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MAIN EXAMINATION

AUGUST – DECEMBER 2018 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCE (CHEMISTRY)

REGULAR PROGRAMME

CHEM 400: DESCRIPTIVE CHEMISTRY OF TRANSITION ELEMENTS

Date: DECEMBER 2018	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions	

Q1. a) i) Define a transition element. **(2Marks)**

ii) Whereas Cu^{+2} is a transition element, Zn^{+2} is not included among the transition elements. Explain**.** **(2Marks)**

b) State 3 reasons why transition metals have a strong tendency to form complex ions with different ligands. **(3Marks)**

c) With a few exceptions, the d-block element exhibit more than one oxidation state. Explain. **(4Marks)**

d) What is the name of the following complex ions:

i) $[CrCl_2(H_2O)_4]^+$

ii) $[CO(NH_3)_6]^{3+}$ **(2Marks)**

e) i) What is unique with transition metals to make them act as catalysts? **(1Mark)**

ii) Name the catalysts used in the following reactions. **(3Marks)**

i) $CH_2{=}CH_2 + H_{2(g)} \rightarrow CH_3CH_{3(s)}$

ii) $2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$

iii) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

f) Differentiate between absorption spectra and emission spectra. **(2Marks)**

g) Write the formulae of each of the following **(4Marks)**

i) Amminetetraaquachromium(II)
ii) Amminesulfatochromium(II)
iii) Amminetetraaquachromium(II) sulfate
iv) Potassium hexacyanoferrate(III)

h) Outline **three** differences between a diamagnetic material and a paramagnetic one. **(3Marks)**

i) State three uses of potassium permanganate ($KMnO_4$). **(3Marks)**

j) i) Name the two metals used in the extraction of Titanium. **(2Marks)**

ii) Lanthanides are used in control rods that are used to regulate nuclear reactors. Explain what makes these elements useful in control rods. **(1Mark)**

Q2. a) Scandium (Sc) and Zinc (Zn) are similar in some ways but different from the rest of the other transition elements. State the 3 ways they differ from the rest of the transition elements. **(6Marks)**

b) By referring to electronic configuration. Explain why:

i) The second ionization energies of both chromium and copper are higher than those of the next element? Indicate the process that is referred to. **(3Marks)**

ii) The 3rd ionization energies of both Mn and Zn are higher than those of the next element? Indicate the process that is referred to. **(3Marks)**

c) Which ions between Fe^{+3} and Fe^{+2} are more stable? Explain. **(4Marks)**

d) Organometallic compounds are often synthesized in an inert atmosphere.

i) Name any two substances that provide the inert atmosphere. **(2Marks)**

ii) Explain why they need to be prepared in an inert atmosphere? **(2Marks)**

Q3. a) State any **FOUR** properties of the transition elements and explain how each arises. **(8 marks)**

b) i) Explain what you understand by "heterogeneous catalysis". **(2Marks)**

ii) Explain how a heterogeneous catalyst works. **(3Marks)**

c) i) Given that Manganese and iron have magnetic moments of 5.92BM and 4.9BM. Calculate the number of unpaired electrons in each of the elements. **(4 Marks)**

ii) Between Manganese and Iron, State which element is more magnetic than the other. Give a reason for your answer. **(3 Marks)**

Q4. a) Draw the shapes of the various d-orbitals, and **explain** why they are split into two groups in an octahedral field. **(7Marks)**

b) Show, diagrammatically, how the d-orbitals are split in the octahedral field. **(5Marks)**

c) i) State **three** Assumptions of Crystal Field Theory. **(3Marks)**

ii) State any **Five** limitations of the Crystal Field Theory. **(5Marks)**

Q5. a) The transition elements consist of the **d-block** and **f-block** elements and both blocks of elements form complex ions. One block has a low tendency of doing so than the other. State which one and why? **(2Marks)**

b) Outline any three consequences of Lanthanide contraction. **(6Marks)**

c) Compare and contrast the Lanthanides and actinides. **(12Marks)**

END