



विद्या सर्वार्थ साधिका

ANANDALAYA
ANNUAL EXAMINATION
Class: XI

Subject: Chemistry (043)

Date : 23-02-2024

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.
- Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

- Which one of the following is more precise? (1)
(A) 4.0 (B) 4.00 (C) 4.000 (D) 4.0000
- What is the maximum number of orbitals that can be identified with the following quantum number? $n=3, l=1, ml=0$? (1)
(A) 1 (B) 2 (C) 3 (D) 4
- Which of the following elements has the maximum electron gain enthalpy? (1)
(A) Oxygen (B) Chlorine (C) Fluorine (D) Nitrogen
- Which of the following molecules has the maximum dipole moment? (1)
(A) CO₂ (B) CH₄ (C) NH₃ (D) NF₃
- During complete combustion of one mole of butane, 2658 kJ of heat is released. (1)
The thermochemical reaction for above change is _____.
(A) $2 \text{C}_4\text{H}_{10}(\text{g}) + 13 \text{O}_2(\text{g}) \rightarrow 8 \text{CO}_2(\text{g}) + 10 \text{H}_2\text{O}(\text{l}); \Delta_c\text{H} = -2658.0 \text{ kJ mol}^{-1}$
(B) $\text{C}_4\text{H}_{10}(\text{g}) + 13/2 \text{O}_2(\text{g}) \rightarrow 4 \text{CO}_2(\text{g}) + 5 \text{H}_2\text{O}(\text{l}); \Delta_c\text{H} = -1329.0 \text{ kJ mol}^{-1}$
(C) $\text{C}_4\text{H}_{10}(\text{g}) + 13/2 \text{O}_2(\text{g}) \rightarrow 4 \text{CO}_2(\text{g}) + 5 \text{H}_2\text{O}(\text{l}); \Delta_c\text{H} = -2658.0 \text{ kJ mol}^{-1}$
(D) $\text{C}_4\text{H}_{10}(\text{g}) + 13/2 \text{O}_2(\text{g}) \rightarrow 4 \text{CO}_2(\text{g}) + 5 \text{H}_2\text{O}(\text{l}); \Delta_c\text{H} = +2658.0 \text{ kJ mol}^{-1}$
- The equilibrium constant K_c for the reaction; $\text{H}_{2(\text{g})} + \text{I}_{2(\text{g})} \rightleftharpoons 2\text{HI}_{(\text{g})}$ at 700K is 16. (1)
What will be the K_c for the reaction $2\text{HI}_{(\text{g})} \rightleftharpoons \text{H}_{2(\text{g})} + \text{I}_{2(\text{g})}$ at the same temperature?
(A) 1/4 (B) 0.02 (C) 1/7 (D) 1.43

7. Resonance is due to _____. (1)
 (A) delocalization of σ electrons (B) migration of H - atom
 (C) delocalisation of π electrons (D) migration of H^+ ion
8. Bond length of (I) ethane, (II) ethene, (III) Acetylene, (IV) Benzene follows the order: (1)
 (A) I > II > III > IV (B) I > II > IV > III
 (C) I > IV > II > III (D) III > IV > II > I
9. The mass of one mole of C-12 is _____. (1)
 (A) 0.012 Kg (B) 0.024 Kg (C) 1 Kg (D) 12 Kg
10. If enthalpy of vapourisation of water is $186.5 \text{ JK}^{-1} \text{ mol}^{-1}$, what is value of ΔS_{vap} at its boiling? (1)
 (A) 1.5 (B) 2.0 (C) 0.5 (D) 1.0
11. In the compound, $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$, the $\text{C}_2 - \text{C}_3$ bond is of the type _____. (1)
 (A) $sp - sp^2$ (B) $sp^3 - sp^3$ (C) $sp - sp^3$ (D) $sp^2 - sp^3$
12. Select the true statement regarding benzene. (1)
 (A) Because of unsaturation benzene easily undergoes addition.
 (B) There are two types of C - C bonds in benzene molecule.
 (C) There is cyclic delocalisation of π -electrons in benzene.
 (D) Monosubstitution of benzene gives three isomeric products.
13. Assertion (A) : The first ionisation energy of Al is lower than that of Mg. (1)
 Reason (R) : The atomic size of Al is smaller than sodium.
14. Assertion (A) : Octet theory cannot account for the shape of the molecule. (1)
 Reason (R) : Octet theory can predict relative stability and energy of a molecule.
15. Assertion (A) : Caesium and fluorine both reacts violently. (1)
 Reason (R) : Caesium is the most electropositive and fluorine the most electronegative element.
16. Assertion (A): The melting point/boiling point of 2-methyl pentane is more than that of n hexane. (1)
 Reason (R) : As branching increases, surface area decreases and melting point/boiling point decreases.

