KATHMANDU UNIVERSITY
End Semester Examination
August, 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 AUG: 1 0 2018

SECTION "A"
[15 Q.×1=15 marks]

Select the most appropriate answer:

1. In which molecule bond distortion is higher according to VSEPR theory?
[ ] SO_2 [ ] NH_3 [ ] O_3 [ ] H_2O

2. Which one of the following has an optical isomer? (en = ethylenediamine)
[ ] $[Zn(en)(NH_3)_2]^{2+}$ [ ] $[Co(en)_3]^{3+}$ [ ] $[Co(H_2O)_4(en)]^{3+}$ [ ] $[Zn(en)_2]^{2+}$

3. The method by which electrical conduction can occur in beryllium metal is
[ ] Half- filled band [ ] Impurity band
[ ] Overlapping band [ ] Valence band

4. Which one of the following compounds will exhibit linkage isomerism?
[ ] $[Pt(NH_3)_2Cl_2]$ [ ] $[Co(NH_3)_5NO_2]Cl_2$
[ ] $[Co(NH_3)_4Cl_2]NO_2$ [ ] $[Ag(NH_3)_2]NO_2$

5. The CFSE for a low-spin d^6 for octahedral complex is
[ ] $-0.4\Delta o$ [ ] $-0.6\Delta o$ [ ] $-1.2\Delta o$ [ ] $-2.4\Delta o$

6. The value of attractive force (F) between nucleus and an electron at covalent radius may be converted to the electronegativity values on the Pauling scale by using the relation:
[ ] $\chi = 0.774 + \frac{0.359 \times Z_{effective}}{r^2}$ [ ] $\chi = 0.369 + \frac{0.539 \times Z_{effective}}{r}$
[ ] $\chi = 0.774 + \frac{0.059 \times Z_{effective}}{r^2}$ [ ] $\chi = 0.591 + \frac{0.965 \times Z_{effective}}{r}$

7. An ambidentate ligand is one which
[ ] is linked to the metal atom at two points.
[ ] has two donor atoms but only one of them has the capacity to form a coordinate bond.
[ ] has two donor atoms but either of the two can form a coordinate bond.
[ ] forms chelate rings.

8. Which of the following compounds can exhibit cis-trans isomerism?
[ ] $[Fe(CO)_5NO_2]^{2+}$ [ ] $[Cu(CO)_5Cl]^{+}$
[ ] $[MnClBr_3]^{2}$ [ ] $[Ni(CO)_2(NH_3)_2]^{2+}$

9. Which of the following statement is incorrect when N_2 and O_2 are converted into N_2^+ and O_2^+ respectively?
[ ] In O_2^+, O - O bond order increases
[ ] In N_2^+, N - N bond become weaker
[ ] N_2^+ become paramagnetic
[ ] Increasing diamagnetism in O_2^+

10. Which of the following statement is incorrect for metallic bond?
[ ] There is attraction between delocalized electrons and atomic kernel.
[ ] Directional property is shown by metal.
[ ] Delocalized electron can change their position easily in crystal.
[ ] Explanation of metallic bond can be given by 'electron sea model'.

11. The beta decay of cesium-137 has a half-life of 30.0 years. How many years must pass to reduce a 25 mg sample of cesium-137 to 8.7 mg?
[ ] 46 yrs [ ] 32 yrs [ ] 3.2 yrs [ ] 52 yrs

12. Which of the following pair of species is isoelectronic and have same structure?
[ ] NO_3^-, CO_3^{2-} [ ] SO_3, CO_3^{2-} [ ] CO_3^{2-}, ClO_3^- [ ] NO_3^-, SO_3

13. Among the ligands NH_3,en, CN^- and CO the correct order of their increasing field strength is
[ ] CO< NH_3<en < CN^-
[ ] NH_3<en< CN^-< CO
[ ] CN^-< NH_3< CO< en
[ ] en< CN^-<NH_3< CO

14. A radioactive isotope with an N/P ratio higher than the stable value tends to stabilize by
[ ] β-emission
[b] α- decay
[c] Positron emission
[d] Proton emission

15. Which is more likely to form a high-spin complex?
[ ] Ethylene-diamine (en)
[ ] Oxalate ion ($C_2O_4^{2-}$)
[ ] Cyanide ion (CN^-)
[ ] Fluoride ion (F^-)

SECTION "B"
[5 Q.×1=5 marks]

Fill in the blanks with most appropriate value or words.

