Q. No.	1	2	3	Total
Marks Scored:				
Out of	**5**	**10**	**5**	**20**

CHM102A: GENERAL CHEMISTRY, 2016-17(Semester-II)

QUIZ-2

Date: 08/04/2017   **Time: 08:30-09:00**   **Total Marks: 20**

Instructions:

*Mobile phones or any other digital gadgets are absolutely **NOT** allowed during the examination.*
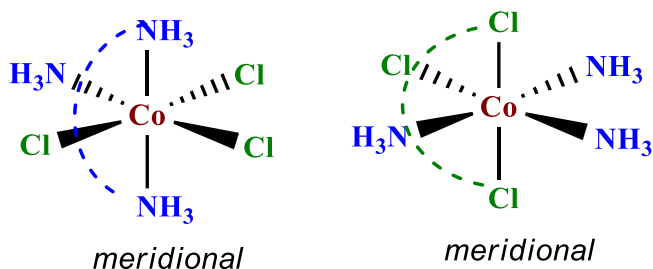*Sharing calculator is not allowed. Please write your answers in provided space in the question paper.*
Use extra sheets or backside of the question paper for doing any rough work.

1. **(a) Show the crystal field splitting diagram with appropriate labelling of d-orbitals and filling of d-electrons for (i) $[PtCl_4]^{2-}$ and (ii) $[FeCl_4]^{-}$. [2+ 2 marks]**

$[PtCl_4]^{2-}$: Pt(II) is $5d^8$ system, square planar geometry.

$[PtCl_4]^{2-}$

[correct splitting & labelling of d-orbital= 1 mark
correct filling of electrons = 1 mark]

$[FeCl_4]^{-}$: Fe(III) is $3d^5$ system, tetrahedral geometry.

[correct splitting & labelling of d-orbital = 1 mark
correct filling of electrons = 1 mark]

(b) Draw the structure of mer-$[Co(NH_3)_3Cl_3]$. [1 mark]

meridional   *meridional*

[Correct drawing for mer-isomer = 1 mark]

2. (a) Determine whether Jahn-Teller distortion (J-T distortion) and orbital contribution towards effective magnetic moment (μ_L) is possible for following complexes. [6 marks]

Complexes	Electronic configuration in terms of t_{2g} and e_g notation	J-T distortion (Yes/No)	Orbital contribution (μ_L) (Yes/No)
$[Co(NH_3)_6]Cl_2$	$t_{2g}^5 e_g^2$	Yes	Yes
$[Ni(H_2O)_6]Cl_2$	$t_{2g}^6 e_g^2$	No	No
$[Cr(H_2O)_6]Cl_2$	$t_{2g}^3 e_g^1$	Yes	No

[Each correct electronic configuration. = 1 mark, each correct Y/N option = 0.5 mark]

(b) Calculate effective magnetic moment (μ_{S+L}) for a free Cu^{2+} ion. [2 marks]

$Cu^{2+} = d^9$ system

$m_l =$ 2   1   0   -1   -2

$L = \Sigma m_l = (2 \times 2) + (2 \times 1) + (2 \times 0) + (2 \times -1) + (1 \times -2)$
$L = 2$
$S = 1/2$

Here $L = 2$, $S = 1/2$

$\mu_{L+S} = [L(L+1) + 4S(S+1)]^{1/2} = [(2 \times 3) + (4 \times 1/2 \times 3/2)]^{1/2} = (9)^{1/2} = 3.0$ B.M.
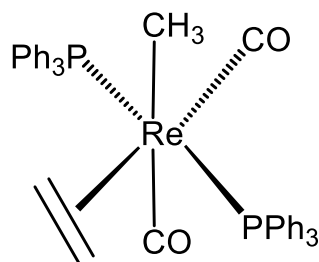Ans: 3.0 B.M.

*[Correct calculation of **L** and **S** = 1 mark, correct calculation for μ_{L+S} = 1 mark, if no unit present for μ_{L+S}, deduct 0.5 mark]*

(c) Mention which of the following statement(s) are TRUE for Hemoglobin (Hb) and/or myoglobin (Mb). [2 marks]

(i) Iron(III) in deoxymyoglobin is in a high-spin state.

(ii) Iron(III) in oxymyoglobin is in a low-spin state. **TRUE**

(iii) Distal histidine residue reduces the affinity of CO binding to Mb. **TRUE**

(iv) Dioxygen present in oxymyoglobin as peroxide form.

[Each TRUE option = 1 mark]

3. (a) Show the electron count around central metal in following complex.   [2 marks]

 Ans:

Oxidation state/ionic method:	Neutral method:
Re(+1) = 6 e⁻	Re = 7 e⁻ (Re in group 7 in PT)

Oxidation state/ionic method:
$Re(+1) = 6$ e⁻
$2\ PPh_3 = 2 \times 2 = 4$ e⁻
2 terminal $CO = 2 \times 2 = 4$ e⁻
$CH_3^- = 2$ e⁻
$CH_2=CH_2 = 2$ e⁻

Total = 18 e⁻

Neutral method:
Re = 7 e⁻   (Re in group 7 in PT)
$2\ PPh_3 = 2 \times 2 = 4$ e⁻
2 terminal $CO = 2 \times 2 = 4$ e⁻
$CH_3^- = 1$ e⁻
$CH_2=CH_2 = 2$ e⁻

Total = 18 e⁻

[Electron count for ALL the ligands and metal centre needed to arrive the total electron count of 18 e⁻ and full mark, any wrong deduction = 0 mark]

b) Match the following metal carbonyls with their corresponding C-O stretching frequencies (ν_{CO}) from the following ν_{CO} values: 1747, 1860, 2000 and 2098 cm⁻¹. [2 marks]

Metal carbonyls	ν_{CO} (cm⁻¹)
$[Mn(CO)_6]^+$	2098
$[V(CO)_6]^-$	1860
$[Cr(CO)_6]$	2000
$[Ti(CO)_6]^{2-}$	1747

*[Each correct matching of ν_{CO} value = 0.5 mark; * No explanation required]*
Explanation: As the electron density on the metal increases, more electron density is pumped into the π^* anti-bonding orbital of CO, this reduces the C-O bond order or bond strength and having lower ν_{CO} stretching frequency.

(c) Which among the following compounds will not undergo oxidative addition of methyl iodide?

(i) $[Ir(PPh_3)_2(CO)Cl]$ (ii) $[RhI_2(CO)_2]^-$ (iii) $(\eta^5\text{-Cp})_2Ti(Me)Cl$ **[1 mark]**

Ans: $(\eta^5\text{-Cp})_2Ti(Me)Cl$.

*[Correct answer = 1 mark, * No explanation required]*

Explanation: As titanium is already in its highest oxidation state of +4 and therefore no d-electrons present for further oxidation necessary in oxidative addition.