REVISION ASSIGNMENT # 07

CHEMISTRY

SECTION–I : (ii) One or more options correct Type

This section contains **17 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct. **4(–1)**

1. Following two equilibrium is simultaneously established in a container

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

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

If some Ni(s) is introduced in the container forming Ni $(CO)_4$ (g) then at new equilibrium

(A) PCl_3 concentration will increase (B) PCl_3 concentration will decrease

(C) Cl_2 concentration will remain same (D) CO concentration will remain same

2. When $NaNO_3$ is heated in a closed vessel, oxygen is liberated and $NaNO_2$ is left. At equilibrium

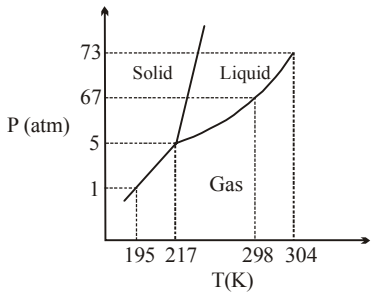
(A) addition of $NaNO_2$ favours reverse reaction

(B) addition of $NaNO_3$ favours forward reaction

(C) increasing temperature favours forward reaction

(D) increasing pressure favours reverse reaction

3. Phase diagram of CO_2 is shown as following



Based on above find the correct statement(s)

(A) 298K is the normal boiling point of liquid CO_2

(B) At 1 atm & 190 K CO_2 will exist as gas.

(C) CO_2(s) will sublime above 195K under normal atmospheric pressure

(D) Melting point & boiling point of CO_2 will increase on increasing pressure

4. Consider the equilibrium $HgO(s) + 4I^-(aq) + H_2O(l) \rightleftharpoons HgI_4^{2-}(aq) + 2OH^-(aq)$, which changes will decrease the equilibrium concentration of HgI_4^{2-}

(A) Addition of 0.1 M HI (aq) (B) Addition of HgO (s)

(C) Addition of H_2O (*l*) (D) Addition of KOH (aq)

5. **Statement-1** : Ammonia at a pressure of 10 atm and CO_2 at a pressure of 20 atm are introduced into an evacuated chamber. If K_p for the reaction $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$ is 2020 atm^3, the total pressure after a long time is less than 30 atm.

Statement-2 : Equilibrium can be attained from both directions.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

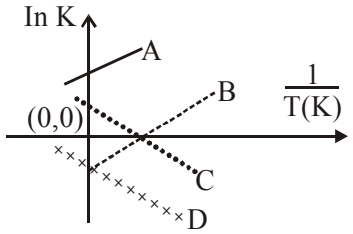
6. **Statement-1** : Catalyst does not alter the equilibrium constant
Statement-2 : Because for the catalysed reaction and uncatalysed reaction ΔH remain same an equilibrium constant depend on ΔH.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

7. For the decomposition of the compound, represented as **[JEE-MAINS(online)-14]**

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

the $K_P = 2.9 \times 10^{-5}$ atm^3.
If the reaction is started with 1 mol of the compound, the total pressure at equilibrium would be
(A) 38.8×10^{-2} atm (B) 1.94×10^{-2} atm
(C) 5.82×10^{-2} atm (D) 7.66×10^{-2} atm

8. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction ? **[JEE-MAINS(offline)-18]**



(A) B and C (B) C and D (C) A and D (D) A and B

9. In which of the following reactions, an increase in the volume of the container will favour the formation of products ? **[JEE-MAINS(online)-18]**

(A) $2NO_2(g) \rightleftharpoons 2NO(g)+O_2(g)$

(B) $3O_2(g) \rightleftharpoons 2O_3(g)$

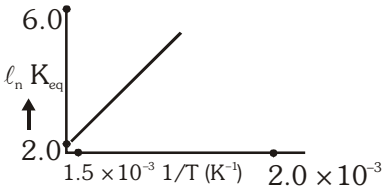
(C) $H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$

