



MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND YEAR SUPPLEMENTARY/SPECIAL EXAMINATION FOR

BACHELOR OF SCIENCE (ANALYTICAL CHEMISTRY)

SAN 202: FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY

DATE: 14/03/2022

TIME: 8:30-10:30 PM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section A is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

QUESTION ONE (30 MARKS)

- a) The Environment of which the environmental chemistry deals with embraces many segments (components).
- Name the four major components of the environment. (4 marks)
 - Describe briefly what each component is made up of. (8 marks)
 - With the help of a suitably well labelled diagram, locate the various components of the atmosphere. (4 marks)
 - Explain in details the variation temperature against the increasing height of the atmosphere. (3 marks)
- b) The stratosphere is the seat of ozone layer, which is known to control harmful radiations from reaching the earth.
- Explain how ozone is made and destroyed in the stratosphere. (3 marks)
 - Explain briefly the chemistry of the troposphere. (3 marks)
 - Providing examples, explain what greenhouse gases are. (3 marks)

- c) Considering the Earth to be in a thermal steady state (i.e., a state where the flux of energy received from the sun equals the energy emitted by the earth, $E_e = E_a$)

$$E_a = (1-A)F$$

E_a is the fraction of energy absorbed on the earth's surface.

E_e is the energy released by the earth as electromagnetic radiation.

Through a series of equations, the T in Kelvin which the earth's surface experiences, is given by

$T = [(1-0.29) 1370/4 (5.67 \times 10^{-18})]^{1/4}$, which is 264K (-17°C). However, the surface temperature of the earth is 298K (25°C).

Explain why the calculated temperature of the Earth is lower than the actual temperature of 25°C.

(2 marks)

QUESTION TWO (20 MARKS)

- a) Man's activities are known to contribute heavily to air pollution.
- Explain briefly how the following pollutants SO_x , NO_x , CO and particulates are generated. (8 marks)
 - Explain what ground level ozone is and how it is formed. (4 marks)
 - Explain how acid rain is formed and its effect on both terrestrial and aquatic environments. (4 marks)
 - Explain clearly the effect of organic matter discharged into aquatic environment. (4 marks)

QUESTION THREE (20 MARKS)

- a) Describe with examples what are non-renewable energy sources (10 marks)
- b) Explain in details the effects of the non-renewable energy on the various segments of the environment. (10 marks)

QUESTION FOUR (20 MARKS)

- a) The solution to the environmental problems caused by use of the non-renewable energy sources is replacing them with renewable energy sources. Describe how solar energy is a renewable energy source and how it can be harnessed to provide clean energy source. (6 marks)
- b) Hydrogen gas is now regarded as the renewable energy that can drive modern economies.
- Describe how H_2 can be generated from the electrolysis of water with the help of a diagram and appropriate chemical equations. (6 marks)

- ii. Describe with the help of a diagram how the H₂ Fuel cell can generate clean and non-polluting energy to be utilized in the various sectors of the modern economies. (8 marks)

QUESTION FIVE (20 MARKS)

- a) Non-renewable energy sources have been shown to contribute towards climate change, hence global warming.
- i. Qualify the above statement with justification. (3 marks)
 - ii. Give three examples of commonly used non-renewable energy source. (3 marks)
- b) Renewable energy sources are currently being considered as alternatives as a way of combating climate change.
- i. Give four examples of renewable energy sources and justify why they are renewable. (4 marks)
 - ii. Explain how solar energy can be harnessed for generation of electricity. (2 marks)
 - iii. Explain what geothermal energy is and how it is harnessed to generate electricity. (3 marks)
 - iv. Explain why renewable energy sources are considered to be friendly to the environment. (2 marks)
- c) Discuss briefly the three forms of power for deriving electrical energy from the ocean. (3 marks)