2ND QUESTION PAPER

EXTERNAL INTEGRATED SUMMATIVE ASSESSMENT (EISA)

OCCUPATIONAL CERTIFICATE: INDUSTRIAL WATER PROCESS CONTROLLER

SAQA ID: 102578 NQF LEVEL: 5 CREDITS: 251

LEARNER DETAILS			
Surname:			
Name:			
ID Number:			
Centre Name:			
Date:		**Mark Allocation:**	**100 Marks**
Time:	**09H00 to 10H30**	**Duration:**	**3Hours**

INSTRUCTIONS TO CANDIDATES

Please read the questions carefully and then answer all the questions on the provided answer sheets.

PLEASE ENSURE THAT YOU ADHERE TO THE FOLLOWING INSTRUCTIONS:

- Cell phones are not allowed.
- Please use a black pen. No script will be marked if written in Pencil.
- Complete all your personal details in the space provided above.
- This is a closed book assessment; no reference material will be allowed, unless otherwise indicated.
- Carefully read through all the case exercises and questions and answer all questions
- Read the instructions for each question before answering.
- Structure all written answers logically.
- Use the mark allocation for each written question to guide the length of your answer.
- If additional paper is used, ensure that you write your Personal Details on each page and clearly mark which question you are answering.
- The invigilators will supply you with a stapler to attach the additional pages to the ANSWER SHEET.
- This question paper consists of the relevant pages and number of relevant addenda

SECTION A

Analyze, interpret and apply legislation, regulations, and standards applicable to industrial water treatment

QUESTION 1

Time: **54** Min

Attached is a Certificate of Analyses obtained from treatment plant

a) Interpret the attached Certificate of Analyses. Which result/s are out of spec. Provide possible reasons for the out-of-specification results (9)

b) Provide recommendations and corrective action for the out-of-norm results. (21)

(30 marks)

Certificate Of Analysis

Company:
Address:

Contact:

Service Request Number: PW-2020-25794
Date of Certificate: 21-September-2020
Date Completed: 21-September-2020
Date of Sampling: 07-September-2020
Date of Receival at Lab: 07-September-2020

Sample Identification:	WTW _ Process Filtered Water 1			
Sample Number: PW-20-89350	Sample Condition: Please Select	Remark:		

Physical / Aesthetic Parameters	Method	Unit	Limit	Result	Analysis Date
Colour (True)	M14	Pt-Co-true		<10.0	2020-09-09
pH @ 25°C	M6	pH units		4.56	2020-09-08
Turbidity	M12	NTU		1.07	2020-09-11

Sample Identification:	WTW _ Settled Water 2			
Sample Number: PW-20-89352	Sample Condition: Please Select	Remark:		

Physical / Aesthetic Parameters	Method	Unit	Limit	Result	Analysis Date
Colour (True)	M14	Pt-Co-true		<10.0	2020-09-09
pH @ 25°C	M6	pH units		5.12	2020-09-08
Turbidity	M12	NTU		4.65	2020-09-11

Sample Identification:	Franskraal - WTW _ Settled Water 1			
Sample Number: PW-20-89351	Sample Condition: Please Select	Remark:		

Physical / Aesthetic Parameters	Method	Unit	Limit	Result	Analysis Date
Colour (True)	M14	Pt-Co-true		<10.0	2020-09-09
pH @ 25°C	M6	pH units		5.09	2020-09-08
Turbidity	M12	NTU		2.18	2020-09-11

Sample Identification:		WTW _ Final Water	
Sample Number:	PW-20-89354	Sample Condition:	Remark: S014M