(D) $4NH_3(g)+5O_2(g) \rightleftharpoons 4NO(g)+6H_2O(l)$

10. Consider the reaction equilibrium **[AIEEE-2003]**

$2SO_{2(g)}+O_{2(g)} \rightleftharpoons 2\ SO_{3(g)}$; $\Delta H^\circ = -198$ kJ
On the basis of Le-Chatelier's principle, the condition favourable for the forward reaction is -
(A) Lowering the temperature and increasing the pressure
(B) Any value of temperature as well as pressure
(C) Lowering of temperature as well as pressure
(D) Increasing temperature as well as pressure

11. A schematic plot of $\ell n\, K_{eq}$ verus inverse of temperature for a reaction is shown below. The reaction must be **[AIEEE-2005]**



(A) endothermic

(B) exothermic

(C) highly spontaneous at ordinary temperature

(D) one with negligible enthalpy change

12. The equlibrium constants K_{p_1} and K_{p_2} for the reaction $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + Q$, respectively are in the ratio of 1 : 9. If the degree of dissociation of X and Z be equal then the ratio of total pressure at these equilibria is **[AIEEE-2008]**

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

13. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K is

(A) 0.3 atm (B) 0.18 atm **[AIEEE-2011]**

(C) 1.8 atm (D) 3 atm

14. 8 mol of $AB_3(g)$ are introduced into a 1.0 dm^3 vessel. If it dissociates as $2AB_3(g) \rightleftharpoons A_2(g) + 3\, B_2(g)$

At equilibrium, 2mol of A_2 are found to be present. The equilibrium constant of this reaction is :- **[JEE-MAINS(online)-12]**

(A) 36 (B) 3 (C) 27 (D) 2

15. The value of Kp 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 **[JEE-MAINS(online)-12]**

(A) 71 (B) 50 (C) 88 (D) 25

16. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g),\ K_1$ (A) **[JEE-MAINS(online)-13]**

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

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

The equation for the equilibrium constant of the reaction

$2\ NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g),\ (K_4)$

in terms of K_1, K_2 and K_3 is :

(A) $\frac{K_1K_3^2}{K_2}$ (B) $\frac{K_2K_3^3}{K_1}$ (C) $\frac{K_1K_2}{K_3}$ (D) $K_1\ K_2\ K_3$

SECTION–I(ii) : (Maximum Marks : 18)

- This section contains **3** questions of matching type.
- This section contains **1** table (having 3 columns and 4 rows)
- Based on table, there are **THREE** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 In all other cases

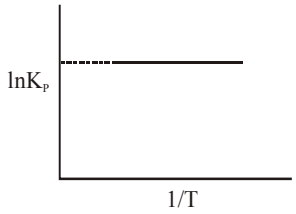
Answer Q.No. 17, 18 and 19 by appropriately matching the information given in the three columns of the following table.

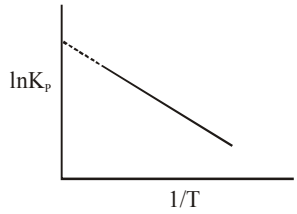
Column-I (Reaction)	**Column-II (If α is negligiable w.r.t. 1)**	**Column-III**
(A) $2X(g) \rightleftharpoons Y(g) + Z(g)$, ΔH = –ve	(P) $\alpha = 2 \times \sqrt{K_p}$	(I) K increase with increase in temperature
(B) $X(g) \rightleftharpoons Y(g) + Z(g)$, ΔH = +ve	(Q) $\alpha = 3 \times \sqrt{K_p.P}$	(II) K decrease with increase in temperature
(C) $3X(g) \rightleftharpoons Y(g) + Z(g)$, ΔH = +ve	(R) $\alpha = \left(\frac{2Kp}{P}\right)^{1/3}$	(III) Pressure has no effect
(D) $2X(g) \rightleftharpoons Y(g) + 2Z(g)$, ΔH = +ve	(S) $\alpha = \sqrt{K_p / P}$	(IV) Addition of inert gas at constant pressure shift equilibrium in forward direction

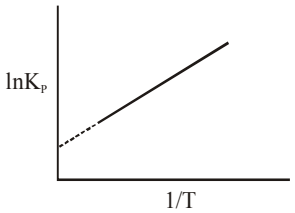
17. Which of the following option is correctly matched ?

