OSDAV Public School, Kaithal
First Unit Test (May,2025)
Class : XII
Subject : Chemistry

SET-A

Time: 1 hr 30 mins **M.M.: 35**

General Instructions: -

All questions are compulsory.

(a) There are 17 questions in this question paper with internal choice.
(b) SECTION A consists of 8 multiple -choice questions carrying 1 mark each.
(c) SECTION B consists of 4 short answer questions carrying 2 marks each.
(d) SECTION C consists of 3 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 long answer questions carrying 5 marks.
(f) Use of log tables and calculators is not allowed.

Q.No.	Questions	Marks
	SECTION-A	
1	ΔG and E^0 cell for a spontaneous reaction will be: a. Positive , negative b. Negative, negative c. Negative, positive d. Positive, positive	1
2	Which of the following aqueous solution should have the highest boiling point? a.1M NaOH b. 1M Na_2SO_4 c. 1M NH_4NO_3 d.1M KNO_3	1
3	An electrochemical cell can behave like an electrolytic cell when: a. $E_{int} = 0$ b. $E_{int} > E_{ext}$ c. $E_{ext} > E_{int}$ d. $E_{int} = E_{ext}$	1
4	An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because…. a. It gains water due to osmosis b. It loses water due to osmosis c. It gains water due to reverse osmosis d. It loses water due to reverse osmosis	1
5	Which one the following pairs will not form an ideal solution? a. Benzene and Toluene b. Nitric Acid and water c. Hexane and Heptane d. Ethyl Chloride and Ethyl Bromide	1
6	Given below are two statements labelled as Assertion (A) and Reason ® Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true **Assertion**: Non-Ideal solutions form azeotropic mixture **Reason**: Maximum boiling point azeotropes are formed by a solution showing negative deviation	1

7	**Assertion:** Copper sulphate cannot be stored in zinc vessel	1
	Reason: Zinc is less reactive than copper	
8	**Assertion:** An ideal solution obeys Henry's Law **Reason:** In an ideal solution**,** solute-solute as well as solvent -solvent interactions are similar to solute-solvent interactions.	1
	SECTION-B	
9	A cell is prepared by dipping a copper rod in 1M $CuSO_4$ solution and a nickel rod in 1M $NiSO_4$ solution. The standard reduction potentials of Copper and Nickel rods are +0.34V and -0.25V respectively. a. Write the cell representation of this electrochemical cell. b. Calculate the EMF of the cell.	2
10	A solution containing 10.2g of glycerine per litre is found to be isotonic with 2% solution glucose. Calculate the molar mass of glycerine.	2
11	a. Rusting of iron becomes quicker in saline medium. Explain b. What are the advantages of fuel cell?	1 1
12	Name the cell which is used in Transistors. Write the reactions taking place at the anode and cathode of this cell.	2
	SECTION-C	
13	a. Why do gases nearly always tend to be less soluble in liquids as the temperature is raised? b. What weight of solute (molecular mass= 60) is required to be dissolved in 180g of water to reduce the vapour pressure to $4/5^{th}$ of pure water?	1 2
14	1. Give reasons for the following: a. Ethylene glycol is used in car radiators in cold countries b. What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone. Give reason? 2. What will happen when RBC's are placed in 1.5% solution of NaCl	2 1
15	Write the cell reaction and Calculate the emf of following cell: Mg (s) /Mg^{+2} (0.001M) // Cu^{+2} (0.0001 M) / Cu(s) $\mathbf{E^0_{Mg+2/Mg}}$ = -2.37V ; $\mathbf{E^0_{Cu+2/Cu}}$ = +0.34V	3
	SECTION -D	
16	a. The Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0 x 10^5 atm. The mole fraction of N_2 in air is 0.8. What is the number of moles of N_2 from air dissolved in 10 moles of water at 298K and 5 atm pressure. b. 19.5g of CH_2FCOOH is dissolved in 500g of water. The depression in freezing point of water observed is 1.0 K. Calculate the van't Hoff factor and dissociation constant of the acid. (K_f = 1.86 K kg/mol)	2 3
17	**Answer the following questions:** a. Define electrochemical series b. Write the overall electrochemical reaction taking place in rusting c. What is the role of $ZnCl_2$ in dry cell? d. Why mercury cell delivers a constant potential during its life time? e. What is cathodic protection?	 1 1 1 1 1

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Class : XII
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SET-B

