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INDIAN SCHOOL SOHAR
TERM II EXAMINATION (2023-2024)
CHEMISTRY (043)

CLASS: XI **MAX.MARKS: 70**
DATE: 11/02/24 **TIME : 3 HOURS**

General Instructions:

(a) There are 33 questions in this question paper with internal choice.
(b) Section A consists of 16 multiple-choice questions carrying 1 mark each.
(c) Section B consists of 5 short answer questions carrying 2 marks each.
(d) Section C consists of 7 short answer questions carrying 3 marks each.
(e) Section D consists of 2 case-based questions carrying 4 marks each.
(f) Section E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) 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.

1. Identify the amphoteric oxide from the given options: 1

(a) CaO (b) CO_2
(c) SiO_2 (d) SnO_2

2. The compound that exhibits geometrical isomerism is: 1

(a) But-2-yne (b) But-2-ene
(c) But-1-ene (d) Butan-2-ol

3. $NH_4NO_2(s)$ decomposes at 127℃ to form $N_2(g)$ and $H_2O(g)$. The ΔH for the reaction at 1 atm pressure and 373 K is -240.5 kJ mol^{-1}. What is the value of ΔU for the reaction? (Given R= 8.3 J $K^{-1}mol^{-1}$) 1

(a) – 230.54 kJ mol^{-1} (b) – 223.8 kJ mol^{-1}
(c) - 308.62 kJ mol^{-1} (d) -250.46 kJ mol^{-1}

4. The total number of electrons present in 3.2 g of methane is: 1

(a) 10 x 6.022 x 10^{22} (b) 10 x 6.022 x 10^{23}
(c) 2 x 10 x 6.022 x 10^{22} (d) 6.022 x 10^{23}

5. The maximum number of orbitals that can be identified with the following quantum number $n = 3, l = 1, m_l = 0$ is: 1

(a) 1 (b) 2
(c) 3 (d) 4

6. The electronic configuration that exhibits the maximum difference in the 1st and 2nd ionization enthalpy is: 1

(a) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (b) $1s^2\ 2s^2\ 2p^6\ 3s^2$
(c) $1s^2\ 2s^2\ 2p^1$ (d) $1s^2\ 2s^2\ 2p^6$

7. The buffer solution comprised of the following has a pH value of less than 7: 1

(a) $HCOONH_4$ (b) CH_3COONH_4
(c) HCOOH+ HCOOK (d) NH_4OH +NH_4Cl

8. The oxidation state of I in $H_4IO_6^-$ is: 1

(a) +7 (b) +5
(c) +1 (d) -1

9. Which of the following species has an electron-releasing (or +I inductive) effect?

(a) $-NO_2$ (b) -COOH 1

(c) $(CH_3)_2CH-$ (d) C_6H_5-

10 For a spontaneous reaction, Δ G should be:

(a) positive (b) negative 1

(c) equal to zero (d) may be positive or negative

11. In PO_4^{3-} the formal charge on the oxygen atom of the P-O bond is:

(a) +1 (b) -1 1

(c) -0.75 (d) +0.75

12. The correct order of increasing energy of atomic orbital is:

(a) 5p<4f<6s<5d (b) 5p<6s<4f<5d 1

(c) 4f<5p<5d<6s (d) 5p<5d<4f<6s

In the following questions (Q. No. 13 to 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

(a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.

(b) Assertion and reason both are correct statements but the reason is not the correct explanation for assertion.

(c) Assertion is a correct statement but the reason is wrong.

(d) Assertion is a wrong statement but the reason is correct.

13. Assertion: Electron enthalpy always becomes less negative as we go down the group. 1

Reason: The size of the atom increases on going down the group and the added electron would be farther from the nucleus.

14. Assertion: Neopentane has a lower boiling point than n-pentane and isopentane. 1

Reason: The boiling point increases with an increase in branching.

15. Assertion: 1 mole of H_2SO_4 is neutralized by 2 moles of NaOH but 1 equivalent of H_2SO_4 is neutralized by 1 equivalent of NaOH. 1

Reason: Equivalent wt. of H_2SO_4 is half of its molecular weight while the equivalent weight of NaOH is 40.

16. Assertion: But-1-ene and 2-Methylprop-1-ene are position isomers.

Reason: Position isomers have the same molecular formula but differ in the position of functional groups. 1

SECTION-B

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

17. Calculate the mole fraction of water in a mixture of 12 g water, 108 g acetic acid and 92 g ethanol. 2

OR

How many grams of $KClO_3$ must be decomposed to prepare 3.36 liters of oxygen at STP?

