NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

**FACULTY OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF NATURAL AND APPLIED SCIENCES**

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| **QUALIFICATION:** BACHELOR OF SCIENCE | |
| **QUALIFICATION CODE:** 07BOSC | **LEVEL:** 7 |
| **COURSE NAME:** ENVIRONMENTAL CHEMISTRY | **COURSE CODE:** ENC702S |
| **SESSION:** JANUARY 2020 | **PAPER:** THEORY |
| **DURATION:** 3 HOURS | **MARKS:** 100 |

| **SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION PAPER** | |
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| **EXAMINER(S)** | Dr JULIEN LUSILAO |
| **MODERATOR:** | Dr JAMES ABAH |

| **INSTRUCTIONS** |
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| 1. Answer ALL the questions in the answer book provided.<br>2. Write and number your answers clearly.<br>3. All written work MUST be done in blue or black ink. |

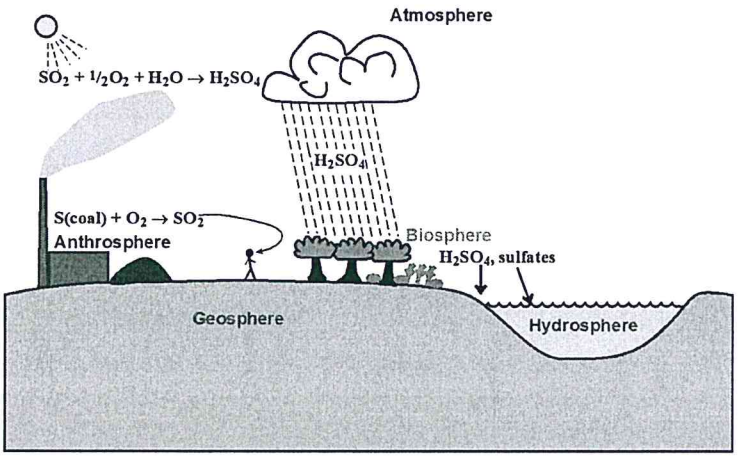
## PERMISSIBLE MATERIALS

Non-programmable Calculators

**THIS QUESTION PAPER CONSISTS OF 5 PAGES** (Including this front page)

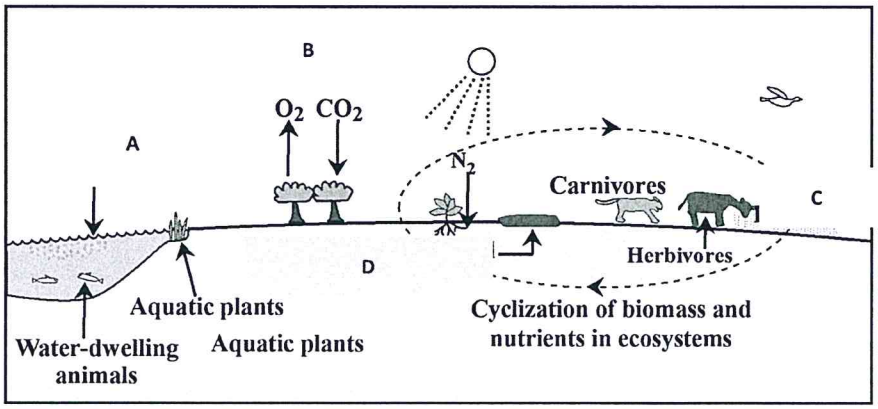
## Question 1 [15]

1.1 The following figure illustrates the definition of Environmental Chemistry with respect to the five spheres of the Earth system.




Explain in detail what is described in this figure. (4)

1.2 It is well known that the biosphere strongly influences the other spheres of the Earth system as shown in the figure below.




Name the processes represented in the figure by A to D with respect to the above statement. (5)

1.3 It is said that Industrial ecology views an industrial system like an industrial ecosystem. Briefly explain this approach in three points. (6)

## Question 2 [30]

2.1 Briefly discuss the following aspects of the troposphere: atmospheric location, major source of heat, major gaseous components, mass, and temperature gradient. (5)

2.2 What phenomenon is responsible for the maximum temperature observed at the boundary between the stratosphere and the mesosphere? (2)

2.3 Give the BALANCED chemical reactions involving oxygen molecule in the following reactions:

(a) Ozone formation (1)

(b) Animal respiration (1)

(c) Combustion of fossil fuel (1)

2.4 Air pollutants may be classified based on the way they reach the atmosphere. Describe (with an example for each case) the different classes of pollutants that fall within this category. (6)

2.5 What is the settling velocity of a particle having a Stokes' diameter of 10 μm and a density of 1 g/cm$^3$ in air at 1.00 atm pressure and 0°C temperature? The viscosity of air at 0°C is 170.8 micropoise (poise = g/cm.S) and the density of air under these conditions is 1.29 g/L. (g = 9.81 m/sec$^2$) (5)

2.6 (a) What is stratospheric ozone depletion? (2)

(b) Describe, with appropriate reactions, how the depletion in (a) occurs using chlorofluorocarbon (CFC) as a starting point. (4)

(c) List the different solutions that are currently used as an ADAPTATION approach to the global warming problem. (3)

## Question 3 [30]

3.1 Define the following:

(a) Evapotranspiration (1)

(b) Infiltration (1)

(c) Runoff (1)

3.2 Write the approximate net reaction between carbonate ion and water in a system that is exposed to atmospheric carbon dioxide. Is the resulting water mildly acidic or mildly alkaline? (2)

3.3 (a) Differentiate between Total Alkalinity and Phenolphthalein Alkalinity. (2)

(b) For a solution having $1.00 \times 10^{-3}$ equivalents/liter total alkalinity (i.e. contributions from $HCO_3^-$, $CO_3^{2-}$, and $OH^-$) at $[H^+] = 4.69 \times 10^{-11}$, what is the percentage contribution to alkalinity from $CO_3^{2-}$? (5)

3.4 (a) Provide the mathematical relationship between *pE* and the oxidation-reduction potential, *E*, at $25^0$C for *E* values measured in volts. (1)

(b) How would you expect *pE* to vary with depth in a stratified lake? (2)

(c) Upon what half-reaction is the rigorous definition of *pE* based? (2)

3.5 Give the main role of the following microorganisms in aquatic environments:
(a) Algae (1)

(b) Fungi (1)

(c) Protozoa (1)

3.6 (a) Provide the likely source of the following water pollutants:
(i) Herbicides (1)

(ii) Fecal coliform bacteria (1)

(iii) Pharmaceutical metabolites (1)

(b) What is water eutrophication and why is it considered as a case of pollution? (5)

(c) What are the most harmful elemental pollutants found in waters? (2)

## Question 4 [25]

4.1 Provide four examples showing the interconnection between the biosphere and the geosphere. (4)

4.2 Give the general chemical formula of the following minerals:
(a) Quartz (1)

(b) Calcite (limestone) (1)

(c) Magnetite (1)

(d) Halite (1)

4.3 What does the geosphere provide to the environment as a source of natural capital? (3)

4.4 What are the main size groups of soil and how are they formed? (5)

4.5 Match the following:
(A) Metamorphic rock; (B) Chemical sedimentary Rocks; (C) Detrital rock; (D) Organic sedimentary rock.
(1) Produced by the precipitation or coagulation of dissolved or colloidal weathering products; (2) Contain residues of plant and animal remains; (3) Formed from action of heat and pressure on sedimentary rocks; (4) Formed from solid particles eroded from igneous rocks as a consequence of weathering. (4)

4.6 (a) What are soil fumigants? (1)

(b) What are the four major categories of concern with respect to pesticides and their residues in soil? (4)

**END**