



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	LEVEL: 7
COURSE NAME: ENVIRONMENTAL CHEMISTRY	COURSE CODE: ENC702S
SESSION: NOVEMBER 2019	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Dr JULIEN LUSILAO
MODERATOR:	Dr JAMES ABAH

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

PERMISSIBLE MATERIALS

Non-programmable Calculators

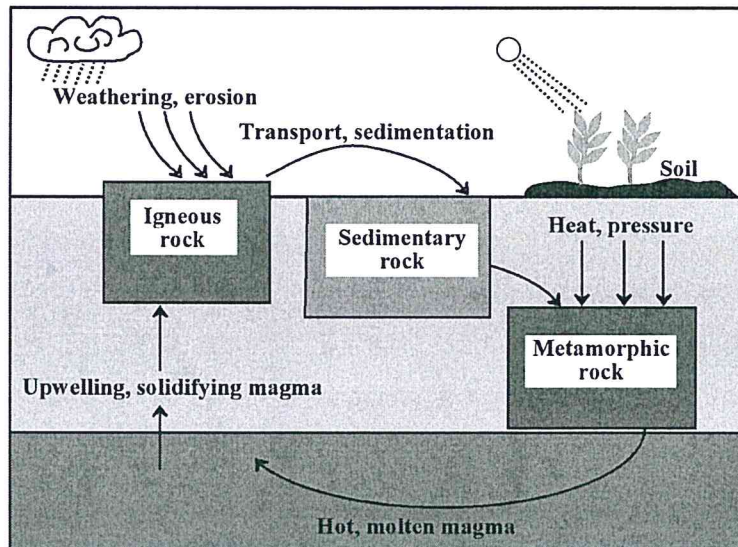
THIS QUESTION PAPER CONSISTS OF 5 PAGES (Including this front page)

Question 1

[15]

1.1 How would you define environmental chemistry if you must consider the different spheres of the Earth system? (4)

1.2 The figure below describes the rock cycle in the geosphere.



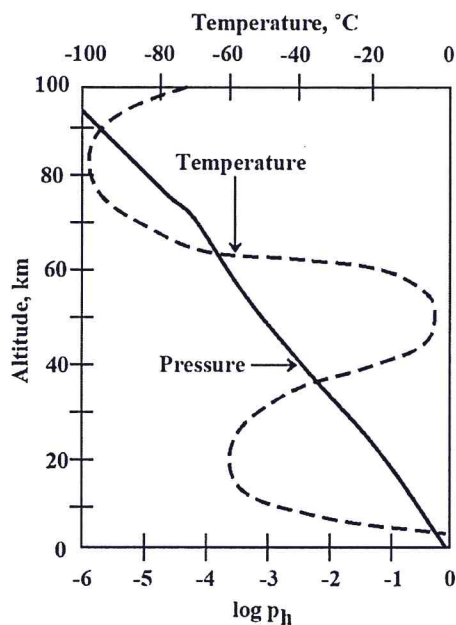
Explain the mechanism for the formation of each type of rock illustrated in the figure. (6)

1.3 Briefly explain what Green Chemistry is and how important is it for both the industry and our ecosystem. (5)

Question 2

[30]

2.1 The following diagram shows the relationship between atmospheric altitude, temperature and pressure.



What observations can be made from this diagram and what are the known implications of these observations? (5)

2.2 Briefly describe the main categories of atmospheric chemical reactions. (6)

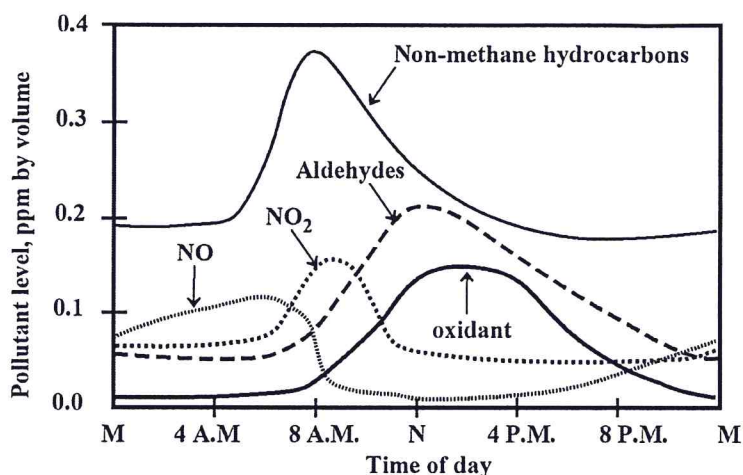
2.3 (a) How would you define air pollution? Avoid the word “pollutant” in your definition. (2)

