KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2018

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 DEC 2 8 2018

SECTION "A"
[15 Q. × 1=15 marks]

Choose the most appropriate answer from the given ones.

1. Which one of the following species does not obey octet rule?
[ ] BF_4^- [ ] NO [ ] NO_2^+ [ ] CO_2

2. When the carbon atom is sp^2 hybridized in a compound, it is bonded to
[ ] 2 other atoms [ ] 3 other atoms [ ] 4 other atoms [ ] 5 other atoms

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. The limiting radius ratio for *3* co-ordination number in an ionic crystal is in the range 0.155 - 0.225. Which of the following is likely to happen when the radius ratio is < 0.155?
[ ] All three anions are in contact with cation
[ ] A more stable structure is formed
[ ] All three anions are in contact with one another and also with cation
[ ] Cation is not in contact with anions

7. The crystal field stabilization energy (*CFSE*) for the octahedral complexes of d^7 metal ion under strong field ligand is
[ ] $2D_q$ [ ] $-8D_q$ [ ] $-12D_q$ [ ] $-18D_q$

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

9. The nuclear powered electricity generating station 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 SO_2 is

[ ] sp [ ] sp^2 [ ] sp^3 [ ] dsp^2

11. The value of magnetic moment (μ_s) of outer orbital octahedral complex of Co^{3+} ion is

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

12. Which of the following species cannot exist on the basis of MOT?

[ ] Li_2 [ ] Be_2 [ ] B_2 [ ] C_2

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^{--} [ ] O_2^+

15. Consider the nuclear reaction, ${}_{48}Cd^{113} + {}_0n^1 \rightarrow {}_{48}Cd^{114} + Energy$
This reaction is described as

[ ] (n, e^-) reaction [ ] (n, γ) reaction [ ] (n, α) reaction [ ] (n, β) reaction

SECTION "B"
[5Q. × 1 = 5 marks]

Fill in the blanks with appropriate words and values.

16. The *IUPAC* name of the complex $K_3[Fe(CN)_5NO]$ is.....

17. The loss of crystal field stabilization energy (*CFSE*) for d^2 configuration in tetrahedral complexes is .....

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

19. The linkage isomer of the complex $[CoNO_2(NH_3)_5]^{2+}$ 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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Level : B.Sc.\B. Pharm.\B. Tech.
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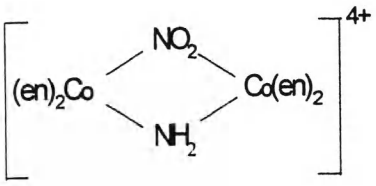
Semester: II
F. M. : 55

SECTION "C"
[5 Q. × 6 = 30 marks]

Attempt *ANY FIVE* questions.

1. Consider the following coordination complexes

I. $[Co(NH_3)_6]Cl_3$ II. $K_2[OsCl_5N]$ III. 

Answer the following questions.

a. Write the IUPAC names of the complexes I, II and III. [1+1+1]

b. Write the primary valency of I and II complexes on the basis of *Werner's coordination theory.* [1+1]

c. Write the total number of optical isomers of complex III. [1]

2. a. Write down the balanced nuclear reactions for the following radioactive isotopes. [3]

i. $_{13}Al^{29}$ (β-decay) ii. $_{6}C^{11}$ (positron emission)

iii. $_{84}Po^{210}$ (α-decay)

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

3.a. What are the postulates of *VSEPR* theory? Describe the shape of ClF_3 on the basis of VSEPR theory. [2+2]

b. Calculate the electron affinity (*EA*) value of $Cl_{(g)}$ by using Born-Haber cycle equation for formation of *NaCl* crystal from following given data. [2]

Enthalpy of formation (ΔH_f) of *NaCl* crystal = -381.2 kJ mol^{-1}

Enthalpy of sublimation (ΔH_s) of $Na_{(s)}$ = 108.4 kJ mol^{-1}

Enthalpy of dissociation (ΔH_d) of $Cl_{2_{(g)}}$ = 241.8 kJ mol^{-1}

Ionaization energy (*IE*) of $Na_{(g)}$ = 495.4 kJ mol^{-1}

Lattice energy of *NaCl* crystal = -757.3 kJ mol^{-1}

4.a. Define with an example. [1+1+1]

i. Nuclear magic number ii. π - accepter ligands iii. Ionization isomers

b. Explain the delocalization of π-bonding in SO_3 molecule on the basis of MOT. [3]

5.a. Draw the shapes of different molecular orbitals formed by the combination of *p* and *d* atomic orbitals. [2]

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

c. A sample of radioactive matter is half disintegrated in 18 hours. How much of it will remain after 42.5 hours? [2]

6. Distinguish between: [2+2+2]
   a. Gerade ($\psi_{(g)}$) and ungerade ($\psi_{(u)}$) molecular orbitals
   b. Nuclear fission and fusion reactions
   c. n-type and p-type semiconductors

7. Explain with reasons. [2+2+2]
   a. The complex ion $[Co(CN)_4]^{2-}$ has square planar shape, but $[CoCl_4]^{2-}$ has tetrahedral shape.
   b. F_2O molecule shows greater distortion from tetrahedral shape than H_2O molecule, but both have angular shape.
   c. The conductivity of metals decreases with increasing temperature.

SECTION "D"

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. Derive Born-lande equation to calculate the lattice energy of ionic compounds. [3]

9.a. Draw molecular orbital diagram for the complex ion $[CoF_6]^{3-}$. [3]
b. Discuss the different factors favouring the polarization and hence covalency? [3]
c. What are radioactive displacement laws? Write with an example. [2]

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

11. Write short notes on (*ANY FOUR*) [2+2+2+2]
   a. Spectrochemical series
   b. π - meson exchange theory
   c. *EAN* rule
   d. Pauling scale of electronegativity
   e. Liquid drop model of nucleus
   f. Coordination isomerism in coordination complexes