Time: 1 hr 30 mins **M.M.: 35**

General Instructions: -

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(a) There are 17 questions in this question paper with internal choice.
(b) SECTION A consists of 8 multiple -choice questions carrying 1 mark each.
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Q.No.	Questions	Marks
	SECTION-A	
1	If the standard electrode potential of an electrode is greater than zero, then we can infer that its: a. Reduced form is more stable compared to hydrogen gas b. Oxidised form is more stable compared to hydrogen gas c. Reduced and oxidized forms are equally stable d. Reduced form is less stable than the hydrogen gas	1
2	Which of the following aqueous solution should have the highest boiling point? a.1M NaOH b. 1M Na_2SO_4 c. 1M NH_4NO_3 d.1M KNO_3	1
3	The difference between electrode potentials of two electrodes when no current is drawn through the cell is called: a. Cell potential b. Cell EMF c. Potential difference d. Cell voltage	1
4	An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because…. a. It gains water due to osmosis b. It loses water due to osmosis c. It gains water due to reverse osmosis d. It loses water due to reverse osmosis	1
5	Which one the following pairs will form positive deviation from Raoult's law: a. Benzene and Toluene b. Nitric Acid and water c. Methanol and acetone d. Phenol and aniline	1
6	Given below are two statements labelled as Assertion (A) and Reason ® Select the most appropriate answer from the options given below: a. Both A and R are true and R is the correct explanation of A b. Both A and R are true but R is not the correct explanation of A. c. A is true but R is false. d. A is false but R is true **Assertion**: Cryoscopic constant depends on nature of solvent	1

	Reason: Cryoscopic constant is universal constant	
7	**Assertion:** Cu is less reactive than hydrogen	1

	Reason: E^oCu^+/Cu is negative	
8	**Assertion:** An ideal solution obeys Henry's Law **Reason:** In an ideal solution**,** solute-solute as well as solvent -solvent interactions are similar to solute-solvent interactions.	1
	SECTION-B	
9	Depict the galvanic cell in which the reaction $Zn(s) + 2Ag^+ \longrightarrow Zn^{+2} + 2Ag(s)$ takes place. Further show: a. Which of the electrode is negatively charged? b. The carriers of the current in the cell.	2
10	A solution containing 10.2g of glycerine per litre is found to be isotonic with 2% solution glucose. Calculate the molar mass of glycerine.	2
11	a. What would happen if no salt bridge were used in an electrochemical cell? b. What are the advantages of fuel cell?	1 1
12	Name the cell which is used in Automobile battery. Write the reactions taking place at the anode and cathode of this cell during discharging.	2
	SECTION-C	
13	a. What do you mean by the term Reverse Osmosis b. When 1.5g of a non volatile solute was dissolved in 90g of benzene, the boiling point of benzene raise from 353.23K to 353.93K. Calculate the molar mass of the solute (K_b for benzene = 2.52 K Kg/mol)	1 2
14	1. Give reasons for the following: a. What do you understand by the term K_f for water is 1.86 K Kg/mol b. What type of deviation from Raoult's law is shown by a mixture of Acetone and Chloroform. Give reason? 2. Predict the state of solute in the solution when i is found to be 0.3	2 1
15	Write the cell reaction and Calculate the emf of following cell: $Mg(s) / Mg^{+2}$ (0.001M) // Cu^{+2} (0.0001 M) / Cu(s) $\mathbf{E^0_{Mg+2/Mg}} = -2.37V$; $\mathbf{E^0_{Cu+2/Cu}} = +0.34V$	3
	SECTION -D	
16	**Answer the following questions:** a. What is the basic difference between primary cell and secondary cell? b. Write the overall electrochemical reaction taking place in rusting c. What is the role of $ZnCl_2$ in dry cell? d. Why mercury cell delivers a constant potential during its life time? **e.** Why is standard hydrogen electrode called reversible electrode?	1 1 1 1 1
17	a. The Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0 x 10^5 atm. The mole fraction of N_2 in air is 0.8. What is the number of moles of N_2 from air dissolved in 10 moles of water at 298K and 5 atm pressure. b. 19.5 g of CH2FCOOH is dissolved in 500g of water. The depression in the freezing point of water is observed 1K. Calculate the van't Hoff factor and dissociation constant of the acid (K_f = 1.86 K Kg/mol)	2 3

OSDAV PUBLIC SCHOOL
FIRST UNIT TEST ANSWER KEY (MAY,2025)
CLASS- XII
SUBJECT- CHEMISTRY
SET A

SECTION- A

1) C
2) B
3) C
4) B
5) B
6) B
7) C
8) D

SECTION-B

9.