(b) Complete the following reactions related to the formation of inorganic particles:



2.4 In 2006, the U.S. Environmental Protection Agency proposed lowering the allowable PM_{2.5} level to 35 $\mu\text{g}/\text{m}^3$. How many particles would this be in a cubic meter of air if all the particles were spheres of a diameter of 2.5 μm and had a density of exactly 1 g/cm^3 ? Note: The volume of 1 sphere, $V = 4/3 \pi r^3$ (5)

2.5 The plot below shows the level OF some species in the atmosphere during a smoggy day



Explain why NO_x (i.e. NO, NO₂) and non-methane hydrocarbons reach their maximum concentrations in the early hours of the morning (i.e. between about 6 and 8 am) whereas the aldehydes and oxidants exhibit maximum peaks around mid-day. (4)

2.6 (a) What are the two main reactions associated with the formation of acid rain? (2)

(b) Give three harmful effects of acid precipitation. (3)

Question 3

[30]

3.1 The study of water is known as _____ whereas _____ is the branch of the science dealing with the characteristics of fresh water, and _____ the science that deals with about 97% of all Earth's water. (3)

3.2 (a) Differentiate between acidity and alkalinity. (2)

(b) Water with an alkalinity of 2.00×10^{-3} equivalents/litre has a pH of 7.00. Calculate [CO₂], [HCO₃⁻], [CO₃²⁻], and [OH⁻].

$K_{a1}(\text{H}_2\text{CO}_3) = 4.45 \times 10^{-7}$; $K_{a2}(\text{HCO}_3^-) = 4.45 \times 10^{-7}$ (5)

3.3 (a) What is the mathematical expression of pE? (1)

(b) What determines the upper and lower limits, respectively, for the thermodynamic stability of water (Show the reactions involved)? (4)

3.4 (a) Define phycolgy. (1)

(b) Differentiate between chemoautotrophs and chemoheterotrophs. Provide an example in each case. (4)

- 3.5 (a) Match the pollutants from the list (A) to (D) with effects or other significant aspects on the bottom list, below:
 (A) Salinity (B) Alkalinity (C) Acidity (D) Nitrate
 (1) Excessive productivity (2) Can enter water from pyrite or from the atmosphere
 (3) Osmotic effects on organisms (4) From soil and mineral strata (4)
- (b) Discuss the chemical, physical and biological characteristics of Acid Mine Drainage (AMD). (6)

Question 4

[25]

- 4.1 Give four examples showing the interaction between the geosphere and the Hydrosphere. (4)
- 4.2 Define the following terms:
- (a) Evaporites (1)
- (b) Weathering (1)
- (c) Clays (1)
- (d) Sediments (1)
- 4.3 Briefly discuss the soil breakdown (or composition). (8)
- 4.4 Match the soil or soil-solution constituent in (1) to (4) with the soil condition described in (A) to (D) below:
 (1) High Mn^{2+} content in soil; (2) Excess H^+ ; (3) High H^+ and SO_4^{2-} concentrations; (4) High organic content.
 (A) "Cat clays" containing initially high levels of pyrite, FeS_2 ; (B) Soil in which biodegradation has not occurred to a great extent; (C) Waterlogged soil; (D) Soil, the fertility of which can be improved by adding limestone. (4)
- 4.5 (a) Explain the meaning of "internal processes" of natural hazards. (1)
- (b) What are the destructive effects of earthquakes? (4)

END