KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

AUG 31 2017

Mark Scored:

Level : B.E./B.Sc./B. Tech.
Year : I

Course : CHEM 102
Semester : II

Exam Roll No. :

Time : 30 mins.

F.M. : 20

Registration No.:

Date :

SECTION "A"
[15Q × 1 = 15 marks]

Select the most appropriate answer.

1. The shape, the number of lone pairs and bond pair electrons in the ClF_3 molecule are
   [ ] Tetrahedral; 1 and 3 [ ] Trigonal planar; 0 and 3
   [ ] Square planar; 0 and 4 [ ] Trigonal bipyramid; 2 and 3

2. Which statement is *incorrect* in regard to tetrahedral complex?
   [ ] All the tetrahedral complexes are high–spin.
   [ ] The direction of orbitals doesn't coincide with direction of ligands.
   [ ] The crystal field splitting in tetrahedral complexes is more significant than in octahedral fields.
   [ ] The central metal ion with low oxidation state favors the formation of tetrahedral complex.

3. What is the relationship between these two complex ions; $[Zn(NCS)_4]^{2-}$ and $[Zn(SCN)_4]^{2-}$?
   [ ] Linkage isomers [ ] Coordination isomers
   [ ] Ionization isomers [ ] Optical isomers

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

5. 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
   [ ] $0.744 + 0.359x\ Z^2_{effective}/r$ [ ] $0.744 + 0.359x\ Z_{effective}/r^2$
   [ ] $0.744 + 0.359x\ Z^2_{effective}/r^2$ [ ] $0.744 + 0.059x\ Z_{effective}/r^2$

6. Which one of the following is expected to exhibit a Jahn-Teller distortion?
   [ ] $[Cr(OH_2)_6]^{3+}$ [ ] $[Fe(CN)_6]^{2-}$ [ ] $[Mn(CN)_6]^{3-}$ [ ] $[Mn(OH_2)_6]^{3+}$

7. Which of the following statements is *incorrect* ?
   [ ] Arsenic appears in three allotropic forms and the stable form is silver-grey solid.
   [ ] Organic arsenic can cause neither cancer, nor DNA damage.
   [ ] Arsenic is a component that is extremely easy to convert water soluble form.
   [ ] High exposure to inorganic arsenic can cause infertility and miscarriages with woman.

8. The CFSE for a low-spin d^4 for octahedral complex is:
   [ ] $-0.4\Delta o$ [ ] $-0.6\Delta o$ [ ] $-1.2\Delta o$ [ ] $-2.4\Delta o$

9. Which of the following is the paramagnetic in nature?
   [ ] CO [ ] N_2 [ ] NO [ ] O_2^{2-}

10. The total number of electrons involved for the delocalization of π- bonding in O_3 is
[ ] 4 [ ] 6 [ ] 8 [ ] 10

11. Consider a nuclear reaction: $^{27}_{13}Al + X \longrightarrow {}^{30}_{15}P + {}^{1}_{0}n$. The projectile (X) used in the reaction is
[ ] A deuteron [ ] A gamma photon [ ] An alpha particle [ ] A neutron

12. Which of the following species form an iso-electronic series?
[ ] $[NO]^+$, $[CN]^-$ and N_2 [ ] O_2, $[NO]^+$ and $[CN]^-$
[ ] O_2, $[O_2]^-$ and $[O_2]^{2-}$ [ ] NO, $[CN]^-$ and $[O_2]^+$

13. Which one of the following complex ion does not obey EAN rule?
[ ] $[PtCl_6]^{2-}$ [ ] $[Ni(NH_3)_6]^{2+}$ [ ] $[Fe(CN)_6]^{4-}$ [ ] $[Pd(NH_3)_6]^{4+}$

14. A radioactive isotope with an N/P ratio high than the stable value tends to stabilize by
[ ] Positron emission [ ] Proton emission
[ ] Electron capture [ ] β-emission

15. The ligand 8-hydroxyquinolinol ion is typically
[ ] Bidentate, and an *N,N'*-donor [ ] Monodentate, and an *N*-donor
[ ] Bidentate, and an *N,O'*-donor [ ] Monodentate, and an *O*-donor

SECTION "B"
[5 Q × 1 =5 marks]

Fill in the blanks with most appropriate value or words.

