JARS EDUCATION
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Practice Paper

Time : 2 Hour | 11th standard (JEE BASED) CHEMICAL EQUILIBRIUM | Total Marks : 200

Chemistry

*** SECTION - A** [160]

1. The equilibrium $SO_2Cl_{2(g)} \rightleftharpoons SO_{2(g)} + Cl_{2(g)}$ is attained at 25^oC in a closed container and an inert gas helium is introduced which of the following statement is correct
   (A) More chlorine is formed
   (B) Concentration of SO_2 is reduced
   (C) More SO_2Cl_2 is formed
   (D) Concentration of SO_2Cl_2, SO_2 and Cl_2 does not change
2. In which of the following K_p is less than K_c ?
   (A) $N_2O_4 \rightleftharpoons 2NO_2$ (B) $2HI \rightleftharpoons H_2 + I_2$
   (C) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ (D) $N_2 + O_2 \rightleftharpoons 2NO$
3. For a gaseous reversible reaction, enthalpy of reaction at constant pressure is $1.8\ Kcal/mol$ greater than that of constant volume at $300\ K$. The value of $\left(\frac{K_P}{K_C}\right)$ for the reaction at $\left(\frac{1}{0.00821}\right) K$ is
   (A) $1000\ atm\ M^{-1}$ (B) $1000\ atm^3\ M^{-3}$ (C) $1000\ atm^{-3}\ M^3$ (D) $0.001\ atm^3\ M^{-3}$
4. For the reaction $2NO_{2(g)} \rightleftharpoons 2NO_{(g)} + O_{2(g)}$,$K_c = 1.8 \times 10^{-6}$ at 185^oC. At 185^oC the K_c for $NO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons NO_{2(g)}$ is
   (A) 1.95×10^{-3} (B) 1.95×10^3 (C) 7.5×10^2 (D) 0.9×10^6
5. If K_c is the equilibrium constant for the formation of NH_3, the dissociation constant of ammonia under the same temperature will be
   (A) K_c (B) $\sqrt{K_c}$ (C) K_c^2 (D) $1/K_c$
6. For the reaction
   $SnO_2(s) + 2H_2(g) \rightleftharpoons 2H_2O(g) + Sn(l)$
   At equilibrium, the mixture of steam and hydrogen contains 40% H_2 by volume then find K_p for the reaction

(A) $\frac{9}{4}$ (B) $\frac{3}{2}$ (C) $\frac{6}{4}$ (D) None of these

7. The equilibrium constant (K_P) for the reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$ at $1000\,K$ is 3.5 . The partial pressure of oxygen gas to give equal mole of SO_2 and SO_3 is ..... atm

(A) 0.29 (B) 3.7 (C) 0.59 (D) 1.85

8. For the reaction in equilibrium

$2NOBr_{(g)} \rightleftharpoons 2NO_{(g)} + Br_{2(g)}$

if P_{Br_2} is $\frac{P}{4}$ At equilibrium and P is total pressure then calculate $\frac{P}{K_P}$.

(A) 1 (B) 4 (C) $4/9$ (D) 2.25

9. In reaction $A + 2B \rightleftharpoons 2C + D$, initial concentration of B was 1.5 times of $[A]$, but at equilibrium the concentrations of A and B became equal. The equilibrium constant for the reaction is

(A) 4 (B) 6 (C) 12 (D) 8

10. For the reaction $3A_{(g)} + B_{(g)} \rightleftharpoons 2C_{(g)}$ at a given temperature, K_c is 9.0. What must be the volume of the flask if a mixture of $2.0\,mol$ each of A, B and C is obtained at equilibrium ? L

(A) 2 (B) 6 (C) 3 (D) 10

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

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

(A) atm (B) atm^{-2} (C) atm^2 (D) atm^{-1}

12. 2 moles of N_2 are mixed with 6 moles of H_2 in a closed vessel of one litre capacity. If $50\%\,N_2$ is converted into NH_3 till equilibrium, find the value of K_c for the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(A) $4/27$ (B) $27/4$ (C) $1/27$ (D) 27

13. For the reaction

$2NO_2(g) \rightleftharpoons N_2O_4(g)$ at $300\,K$

The value of Kp is $2\,atm^{-1}$. The total pressure at equilibrium is $10\,atm$. If volume of container become two times of its original volume, what will be its equilibrium pressure at $300\,K$ .....atm

(A) 6.4 (B) 4.51 (C) 6 (D) 5.19

14. A $1\,M$ solution of glucose reaches dissociation equilibrium according to equation given below $6HCHO \rightleftharpoons C_6H_{12}O_6$. What is the concentration of $HCHO$ at equilibrium if equilibrium constant is 6×10^{22}

