विद्या सर्वार्थि साधिका

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ANNUAL EXAMINATION

Class: XI

Subject: Chemistry MM : 70

Date : 20-02-2023 Time: 3 hours

General Instructions:

Read the following instructions carefully.

a) There are 35 questions in this question paper with internal choice.

b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

d) SECTION C consists of 5 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. The molarity of a solution obtained by maxing 750 mL of 0.5 M HCl with 250 mL of 2 M HCl will be (1)

(A) 0.975 M (B) 0.875 M (C) 1.00 M (D) 1.175 M

2. Which of the following is dependent on temperature? (1)

(A) Molarity (B) Molality (C) Mole fraction (D) Mass percentage

3. The magnetic quantum number of an atom is related to the: (1)

(A) size of the orbital (B spin angular momentum

(C) orbital angular momentum (D) orientation of the orbital in space

4. For principal quantum number, n = 4, the total number of orbitals having 1 = 3 is: (1)

(A) (B) 7 (C) 5 (D) 9

5. Among halogens, the correct order of amount of energy released in electron gain (electron gain enthalpy) is: (1)

(A) F > Cl > Br > I (B) F < Cl < Br < I (C) F < Cl > Br > I (D) F < Cl < Br < I

6. The shape of XeF_4 molecule according to VSEPR theory is (1)

(A) Square planar (B) Square pyramid

(C) Tetrahedral (D) Pyramidal

7. Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment? (1)

(A) CO_2 (B) HI (C) H_2O (D) SO_2

8. Isostructural species are those which have the same shape and hybridisation. Among the given species identify the isostructural pairs. (1)

(A) [NF_3 and BF_3] (B) [BF_4^- and NH_4^+] (C) [BCl_3 and $BrCl_3$]

(D) [NH_3 and NO_3^-]

9. The entropy change can be calculated by using the expression $\Delta S = \frac{qrev}{T}$. When water freezes in a glass beaker, choose the correct statement amongst the following: (1)
(A) ΔS (system) decreases but ΔS (surroundings) remains the same.
(B) ΔS (system) increases but ΔS (surroundings) decreases.
(C) ΔS (system) decreases but ΔS (surroundings) increases.
(D) ΔS (system) decreases and ΔS (surroundings) also decreases.

10. For the reaction $CO(g) + Cl_2(g) \rightarrow COCl_2(g)$, the value of Kc/Kp is equal to (1)
(A) RT (B) $(RT)^2$ (C) 1/RT (D) 1.0

11. The reaction shown here has a Kp = 4.5 x 10^2 at 825 K. Find Kc for the reaction at this temperature. $CH_4(g) + CO_2(g) \rightleftharpoons 2\,CO(g) + 2\,H_2(g)$ (1)
(A) 0.098 (B) 2.1 x 10^6 (C) 6.6 (D) 4.5 x 10^{-2}

12. The more positive the value of E^0, the greater is the tendency of the species to get reduced. Using the standard electrode potential of redox couples given below find out which of the following is the strongest oxidising agent. E^0 values: Fe^{3+}/Fe^{2+} = + 0.77; I_2 (s)/I^- = + 0.54; Cu^{2+}/Cu = + 0.34; Ag^+/Ag = + 0.80V (1)
(A) Fe^{3+} (B) I_2 (s) (C) Cu^{2+} (D) Ag^+

13. Which of the following arrangements represent increasing oxidation number of the central atom? (1)
(A) CrO_2^-, ClO_3^-, CrO_4^{2-}, MnO_4^- (B) ClO_3^-, CrO_4^{2-}, MnO_4^-, CrO_2^-
(C) CrO_2^-, ClO_3^-, MnO_4^-, CrO_4^{2-} (D) CrO_4^{2-}, MnO_4^-, CrO_2^-, ClO_3^-

14. Which of the following compounds contain all the carbon atoms in the same hybridisation state? (1)
(A) H—C ≡ C—C ≡ C—H (B) CH_3—C ≡ C—CH_3
(C) $CH_2 = C = CH_2$ (D) CH_2 = CH—CH = CH_2

Q. 15 to 18 are assertion and reasoning type questions. Given below are two statements labelled as Assertion (A) and Reason (R). 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.
E. A and R both are wrong statement.

