

K DACT --- KANNUR DISTRICT ASSOCIATION OF CHEMISTRY TEACHERS
Time 1hour PLUS ONE CHEMISTRY TEST SERIES 2 max score 30
FOCUS AREA TEST PAPER FOR SEPTEMBER 2021 EXAM

(Thermodynamics, Equilibrium, Redox reaction Hydrogen,)

Answer any five questions each question carry 2 marks (5x2=10)

1. Differentiate extensive and intensive property. Give examples for each
2. The species HCO_3^- and NH_3 can act both Bronsted acid and Bronsted base. For each case give corresponding conjugate acid and conjugate base
3. H_2O_2 is stored in wax lined glass or plastic vessel in dark why?
4. Permanent hardness of water can be removed by chemical method.
 - a. Write the name of any one salt responsible for permanent hardness
 - b. Sodium hexametaphosphate is commercially called
5. Identify that the following is a redox reaction $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$
6.
 - a. Define Entropy?
 - b. For the reaction $2\text{Cl}_2(\text{g}) \rightarrow 4\text{Cl}(\text{g})$ what are the signs of ΔH and ΔS ?
7. Calculate oxidation state of S in SO_4^{2-} and H_2SO_4 , P in NaH_2PO_4 , and H_3PO_4
8.
 - a. What is enthalpy of a system?
 - b. What do you mean by isolated system give an example?

Answer any four questions each question carry 3 mark (4X3=12)

9. State Hess's law of constant heat summation illustrate?
10.
 - a. What is ionic product K_w of water? what is the effect of Temperature on K_w ?
 - b. The concentration of H^+ ion in sample of soft drink is $3.8 \times 10^{-3} \text{ M}$
Find pH?

11. About 18% of total production of dihydrogen is produced from Coal
- What is coal gasification?
 - How is dihydrogen produced by water gas shift reaction ?
12. Redox reaction classified in to four types describe any three of them with examples
13. Find the value of standard reaction enthalpy ($\Delta_r^\circ H$) for the reaction
- $$\text{N}_2\text{O}_{4(g)} + 3\text{CO}(g) \rightarrow \text{N}_2\text{O}(g) + 3\text{CO}_{2(g)}$$
- Given standard Enthalpy of formation of $\text{CO}(g)$, $\text{CO}_2(g)$, $\text{N}_2\text{O}_4(g)$, $\text{N}_2\text{O}(g)$ are -110, -393, 9.7, 81 kJ/mol respectively
- 14 . a. write the expression for equilibrium constant K_c for the reaction
- $$2\text{NOCl}(g) = 2\text{NO}(g) + \text{Cl}_2(g)$$
- for the above reaction if $K_p = 1.8 \times 10^{-8}$ at 500K find the value of K_c
15. Give the Lewis concept of acids and bases with examples
- Answer any two each question carry 4 marks (2x4=8)
16. Balance the following redox reaction by half reaction method
- $$\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Fe}^{3+} + \text{Cr}^{3+} \text{ (acidic medium)}$$
- 17 .a. what is a spontaneous process?
- For the reaction $4\text{Fe}(s) + 3\text{O}_2(s) \rightarrow 2\text{Fe}_2\text{O}_3(s)$ entropy change is - 549.4 J/K/mol at 298K predict whether the reaction is Spontaneous or not standard enthalpy change is -1648 kJ/mol
18. The common oxidation state of hydrogen is +1 but there are Compounds in which hydrogen shows -1 oxidation state
- name such compounds
 - Give the classification of such compounds with examples
- 19 .a what are buffer solution? give an example for a buffer Solution?
- illustrate conjugate acid base pair with suitable example?

K DACT --- KANNUR DISTRICT ASSOCIATION OF CHEMISTRY TEACHERS

Time: 1 hour

PLUS ONE CHEMISTRY TEST SERIES 2

Max score: 30

FOCUS AREA TEST PAPER FOR SEPTEMBER 2021 EXAM

ANSWER KEY

Answer five questions. Each question carries 2 marks (5x2=10)

1. Differentiate extensive and intensive property. Give examples for each.

Ans: **Extensive property** depends on quantity of matter present in the system.

