



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF ENVIRONMENTAL SCIENCE

ENS 131: ENVIRONMENTAL CHEMISTRY

DATE: 9/5/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS TO CANDIDATES

- The paper consists of **two** sections.
- Section **A** is **compulsory**.
- Answer any **two** questions from section **B**.

SECTION A: COMPULSORY

QUESTION ONE (30 MARKS)

- a) Define the following terms
- i. Organic material. (1 mark)
 - ii. Periodic table. (1 mark)
 - iii. Bond enthalpy. (1 mark)
 - iv. Photochemical smog. (1 mark)
- b) Consider the complete combustion of methane and
- i. Write the balanced equation and draw the Lewis structures for the molecules involved. (3 marks)
 - ii. Estimate the ΔH of the reaction. (4 marks)
- c) Calculate the amount of work done on the surroundings when 1 liter of an ideal gas, initially at a pressure of 10 atm, is allowed to expand at constant temperature to 10 liters by
- i. Reducing the external pressure(p) to 1 atm in a single step (2 marks)
 - ii. Reducing P first to 5 atm, and then to 1 atm, (2 marks)
 - iii. Allowing the gas to expand into an evacuated space so its total volume is 10 liters. (2 marks)
- d) List and explain:
- i. Two causes of tropospheric pollution (4 marks)
 - ii. Two gaseous pollutants that can cause acid rain (3 marks)
 - iii. Three groups of humic substances (6 marks)

SECTION B: ANSWER ANY TWO (2) QUESTIONS (20 MARKS EACH)

QUESTION TWO (20 MARKS)

- a) Differentiate between the following
- i. Exothermic and endothermic reaction (2 marks)
 - ii. System and surroundings (2 marks)
- b) Using a relevant example explain the term 'state function' as applied in the equation for the first law of thermodynamics. (2 marks)

- c) A gas occupies 221 cm^3 at a temperature of 0°C and pressure of 760 mm Hg. Determine its volume at 100°C . (5 marks)
- d) Explain the following statements
- (i) When a hand pump is used to inflate a bicycle tire, the bottom of the pump barrel can get quite warm. (2 marks)
 - (ii) It gets cooler as one goes high up. (2 marks)
 - (iii) Large bodies of water have a “moderating” effect on the local weather, reducing the extremes of temperature that occur in other areas. (2 marks)
- e) Hydrogen chloride gas readily dissolves in water, releasing 75.3 kJ/mol of heat in the process. If one mole of HCl at 298 K and 1 atm pressure occupies 24.5 liters, find the ΔU for the system when one mole of HCl dissolves in water under these conditions. (3 marks)

QUESTION THREE (20 MARKS)

- a) Define the term Carbon sequestration. (1 mark)
- b) Briefly describe the three phases in which mineralization and humification occurs in the environment. (9 marks)
- c) Using relevant examples, describe in details the effects of sulfur oxides in the environment. (10 marks)

QUESTION FOUR (20 MARKS)

- a) List and explain five effects of dissolved organic matter to the environment. (10 marks)
- b) List three (3) differences between hexavalent chromium and trivalent chromium. (3 marks)
- c) Soil organic matter strongly affects the effectiveness of soil remediation processes. Using relevant heavy metals and in the presence of nanozero valent iron (NZV I), briefly explain this statement. (7 marks)

QUESTION FIVE (20 MARKS)

- a) Differentiate between the following terms as used in Environmental Chemistry.
- i. Colloidal particles and crystalline particles. (2 marks)
 - ii. Titrimetric analysis and gravimetric analysis. (2 marks)
- b) List five factors that are normally considered when carrying out gravimetric analysis. (5 marks)
- c) The water in a soil sample was found to have $[\text{OH}^-]$ equal to 1.47×10^{-9} mole/L. Determine
- i. $[\text{H}^+]$ (2 marks)
 - ii. pH, and (2 marks)
 - iii. pOH (2 marks)
- d) Hypochlorous acid, HOCl, has a pKa of 7.52. Calculate
- i. The pH of 0.25 M solution of HOCl. (3 marks)
 - ii. The percent ionization. (2 marks)