Ni/Ni^{+2} (1M) // Cu^{+2}(1M)/Cu

(b)

$$E^0_{cell} = E^0_{Cu^{2+}/Cu} - E^0_{Ni^{2+}\,Ni}$$
$$= 0.34 - (-0.25)$$
$$= 0.59\ V$$

10.

$$\frac{10.2\,RT}{M} = \frac{2RT}{180 \times 0.1}$$
$$M = \frac{10.2\,RT}{1} \times \frac{180 \times 0.1}{2RT}$$
$$M = 91.8\,gmol^{-1}$$

11. (a) Saline medium has extra salts such as sodium chloride dissolved in water. This means that it has a greater concentration of electrolyte than ordinary medium. The ions present will favour the formation of more electrochemical cells and will thus promote rusting or corrosion.

(b) (i) It does not cause pollution

(ii) It provides safe drinking water

(iii) excellent efficiency of around 60-70%

12. Dry cell is used in Transistors

$$Zn \rightarrow Zn^{2+} + 2\,e^-$$

Reduction reaction occurs at graphite cathode. Write the reduction half reaction.

$$2\,NH_4^+ + 2\,MnO_2 + 2\,e^- \rightarrow Mn_2O_3 + 2\,NH_3 + H_2O$$

Write the overall cell reaction:

$$Zn(s) + 2MnO_2(s) + 2NH_4^+(aq) \rightarrow Mn_2O_3(s) + H_2O(l) + Zn^{2+} + 2NH_3(g)$$

SECTION-C

13. a. Gases tend to be less soluble in liquids as the temperature increases because the dissolution process is exothermic, meaning it releases heat energy. According to Le Chatelier's Principle, increasing the temperature shifts the equilibrium to favor the endothermic process, which in this case is the release of the gas from the liquid.

b.

M. wt. = 60

W = 180 gm

Vapour pressure, P = 4/5 of pure water = 4/5 P°

To Find:

The weight of non- volatile solute (w).

Calculation:

⇒ No of moles of solute, n1 = w/60

- No of moles of water, n2 = 180/18 = 10

- We Know that:

Relative lowering of V. P. = Mole fraction of solute

⇒ (P° - P) / P° = X

⇒ (P° - 4/5 P°) / P° = (w/60) / { (w/60) + 10}

⇒ 1/5 = w / (w + 600)

⇒ w + 600 = 5w

⇒ **w = 150 gm**

- So, the weight of non- volatile solute is **150 gm.**

14. 1. (a) Ethylene glycol is added to car radiators in winters to prevent the coolant from freezing. It lowers the freezing point of the water-ethylene glycol mixture, ensuring that the coolant remains liquid even at very low temperatures. This is crucial for the radiator to continue functioning properly and protecting the engine from damage caused by frozen coolant. a mixture of ethylene glycol and water can prevent the solution from freezing at temperatures much lower than 0°C, allowing the car's engine to operate safely.

(b) A mixture of ethanol and acetone shows a positive deviation from Raoult's law. This is because the interaction between ethanol and acetone molecules (A-B) is weaker than the interactions between pure ethanol molecules (A-A) and pure acetone molecules (B-B), leading to an increase in vapor pressure. Ethanol forms hydrogen bonds, and when acetone is added, it disrupts some of these hydrogen bonds, weakening the overall molecular interactions.7 As a result, the solution exhibits a positive deviation from Raoult's law, where the total vapor pressure is higher than predicted by Raoult's law.

2. When red blood cells (RBCs) are placed in a 1.5% NaCl solution, the solution is hypertonic compared to the RBCs. As a result, water will move out of the RBCs into the surrounding solution to balance the concentration gradient. This causes the RBCs to shrink

15.

- **Anode (oxidation):** $Mg(s) \rightarrow Mg^{2+} + 2e^-$
- **Cathode (reduction):** $Cu^{2+} + 2e^- \rightarrow Cu(s)$

Overall Reaction:

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

$$E_{cell} = E^{\ominus}_{cell} - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= \{0.34 - (-2.36)\} - \frac{0.0591}{2} \log \frac{.001}{.0001}$$

$$= 2.7 - \frac{0.0591}{2} \log 10$$

= 2.7 − 0.02955

= 2.67 V (approximately)

SECTION-D

16. (i)

P_{N_2} = **Total Pressure** × **Mole Fraction of** N_2

Substituting the values:

$P_{N_2} = 5\,\text{atm} \times 0.8 = 4\,\text{atm}$

Step 2: Apply Henry's Law to find the mole fraction of nitrogen in water.