Example: Mass, Volume, Internal Energy etc

Intensive property is independent of quantity of matter present in the system.

Example: Temperature, Density, Pressure etc.

2. The species HCO_3^- and NH_3 can act both as Bronsted acid and Bronsted base. For each case give corresponding conjugate acid and conjugate base.

Ans: HCO_3^- Conjugate acid = Base + H^+
 $\text{HCO}_3^- + \text{H}^+$
 H_2CO_3
Conjugate base = Acid - H^+
 $\text{HCO}_3^- - \text{H}^+$
 CO_3^{2-}

NH_3 Conjugate base = NH_2^-
Conjugate acid = NH_4^+

3. H_2O_2 is stored in wax lined glass or plastic vessel in dark. Why?

Ans: H_2O_2 readily decomposes as



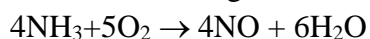
This reaction is catalysed in the presence of traces of alkali present in glass and also in the presence of sun light. So H_2O_2 is either kept in plastic bottles or in wax lined glass bottles in dark.

4. Permanent hardness of water can be removed by chemical method.
a. Write the name of any one salt responsible for permanent hardness.
b. Sodiumhexametaphosphate is commercially called as

Ans: a) Calcium Chloride, Magnesium Sulphate

b) Calgon

5. Identify that the following is a redox reaction.



Ans: $\begin{matrix} -3 & 0 & +2 & +1 & -2 \\ 4\text{NH}_3 & + & 5\text{O}_2 & \rightarrow & 4\text{NO} & + & 6\text{H}_2\text{O} \end{matrix}$



'N' oxidation number increased from -3 to +2 (Oxidation)

'O' oxidation number decreased from 0 to -2 (Reduction)

Since oxidation and reduction takes place simultaneously. It's a redox reaction.

6. a. Define Entropy?
 b. For the reaction $2\text{Cl}_{(\text{g})} \rightarrow \text{Cl}_{2(\text{g})}$. What is the sign of ΔH and ΔS ?

Ans: Entropy is the measure of disorderness or randomness of a system



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

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

7. Calculate oxidation state of S in SO_4^{2-} and in H_2SO_4 & P in NaH_2PO_4 and in H_3PO_4 .

Ans: SO_4^{2-} Let 'x' be the oxidation number of S.

$$\therefore x + 4(-2) = -2$$

$$x - 8 = -2$$

$$x = +6$$



$$2 + x - 8 = 0$$

$$x = +6$$



$$(+1) + 2(+1) + x + 4(-2) = 0$$

$$1 + 2 + x - 8 = 0$$

$$x = +5$$



$$+3 + x - 8 = 0$$

$$x = +5$$

8. a. What is enthalpy of a system?
 b. What do you mean by isolated system? Give example.

Ans: a) Enthalpy is the sum of internal energy and pressure volume energy.

$$\text{or } H = U + PV$$

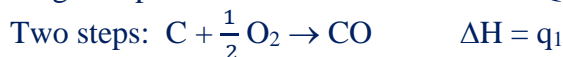
b) Isolated system – A system which exchange neither energy nor matter with the surroundings. Eg: - hot water kept in a thermal flask.

Answer any four questions. Each question carries 3 marks (4x3=12)

9. State Hess's law of constant heat summation illustrate?

Ans: **Hess's law** - Enthalpy change of a chemical reaction is same whether the reaction takes place in single step or several steps.

Illustration: CO_2 formation in two different ways.



According to Hess's law

$$Q = q_1 + q_2$$

10. a. What is ionic product K_w of water? What is the effect of Temperature on K_w ?
 b. The concentration of H^+ ion in a sample of soft drink is $3.8 \times 10^{-3} \text{M}$. Find its pH .

