

| <b>DEVELOPMENT OF CONTENT AREAS- CHEMISTRY</b>    |                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <b>CONTENT AREA</b>                               | <b>COMPETENCIES</b>                                                                                                                                                  | <b>DESCRIPTIVE STATEMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                   |
| 1. General Practices and Safety in the Laboratory | Demonstrate knowledge of laboratory equipment, best practices, safety and administration of first aid in the science laboratory                                      | <ul style="list-style-type: none"> <li>i. Explain laboratory rules, best practices, safety precautions needed in the chemistry laboratory</li> <li>ii. Identify possible hazards and possible safety measures to prevent likely accidents in the laboratory.</li> <li>iii. Names and uses of basic apparatuses and administration of first aid before requesting for assistance of a medical doctor.</li> </ul> |
| 2. Measurement of Physical Quantities             | Good knowledge in basic and derived unit                                                                                                                             | <ul style="list-style-type: none"> <li>i. Distinguish between derived and basic units</li> </ul>                                                                                                                                                                                                                                                                                                                |
| 3. Structure of the Atom                          | Understand the contribution of various scientists and their limitations in developing the structure of the atom                                                      | <ul style="list-style-type: none"> <li>i. Determine the contributions of each of the various scientists and their limitations such as John Dalton, JJ Thomson, Ernest Rutherford, Chardwick</li> <li>ii. Illustrate energy levels in atoms</li> </ul>                                                                                                                                                           |
| 4. Electronic Configuration of Atoms              | Show an ability to write electronic configuration of atoms using the guiding principles and idea of energy levels and to use the electronic configuration to explain | <ul style="list-style-type: none"> <li>ii. Write the electronic configuration of atoms including the electron in box.</li> </ul>                                                                                                                                                                                                                                                                                |

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|                                          | arrangement of atoms in the periodic table and some characteristics of some atoms.                                                                                                                                                                         | <ul style="list-style-type: none"> <li>iii. Differentiate between Aufbau principle or Hund's rule and Pauli's exclusion principle.</li> <li>iv. Use the electronic configuration to explain some discrepancies in the periodic properties of some atoms</li> </ul>                                                         |
| 5. Periodicity                           | <ul style="list-style-type: none"> <li>1. Knowledge in arrangement of the atoms in the periodic table</li> <li>2. Variations of periodic properties across a period and down the group and classification of elements into s, p, d and f blocks</li> </ul> | <ul style="list-style-type: none"> <li>i. Explain the periodic law</li> <li>ii. Identify and explain the properties in the periodic trends of elements</li> <li>iii. The concept of trends in periodic properties such as atomic size, ionic size, electron affinity, ionization energy, electronegativity etc.</li> </ul> |
| 6. Inter and Intra-Atomic Bonding        | Demonstrate understanding of interatomic and intra-atomic bonding                                                                                                                                                                                          | i. Explain the types, formation and structure of bonding such as ionic, covalent, dative, metallic, hydrogen and van der Waals forces and polarity Predict the chemical properties of the bonds                                                                                                                            |
| 7. Hybridization and Shapes of Molecules | Understand the terminologies associated with hybridization                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>i. Show the formation of <math>sp^3</math>, <math>sp^2</math>, and <math>sp</math> hybrid orbitals.</li> <li>ii. Identify the type of properties of hybridization</li> </ul>                                                                                                        |

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|                                            |                                                                                                                                                                                                                                                       | iii. sketch the shape of hybrid orbitals                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8. Transition Chemistry                    | <ol style="list-style-type: none"> <li>1. Knowledge of transition elements, electronic configuration, properties.</li> <li>2. Recognise the nomenclature, shapes of complex compounds., nomenclature and shapes of complexes and compounds</li> </ol> | <ol style="list-style-type: none"> <li>i. Show the detailed electronic configuration of transition elements.</li> <li>ii. Identify the properties of transition elements</li> <li>iii. Name and give and shapes of complexes</li> </ol>                                                                                                                                                                                                                                                                            |
| 9. Rate of Reactions and Nuclear Chemistry | Demonstrate understanding of rate of chemical reactions and nuclear chemistry                                                                                                                                                                         | <ol style="list-style-type: none"> <li>i. Determine the rate constant using experimental data</li> <li>ii. Explain the factors affecting reaction rate</li> <li>iii. Deduce Half-life of a reaction and decay constant</li> <li>iv. Use the rate determining steps to determine the order of reaction</li> <li>v. Derive the expression of K</li> <li>vi. Deduce the general law equation from experimental data</li> <li>vii. Determination of rates of reaction from concentration versus time curves</li> </ol> |
| 10. Chemical Equilibrium                   | Application of the concept of equilibrium system and for industrial process                                                                                                                                                                           | <ol style="list-style-type: none"> <li>i. Write mathematical expression for the determination of equilibrium constant <math>K_c</math> and <math>K_p</math> for a given reaction</li> </ol>                                                                                                                                                                                                                                                                                                                        |