Select the most appropriate answer from the options given below for questions 13-16 above.

- (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.

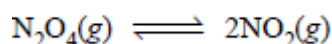
SECTION B

This section contains 5 questions with internal choice in one question. The questions are very short answer type and carry 2 marks each.

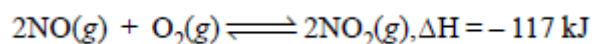
17. A compound on analysis found to contain following percentage composition. (2)
Sodium = 43.4%, Carbon = 11.4% and Oxygen = 45.3%. Determine the empirical and molecular formula of this compound. [The relative molecular mass of compound is 106 u].
(Na = 23u, C = 12u, O = 16u)

18. (a) Find out the total number of d-electrons in Cr^{3+} ions. (2)
(b) What is the maximum number of emission lines when the excited electron of an atom in $n = 6$ drops to the ground state in hydrogen atom?

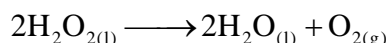
19. (a) Write expression of K_p for the reaction: (2)



- (b) Predict the effect of an increase in concentration of NO on the equilibrium concentration of NO_2 .



20. The $\Delta_f H^0$ values for H_2O_2 and H_2O are -188 and -286 KJ mol^{-1} respectively. Find out the enthalpy change for the following reaction. (2)



OR

The equilibrium constant for a reaction is 10. What will be the value of $\Delta^0 G$?

[$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$, $T = 300 \text{ K}$, $\log 10 = 1$)]

21. (a) Which of the following orbitals has the lowest energy? (2)
4d, 4f, 5s, 5p

- (b) Represent the hydrogen bonding in ammonia.

SECTION C

This section contains 7 questions with internal choice in one question. The questions are short answer type and carry 3 marks each.

22. (a) Concentrated solution of Sulphuric acid is 98 % by mass and has a density $d = 1.84 \text{ g/cm}^3$. (3)
Find out the molarity of this solution.

- (b) Find out the molarity of pure water. ($d = 1 \text{ g/ml}$)

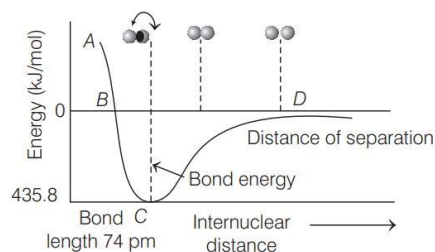
23. (a) Calculate the wave number of the line having frequency $5 \times 10^{16} \text{ Hz}$. (3)
(b) What is the energy of an electron of hydrogen atom in the state $n = 2$?

24. (a) How would you react to the statement the electronegativity of N on Pauling scale is 3.0 in all the nitrogen compounds? (3)

- (b) Write the general electronic configuration of d-block elements?

25. (a) BF_3 does not have proton but still acts as an acid and reacts with NH_3 . How? (3)

- (b) The potential energy curve is given for the formation of H_2 molecule as a function of internuclear distance of H-atoms. At what point in the curve, H_2 is found in the most stable state?

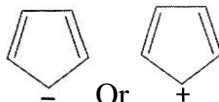


(c) Arrange the following species into the decreasing order of their stability.

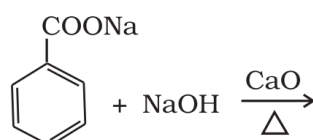


26. If $K_w = 49 \times 10^{-14}$, what will be neutral pH of H_2O ? (Log 7 = 0.8451) (3)

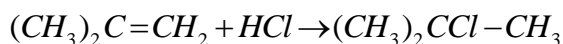
27. (a) Which of the followings is aromatic in nature? Also justify your answer. (3)



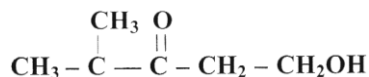
(b) Complete the following reaction.



28. (a) Identify the type of this reaction. (3)



(b) Write the IUPAC name of the following compound.

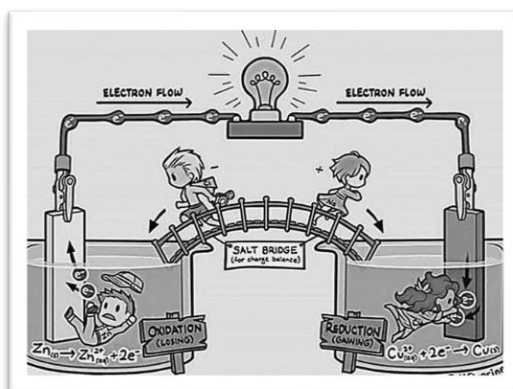


(c) Give one example of position isomers.

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (2+1+1) marks each. Read the passage carefully and answer the questions that follow.

