

UNIVERSITY OF RUHUNA  
BACHELOR OF SCIENCE GENERAL DEGREE LEVEL III (SEMESTER II)  
EXAMINATIONS – JANUARY-2018

SUBJECT: **Chemistry**

COURSE UNIT: **CHE 322α**

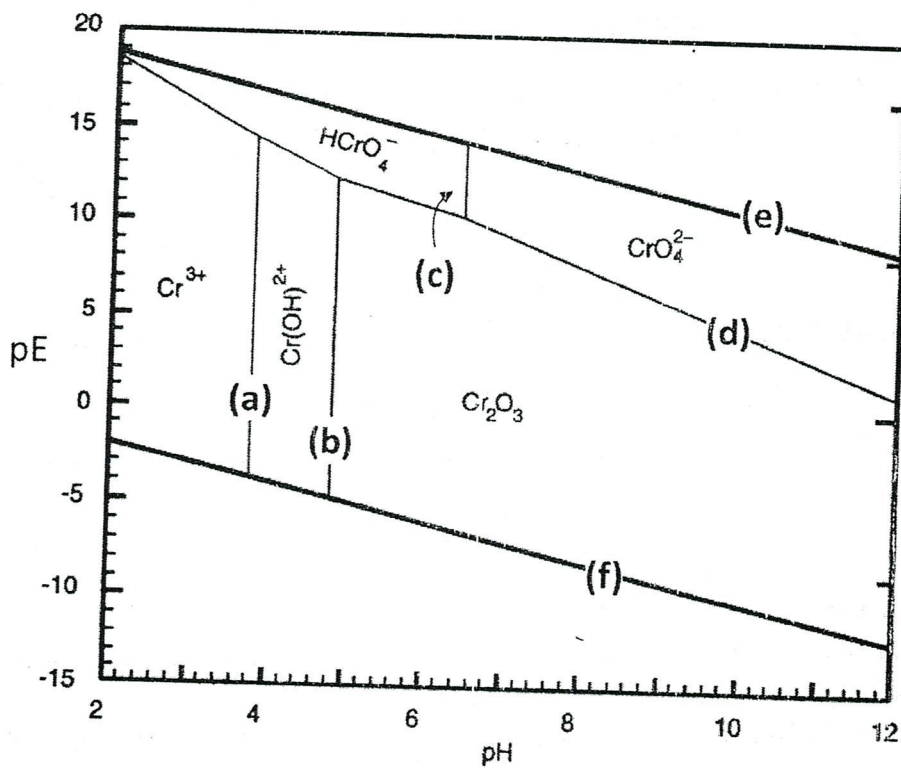
TIME: **One (01) hour**

Answer **Three (3)** Questions

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✓. Answer **all** parts

- a) Answer parts (i) and (ii)
- (i). What is meant by “hardness of water”? List **three** negative effects of hard water. Describe temporary and permanent hardness.
- (ii). When a 50.00 cm<sup>3</sup> of a water sample was titrated with 0.010 mol dm<sup>-3</sup> EDTA solution using EBT indicator in a pH 10 buffered solution, the endpoint was 25.45 cm<sup>3</sup>. What is the hardness of the water sample in mg/L CaCO<sub>3</sub>? (relative atomic masses Ca = 40.0, O = 16.0, C = 12.0 )
- (30 marks)**
- b) Describe how you would determine dissolved oxygen (DO) and biochemical oxygen demand (BOD<sub>5</sub>) of a water sample using Winkler method. In your description include steps in sample collection, preservation and laboratory analysis. Provide necessary balanced chemical equations to describe the chemistry behind the above procedure.
- (34 marks)**
- c) The pE-pH diagram given below shows the speciation of chromium in an aquatic system at 25 °C. Write balanced chemical equations for the reactions taking place at the boundaries labeled as (a), (b), (c), (d), (e) and (f).



(36 marks)

2. Answer **all** parts

(a) Several kinds of chemical species are involved in chemical and photochemical reactions occurring in the atmosphere. Give two examples for each of the following groups of chemical species found in atmosphere.

- (i). Inorganic oxides
- (ii). Oxidants
- (iii). Reductants
- (iv). Oxidized organics
- (v). Photochemically active species
- (vi). Acids

(30 marks)

(b) Write down four major processes responsible for the loss of excitation energy from electronically excited species in atmosphere. Give one example for each process

(20 marks)

(c) What is the mechanism of ozone loss catalysed by hydroxyl radicals in stratosphere?

(20 marks)

(d) More efficient mechanism for long-range transport of anthropogenic  $\text{NO}_x$  to the global troposphere is through the formation of another reservoir species. PAN is one of the reservoir species. Giving appropriate chemical reactions explain how PAN is formed.

(30 marks)

3. Answer all parts

(a) Soil can be defined as the unconsolidated cover on the surface of the earth and it is made up of mineral particles, organic particles, air and water.

- (i). Write down the soil mineralogical components with suitable examples.
- (ii). Soil organic matter is considered to be labile and renewable. Explain.
- (iii). Porosity ( $\phi$ ) is an important physical property of soil and it can be defined using the equation given below.

$$\phi = \frac{V_V}{V_T}$$

Define the each term in the above equation and deduce a relationship between soil porosity and soil density (bulk density-  $D_B$  and particle density-  $D_P$ ) parameters.

(40 marks)

(b) Cation exchange plays a major role in upholding soil fertility by maintaining soil acidity and basicity.

- (i). Briefly explain the cation exchange process in soil.
- (ii). Define the cation exchange capacity (CEC) of soil.
- (iii). Calculate the percent base saturation for a soil that has following exchangeable cations.

Cation	Amount/cmole Kg <sup>-1</sup>
H <sup>+</sup>	9.4
K <sup>+</sup>	0.5
Na <sup>+</sup>	0.1
Ca <sup>2+</sup>	14
Mg <sup>2+</sup>	3

(iv). Al<sup>3+</sup> ions produce acidity in soil. Explain.

**(30 marks)**

(c) Soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alterations in the natural soil environment.

- (i). Discuss the main causes for soil pollution and how it can be minimized/prevented.
- (ii). What is meant by bioremediation?
- (iii). What factors affect the bioremediation process?

**(30 marks)**

#### 4. Answer all parts

(a) (i). Write down the basic steps involved in the treatment of water for the drinking purpose.

**(15 marks)**

(ii). What are the advantages of polyaluminium chloride over alum as a coagulant in water treatment?

**(15 marks)**

(b) You have been asked to propose a suitable treatment plan for the treatment of textile dyeing wastewater.

- (i). What are the basic steps you would propose in the treatment plan?
- (ii). Explain how you would remove fibers in textile dyeing wastewater.
- (iii). Discuss the importance of colour removal of textile wastewater. Propose three suitable methods to decolorize these effluents.

**(45 marks)**

(c) Write down the common methods for eliminating or reducing gaseous pollutants and particulate matter in industrial emissions.

**(25 marks)**

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