CHUKA  UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL

EXAMINATIONS FOR THE AWARD OF
BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

CHEM 212: COMPARATIVE STUDY OF s AND p BLOCK ELEMENTS

STREAMS: BSC & BED (SCI) **TIME: 2 HOURS**

DAY/DATE: TUESDAY 02/02/2021 **8.30 A.M. – 10.30 A.M.**

INSTRUCTIONS: Answer Question **ONE** and Any other **TWO** **Questions**

QUESTION ONE [30 Marks]

a) (i).In a quantum mechanical description of the hydrogen atom what is the significance of the square of the wave function Ψ^2?. Explain what is meant by the expression 'electron density'? **[2 marks]**

(ii). Sketch the radial distribution functions for the 3s, and 3p orbitals in a hydrogen atom and, **[2 marks]**

(iii) With reference to your diagrams in (ii) above explain why a 3s orbital is lower in energy than a 3p orbital. **[1.5 marks]**

(iv) What is a node? Predict how many nodes are in a 4p orbital **[1.5 marks]**

b). (i). Give the names and symbols of the four quantum numbers required to define the energy of electrons in atoms. What do these quantum

numbers relate to, and what numerical values are possible for each? **[4 marks]**

(ii) Give the sequence in which the energy levels in an atom are filled with electrons**.**

[2 marks]

(iii) Write the condensed electronic configurations for the following elements (using appropriate noble gas core abbreviations) of atomic number 12, and 25, and from this decide to which group in the periodic table each element belongs. **[2 marks]**

(c). (i). What is meant by the term effective nuclear charge? How does effective nuclear charge experienced by the valence electrons of an atom vary going from left to right across the period of a periodic table and down the group. Explain**.** **[4 marks]**

(ii). Use Slater's rule to find the effective nuclear charge felt by an electro in a 5s orbital in strontium [atomic number of Sr = 38] **[3 marks]**

(d). (i). Arrange the following atoms in order of increasing effective nuclear charge experienced by the electrons in the n= 3 electron shell: K, Mg, P, Rh and Ti. Explain the basis of your order **[2 marks]**

(ii). Mention any three anomalous behavior of beryllium as compared to other group two alkaline earth metals **[3 marks]**

(e). (i). What is an isoelectronic series? **[1 mark]**

(ii). Which experiences the greatest effective nuclear charge, a 2p electron in F^-, a 2p electron in Ne or a 2p electron in Na? Explain your answer

[2 marks]

QUESTION TWO [20 MARKS]

a) (i). Distinguish between ionization energy and electron affinity**. [3 marks]** (ii) Why are the ionization energies always positive quantities and electron affinities negative quantities? Which elements have positive electron affinities Explain **[2 marks]**

(iii). Why does Li have a larger first ionization energy than Na and why does Li have a much larger second ionization energy than Be**?**

[3 marks]

(b). Explain Why Are Group I elements [**5 marks]**

(i). univalent (ii) largely ionic (iii) strong reducing agents (iv). soft and have low melting points and are of low density

(c).(i). What products are formed when each of the Group I metals is burnt in oxygen? How do these products react with water? **[4 marks]**

(ii). Why does lithium resemble magnesium? Give three five similarities between lithium and magnesium**.**

[3 marks]

QUESTION THREE [2 marks]

(a). (i). What do you understand by the term diagonal relationship? List pairs of elements that show diagonal relationship **[4 marks]**

(ii) What factors are responsible for occurrence of diagonal relationship? **[3 marks]**

(b). By giving reasons for your answer discuss how the following properties of alkaline earth metals vary and compare to those of alkali metals **[9 marks]**

(i). Atomic and ionic radii (ii). Ionization enthalpy (iii) hydration enthalpies

(c). Explain why calcium is generally more reactive than magnesium while calcium is generally less reactive than potassium **[4 marks]**

QUESTION FOUR [20 MARKS]

a) (i). Define any **four** of the following terms **[4 marks]**

(i). Allotrope (ii) inert pair effect (iii) diagonal relationship (iv) catenation

(v) interhalogen compounds

b). (i). Outline the steps in the extraction of boron from their ores **[5 marks]**

(ii) Give a brief description of diborane (B_2H_6) and account for all the valence

electrons**.** **[3 marks]**

c). Explain reasons for the following observations

(i). Salts of group 2 elements are more hydrated than those of group 1 Elements [**2 marks]**

(ii). Whereas PF_5, PBr_5, PCl_5 and SbF_6 $SbCl_5$, AsF_5 are known no penthalides of nitrogen are known

[2marks]

(iii). diamond is extremely hard, has high melting point and is a bad conductor whereas graphite is soft, has high melting point and a good conductor of electricity

[4 marks]
