

DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF SWAZILAND

C616/ERM 641

CHEMICAL POLLUTION STUDIES

MAY 2015

FINAL EXAMINATION

Time Allowed:

Three (3) Hours

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**Instructions:**

1. This examination has six (6) questions.
2. Answer any four (4) questions fully; diagrams should be clear, large and properly labelled. Marks will be deducted for improper units and lack of procedural steps in calculations.
3. Each question is worth 25 marks.

**Special Requirements**

NONE

YOU ARE NOT SUPPOSED TO OPEN THIS PAPER UNTIL PERMISSION TO DO SO HAS BEEN GIVEN BY THE CHIEF INVIGILATOR.

**Question 1 [25]**

- (a) The Nitrogen cycle is one of nature's most vital dynamic processes. Use diagrams and chemical equations to describe it. [6]
- (b) The Carbon cycle is one of nature's most vital dynamic processes. Use diagrams and chemical equations to describe it. [6]
- (c) The Sulphur cycle is one of nature's most vital dynamic processes. Use diagrams and chemical equations to describe it. [6]
- (d) Summarise, with the aid of a diagram, the primary features of oxygen exchange among the atmosphere, lithosphere, hydrosphere, and biosphere. [7]

**Question 2 [25]**

- (a) List any two (2) major chemical pollutants of concern in domestic sewage, and state how they get into domestic waste water. [4]
- (b) List and describe the four stages of domestic effluent treatment using oxidation ponds. [8]
- (c) Use chemical equations to explain how each stage of the oxidation ponds work. [8]
- (d) Biofilter technology through the two stage trickling filter process is an appropriate alternative technology for treatment of domestic effluents. Discuss how this technology works. [5]

**Question 3 [25]**

- (a) In regard to "acid mine drainage" in coal mining,
- (i) Use equations to explain the origins of AMD [6]
- (ii) What pollution risks does AMD pose? [3]
- (iii) Annually, treatment of AMD runs into millions of Emalangeni. Describe the technologies currently used in South Africa for treating AMD. [5]
- (b) Treatment technologies are specific for industrial wastes.
- (i) Explain why oxidation pond technology is not suitable for industrial pollutants. [3]
- (ii) Describe how activated sludge technology works, and give an example of the type of industrial pollutants it is targeted for. [4]
- (iii) Describe how reverse osmosis works, and give an example of the type of industrial pollutants it is targeted for. [4]

**Question 4 [25]**

- (a) (i) What is meant by e-waste? [1]
- (ii) Discuss one (1) major health effect of elemental Mercury (Hg) contained in e-waste [2]
- (iii) How is mercury waste managed in a laboratory? [2]
- (iv) How is mercury waste managed in a dental hospital? [2]

- (b) Cadmium is a toxic heavy metal.
- (i) List two (2) sources of Cd that are currently leading to the release of Cd in the environment. [2]
  - (ii) Discuss the health effects of Cd in humans. [3]
  - (iii) Discuss the effects of Cd in the environment. [3]
  - (iv) With reference to rubber waste, discuss the environmental consequences of burying tyres in dumpsites, and suggest how such wastes can be managed. [3]
- (c) Solid waste management is regulated in Swaziland, and disposal sites are licensed. In relation to the Matsapha landfill,
- (i) Explain how leachate is produced, and how it is contained through landfill cell engineering. [3]
  - (ii) Discuss the climatic factors considered when designing a leachate pond. [2]
  - (iii) Explain how waste is classified by the Australian AS 2.11 Standard, and how co-disposal enables toxic sludges to be landfilled in a class 3 facility [2]

#### **Question 5 [25]**

- (a) (i) Write chemical equations for  $\text{CH}_4$  generation in a landfill. [2]
- (ii) What are the global consequences of releasing  $\text{CH}_4$  into the atmosphere? [3]
- (iii) How can a landfill facility capture  $\text{CH}_4$  and how could the captured  $\text{CH}_4$  be useful? [4]
- (b) Use equations to explain the origins of radioactive waste from the nuclear industry [3]
- (c) Explain how radioactive waste from nuclear plants is stored and disposed of [4]
- (d) Name a common greenhouse gas, and explain how it contributes to “global warming”? [3]
- (e) Explain what is meant by
- (i) Carbon footprint [2]
  - (ii) Carbon credits [2]
  - (iii) Carbon fund [2]

#### **Question 6 [25]**

- (a) One of the Persistent Organic Pollutants (PoPs) identified under the Strategic Approach to International Chemicals Management (SAICM) is DDT.
- (i) Explain how DDT gets into environment [2]
  - (ii) Explain how DDT is harmful to the environment. [2]
- (b) (i) What is meant by the “green house effect”? [2]
- (ii) List any two gases produced by human activities that cause the “green house” effect [4]
- (c) (i) What is meant by the “ozone layer”? [2]

(ii) List any two compounds that cause the destruction of the ozone layer [2]

(iii) Discuss any three (3) industrial sources of compounds that destroy the ozone layer [3]

(d) (i) What is meant by Clean Development Mechanism (CDM) in relation to the Kyoto Protocol [4]

(ii) What are "carbon credits" and how are they traded internationally? [4]