



ANANDALAYA
PERIODIC TEST -2
Class: XII

Subject: Chemistry
Date : 22-09-2023

MM: 70
Time: 3 hours.

General Instructions:

- Read the following instructions carefully.
- There are 33 questions in this question paper with internal choice.
- SECTION A consists of 16 multiple - choice questions carrying 1 mark each.
- SECTION B consists of 5 short answer questions carrying 2 marks each.
- SECTION C consists of 7 short answer questions carrying 3 marks each.
- SECTION D consists of 2 case - based questions carrying 4 marks each.
- SECTION E consists of 3 long answer questions carrying 5 marks each.
- All questions are compulsory.

SECTION A

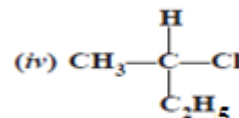
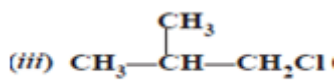
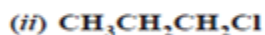
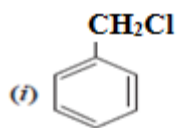
- When 1 mole of benzene is mixed with 1 mole of toluene, the vapour will contain _____. (1)
(Given: vapour of benzene = 12.8 kPa and vapour pressure of toluene = 3.85 kPa).
(A) equal amount of benzene and toluene as it forms an ideal solution
(B) unequal amount of benzene and toluene as it forms a non-ideal solution
(C) higher percentage of benzene
(D) higher percentage of toluene
- Consider the Arrhenius equation given below and mark the correct option. (1)
 $k = A e^{-E_a / RT}$
(A) Rate constant increases exponentially with increasing activation energy and decreasing temperature.
(B) Rate constant decreases exponentially with increasing activation energy and decreasing temperature.
(C) Rate constant increases exponentially with decreasing activation energy and decreasing temperature.
(D) Rate constant increases exponentially with decreasing activation energy and increasing temperature.
- We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentrations 0.1M, 0.01M and 0.001M, respectively. The value of van't Hoff factor for these solutions will be in the order: (1)
(A) $i_A < i_B < i_C$ (B) $i_A > i_B > i_C$ (C) $i_A = i_B = i_C$ (D) $i_A < i_B > i_C$
- The partial pressure of a gas over a liquid at constant temperature is doubled. Then which one of the given statements is true? (1)
(A) The Henry's law constant is doubled.
(B) The Henry's law constant is decreased by half.
(C) There are half as many gas molecules in the liquid.
(D) There are twice as many gas molecules in the liquid.

5. At a certain time in a reaction, substance A is disappearing at a rate of 4.0×10^{-2} M/s, substance B is appearing at a rate of 2.0×10^{-2} M/s, and substance C is appearing at a rate of 6.0×10^{-2} M/s. Which of the following could be the stoichiometry for the reaction being studied?
 (A) $2A + B \rightarrow 3C$ (B) $A \rightarrow 2B + 3C$ (C) $A + 2B \rightarrow 3C$ (D) $2A \rightarrow B + 3C$ (1)

6. The following two half-reactions occur in a voltaic cell:
 $Ni(s) \rightarrow Ni^{2+} + 2e^{-}$ (electrode = Ni), $Cu^{2+} + 2e^{-} \rightarrow Cu(s)$ (electrode = Cu) (1)

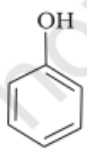
Which one of the following descriptions most accurately describes what is occurring in the half-cell containing the Cu electrode and $Cu^{2+}(aq)$ solution?

- (A) The electrode is losing mass and cations from the salt bridge are flowing into the half-cell.
 (B) The electrode is gaining mass and cations from the salt bridge are flowing into the half-cell.
 (C) The electrode is losing mass and anions from the salt bridge are flowing into the half-cell.
 (D) The electrode is gaining mass and anions from the salt bridge are flowing into the half-cell
7. How long it would take to deposit 50 g of Al from an electrolyte cell using a current of 105 amperes? (Atomic mass of Al = 27 u) (1)
 (A) 1.54 hr (B) 1.42 hr (C) 1.32 hr (D) 2.15 hr
8. The standard reduction potentials for Zn^{2+}/Zn , Ni^{2+}/Ni , Fe^{2+}/Fe are -0.76 V, -0.23 V and -0.44 V respectively. The reaction $X + Y^{2+} \rightarrow X^{2+} + Y$ will be spontaneous when:
 (A) X = Zn, Y = Ni (B) X = Ni, Y = Fe (C) X = Ni, Y = Zn (D) X = Fe, Y = Zn (1)
9. Which of the following compound will undergo racemisation when reacts with aq. KOH? (1)

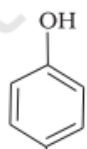


- (A) (i) and (ii) (B) (ii) and (iv) (C) (iii) and (iv) (D) (iv)