Henry's Law states that:

$P_{N_2} = K_H \times x_{N_2}$

where K_H is the Henry's law constant. Given $K_H = 1.0 \times 10^{-5}\,\text{atm}$, we can rearrange the formula to find the mole fraction of nitrogen in water (x_{N_2}):

$$x_{N_2} = \frac{P_{N_2}}{K_H}$$

Substituting the values:

$$x_{N_2} = \frac{4\,\text{atm}}{1.0 \times 10^{-5}\,\text{atm}} = 4 \times 10^5$$

Step 3: Relate mole fraction to the number of moles.

The mole fraction of nitrogen in water can also be expressed as:

$$x_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{H_2O}}$$

where $n_{H_2O} = 10\,\text{mol}$. Rearranging gives:

$n_{N_2} = x_{N_2} \times (n_{N_2} + n_{H_2O})$

Substituting n_{H_2O} into the equation:

$n_{N_2} = x_{N_2} \times (n_{N_2} + 10)$

Step 4: Solve for n_{N_2}.

Substituting the value of x_{N_2}:

$n_{N_2} = 4 \times 10^5 \times (n_{N_2} + 10)$

This is a linear equation in n_{N_2}. Rearranging gives:

$n_{N_2} - 4 \times 10^5 n_{N_2} = 4 \times 10^5 \times 10$

$(1 - 4 \times 10^5) n_{N_2} = 4 \times 10^5$

$$n_{N_2} = \frac{4 \times 10^5}{1 - 4 \times 10^5}$$

Step 5: Calculate n_{N_2}.

Since $1 - 4 \times 10^5$ is negative, we need to reconsider the values. The mole fraction x_{N_2} is extremely high, indicating that the amount of nitrogen dissolved is very small compared to water.

Using a more straightforward approach:

$n_{N_2} = 4 \times 10^{-4}\,\text{mol}$

(ii)

Given values are,

$w_2 = 19.5\ g,\ w_1 = 500\ g,\ K_f = 1.86\ K\ kg\ mol^{-1}$

$\Delta T_f = 1.0^\circ C$

$$M_2 = \frac{1000 \times K_f \times w_2}{w_1 \times \Delta T_f}$$

$$M_2 = \frac{1000 \times 1.86 \times 19.5}{500 \times 1.0} = 72.54\ g/mol$$

Thus M_2 (observed) = 72.54 g/mol

M_2 (calculated) for CH_2FCOOH = 14 + 19 + 45

= 78 g/mol

van't Hoff factor, i= M_2 (cal)/ M_2 (obs)

= 78/72.54 = 1.0753

Let α be the degree of dissociation of CH_2FCOOH

$$\underset{\text{At eq.}}{\text{Initial conc.}} \quad \underset{C(1-\alpha)}{\underset{C\ mol/L}{CH_2FCOOH}} \rightleftharpoons \underset{C\alpha}{\underset{0}{CH_2FCOO^-}} + \underset{C\alpha}{\underset{0}{H^+}}$$

$$\text{Total} = C(1+\alpha)$$

Therefore,

$$i = \frac{C(1+\alpha)}{C} = 1 + \alpha$$

$$\alpha = i - 1 = 1.0753 - 1 = 0.0753$$

$$K_a = \frac{[CH_2FCOO^-][H^+]}{[CH_2FCOOH]} = \frac{C\alpha . C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{C(1-\alpha)}$$

Taking the volume of the solution as 500 mL, we have the concentration:

$$C = \frac{19.5}{78} \times \frac{1}{500} \times 1000$$

$$= 0.5\ M$$

$$K_a = \frac{C\alpha^2}{(1-\alpha)} = \frac{(0.5)(0.0753)^2}{1 - 0.0753} = 3.07 \times 10^{-3}$$

17 (i) An electrochemical series is a series of chemical elements arranged in the order of their standard electrode potential. Electrode potential is defined as the potential of a cell with one electrode as the cathode and a standard hydrogen electrode (SHE) as the anode. At the cathode, reduction always occurs whereas oxidation always occurs at the anode.

(ii) Anode (oxidation):

$Fe \rightarrow Fe^{2+} + 2e^-$

Cathode (reduction):

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ (in acidic medium)

Overall Reaction:

$2Fe + O_2 + 4H^+ \rightarrow 2Fe^{2+} + 2H_2O$

(iii) In a dry cell, $ZnCl_2$ acts as an electrolyte and helps conduct ions. It also reacts with ammonia (NH_3), produced during the reduction at the cathode, to form a coordination complex:

Reaction:

$Zn^{2+} + 4NH_3 \rightarrow [Zn(NH_3)_2Cl_2]$

This prevents ammonia from accumulating, which helps maintain the cell's function by reducing internal pressure and avoiding leakage.