Ans: a) Ionic product of water $K_w = [\text{H}_3\text{O}^+] [\text{OH}^-] = 10^{-14} \text{M}$

As temperature increase K_w increases.

$$\text{b) } \text{pH} = -\log [\text{H}^+]$$

$$\text{pH of sample} = -\log [3.8 \times 10^{-3}] = 2.52$$

11. About 18% of total production of dihydrogen is produced from Coal.

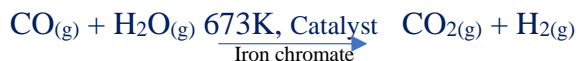
- What is coal gasification?
- How is dihydrogen produced by water gas shift reaction?

Ans: a. The process of producing **syn gas** from coal is called coal gasification.



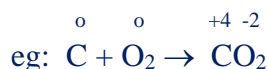
b) water gas shift reaction:

Syn gas reacts with steam in presence of iron chromate catalyst to give H_2



12. Redox reaction is classified into four types. Describe any three of them with examples.

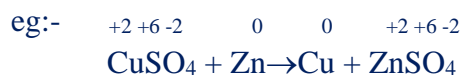
Ans: 1. **Combination reaction:** It is of the type $\text{A} + \text{B} \rightarrow \text{C}$, either A or B or Both A and B must be in elemental form.



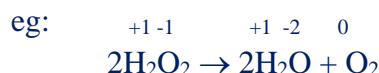
2. **Decomposition reaction:** It is of the type $\text{A} \rightarrow \text{B} + \text{C}$



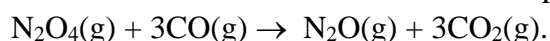
3. **Displacement reaction:** It is of the type $\text{X} + \text{YZ} \rightarrow \text{XZ} + \text{Y}$



4. **Disproportionation reaction:** The reaction in which the same species undergo simultaneous oxidation and reduction.



13. Find the value of standard reaction enthalpy ($\Delta_r H^\circ$) for the reaction



Given standard enthalpy of formation of $\text{CO}_{(g)}$, $\text{CO}_{2(g)}$, $\text{N}_2\text{O}_{4(g)}$ and $\text{N}_2\text{O}_{(g)}$ are -110 , -393 , 9.7 and 81 kJ/mol respectively

Ans: $\Delta H_f \text{ CO} = -110$ kJ/mol

$\Delta H_f \text{ CO}_2 = -393$ kJ/mol

$\Delta H_f \text{ N}_2\text{O}_4 = 9.7$ kJ/mol

$\Delta H_f \text{ N}_2\text{O} = 81$ kJ/mol

$\Delta_r H = \text{Sum of enthalpies of products} - \text{sum of enthalpies of reactants}$

$$\Delta_r H = [\Delta H(\text{N}_2\text{O}) + 3\Delta H(\text{CO}_2)] - [\Delta H(\text{N}_2\text{O}_4) + 3\Delta H(\text{CO})]$$

$$= [81 + 3(-393)] - [9.7 + 3(-110)]$$

$$= [81 - 1179] - [9.7 - 330]$$

$$= -1098 + 320.3$$

$$= -777.7 \text{ kJ/mol}$$

14. a. Write the expression for equilibrium constant K_c for the reaction



b. For the above reaction if $K_p = 1.8 \times 10^{-8}$ at 500K, find the value of K_c

Ans:

a) $K_c = \frac{[\text{Cl}_2][\text{NO}]^2}{[\text{NOCl}]^2}$

b) $K_p = K_c(RT)^{\Delta n}$
Here $\Delta n = 3-2=1$
 $K_p = K_c \times RT$
 $K_c = \frac{K_p}{RT} = \frac{1.8 \times 10^{-8}}{500 \times 0.0821} = 4.4 \times 10^{-10}$

15. Give the Lewis concept of acids and bases with examples.

Ans: Acids are electron pair acceptors (electron deficient species)

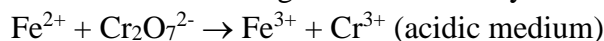
eg:- BF_3 , B_2H_6 etc..