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|                              |                                                                                                                          | ii. Perform simple calculation using the equilibrium laws                                                                                                                                                                                        |
| 11. Acids and Bases          | Understand the concepts of the theories and properties of acids and bases, pH, pOH, buffers                              | i. Describe Arrhenius, Bronsted-Lowry and Lewis concepts of acids and bases<br>ii. Deduce the pH and pOH from specified concentrations of acids and bases<br>iii. Prepare buffer solutions<br>iv. Show the effect of buffer solution in systems  |
| 12. Solubility of Substances | Show knowledge of solubility and qualitative analysis of anions and cations                                              | i. Determine the solubility product of substances<br>ii. Predict the preliminary and confirmatory test of anions and cations                                                                                                                     |
| 13. Redox Reactions          | Show awareness of redox reactions and its applications (Oxidation – reduction processes and oxidizing – reducing agents) | i. Define oxidation and reduction in terms of addition of hydrogen, subtraction of oxygen and electron lost or gain.<br>ii. Determine the oxidizing and reducing agents.<br>iii. Explain why oxidation and reduction must occur at the same time |

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|                                                      |                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>iv. Balance redox Reactions involving half-cell reaction</li> <li>v. Explain Faraday's laws of electrolysis and use them to solve questions based on the laws</li> </ul>                                  |
| 14. Organic Compounds                                | Show general awareness of the sources, structure, IUPAC nomenclature, properties of carbon compounds                                                                                                                                   | <ul style="list-style-type: none"> <li>i. classify organic compounds into aliphatic, alicyclic, heterocyclic and aromatic</li> <li>ii. name the hydrocarbons, alkanols, carboxylic and its derivatives</li> </ul>                                |
| 15. Identification of Elements in Organic Compounds  | Demonstrate understanding of identification of elements found in an organic compound (Alkanes, alkenes, alkynes and their respective alicyclic aromatic and heterocyclic compounds, alcohols, ketones, aldehydes and carboxylic acids) | <ul style="list-style-type: none"> <li>i. Demonstrate the experimental determination of the elements: C, H, O, N, S and halogens in a given organic compound</li> <li>ii. Estimating the empirical, molecular and structural formulae</li> </ul> |
| 16. Separation and Purification of Organic Compounds | Demonstrate knowledge of filtration, recrystallization, distillation and chromatography, melting point determination                                                                                                                   | <ul style="list-style-type: none"> <li>i. Explain the various methods of separations</li> </ul>                                                                                                                                                  |
| 17. Chemical Industry                                | Recognise the processes and role of chemical industries for the society                                                                                                                                                                | <ul style="list-style-type: none"> <li>i. Discuss the chemical processes that go on in chemical industries and its environmental implications</li> </ul>                                                                                         |
| 18. Extraction of Metals                             | Show awareness of minerals in Ghana and understand how they are exploited                                                                                                                                                              | <ul style="list-style-type: none"> <li>i. Outline the extraction processes of minerals in Ghana with equations.</li> </ul>                                                                                                                       |

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|                                                      |                                                                                                    | ii. Discuss the domestic and industrial use of minerals in Ghana                                                                                                                                                                                         |
| 19. Extraction of Crude Oil and Petroleum Processing | Show knowledge of crude oil formation, composition and the market dynamics in terms of its sources | i. Explain why light -sweet crude is preferred to heavy sour crude oil for industrial use<br>ii. Explain the terminologies association with crude oil production and petroleum such octane number', knocking,' anti-knocking', cracking substances       |
| 20. Environmental Pollution                          | Recognise the effect of chemical industries and mining particular to the environment               | i. Discuss why Lead tetraethyl has been faced out as an additive to gasoline<br>ii. Discuss greenhouse effect, acid rain and ozone depletion<br>iii. Explain why aquatic organism in lakes containing limestones seems to experience less adverse effect |
| 21. Fats and Oils                                    | Understand the chemical reactions and impact of fats and oils for humans and the environment       | i. Outline the chemical process involve in the production of soap<br>ii. Explain terminologies associated with soap productions such as salting out', soapy detergent, soapless detergent',                                                              |

