EXTERNAL INTEGRATED SUMMATIVE ASSESSMENT
THEORY PAPER 1 MEMORANDUM

STUDENT INFORMATION

SURNAME	
NAMES	
ID NUMBER	
EISA REGISTRATION NUMBER	
ASSESSMENT CENTRE	
ASSESSMENT CENTRE ACCREDITATION NUMBER	

QUALIFICATION INFORMATION

QUALIFICATION TITLE	OCCUPATIONAL CERTIFICATE: CHEMICAL PLANT CONTROLLER
SAQA ID	111359
NQF LEVEL	5
CREDITS	180
EXAM DURATION	03 HOURS
EXAM TOTAL MARKS	150
EXAM PASS MARK	60%
DATE OF EISA	

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1. Students are ONLY allowed to use the supplied **EISA BOOKLETS.**
2. Students are ONLY allowed to use a **BLACK PEN** for their answers.
3. Students to ensure that their **NAMES, SURNAMES** and **EISA registration numbers** appears on the front on your EISA booklet.
4. This is a closed book examination, therefore, no other materials or belongings are to be brought into the assessment centre. Should you bring any other materials or belongings into the assessment centre, you will be required to leave such at the front of the assessment centre examination room. The assessment centre will not be held liable for any loss or damage to property brought into the assessment centre examination room.
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I HEREBY CONFIRM THAT I HAVE READ THE ABOVE EISA RULES AND DECLARE THAT I UNDERSTAND AND ACCEPT THE RULES

_____

CANDIDATE SIGNATURE

CANDIDATE INSTRUCTION

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b) Candidates must ensure that they use only a BLACK PEN when completing this EISA.
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QUESTION 1

1.1 Plan and Execute plant operations

1.1.1

Production organisations operate on the basis of meeting or even exceeding customer expectations. However, this cannot be achieved if proper Production Plans are not in place.

Consider the CASE STUDY below:

Company PTY LTD has 15 employees who in various stages of the production process produce a yield of 1.5m^3 of product in 6 hours. For Company PTY LTD to double its yield over a period of 24hours, it needs to consider several factors, such as:

i. Product demand
ii. Capacity of the machinery/production equipments
iii. Availability of raw materials
iv. Quality control of the production processes
v. Upgrading of production systems
vi. Storage and transportation of the final products

The anticipated yield cannot be achieved without a realistic Production Plan.

Consider Figure 1 below which indicates the Process Flow Diagram of Company PTY LTD:

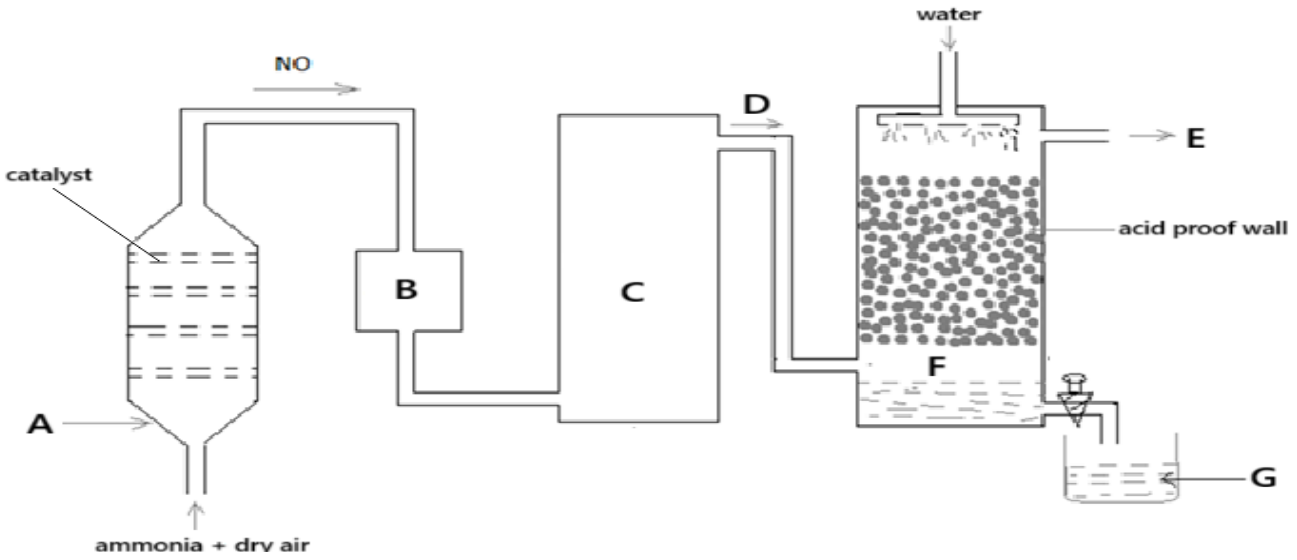


Figure 1: Nitric Acid *manufacturing Process*

a.	**CIRCLE a LETTER** corresponding to an **INCORRECT STATEMENT/ PHRASE or WORD**

i. Developing a Production plan is important for manufactures who want to:

A. Reduce operation cost
B. Increase production efficiency
C. Sustain the production cycle
D. Only A and B are correct

ii. Analyzing the customer demands ensures that:

A. Product demand is more than the production
B. Production meets the demand
C. Enough product is manufactured for the business to be profitable
D. Only B and C are correct

iii. During the evaluation of raw materials availability, the organisation aims to verify if:

A. Production plan can be met
B. Departments can re-plan the output should raw material be insufficient
C. Departments optimize the production process until enough raw materials are available
D. Only A is correct.

iv. Company PTY LTD cannot increase production to meet the demand if the following cannot be met:

