



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

Laboratory Management and Research Methods

SCH 5101

First Semester Examination Paper

December 2024

This examination paper consists of 5 printed pages

Time Allowed: 3 hours
Total Marks: 100
Special Requirements: None
Examiner's Name: Dr. A. Ndiripo
External Examiner Prof. G. Mehlana

INSTRUCTIONS

1. Answer **all** questions from Section A and **any three** from Section B. Section A carries 40 marks and each question in section B carries 20 marks.
2. Start a new question on a new page. (**Not each part of a question**).

MARK ALLOCATION

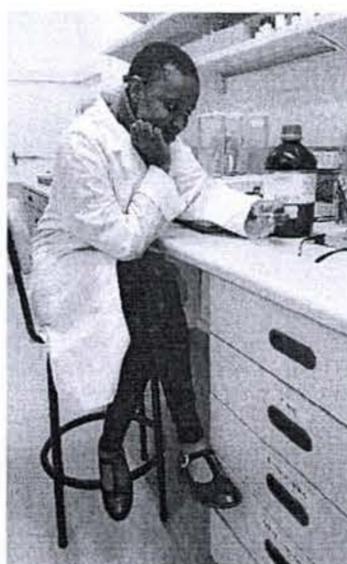
| QUESTION | MARKS |
|-----------------------------|------------|
| 1 | 40 |
| 2. | 20 |
| 3. | 20 |
| 4. | 20 |
| 5 | 20 |
| TOTAL POSSIBLE MARKS | 100 |

SECTION A

1. (a) Identify and state the names of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) symbols in the picture below. [5 Marks]



- (b) Identify **two (2)** laboratory safety violations in the picture below.

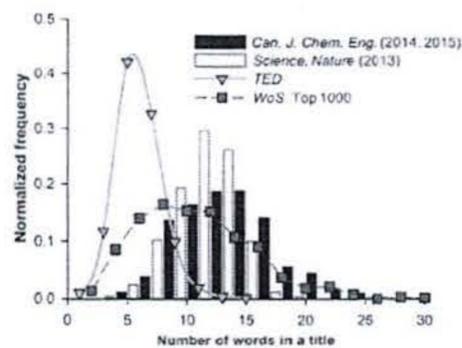


[2 Marks]

- (c) State **any three (3)** types of biohazardous waste that can be found in a laboratory. [3 Marks]
- (d) Project proposals and execution can lead to the development of new scientific inventions/ideas which are crucial for the industry and the community. In addition, these projects can be small or be carried out on a larger scale. At the end of the project, one has to report on their findings.
- (i) List any **three (3)** types of stakeholders you may work with in a project. [3 Marks]
- (ii) What is the main difference between a proposal and a scientific report? [2 Marks]
- (iii) Distinguish between a **scientific paper** and a **thesis/dissertation** as two methods of presenting scientific results. [4 Marks]
- (iv) State any **two (2)** reasons why you may reject a proposal. [2 Marks]
- (e) Some situations in the laboratory may require that we are always aware of what we are doing and what others are doing around us. For a laboratory setup, which of the following are true or false.

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- (i) If you see your colleague in a laboratory finishing off his/her lunch, it is ok because they are your buddy.
 - (ii) Lab coats can be kept on when exiting the lab and entering a non-laboratory area so that people see you are a scientist.
 - (iii) Its ok to take a few chemicals home to solve your pest problems.
 - (iv) All lab users must know the location of all safety equipment.
 - (v) You can carry an instrument like a microscope with one hand to show your strength.
 - (vi) Its ok not to wash your hands before and after lab, you will wear gloves anyways.
 - (vii) Good Laboratory Practice (GLP) is a method employed in a laboratory setting to prevent contamination, accidents, and injuries. **[7 Marks]**
- (f) What is ISO 17025:2017? **[4 Marks]**
- (g) The graph below is extracted from an article comparing TED talks, 1000 top-cited articles in World of Science (WoS), Science, Nature, or Can. J. Chem. Eng. Those in WoS have a higher percentage of shorter titles than either Science or Nature but they also have a higher percentage of longer titles.



