CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATIONS

FOURTH YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 419: CHEMISTRY OF TRANSITION ELEMENTS

STREAMS: BSC Y4S1 **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 03/02/2021 **2.30 P.M – 4.30 P.M**

INSTRUCTIONS:

Answer any THREE questions

QUESTION ONE

(a). (i). Explain the position and classification of the transition elements in the periodic table and give reasons why they are called transition elements

(ii). Explain why transition elements show tendency to form large number of Complexes

(iii). Enumerate the characteristics of transition elements. Which of the d block elements may not be regarded as transition elements. Give. reasons for your answer.

(b) Discuss the trends in the following properties of first row transition metals. Give reasons for the observed trends

i) Melting and Boiling points

ii). Atomic and Ionic sizes (for a given oxidation state)

(c). Comment on the following observations

(i). Scandium [Z= 21] is a transition element but zinc [Z= 30] is not?
(ii) Transition metals and their many compounds act as good catalysts
(iii). Of the d^4 species, Cr(II) is strongly reducing while Mn(III) is strongly oxidizing
(iv) Transition metals have high density and high melting points and boiling points.
(v). The metallic radii of the second(4d) transition series are virtually the same as those of the corresponding members of the third (5d) transition series.

(d) Explain the metallic character of the d-block elements. Why are Cr, Mo and W hard metals while Zn, Cd and Hg are soft?

(e) Discuss the oxidation states of the first row transition elements and give reasons why the highest oxidation state of a transition metal is exhibited in its oxide or fluoride?

QUESTION TWO

(a). (i). Define the term ionization enthalpy

(ii). Explain the trends observed in the ionization enthalpies of the d-block elements.

(iii). How would your account for the irregular variation of the first and second? ionization energies in the first series of d-block metals?

(iv). Explain the thermodynamic stability of transition metal compounds on the basis of ionization enthalpy**.** Use the following reactions as examples to explain your answer

$Ni \longrightarrow Ni^{2+} + 2e \qquad IE = 2.49 \times 10^3\ kJ/mol$

$Pt \longrightarrow Pt^{2+} + 2e \qquad IE = 2.66 \times 10^3 kJ/mol$

$Ni \longrightarrow Ni^{4+} + 4e \qquad IE = 11.29 \times 10^3\ kJ/mol$

$Pt \longrightarrow Pt^{4+} + 4e \qquad IE = 9.36 \times 10^3 kJ/mol$

(b)(i) Illustrating with examples where possible, show the extent to which the electronic configuration decide the stability of oxidation states in transition elements

(ii). By giving an example, suggest reasons for the following features of the transition elements 'The lowest oxides of transition metal are basic, the highest is amphoteric/acidic'

(iii). Which element of the 3d series of transition elements exhibits the largest number of oxidation states and why

(c). Enumerate the main differences between the second and third series of transition elements on one hand and those of the first series of transition elements on the other hand with respect to

(i). Electronic configuration
(ii). Atomic and ionic radii sizes
(iii). Oxidation states
(iv). Formation of metal-metal bonds
(v). Magnetic properties
(vi). Ligand –donor prevalence and coordination number.

(d)). (i). Explain the origin of the magnetic moments of transition metals. Why does Mn(II) ion show maximum paramagnetic character amongst bivalent ions of the elements of the 3d series

(ii) Give the spin only formula for calculating magnetic moments. Hence calculate the spin only magnetic moment of $M^{2+}(aq)$ ion (Z = 27).

QUESTION THREE

(a)(i). Distinguish between standard reduction potential and standard oxidation potential. Explain briefly how they are measured and comment on their relationship.

(ii). Discuss briefly the reducing and oxidizing ability of chemical species in aqueous solution on the basis of reduction potential

(b)). Given the standard electrode potentials,

$K^+ / K = -2.93V$,

$Ag^+ /Ag = 0.80V$,

$Hg^{2+} / Hg = 0.79V$

$Mg^{2+} /Mg = -2.37V$.

$Cr^{3+} /Cr = -0.74V$

Arrange these metals in their increasing order of reducing power. Elaborate the principle on which you based your answer

c). Describe properties which demonstrate that f block elements are different from d-block elements

QUESTION FOUR

a). Compare the chemistry of lanthanides with that of actinides with special reference to

i. Electronic configuration
ii. Atomic and ionic sizes
iii. Oxidation state
iv. Chemical reactivity
v. Tendency to form complexes

b) (i) Distinguish between lanthanide contraction and actinide contraction. What are the causes and consequences of lanthanide contraction?

(ii). Explain why actinide contraction is more than lanthanide contraction

c) . (i). Write the general electronic configuration of 4f and 5f series of elements

(ii). Explain why lanthanum, gadolinium and lutetium show different electronic configurations and oxidation states.

d).(i) The most stable complexes of lanthanide elements are those which involve coordination to oxygen donor polydentate ligands. Explain

(ii). By giving examples where possible give any two uses of lanthanides and twq uses of actinides

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