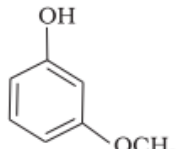
10. Mark the correct order of decreasing acid strength of the following compounds. (1)



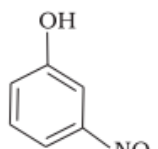
(a)



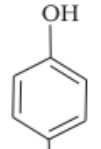
(b)



(c)



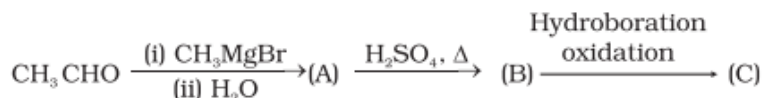
(d)



(e)

- (A) $e > d > b > a > c$ (B) $b > d > a > c > e$ (C) $d > e > c > b > a$ (D) $e > d > c > b > a$

11. Compounds A and C in the following reaction are _____ (1)



- (A) identical (B) positional isomers (C) functional isomers (D) optical isomers

12. The reagent which does not react with both, acetone and benzaldehyde is _____ (1)

- (A) Sodium hydrogen sulphite (B) Phenyl hydrazine
 (C) Fehling's solution (D) Grignard reagent

In the following questions (Q13-16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (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.

13. Assertion (A): Alcohols react both as nucleophiles and electrophiles. (1)
Reason (R): The bond between C–O is broken when alcohols react as nucleophiles.
14. Assertion (A): Strong oxidising agents oxidise toluene and its derivatives to benzoic acids. (1)
Reason (R): It is possible to stop the oxidation of toluene at the aldehyde stage with suitable reagents.
15. Assertion (A): Benzoic acid does not give Friedel-Crafts reaction. (1)
Reason (R): The carboxyl group is deactivating and gets bonded to Lewis acid AlCl_3
16. Assertion (A): The α -hydrogen atom in carbonyl compounds is less acidic. (1)
Reason (R): The anion formed after the loss of α -hydrogen atom is resonance stabilised.

SECTION B

17. Carboxylic acids contain carbonyl group but do not show the nucleophilic addition reaction like aldehydes or ketones. Why? (2)
18. Ethers can be prepared by Williamson's synthesis in which an alkyl halide is reacted with sodium alkoxide. Explain why di-tert-butyl ether cannot be prepared by this method. (2)
19. Compound 'A' with molecular formula $\text{C}_4\text{H}_9\text{Br}$ is treated with aq. KOH solution. The rate of this reaction depends upon the concentration of the compound 'A' only. When another optically active isomer 'B' of this compound was treated with aq. KOH solution, the rate of reaction was found to be dependent on concentration of compound and KOH both. (2)
(i) Write down the structural formula of both compounds 'A' and 'B'.
(ii) Out of these two compounds, which one will be converted to the product with inverted configuration?
20. Write a test to differentiate between pentan-2-one and pentan-3-one. (2)
21. State Henry's law and explain why are the tanks used by scuba divers filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen)? (2)

SECTION C

22. Calculate the emf of the following cell at 298 K: $\text{Al(s)}/\text{Al}^{3+}(0.15\text{M})//\text{Cu}^{2+}(0.025\text{M})/\text{Cu(s)}$ (Given $E^\circ(\text{Al}^{3+}/\text{Al}) = -1.66\text{ V}$, $E^\circ(\text{Cu}^{2+}/\text{Cu}) = 0.34\text{ V}$, $\log 0.15 = -0.8239$, $\log 0.025 = -1.6020$) (3)

OR

- (a) Can we construct an electrochemical cell with two half-cells composed of ZnSO_4 solution and zinc electrodes? Explain your answer.
- (b) Calculate the λ_m^0 for Cl^- ion from the data given below: $\Lambda_m^0 \text{MgCl}_2 = 258.6 \text{ Scm}^2\text{mol}^{-1}$ and $\lambda_m^0 \text{Mg}^{2+} = 106 \text{ Scm}^2\text{mol}^{-1}$