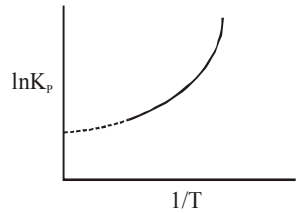
(A) A-Q-III (B) B-S-II (C) C-Q-II (D) D-R-IV

18. Correct representation of reaction in option (A) is represented by graph

(A)


(B)


(C)


(D)


19. For the reaction of option (B) if degree of dissociation varies inversily as square root of pressure of the system. Suppose at constant temperature volume is increased 16 times of its initial volume the degree of dissociation (α) for this reaction will become :

(A) 4 times (B) 2 times (C) 1/4 times (D) 1/2 times

SECTION-III : (Integer Value Correct Type)

This section contains **2 questions**. The answer to each question is **a single digit Integer**, ranging from **0 to 9** (both inclusive) **4(–1)**

1. In the esterfication C_2H_5OH (l) + CH_3COOH (l) $\rightleftharpoons$ $CH_3COOC_2H_5$ (l) + H_2O (l) an equimolar mixture of alcohol and acid taken initially yields under equilibrium, the water with mole fraction = 0.333. Calculate the equilibrium constant.

2. Ammonia is a weak base that reacts with water according to the equation

NH_3 (aq) + H_2O (l) $\rightleftharpoons$ NH_4^+ + OH^- (aq)

Will any of the following increase the percent of ammonia that is converted to the ammonium ion in water?

(a) Addition of NaOH. (b) Addition of HCl. (c) Addition of NH_4Cl.

SECTION-IV : SUBJECTIVE

1. Write down the expression for equilibrium constant K_C and K_P for the following reactions :

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

(b) $H_2O(\ell) \rightleftharpoons H_2O(g)$

(c) $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

(d) $CH_3COOH(\ell) + C_2H_5OH(\ell) \rightleftharpoons CH_3COOC_2H_5(\ell) + H_2O(\ell)$

(e) $NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

(excess)

(f) $Zn(s) + 2H^+(aq) \rightleftharpoons Zn^{2+}(aq) + H_2(g)$

2. Write the relationship between K_p and K_c for the following reactions :

(a) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ (b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (d) $2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$

(e) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

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

4. A sample of HI (9.6×10^{-3} mol) was placed in an empty 2.00 L container at 1000 K. After equilibrium was reached, the concentration of I_2 was 4×10^{-4} M. Calculate the value of K_c at 1000 K for the reaction $H_2\ (g) + I_2\ (g) \rightleftharpoons 2HI\ (g)$.

5. One mole of H_2O and one mole of CO are taken in a 10 L vessel and heated to 725 K. At equilibrium 40 percent of water (by mass) reacts with carbon monoxide according to the equation.

$$H_2O_{(g)} + CO_{(g)} \rightleftharpoons H_{2(g)} + CO_{2(g)}$$

Calculate the equilibrium constant for the reaction.

6. Calculate the equilibrium concentration of H_2, I_2 and HI at 300 K if initially 2 mol of H_2 and I_2 are taken in a closed container of having volume 10 lit. **[Given : $H_2 + I_2 \rightleftharpoons 2HI$; K = 100 at 300 K]**

7. For the given reaction,

$A(g) + B(g) \rightleftharpoons C(g) + D(g)$

the number of moles at equilibrium was found to be 4, 4 , 2 & 8 respectively in 1 L container. Find the new equilibrium concentration if 18 moles of D are added to above 1 L container.

8. For the given reaction,

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

the number of moles at equilibrium was found to be 2, 6 & 4 respectively at 10 atm pressure. Find the new equilibrium moles & partial pressure, if it is restablished at an equilibrium pressure 50 atm.

9. For the reaction $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$

Initially 5 moles of SO_3 is taken and at equillibrium 4 moles of SO_3 is dissociated then find out α and the value of K_C (Volume = 2litre)

10. The degree of dissociation of N_2O_4 into NO_2 at 1.5 atmosphere and 40°C is 0.25. Calculate its K_p at 40°C.Also report degree of dissociation at 10 atmospheric pressure at same temperature.

