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KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2016/2017 ACADEMIC YEAR**

FOR THE DEGREE OF BACHELOR OF SCIENCE

**THIRD YEAR SECOND SEMESTER
(Supplementary Examination)**

COURSE CODE: SCH 351

COURSE TITLE: AQUATIC CHEMISTRY

TIME: 2 HOURS

DATE: 21ST SEPTEMBER 2017 TIME: 3 – 5PM

INSTRUCTIONS TO CANDIDATES

This paper consists of FIVE questions. Answer question ONE which is COMPULSORY (30 marks) and any other TWO questions (20 marks each).

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This paper consist of 3 printed pages

Question 1

- a) State five sources of natural water. [5mks]
- b) Explain five unique physical properties of water.[5mks]
- c) Describe the water cycle in nature. [5mks]
- d) Outline three ways in which solar energy drives the water cycle.[3mks]
- e) State five domestic uses of water[5mks]
- f) State four purpose wise standards for swimming pool water. [4mks]
- g) **Phase diagrams** help describe how water changes states depending on the pressure and temperature.
 - i. What is meant by phase diagram?[1mk]
 - ii. Explain the following terms;
 - I. The critical point (CP) [1mk]
 - II. The triple point (TP)[1mk]

Question 2

- a) Explain clearly how suspended solids are removed in the treatment of water for drinking. [4mks]
- b) Identify three chemicals added to the final stages of the treatment of water for drinking. State the purpose of adding each chemical identified.[6mks]
- c) What is meant by eutrophication?[1mk]
- d) Describe the process occurring in water leading to eutrophication.[5mks]
- e) Distinguish between the primary and secondary stages of sewage treatment.[2mks]
- f) Name the substances removed by tertiary treatment of sewage.[2mks]

Question 3

- a) State five chemical indicators of water quality.[5mks]
- b) A wastewater sample is being analyzed to determine its BOD content. The sample is diluted in order to perform the test: 295 mL of distilled water are added to 5 mL of sample to fill the 300 mL BOD bottle. The bottle has an initial dissolved oxygen concentration of 7.9 mg/L. After incubating 5 days, the dissolved oxygen concentration is 4.5 mg/L.

- i. What is the 5-day BOD of the wastewater? [3mks]
 - ii. The deoxygenation rate constant, k_1 , is 0.013 day^{-1} . What is the **ultimate BOD** of the wastewater? [5mks]
- c) What is meant by chemical oxygen demand, COD? [1mk]
- d) State the importance of chemical oxygen demand, COD test. [4mks]
- e) State two limitations of COD test.[2mks]

Question 4

- a) State five types of water pollution. [5mks]
- b) Explain how a water collection reservoir may affect;
- i) suspended solids carried by the river downstream.[3mks]
 - ii) The climate of the area. [3mks]
- c) State five effects of water pollution.[5mks]
- d) State any four ways that help minimize water pollution.[4mks]

Question 5

- a) Define the following terms; [3mks]
- i. PH
 - ii. Alkalinity
 - iii. acidity
- b) If a solution contains a concentration of H^+ as $8.6 \times 10^{-9} \text{ mol dm}^{-3}$, calculate the PH of the solution. [3mks]
- c) A sample of water having a pH of 7.2 has the following concentrations of ions;

ion	Conc. (mg/L)	Molecular weight (mg/mmol)	Conc. (mol/L) $\times 10^{-3}$	Conc. (mg/L) as CaCO_3
Ca^{2+}	40.0	40.1	0.998	99.8
Mg^{2+}	10.0	24.3		41.2
Na^+	11.8	23.0		25.7
K^+	7.0	39.1		8.95
HCO_3^-	110.0	61.0		90.2
SO_4^{2-}	67.2	96.1		69.9
Cl^-	11.0	35.5		15.5

I) Complete the table by calculating concentration in moles/litre each kind of ion in water. . . .
[3mks]

II) Calculate the;

- i. Total hardness (TH) [1mk]
- ii. Alkalinity (given $\text{H}_2\text{CO}_3 \leftrightarrow \text{CO}_3^{2-} + \text{H}^+$ and $k = 10^{-10.33}$ at 25 °C). [7mks]
- iii. Carbonate Hardness (CH) [1mk]
- iv. Non-carbonate Hardness (NCH) [2mks]