A. Acceptable product Quality Standards
B. Documentation of the production process
C. Ensuring safety of the operators
D. None of the above is correct

v. During the evaluation of the production process, production plan as an ongoing process may need to be:

A. Amended
B. Left as is
C. Improved
D. Changed

(5 marks)

Section 1.1.1 Subtotal = 5 marks
Marks obtained =

1.1.2

a. **CIRCLE a LETTER** corresponding to an **INCORRECT STATEMENT/ PHRASE or WORD**

i. In the Process Flow Diagram in Figure 1 above, raw materials required to produce the final product includes:

A. Water
B. Air (O_2 + N_2)
C. Ammonia (NH_3)
D. Platinum

ii. The Ammonia used during the Nitric Acid production process in Figure 1 could be obtained from

A. The Atmosphere
B. Reacting Hydrogen with Nitrogen (Haber – Bosch process)
C. External suppliers

iii. Air used in the Nitric Acid making process allows for

A. Easy breathing for operators
B. Driving forward chemical reactions
C. Combustion of Ammonia
D. Providing oxygen for oxidation

iv. Some of the equipments to be ensured available during the Nitric Acid making process includes:

A. Catalytic Converter
B. Cooling and Oxidation Chambers
C. Heat Exchanger
D. Thickeners

v. Utilities that are required during the production of the Nitric Acid includes :

A. Compressed Air
B. Water

C. Nitrogen Gas
D. Electricity

(5 marks)

Section 1.1.2 Subtotal = 5 marks
Marks obtained =

1.1.3

Company PTY LTD has a capacity to produce 1.5m^3 of Nitric Acid in 6hours. Given that the density of Nitric Acid is 1.51grams /cm^3

Consider that this production process has a yield 100% Nitric Acid.

a. Calculate the actual Nitric Acid weight in ***kilograms*** produced in 6 hours

Given the density of nitric acid as: 1.51 g/cm^3 , product yield in 6 hours is 1.5m^3

Density =Mass / Volume
Mass = density x volume
Mass = 1.51g/cm^3 x1 500 000cm^3
Mass = 2 265 000g
= 2 265kg will be produced

(2 mark)

b. How many kilograms of Nitric Acid will be produced in 24 hours

Since 2 265kg of nitric acid are produced in 6 hours
Then, x (kg) of nitric acid = 24 hours

x (kg) of nitric acid = [(2 265kg) x 24 hours] ÷ 6 hours
= 9 060 kg

(2 mark)

c. Consider the chemical reaction below of Nitric Acid production and answer question that follow:

$$3NO_2\,(g) + H_2O\,(l) \longrightarrow 2HNO_3\,(aq) + NO\,(g)$$

How many litres of water will be required to produce nitric acid in 24 hours
(The Periodic Table is attached at the back for reference)

Since 9060kg of Nitric Acid is produced in 24 hours, then

17g/mole of H_2O yield 124 g/mole of nitric acid
x(l) of water should yield 9 060kg of nitric acid
x(l) H_2O = [(9 060 kg of HNO_3) x (17g/mole of H_20)] ÷ 124g/mole of HNO_3
x(l) H_2O = 1 242 kg = 1 242 (l)

(3 marks)

d.	Calculate the amount of NO_2 required to produce 9 060kg of Nitric Acid in 24 hours (The Periodic Table is attached at the back for reference)

Considering this equation: $3NO_2\ (g) + H_2O\ (l) \longrightarrow 2HNO_3\ (aq) + NO\ (g)$

If: 138g/mole of NO_2 yield 124g/mole of HNO_3

x(kg) of NO_2 yield 9 060 kg of HNO_3

therefore: x(kg) of NO_2 = [9 060 kg of HNO_3 X 138g/mole of NO_2] ÷ 124g/mole of HNO_3

x(kg) of NO_2 = 10 083 kg of NO_2

(3 marks)

Section 1.1.3 Subtotal = 10 marks
Marks obtained =

1.1.4	
a.	**CIRCLE a LETTER** corresponding to an **INCORRECT STATEMENT/ PHRASE or WORD**

i. Safe startup of a catalytic converter in nitric acid production requires:

A. Controlled heating of the platinum-rhodium gauze
B. Rapid introduction of ammonia-air mixture
C. Monitoring of temperature and pressure
D. Control of NO_x emissions

ii. Emergency shutdown readiness required during the startup of the catalytic converter ensures that:

A. Ammonia feed is immediately cut off as soon as temperature rises
B. Safety of operators is assured
C. Palladium catalyst is converted to platinum
D. Emission of NO_x release is avoided

iii. Catalytic converter in nitric acid production process can be damaged by the following:

A. Uncontrolled ammonia feed
B. Thermal shock
C. Operator's vigilance
D. Poor mixing of ammonia and air mixture

iv. Emergency shutdown operations of the absorption column in the Nitric Acid production process includes:

A. Closing feed gas valve leading to the column
B. Cutting ammonia feed to the catalytic converter
C. Activate emergency block valves which isolate the column from upstream and downstream production units
D. Increase absorption column temperature to enhance quick acid formation

v. During emergency shutdown of the absorption column , it is important to:

A. Evacuate non-essential personnel from the absorption area
B. Activate alarms to alert plant staff
C. Trip pumps, compressors and blowers supplying the column
D. None of the above is correct

(5 marks)

Section 1.1.4 Subtotal = 5 marks
Marks obtained =

Question 1 - Subtotal = 25 marks
Marks obtained =
Percentage =

QUESTION 2

2.1 Control and monitor plant operations as per SOP

2.1.1

Below is the SCADA screenshot of a Water Treatment plant.

