



NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

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QUALIFICATION : BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 7
COURSE: ENVIRONMENTAL CHEMISTRY	COURSE CODE: ENC702S
DATE: NOVEMBER 2024	SESSION: 1
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY: EXAMINATION QUESTION PAPER

EXAMINER: *Mr Tjaronda Karumendu, Mr Festus Shafodino*
MODERATOR: *Prof. James Abah*

INSTRUCTIONS

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS

1. Non-Programmable Calculator

This paper consists of **3** pages including this front page and Periodic table.

Question 1**[30]**

- 1.1. Define the following terms (6)
 - a. Geology:
 - b. Geochemistry
 - c. Environmental geochemistry
- 1.2. Explain the variations of temperature with altitude in different layers of the atmosphere. (2)
- 1.3. The mechanism by which the earth self regulates its temperature is called the carbon dioxide cycle. Explain how the CO₂ geochemical cycle illustrates the definition of environmental chemistry. (10)
- 1.4. Briefly explain what Earth's Natural Capital is and what it provides to ensure life on Earth (4)
- 1.5. It is encouraged that economic systems must emphasize provision of services rather than material goods that deplete resources. Suggest two ways in which the above can be achieved. (2)
- 1.6. Briefly describe the Goldschmidt's geochemical classifications of elements. (6)

Question 2**[20]**

- 2.1. What is stratospheric ozone depletion? (2)
- 2.2. Describe how and where (tropic level) nitric oxide is responsible for the **destruction** of ozone. Show reactions and the sources of all reactants involved. (5)
- 2.4. A fly ash particle emitted into the atmosphere reaches altitude of 500 m. The fly ash particle has density of 0.8 g cm⁻³ and falls at 1 m s⁻¹. Below is Stokes' law equation for sedimentation.

$$v = \frac{gd^2(\rho_1 - \rho_2)}{18\eta}$$

- a. Taking the density of air as 1.2 g L⁻¹, air viscosity as 170.8×10⁻⁶ g cm⁻¹s⁻¹, and acceleration due to gravity as 9.8 m s⁻², calculate the effective diameter of the fly ash particle. Would this particulate be classified as one of the six priority pollutants regulated by USEPA. Justify your answer (10)
- b. Considering the maximum altitude the particle can reach, estimate the residence time, of this particulate matter in the atmosphere. (3)

Question 3**[25]**

- 3.1. Define the following terms
- a. Evapotranspiration (1)
 - b. Thermal stratification (2)
 - c. Oxygen sag curve (1)
- 3.2. Consider the unique and important properties of water. Describe each of the following unique properties of water related to
- a. High heat of evaporation (2)
 - b. Transmission of light (transparency) (2)
 - c. High surface tension (2)
 - d. Excellent solvent (2)
- 3.3. Water with an alkalinity of 2.00×10^{-3} equivalents/liter has a pH of 7.00. Calculate $[\text{CO}_2]$, $[\text{HCO}_3^-]$, $[\text{CO}_3^{2-}]$, and $[\text{OH}^-]$. (8)
- 3.4. State the balanced reaction and the bacteria that is involved in catalysing the oxidation of Fe (II) to Fe (III). (3)

Question 4**[25]**

- 4.1. Differentiate between phytoremediation and cation exchange (2)
- 4.2. What does AMD stand for, and what is the general balanced equation for this process? (3)
- 4.3. How does water naturally accumulate dissolved solids, and why is evaporation considered as the main cause of salinity problems? (3)
- 4.4. It is well known that the sorption properties of clay minerals and humus usually are pH dependent. Give 3 examples (with reactions) demonstrating the pH dependency of these materials. (6)
- 4.5. State four (4) processes through which the soil can modify the water chemistry and/or water quality. (4)
- 4.6. State three (3) the negative environmental impacts of volcanoes into the geosphere, biosphere, and atmosphere. (3)
- 4.7. Why is the geosphere regarded as a source of natural capital? (3)

***** END OF QUESTION PAPER *****