Annual Examination, 2020-2021

CHEMISTRY

Grade: 11   **Time: 3 Hours**

Date: 10.02.2021   **Max. Marks: 70**

<u>General Instructions.</u>

(i)   There are **33** questions in this question paper. All questions are compulsory**.**
(ii)   Section A: Question numbers **1** to **2** are case-based questions having MCQs or Reason Assertion type based on given passage each carrying 1 mark.
(iii)   Section A, Question numbers **3** to **16** are MCQs and Reason Assertion type questions carrying 1 mark each.
(iv)   Section B, Question numbers **17** to **25** are short-answer questions and carry **2** marks each.
(v)   Section C, Question numbers **26** to **30** are also short-answer questions and carry **3** marks each.
(vi)   Section D, Question numbers **31** to **33** are long answer questions and carry **5** marks each.
(vii)   There is no overall choice. However, internal choices have been provided.
(viii) Use Log Tables, if necessary. Use of calculators is **not** allowed

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Section A

Read the given passage and answer the following questions:

1.   The properties of elements such as atomic or ionic radii, ionization enthalpy, electron gain enthalpy and electronegativity are directly or indirectly related to their electronic configuration and are called periodic properties. A part of the periodic table is given below:

C	N	O	F
	P	S	Cl
		Se	Br
			I

i.   Which of the following has highest ionization enthalpy?   **1**

a) N   b) P   c) O   d) C

ii.   Bromine belongs to period: **1**

a) third   b) fourth   c) fifth   d) second

iii.   As compared to nitrogen, oxygen is: **1**

a) less electronegative and less reactive.
b) more electronegative and less reactive.
c) more electronegative and more reactive.
d) less electronegative and more reactive.

iv.   Which of the following has highest negative electron gain enthalpy?   **1**

                a) F   b) N   c) S   d) Br

(OR)

Electronic configurations of four elements A, B, C and D are given below:
- (A) $1s^2\ 2s^2\ 2p^6$
- (B) $1s^2\ 2s^2\ 2p^4$
- (C) $1s^2\ 2s^2\ 2p^6\ 3s^1$
- (D) $1s^2\ 2s^2\ 2p^5$

Which of the following is the correct order of increasing tendency to gain electron?
- a. A < C < B < D
- b. A < B < C < D
- c. D < B < C < A
- d. D < A < B < C

2   **In these questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following statement.**

The position and energy of an electron is specified with the help of four quantum numbers namely, principal quantum number(n), azimuthal quantum number(l), magnetic quantum number(m_l) and spin quantum number(m_s). The permissible values of these are:

n= 1,2,…

l = 0, 1, 2……(n-1)

m_l = -l ….. to ….. +l

m_s = + ½ and – ½

The electrons having the same value of n, l and m_l are said to belong to the same orbital. According to Pauli's exclusion principle, an orbital can have maximum of two electrons and these two must have opposite spin.

(A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(C) Assertion is correct, but reason is wrong statement.
(D) Assertion is wrong, but reason is correct statement.

i)   **Assertion:** The 19th electron in potassium atom enters into 4s- orbital and not in **1**
the 3d- orbital.

Reason: (n+l) rule is followed for determining the orbital of lowest energy state.

ii) **Assertion:** The configuration of C cannot be $1s^2 2s^2 2p^2_x$.   1

Reason: According to Pauli exclusion principle, an orbital can have a maximum of two electrons.

iii) **Assertion:** All isotopes of a given element show the same type of chemical behaviour.   1

Reason: The chemical properties of an atom are controlled by the number of electrons in the atom.

iv) **Assertion:** The energy of an electron is largely determined by its principal quantum number and spin quantum number.   1

Reason: The principal quantum number (n) is a measure of the probable distance of finding the electron around the nucleus.

Following questions (No. 3-11) are multiple choice questions carrying 1 mark each.

