KATHMANDU UNIVERSITY
End Semester Examination
August, 2019

Marks scored:

Level : B.Sc./B.Pharm./B.Tech.
Year : I
Course : CHEM 102
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date AUG 12 2019

SECTION "A"

[15 Q. × 1 = 15 marks]

Select and mark [X] in the most appropriate answer:

1. The bond formed between electronegative and electropositive elements is
[ ] Metallic [ ] Ionic [ ] Covalent [ ] Dative

2. The body-centered cubic structure of barium, Ba , metal at room temperature is probably due to
[ ] Pairing of electrons in the *s*-orbital
[ ] Excitation of *s*-electrons to the *p*-orbitals
[ ] Excitation of *s*-electrons to the *d*-orbital
[ ] Excitation of *p*-electrons to the *d* –orbitals

3. Bond angles in BrF_5 equals to
[ ] $84^0 30'$ [ ] $87^0 40'$ [ ] 90^0 [ ] 120^0

4. How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion?
[ ] One [ ] Two [ ] Three [ ] Six

5. The metallic structure of Zn metal is
[ ] Body-centred cubic
[ ] Face-centred cubic
[ ] Hexagonal close-packed
[ ] Cubic close-packed

6. Which of the following type of isomerism is shown by the complex ion $[CoCl_2(en)_2]^+$?
[ ] Geometric
[ ] Linkage
[ ] Optical
[ ] Geometric and Optical

7. The difference between theoretical and experimental value of lattice energy of CdI_2 is 22.6 %. This large difference indicates that CdI_2 has ..... bonding
[ ] Ionic [ ] Metallic [ ] Covalent [ ] Co-ordinate covalent

8. Which one of the following is the strongest ligand?
[ ] H_2O [ ] NH_3 [ ] CO [ ] Cl^-

9. The hydrogen bomb is an application of which of the following nuclear reactions
[ ] Nuclear fission
[ ] Radioactive decay
[ ] Nuclear fusion
[ ] Induced nuclear reaction

10. The type of hybridization on the central atom of IF_7 is
[ ] dsp^2 [ ] sp^3d [ ] sp^3d^2 [ ] sp^3d^3

11. The value of magnetic moment (μ_s) of tetrahedral complex of Co^{2+} ion is

[ ] 1.73 BM [ ] 2.83 BM [ ] 3.87 BM [ ] 4.9 BM

12. When the magnetic quantum number (λ) of molecular orbital (MO) is ± 2, they are called

[ ] σ MO [ ] π MO [ ] δ MO [ ] Nonbonding

13. In Allred and Rochow scale, the value of attractive force (F) between nucleus and an electron at covalent radius may be converted to electronegativity (χ) values on Pauling scale by using equation

[ ] $\chi = \frac{e^2 Z_{effective}}{r^2}$ [ ] $\chi = 0.744 + \frac{0.359 Z_{effective}}{r^2}$

[ ] $\chi = 0.359 + \frac{0.744 Z_{effective}}{r^2}$ [ ] $\chi = 0.744 + \frac{0.359 r^2}{Z_{effective}}$

14. Which one of the following species is diamagnetic in nature?

[ ] O_2 [ ] O_2^- [ ] O_2^{--} [ ] B_2

15. Consider the nuclear reaction, $_7N^{14} + _2He^4 \rightarrow _8O^{17} + _1H^1$

This reaction is described as

[ ] (α, p) reaction [ ] (α, n) reaction [ ] (α, e^-) reaction [ ] (p, n) reaction

SECTION "B"

[5Q. × 1 = 5 marks]

Fill in the blanks with appropriate words and values

16. The chemical formula of the complex 'Tri-μ-carbonyl-bis(tricarbonyliron(0))' is .....

17. The octahedral crystal field stabilization energy (*CFSE*) for d^7 configuration in weak field ligand is .....

18. The molecular orbital electronic configuration of NO molecule is .....

19. The coordination isomer of the complex $[Co(NH_3)_6][Cr(CN)_6]$ is .....

20. The total nuclear binding energy in MeV for one mole of lithium atoms is .....

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

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SECTION "C"
[5 Q. × 6 = 30 marks]

Attempt *ANY FIVE* questions

1) a. Write the IUPAC name of each of the following complexes. [1+1+1]
   i. $Li[AlH_4]$
   ii. $[CuCl_2(CH_3NH_2)_2]$
   iii. $[CoCl.CN.NO_2.(NH_3)_3]$
   b. Write down the balanced nuclear reactions for the following radioactive isotopes. [1+1+1]
   i. ${}_{19}K^{40}$ (electron capture)
   ii. ${}_{6}C^{14}$ (β-decay)
   iii. ${}_{92}U^{238}$ (α-decay)

2) a. Explain 'Werner's co-ordination theory' describing different valencies of metal in co-ordination complexes with examples. [3]
   b. What are radioactive displacement laws? Write with an example. [2+1]

3) a. What are the postulates of VSEPR theory? Describe the shape of ClF_3 on the basis of VSEPR theory. [2+2]
   b. Draw the shapes of different molecular orbitals formed by the combination of p and d atomic orbitals. [2]

4) a. Define with an example. [1+1+1]
   i. Nuclear magic number
   ii. π - accepter ligands
   iii. EAN rule
   b. The half-life of Palladium-100 (Pd^{100}) is 4 days. After 12 days, a sample of Pd^{100} has been reduced to a mass of 4 mg. Determine the starting mass. What is the mass after 8 weeks from the start? [3]

5) a. Explain the delocalization of π-bonding in CO_2 molecule on the basis of MOT. [3]
   b. What is metal toxicity? Illustrate with an example. Explain the use of chelates in the treatment of metal poisoning. [2+1]

6) Distinguish between [2+2+2]
   a. Inner-orbital and outer-orbital octahedral complexes (on the basis of VBT)
   b. Crystal field splitting (Δ) and crystal field stabilization energy (CFSE)
   c. Gerade ($\psi_{(g)}$) and ungerade ($\psi_{(u)}$) molecular orbitals

7) Explain with reasons. [2+2+2]

a. Tetrahedral complexes are high spin complexes.

b. The six co-ordinate NaCl structure is more stable than eight co-ordinate CsCl and four co-ordinate ZnS structure.

c. PCl_5 exists but PH_5 does not.

SECTION "D"

[25 marks]

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

8) a. What are the main assumptions of crystal field theory of bonding in transition metal complexes? Explain the splitting of d - orbitals in tetrahedral and octahedral complexes. [2+2+2]

b. 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]

9) a. Draw and explain molecular orbital energy diagram for the complex ion $[Co^{III}(NH_3)_6]^{3+}$. [4]

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

10) 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+3]

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

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

a. Spectrochemical series

b. Nuclear fission

c. π - meson exchange theory

d. n-type semiconductors

e. Radius ratio rule

f. Hydrate isomerism in coordination complexes