(iv) The mercury cell delivers a constant voltage because its overall reaction does not involve any ions in the net equation:

Anode: $Zn(Hg) \rightarrow Zn^{2+} + 2e^-$

Cathode: $Hg_2^{2+} + 2e^- \rightarrow 2Hg(l)$

Overall reaction:

$Zn(Hg) + Hg_2Cl_2(s) \rightarrow ZnO(s) + 2Hg(l) + 2Cl^-$

But in a more simplified form used often:

$Zn + HgO \rightarrow ZnO + Hg$

Since no ions appear in the net overall reaction and the reactants/products are solids or liquids, their activities remain constant, resulting in a stable voltage output.

(v) Cathodic protection is a technique used to prevent metal corrosion by making the metal act as a cathode in an electrochemical cell. This is done by attaching a more reactive metal (like Zn or Mg) called a sacrificial anode, which corrodes instead. The protected metal thus stays safe from oxidation.

OSDAV PUBLIC SCHOOL
FIRST UNIT TEST ANSWER KEY (MAY,2025)
CLASS- XII
SUBJECT- CHEMISTRY
SET B (only different questions)

SECTION- A

1. A

2. B

3. B

4. B

5. C

6. C

7. C

8. D

SECTION-B

9. a. Anode (Zn) will act as the negatively charged.

b. electrons are the carriers of current

or

ions are the carriers of current

10. –

11. a. If no salt bridge is used in an electrochemical cell, the circuit becomes incomplete because ions cannot flow between the two half-cells. This causes charge buildup, stopping the flow of electrons and halting the redox reaction, so the cell won't produce any current.

b. –

12. The cell used in automobiles is the lead-acid battery.

Anode (oxidation):

$Pb\ (s) + SO_4^{2-}\ (aq) \rightarrow PbSO_4\ (s) + 2e^-$

Cathode (reduction):

$PbO_2\ (s) + 4H^+\ (aq) + SO_4^{2-}\ (aq) + 2e^- \rightarrow PbSO_4\ (s) + 2H_2O\ (l)$

Overall reaction:

$Pb\ (s) + PbO_2\ (s) + 2H_2SO_4\ (aq) \rightarrow 2PbSO_4\ (s) + 2H_2O\ (l)$

SECTION-C

13. (a) **Reverse osmosis** is a water purification process where pressure is applied to force water through a semipermeable membrane, removing impurities, salts, and contaminants. It works opposite to natural osmosis, allowing only pure water to pass while blocking dissolved solids and harmful substances.

(b)

$$\Delta T_b = 353.93 - 353.23 = 0.7\,K$$

$$m = \frac{\Delta T_b}{K_b} = \frac{0.7}{2.52} = 0.2778\,\text{mol/kg}$$

$$\text{moles of solute} = m \times \text{kg solvent} = 0.2778 \times 0.09 = 0.025$$

$$M = \frac{\text{mass}}{\text{moles}} = \frac{1.5}{0.025} = 60\,\text{g/mol}$$

Molar mass = 60 g/mol

14. (i) a. we understand that depression in freezing point is 1.86 in 1 molal water solution.
b. Acetone and chloroform show negative deviation from Raoult's law. This happens because strong hydrogen bonding forms between acetone's carbonyl group and chloroform's acidic hydrogen, making their intermolecular attraction stronger than in the pure liquids. This lowers the vapor pressure more than expected, causing negative deviation.
(ii) If the van't Hoff factor i=0.3i = 0.3 (less than 1), it means the solute particles are associating or combining in the solution, reducing the total number of particles. So, the solute likely exists as associated molecules (like dimers or larger clusters) rather than fully dissociated ions or molecules.
15. –

SECTION-D

16. (i) A primary cell is a type of battery that cannot be recharged because its chemical reactions are irreversible. Once the energy is used up, the cell is discarded, like in the case of a dry cell. In contrast, a secondary cell can be recharged since its chemical reactions are reversible. This allows the battery to be used multiple times by restoring its original chemicals through recharging, such as in lead-acid batteries commonly used in vehicles.
(ii) –
(iii) –
(iv) –
(v) The standard hydrogen electrode (SHE) is called a **reversible electrode** because the reaction at its surface can proceed easily in both directions—hydrogen gas can be oxidized to H^+ ions or H^+ ions can be reduced to hydrogen gas—without any change in electrode properties. This reversibility ensures a stable and reproducible reference potential.
17. (a) –
(b) –