15. **Assertion (A)**: Energy of resonance hybrid is equal to the average of energies of all canonical forms (1)
Reason (R): Resonance hybrid cannot be presented by a single structure.

16. **Assertion (A):** Tertiary carbocations are generally formed more easily than primary carbocations. (1)
Reason (R): Hyperconjugation as well as inductive effectdue to additional alkyl groups stabilize tertiary carbocations.

17. **Assertion (A):** Acidity of C-H bond decreases in the order:
HC ≡ CH > H2C = CH2 > H3C – CH3
Reason (R): Greater the percentage s-character, more is the acidity of C – H bond. (1)

18. **Assertion (A):** Nitration of benzene with nitric acid requires concentrated sulphuric acid (1)

Reason (R): The mixture of concentrated nitric acid and concentrated sulphuric acid produces the electrophile NO_2^+

SECTION B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. How many significant figures are present in the following: (2)
(a) 4.00005 (b) 0.004

20. A 100-watt bulb emits monochromatic light of wavelength 400 nm. Calculate the number of protons emitted per second by the bulb. (2)

OR

The Balmer series in the hydrogen spectrum corresponds to the transition from $n_1 = 2$ to $n_2 = 3,4,$ .....This series lies in the visible region. Calculate the wave number of line associated with the transition in Balmer series when the electron moves to n = 4 orbit. ($R_H = 109677$ cm–1)

21. Nitrogen has positive electron gain enthalpy whereas oxygen has negative. However, oxygen has lower ionisation enthalpy than nitrogen. Explain. (2)

OR

Explain the following:
(a) Electronegativity of elements increase on moving from left to right in the periodic table.
(b) Ionisation enthalpy decrease in a group from top to bottom?

22. (a) Conjugate acid of a weak base is always stronger. What will be the decreasing order of basic strength of the following conjugate bases? $OH^–$, $RO^–$, $CH_3COO^–$, $Cl^–$ (2)
(b) Arrange the following in increasing order of pH:
KNO_3 (aq), CH_3COONa (aq), NH_4Cl (aq), $C_6H_5COONH_4$ (aq)

23. Balance the following redox reactions by ion – electron method: (2)
MnO_4^- (aq) + I^- (aq) → MnO_2 (s) + I_2(s) (in basic medium)

24. Draw the resonance structures for the following compounds. Show the electron shift using curved-arrow notation. (a) C_6H_5OH (b) $C_6H_5NO_2$ (2)

25. How will you convert benzene into (i) p-nitrobromobenzene (ii) m- nitrochlorobenzene (2)

SECTION C

The following 5 questions are short answer type and carry 3 marks each.

26. 3.0 g of H_2 react with 29.0 g of O_2 yield H_2O. (3)
(a) Which is the limiting reagent.
(b) Calculate the maximum amount of H_2O that can be formed.
(c) Calculate the amount of reactant left unreacted.

27. The first ionisation enthalpy values (in kJmol–1) of group-13 elements are: (3)

B	Al	Ga	In	Tl
801	577	579	558	589

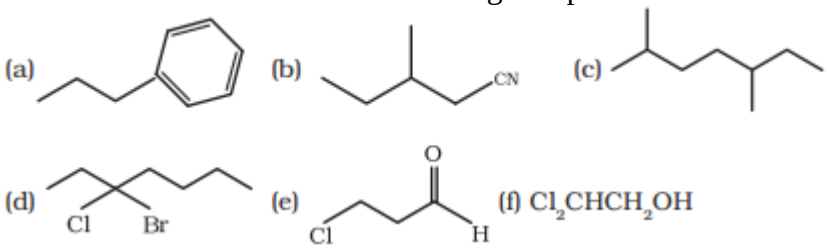
How would you explain this deviation from the general trend?