18. Describe the hybridization and structure of SF_6. 2

19. (a) Predict whether the reaction between $Br_2(aq)$ and $Fe^{2+}(aq)$ is feasible. 2x1

(Given: standard reduction potential for $E^0\ Br_2/Br^-$ = 1.09 V, E^0Fe^{3+}/Fe^{2+} = 0.77 V).

(b) Give an example of a disproportionation reaction.

20. (a) Name two positively charged and two neutral electrophiles.

(b) List the following carbocations in the order of decreasing stability: 2x1

CH_3-$CHCl$-CH_2-CH_2^+, $(CH_3)_2CH$-CH_2-CH_2^+, CH_3-CH_2-$CHCl$-CH_2^+

21. (a) Assuming complete dissociation, calculate the pH of 0.005 M NaOH.
(Given log 2= 0.3010, log 5= 0.6990) 2x1

(b) If $Q_c < K_c$, predict the direction of the reaction.

SECTION-C

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

22. (a) Balance the following equation by ion-electron method:

$Zn(s) + NO_3^-(aq) \longrightarrow Zn^{2+} + NH_4^+(aq) + H^+$ (Acidic medium)

(b) Out of Zn and Cu vessels which one will be more suitable to store 1 M HCl? 2+1
(Given: $E^0 Zn^{2+}/Zn$ = -0.76 V, $E^0 cu^{2+}/ Cu$= +0.34 V)

23. Calculate the equilibrium constant for the following reaction at 298 K and 1 atmospheric pressure:

$NO(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO_2(g)$

(Given: $\Delta_f H^o$ at 298 K for NO(g) = 90.4 kJ mol^{-1}; for NO_2(g) = 33.8 kJ mol^{-1} and ΔS^0 at 298 K for the reaction = -70.8 J $K^{-1}mol^{-1}$) 3

24. A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molecular mass is 98.96. What are its empirical and molecular formulae?

OR

Commercially available concentrated hydrochloric acid contains 45% HCl by mass. 3
(i) What is the molarity of this solution? The density is 1.19 g mL.
(ii) What volume of conc. HCl is required to make 1.00 L of 0.24 M HCl?

25. (a)A photon of wavelength 4 x 10^{-7} m strikes a metal surface, the work function of the metal is 2.13 eV. Calculate (i) the energy of the photon (eV) and (ii) the kinetic energy of the emission. 2+1

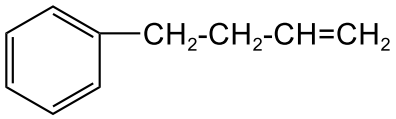
(b) Write the electronic configuration of Cu^{2+}. Calculate its magnetic moment.

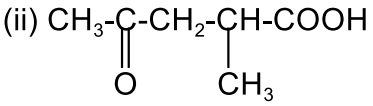
26. Write the mechanism for the chlorination of benzene. 3

27. (a) Assign the position of the element having outer electronic configuration: (n-1) d^2ns^2 for n=4. 3x1

(b)Give a reason for the following:
(i) Noble gases have bigger atomic sizes than halogens.
(ii) The electron gain enthalpy of fluorine is less negative than that of chlorine.

28. (a) Give the IUPAC name of the following molecules:

(i) 

(ii) 

(b) Write the structural and bond line formula for 3-Hydroxy-4-methylpent-4-en-1-al.

(c) Draw the resonance structure for phenol.

SECTION-D

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

29. Read the passage given below and answer the questions which follow:

Atomic spectra are the distinctive patterns of light emitted or absorbed by atoms when they interact with energy, such as heat or electromagnetic radiation. This spectrum consists of sharp well-defined lines or bands corresponding to definite frequencies. There are two types of atomic spectra: emission spectra and absorption spectra. Hydrogen, the simplest element, provides a classic example of spectral analysis. Its emission spectrum consists of a series of lines, each corresponding to a specific electron transition. Some lines are present in the visible region while others are in the

ultraviolet and infrared regions. The most prominent and well-known series are the Lyman, Balmer, Paschen, Brackett, and Pfund. The Bohr model, proposed by Niels Bohr in 1913, successfully explained the spectral lines by introducing the concept of quantized angular momentum and discrete electron orbits.

Answer the following questions:

(a) Which transitions between Bohr orbits correspond to (i) the second line in the Balmer series and (ii) the first line in the Brackett series of the hydrogen spectrum?

OR

Which series of the hydrogen spectrum lies in the (i) ultraviolet region and (ii) near-infrared Region?

(b) How are emission and absorption spectra crucial in identifying elements?

(c) In the Rydberg equation, a spectral line corresponds to n_1= 2 and n_2= 4. Calculate the wavelength and frequency of this spectral line.

