

# **UNIVERSITY OF SWAZILAND**

**Faculty of Health Sciences**

**BSc IN ENVIRONMENTAL HEALTH**

**FIRST SEMESTER FINAL EXAMINATION PAPER DECEMBER 2010**

**TITLE OF PAPER** : ENVIRONMENTAL CHEMISTRY 1

**COURSE CODE** : EHS 413

**DURATION** : TWO HOURS

**MARKS** : 100

**INSTRUCTIONS** : ANSWER ONLY FOUR QUESTIONS

: EACH QUESTION CARRIES 25 MARKS

: QUESTIONS ONE AND TWO ARE COMPULSARY

: NO QUESTION PAPER SHOULD BE BROUGHT INTO  
NOR OUT OF THE EXAMINATION ROOM

: BEGIN EACH QUESTION ON A SEPARATE SHEET  
OF PAPER

**DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED  
BY THE INVIGILATOR**

## QUESTION ONE (COMPULSARY)

For each of the following, indicate the most appropriate answer by writing the question number and the letter of the correct answer next to it (E.g. 1. E).

1. The most significant feature of the atmospheric chemistry is the occurrence of ----  
----- resulting from the absorption by molecules of light photons.
  - a. Oxidation reactions.
  - b. Reduction reactions.
  - c. Photochemical reactions.
  - d. Acid-base reactions.
  
2. Albedo refers to
  - a. Reflective index of the earth.
  - b. The absorptive index of the earth.
  - c. Positive lapse rate.
  - d. Negative lapse rate.
  
3. Thermal stratification of bodies of water results from water's
  - a. Unique temperature-density relationship.
  - b. Unique temperature-pressure relationship.
  - c. High surface tension.
  - d. Unique water solubility property.
  
4. The dissolving of material from the upper layers of the soil and its movement to lower horizons is called
  - a. Percolation.
  - b. Weathering.
  - c. Accumulation
  - d. Leaching.
  
5. Soil texture most directly determines
  - a. Porosity.
  - b. pH.
  - c. Color.
  - d. Nutrient content
  
6. Most soil erosion is caused by
  - a. Moving water.
  - b. Wind.
  - c. Earthquakes.
  - d. Volcanoes.

7. Salt build up in soils may
  - a. Increase crop growth.
  - b. Increase yields.
  - c. Eventually kill weeds.
  - d. Eventually make the land unproductive.
  
8. The surface litter horizon of soil is described by the letter
  - a. A.
  - b. B.
  - c. C.
  - d. O.
  
9. As it is weathered, ----- gives rise to the C-horizon.
  - a. Parent material.
  - b. Leaching.
  - c. Subsoil.
  - d. Bed rock.
  
10. A thermal inversion is the result of
  - a. Precipitation.
  - b. Cold air drainage.
  - c. A lid of warm air on top of cooler, stagnant air.
  - d. A cold blanket of air that prevents warm air from rising.
  
11. Photochemical smog is characteristic of urban areas with many vehicles and a climate that is
  - a. Cool, wet and cloudy.
  - b. Cool, dry, and sunny.
  - c. Warm, dry, and sunny.
  - d. Warm, wet, and cloudy.
  
12. The major greenhouse gases include all of the following except
  - a. Chlorofluorocarbons (CFCs).
  - b. Carbon dioxide and water vapor.
  - c. Sulfur dioxide.
  - d. Ozone and nitrous oxide.
  
13. All of the following greenhouse gases have increased in recent decades except
  - a. Carbon dioxide.
  - b. Methane.
  - c. Water vapor.
  - d. Nitrous oxide.