3. The type of hybridisation on the five carbon atoms from left to right in the molecule CH_3-CH=C=CH-CH_3 are: 1
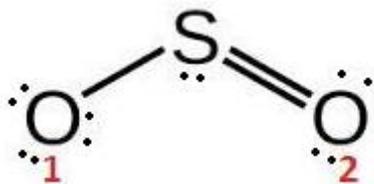
    a. sp^3, sp^2, sp^2, sp^2, sp^3
    b. sp^3, sp, sp^2, sp^2, sp^3
    c. sp^3, sp^2, sp, sp^2, sp^3
    d. sp^3, sp, sp, sp^2, sp^3

4. Bond order of 1.5 is shown by: 1

    a. O_2^{+1}
    b. O_2^{-1}
    c. O_2^{2-}
    d. O_2

(OR)

Formal charge on two O atoms (1 and 2) in the following molecule is:

    a. -1, +1
    b. -1, 0
    c. 0, +1
    d. -1, -1

5. 1, 2-Dibromopropane on heating with Zn dust in ethanol gives: **1**

   a. Propene
   b. Propane
   c. Propyne
   d. Ethene

6. Oxidation number of P in PO_4^{3-}, S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$ are respectively: **1**

   a. +3, +6 and +5
   b. -3, +6 and +6
   c. +5, +3 and +6
   d. +5, +6 and +6

   (OR)

   The oxidation number of Mn is maximum in:

   a. MnO_2
   b. K_2MnO_4
   c. Mn_3O_4
   d. $KMnO_4$

7. The exhibition of highest co-ordination number depends on the availability of vacant orbitals in the central atom. Which of the following element is not likely to act as central atom in MF_6^{3-}? **1**

   a. B
   b. Al
   c. Ga
   d. In

   (OR)

   The geometry of a complex species can be understood from the knowledge of type of hybridisation of orbitals of central atom. The hybridisation of orbitals of central atom in $[Be(OH)_4]^-$ and the geometry of the complex are respectively:

   a. sp^3, tetrahedral
   b. sp^3, square planar
   c. sp^3d^2, octahedral
   d. dsp^2, square planar

8. The stable bivalency of Pb and monovalency of Tl is due to: **1**

   a. 'd' contraction in Pb and Bi
   b. relativistic contraction of the 6s orbitals of Pb and Tl, leading to inert pair effect.
   c. screening effect
   d. attainment of noble gas configuration.

   (OR)

Catenation i.e., linking of similar atoms depends on size and electronic configuration of atoms. The tendency of catenation in Group 14 elements follows the order:

    a. C > Si > Ge > Sn

    b. C >> Si > Ge ≈ Sn

    c. Si > C > Sn > Ge

    d. Ge > Sn > Si > C

9. In which of the following, the geometry is not correctly given? **1**

    a. PH_3: Trigonal pyramidal
    b. SiH_4: Tetrahedral
    c. ClF_3: Trigonal planar
    d. SF_4: See-saw

10. The correct order regarding the electronegativity of hybrid orbitals of carbon is: **1**
    a. $sp > sp^2 > sp^3$
    b. $sp < sp^2 > sp^3$
    c. $sp < sp^2 < sp^3$
    d. $sp > sp^2 < sp^3$

(OR)

Which of the following has highest lattice energy?
    a. LiF
    b. NaF
    c. KF
    d. RbF

11. The standard enthalpies of combustion of C_6H_6, C(graphite) and H_2 are respectively -3270 kJ/mol, -394 kJ/mol and -286kJ/mol. What is the standard enthalpy of formation of C_6H_6 in kJ/mol? **1**

    a. -48
    b. 48
    c. -480
    d. 480

In the following questions (Q. No. 12-16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(C) Assertion is correct, but reason is wrong statement.
(D) Assertion is wrong, but reason is correct statement.

