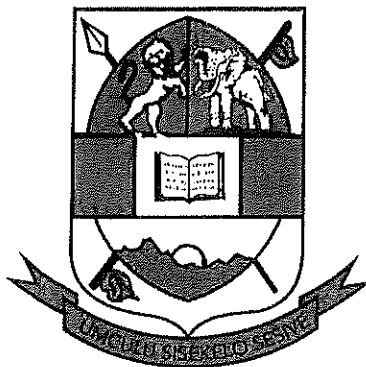


UNIVERSITY OF ESWATINI
DEPARTMENT OF CHEMISTRY



MAIN EXAMINATION 2020/2021

TITLE OF PAPER: CHEMICAL POLLUTION STUDIES

COURSE NUMBER: CHE 610

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS: ANSWER ANY FOUR (4) QUESTIONS

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

Question 1 [25]

- (a) Use chemical equations and diagrams to describe the role of each of the four (4) major stages involved in oxidation pond technology for treatment of domestic effluent. [8]
- (b) Treatment technologies are specific for industrial wastes.
- (i) Describe how biofilter technology works, and give an example of the type of industrial pollutants it is targeted for. [3]
 - (ii) Describe how activated sludge technology works, and give an example of the type of industrial pollutants it is targeted for. [3]
 - (iii) Describe how reverse osmosis works, and give an example of the type of industrial pollutants it is targeted for. [3]
 - (iv) Describe how ozonolysis 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 in coal mines is Acid Mine Drainage (AMD).
- (i) 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]

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 [3]
 - (ii) Carbon credits [3]
 - (iii) Carbon fund [3]
- (d) (i) Use equations to describe how the "ozone layer" protects human health [2]
- (ii) List any two compounds that cause the destruction of the ozone layer [2]
 - (iii) List any two (2) compounds that are currently used to replace ozone depleting substances in the refrigeration industry in Eswatini. [2]
- (c) What is meant by bioremediation, and how it is applied to oil-contaminated soils? [3]

Question 3 [25]

- (a) (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]

(b) 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
[5]

(ii) Electromagnetic radiation treatment
[5]

(c) (i) What is meant by PM_{10} and $PM_{2.5}$ in coal-fired power stations and what are the hazards associated with each? [4]

(ii) Describe the technology used to reduce PM_{10} and $PM_{2.5}$ from the flue gas in a coal-fired power stations [5]

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 two (2) such major effects. [2]

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

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

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

(i) What is coal 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 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]

(b) Solid waste management is regulated in Eswatini, 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) (i) Discuss two main industrial uses of chrysolite [2]
- (ii) Why are chrysolite tailings hazardous to human health [3]
- (iii) Explain how chrysolite tailings are rehabilitated in practice [4]

Question 6 [25]

- (a) Use chemical equations to describe the phenomenon of "acid rain" [3]
- (b) One of the major problems associated with coal-fired power stations is ash.
- (i) Why is coal ash considered a hazardous substance? [2]
- (ii) Describe two ways in which coal ash is discarded [4]
- (iii) Explain how pollutants from ash disposal sites are prevented from polluting groundwater, and how this is monitored. [5]
- (c) One of the concerns with coal-fired power stations is sulfurous emissions.
- (i) What is the source of sulfurous emissions in these type s of plants [2]
- (ii) Describe how sulfurous emissions are reduced in coal-fired power plants [5]
- (iii) Describe how sulphur containing waste from coal power station can be utilised by industry [4]