14. As global warming progresses, methane
- Might be absorbed as permafrost melts in the arctic tundra.
  - Might be absorbed from natural wetlands with rising carbon dioxide.
  - May be released from oceanic mud as ocean waters warm.
  - May be reduced by bacteria in tundra soils.
15. Which of the following statements is false?
- The formation of ozone layer enabled life on land to evolve.
  - Chlorofluorocarbons are odorless and stable.
  - Chlorofluorocarbons are nonflammable, nontoxic, and noncorrosive.
  - Fluorine atoms are responsible for the breakdown of ozone to molecular oxygen.
16. In addition to solid mineral and organic matter and water, roughly 35% of the volume of typical soil is composed of
- Pore spaces.
  - Moisture.
  - Organic matter.
  - Clay minerals.
17. An important property of soil abbreviated CEC expresses its capacity to
- Exchange cations.
  - Exchange anions.
  - Adsorb cations.
  - Adsorb anions.
18. The most important class of complexing agents that occur naturally are
- Colloids.
  - Humic substances.
  - Fulvic acid.
  - Humic.
19. Complexing agents in wastewater are of concern primarily because of
- Their ability to solubilize heavy metals.
  - Their ability to adsorb heavy metals.
  - Their ability to immobilize metals.
  - Their ability to detoxify heavy metals.
20. The ozone layer is most effective in blocking
- Ultraviolet-C, the highest-energy UV band.
  - Ultraviolet-B, the middle-energy UV band.
  - Ultraviolet-A, the lowest-energy UV band.
  - Chlorofluorocarbons.

21. The ability of solutes in water to neutralize added strong acids is called
- Neutralization
  - Alkalinity
  - Acidity
  - Oxidation
22. In water near neutral pH the major contributor to alkalinity is
- $\text{HCO}_3^-$
  - $\text{Ca}^{2+}$
  - $\text{PO}_4^{3-}$
  - $\text{CO}_3^{2-}$
23. The reaction  $2\text{C}_{17}\text{H}_{33}\text{COO}^-\text{Na}^+ + \text{Ca}^{2+} \rightarrow \text{Ca}(\text{C}_{17}\text{H}_{33}\text{CO}_2)_{2(s)} + 2\text{Na}^+$  is a manifestation of
- Saponification.
  - Complexation.
  - Water hardness.
  - Esterification.
24. The relative oxidation-reduction tendencies of a chemical system depends upon
- The activity of the electron ( $e^-$ ).
  - The pH.
  - Bacterial activity.
  - Acid-base reactions.
25. In the pE-pH diagram for iron in water, the species that predominates at low pE and low pH is
- $\text{Fe}^{3+}$ .
  - $\text{Fe}^{2+}$ .
  - $\text{Fe}(\text{OH})_3$ .
  - $\text{Fe}(\text{OH})_2$ .

**Total 25 marks**

## QUESTION TWO (COMPULSORY)

- (a) Today's global use and misuse of chemicals has triggered concern amongst environmentalists. As an environmental health scholar, advance arguments in favor of this statement (10 marks)
- (b) The atmosphere is one of the important life support systems of the planet Earth. However in our endeavor to improve our quality of life, we are believed to be deteriorating its role as a life support system. Discuss some of the benefits and services we derive from the atmosphere (9 marks)
- (c) With the aid of **two** balanced chemical equations, describe the role played by Acid-Base reactions in the environmental chemistry of the atmosphere(6 marks)

**Total 25 marks**

## QUESTION THREE

- (a) The Cation Exchange Capacity (CEC) of the soil plays a very crucial role in the environmental chemistry of soils. Discuss these roles and propose the factors that determine the CEC of soils (12 marks)
- (b) With the help of a chemical equation, motivate the contribution of pyrite oxidation to soil acidity (6 marks)
- (c) In the course of this study, one of the chemical properties of the soil is organic matter. Briefly discuss the important roles played by organic matter in the soil (7 marks)

**Total 25 marks**

## QUESTION FOUR

- (a) Water supports all forms of life. It would be a grave mistake to tamper with its chemistry. Support this argument (8 marks)
- (b) Water has a higher surface tension than any other liquid. Describe how the surface tension of water comes about with particular reference to the water molecular (7 marks)
- (c) Water has a maximum density as a liquid at 4<sup>o</sup>c. Discuss the important role of this property played in the water environment (5 marks)
- (d) Discuss the role played by Oxidation-Reduction reactions in the chemistry of dissolved chemical species in water (5 marks)

**Total 25 marks**

## QUESTION FIVE

- (a) Briefly explain how climatic and topographic factors may affect the intensity and dispersion of air pollution in a city. (5 marks)
- (b) With the aid of balanced chemical equations, illustrate the nitrogen cycle and explain how nitrogen oxides may affect the atmosphere, our health and property. (20 marks)

**Total 25 marks**