



NATIONAL UNIVERSITY OF LESOTHO

BSc Environmental Health

End of semester B supplementary examination

Course Title: Environmental Analysis

Course code: EHS 2307

August 2023

Time: 3 HOURS

TOTAL MARKS: 100

SECTION A [40 MARKS]

Question 1

Instruction(s): Answer all Questions in this question by writing the letter of the correct answer next to the corresponding question.

Multiple choice questions (24 marks)

I. You have looked up the hazards of the chemicals you will be using in a particular lab, and found out that they are mild health hazards, requiring you to avoid skin contact and vapor inhalation. Therefore, when in lab you should:

- a) wear short shorts and sandals
- b) wear long pants, closed toed shoes, and a lab apron
- c) Wear a respiratory mask
- d) b and c

II. If your clothing catches fire in the lab, what should you do?

- a) drop to the floor and roll to extinguish the fire
- b) use a fire blanket and roll on the floor
- c) spray the fire with a fire extinguisher
- d) a and b

III. If you spill an acid or a base on the bench, you should:

- a) rinse with a neutralizing solution
- b) ask your teacher what to do
- c) immediately wash with soap and cool water and tell your teacher
- d) do nothing unless you see some bubbles

IV. Broken glassware left around the lab is a hazard because:

- a) if on the floor, someone might step on it and cut their foot
- b) if on the lab bench, someone might lean on the bench and cut their arm
- c.) if in the sink, someone might try to pick it up to throw it away properly and cut themselves
- d) All of the above

V. What is the name of this piece of glassware?



- a) separating funnel
- b) volumetric flask
- c) buchner flask
- d) beaker

VI. Which pieces of equipment are used for obtaining solids for measuring mass?

- a) spatula
- b) tongs
- c) insulated gloves
- d) clamps

VII. Which pieces of equipment are used to obtain precise measurements of liquids?

- a) pipettes
- b) measuring cylinders

- c) beakers
- d) conical flasks

VIII. Which of the following items are used for stirring?

- a) spatula and stirring rod
- b) magnetic stirrer and thermometer
- c) magnetic stirrer and stirring rod
- d) all of the above

IX. The objective of the sampling is to collect a portion of material that represents the actual sample composition.

- a) Maybe
- b) True
- c) False
- d) Not sure

X. ----- of the sample must be measured on-site.

- a) temperature
- b) COD
- c) BOD
- d) TDS

XI. Concentrated sulfuric acid is used as preservative for analysis of -----.

- a) BOD
- b) COD
- c) metals
- d) Ordor

XII. A “holding time “ is the elapsed amount of time from the point of sample collection to the amount of preparation or analysis. What is the holding time for BOD?

- a) 6 hours
- b) 28 days
- c) 24 hours
- d) 6 months

Question 2 (16 marks)

Lipolelo is a 4th year EHS research student. She is carrying out acid digestion in the lab. Acid digestion involves boiling a sample in hot nitric acid.



- a) Identify four potential hazards in the picture above. (8 marks)
- b) In which safety equipment was Lipolelo supposed to be doing this digestion? (1 mark)
- c) What other PPE was Lipolelo supposed to be wearing on her face, other than the safety goggles? (1 mark)

Acid digestion is normally carried out before metal analysis.

- d) What is the holding time for metal analysis? (1 mark)
- e) If Liepollo was to test the sample for Cu^{2+} ions, explain how she is supposed to preserve her sample. (2 marks)
- f) The following hazard symbol is found on nitric acid container. What does the symbol mean? (2 marks)



- g) Define the term sample acid digestion. (1 mark)

SECTION B [30 MARKS]

Instruction(s): Answer all questions in this section

Briefly discuss the following methods used to determine the endpoint in a titration. (2 marks each)

- Indicator
- pH meter
- Conductivity
- Precipitation
- Potentiometer

Question 2

Define the following terms. (2 marks each)

- Molarity
- Molality
- Actual yield
- Dilution
- Equivalence point

Question 3

I. Balance the following chemical equations (2 marks each)

- $\text{H}_3\text{PO}_4 + \text{KOH} \rightarrow \text{K}_3\text{PO}_4 + \text{H}_2\text{O}$
- $\text{K} + \text{B}_2\text{O}_3 \rightarrow \text{K}_2\text{O} + \text{B}$
- $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- $\text{Na} + \text{NaNO}_3 \rightarrow \text{Na}_2\text{O} + \text{N}_2$
- $\text{C} + \text{S}_8 \rightarrow \text{CS}_2$

SECTION C [30 MARKS]

Instruction(s): Answer all questions in this section

Question 1

- I. Differentiate between quantitative and qualitative analysis. [4 marks]

- II. Briefly discuss the two types of quantitative analysis. [4 marks]

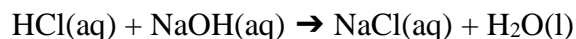
- III. Briefly discuss the following methods of qualitative analysis. [2 marks each]

Question 2

Use the information provided below to answer the questions that follow.

- A 25 cm³ sample of hydrochloric acid is sucked into a pipette and transferred into a 250 cm³ volumetric flask. The solution is made up to the mark.
- 25 cm³ of the diluted acid is transferred into a conical flask using a pipette.
- A burette is used to neutralise the acid with 0.1 mol dm⁻³ sodium hydroxide.

Hydrochloric acid reacts with sodium hydroxide according to the equation:



- a) The average titre of the sodium hydroxide solution was 30.00 cm³

Calculate the number of moles in the average titre. (2 marks)

- b) Determine the number of moles in the diluted sample of hydrochloric acid, and hence the concentration of the diluted acid. (4 marks)

- c) Calculate the concentration of the undiluted hydrochloric acid in mol dm⁻³ (2 marks)

- d) Calculate the concentration of the hydrochloric acid in g dm⁻³ (2 marks)

Question 3

1. A 5.00 g sample of limestone (CaCO_3) was dissolved in hydrochloric acid (HCl) and all the calcium present in the sample was converted to $\text{Ca}^{2+}_{(\text{aq})}$. Excess ammonium oxalate solution, $(\text{NH}_4)_2\text{C}_2\text{O}_4(\text{aq})$ was then added to the solution to precipitate the calcium ions as calcium oxalate, $\text{CaC}_2\text{O}_4(\text{s})$. The precipitate was filtered, dried, and weighed to a constant mass of 6.43g. Determine the percentage by mass of calcium in the limestone sample. NB: Mr Ca = 40.01 g/mol, Mr O = 16 g/mol and Mr C = 12.01 g/mol]. [10 marks]

.....*The end*.....