16. The type of hybridization involved in the IF_7 molecule is _____.

17. Considering the theoretical mass of ^4_2He as 4.034116 amu and actual mass of ^4_2He as 4.0039, the amount of energy that will be required to separate all nucleons of 1 mole of helium atoms is_____.

18. The type of structure adopted by metal, zinc (Zn) is given by
_____.

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 for O_2 molecule is _____.

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F. M. : 55

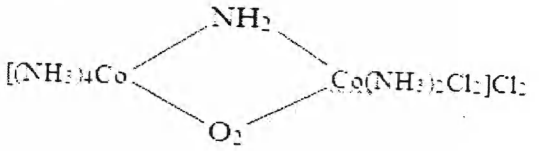
SECTION "C"

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

1. a. Answer the following questions based on the given complex compounds.

I. $[Co(NH_3)_5NO_2]Cl_2$ II. $[Pt(NH_3)_2Cl_2]$

III. $[Co(en)_2Cl_2]^+$ IV.



i. Write the IUPAC names of the compounds I, II, III and IV. [4 × 0.5 = 2]
ii. What are possible linkage isomers of I ? [0.5]
iii. Write down the geometrical isomers of II. [0.5]
iv. Write down the optical isomers of III. [1]

b. Define VSEPR theory. Give major postulates of VSEPR theory. [1+2=3]

2. a. Write the complete nuclear equation for the following radioactive isotopes. [4 × 1 = 4]
i. $^{232}_{90}Th$ (α- decay) ii $^{211}_{82}Pb$ (β- decay)
iii. $^{27}_{13}Zn$ (β^+ emission) iv. $^{71}_{32}Ge$ (electron capture)

b. Define spectrochemical series. Show the crystal field splitting due to strong field ligand (CN^-) and weak field ligand (Cl^-) taking a reference complex. [2]

3. a. Explain the delocalization π-bonding in nitrate (NO_3^-) on the basis of MOT. [3]
b. How does Werner's coordination theory explain different valencies in a complex compound? Also justify prediction of geometry of such compound. [2+1=3]

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

Reactions	ΔH [KJ mol^{-1}]
$K(s) + \frac{1}{2} Br_2(l) \longrightarrow K^+Br^-(s)$	-392
$K(s) \longrightarrow K(g)$	+90
$K(g) \longrightarrow K^+(g) + e^-$	+420
$\frac{1}{2} Br_2(l) \longrightarrow Br(g)$	+112
$Br(g) + e^- \longrightarrow Br^-(g)$	-342

b. Compare methods by which conduction occurs in lithium and beryllium metal. [3]

5. Give the reasonable explanation for following facts. [3 × 2 = 6]
   a. PCl_5 molecule exists but PH_5 does not exist.
   b. Outer orbital complexes are labile whereas inner orbital complexes are more stable.
   c. The conductivity of semiconductors increases with temperature which is converse for metal.

6. a. Define heavy metal toxicity? Discuss briefly about environmental and biochemical impacts of Lead. [1+2=3]
   b. What do you mean by gerade and ungerade symmetry of molecular orbitals? How would s-p and p-p combination of atomic orbitals result BMO and ABMO through different modes of orbital overlap? [1+2 = 3]

7. Distinguish between followings (at least 3 points) [3 × 2 = 6]
   i. Coordination compounds and double salt.
   ii. Nuclear fission and fusion.
   iii. n-type and p-type semi-conductors

SECTION "D"

[3Q × 8 = 24 marks]

Attempt *ANY THREE* questions.

