00154

The Open University of Sri Lanka
Faculty of Natural Sciences
Department of Chemistry

Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	**: CYU5309- Environmental Chemistry**
Academic Year	: 2023/24
Date	: 08.10.2023
Time	: 9.30 a.m. – 11.30 a.m.
Duration	: 02 Hours

1. Read all instructions carefully before answering the questions.
2. This question paper consists of four **(04)** questions in **four (04)** pages.
3. **Answer all four (04) questions.** All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary.
6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense
7. Use blue or black ink to answer the questions.
8. Circle the number of the questions you answered in the front cover of your answer script.
9. Clearly state your **index number** in your answer script

1.a.i. Explain the difference between the terms "pollutant" and "contaminant".

(10 marks)

ii. Define the term "residence time" as applied to environmental chemistry.

iii. Estimate the residence time of water in the ocean using the data given below. The steady state amount of water in the ocean is 2.6×10^{14} kg/y, whereas lakes and rivers account for 7.0×10^{10} kg/y annual flux into the ocean. The pore water and precipitation contribute an additional flux of 2.4×10^{10} kg/y and 4.0×10^{10} kg/y respectively.

(30 marks)

c. A pollutant can be classified into two categories as "primary pollutant" and "secondary pollutant".

i. Define the terms "primary pollutant" and "secondary pollutant".

CO and SO_2 are some well-known atmospheric pollutants. State the following parameters with respect to CO and SO_2.

ii. Whether it is a primary or secondary pollutant?

iii. A source

iv. A sink

(20 marks)

d. i. Draw and label the Oxygen cycle. Give one anthropogenic activity that disturb this cycle.

ii. Write equations for the destruction of ozone layer catalyzed by NO.

(40 marks)

2.a. Discuss the processes and the consequences occurring in the water leading to eutrophication.

(20 Marks)

b. Calculate the chemical oxygen demand (COD) of a 25.0 mL wastewater sample from a chocolate factory, if it required 8.48 mL of 0.8 $x10^{-3}$ M $K_2Cr_2O_7$ to reach the end point in a COD titration. You are given the half – cell reactions (unbalanced) of the dichromate (unbalanced) and oxygen.

$$Cr_2O_7^{2-}(aq) + 8H^+ + e^- \leftrightarrow Cr^{3+} + H_2O$$

$$O_2(aq) + 4H^+ + e^- \leftrightarrow H_2O$$

(20 Marks)

c.i. What is meant by the term "alkalinity" of water?

ii. Discuss the significance of alkalinity of a water body.

iii. What are the main sources of alkalinity in water?

iv. A water sample is not alkaline to phenolphthalein indicator. However 100.0 mL of water sample reached the end point of titrations using methyl orange as indicator with 27.70 mL of 0.02 M HCl. Calculate the alkalinity as mg $CaCO_3$ L^{-1}.

(30 Marks)

d. i. Briefly describe the terms Temporary hardness and Permanent hardness.

ii. Calculate Temporary hardness of water sample containing the following impurities:

$CaSO_4$ = 162 mg/L; $Ca(HCO_3)_2$ = 6 mg/L ; $Mg(HCO_3)_2$ = 1.5 g/L

[Relative atomic weight: Ca = 40; Mg = 24; C = 12; O = 16; H = 1; S = 32]

iii. Discuss the problems associated with water hardness in day to day life.

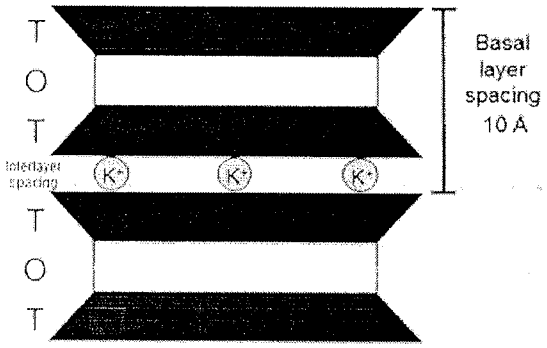
(30 Marks)

3.a. Explain how soils are influenced during their formation by the following factors.

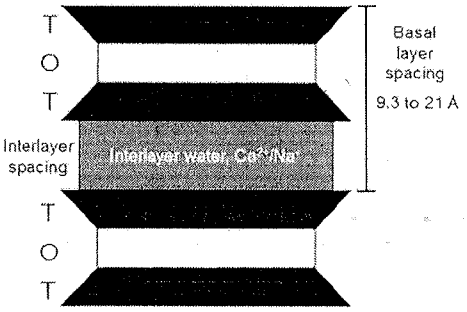
i. Parent material
ii. Climate
iii. Topography
iv. Living organisms

(20 Marks)

b. Structure of two types of soils (Soil A and Soil B) are given below.



Soil A



Soil B

i. Briefly describe the structure of both soil types.

ii. Explain the swelling properties of each soil as rain events occurs after a prolonged dry period.

iii. Discuss cation exchange capacity of both soil types.

(30 marks)

c. i. What is meant by acidification of soil?

ii. What are the major sources of soil acidity?

ii. What are the consequences of soil acidity?

(30 Marks)

d. i. Describe what isomorphous substitution in clay minerals is by giving an example.

ii. Why isomorphous substitution is important in agriculture and environmental protection?

(20 Marks)

4.a. i. Briefly describe thermal stratification of a lake.

ii. Explain how dissolved oxygen varies with the depth of this lake.

iii. What is meant by Lake Overturn?

(25 Marks)

b. i. Briefly describe biochemical oxygen demand of a water body.

ii. Why is seeding necessary for BOD test?

iii. You are given the following information for a seeded BOD_5 test. A BOD test was conducted at 20° C in which 20.0 mL of wastewater sample with seeded dilution water to 300.0 mL. Initial DO of diluted sample was 9.0 mg/L. Final DO after 5 days was 2.8 mg/L. Initial DO of seeded dilution water was 9.4 mg/L. Final DO of seeded dilution water was 8.1 mg/L. Calculate BOD_5 at 20° C.

(30 marks)

c. A number of gases in the lower atmosphere are responsible for the greenhouse effect. This effect is generally beneficial, but it has been increasing in recent times, and this increased greenhouse effect is believed to be responsible for various kinds of damage to the environment.

i. What is greenhouse effect?

ii. Name **two (02)** gases responsible for causing greenhouse effect.

iii. Why the greenhouse gas is largely beneficial?

iv. Give **two (02)** kinds of environmental damage that may result from the increased greenhouse effect.

(20 marks)

d. i. Distinguish between the primary and secondary stages of wastewater treatment.

ii. The treatment of a water may involve several steps. These steps may include skimming, sedimentation, and flocculation. Describe what happens at each of these **three steps**.

(25 Marks)

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