12. **Assertion:** Buffer solutions are those which resist change in pH value on the addition of a small amount of acid or a base to it.
Reason: Mixture of NH_4OH and NH_4Cl act as a basic buffer. **1**

13. **Assertion:** A liquid crystallizes into a solid and is accompanied by decrease in entropy.
Reason : In crystals, molecules organize in an ordered manner. **1**

14. **Assertion:** Pressure has no effect on the equilibrium reaction: **1**

$$2\ HI\ (g)\ \rightleftharpoons\ H_2\ (g) + I_2\ (g)$$

Reason: Equilibrium constant of gaseous reactions is independent of pressure.

(OR)

Assertion: OH^- can behave as amphoteric.

Reason: It can accept and donate H^+.

15. **Assertion:** Toluene on Friedel Crafts methylation gives o-and p-xylene. **1**

Reason: -CH_3 group bonded to benzene ring increases electron density at o-and p- position.

16. **Assertion:** Nitration of benzene with nitric acid requires the use of concentrated sulphuric acid. **1**
Reason: The mixture of concentrated sulphuric acid and concentrated nitric acid produce the electrophile NO_2^+.

Section B

The following questions, Q. No 17-25 are short answer type carry 2 marks each.

17. At 473K, equilibrium constant K_c for decomposition of PCl_5 to PCl_3 and Cl_2 is 8.3×10^{-3} with $\Delta_r H^o = 124kJ/mol$. **2**

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

a. What would be the effect on K_c if temperature is increased?
b. What is the value of K_c for reverse reaction at the same temperature?
(OR)

The value of K_w is 9.55×10^{-14} at a certain temperature. Calculate the pH of water at this temperature.

18. Account for the following: **2**

   a) Boron does not form B^{3+} ion.
   b) Gallium has higher ionization enthalpy than Aluminium.

19. Dichromate ion in acidic medium oxidises iron(II) ions to iron (III) ions and itself gets reduced to chromium(III) ions. Write a balanced ionic equation to represent this redox reaction. **2**

(OR)

Balance the following redox reaction.

$Cr(OH)_3 + IO_3^- \longrightarrow I^- + CrO_4^{2-}$ (basic medium)
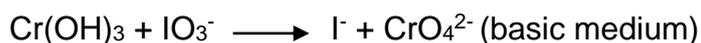
20. a) What is the maximum number of unpaired electrons in Cu(Z=29) and Fe(Z=26)? **2**
b) State Hund's rule of maximum multiplicity.

(OR)

a) Calculate the wavelength associated with an electron (mass = 9.1×10^{-31}kg) having kinetic energy 3×10^{-25}J.

21. a) What is the oxidation state of O in KO_2? **2**
b) What is the colour of strontium to an oxidizing flame?

(OR)

a) What is the oxidation state of O in Na_2O_2?
b) Be and Mg do not give colour to an oxidizing flame whereas other alkaline earth metals do so. Why?

22. When a metal of group 1 was dissolved in liquid ammonia, the following observations are obtained. **2**
   a) Blue solution was obtained initially.
   b) On concentrating the solution, blue colour changed to bronze colour.
How do you account for the blue colour of the solution? Give name of the product formed on keeping the solution for some time.

23. An alkene 'A' contains three C-C sigma bonds, eight C-H sigma bonds and one C-C pi bond. On ozonolysis, 'A' gives two moles of an aldehyde of molar mass 44u. Write the IUPAC name of 'A' and write the ozonolysis equation involved. **2**

24. Explain disproportionation reaction with the help of an example. Write the equation also. **2**

25. Write IUPAC name of the following organic compounds. **2**

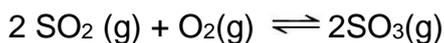   a) $CH_3 COCH_2 CH_2 CHO$
   b) $CH_3CH(Cl)CH_2C(Br)(C_2H_5)CN$

Section -C

Q. No 26-30 are Short Answer type II carrying 3 marks each.

26. Calculate (a) ΔG^o and (b) the equilibrium constant for the formation of NO_2 from NO and O_2 at 298K. **3**

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

Given $\Delta_f G^o$ (NO_2) = 52kJ/mol and $\Delta_f G^o$ (NO) = 87 kJ/mol.