Chemical	Method	Unit	Limit	Result	Analysis Date
Calcium Hardness as CaCO3*	Calc	mg/L as CaCO3		33.0	2020-09-21
Magnesium Hardness as CaCO3*	Calc	mg/L as CaCO3		40.4	2020-09-21
Total Hardness as CaCO3*	Calc	mg/L		73.4	2020-09-21
Microbiological Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
E. coli (MF)	M10	cfu's/100mL	0	Not Detected	2020-09-09
Heterotrophic Plate Count	M11	cfu's/1mL	<1 000	Not Detected	2020-09-09
Total Coliforms	M10	cfu's/100mL	<10	Not Detected	2020-09-09
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Colour (True)	M14	Pt-Co-true	<15	<10.0	2020-09-09
Electrical Conductivity @ 25°C	M4	mS/m	<170	75.1	2020-09-08
pH @ 25°C	M6	pH units	5 - 9.7	5.16	2020-09-08
Turbidity	M12	NTU	<1	1.24	2020-09-11
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Calcium as Ca	M18	mg/L		13.2	2020-09-20
Magnesium as Mg	M18	mg/L		9.86	2020-09-20
Sodium as Na	M18	mg/L	<200	110	2020-09-20
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al	M16	µg/L	<300	280	2020-09-17
Iron as Fe	M16	µg/L	<300	<20.0	2020-09-17

Sample Identification:		WTW _ Raw Water	
Sample Number:	PW-20-89355	Sample Condition: Please Select	Remark:

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli (MF)	M10	cfu's/100mL		Not Detected	2020-09-09
Heterotrophic Plate Count	M11	cfu's/1mL		100	2020-09-09
Total Coliforms	M10	cfu's/100mL		Not Detected	2020-09-09
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Colour (True)	M14	Pt-Co-true		206	2020-09-09
Electrical Conductivity @ 25°C	M4	mS/m		66.4	2020-09-08
pH @ 25°C	M6	pH units		6.88	2020-09-08
Turbidity	M12	NTU		2.66	2020-09-11
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Sodium as Na	M18	mg/L		94.9	2020-09-20
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al	M16	µg/L		516	2020-09-17
Iron as Fe	M16	µg/L		360	2020-09-17

SEDIMENTATION TROUBLESHOOTING GUIDE

Observation	Probable Cause	Check	Remedy
Changes in Turbidity and Color Changes in Alkalinity, pH or Temperature	Turbidity in source water has increased / decreased without appropriate change in chemical dosing. Significant change in temperature since last chemical dose change Mechanical adjustment needed in mixing or flocculation speeds.	Check Water Quality Parameters such as alkalinity, pH and temperature Check Coagulant Dosing based on jar test For changes in temperature check flash mixer & flocculator for proper dispersion and mixing speed.	Adjust Coagulant dose Consider coagulant aids Adjust alkalinity as needed; requires 0.35 mg/l lime for each mg/l of alum added. Make process change to flash mixer / flocculator mixing intensity. (Velocity Gradient Requirements)
Poor Floc formation such as dispersion, size and break up.	pH of source water has changed. Alkalinity being consumed by coagulant	pH of source water Alkalinity of source water. Retention time in coagulation tank	Adjust pH to target levels indicated by jar test. Adjust alkalinity Make process adjustments
Some floc forms but does not settle.	Polymer feed is too low. Process control problem with mixing and dispersion of coagulant	Determine Coagulant/Polymer feed based on jar test. Perform mixing analysis (G-value calculation)	Make appropriate chemical adjustments. Make appropriate mixing adjustments