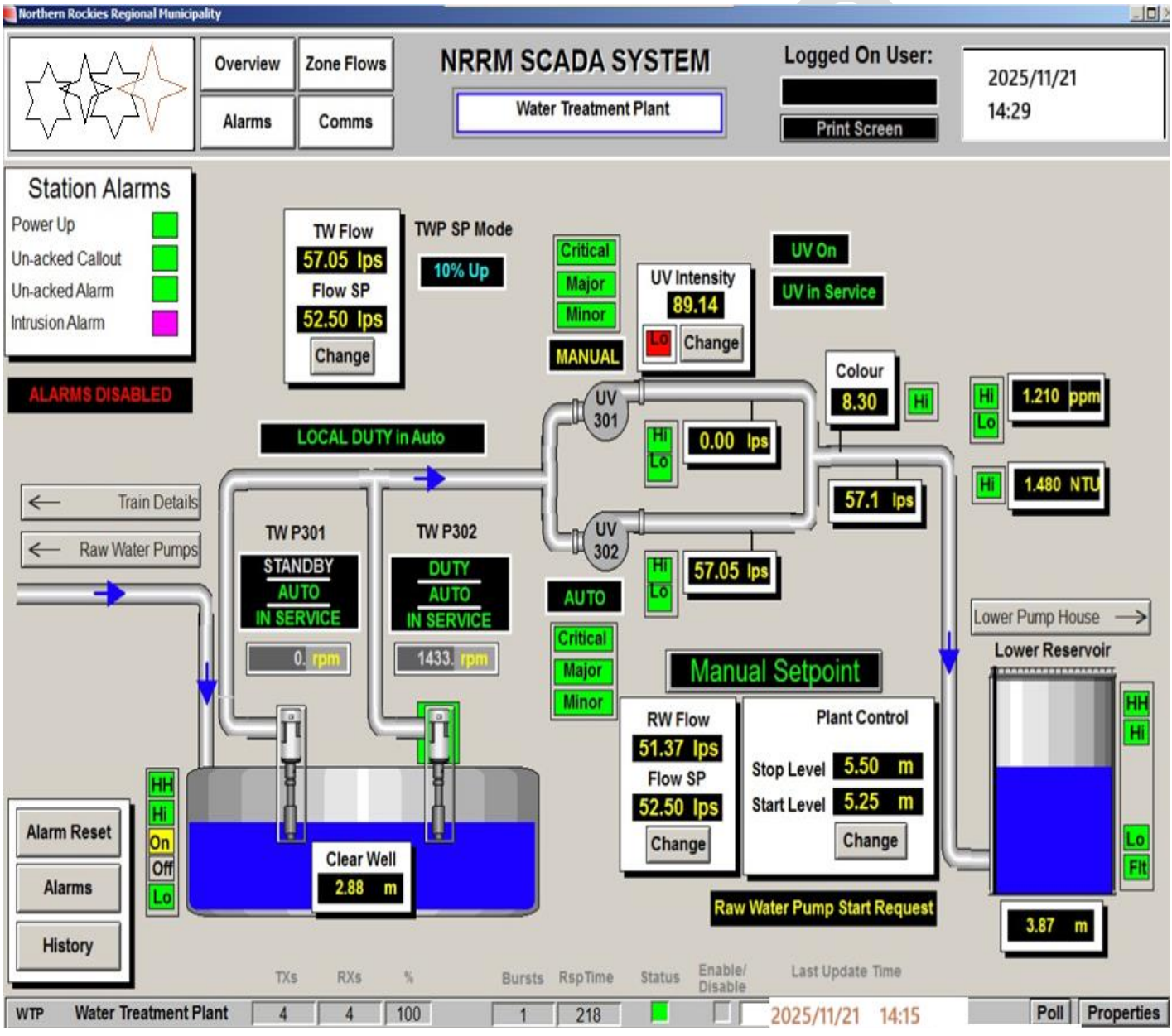


Figure 2: NRRM SCADA System to monitor Water Treatment operation

Refer to Figure 2 and answer questions that follow.			
a.	**UNDERLINE or CIRCLE TRUE or FALSE** for the statements below.		
i.	Chemical Plan controllers are required to wear eye glass to be able to correctly monitor SCADA systems in the control room	TRUE	FALSE
ii.	SCADA is an abbreviation for Supervisory Control and Data Acquisition	TRUE	FALSE
iii.	When monitoring plant monitors, operators are required to review inspection schedule and plant SOP's	TRUE	FALSE
iv.	It is not necessary to check for monitor displays brightness and clarity.	TRUE	FALSE
v.	Functionality of alarms and indicators is work left for the artisan and operators should not monitor functionality of instruments	TRUE	FALSE
			(5 marks)

Section 2.1.1 Subtotal = 5 marks
Marks obtained =

2.1.2

Match COLUMN A and B regarding SCADA diagram in figure2 regarding the Plant Status of the process illustrated.
Write the Letter for the correct answer in the provided column.

a.	Column A	Column B	Correct Answer
i.	Treated water setpoint flow rate is set at	A. 51.37 lps	D or B (1)
ii.	Raw water flowrate is indicated as	B. 52.5 lps	A (1)
iii.	Treated water flow rate is indicated as	C. 5.25 m	E (1)
iv.	Setpoint to start Raw water pump is set at	D. 52.50 lps	C (1)
v.	Setpoint for raw water flowrate is set at	E. 57.05 lps	B or D (1)

(5 marks)

b. List three (3) process variables that are indicated in the SCADA diagram in figure 2

ANY THREE (3)

1. Raw Water flow rate
2. Treated Water flow rate
3. Raw Water storage Level
4. Treated Water storage level
5. Raw water transfer pump speed
6. UV intensity
7. Treated Water colour
8. Mineral concentration
9. Water Turbidity

(3 marks)

c. Briefly explain what is indicated in pump TW P302 control panel

- Pump TW P302 control indicates that the pump is in USE and is on AUTO, this means that the pump is interlocked with UV Pump.
- Pump TW P302 panel also indicates that the pump rotational speed is 1433 rotation per minute.