- (i) Titles should be concise but informative. Words in titles are a primary source for text-matching for internet search engines. How many characters and words should your title have?
 - Characters**
 - (a) 50 ± 25
 - (b) 70 ± 25
 - (c) 90 ± 25
 - (d) 110 ± 25
 - Words**
 - (a) 2 – 5
 - (b) 4 – 6
 - (c) 8 – 10
 - (d) 12 – 20 **[4 Marks]**
- (ii) List the **four (4)** classes of titles most authors use for their articles. **[4 Marks]**

END OF SECTION A

SECTION B

Question 2

You have been appointed a lab manager and are responsible for the day-to-day running of the laboratory. You immediately realize that the chemical stores are not organized properly.

- (a) Describe how you would set out to organize the chemical store in a way that promotes safety and order using the Japanese 5s tool. **[5 Marks]**
- (b) You are also made aware that one of your employees feels disgruntled because of unfair compensation. Using your knowledge of one of the eight principles of laboratory management, describe how you would resolve the situation. **[5 Marks]**
- (c) One of your tasks is to hire additional manpower for the laboratory. You have three candidates shortlisted all qualified. Given the list of candidates below, explain with reasoning which candidate you would hire. Give an explanation why the other two would not be considered.

| Candidate | Qualifications | Attitude |
|-----------|----------------|----------|
| A | Medium | Great |
| B | Poor | Great |
| C | Very good | Poor |

[10 Marks]

Question 3

Although originally designed for industrial manufacturing lines to increase speed and productivity, Lean Manufacturing can be applied to small laboratory setups helping to reduce small and life-threatening incidents.

- (a) List **seven (7)** sources of muda in Lean Manufacturing. **[7 Marks]**
- (b) In detail, explain one type of muda listed in a and provide a solution for overcoming this. **[3 Marks]**
- (c) You would like to obtain ISO/IEC 17025 accreditation by the Southern Africa Accreditation Service (SAAS). However, your boss did not know the difference between ISO 9001 certification and ISO/IEC 17025 accreditation. Prepare a short note with less than 200 words to convince your boss about the benefits of accreditation over certification.

[10 Marks]

Question 4

Most organizations/companies employ several tools to get their houses in order. In some cases, underperforming organizations hire champions to clean up house. However, trained laboratory managers can use similar tools to optimize organizational performance. Some of these tools are Six Sigma and DMAIC.

You have been assigned the role in your organization which produces latex for laboratory gloves. Customer feedback shows quality concerns as several gloves per box contain holes in them. Using your acquired knowledge, answer the following questions:

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- (a) Where is the Six Sigma name in quality control derived from? **[2 Marks]**
- (b) Describe how you would measure and find the root cause of the problem described above using the following tools.
- (i) Six Sigma? **[5 Marks]**
 - (ii) DMAIC. **[5 Marks]**
 - (iii) What is the recommended organizational structure when implementing Six Sigma? Explain your answer. **[4 Marks]**
 - (iv) Are there any disadvantages of using the Six Sigma initiative? If any, give your reasons. **[4 Marks]**
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Question 5

One of the toughest responsibilities in an organization is being a safety, health and environment officer (SHE officer). In most organizations containing laboratories, these individuals patrol the laboratory environments ensuring that everyone is adhering to safety protocols and proper laboratory safety wear. Safety in the laboratory is important for your health and those around you. Safety and health concerns can be immediate (acute) or take time to develop.

- (a) Describe how you would make the broader organization embrace safety in a non-confrontational manner. **[3 Marks]**
 - (b) There has been a non-life-threatening incident in the laboratory that everyone should learn from. Would you publicly ridicule the victim of the incident so that others learn from it or try to learn as much as you can/investigate the incident without shaming the victim. Explain your answer. **[2 Marks]**
 - (c) What is chemical waste? Give **two (2)** examples **[3 Marks]**
 - (d) Give **two (2)** examples each of
 - (i) acute and
 - (ii) long term health implications of laboratory exposure to hazardous substances. **[4 Marks]**
 - (e) Outline in detail, the steps to be taken in the event of
 - (i) a simple chemical spill
 - (ii) a life-threatening chemical spill. **[8 Marks]**
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END OF EXAMINATION!!!!