



MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

DEPARTMENT: CHEMICAL AND PROCESSING ENGINEERING

MODULE: ENVIRONMENTAL MANAGEMENT AND RISK ASSESSMENT

CODE: HCHE526/HMIE525

SESSIONAL EXAMINATIONS

DECEMBER 2022

DURATION: 3 HOURS

EXAMINER: K NYENYAYI (MR)

INSTRUCTIONS

1. Answer **All** in Section A
2. Answer any **three** questions in Section B.
3. Start a new question on a fresh page
4. Total marks 100

Additional material(s): Calculator, Graph paper

SECTION A

QUESTION 1

- a) What do you understand by the following terms: *sustainability*, *HAZOP analysis* and *water demand management (WDM)*. [6]
- b) Briefly explain any **three** (3) policy instruments that can be used to control negative pollution externalities by mining or chemical processing companies. [9]
- c) With reference to mining or industrial manufacturing projects, outline how Environmental Impact Assessments (EIAs) assists in protecting the environment and achieving sustainable development. [5]

QUESTION 2

- a) With reference to the hydrological cycle processes, deduce the water balance equation. [6]
- b) Discuss factors which affect water consumption within a mining or chemical process facility. [6]
- c) Briefly explain the 4 stages of Risk Management within a work system. [8]

SECTION B

QUESTION 3

- a) The simple process diagram shown in **Fig. 1** represents a production process in a plant where substances *X* and *Y* react with each other to form a new substance *Z*. If there is more *Y* than *X* there may be an explosion.

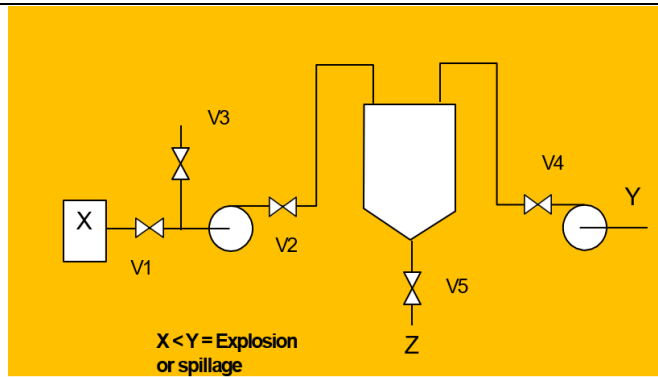


Fig. 1

Construct a HAZOP analysis for the process above for purposes of Hazard Identification and Risk Assessment (HIRA). [12]

- b) Outline any **three** opportunities and/or challenges leading to the need of Intergrated Solid Waste Management (ISWM) in global context. [3]
- c) Give any **five** benefits of Integrated Management Systems (IMS) to a chemical or mining organisation. [5]

QUESTION 4

- a) Give **any 4** motivations to carrying out Hazard Identification and Risk Assessment (HIRA) in chemical or mining industrial workplaces. [4]
- b) A contractor working at a mineral processing facility has been injured after a boiler explosion at the facility. Use a Fault Tree Analysis to assess Cause-Effect Relationships of the incident. [10]
- c) Risk assessment should be seen as a continual process. As an engineering intern at a chemical processing or mining facility, how would you propose to review Hazard Identification and Risk Assessment (HIRA) at the facility? [6]

QUESTION 5

- a) Identify the **three** main sources of water and give **two** advantages of associated with each source. [6]
- b) ABC Mining Group in Buhera Zimbabwe has 15 years of recorded and reliable water use figures and the available historical water use data is shown in Table 1.

Year	$\times 10^6 \text{ m}^3$
2005	8.5
2007	10.3
2009	14.1
2011	15.9
2013	18.1
2015	19.8
2017	23.2

- i. By means of a graph, develop a linear regression fit for purpose of forecasting water use until year 2030. [9]
- ii. Use your graph to estimate water use between 2023 and 2025. [5]

QUESTION 6

Discuss the status of environmental management regulations in Zimbabwe with particular reference to their effectiveness, strengths, weaknesses and comparability either regionally or internationally. [20]

END OF EXAMINATION