(2 marks)

Section 2.1.2 Subtotal = 10 marks
Marks obtained =

2.1.3	
	In the SCADA diagram in figure 2, it is indicated that Treatment Water flowrate is 57.05 litres per second.
a.	Assuming that there were no breakdowns and that water treatment plant has been operating for 4 hours. Calculate the total amount of water treated in the 4 hour period.

Given is the water treatment flowrate of 57.05 litres per second

In ***1 minute*** = x(l) of water would be treated in 60 seconds
x(l) = 57.05 liters per second x 60 seconds
= **3 423 liters treated in a minute**

Therefore in ***1 hour*** (60 minutes) treated water will be:
Y(l) = (3 423 liters per minute) x 60 minutes
= **205 380 liters per hour**

In ***4 hours***, treated water will be = 205 380 liters x 4 hours
= **821 520 liters**

(5 marks)

Section 2.1.3 Subtotal = 5 marks
Marks obtained =

2.1.4	
a.	List four (4) communications requirements that should happen during the shift hand over process.

ANY FOUR (4)

1. Shift hand over must be done face-to -face in the control room between the Incoming operator and the outgoing operator
2. Outgoing operator should prepare plant information related notes and the outgoing operator should verify information given before assuming responsibilities
3. An approved standardized shift hand over form should be used during handover to avoid confusion.
4. Outgoing operator should sign-off on the shift hand over document while incoming operator should sign-in the shift hand over form as a sign of acknowledging responsibilities.
5. Outgoing operator cannot leave the control room until the incoming operator has arrived.
6. Shift hand over forms should be neatly completed using a standard writing pen.

(4 marks)

b.	List three (3) crucial information that should be recorded in the shift hand over forms and give one example of each:

ANY THREE

1. **Plant status** – process parameters settings, operating conditions, production rate, equipment performance, manually operated equipments.
2. **Safety issues** – incidents, near misses, alarms, permit-to-work, isolation status, by-passed working instructions,
3. **Maintenance activities** – ongoing repairs, out-of-service equipments, scheduled maintenance work.
4. **Pending tasks/issues** – unresolved problems, pending inspections, pending laboratory results,
5. **Inventory/chemical handling** – tank levels, raw material availability, waste streams
6. **Environmental compliance issues** – emissions, effluent treatment status, deviations from compliances.

(6 marks)

Section 2.1.4 Subtotal = 10 marks

Marks obtained =

2.1.5

Responding to workplace emergencies requires operators to be familiar with the types of emergencies they are likely to encounter in their area of operation.
Emergency response plans are developed to ensure that operators, plant equipments and the environment is protected from hazards present in the workplace.

Match COLUMN A and B regarding Preparedness and Hazards Assessments during an emergency

a.	Column A	Column B	Correct Answer
i.	Classification of chemical materials by their categories (flammable, corrosive, poisonous, toxic, radio active, etc)	A. Risk analysis	C (1)
ii.	Assessing the likelihood and severity of an incident (fire, leak, explosion, gas release)	B. Safety Drills	A (1)
iii.	Developed site specific procedure to be used during an emergency.	C. Hazard identification	D (1)
iv.	Regular staff training on evacuations, containment and PPE use	D. Emergency response plan	B (1)
v.	Regulation policy that ensures emergency plans are developed	E. OSH Act	E (1)

(5 marks)

b. State **THREE (3)** types of actions that should immediately be implemented when responding to an emergency.

ANY THREE actions:

1. Stop whatever you are doing
2. Emergency shut down the equipment
3. Activate / Trigger the emergency alarms
4. Notify the emergency services
5. Assist people with disabilities
6. Evacuate or shelter – in – place.
7. Coordinate with First responders if trained to do so

(3 marks)

c. List **TWO (2)** types of Hazards containment measures that the operator can implement during an emergency.

ANY TWO

1. Shutting down the process plant equipments
2. Isolate leaks or spillages
3. Activate sprinkler systems
4. Neutralize the systems (closing doors and windows or even switching off the fans in case of a fire)

(2 marks)

d.	State an area where employees should gather when an emergency alarm has been triggered

Assembly point / Gas Room / Bunker Room

(1 mark)

e.	State the purpose of informing staff through intercom/public announcement system about the emergency

Staff should be informed so that they can take necessary safety precautions and evacuate to the nearest assembly point

(2 marks)

f.	List **TWO (2)** types of information that should be documented and reported in the emergency report

ANY TWO:

1. Name and Contact details of the Person reporting the emergency
2. Date and Time of the emergency
3. Location where the emergency occurred
4. Nature of the emergency
5. Actions taken after the emergency happened
6. Root cause of the emergency
7. Factors that caused or contributed to the emergency
8. Documented deviations from procedures
9. Preventive measures implemented or recommended
10. Parties responsible for the implementation of corrective measures

(2 marks)

Section 2.1.5 Subtotal = 15 marks

Marks obtained =

2.1.6

Chemical plant equipment is made from various materials and operates within specific conditions. Regular maintenance is essential to ensure their reliability and efficiency.