- (c) The cell constant of a conductivity cell is 0.146 cm^{-1} . What is the conductivity of 0.01 M solution of an electrolyte at 298 K , if the resistance of the cell is 1000 ohm ?
23. The half-life for the reaction: (3)
- $$\text{N}_2\text{O}_5 \longrightarrow 2\text{NO}_2 + \frac{1}{2}\text{O}_2 \text{ is } 2.4 \text{ hours at } 30 \text{ }^\circ\text{C}.$$
- (a) Starting with 100 grams of N_2O_5 , how many grams will remain after 9.6 hours ?
- (b) What time would be required to reduce 5×10^{10} molecules of N_2O_5 to 10^8 molecules?
24. Account for the following: (3)
- (i) The boiling points of alcohols decrease with increase in branching of the alkyl chain.
- (ii) Phenol does not give protonation reaction readily.
- (iii) Phenylmethyl ether reacts with HI to give Phenol and Methyl iodide and not Iodobenzene and Methyl alcohol.
25. You are given four organic compounds "A", "B", "C" and "D". The compounds "A", "B" and "C" (3) form an orange-red precipitate with 2,4 DNP reagent. Compounds "A" and "B" reduce Tollen's reagent while compounds "C" and "D" do not. Both "B" and "C" give a yellow precipitate when heated with iodine in the presence of NaOH . Compound "D" gives brisk effervescence with sodium bicarbonate solution. Identify "A", "B", "C" and "D" given the number of carbon atoms in three of these carbon compounds is three while one has two carbon atoms. Give an explanation for your answer.
26. In general, it is observed that the rate of chemical reaction doubles with every 10° rise in (3) temperature. If the generalization holds good for the reaction in the temperature range 295 K to 305 K , what would be the value of activation energy for this reaction? ($R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$)
27. What happens when: (3)
- (i) Chlorobenzene is treated with $\text{Cl}_2/\text{FeCl}_3$,
- (ii) ethyl chloride is treated with AgNO_2 ,
- (iii) 2-bromopentane is treated with alcoholic KOH ?
- Write the chemical equations in support of your answer.
28. Write the mechanism of acid dehydration of ethanol to yield ethene. (3)

SECTION D

29. Read the following passage and answer the following questions: (4)
- The lead-acid battery represents the oldest rechargeable battery technology. Lead acid batteries can be found in a wide variety of applications including small-scale power storage such as UPS systems, ignition power sources for automobiles, along with large, grid-scale power systems. The spongy lead act as the anode and lead dioxide as the cathode. Aqueous sulphuric acid is used as an electrolyte. The half-reactions during discharging of lead storage cells are:
- Anode: $\text{Pb}(s) + \text{SO}_4^{2-}(aq) \rightarrow \text{PbSO}_4(s) + 2e^-$
- Cathode: $\text{PbO}_2(s) + 4\text{H}^+(aq) + \text{SO}_4^{2-}(aq) + 2e^- \rightarrow \text{PbSO}_4(s) + 2\text{H}_2\text{O}$
- There is no safe way of disposal and these batteries end - up in landfills. Lead and sulphuric acid are extremely hazardous and pollute soil, water as well as air. Irrespective of the environmental challenges it poses, lead-acid batteries have remained an important source of energy. Designing green and sustainable battery systems as alternatives to conventional means remains relevant. Fuel cells are seen as the future source of energy. Hydrogen is considered a green fuel. Problem with

fuel cells at present is the storage of hydrogen. Currently, ammonia and methanol are being used as a source of hydrogen for fuel cell. These are obtained industrially, so add to the environmental issues. If the problem of storage of hydrogen is overcome, is it still a “green fuel?” Despite being the most abundant element in the Universe, hydrogen does not exist on its own so needs to be extracted from the water using electrolysis or separated from carbon fossil fuels. Both of these processes require a significant amount of energy which is currently more than that gained from the hydrogen itself. In addition, this extraction typically requires the use of fossil fuels. More research is being conducted in this field to solve these problems. Despite the problem of no-good means to extract Hydrogen, it is a uniquely abundant and renewable source of energy, perfect for our future zero-carbon needs.

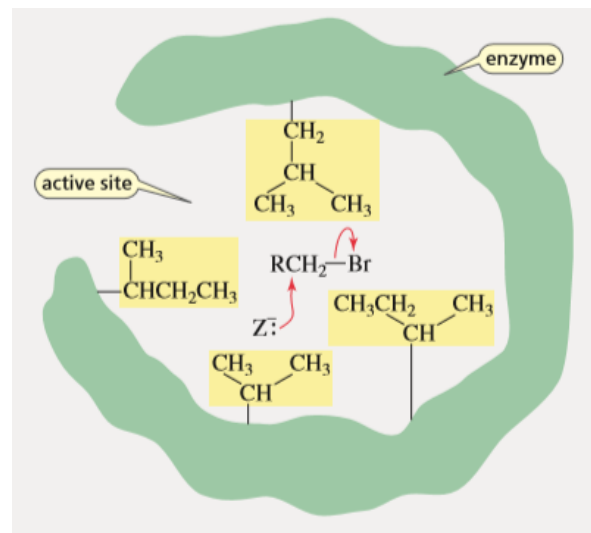
- How many coulombs have been transferred from anode to cathode in order to consume one mole of sulphuric acid during the discharging of lead storage cell?
- How much work can be extracted by using lead storage cell if each cell delivers about 2.0 V of voltage? ($1 F = 96500 C$)
- Do you agree with the statement – “Hydrogen is a green fuel”. Give your comments for and against this statement and justify your views.