28. Consider the combustion of propane gas: (3)
C_3H_8(g) + 5 O_2(g) →3 CO_2(g) + 4 H_2O(g) ΔHrxn = -2044 kJ
(a) Calculate the entropy change in the surroundings associated with this reaction occurring at 25 °C.

(b) Determine the sign of the entropy change for the system.
(c) Determine the sign of the entropy change for the universe. Is the reaction spontaneous?

29. The solubility product of Al $(OH)_3$ is 2.7×10^{-11}. Calculate its solubility in gL^{-1} and also find out pH of this solution. (Atomic mass of Al = 27 u). (3)

30. Give the IUPAC names of the following compounds: (3)

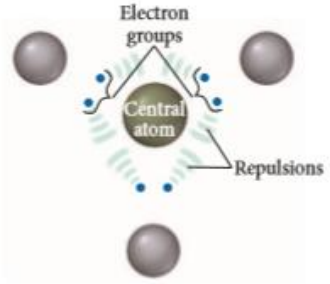


SECTION D

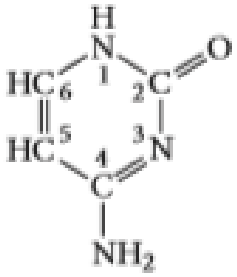
The following questions are case-based questions. Each question carries 4 marks each. Read the passage carefully and answer the questions that follow.

31. VSEPR Theory: Predicting Molecular Shape (4)

- In VSEPR theory, molecular geometries are determined by the repulsions between electron groups on the central atom. An electron group can be a single bond, double bond, triple bond, lone pair, or even a single electron.
- The five basic molecular shapes are linear (two electron groups), trigonal planar (three electron groups), tetrahedral (four electron groups), trigonal bipyramidal (five electron groups), and octahedral (six electron groups).
- When lone pairs are present on the central atom, the electron geometry is still one of the five basic shapes, but one or more positions are occupied by lone pairs. The molecular geometry is therefore different from the electron geometry. Lone pairs are positioned so as to minimize repulsions with other lone pairs and with bonding pairs.



(a) A molecule with the formula AB_3 has a trigonal pyramidal geometry. How many electron groups are on the central atom (A)?
(b) Assign a geometry to each numbered interior atom.



32. The step-by-step description of the process by which reactants (in this case, an alkene + HBr) are changed into products (an alkyl halide) is called the mechanism of the reaction. (4)

We use curved arrows to help us understand a mechanism.

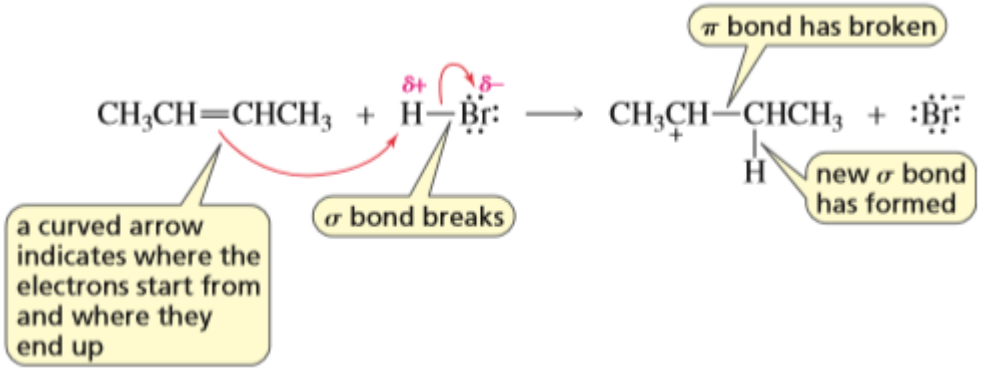
■ Curved arrows are drawn to show how the electrons move as new covalent bonds are formed and existing covalent bonds are broken.

