



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## University Examinations 2023/2024

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF  
SCIENCE CHEMISTRY, BACHELOR OF EDUCATION SCIENCE

### SCH 3200: COMPARATIVE STUDY OF S AND P BLOCK ELEMENTS

DATE: DECEMBER 2023

TIME: 2 HOURS

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INSTRUCTIONS: *answer question one and any other two questions*

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#### QUESTION ONE – 30 MARKS

- a) When heated in air, the alkali metals form various oxides. Mention the main oxides formed by Li, Na and K. (2 marks)
- b) When water is added to compound (A) of calcium and filtered, solution of compound (B) is obtained as filtrate. When carbon dioxide is passed into the solution, it turns milky due to the formation of compound (C). If excess of carbon dioxide is passed into the solution milkiness disappears due to the formation of compound (D). Identify the compounds A, B, C and D. Explain why the milkiness disappears in the last step. (5 marks)
- c) Ions of an element of group 1 participate in the transmission of nerve signals and transport of sugars and aminoacids into cells. This element imparts yellow colour to the flame in flame test and forms an oxide and a peroxide with oxygen.
- Identify the element (1 marks)
  - write chemical reaction to show the formation of its peroxide (1 mark)
  - Why does the element impart colour to the flame? (2 marks)
- d) account for each of the following
- The carbonate of lithium decomposes easily on heating to form lithium oxide and CO<sub>2</sub>. (2 marks)
  - Sulphur (S) forms SF<sub>6</sub> but oxygen does not form OF<sub>6</sub>. (2 marks)

- iii) Oxygen exists as O<sub>2</sub> but sulphur as S<sub>8</sub>. ( 2 marks)
- iv) In NO<sub>3</sub><sup>-</sup> ion, all the three N– O bonds are identical. ( 2 marks)
- v) NH<sub>3</sub> has higher boiling point than PH<sub>3</sub>. ( 2 marks)
- vi) HF is weaker acid than HCl. ( 2 marks)
- e) Define the following terms
  - i) Inert pair effect (2 marks)
  - ii) Oxo-acids ( 2 marks)
- f) Match the items of column 1 and column 2 (4 marks)
 

(A) H <sub>2</sub> SO <sub>4</sub>	(1) Highest electron gain enthalpy
(B) CCl <sub>3</sub> NO <sub>2</sub>	(2) Chalcogen
(C) Cl <sub>2</sub>	(3) Tear gas
(D) Sulphur	(4) Storage batteries
- g) Why are greenhouse gases essential to life? (1 mark)

### QUESTION TWO – 20 MARKS

- a) Give four examples of greenhouse gases? (3 marks)
- b) Based on your understanding of how the periodic table is organized explain the following
  - i) Why there are only two elements in the first period, but eight elements in the second period (2 marks)
  - ii) Why elements in the same group generally form the same types of ions. (2 marks)
  - iii) Why the noble gases are so stable. (2 marks)
- c) Discuss the general characteristics of Group 15 elements with reference to their electronic configuration, oxidation state, atomic size, ionisation enthalpy and electronegativity. (8 marks)
- d) When a metal of group 1 was dissolved in liquid ammonia, the following observations were obtained: Blue solution was obtained initially and on concentrating the solution, blue colour changed to bronze colour. How do you account for the blue colour of the solution?

### QUESTION THREE – 20 MARKS

- a) Account for high reduction potential of lithium? (2 marks)
- b) How is nitrogen prepared in the laboratory? Write the chemical equations of the reactions involved. (3 marks)
- c) Describe the manufacture of H<sub>2</sub>SO<sub>4</sub> by contact process? (6 marks)
- d) How is SO<sub>2</sub> an air pollutant? (6 marks)

- e) Classify the following 15<sup>th</sup> group p-block elements into nonmetals/metalloids /metal.  
1) Nitrogen 2) Phosphorus 3) Arsenic 4) Antimony 5) Bismuth (3 marks)

**QUESTION FOUR – 20 MARKS**

- a) Arrange the following in the order of property indicated for each set:
- (i) F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub> - increasing bond dissociation enthalpy. (2 marks)
  - (ii) HF, HCl, HBr, HI - increasing acid strength. (2 marks)
- b) Describe how sodium carbonate is obtained by solvay process (5 marks)
- c) Show how ammonia can be recovered in solvay process (2 marks)
- d) Provide chemical formula for each of the following (4 marks)
- i) Soda ash
  - ii) Lime stone
  - iii) Caustic soda
  - iv) Washing soda
- e) What constitute clinker in cement manufacturing (3 marks)
- f) Explain why potassium and sodium present in cement raw material undesired by builders. (2 marks)