



# RAJARATA UNIVERSITY OF SRI LANKA

## FACULTY OF APPLIED SCIENCES

### BSc Honours in Chemistry

Fourth Year - Semester I Examination – July / August 2023

### CHE 4308 – ADVANCED ENVIRONMENTAL CHEMISTRY

Time: Two (03) hours

Answer **all** questions

Use of a non-programmable calculator is permitted.

1.

- What are heavy metal ions? How does heavy metal ions toxicity occur?
- Compared to developing countries, pollution due to mercury is declining in the developed countries. Comment.
- Why methylated mercury is extremely toxic compared to  $\text{Hg}^{2+}$  or  $\text{Hg}^0$ ?
- Discuss the mercury distribution cycle in the environment. How the cyclic nature of mercury species is disturbed by anthropogenic activities.

2.

- Mark the following water types in appropriate regions in the Eh-pH diagram. The Eh-pH template is given separately.

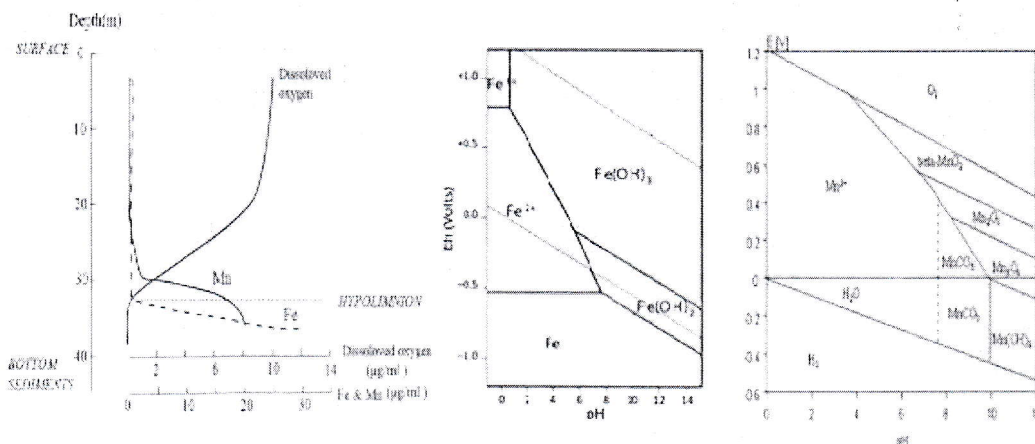
Water type: Rainwater, River water, Groundwater with  $\text{Fe}^{2+}$ , Seawater and Peat bog water.

State the regions of anoxic, suboxic, and oxic environments in the same diagram.

Deduce the oxic water types.

For parts (b) to (d),

The distribution of dissolved iron and manganese in lake water and relevant Eh-pH diagrams is shown below.



- b) Discuss factors that influence the distribution of oxygen in lake water.
- c) What are the likely iron and manganese species in the lake water? How is the speciation of these elements depending on the distribution of oxygen in the water?
- d) What would be the likely causes for sudden fish kills in Sri Lankan lakes?

3

- a) Comment on surface hydroxylation of minerals upon contact with the water.
- b) Discuss the difference between variable and non-variable charge surfaces found in the environment.
- c) Discuss the formation of an electrical double layer at the mineral-water interface defining the region of zeta potential.
- d) Discuss the colloid coagulation mechanism with the aid of double layer theory.

4.

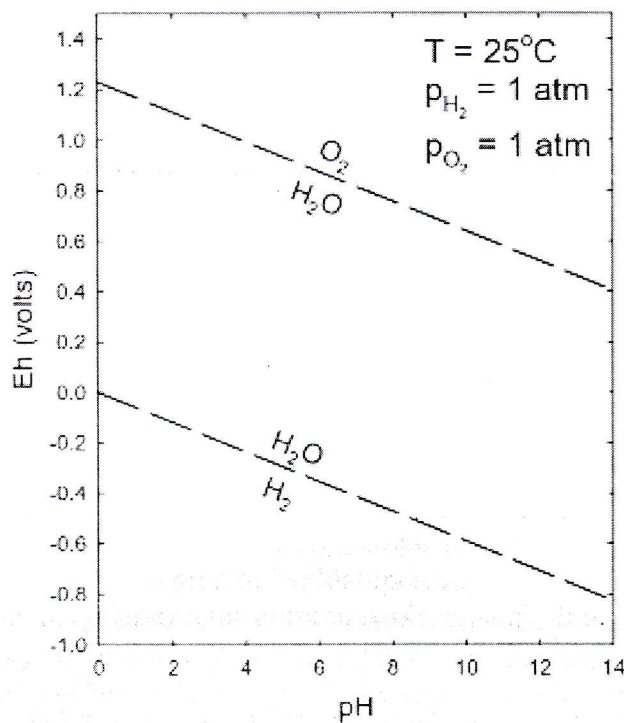
- a) Organic pollutants are the most toxic compared to heavy metal ions pollution. Critically discuss.
- b) State the meaning of POPs in the environment. Why is chlorofluorocarbon (CFC) not included in the POP's list?
- c) Define natural organic matter based on its solubility in acids and bases. Discuss the formation of THMs upon water chlorination in the presence of natural organic matter.
- d) Discuss the current status of oil pollution in groundwater in the Jaffna Peninsula.

5.

- a) How secondary aerosols are formed in the presence of VOC and  $O_3$  in the atmosphere?
- b) Discuss the tropospheric ozone formation mechanism in the presence of sunlight.
- c) Comment on the three factors responsible for global warming.
- d) In early 2023, the animals in the dry zone villages died due to extreme weather conditions. Comment.

Annex.

To accompany question 4(annex this diagram with your answer)



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