Match COLUMN A and B regarding making plant equipment safe. Choose the correct word or statement that matches those in Column A. Write the letter corresponding to the correct explanation in the correct answer column.

a.	**Column A**	**Column B**	**Correct Answer**
i.	Equipment construction materials should be resistant to corrosion, chemical exposure and thermal stress.	A. High risk period	E (1)
ii.	Check equipment, procedures, and emergency systems before starting up.	1. Stepwise approach	G (1)
iii.	Keeping thorough records of equipment design, as well as safety and compliance inspections	2. Communication and Training	I (1)
iv.	Periods when incidents are expected to happen more frequently than during normal operations	3. Safety systems integration	A (1)
v.	Tracking process variables with SCADA/DCS systems	4. Material compatibility	H (1)
vi.	Procedures are adhered in sequences to minimise the risk of deviations that may result in uncontrolled reactions.	5. SOP	B (1)
vii.	Hazards identification in equipment design	6. Pre-Startup safety review (PSSR)	J (1)
viii.	They ensure that operators, contractors and supervisors understand their roles	7. Monitoring	C (1)
ix.	Installation of relief valve, bunds, fire suppressors and emergency shutdown systems on equipments	8. Documentation and treceability	D (1)
x.	Verified steps for shutting down each piece of equipment	9. HAZOP	F (1)

(10 marks)

b.	List **FIVE (5)** Emergency Operations that organisations have developed to be able to respond to workplace emergencies.

ANY FIVE

1. Emergency response drills/plans for various emergencies are developed
2. Immediate response actions such activation of alarms, evacuation procedures and routes are developed
3. Coordination of Emergency response units such as HAZMAT teams, Fire marshals, First Aiders are developed
4. Communication and alert systems are developed
5. Risk management programs such as HIRA are developed in line with OSH policy
6. Operator's responsibilities during an emergency are developed
7. Scheduled emergency alarm systems (Dry-Run systems) activation are developed
8. Visitors and Contractors safety induction programs are developed
9. Visitors and Contractors safety assessments.

(5 marks)

c.	State the document that is completed by the operator to report an incident

Incident Report

(1 mark)

e.	List four (4) reasons workplace incident should be reported.

ANY FOUR

1. They are reported to protect employees from associated hazards
2. They are reported to ensure legal compliance
3. They are reported to prevent future accidents
4. They are reported so that corrective actions can be implemented to prevent similar events from happening again
5. They are reported to provide data to identity hazards and root causes
6. They are reported to provide information on unsafe practices, equipment failures and environmental hazards
7. They are reported to help improve training, procedures and risk control systems
8. They are reported to help improve productivity and reduce downtime
9. They help build trust and motivates employees to be proactive about hazards
10. They are reported to highlight inefficiencies or unsafe bottlenecks in the process

(4 marks)

Section 2.1.6 Subtotal = 20 marks

Marks obtained =

2.1.7	
Different chemical companies use different types of equipments to manufacture specific chemical products. These equipments have critical operating parameters that require continuous monitoring.	
a.	List five (5) common process parameters that require monitoring in the chemical plant and give **an example** of the process equipment which operates using such a parameter .
ANY FIVE (5) 1. Flowrate – Cooling Tower / Mixer Steam Jackets / Effluent Pump / Raw material pump 2. Level – Tanks / Scrubbers / Separators/etc 3. Temperature – Furnace / Reactors / Oxidation Chamber/etc 4. Pressure – Vessels / Pipelines / Compressors / etc 5. Composition – Gas Analysers / pH/ Digester/etc (5 marks)	
b.	List four (4) monitoring methods that are used in a chemical plant to monitor process parameters.
1. Alarms are used detect deviations occurring in the process 2. Trends are used to analyse process parameters so that gradual shifts from setpoints are identified before they become incidents 3. SCADA/DCS systems are used to obtain process parameters real time data 4. Sampling of products is used to monitor product characteristics which will help confirm accuracy of process parameter settings 5. Manual inspection of products to verify colour variation which also confirms process parameter settings (4 marks)	
c.	List three (3) instruments/techniques that are used in the chemical plant to control plant equipment parameters
1. Control Loops (Feedback/ Feedforward/ Split Range) 2. Interlocks / Trips 3. Redundancy systems (3 marks)	

The table below indicates process data collected on process equipment instruments over a nine (8) hour period on **Saturday, the 17th of May, 2025**

Time (Hours.)	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00
Temperature (˚c)	1590	1550	1620	1680	1600	1595	1750	1545
Pressure (MPa)	0.6	1.2	0.9	1.1	1.6	0.8	1.7	0.9
[Speed] meters/minute	3.5	2.4	3.3	2.2	3.2	4.2	3.3	3.6

Table 1: ***Recorded process parameters data***

d. **LOGBOOK DATA COMPLETION**

Complete the Logbook below with the recordings of the data in **Table 1**.

PLANT LOGBOOK			
OPERATOR NAME			
OPERATOR SURNAME			
EMPLOYEE NUMBER	CPC 111359	DATE	17/05/2025
SHIFT	F	SUPERVISOR	Daniel Tsolo

TIME (Hours)	Temperature (˚C)	Pressure (MPa)	Speed (Meters/minute)
07:00	1590	0.6	3.5
08:00	1550	1.2	2.4
09:00	1620	0.9	3.3
10:00	1680	1.1	2.2
11:00	1600	1.6	3.2
12:00	1595	0.8	4.2
13:00	1750	1.7	3.3
14:00	1545	0.9	3.6
OPERATORS SIGNATURE			

(8 marks)

Section 2.1.7 Subtotal = 20 marks
Marks obtained =

2.1.8	
a.	List five (5) key information that should be included when incident, accidents or mitigation are recorded in the workplace

