

DEPARTMENT OF CHEMISTRY

UNIVERSITY OF SWAZILAND

C616

CHEMICAL POLLUTION STUDIES

MAY 2011

FINAL EXAMINATION

Time Allowed:

Three (3) Hours

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) List any three (3) major chemical pollutants of concern in domestic sewage, and state how they get into domestic waste water. (6)
- (b) List and describe the four stages of domestic effluent treatment using oxidation ponds. (4)
- (c) Use chemical equations to explain how oxidation ponds work in the treatment of domestic waste water. (3)
- (d) Describe how each of the following disinfection technologies used in waste water treatment plants today works, list any one advantage and any one disadvantage,
 - (i) Chlorination (4)
 - (ii) Electromagnetic radiation treatment (4)
 - (iii) Ozonolysis (4)

Question 2[25]

- (a) In regard to "mine acid drainages" in coal mining,
 - (i) What are its origins? (2)
 - (ii) What pollution risks do they pose? (2)
 - (iii) How are they treated? (3)
- (b) Use equations to explain how metallurgy effluents are pre-treated prior to discharge into industrial sewers. (3)
- (c) The activated sludge process is probably the most versatile and effective of all waste treatment processes. Discuss how activated sludge technology works in the treatment of waste water from a sugar cane mill. (5)
- (d) Biofilter technology through the two stage trickling filter process is the most appropriate technology for treatment of domestic effluents. Discuss how this technology works. (5)
- (e) (i) What pollutant is a major problem common to both textiles and tanneries? (1)
 - (ii) Describe the technique of reverse osmosis as it applies to textile and tannery effluent treatment. (4)

Question 3[25]

- (a) (i) Use chemical equations to describe the phenomenon of "acid rain" (3)
 - (ii) Ample evidence exists of the damaging effects of acid rain. Discuss the major such effects. (4)
- (b) (i) What is photochemical smog and what causes it? (3)
 - (ii) Ample evidence exists of the damaging effects of photochemical smog. Discuss the major such effects. (3)

(c) For each of these persistent organic pollutants (PoPs),

PCBs

DDT

Dieldrin

Benzene

Describe,

- (i) How they get into environment. (4)
- (ii) How they are detected (4)
- (iii) Why they are harmful to the environment. (4)

Question 4[25]

- (a) (i) What is meant by the “green house effect”? (2)
- (ii) List any four gases produced by human activities that cause the “green house” effect. (4)
- (iv) Ample evidence exists of the damaging socio economic effects of global warming. Discuss the major such effects (5)
- (b) (i) What is meant by the “ozone layer”? (2)
- (ii) List any two compounds that cause the destruction of the ozone layer (2)
- (iv) Discuss any three (3) industrial sources of compounds that destroy the ozone layer (3)
- (v) What are the socio economic impacts of ozone layer destruction? (3)
- (c) What are “carbon credits” and how are they traded internationally? (4)

Question 5[25]

(a) Discuss the human consequences of ingestion of the following heavy metals.(2)

Pb

Cd

- (b) Describe why it is not acceptable to dispose of metallurgical waste in a “dumpsite”, but can be acceptable in a “landfill”. (3)
- (c) What is leachate, and explain the interplay of evaporation and precipitation in the design of leachate ponds in a landfill.(5)
- (d) (i) Write chemical equations for CH₄ generation in a landfill. (1)
- (ii) What are the global consequences of releasing CH₄ into the atmosphere? (3)
- (iii)How can a landfill facility capture CH₄ and how could the captured CH₄ be useful? (4)
- (e) Use equations to explain the origins of radioactive waste from the nuclear industry.(3)
- (f) Explain how radioactive waste from nuclear plants is stored and disposed of. (4)

Question 6[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)