OR

- Imagine you are a member of an agency funding scientific research. Which of the following projects will you fund and why?
 - safe recycling of lead batteries
 - extraction of hydrogen

30. Read the following passage and answer the following questions:

The microorganism *Xanthobacter* has learned to use alkyl halides that reach the ground as industrial pollutants as a source of carbon. The microorganism synthesizes an enzyme that uses the alkyl halide as a starting material to produce other carbon-containing compounds that the microorganism needs. The first step of the enzyme-catalysed reaction is an S_N2 reaction with a charged nucleophile. The enzyme has several nonpolar groups at its active site (the pocket in the enzyme where the reaction it catalyses takes place). The nonpolar groups on the surface of the enzyme provide the nonpolar environment needed to maximize the rate of the reaction.



(4)

- Why are S_N2 mechanisms favoured by non-polar solvents?
- Why is S_N1 mechanism favoured in a polar solvent?
- Arrange the compounds of each set in order of reactivity towards S_N2 displacement:
 - 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane
 - 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane

OR

- 2-bromobutane on heating with alc KOH gives 81% 2-butene. Give reason

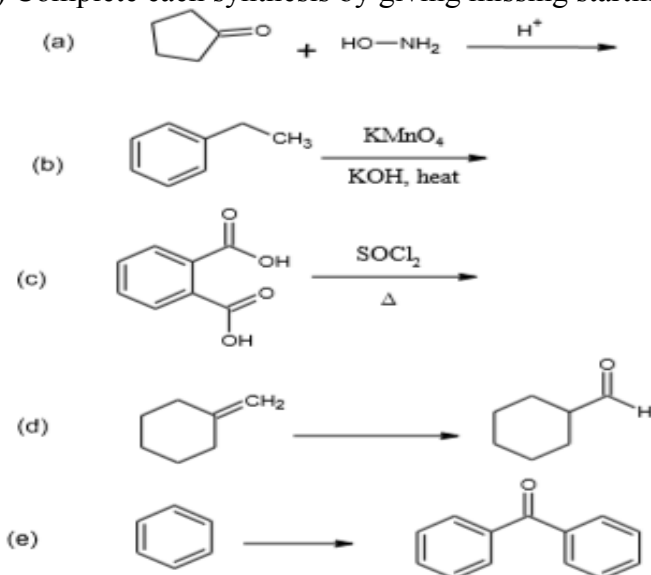
SECTION E

31. How will you bring about the following conversions in not more than two steps? (5)
- Propanone to Propene
 - Benzoic acid to Benzaldehyde
 - Ethanol to 3-Hydroxybutanal

(iv) Benzene to m-Nitroacetophenone (v) Benzaldehyde to Benzophenone

OR

(i) Complete each synthesis by giving missing starting material, reagent or products:



32. (a) What is the effect of temperature on the solubility of glucose in water? (5)
- (b) A student collected a 10mL each of fresh water and ocean water. He observed that one sample labelled "P" froze at 0°C while the other "Q" at -1.3°C. The student forgot which of the two, "P" or "Q" was ocean water. Help him identify which container contains ocean water, giving rationalization for your answer.
- (c) Calculate van't Hoff factor for an aqueous solution of $K_3[Fe(CN)_6]$ if the degree of dissociation (α) is 0.852. What will be boiling point of this solution if its concentration is one molal? ($K_b=0.52$ K kg/mol)

OR

- (a) What type of deviation from Raoult's Law is expected when phenol and aniline are mixed with each other? What change in the net volume of the mixture is expected? Graphically represent the deviation.
- (b) The vapour pressure of pure water at a certain temperature is 23.80 mm Hg. If 1 mole of a non-volatile non-electrolytic solute is dissolved in 100g water, Calculate the resultant vapour pressure of the solution
33. (a) Why does the cell voltage of a mercury cell remain constant during its lifetime? (5)
- (b) Write the reaction occurring at anode and cathode and the products of electrolysis of aq KCl.
- (c) What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.59 V at standard temperature and pressure?

OR

- (a) Molar conductivity of substance "A" is 5.9×10^3 S/m and "B" is 1×10^{-16} S/m. Which of the two is most likely to be copper metal and why?
- (b) What is the quantity of electricity in Coulombs required to produce 4.8 g of Mg from molten $MgCl_2$? How much Ca will be produced if the same amount of electricity was passed through molten $CaCl_2$? (Atomic mass of Mg = 24 u, atomic mass of Ca = 40 u)
- (c) What is the standard free energy change for the following reaction at room temperature? Is the reaction spontaneous? $Sn(s) + 2Cu^{2+}(aq) \rightarrow Sn^{2+}(aq) + 2Cu^+(s)$