KATHMANDU UNIVERSITY
End Semester Examination [C]
January 2025

Marks Scored:

Level : B.Sc.
Year : I

Course : CHEM 102
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date 08 JAN 2025

SECTION "A"
[15Q. × 1 = 15 marks]

Choose and mark [X] in the most appropriate answer. Symbols have their usual meanings.

1. Which one of the following compounds has highest bond angle?
[ ] NF_3 [ ] F_2O [ ] BrF_5 [ ] XeF_4

2. The expression for the relation of the units of radioactivity, Curies (Ci) and Becquerel (Bq), is
[ ] 1 Ci = 27×10^{-12} Bq [ ] 1 Ci = 3.7×10^{10} Bq
[ ] 1 Ci = 3.7×10^{-12} Bq [ ] 1 Ci = 1.7×10^{10} Bq

3. The bond order in carbonate ion (CO_3^{2-}) is
[ ] 1 [ ] 1.33 [ ] 1.5 [ ] 2

4. Which one of the following complexes follow EAN rule?
[ ] $[Pd(Cl)_4]^{2-}$ [ ] $[Fe(CN)_6]^{3-}$ [ ] $[Ni(NH_3)_6]^{2+}$ [ ] $[Cu(CN)_4]^{3-}$

5. The metallic structure of Copper (Cu) metal is
[ ] Body-centred cubic (bcc) [ ] Hexagonal close-packed (hcp)
[ ] Cubic close-packed (ccp) [ ] All the above

6. What are the oxidation number (ON) and co-ordination number (CN) of cobalt in the co-ordination complex, $[CoCl_2(en)_2]^+$?
[ ] ON = 1; CN = 4 [ ] ON = 3; CN = 4 [ ] ON =1; CN = 6 [ ] ON =3; CN = 6

7. $[Co(NO_2)_2(NH_3)_4]Cl$ can show
[ ] Linkage, Ionization & Optical isomerism
[ ] Linkage, Ionization & Geometrical isomerism
[ ] Linkage, Optical & Geometrical isomerism
[ ] Ionization, Optical & Geometrical isomerism

8. Which one of the following is the weakest ligand?
[ ] H_2O [ ] NH_3 [ ] CO [ ] EDTA

9. When both cation and anion are complex ions, the interchange of ligands between cation and anion gives _____
[ ] Co-ordination isomerism [ ] Linkage isomerism
[ ] Co-ordination position isomerism [ ] Optical isomerism

10. The trigonal bipyramid shape has _____ hybridization.
[ ] dsp^2 [ ] sp^3d [ ] sp^3d^2 [ ] sp^3d^3

11. The electronegativity value in Mulliken's scale can be converted into Pauling scale value and $KJmol^{-1}$ by the expression

[ ] $EN = \frac{IE + EA}{2}$ [ ] $EN = 0.208\sqrt{\Delta}$

[ ] $EN = 0.1017\sqrt{\Delta}$ [ ] $EN = \frac{IE + EA}{540}$

12. When the magnetic quantum number (λ) of molecular orbital (MO) is zero, they are called
[ ] σ MO [ ] π MO [ ] δ MO [ ] Nonbonding

13. The nuclear force which binds the nucleons together in the nucleus of atom is called
[ ] electrostatic force [ ] short range force
[ ] van der Waals forces [ ] Dipole-dipole interaction

14. Which one of the following species is diamagnetic in nature?
[ ] B_2 [ ] O_2 [ ] NO [ ] CO

15. Consider a nuclear reaction, $_7N^{14} + _2He^4 \rightarrow _8O^{17} + _1H^1$. This nuclear reaction is described as
[ ] (α, n) reaction [ ] (α, p) reaction [ ] (α, γ) reaction [ ] (p, n) reaction

SECTION "B"

[5Q. × 1 = 5 marks]

Fill in the blanks with most appropriate value or words.

16. The conductivity of metal _____ with the increase of temperature.

17. The crystal field stabilization energy (CFSE) of octahedral complex for d^6 configuration in strong field ligand is _____.

18. The chemical formula for the complex, μ-amidobis[pentaamminecobalt(III)] nitrate, is _____.

19. In Born Haber Cycle, the expression for the determination of lattice energy of solid NaCl ionic crystals experimentally is _____.

20. The molecular orbital electronic configuration of NO molecule is _____.

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08 JAN 2025

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F. M. : 55

SECTION "C"
[5Q. × 6 = 30 marks]

Attempt *ANY FIVE* questions.

1.

a. Write the IUPAC name of following complexes. [1+1+1]

i. $K_4[Fe(CN)_6]$ ii. $[Zn(NCS)]^{2-}$ iii. $[CoCl.CN.NO_2.(NH_3)_3]$

b. Write down the balanced nuclear reactions for the following radioactive isotopes. [1+1+1]

i. ${}_4Be^7$ (k-electron capture) ii. ${}_6C^{14}$ (β-decay) iii. ${}_{92}U^{238}$ (α-decay)

2.

a. Deduce the following relation,

$$U = -\frac{N_0 A z^+ z^- e^2}{r_0}\left(1 - \frac{1}{n}\right)$$

where, the symbols have their usual meaning. [3]

b. PCl_5 exists but PH_5 does not. Explain with reason on the basis of hybridization. [3]

3.

a. Discuss the different factors affecting 'crystal field splitting (Δ)'. [3]

b. The half-life period of ${}_{36}Kr^{85}$ is 10.6 years. How long will it take for 99 % of ${}_{36}Kr^{85}$ to disintegrate? [3]

4.

a. Draw the molecular orbital energy diagram for the complex ion $[Co(NH_3)_6]^{3+}$. [3]

b. $[Co(CN)_4]^{2-}$ is paramagnetic and square planar complex on the basis of VBT. Explain with reason. [3]

5.

a. Explain the delocalization of π-bonding in O_3 molecule on the basis of MOT. [3]

b. What are chelates? Define with an example. Also write its biological importance and applications. [3]

6. Distinguish between (***ANY TWO***) [3+3]

a. Nuclear fusion and Nuclear fission reaction

b. n-type and p-type semiconductor

c. Double salt and complex compound

P.T.O.

7.

a. Describe the shape of ClF_3 on the basis of VSEPR theory. [3]

b. Calculate the binding energy per nucleon in KJ mol^{-1} for $_3Li^6$ nucleus. [3]

(Given, Mass of $_3Li^6$ = 6.0170 amu; $_0n^1$ = 1.008665 amu and $_1p^1$ = 1.007277 amu)

SECTION "D"

[25 marks]

Attempt *ANY THREE* questions. **Question No. 8 is compulsory**.

8.

a. Define Jahn-teller theorem. Explain the tetragonal distortion of octahedral complex of Cu^{2+} in case of both weak and strong field ligands. [1+4]

b. Explain the conductivity of lithium and beryllium metals on the basis of band theory. [4]

9.

a. Explain the splitting of d-orbitals in tetrahedral and octahedral complexes. [4]

b. Define polarizing power and polarizability. Explain the different factors favouring polarization of ions with appropriate examples. [1+3]

10.

a. What are the postulates of VSEPR theory? Describe the shape of I_3^- on the basis of VSEPR theory. [2+2]

b. When does the non-bonding combination of atomic orbitals occurs? Also sketch a diagram. [2]

c. What is metal toxicity? Illustrate with an example. [2]

11. Write short notes on (***ANY FOUR***). [2+2+2+2]

a. Nuclear shell model

b. Radius ratio rule

c. π - meson exchange theory

d. Werner's co-ordination theory

e. Geometric isomerism