



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE HONOURS	
QUALIFICATION CODE: 08BOSH	LEVEL: 8
COURSE NAME: ENVIRONMENTAL POLLUTION, MONITORING AND REMEDIATION	COURSE CODE: EPM821S
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 works MUST be done in blue or black ink.

PERMISSIBLE MATERIALS

None

ATTACHMENT

None

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

Question 1

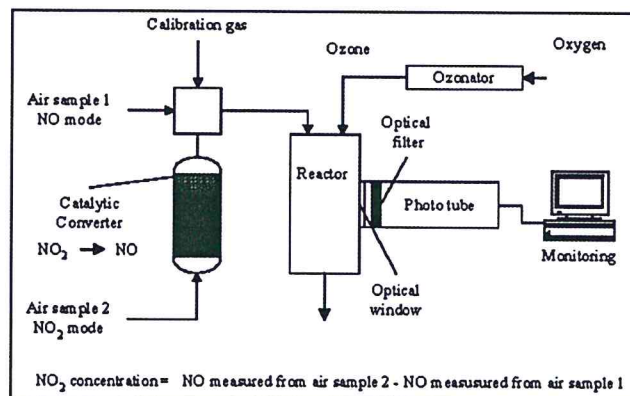
[20]

- 1.1 Explain how an earthquake can cause an overtopping on a Tailings Storage Facility. (4)
- 1.2 Define the following properties with respect to hazardous waste:
- (a) Irritant (2)
 - (b) Toxic (2)
 - (c) Corrosive (2)
- 1.3 Provide a typical sequence for managing hazardous waste (be mindful of the order of priority) and briefly explain each step. (10)

Question 2

[20]

- 2.1 Differentiate between stock pollutants and flow pollutants. (4)
- 2.2 Discuss the near-term and long-term approaches for the mitigation of climate change. (6)
- 2.3 The following diagram represents the analytical processes occurring in a chemiluminescence nitric oxide analyzer.



Explain in detail (with reactions) the procedures illustrated in the diagram. (10)

Question 3

[20]

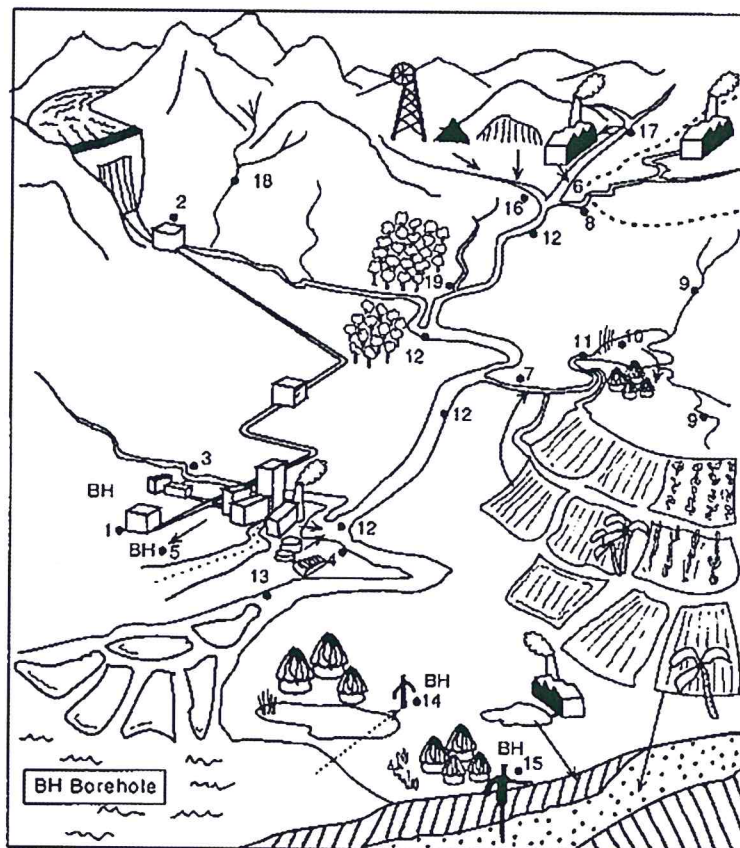
- 3.1 What parameters should be considered when describing the quality of an aquatic environment? (4)

3.2 (a) Define a watershed. (2)

(b) What are the three tiers characteristics of risks assessment methods of water pollution? (3)

3.3 The Darcy's Law is the basic approach for the evaluation of groundwater movement at low Reynolds numbers (R): $V = K(dh/dl)$ where V : velocity of groundwater in aquifer (m/day); K : coefficient of permeability of aquifer; (dh/dl) : hydraulic gradient which represents the driving force for movement. Briefly discuss the relevance of this law in understanding pollution travel in the underground domain. (6)

3.4 The figure below illustrates a typical sampling sites for a multi-purpose monitoring where the numbers are the sampling sites.