Bases are electron pair donors (electron rich species)

eg:- NH_3 , H_2O etc

Answer any two. Each question carries 4 marks (2x4=8)

16. Balance the following redox reaction by half reaction method.



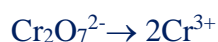
Ans: $\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Fe}^{3+} + \text{Cr}^{3+}$ (acidic medium)

Step 1: Split the equation in to two half reactions

Oxidation Half reaction:- $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$

Reduction Half reaction :- $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$

Step 2: Balance atoms other than O and H



Step 3: Balance number of O atoms by adding H_2O



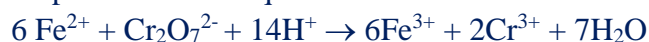
Step 4: Balance charge by adding e^-



Step 5: Equalise the no. of e^- s in both equations



Step 6. Add the 2 equations



17. a. What is a spontaneous process?

b. For the reaction $4\text{Fe}_{(s)} + 3\text{O}_{2(s)} \rightarrow 2\text{Fe}_2\text{O}_{3(s)}$, entropy change is -549.4 J/K/mol at 298K . Predict whether the reaction is spontaneous or not. Standard enthalpy change is -1648kJ/mol .

Ans: A process which has a natural tendency to occur. Usually, entropy increases during the course of a spontaneous reaction.

$$\Delta G = \Delta H - T\Delta S$$

$$\text{Given. } \Delta S = -549.4 \text{ J/K/mol}$$

$$T = 298 \text{ K}$$

$$\Delta H = -1648 \text{ kJ/mol} = -1648000 \text{ J/mol}$$

$$\begin{aligned}\Delta G &= -1648000 - (298 \times -549.4) \\ &= -1484278 \text{ J/mol} = -1484.3\text{kJ/mol}\end{aligned}$$

Since ΔG is negative, the process is spontaneous.

18. The common oxidation state of hydrogen is $+1$ but there are compounds in which hydrogen shows -1 oxidation state.

a. Name such compounds.

b. Give the classification of such compounds with examples.

Ans: a- **Ionic or Saline Hydrides (eg: LiH, NaH, CaH₂ etc)**

b- Hydrides are binary compounds of H with other elements.

They are classified as

1- **Ionic or Saline Hydrides:** -

They are hydrides of s-block elements.

They are non-conductors in solid state and do conduction in molten state.

2- **Covalent or Molecular Hydrides** – They are hydrides of p-block elements. They are further classified as

I- Electron deficient hydrides – eg: B₂H₆

II- Electron Precise hydrides– eg: CH₄

III- Electron rich hydrides- eg: NH₃

3- **Metallic or Interstitial Hydrides** – Hydrides of d and f-block elements. They conduct heat and electricity. Eg: LaH₃

19. a. What are buffer solutions? Give an example for a buffer Solution.

b. Illustrates conjugate acid base pair with suitable example.

Ans: Buffer solution is a solution which can withstand small P^H Changes. They are of two types: -

Acidic Buffer – A mixture of weak acid and its salt with a strong base.

eg: CH₃COOH + CH₃COONa

Basic Buffer – A solution of a weak base and its salt with a strong acid.

eg: NH₄OH + NH₄Cl

Conjugate base is a species formed by the removal of H⁺ from an acid

Conjugate base = acid – H⁺

HCl → H⁺ + Cl⁻ (Cl⁻ is conjugate base.)

Conjugate acid is a species formed by the addition of H⁺ to a base.

Conjugate acid = base + H⁺

NH₃ + H⁺ → NH₄⁺ (NH₄⁺ is Conjugate acid)

NH₃ + H₂O ↔ NH₄⁺ + OH⁻

Here, NH₃ and NH₄⁺ are a conjugate acid-base pair. Similarly H₂O and OH⁻ are another conjugate acid-base pair.

Best wishes