■ Each arrow represents the simultaneous movement of two electrons (an electron pair) from a nucleophile (at the tail of the arrow) toward an electrophile (at the point of the arrow).

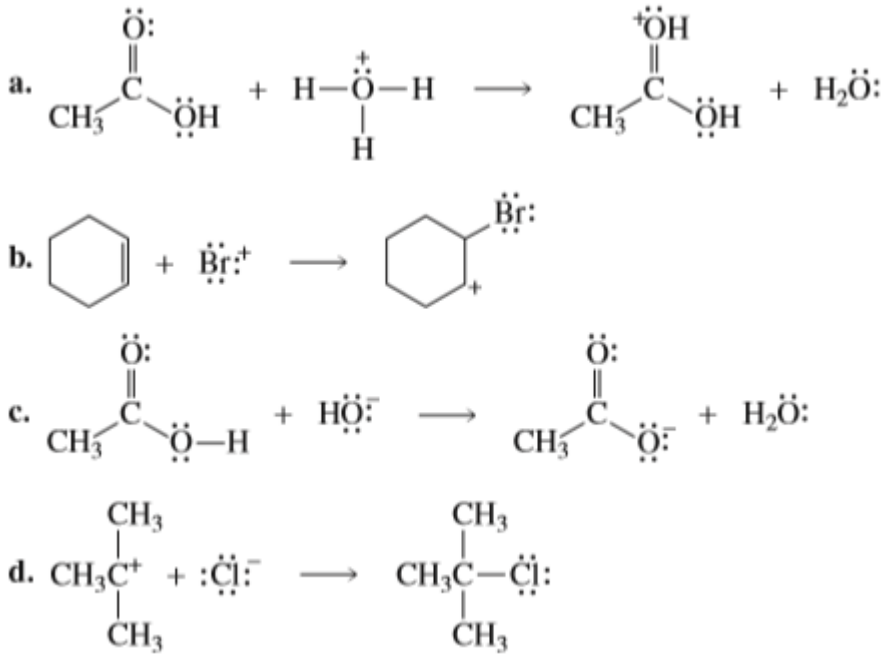
■ The tail of the arrow is positioned where the electrons are in the reactant; the tail always starts at a lone pair or at a bond.

■ The head of the arrow points to where these same electrons end up in the product; the arrow always points at an atom or a bond.

For the reaction of 2-butene with HBr, an arrow is drawn to show that the two electrons of the p bond of the alkene are attracted to the partially positively charged hydrogen of HBr.



Use curved arrows to show the movement of electrons in the following reaction steps. Look at the reactants and look at the products and then draw the arrows to convert the reactants to products.



SECTION E

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

33. Why was a change in the Bohr Model of atom required? Due to which important development (s), concept of movement of an electron in an orbit was replaced by, the concept of probability of finding electron in an orbital? What is the name given to the changed model of atom? (5)

OR

What is photoelectric effect? State the result of photoelectric effect experiment that could not be explained on the basis of laws of classical physics. Explain this effect on the basis of

quantum theory of electromagnetic radiations.

34. Extensive properties depend on the quantity of matter but intensive properties do not. Explain whether the following properties are extensive or intensive. (5)
Mass, internal energy, pressure, heat capacity, molar heat capacity, density, mole fraction, specific heat, temperature and molarity.

OR

ΔG is net energy available to do useful work and is thus a measure of "free energy". Show mathematically that ΔG is a measure of free energy. Find the unit of ΔG. If a reaction has positive enthalpy change and positive entropy change, under what condition will the reaction be spontaneous?

35. (a) Why is Wurtz reaction not preferred for the preparation of alkanes containing odd number of carbon atoms? Illustrate your answer by taking one example. (5)
(b) Out of benzene, m–dinitrobenzene and toluene which will undergo nitration most easily and why?
(c) Propanal and pentan-3-one are the ozonolysis products of an alkene? What is the structural formula of the alkene?
(d) Draw the cis and trans structures of hex-2-ene. Which isomer will have higher boiling point and why?