(A) $1.6 \times 10^{-8} M$ (B) $3.2 \times 10^{-6} M$ (C) $3.2 \times 10^{-4} M$ (D) $1.6 \times 10^{-4} M$

15. $120\,gm$ of urea are present in $5\,litre$ solution, the active mass of urea is

(A) 0.2 (B) 0.06 (C) 0.4 (D) 0.08

16. At $600\,K, 2\,mol$ of NO are mixed with $1 mol$ of O_2.
$2NO_{(g)} + O_2(g) \rightleftarrows 2NO_2(g)$
The reaction occurring as above comes to equilibrium under a total pressure of 1 atom. Analysis of the system shows that $0.6 mol$ of oxygen are present at equilibrium. The equilibrium constant for the reaction is ..... (Nearest integer).

(A) 1 (B) 0 (C) 2 (D) 3

17. $2\mathrm{SO}_2(\mathrm{~g}) + \mathrm{O}_2(\mathrm{~g}) \rightleftharpoons 2\mathrm{SO}_3(\mathrm{~g})$
In an equilibrium mixture, the partial pressures are
$P_{SO_3} = 43\,\mathrm{kPa}; \quad P_{O_2} = 530\ \mathrm{Pa}$ and
$\mathrm{P}_{\mathrm{SO}_2} = 45\,\mathrm{kPa}$ The equilibrium constant $\mathrm{K}_\mathrm{p} = \ldots\ldots \times 10^{-2}$. (Nearest integer)

(A) 498 (B) 123 (C) 745 (D) 172

18. A homogeneous ideal gaseous reaction $AB_{2(g)} \rightleftharpoons A_{(g)} + 2B_{(g)}$ is carried out in a $25\,litre$ flask at $27^\circ C$. The initial amount of AB_2 was $1\,mole$ and the equilibrium pressure was $1.9\,atm$. The value of K_P is $x \times 10^{-2}$. The value of x is ..... (Integer answer)

(A) 63 (B) 74 (C) 82 (D) 51

19. The gas phase reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$ is an exothermic reaction. The decomposition of N_2O_4, in equilibrium mixutre of $NO_2(g)$ and $N_2O_4(g)$, can be increased by

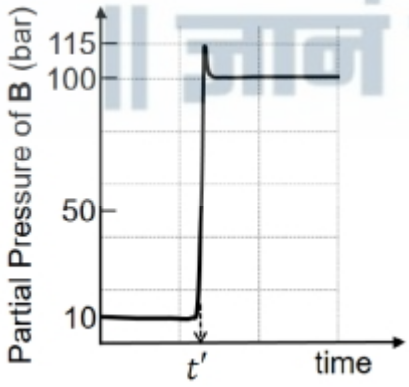
(A) addition of an inert gas at constant pressure

(B) lowering the temperature

(C) increasing the pressure

(D) addition of an inert gas at constant volume

20. Consider the reaction $A \rightleftharpoons B$ at $1000K$. At time t', the temperature of the system was increased to $2000K$ and the system was allowed to reach equilibrium. Throughout this experiment the partial pressure of A was maintained at 1 bar. Given below is the plot of the partial pressure of B with time. What is the ratio of the standard Gibbs energy of the reaction at $1000K$ to that at $2000K$?



(A) 0.10 (B) 0.10 (C) 0.20 (D) 0.25

21. In what manner will increase of pressure affect the following equation ?
$C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$
(A) Shift in the forward direction
(B) Shift in the backward direction
(C) Increase in the yield of H_2
(D) No effect

22. Some inert gas is added at constant volume to the following reaction at equilibrium
$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$
Predict the effect of adding the inert gas
(A) The equilibrium shifts in the forward direction
(B) The equilibrium shifts in the backward direction
(C) The equilibrium remains unaffected
(D) The value of K_p is increased

23. For the reaction; $3X_{(g)} + Y_{(g)} \rightleftharpoons X_3Y_{(g)}$, the amount of X_3Y at equilibrium is affected by
(A) Temperature and pressure
(B) Pressure only
(C) Temperature only
(D) Temperature, pressure and catalyst

24. On cooling of following system at equilibrium
$CO_2(s) \rightleftharpoons CO_2(g)$
(A) There is no effect on the equilibrium state
(B) More gas is formed
(C) More gas is solidifies
(D) None of above

25. Δn, the change in the number of moles for the reaction, $C_{12}H_{22}O_{11(s)} + 12O_{2(g)} \rightleftharpoons 12CO_{2(g)} + 11H_2O_{(l)}$ at $25\,^oC$ is
(A) 0 (B) 2 (C) 4 (D) -1

