaction

$A_2 + B_2 \Leftrightarrow 2AB$

is K, then the backward reaction,

$AB \Leftrightarrow \frac{1}{2}A_2 + \frac{1}{2}B_2$

the equilibrium constant is $1/K$.

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3. Catalyst makes a reaction more exothermic.

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4. The rate of an exothermic reaction increases with increasing temperature.

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Archives (Subjective)

1. 1 mol of nitrogen is mixed with 3 mol of hydrogen in a $4L$ container. If 0.25% of nitrogen is converted to ammonia by the following reaction

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

then calculate the equilibrium constant K_c in concentration units. What will be the value of K_c for the following equilibrium?

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

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2. 1mol of N_2 and 3 mol of PCl_5 are placed in a $100L$ vessel heated to $227^\circ C$. The equilibrium pressure is 2.05 atm. Assuming ideal behaviour, calculate the degree of dissociation for PCl_5 and K_p for the reaction.

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

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3. The equilibrium constant of the reaction

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

at $100^\circ C$ is 50. If a $1-L$ 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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4. At a certain temperature, equilibrium constant $\left(K_c\right)$ is 16 for the reaction:

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

If we take 1 mol of each of the four gases in a 1 - L container, what would be the equilibrium concentrations of NO and NO_2?

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5. N_2O_4 is 25 % dissociated at $37^\circ C$ and $1 atm$. Calculate (i) K_p and (ii) the percentage dissociation at 0.1 atm and $37^\circ C$.

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6. For the reaction

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

hydrogen gas is introduced into a 5 - L flask at $327^\circ C$ containing 0.2 mol of $CO(g)$ and a catalyst, untill the pressure is 4.92 atm. At this point, 0.1 mol of $CH_3OH(g)$ is formed. Calculate the equilibrium constant K_p and K_c

.

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7. When 0.15 mol of CO taken in a $2.5L$ flask is maintained at $750K$ along with a catalyst, the following reaction takes 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 before are used, but with no catalyst so that the reaction does not take place.

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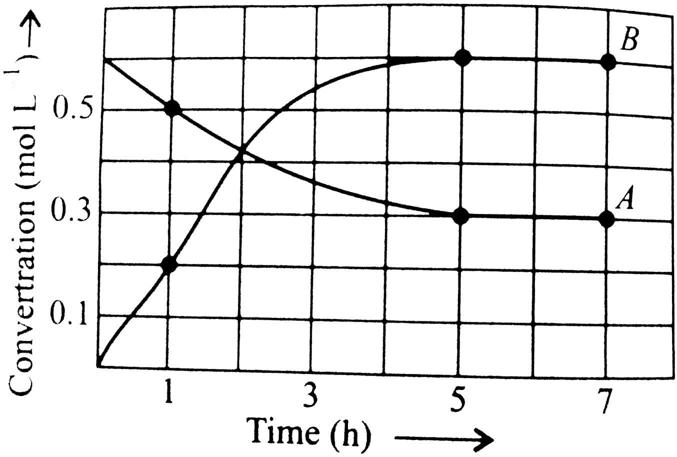
8. The progress of the reaction $A \Leftrightarrow nB$ with time is persented in the figure given below:



Determine

a. The value of n.

b. The equilibrium constant K.

c. The initial rate of concentration of A.

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9. The degree of dissociation is 0.4 at $400K$ and 1.0 atm for the gaseous reaction

$PCl_5 \Leftrightarrow PCl_3 + Cl_2$

assuming ideal behaviour of all gases, calculate the density of equilibrium mixture at $400K$ and 1.0 atm (relative atomic mass of P is 31.0 and of Cl is 35.5).

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10. When $3.06g$ of solid NH_4HS is intoduced into a 2 - L evacuated flask at $27^\circ C, 30\%$ of the solid decomposes into gaseous ammonia and hydrogen sulphide.

a. Calculate K_c and K_p for the reaction at $27^\circ C$.

b. What would happen to the equilibrium when more solid NH_4HS is introduced into the flask?

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11. In the reaction equilibrium

$N_2O_4 \Leftrightarrow 2NO_2(g)$

When 5 mol of each is taken and the temperature is kept at $298K$, the total pressure was found to be 20 bar.

Given : $\Delta_f G^{\ominus}_{n_2O_4} = 100kJ, \Delta_f G^{\ominus}_{NO_2} = 50KJ$

a. Find ΔG of the reaction at $298K$.

b. Find the direction of the reaction.

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