UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination-Online Bb mode, July 2020 (date of exam: 6th July 20)

Course: Inorganic Chemistry-III   **Semester:** IV
Program: B Sc (H) Chemistry   **Time 03 hrs.**
Course Code: CHEM2004   **Max. Marks:** 100

PART- A(Answer ALL questions)   30 x 2 = 60 Marks
PART A contains 30 questions for a total of 60 marks.
Part-A contains multiple (MCQs) choice and multiple answer questions(MAQs)(Negative marks for MAQs incorrect answers)

Q 1 Lanthanides (Ln) dominated by its +3 oxidation state, which of the following statements is incorrect?

     A. The ionic sizes of Ln (III) decrease in general with increasing atomic number
     B. Ln (III) compounds are generally colourless
     C. Ln (III) hydroxides are mainly basic in character
     D. Because of the large size of the Ln (III) ions the bonding in its compounds is predominantly ionic in character

Q 2 Lanthanide contraction is caused due to?

     A. the imperfect shielding on outer electrons by 4f electrons from the nuclear charge
     B. the same effective nuclear charge from Ce to Lu
     C. the appreciable shielding on outer electrons by 5d electrons from the nuclear charge
     D. the appreciable shielding on outer electrons by 4f electrons from the nuclear charge

Q 3 Larger number of oxidation states are exhibited by the actinides than those by the lanthanides, the main reason being

     A. 4f orbitals more diffused than the 5f orbitals
     B. more energy difference between 5f and 6d than between 4f and 5d orbitals
     C. more reactive nature of the actinides than the lanthanides
     D. lesser energy difference between 5f and 6d than between 4f and 5d orbitals

Q 4 The electronic configurations of Am and Cm are.

     A. [Rn] $5f^7 7s^2$ and [Rn] $5f^7 6d^1 7s^2$
     B. [Rn] $5f^7 6d^1 7s^2$ and [Rn] $5f^7 7s^2$
     C. [Rn] $5f^7 6d^1 7s^2$ and [Rn] $5f^7 6d^1 7s^1$
     D. [Rn] $5f^6 6d^2 7s^2$ and [Rn] $5f^7 6d^1 7s^1$

Q 5 Maximum oxidation state +7 exhibited by element

     A. Pa
     B. U
     C. Np
     D. None

Q6	Give the oxidation state, d orbital occupation and coordination number of the central metal ion in the following complex $K_3[Co(C_2O_4)_3]$
	A. Zero
	B. +1
	C. +2
	D. +3
Q7	Write down the IUPAC name for each of the complex $K_4[Mn(CN)_6]$
	A. Potassiumhexacyanomanganeese(II)
	B. Hexacyanopotassium(IV)manganeese
	C. Potassiumhexacyanomanganate(II)
	D. Hexacyanomanganeese (IV) potassium
Q8	How many ions are produced from the complex $Co(NH_3)_6Cl_3$ in solution?
	A. 6
	B. 2
	C. 4
	D. 3
Q9	Amongst the following ions which one has the highest magnetic moment value?
	A. $[Cr(H_2O)_6]^{3+}$
	B. $[Fe(H_2O)_6]^{3+}$
	C. $[Zn(H_2O)_6]^{2+}$
	D. $[Ni(CO)_4]$
Q10	Which one of the following complexes can exhibit geometrical isomerism?
	A. $[Pt(NH_3)_2Cl_2]$ (Square planar)
	B. $[Zn(NH_3)_2Cl_2]$ (Tetrahedral)
	C. $[Cu(NH_3)_4]^{2+}$ (Square planar)
	D. $[Co(NH_3)_5Cl]^{2+}$ (Octahedral)
Q11	A magnetic moment of 1.73 BM will be shown by one among the following
	A. $[Cu(NH_3)_4]^{2+}$
	B. $[Ni(CN)_4]^{2-}$
	C. $TiCl^{4-}$
	D. $[CoCl_6]^{4-}$
Q12	Among the ligands NH_3, ethylene diamine (en), CN– and CO, the order of increasing field strength, is
	A. en $<$ CN$^-$ $<$ NH_3 $<$ CO
	B. NH_3 $<$ en $<$ CN$^-$ $<$ CO
	C. NH_3 =en $<$ CN$^-$ =CO
	D. NH_3 $<$ en =CN$^-$ $<$ CO
Q13	According to Crystal Field Theory, Identify the true statements
	A. Low spin complexes contain strong field ligands.