29. As shown in the picture below, redox reactions are reactions in which oxidation and reduction takes place simultaneously. Oxidation number are assigned in accordance with the set of rules. Oxidation number and ion electron methods both are used in balancing ionic equations. Redox reactions are classified as combination, decomposition, displacement and disproportionation reactions. The concept of redox couple and electrode processes is basis of electrolysis and electrochemical cells. (4)



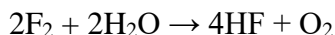
- (a) The compound AgF_2 is unstable compound. However, if formed, the compound acts as a very strong oxidising agent. Why?

OR

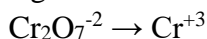
- (a) Find out the oxidation states of underlined elements in the following compounds.



- (b) Identify the element undergoing oxidation and reduction in the following reaction.



- (c) Balance the following half reaction through half reaction method in acidic medium.



30. Read the passage given below and answer the following questions: (4)

In order to explain the shapes of molecules adequately, Sidgwick and Powell in 1940 proposed a theory based on the repulsive interaction of the electron pairs in the valence shell of the atoms. Nyholm and Gillespie (1950) further developed and redefined the concept.

The main postulates of this theory are as follows:

The number of valence shell electron pairs (bonded or non-bonded) present around the central atom decides the shape of the molecules. The shared electron pairs are called bond pairs and unshared or non-bonding electrons are called lone pairs.

Electron pairs of valence shell repel one another because their electron clouds are negatively charged.

These electron pairs arrange themselves in such a way so that there is a minimum repulsion and a maximum distance in between them. The valence shell is considered as a sphere in which the electron pairs are localised on the spherical surface at maximum distance from one another.

A lone pair occupies more space than a bonding pair, since it lies closer to the central atom.

This means that the repulsion between the different electron pairs follow the order:

Lone pair-lone pair > lone pair-bond pair > bond pair-bond pair

- (a) Give one example of AB_3E type of compound and also draw its structure as per VSEPR theory.

OR

- (a) Draw the shape of XeF_4 molecule. Also mention the no. of lone pair/s around central atom.
(b) What is the bond angle present in SF_6 molecule?
(c) Apart from tetrahedral geometry, another possible geometry for CH_4 is square planar with the four H atoms at the corners of the square and the C atom at its centre. Explain why CH_4 is not square planar.

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

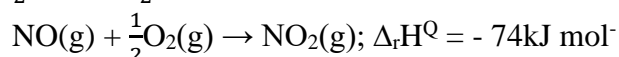
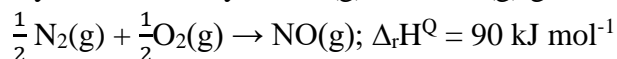
31. Attempt any five of the following: (5)

(a) Define: Standard enthalpy of formation

(b) In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system.

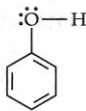
What is the change in internal energy for the process?

(c) Comment on the thermodynamic stability of $\text{NO}(\text{g})$ and $\text{NO}_2(\text{g})$ given:



- (d) What is the enthalpy change for an adiabatic process?
 (e) Out of diamond and graphite which has higher entropy? Give reason.
 (f) Is molarity an extensive or intensive property? Justify your answer.

32. (a) Which is more stable, $\text{CH}_3\text{CH}_2\text{O}^-$ or $\text{O}_2\text{NCH}_2\text{CH}_2\text{O}^-$? Why? (5)
 (b) Draw the resonance structures during positive resonance in following compound.
 Show the electron shift using curved-arrow notation.



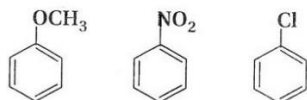
OR

- (a) What is the hybridization of carbon in methyl carbocation? Also draw the three dimensional structure of it.
 (b) Arrange the followings in decreasing order of their stability and justify your answer.

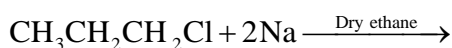


- (c) Write the chemical equation involved in the formation of iron(III)hexacyanidoferrate(II) (ferriferrocyanide) during the detection of nitrogen in Lassaigne's test.

33. (a) Arrange the following set of compounds in the order of their decreasing relative reactivity with an electrophile. (5)



- (b) Write a chemical reaction to show the acidic nature of alkynes.
 (c) One mole of a hydrocarbon (A) reacts with one mole of bromine giving a dibromo compound (B), $\text{C}_5\text{H}_{10}\text{Br}_2$. Substance (A) on treatment with cold dilute alkaline KMnO_4 solution forms a compound (C) $\text{C}_5\text{H}_{12}\text{O}_2$. On ozonolysis (A) gives equimolar quantities of propanone and ethanal. Deduce the structural formula of (A) and (C).
 (d) Complete the reaction.



OR

- (a) Draw Sawhorse projections for the staggered conformations of ethane.
 (b) Write a chemical equation for the following conversion.
 "2-bromopropane to 1-bromopropane"
 (c) Write the structures of the A and B in the following reaction.