If the objective for the monitoring is the identification of baseline conditions in the water-course system:

(a) What analytical assessment(s) would you consider in order to meet your goals? (3)

(b) Which sampling sites will you target for that purpose? (2)

Question 4

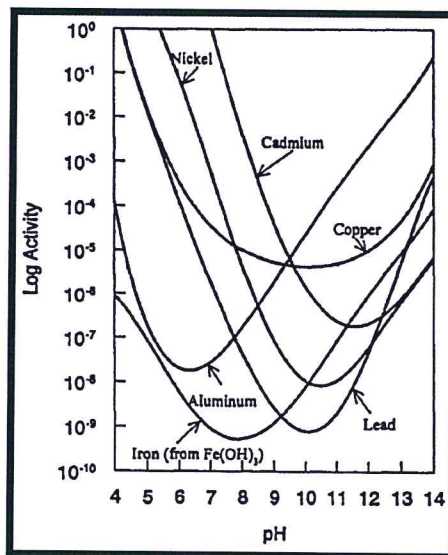
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4.1 Define the following:

- (a) Saline soil (1)
- (b) Sodic soil (1)
- (c) Saline-sodic soil (1)
- (d) Brine (1)
- (e) Anoxic Limestone Drain (ALD) (1)

4.2 Give and explain the sources of salts in arid and humid regions. (4)

4.3 The graph below shows the total solubility of various metals with pH.



- (a) What is the key observation that can be made from this figure? (1)
 - (b) What conclusion can be drawn from the observation in (a) in terms of the remediation of water systems contaminated by these metals? (2)
 - (c) Based on the conclusion in (b), what is the best approach that can be taken to remediate waters affected by these metals? (2)
- 4.4 Discuss (with reactions) the use of wetlands as technique of choice for acid drainage (AD) prevention. (6)

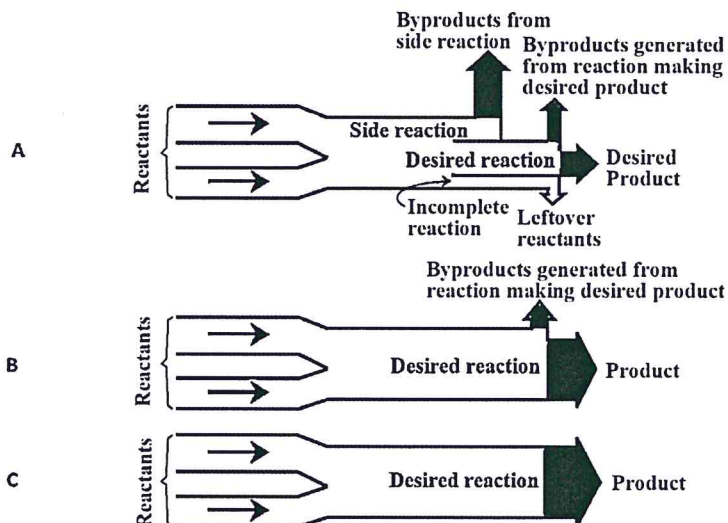
Question 5

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5.1 It is said that Green Chemistry is Sustainable Chemistry with respect to economics, materials and waste. Explain this statement. (5)

5.2 (a) Differentiate between the percentage yield and atom economy. (2)

(b) The figure below illustrates three different scenarios of Percent Yield and Atom Economy.



Briefly describe the scenarios in A, B and C. (3)

(c) Which of the scenarios in (b) best illustrates the use of a Green Chemistry approach? Explain (2)

5.3 What are the three main characteristics of industrial ecology? (3)

5.4 Provide the five major components of an industrial ecosystem. (5)

END