	B. In high spin octahedral complexes, Δ_{oct} is less than the electron pairing energy, and is relatively very small C. Diamagnetic metal ions cannot have an odd number of electrons. D. In an octahedral crystal field, the d electrons on a metal ion occupy the e_g set of orbitals before they occupy the t_{2g} set of orbitals.
Q14	Facial and meridional isomerism will not be shown by A. $[Co(NH_3)_3Cl_3]$ B. $[Co(NH_3)_4Cl_2]$ Cl C. $[Co(en)_3]$ Cl$_3$ D. Co(NH$_3$)$_5$Cl] Cl$_2$.
Q15	Which one will not show optical isomerism? A. $[Co(NH_3)_3Cl_3]$ B. cis-[Co(en)$_2$ Cl$_2$] Cl C. trans-[Co(en)$_2$ Cl$_2$] Cl D. $[Co(NH_3)_4$ Cl$_2]$ Cl
Q16	In the following Latimer diagram, the species that undergoes disproportionation reaction is : $MnO_4^- \xrightarrow{+0.56} MnO_4^{2-} \xrightarrow{0.27} MnO_4^{3-} \xrightarrow{0.93} MnO_2 \xrightarrow{+0.15} Mn_2O \xrightarrow{0.25} Mn(OH)_2 \xrightarrow{-1.56} Mn$ (A) MnO_4^{2-} (B) MnO_4^{3-} (C) Mn_2O_3 (D) $Mn(OH)_2$
Q17	In which of the following complex oxidation number of Fe is +1? A. Fe$_4$[Fe(CN)$_6$]$_3$ B. [Fe(H$_2$O)$_5$NO]SO$_4$ C. [FeBr$_4$]$^-$ D.[Fe(H$_2$O)$_6$]$^{2-}$
Q18	Number of C≡N and C≡O ligands bonded to iron in the Sodium nitroprusside (SNP) with formula C$_5$FeN$_6$Na$_2$O A. 5 B. 1 C. 2 D. 4

Q19	IUPAC name of Sodium cobalt nitrite and oxidation state of Co in Na$_3$[Co(NO$_2$)$_6$]
	     A. Sodium hexanitrocobaltate B. Sodium nitrocobaltate(II) and oxidation state Co is +2
	     C. Sodium hexanitrocobaltate(III) and oxidation state of Co is +3 D. Oxidation state of Co is 3

Q20	The reactions of [PtCl$_4$]$^{2-}$ with NH$_3$ (reaction I) and of [PtCl$_4$]$^{2-}$ with [NO$_2$]$^-$ followed by NH$_3$ (reaction II) are ways of preparing: A. I: trans-[PtCl$_2$(NH$_3$)$_2$]; II: trans-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$ B. I: cis-[PtCl$_2$(NH$_3$)$_2$]; II: trans-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$ C. I: trans-[PtCl$_2$(NH$_3$)$_2$]; II: cis-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$ D. I: cis-[PtCl$_2$(NH$_3$)$_2$]; II: trans-[PtCl$_2$(NH$_3$)(NO$_2$)]$^-$

Q21	Which statement about the trans-effect and the trans-influence is correct?
	     A. The trans-influence is a ground-state effect, whereas the trans-effect has a kinetic origin
	     B. e trans-effect is a ground-state effect, whereas the trans-influence has a kinetic origin
	     C. Both the trans-effect and trans-influence are ground-state effects
	     D. Rates of substitution are affected by the *trans*-effect but have nothing to do with the *trans*-influence of ligands

Q22	The Trans effect is increasing in the order of A. NO$_2^-$ > Cl$^-$ > NH$_3$ B. NO$_2^-$ < Cl$^-$ < NH$_3$ C. NO$_2^-$ < Cl$^-$ < NH$_2$