30. Read the passage given below and answer the questions which follow:

Enthalpy, a fundamental thermodynamic quantity, manifests in various forms. These various forms of enthalpy help us understand the energy changes in chemical reactions, crystal structures, and phase changes. There are several types of enthalpies, like standard enthalpy of formation, standard enthalpy of combustion, standard enthalpy of reaction, lattice enthalpy and enthalpy of phase transformations. They all give us a complete view of the energy aspects of substances and reactions. Hess's law provides a powerful tool for calculating the overall enthalpy change of a reaction, especially when it cannot be directly measured.

Answer the following questions:

(a) State Hess's law of constant heat summation.

(b) The enthalpy of reaction for the reaction:

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ is $\Delta_r H^o$= -92.2 kJ mol^{-1}. What will be the standard enthalpy of the formation of ammonia?

(c) Calculate the standard enthalpy of the formation of CH_3OH (l) from the following data:

(i) $CH_3OH(l) + \frac{3}{2} O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$; $\Delta_r H^0$ = -726 kJ mol^{-1}

(ii) $C(g) + O_2(g) \rightarrow CO_2(g)$; $\Delta_c H^0$ = -393 kJ mol^{-1}

(iii) $H_2(g) + \frac{1}{2} O2(g) \rightarrow H_2O(l)$; $\Delta_f H^0$ = -286 kJ mol^{-1}

OR

Enthalpies of formation of CO(g), CO_2(g), N_2O(g) and N_2O_4(g) are –110 kJ mol^{-1}, – 393 kJ mol^{-1}, 81 kJ $mol^{-1}$and 9.7 kJ mol^{-1}respectively. Find the value of $\Delta_r H$ for the reaction:

$N_2O_4(g) + 3CO(g) \longrightarrow N_2O(g) + 3CO_2(g)$

SECTION-E

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

31. (a) Write the resonating structures for SO_3 and NO_3^-. 5x1

(b) Among But-1-ene and But-1-yne, which one has a higher dipole moment and why?

(c) Draw the hydrogen bond between two molecules of the given substances wherever appropriate.
(i) CH_3CH_2OH (ii) CH_3COOH

(d) Arrange the following sets of molecules in the decreasing order of bond angle:
BeH_2, H_2O, $AlCl_3$, H_2S

(e) N_2 has greater bond dissociation energy than N_2^+. Give reason.

(f) Give the shapes of the following covalent compounds based on VSEPR theory: (i) XeF_2 (ii) AsF_5

(g) Give one difference between sigma and pi bonds.

32. (a)How will you carry out the following conversions in only two steps? 3+1+1

(i) Ethyne to ethanal

(ii) 1-Bromopropane to 2- Bromopropane

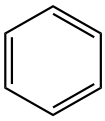
(iii) Benzene to p-nitrochlorobenzene

(b) Propanal and Pentan-3-one are the ozonolysis products of an alkene. What is the structural formula of the alkene?

(c) Draw the Newman's projection formula for the staggered form of 1,2-dichloroethane.

OR

(a) Give the main product of the following reactions and identify the type of reaction:

(i)  $+ C_6H_5COCl \xrightarrow{AlCl_3}$

(ii) $(CH_3)_2C{=}CH{-}CH_3 + HBr \xrightarrow{\text{peroxide}}$

(iii) $3\ CH{\equiv}CH \xrightarrow{\text{Red hot Fe tube}}$

(b) Arrange the following sets of compounds in order of their decreasing relative reactivity with an electrophile: Chlorobenzene, 2, 4-dinitrochlorobenzene, p-nitrochlorobenzene

(c) Write a note on Wurtz's reaction with an example.

33. (a) Calculate the concentration of each species at equilibrium in an aqueous solution containing 0.1 M NH_4OH along with 0.1 M NH_4Cl. (Given K_b for NH_4OH= 1.8 x 10^{-5}) 3+1+1

(b) The ionization constant of HCN at 298 K is 4.8 x 10^{-9} K. Calculate the ionization constant of the corresponding conjugate base.

(c) Classify the following into acids and bases according to Lewis's concept:

(i) S^{2-} (ii) F^- (iii) H^+ (iv) Ni^{2+}

OR

(a) What is the equilibrium concentration of each of the substances in the equilibrium when the initial concentration of ICl was 0.78 M?

$2\ ICl(g) + \rightleftharpoons I_2(g) + Cl_2(g)$; $K_c = 0.14$

(b) What is Kc for the following reaction?

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

(Given $[SO_2] = 0.6$ M; $[O_2] = 0.82$ M; $[SO_3] = 1.90$ M)

(c) Predict the effect of increasing pressure in the following reactions:

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

(ii) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

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