16. A molecule having dsp^2 hybridization has..... geometry.

17. Ethylenediaminetetraacetate ion ($EDTA^{4-}$) is commonly referred to as a .....
.....ligand.

18. The π- bonding MO's have symmetry of ..... whereas all σ-bonding MO's are .....

19. In world war II, two atom bombs (^{235}U and ^{239}Pu) were blasted in Japan. The nuclear process on which they were based is called .....

20. The order of energy of MO's for F_2 molecule is .....
.....
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SECTION "C"
[31 marks]

Attempt ***ANY FIVE*** questions. ***(Q.N. 1 is compulsory).***

1.a. Consider the following complex compounds

i. $[Co\ (en)_2\ (NCS)_2]\ Cl$ ii. $[Pt\ (H_2O)_2\ Cl_2]$
iii. $[Cr\ (NH_3)_2(SCN)_2]^-$ iv. $[Ni(CO)_4]$
v. $[Mn\ (H_2O)_2(ox)]^{2-}$ vi. $[Ni(CN)_4]^{2-}$

Answer these questions.

I. Write the IUPAC names of the compounds i, ii, iii and v. [4×0.5 =2]
II. Write the structures of compounds iii and iv? [1]
III. Which of the above compounds show optical isomerism? [1]
IV. Which can form linkage and cis-trans isomer? [1]

b. Show the different modes of combination of p-p atomic orbital resulting BMO's and ABMO's with their symmetry. [2]

2.a. Complete following nuclear reactions. [4×1=4]

i. $^{226}_{88}Ra \longrightarrow \cdots\cdots + {}^{4}_{2}He$

ii. $^{14}_{7}N + \cdots\cdots \longrightarrow {}^{17}_{8}O + {}^{1}_{1}H$

iii. $^{211}_{82}Pb \longrightarrow \cdots\cdots + {}^{0}_{-1}e$

iv. $^{235}_{92}U + \cdots\cdots \longrightarrow {}^{144}_{56}Ba + {}^{90}_{36}Kr + 2\,({}^{1}_{0}n)$

b. How do compounds $[Cr(NH_3)]^{3+}$ and $[Fe\ (H_2O)_6]^{3+}$ form inner and outer orbital complex? [2]

3.a. Define lattice energy. Using the information given below, calculate the lattice energy of lithium fluoride. [1+2=3]

Reactions	ΔH [KJ mol^{-1}]
$Li(s) + ½\ F_2(g) \longrightarrow Li^+ F^-(s)$	-504.1
$Li(s) \longrightarrow Li(g)$	+155.2
$Li(g) \longrightarrow Li^+(g) + e^-$	+520.0
$F_2(l) \longrightarrow 2F(g)$	+150.4
$F(g) + e^- \longrightarrow F^-(g)$	-33.0

b. Describe extrinsic and intrinsic semi-conductors showing energy-level bands. [3]

4.a. Explain the delocalization π-bonding in carbon dioxide (CO_2) on the basis of MOT. [3]

b. Define EAN rule. Explain this rule with suitable examples. [1+2=3]

5. Give the reasonable explanation for following facts. [3×2=6]
   a. Attractive forces in the nucleus cannot be electrostatic in nature.
   b. The bond angle in F_2O is less than in H_2O.
   c. The asymmetric filling of the e_g orbital causes a significant distortion of the octahedral shape than that of t_{2g} orbital.

6.a. Discuss briefly environmental and biochemical impacts of Mercury. [3]

b. Define the term polarizability. Discuss the Fajan's rule. [1+2= 3]

7. Distinguish between the followings (at least 3 points) [3×2=6]
   i. π-acceptor and π-donor ligands
   ii. Gerade and ungerade symmetry
   iii. π^+- meson and π^-- meson

SECTION "D"

[3Q × 8 = 24 marks]

Attempt ***ANY THREE*** questions.

8.a. Deduce the equation, $U = -\frac{N_0 A Z^+ Z^- e^2}{4\pi\varepsilon_0 r_0}\left[1-\frac{1}{n}\right]$ where the symbols have their usual meaning. [4]

b. Define the term 'electro-negativity'. What are the different scales for the measurement of electronegativity? [1+3=4]

9.a. Define the term 'crystal field stabilization energy'. Discuss the factors affecting the magnitude of Δ_0 for octahedral complex. [1+3=4]

b. Draw the molecular orbital energy level diagram for O_2^- molecular ion and NO molecule with their MO configuration. Also predict the bond order and magnetic properties. [4]

10.a. What do you mean by structural isomerism? Discuss different types of structural isomers in coordination chemistry with suitable example. [1+3=4]

b. Describe the different factors affecting the nuclear stability. [4]

11.a. Describe crystal field splitting in tetrahedral complex with example. [1+3=4]

b. What are the methods by which conduction can occur in metal? Discuss briefly. [4]