	D. $NO_2^- > Cl^- > NH_2$
Q23

   A.   A: NH_3 B: NO_2^- C: NO_2^- D: NH_3
   B.   A: NO_2^- B: NH_3 C: NO_2^- D: NH_3
   C.   A: NO_2^- B: NH_3 C: NH_3 D: NO_2^-
   D.   A: NH_3 B: NH_3 C: NO_2^- D: NO_2^- |
| Q24 | To identify the physical and chemical properties of transition elements which differ from main group elements (s-block). Properties of transition elements include:
   A. have small charge/radius ratio
   B. form coloured ions and compounds
   C. form compounds with profound catalytic activity
   D. show variable oxidation states |
| Q25 | Identify the correct electron configuration of Pb^{2+} [^{82}Pb 207.2]
   A. [Xe] $6s^2 5d^{10} 4f^{14}$
   B. [Xe] $6s^2 5d^{10} 4f^{12}$
   C. [Xe] $4f^{14} 5d^{10} 6s^2 6p^0$
   D. [Xe] $4f^{12} 5d^{10} 6s^2 6p^2$ |
| Q26 | The relative rates of various ligands (L) like $C_2H_4 > NO_2^- > Br^- > Cl^-$ increases as the trans effect ...^{A}......., however activation energy....^{B}... in the same way.
How A and B will vary in the above statement for trans effect?
   A. A : Increases, B: Decreases
   B. A: Increases
   C. B: Decreases
   D. A: Decreases, B: Increases |
| Q27 | According to this theory the polarization (effect of σ-bonding) of a ligand would be directly related to its Trans effect. In case of [Pt(X)4] type complex, the overall dipole generated will be -----------, hence we observed-------- trans effect.
   A. Zero, No
   B. double, Yes
   C. Triple, No
   D. increases, No |
| Q28 | The first step in the Eigen-Wilkins mechanism for ML_6 undergoing Y for L substitution is:

   A. *loss of L*
   B. *addition of Y*
   C. *formation of a weakly bound encounter complex*
   D. *formation of a 7-coordinate complex in the rate-determining step* |

Q29	Which ion is kinetically inert? A. Cr^{2+} B. Co^{3+} C. Co^{2+} D. Fe^{3+}
Q30	The usual form of the experimental rate law for substitution in square planar Pt(II) complexes contains two terms: Rate = $k_1[PtL_3X] + k_2[PtL_3X][Y]$ where PtL_3X is the starting complex and Y is the entering group. The reason for the two-term law is that: A. *there are competitive associative and dissociative pathways* B. *there are two competing dissociative pathways* C. *the solvent enters in the rate-determining step, and then two competing fast steps follow* D. the solvent competes with Y in the rate-determining step

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Part- B   (Answer ALL questions)   **5 x 8 = 40 Marks**

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1. There are total of five questions attempt all carry equal marks
2. **PART B** consist of long answer based questions and has the total weightage of 40%. (Whereas **PART A** it is 60%)
3. **The PART B** responses(Answers) should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, SAP ID at the top (as in the format) and signature at the bottom (right hand side bottom corner)

Q 1	Describe the Werner's explanation regarding nature of bonding in metal complexes.
Q 2	Draw the molecular orbital diagram of $[Co(NH_3)_6]^{3+}$
Q 3	How, do the lanthanides purified with Ion exchange method?
Q 4	Describe the mechanism for Square Planar Ligand Substitution of ML_4 type compounds.
Q 5	Explain what is meant by the term 'intimate' reaction mechanism as it applies to ligand substitution reactions. Differentiate between the two types of intimate mechanism that can operate and use the data shown for reaction (2) below (py = pyridine) to deduce the overall mechanism (both stoichiometric and intimate) for this reaction $trans - PtCl_2(py) + A \rightarrow [PtCl_2(py)_2A] \rightarrow PtCl(py)_2A + Cl^-$

A	$k/dm^3mol^{-1}s^{-1}$
NH_3	4.7×10^{-4}
Br^-	3.7×10^{-3}
I^-	1.1×10^{-1}
Thiourea	6.0

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