8. a. Deduce a theoretical expression to determine the lattice-energy of ionic solids. [4]
   b. Define the term polarizability. Discuss the different factors favoring the polarization and hence covalency. [1+3=4]

9. a. Define crystal field stabilization energy. How does crystal field theory explain crystal field splitting in tetrahedral complex? [1+3=4]
   b. Draw the molecular orbital energy level diagram for B_2 molecule and NO molecule with their MO configuration. Also predict the bond order and magnetic properties. [4]

10. a. What are labile and stable complexes? Explain with suitable examples on the basis of VBT and also mention the limitations of VBT. [1+2+1=4]
    b. Define binding energy. Deduce the equation for radioactive disintegration rate law. Also show the half life period. [1+ 3= 4]

11. a. State Jahn- Teller theorem. Discuss the Jahn–Teller distortion of octahedral complex of metal ion with d^9 configuration. [1+3=4]
    b. How does band theory explain the differences between conductors, insulator and semiconductor? [4]

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Date	Day	I - II	II – I	II-II	III – I	III – II
August 27	Sunday					EEEG 309 MEEG 309 COMP 302 GEOM 315 CIEG 308 ENVS 335 PHAR 313 BIOT 306 PHYS 311
August 28	Monday		MATH 208	MATH 208 ENVS 224 PHAR 214 BIOT 210 HBIO 213 PHYS 213	MGTS 301	
August 29	Tuesday					ENVS 306
August 30	Wednesday					ETEG 301 EPEG 301 MEEG 308 COMP 314 GEOM 306 CIEG 309 MGTS 302 BIOT 307 PHYS 312
August 31	Thursday	ENVE 101 CHEM 102		EEEG 214 MEEG 207 COMP 232 GEOM 204 CIEG 208 ENVS 204 BIOL 206 BIOT 209 HBIO 215 CHEG 211	COMP 307	ENVS 303 ENVE 311
September 1	Friday		EEEG 211	PHYS 212		

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(Sheets 1 of 3)

Controller of Examinations

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Date	Day	I - II	II – I	II-II	III – I	III – II
September 3	Sunday	PHYS 102 PHYS 114				EPEG 315 ETEG 303 MEEG 317 COMP 306 MATH 322 GEOM 310 CIEG 312 ENVS 318 ENVS 345 PHAR 311 BIOT 308 PHYS 313
September 4	Monday			EEEG 215 MEEG 202 COMP 231 CEEG 201 CIEG 206 CHEM 212 HBIO 212 PHYS 211 CHEG 213	COMP 315	
September 5	Tuesday	ENGT 102	EEEG 202			
September 6	Wednesday					MEEG 318 COMP 304 COMP 409 GEOM 313 CIEG 314 ENVS 337 MEEG 306 PHAR 315 BIOT 309 PHYS 314
September 7	Thursday			MCSC 202 PHYS 207 CHEM 203 BIOT 207	COMP 316	EPEG 318 ETEG 304
September 8	Friday	MATH 104 MATH 102 STAT 101	MCSC 201			

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Date	Day	I - II	II – I	II-II	III – I	III – II
September 10	Sunday			COMP 201 MEEG 206 COMP 204 CIEG 207 BIOL 207 PHAR 212 BIOT 206 INAN 211 STAT 221 CHEG 210	COMP 317	COEG 301 ETEG 305 MEEG 316 COMP 341 GEOM 307 CIEG 310 ENVS 331 PHAR 316 BIOT 305
September 11	Monday	ENGG 112 ENVS 101 PHAR 111 BIOT 101 HBIO 101 MATH 103				
September 12	Tuesday		COMP 202			
September 13	Wednesday			GEOM 206 CIEG 209 ENVE 205 BIOT 208 MATH 217 CHEG 212	COMP 342	COMP 342 COMP 323 GEOM 319 CIEG 317 CIEG 313 ENVS 328 ENVE 399
September 14	Thursday	COMP 116 COMP 102 HBIO 103		MATH 207		

Note: *Examinations will be conducted as per this schedule and under no circumstance the dates and times will be changed unless the University publishes prior notice.*

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