26. In the thermal decomposition of potassium chlorate given as ,
$2K\,ClO_3 \rightarrow 2KCl + 3O_2$ law of mass action
(A) Cannot be applied
(B) Can be applied
(C) Can be applied at low temperature
(D) Can be applied at high temp. and pressure

27. If concentration of reactants is increased by $'x'$, then K becomes

(A) ln (K/x) (B) K/x (C) $K+x$ (D) K

28. Ammonia carbonate when heated to 200^oC gives a mixture of NH_3 and CO_2 vapour with a density of 13.0. What is the degree of dissociation of ammonium carbonate

(A) 1.5 (B) 0.5 (C) 2 (D) 1

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

$A_2\,(g)+B_2\,(g) \rightleftharpoons C_2\,(g)+D_2\,(g)$

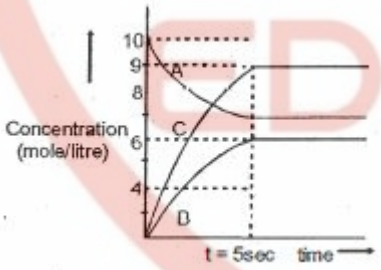
If we take $1\ mole$ of each of the four gases in a $10\ litre$ container, what would be equilibrium concentration of $A_2(g)$?

(A) $0.331\ M$ (B) $0.033\ M$ (C) $0.133\ M$ (D) $1.33\ M$

30. In a $500\,mL$ capacity vessel CO and Cl_2 are mixed to form $COCl_2$. At equilibrium it contains $0.2\,mole$ of $COCl_2$ and $0.1\,mole$ of each of CO and Cl_2. The equilibrium constant K_c for reaction, $CO+Cl_2 \rightleftharpoons COCl_2$ is

(A) 5 (B) 10 (C) 15 (D) 20

31. Attainment of the equilibrium $A(g) \rightleftharpoons 3C(g)+2B(g)$ gave the following graph. Find the correct option. (% dissociation = fraction dissociated $\times 100$)



(A) At $t=5\ sec$ equilibrium has been reached and $K_c=128(mol/litre)^2$

(B) At $t=5\ sec$ equilibrium has been reached and % dissociation of A is 70%

(C) At $t=5\ sec$ equilibrium has been reached and % dissociation of A is 30%

(D) None of these

32. The values of for the reactions,

$X \rightleftharpoons Y+Z \quad \ldots(i)$

$A \rightleftharpoons 2B \quad \ldots(ii)$

are in the ratio $9:1$. If degree of dissociation of X and A be equal, then total pressure at equilibrium (i) and (ii) are in the ratio

(A) $36:1$ (B) $1:1$ (C) $3:1$ (D) $1:9$

33. In Haber process 30 litres of dihydrogen and 30 litres of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition in the end

(A) 20 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

(B) 20 litres ammonia, 20 litres nitrogen, 20 litres hydrogen

(C) 10 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

(D) 20 litres ammonia, 10 litres nitrogen, 30 litres hydrogen

34. The equilibrium constants of the following are

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1

$N_2 + O_2 \rightleftharpoons 2NO$; K_2

$H_2 + 2O_2 \rightleftharpoons H_2O$; K_3

The equilibrium constant (K) of the reaction :

$2NH_3 + \frac{5}{2} \overset{K}{\leftrightarrows} 2NO + 3H_2O$

(A) $K_2K_3^3/K_1$ (B) K_2K_3/K_1 (C) $K_2^3K_3/K_1$ (D) $K_1K_3^3/K_2$

35. The equilibrium constant (K_c) for the reaction $\mathrm{HA} + \mathrm{B} \rightleftharpoons \mathrm{BH}^+ + \mathrm{A}^-$ is 100. If the rate constant for the forward reaction is 10^5, then rate constant for the backward reaction is

(A) 10^7 (B) 10^3 (C) 10^{-3} (D) 10^{-5}

36. Assertion : Reaction quotient is defined in the same way as equilbrium constant at any stage of the reaction.

Reason : If Q_c (reaction quotient) $< K_C$ (equilibrium constant) reaction moves in direction of reactants.

(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(C) If the Assertion is correct but Reason is incorrect.

(D) If both the Assertion and Reason are incorrect.