11. $2\ NOBr\ (g) \rightleftharpoons 2\ NO\ (g) + Br_2\ (g)$. If nitrosyl bromide (NOBr) is 33.33% dissociated at 25° C & a total pressure of 0.28 atm . Calculate K_p for the dissociation at this temperature.

12. Anhydrous calcium chloride is often used as a dessicant. In the presence of excess of $CaCl_2$, the amount of the water taken up is governed by $K_p = 6.4 \times 10^{85}$ for the following reaction at room temperature, $CaCl_2(s) + 6H_2O(g) \rightleftharpoons CaCl_2 .6H_2O(s)$. What is the equilibrium vapour pressure of water in a closed vessel that contains $CaCl_2(s)$?

13.(a) Methanol, a liquid fuel that could possibly replace gasoline, can be prepared from water gas and additional hydrogen at high temperature and pressure in the presence of a suitable catalyst. Write the expression for the equilibrium constant for the reversible reaction.

$2H_2\ (g) + CO\ (g) \rightleftharpoons CH_3OH\ (g) \qquad \Delta H = -90.2\ kJ$

(b) Assume that equilibrium has been established and predict how the concentration of H_2, CO and CH_3OH will differ at a new equilibrium if (A) more H_2 is added. (B) CO is removed. (C) CH_3OH is added. (D) the pressure on the system is increased. (5) the temperature of the system is increased. (6) more catalyst is added.

14. Listed in the table are forward and reverse rate constants for the reaction $2NO\ (g) \rightleftharpoons N_2(g) + O_2(g)$

Temperature (K)	k_f ($M^{-1}s^{-1}$)	k_r ($M^{-1}s^{-1}$)
1400	0.29	1.1×10^{-6}
1500	1.3	1.4×10^{-5}

Is the reaction endothermic or exothermic? Explain in terms of kinetics.

15. One mole of N_2O_4 (g) at 300 K is left in a closed container under one atm . It is heated to 600 K when 20 % by mass of N_2O_4 (g) decomposes to NO_2 (g) . Calculate resultant pressure.

16. Solid Ammonium carbamate dissociates as: $NH_2\ COONH_4\ (s) \rightleftharpoons 2NH_3(g) + CO_2(g)$. In a closed vessel solid ammonium carbamate is in equilibrium with its dissociation products. At equilibrium, ammonia is added such that the partial pressure of NH_3 at new equilibrium now equals the original total pressure. Calculate the ratio of total pressure at new equilibrium to that of original total pressure.

17. A definite amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure. NH_4HS decomposes to give NH_3 and H_2S and at equilibrium total pressure in flask is 0.84 atm. Calculate equilibrium constant for the reaction :

18. For the reaction $A(g) + 2B(g) \rightleftharpoons C(g) + D(g)$; $K_c = 10^{12}$.
If the initial moles of A,B,C and D are 0.5, 1, 0.5 and 3.5 moles respectively in a one litre vessel. What is the equilibrium concentration of B?

19. At certain temperature (T) for the gas phase reaction

$2H_2O(g) + 2Cl_2\ (g) \rightleftharpoons 4HCl(g) + O_2(g)$ $\quad K_p = 12 \times 10^8$ atm

If Cl_2, HCl & O_2 are mixed in such a manner that the partial pressure of each is 2 atm and the mixture is brough into contact with excess of liquid water. What would be approximate partial pressure of Cl_2 when equilibrium is attained at temperature (T)?

[Given : Vapour pressure of water is 380 mm Hg at temperature (T)]

20. In a vessel, two equilibrium are simultaneously established at same temperature as follows,

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

$N_2(g) + 2H_2(g) \rightleftharpoons N_2H_4(g)$ .....(ii)

Initially the vessel contains N_2 and H_2 in the molar ratio of 9 : 13. The equilibrium pressure is $7\ P_0$ in which pressure due to ammonia is P_0 and due to hydrogen is $2P_0$. Find the values of equilibrium constants (K_p's) for both the reactions.