



**PAMIBIA UNIVERSITY**  
OF SCIENCE AND TECHNOLOGY

**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**DEPARTMENT OF NATURAL AND APPLIED SCIENCES**

<b>QUALIFICATION:</b> BACHELOR OF SCIENCE	
<b>QUALIFICATION CODE:</b> 07BOSC	<b>LEVEL:</b> 7
<b>COURSE NAME:</b> ENVIRONMENTAL CHEMISTRY	<b>COURSE CODE:</b> ENC702S
<b>SESSION:</b> JANUARY 2023	<b>PAPER:</b> THEORY
<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 100

<b>SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION PAPER</b>	
<b>EXAMINER(S)</b>	Dr JULIEN LUSILAO
<b>MODERATOR:</b>	Dr JAMES ABAH

<b>INSTRUCTIONS</b>
<ol style="list-style-type: none"><li>1. Answer ALL the questions in the answer book provided.</li><li>2. Write and number your answers clearly.</li><li>3. All written work MUST be done in blue or black ink.</li></ol>

**PERMISSIBLE MATERIALS**

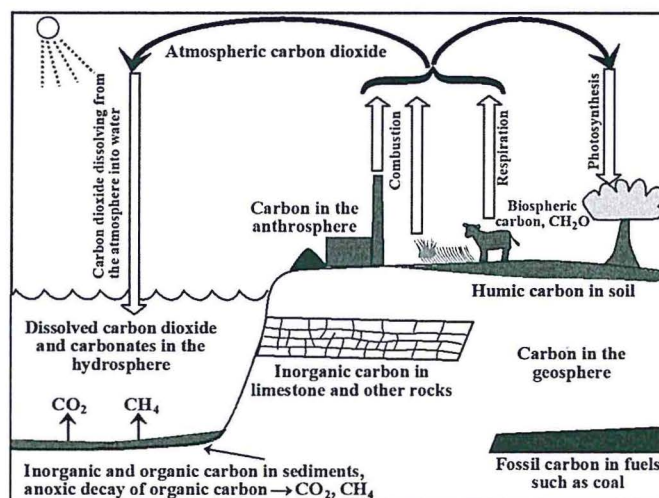
Non-programmable Calculators

**THIS QUESTION PAPER CONSISTS OF 4 PAGES** (Including this front page)

## Question 1

[20]

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.

(6)

1.2 Briefly discuss the geochemical (Goldschmidt) classification of the elements.

(8)

1.3 Explain the processes that result in the over accumulation of some elements in localized areas (i.e. formation of ore minerals) with examples.

(6)

## Question 2

[30]

2.1 (a) The table below shows the values of the average atmospheric pressure at sea level with different units.

Unit	Value
1. Torr	A. 1
2. Atmosphere	B. 76
3. cm Hg	C. 14.7
4. Pascal	D. 1.01325
5. Bar	E. 760
6. Psi	F. $1.01325 \times 10^5$

Associate each unit (1 to 6) to its corresponding value (A to F).

(3)

(b) Give the trade names of the following fluorocarbons

(i) Trichlorofluoromethane ( $CCl_3F$ )

(1)

(ii) Dichlorodifluoromethane ( $CCl_2F_2$ ) (1)

(iii) Bromotrifluoromethane ( $CBrF_3$ ) (1)

2.2 The atmosphere is divided in 4 main regions called troposphere, stratosphere, mesosphere and thermosphere.

(a) What is the main criterion used for the division of the atmospheric regions? (2)

(b) It has been reported that while water vapour can range between 1 to 5% in the troposphere, little water is found in the stratosphere.

(i) What prevents tropospheric water to reach the stratosphere? (2)

(ii) What is the main source of stratospheric water? Show the reaction involved. (2)

(iii) What is the main purpose of stratospheric water? Show the reaction involved. (2)

2.3 It has been reported that the inorganic oxides are the main gases responsible for the acidification of rain water. Name three different elements which oxides may react with to form atmospheric acids and write the corresponding BALANCED reaction in each case. (6)

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 Persistent Organic Pollutants (POPs) are poorly biodegradable organic compounds recognized as especially troublesome. Provide the reasons behind the underlined statement. (4)

### **Question 3** [30]

3.1 Water is an excellent solvent, it has higher heat of evaporation than any other material (540 cal/g) and has the higher latent heat of fusion ( $3.33 \times 10^5$  J/kg) than any other liquid (except  $NH_3$ ). Provide the respective environmental significance of the underlined properties of water. (6)

3.2 (a) Define water alkalinity. (2)

(b) Why is the determination of the bicarbonate alkalinity (also called phenolphthalein alkalinity) is done at pH 8.3? (2)

(c) For a solution having  $1.0 \times 10^{-3}$  equivalents/liter total alkalinity (i.e. from  $HCO_3^-$ ,  $CO_3^{2-}$ , and  $OH^-$ ) at  $[H^+] = 4.69 \times 10^{-11}$ , what is the percentage contribution to alkalinity from  $CO_3^{2-}$  ( $K_{a1} = 4.45 \times 10^{-7}$  and  $K_{a2} = 4.69 \times 10^{-11}$ )? (4)

- 3.3 (a) What are humic substances? (2)
- (b) Differentiate between humin material and fluvic acid. (2)
- (c) Provide two environmental concerns related to the occurrence of humic substances in freshwater systems. (2)
- 3.4 (a) Provide the likely source of the following water pollutants:
- (i) Herbicides (2)
- (ii) Fecal coliform bacteria (2)
- (b) Briefly discuss the main environmental concerns associated with the occurrence of pesticide metabolites and other organic pollutants in water? (6)

#### **Question 4**

**[20]**

4.1 Define the following terms:

- (a) Evaporites (1)
- (b) Weathering (1)
- (c) Clays (1)
- (d) Sediments (1)
- (e) Sublimates (1)

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

4.3 (a) What are soil macronutrients? (2)

(b) Provide the main chemical forms of occurrence of the following nutrients in soil:

- (i) Carbon (1)
- (ii) Nitrogen (1)
- (iii) Phosphorous (1)

4.4 Name five surface processes that cause natural hazards in the geosphere. (5)

**END**