ANY FIVE (5)

1. Name of the supervisor who was immediately notified
2. Safety measures taken to stabilize the situation
3. Date , Time and Location of the occurrence
4. Type of the event reported
5. Persons involved in the occurrence
6. Detailed description of the event
7. Plant operating parameters at the time of the occurrence
8. Deviations from operating settings
9. Supporting events in form of Inspection sheets, sample results, SCADA/DSC logs
10. Corrective actions taken to curtail the occurrence
11. Preliminary observations
12. Long term preventive recommendations
13. Signature of the operator and supervisor responsible
14. Filing of the occurrence in to the log system for audits and compliance

(5 marks)

Section 2.1.8 Subtotal = 5 marks
Marks obtained =

Question 2 - Subtotal = 90 marks
Marks obtained =
Percentage =

QUESTION 3

3.1 PERFORM QUALITY CONTROLS

Consider the CASE STUDY indicating the Quality Control of a Pharmaceutical Product

Product Specification of a Pain Relief Tablet: 500mg ± 5mg

- Active Ingredient: 200mg of Ibuprofen per tablet
- Acceptable Range of Ibuprofen: ± 5% per tablet

Sample Data Collected: A batch of 10 tablets was sampled from the production line and each tablet was weighed and its ibuprofen content measured using Analytical balance.

Table No	*Weight (mg)*	*Ibuprofen Content (mg)*
1	503	205
2	499	200
3	502	203
4	505	211
5	497	198
6	480	182
7	500	200
8	511	204
9	495	198
10	492	187

Table 1: Collected sample data

3.1.1

a. Consider the given Product Specification of a Pain Relief Tablet above, calculate the acceptable weight limits through which the measured tablets weight should conform with.

Product Specification of a Pain Relief Tablet: **500mg ± 5mg**

Upper Control Weight Limit = Setpoint + Variance

= 500mg +5mg = **505mg**

Lower Control Weight Limit = Setpoint – Variance

= 500mg – 5mg = **495mg**

(5 marks)

Section 3.1.1 Subtotal = 5 marks
Marks obtained =

3.1.2	
a.	Use the given data in table 1 to indicate which tablets have active ingredients falling outside Ibuprofen limits Use calculations to motivate your answer
Ibuprofen Tablet content setpoint: 200mg ± 5%	
Upper Ibuprofen Limit = 200mg + 5%	
= 200mg + (200mg x 0.05) = 200mg + 10mg = **210mg**	
Lower Ibuprofen Limit = 200mg – 5%	
= 200mg – (200mg x 0.05) = 200mg – 10mg = **190mg**	
Tablet 4 Ibuprofen content = 211mg Tablet 6 Ibuprofen content = 182mg Tablet 10 Ibuprofen content = 187mg	
The above tablets measure Ibuprofen content which is outside required limits.	
(5 marks)	

Section 3.1.2 Subtotal = 5 marks
Marks obtained =

3.1.3

a. Plant product specifications depends on plant equipment performance, these equipments require settings that would enable them to operate within set parameters. Deviations however do occur during their operations and operators should be able implement corrective actions that will mitigate the impact of such deviation.

From the given deviations below, list associated corrective actions that should be implemented to mitigate the impact of such deviations.

i. Temperature deviation on Heat Exchanger

CAUSE OF DEVIATION	MITIGATION MEASURE
1. Fouled or chocked tubes/plates 2. Insufficient cooling medium	1. Clean tubes/plates 2. Ensure enough cooling medium is available (2marks)

ii. Pressure deviation on Compressor

1. Fluctuation caused by surge resulting to backward air flow 2. High discharge pressure	1. Adjust compressor controls and inspect for mechanical faults 2. Open recycle valve / Open vents to release excess air (2marks)

iii. Flow rate deviation

1. Pump cavitation 2. Valve sticking 3. Leaks	1. Correct suction conditions of the pump 2. Lubricate/replace the valve 3. Repair leak (3marks)

iv. Quality deviation

1. Incorrect feed composition 2. Catalyst deactivation 3. Contamination	1. Verify feedstock 2. Regenerate catalyst 3. Flush/clean system (3marks)

(10 marks)

Section 3.1.3 Subtotal = 10 marks

Marks obtained =

3.1.4	
a.	**CIRCLE** a **LETTER** corresponding to a **INCORRECT STATEMENT/ PHRASE** or **WORD**

i. Process plant performance can be improved by:

A. Installing advanced process control systems
B. Upgrading process equipments
C. Integrating energy systems
D. Only C is incorrect

ii. Improved plant performance techniques are aimed at:

A. Increasing operational costs
B. Increasing process throughput
C. Enhance process safety and sustainability
D. Keep up with the current technologies

iii. Plant performance can be optimized through

A. Minimising process flow bottlenecks and errors
B. Streamlining the production process to improve reliability
C. Increasing the production process complexity
D. Simplifying flows to lower capital and operational costs

iv. Implemented advanced process control systems help:

A. Boost production throughput
B. Automate predictive control systems to dynamically adjust parameters
C. Significantly decrease energy consumption
D. Only A and C are incorrect

v. Optimization of the process plant is based on the following:

A. Linear and non-linear programming
B. Process simulation models
C. Identifying process inefficiencies before changing the process
D. None is correct

(5 marks)

b.	Briefly explain what is a Pinch Analysis method .

This is a systematic method which is used to minimize energy consumption by optimizing heat recovery between hot and cold streams in industrial processes.

(2 marks)

c.	What is a Pinch Point?

