

**FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI**  
**SCHOOL OF PHYSICAL SCIENCE**  
**DEPARTMENT OF CHEMISTRY**

**CHM303: Inorganic Chemistry II**

**Time Allowed: 1½ hrs**

**Instruction: Answer All**

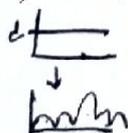
**Date: 7<sup>th</sup> June, 2019**

**Question 1**

- a) The reaction between permanganate and arsenious oxide involves:  
 $2\text{MnO}_4^- + 5\text{H}_3\text{AsO}_3 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{H}_3\text{AsO}_4 + 3\text{H}_2\text{O}$ .  $40\text{cm}^3$  of  $0.15\text{M MnO}_4^-$  solution reacts with  $5\text{g}$  sample of an impure arsenious oxide. What is the percentage purity of the sample. Molecular weight of arsenious oxide is  $197.82\text{g}$ .
- b) A  $0.200\text{g}$  sample of chromite ore was fused with sodium peroxide to convert  $\text{Cr}_2\text{O}_3$  to sodium chromate. The melt was then dissolved and the excess peroxide destroyed by boiling. The solution was acidified and titrated with  $0.200\text{M}$  ferrous ( $\text{Fe}^{2+}$ ) solution of which  $17.00\text{cm}^3$  were required. What was the percentage by weight of  $\text{Cr}_2\text{O}_3$  found in the chromite ore. ( $\text{Cr}=52$ ;  $\text{O}=16$ ).

**Question 2**

- a) Explain the reactions in these 3 equilibrium equations and which is the most reactive.  
 $\text{Fe}(\text{H}_2\text{O})_6^{3+} + \text{en} \leftrightarrow \text{Fe}(\text{en})(\text{H}_2\text{O})_4^{2+} + 2\text{H}_2\text{O}$ ,  $K = 10^{4.3}$  -----(i)  
 $\text{Fe}(\text{en})(\text{H}_2\text{O})_4^{2+} + \text{en} \leftrightarrow \text{Fe}(\text{en})_2(\text{H}_2\text{O})_2^{2+} + 2\text{H}_2\text{O}$ ,  $K = 10^{3.3}$  -----(ii)  
 $\text{Fe}(\text{en})_2(\text{H}_2\text{O})_2^{2+} + \text{en} \leftrightarrow \text{Fe}(\text{en})_3^{2+} + 2\text{H}_2\text{O}$ ,  $K = 10^2$  -----(iii)
- ✓ b) Calculate in units of the  $\Delta_o$  ligand field stabilization energies (LFSE'S) of the following high spins in their octahedral complexes:  $\text{Fe}(\text{en})(\text{H}_2\text{O})_4^{2+}$ ,  $\text{MnCl}_4^{2-}$ ,  $\text{MnBr}_5^{2-}$ ,  $\text{Co}(\text{en})_2\text{Cl}_2^+$ ,  $\text{NiI}_4^{2-}$ ,  $\text{Mn}_2(\text{CO})_{10}^{2+}$ ,  $\text{Cr}(\text{dipy})_3^+$
- c) Give the Orgel diagrams and UV absorption spectra of the following compounds.  
 (i)  $\text{TiBr}_6^{3-}$  (ii)  $\text{VCl}_4^-$ , (iii)  $\text{MnO}_4^{3-}$ , (iv)  $\text{Cr}(\text{NH}_3)_6\text{Br}_3$ . (v)  $\text{Mn}(\text{NH}_3)_6^{2+}$ , (vi)  $\text{Co}(\text{NH}_3)_4^{2+}$ , (viii)  $\text{Co}(\text{en})_2\text{Cl}_2^+$ .



**Question 3**

- ✓ a) State giving reasons why chromium is considered to be a transition element. Illustrate your answer by reference to suitable compounds of the element.
- ✓ b) Why are the 4s electrons removed before the 3d when the 4s orbital is filled before 3d.
- c) Why does  $\text{Co}^{2+}$  forms many complexes of both octahedral and tetrahedral types than any transition metal ion.
- d) What accounts for the purple colour of  $\text{Mn}^{7+}$ .

- e) What accounts for the brown colour in the brown ring test for nitrate.
- f) Draw the structure of vitamin B<sub>12</sub> and of what use is it to the human body.
- g) What is disproportionation. Illustrate with a particular example.
- h) Write in electronic terms the reaction between KBr and Cl<sub>2</sub>.
- i) There may be kinetic reasons for the oxidation of Fe<sup>2+</sup> to Fe<sup>3+</sup> by molecular oxygen through the formation and decomposition to hydroferroxo ion. Illustrate with equation(s).
- j) Complete the equation:  $\text{Cl}_2 + \text{NH}_3 \rightarrow \text{CN} + \text{H}_3\text{I}$