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| 22. Synthetic Polymers | Show knowledge of types, reactions and uses synthetic polymers. | <ul style="list-style-type: none"><li>i. Distinguish between addition and condensation polymerisation</li><li>ii. Discuss the effect of heat, acids and bases on plastics</li></ul> |
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**TABLE OF SPECIFICATION-CHEMISTRY**

| <b>SN</b> | <b>COMPETENCY AREAS</b>                                                                                                                                | <b>LEVEL 1<br/>(Recall)</b> | <b>LEVEL 2<br/>(Skill/Concept)</b> | <b>LEVEL 3<br/>(Strategic Thinking)</b> | <b>LEVEL 4<br/>(Extended Thinking)</b> | <b>Total</b> |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------|-----------------------------------------|----------------------------------------|--------------|
| 1         | Demonstrate knowledge of laboratory equipment, best practices, safety and administration of first aid in the science laboratory                        | 1                           | 0                                  | 0                                       | 1                                      | 2            |
| 2         | Show good knowledge in basic and derived unit                                                                                                          | 0                           | 0                                  | 0                                       | 1                                      | 1            |
| 3         | Understand the contribution of various scientists and their limitations in developing the structure of the atom                                        | 1                           | 1                                  | 1                                       | 0                                      | 3            |
| 4         | Show an ability to write electronic configuration of atoms using the guiding principles and idea of energy levels                                      | 0                           | 0                                  | 1                                       | 1                                      | 2            |
|           | Use the electronic configuration to explain arrangement of atoms in the periodic table and some characteristics of some atoms.                         | 0                           | 0                                  | 1                                       | 1                                      | 2            |
| 5         | Knowledge in arrangement of the atoms in the periodic table                                                                                            | 1                           | 0                                  | 1                                       | 1                                      | 3            |
| 6         | Show an understanding of variations of periodic properties across a period and down the group and classification of elements into s, p, d and f blocks | 1                           | 1                                  | 0                                       | 1                                      | 3            |
| 7         | Demonstrate understanding of interatomic and intra-atomic bonding                                                                                      | 0                           | 1                                  | 1                                       | 0                                      | 2            |
| 8         | Understand the terminologies associated with hybridization                                                                                             | 0                           | 1                                  | 0                                       | 1                                      | 2            |
| 9         | Knowledge of transition elements, electronic configuration, properties.                                                                                | 1                           | 0                                  | 1                                       | 1                                      | 3            |



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| 10 | Recognise the nomenclature, shapes of complex compounds., nomenclature and shapes of complexes and compounds                                                                                                                            | 1 | 0 | 1 | 1 | 3 |
| 11 | Demonstrate understanding of rate of chemical reactions and nuclear chemistry                                                                                                                                                           | 1 | 1 | 0 | 1 | 3 |
| 12 | Application of the concept of equilibrium system and for industrial process                                                                                                                                                             | 1 | 0 | 1 | 1 | 3 |
| 13 | Understand the concepts of the theories and properties of acids and bases, pH, pOH, buffers                                                                                                                                             | 0 | 1 | 1 | 0 | 2 |
| 14 | Show knowledge of solubility and qualitative analysis of anions and cations                                                                                                                                                             | 0 | 0 | 1 | 1 | 2 |
| 15 | Show awareness of redox reactions and its applications ( Oxidation – reduction processes and oxidizing – reducing agents                                                                                                                | 0 | 1 | 1 | 0 | 2 |
| 16 | Show general awareness of the sources, structure, IUPAC nomenclature, properties of carbon compounds                                                                                                                                    | 0 | 1 | 1 | 1 | 3 |
| 17 | Demonstrate understanding of identification of elements found in an organic compound (Alkanes, alkenes, and their respective alicyclic aromatic and heterocyclic compounds. Alkynes. Alcohols, ketones, aldehydes and carboxylic acids) | 0 | 1 | 1 | 1 | 3 |
| 18 | Demonstrate knowledge of filtration, recyclization, distillation and chromatography, melting point determination                                                                                                                        | 0 | 1 | 1 | 0 | 2 |
| 19 | Recognise the processes and role of chemical industries for the society                                                                                                                                                                 |   | 1 | 1 | 1 | 3 |
| 20 | Show awareness of minerals in Ghana and understand how they are exploited                                                                                                                                                               | 0 | 0 | 1 | 1 | 2 |
| 21 | Show knowledge of crude oil formation, composition and the market dynamics in terms of its sources                                                                                                                                      | 0 | 1 | 1 | 0 | 2 |

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| 22 | Recognise the effect of chemical industries and mining particular to the environment         | 1          | 1          | 1          | 0          | 3          |
| 23 | Understand the chemical reactions and impact of fats and oils for humans and the environment | 0          | 1          | 0          | 1          | 2          |
| 24 | Show knowledge of types, reactions and uses synthetic polymers.                              | 0          | 1          | 0          | 1          | 2          |
|    | <b>TOTAL NUMBER OF QUESTIONS</b>                                                             | <b>9</b>   | <b>15</b>  | <b>18</b>  | <b>18</b>  | <b>60</b>  |
|    | <b>Total</b>                                                                                 | <b>15%</b> | <b>25%</b> | <b>30%</b> | <b>30%</b> | <b>100</b> |