This is a point of closest temperature between hot and cold stream

(1 marks)

d.	Explain how optimisation of catalyst used in the process plant can be done

Optimisation of the catalyst can be done by fine-tuning (*setting conducive temperatures, pressures, feed composition, etc*) the reaction conditions to maximize the yield and minimize by-products.

(2 marks)

Section 3.1.4 Subtotal = 10 marks
Marks obtained =

3.1.5

Consider the **Inspection Findings Record** below and answer questions that follow:

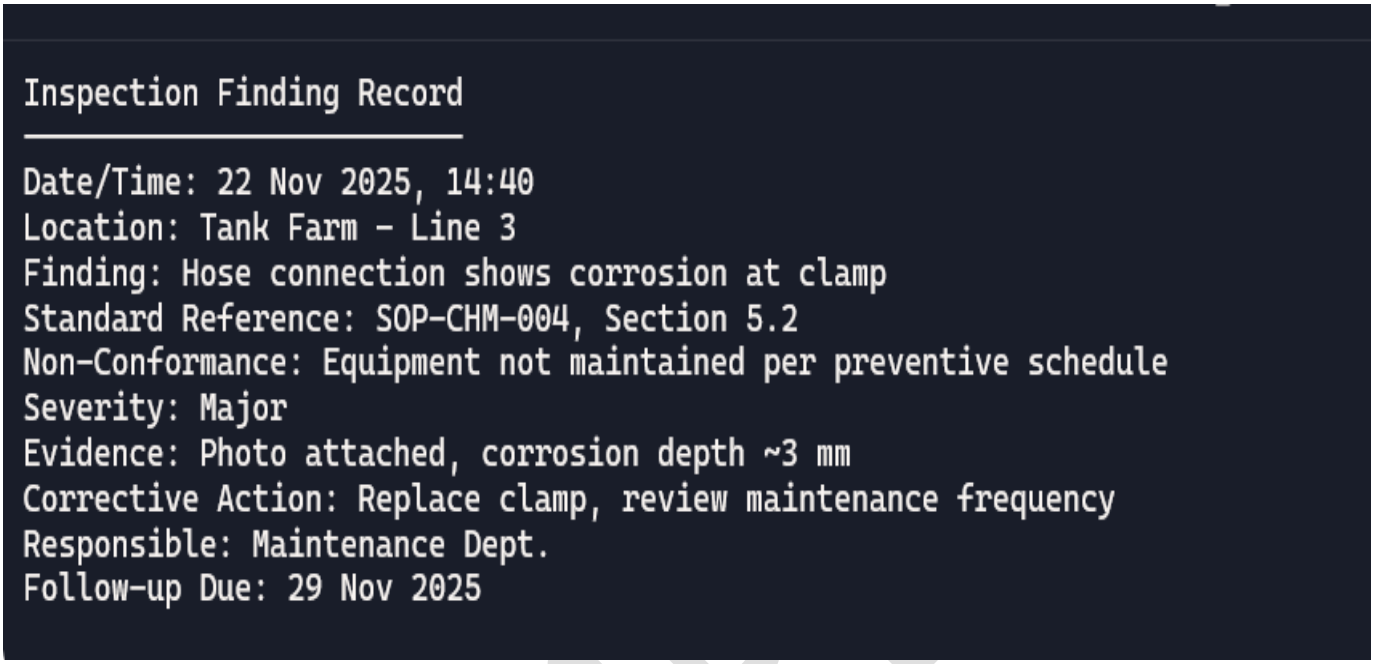


Figure 3: Inspection Findings Record

a.	Accurate recording of findings and clear reporting of non-conformances are principles of which Quality System?

Quality Assurance

(1 mark)

b.	On the Inspection Findings record in figure 3, where is the location of a non-conformance

Tank Farm

(1 mark)

c.	According to the Inspection Finding Record, what was identified?

Hose connections show corrosion at a clamp

(1 mark)

d.	When was the Inspection Finding Record completed

22 November 2025 , 14:40

(1 mark)

e.	When will another Inspection be conducted

25 November 2025

(1 mark)

Section 3.1.5 Subtotal = 5 marks
Marks obtained =

Question 3 - Subtotal = 35 marks
Marks obtained =
Percentage =

FOR SSESSOR USE ONLY

MARKS ALLOCATION GRID

QUESTION 1			
SECTION 1.1		(25)	
Subsection	1.1.1	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	1.1.2	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	1.1.3	Marks Allocation	Marks Awarded
	a	2	2
	b	2	2
	c	3	3
	d	3	3
Subtotal		10	10
Subtotal	1.1.4	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
QUESTION 1 SECTION 1.1 GRAND TOTAL		25	25

QUESTION 2			
SECTION 2.1		(90)	
Subsection	**2.1.1**	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	2.1.2	Marks Allocation	Marks Awarded
	a	5	5
	b	3	3
	c	2	2
Subtotal		10	10
Subsection	2.1.3	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	2.1.4	Marks Allocation	Marks Awarded
	a	4	4
	b	6	6
Subtotal		10	10
Subsection	2.1.5	Marks Allocation	Marks Awarded
	a	5	5
	b	3	3
	c	2	2
	d	1	1
	e	2	2
	f	2	2
Subtotal		15	15
Subsection	2.1.6	Marks Allocation	Marks Awarded
	a	10	10
	b	5	5
	c	1	1
	d	4	4
Subtotal		20	20
Subsection	2.1.7	Marks Allocation	Marks Awarded
	a	5	5
	b	4	4
	c	3	3
	d	8	8
Subtotal		20	20
Subsection	2.1.8	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
QUESTION 2 SECTION 2.1 GRAND TOTAL		90	90

