DEPARTMENT OF CHEMISTRY

UNIVERSITY OF SWAZILAND

C616/ERM 641 **CHEMICAL POLLUTION STUDIES**

MAY 2014 **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) In Swaziland, industrial pollutants are a major concern, especially in the industrial sites which are serviced by the country's rivers. For each of the following industries, list its major pollutant, and how it arises.

(i) Textile manufacturing [2]

(ii) Sugar cane farming [2]

(b) Treatment technologies are specific for industrial wastes.

(i) Explain why oxidation pond technology is not suitable for industrial pollutants. [2]

(ii) Describe how biofilter technology works, and give an example of the type of industrial pollutants it is targeted for. [3]

(iii) Describe how activated sludge technology works, and give an example of the type of industrial pollutants it is targeted for. [3]

(iv) Describe how reverse osmosis works, and give an example of the type of industrial pollutants it is targeted for. [3]

(c) In Southern Africa, a major environmental pollution concern is Acid Mine Drainage (AMD) in coal mines.

(i) As a technological option for mining coal, describe the bord and pillar mining technique for extracting coal in Swaziland. [3]

(ii) This technology is notorious for acid mine drainage in South African coal mines. Use equations to explain how acid mine drainage forms in these mines. [4]

(v) Annually, treatment of AMD runs into millions of Emalangeni. Describe the technologies currently used in South Africa for treating AMD. [3]

Question 2 [25]

(a) Name a common greenhouse gas, and explain how it contributes to "global warming"? [3]

(b) Discuss two (2) major socio-economic effects of global warming [4]

(c) Explain what is meant by

(i) Carbon footprint [2]

(ii) Carbon credits [2]

(iii) Carbon fund [2]

(d) (i) What is the importance of the "ozone layer" to human health? [2]

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

(iii) What are the socio economic impacts of ozone layer destruction? [3]

(iv) List any two (2) compounds that are currently used to replace ozone depleting substances in the refrigeration industry in Swaziland. [2]

(e) Describe how Ozonolysis works, and give an example of the type of industrial pollutants it is targeted for. [3]

Question 3[25]

(a) 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. [2]

(iii) Discuss the effects of Cd in the environment. [2]

(iv) With reference to rubber waste, discuss the environmental consequences of burying tyres in dumpsites, and suggest how such wastes can be managed. [3]

(b) (i) Used oil is a major threat to surface water resources. Discuss. [3]

(ii) Explain how oil separators used in the construction industry work in preventing water pollution. [3]

(iii) What is meant by bioremediation, and how it is applied to oil-contaminated soils? [3]

(c) Lead is a toxic heavy metal found in paint.

(i) Discuss the health effects of Pb in humans. [2]

(ii) Discuss the effects of Pb in the environment. [2]

(iii) How is waste paint managed by the paint manufacturing industry in Swaziland? [3]

Question 4 [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. [3]

(b) (i) Use equations to explain the phenomenon of photochemical smog. [4]

(ii) Ample evidence exists of the damaging effects of photochemical smog. Discuss three (3) such major effects. [3]

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

(ii) If Swaziland were to use "dirty" coal to generate thermal power, what approach can be used in securing funding from IMF-affiliated funding agencies, e.g., World Bank? [4]

(iii) Use the example of SASOL (coal to synfuels plant) to explain how the CDM can be used to access carbon funds. [5]

Question 5 [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) 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) What is the role of a monitoring borehole in landfills, and why must the landfill be monitored for 40 years after closure? [3]

(c) One of the environmental problems associated with landfilling is landfill gas.

(i) Discuss two (2) environmental problems associated with land fill gas. [2]

(ii) Using the example of the Marianhill landfill in Durban, South Africa, explain how land fill gas can be used by the Matsapha Town Council to become an independent power producer (IPP) [3]

(d) One of the major aesthetic problems associated with coal mines is discard.

(i) What is discard? Why is it an aesthetic problem? [2]

(ii) One of the ways of mitigating the aesthetic impact of discard is to use it in gravelling roads and watering with dilute molasses stillage to suppress dust. What are the environmental implications of this approach? [3]

Question 6 [25]

(a) What is meant by chemical oxygen demand, and how is it related to biochemical oxygen demand? [2]

(b) Name the four stages of domestic effluent treatment using oxidation ponds. [4]

(c) Use chemical equations to explain how each stage works at 6 (b) above in the treatment of domestic waste water. [8]

(d) Describe how each of the following disinfection technologies used in waste water treatment plants today works, and describe any one advantage, and any one disadvantage of each.

(i) Chlorination [3]

(ii) Electromagnetic radiation treatment [3]

(e) (i) Use chemical equations to describe the phenomenon of "acid rain" [2]

(ii) Ample evidence exists of the damaging effects of acid rain. Discuss these effects. [3]