(OR)

Determine Kc for the following reaction:

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

Given $Kp = 3.4\ bar^{-1}$ at $1000^{\circ}C$.

27. What do you understand by: **3**

   (i)   electron deficient
   (ii) electron- precise
   (iii) electron-rich compounds of hydrogen?

   Provide justification with suitable examples.

(OR)

   (i)   What causes the temporary and permanent hardness of water?
   (ii) What is 'syngas'? Write equation for its preparation.

28. Predict whether it is possible or not to reduce magnesium oxide using carbon at   **3**
   298K according to the reaction:
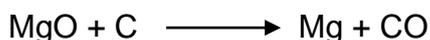
   $$MgO + C \longrightarrow Mg + CO$$
   $\Delta_r H^{\circ} = 491.2\ kJ/mol$ and $\Delta_r S^{\circ} = 197.7 JK^{-1}mol^{-1}$.
   If not, at what temperature the reaction becomes spontaneous?

29. At 273K, the density of a gaseous oxide at 2 bar is same as that of nitrogen at 5   **3**
   bar. Calculate the molecular mass of the oxide.

30. Account for the following: **3**
   a) BF_3 molecule has a zero dipole moment although B-F bonds are polar.
   b) The structure of NH_3 molecule is pyramidal.
   c) The two O-O bonds in ozone molecule are equal.
(OR)
   a) CO_2 and H_2O both are triatomic molecules but there is large difference in
       their dipole moment values. Explain.
   b) Using the concept of hybridisation, explain the shape of SF_6 molecule.
   c) Define intramolecular hydrogen bonding. Give an example.

Section-D
Q. No 31 to 33 are long answer type carrying 5 marks each.

31.   a. N_2 and H_2 react with each other to produce ammonia.   **5**
         i) Calculate the mass of NH_3 produced if 200g of N_2 reacts with 100g of H_2.
        ii) Will any of the two reactants remain unreacted?
       iii) If yes, which one and what would be its mass?
       b. Calculate the weight of iron which will be converted into its oxide (Fe_3O_4) by
          the action of 14.4g of steam on it.
(OR)

a. What weight of zinc would be required to produce enough hydrogen to reduce completely 10g of CuO to copper?

b. 2.82g of glucose (molar mass = 180) are dissolved in 30g of water. Calculate (i) the molality of the solution and
(ii) mole fraction of glucose and water.

(Given atomic masses: Fe=56, Cu=63.5, Zn=65, N=14, H=1, O=16)

32.
a. Explain why $(CH_3)_3C^+$ is more stable than $CH_3CH_2^+$ and CH_3^+ is the least stable cation.   **5**

b. In which C-C bond of $CH_3CH_2CH_2Br$, the inductive effect is expected to be the least?

c. Draw the structure for Cyclohex-2-en-1-ol.

d. What are electrophiles? Give an example.

e. Explain metamerism with an example.

(OR)

a. What are carbocations? Arrange primary, secondary and tertiary carbocation in the increasing order of their stability.

b. Explain functional isomerism with suitable example.

c. What are nucleophiles? Give an example.

d. Write the structure for 2-Hydroxy-1,2,3-propanetricarboxylic acid.

33.
i) Explain the following reactions with the help of an example: **5**

a. Wurtz reaction.
b. Friedel Craft's alkylation.
c. Decarboxylation.

ii) What are the conformations of ethane? How will you account for their difference in their relative stability?

(OR)

i) How will you convert the following?

a. Propyne to propanone.
b. Ethyne to nitrobenzene.
c. Benzene to acetophenone.

ii) What happens when propanol is heated with conc. H_2SO_4 at 443K? Explain the type of reaction with the help of equation.