FOR ASSESSOR USE ONLY

MARKS ALLOCATION GRID

QUESTION 3			
SECTION 3.1		(35)	
Subsection	3.1.1	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	3.1.2	Marks Allocation	Marks Awarded
	a	5	5
Subtotal		5	5
Subsection	3.1.3	Marks Allocation	Marks Awarded
	a	10	10
Subtotal		10	10
Subsection	3.1.4	Marks Allocation	Marks Awarded
	a	5	5
	b	2	2
	c	1	1
	d	2	2
Subtotal		10	10
Subsection	3.1.5	Marks Allocation	Marks Awarded
	a	1	1
	b	1	1
	c	1	1
	d	1	1
	e	1	1
Subtotal		5	5
QUESTION 3 SECTION 3.1 GRAND TOTAL		**35**	**35**

ASSESSMENT OUTCOME			
	MARKS ALLOCATED	MARK AWARDED	% SCORED
QUESTION 1	25	25	
QUESTION 2	90	90	
QUESTION 3	35	35	
GRAND TOTAL	150	150	
PERCENTAGE SCORED			

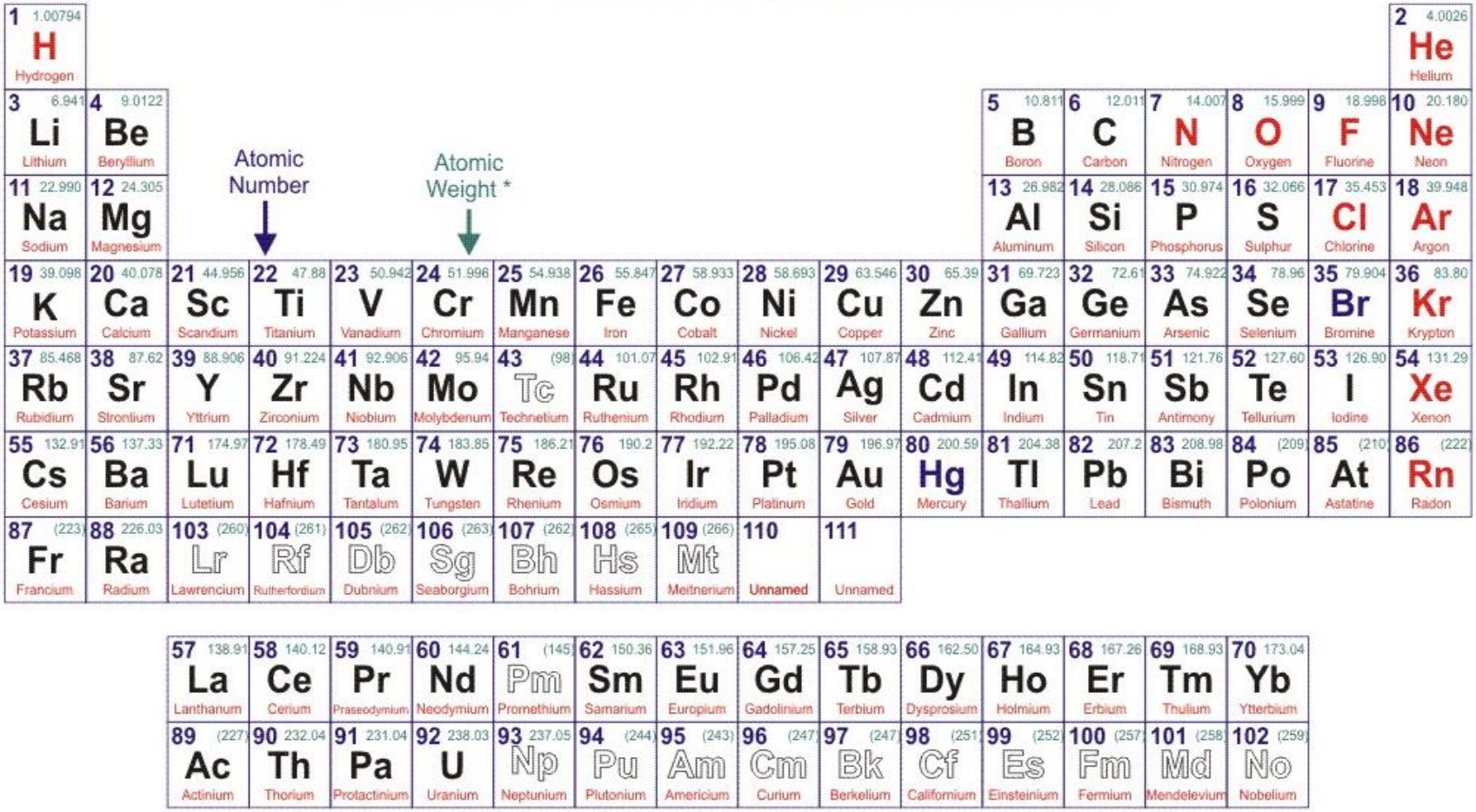
Assessor Signature	
Date	

ASSESSOR DETAILS			
Assessor Names			
Assessor Surname			
Assessor Registration Number		**Assessor Signature**	
Assessment Date			
Assessor remarks			

INTERNAL MODERATOR DETAILS			
Moderator Names			
Moderator Surname			
Moderator Registration Number		**Moderator Signature**	
Moderation Date			
Moderator remarks			

CHIETA
INNOVATING FOR IMPACT

Periodic Table of the Elements



* Atomic weights are based on carbon-12. Atomic weights in parentheses indicate the most stable or best known isotope.

Note: The color of the symbol for each element indicates its state at 298 K. (Black = solid, Blue = liquid, Red = gas)
Elements with symbols that are shown as a hollow outline are not naturally occurring.

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