37. For reaction $2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_{2(g)}$, K_C at 427^oC is $3 \times 10^{-6}\, L\, mol^{-1}$. The value of K_P is nearly .....$\times 10^{-4}$

(A) 0.75 (B) 0.25 (C) 2.50 (D) 1.75

38. A chemical reaction is catalyzed by a catalyst X. Hence X

(A) Reduces enthalpy of the reaction

(B) Decreases rate constant of the reaction

(C) Increases activation energy of the reaction

(D) Does not affect equilibrium constant of reaction

39. Which of the following factors will favour the reverse reaction in a chemical equilibrium

(A) Increase in the concentration of one of the reactants

(B) Removal of at least one of the product at regular time intervals

(C) Increase in the concentration of one or more products

(D) None of these

40. At $1050\ Kelvin$, For chemical reaction $FeO_{(s)} + CO_{(g)} \rightleftharpoons Fe_{(s)} + CO_{2(g)}; K_p = 0.25$ What are the equilibrium partial pressure of $CO_{(g)}$ and $CO_{2(g)}$ at $1050\ Kelvin$, if the initial partial pressure are ; $P_{CO_{(g)}} = 1.6\,atm$ and $P_{CO_{2(g)}} = 0.8\,atm$

(A) $0.52\,atm, 0.95\,atm$ (B) $0.86\,atm, 1.16\,atm$ (C) $2.12\,atm, 0.38\,atm$ (D) $1.92\,atm, 0.48\,atm$

*** SECTION - B** **[40]**

41. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ the value of $K_p = 41$ at $400\,K$. Find out the value of K_p for following reaction at the same temperature $2N_2(g) + 6H_2(g) \rightleftharpoons 4NH_3(g)$

42. Equilibrium concentration of HI, I_2 and H_2 is $0.7, 0.1$ and $0.1\,M$ respectively. The equilibrium constant for the reaction $I_2 + H_2 \rightleftharpoons 2HI$ is

43. For a reaction $H_2 + I_2 \rightleftharpoons 2HI$ at $721\,K$, the value of equilibrium constant is 50. If 0.5 mols each of H_2 and I_2 is added to the system the value of equilibrium constant will be

44. 40° of HI undergoes decomposition to H_2 and I_2 at $300\,K. \Delta G^\ominus$ for this decompostion reaction at one atmosphere pressure is $\ldots J\,mol^{-1}$. [nearest integer]
(Use $R = 8.31\,J\,K^{-1}\,mol^{-1}; \log 2 = 0.3010$. In $10 = 2.3, \log 3 = 0.477$)

45. PCl_5 dissociates as
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
5 moles of PCl_5 are placed in a $200\ litre$ vessel which contains $2\,moles$ of N_2 and is maintained at $600\,K$. The equilibrium pressure is $2.46\,atm$. The equilibrium constant K_p for the dissociation of PCl_5 is ..... $\times 10^{-3}$. (nearest integer)
(Given: $R = 0.082\,L\,atm\,K^{-1}\,mol^{-1}$: Assume ideal gas behaviour)

46. The standard free energy change (ΔG°) for 50% dissociation of N_2O_4 into NO_2 at $27^\circ C$ and $1\,atm$ pressure is $-x\,J\,mol^{-1}$. The value of x is ..... (Nearest Integer)
[Given : $R = 8.31\,J\,K^{-1}\,mol^{-1}, \log 1.33 = 0.1239\ \ln 10 = 2.3$]

47. $2\mathrm{SO}_2(\mathrm{g}) + \mathrm{O}_2(\mathrm{g}) \rightleftharpoons 2\mathrm{SO}_3(\mathrm{g})$
In an equilibrium mixture, the partial pressures are
$P_{SO_3} = 43\,\mathrm{kPa}$; $P_{O_2} = 530\ \mathrm{Pa}$ and
$\mathrm{P}_{\mathrm{SO}_2} = 45\,\mathrm{kPa}$ The equilibrium constant $\mathrm{K_p} =$..... $\times 10^{-2}$. (Nearest integer)

48. The equilibrium constant K_c at $298\ \mathrm{K}$ for the reaction $\mathrm{A} + \mathrm{B} \rightleftharpoons \mathrm{C} + \mathrm{D}$ is 100. Starting with an equimolar solution with concentrations of $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D all

equal to $1\,\mathrm{M}$, the equilibrium concentration of D is $\ldots\ldots\times10^{-2}$ M. (Nearest integer)

49. At $320\,K$, a gas A_2 is 20% dissociated to $A(g)$. The standard free energy change at $320\,K$ and $1\,atm$ in $J\,mo1^{-1}$ is approximately
$(R = 8.314\ JK^{-1}\ mol^{-1};\ ln\,2 = 0.693;\ ln\,3 = 1.098)$

50. The value of K_P for the equilibrium reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is 2. The percentage dissociation of $N_2O_4(g)$ at a pressure of $0.5\,atm$ is

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