FILTRATION TROUBLESHOOTING GUIDE

Observation	Probable Cause	Check	Remedy
Filter not performing as expected	Filter still in ripening stage Filter reached the end of the filter run / extended into breakthrough	Check current position of the filter in the filtration cycle.	Filter-to-waste while filter ripens Remove filter from operation & backwash / clean
Turbidity Increasing Rapidly Color Increasing Head Loss Changing Rapidly Frequent Backwashing	Change in source water quality.	Increase sampling frequency of raw water	
	Upset in Coagulation / Flocculation Process Hydraulic Overloading	Perform Jar Test Check hydraulic and weir loading rates	Adjust Coagulant (or change to different product) as indicated by jar test. Check mixing and flocculator speeds (see Coagulation / Flocculation) Increase backwash rate to remove higher levels of turbidity
Media Depth Shrinkage	Media carryover into wash water trough during backwash Backwash Rate too high. Media Boils are causing loss of media.	Check for loss by using a burlap bag to filter effluent and checking for media deposits in clearwell Determine media shrinkage by measurement from top of basin and comparing with previous measurement. Check backwash rate. Media expansion should be 20% to 25% of depth of media. Measure while backwash is activated.	Adjust backwash rate to achieve proper expansion. To achieve cleaning rate will be between 30 to 25 L/min (15 is average rate) per m^2 of surface area. (Note: 1 L/min is approximately 30 mm per minute of rise.) Media loss that results in unacceptable turbidity levels will need to be replaced.

Media not Clean after Backwash	Media not fully expanded. Improper backwash flow rate. Surface scour rates is too short.	Observe media expansion. Record surface wash rate and duration. Test Specific Deposit	Adjust media expansion within proper range. To achieve cleaning rate will be between Adjust backwash rate and duration within proper range. Adjust Surface scour rate and duration into proper range.
Coagulants Observed on Filter Service and not removed during Backwash	Coagulants Over Fed Coagulants not mixed properly Coagulants have adhered to surface	Perform Jar Test Check flash mixer and flocculator speed	Adjust Coagulants Adjust mixing / flocculation speeds (see Coagulation Section)
Mudball Formation in Filter Beds. Cracks and clogging in Filter Bed.	Improper Backwashing.	Observe Surface Wash / Air Scour. Observe Backwash duration and rate. Observe Filter Bed expansion.	Adjust Backwash Cycle.
	Upset in upstream processes		Make upstream process adjustments

SECTION B

Apply safety and emergency protocols on industrial water treatment plant

QUESTION 2

Time: 18min

Scenario:

Review the following Standard Operating Procedure. Comment on the adequacy of this SOP by discussing any 5 aspects of the document

(10 marks)

STANDARD OPERATING PROCEDURE MATERIALS HANDLING		
	Directorate:	Infrastructure Services
	Code:	
	Version:	0
	Date:	April 2018
	Effective period:	
	Pages:	2
	Signature authorizer:	

1. Objectives & Scope

This procedure is intended to reduce the number of injuries caused by incorrect handling of heavy / bulky objects. It applies to all personnel employed at a Water Services Works.

2. Abbreviations and definitions

- One-man-lift — A load that can be safely handled by one person. This load should not exceed 25kg.
- PPE: — Personal Protective Equipment.

3. Tasks, responsibilities and accountabilities

Task	Responsible Person
Assess weight to be handled.	Team Leader
Inspect lifting gear / equipment to be used.	Team Leader
Ensure that all material handling incidents / accidents are recorded on the Incident / Accident Report Control Form “DKS-REC-INC”.	Process Controller

4. Tools & Equipment Required

- Lifting gear / beam, Gantry, Hoist / Crane, with safe working load displayed.
- Hand trucks / Trolleys / Carry ring all in good condition.

5. Personal Protective Equipment (PPE) Requirement

- Gloves.
- Safety boots with non-slip soles.

6. Required Precautions

- Use suitable lifting gear wherever possible.
- No person should attempt to lift more than can be handled comfortably.
- Ensure firm footing and good visibility whilst manoeuvring.
- Regularly inspect the lifting equipment to ensure this stay in a good condition.

7. Procedure

When you have to handle something by hand, ensure that you pay attention to the following:

- Evaluate the weight of any object and do not lift more than can be safely carried. Hand trucks, dollies or other equipment must be used when items are too heavy to carry alone and help is not readily available.
- Warm up your muscles.
- Plan your route.
- Wear gloves when possible. Otherwise insure that the hands on the subject are clean and not slippery, and that it is free from jagged edges, metal slivers, nails and splinter.
- Lift the object in the right way.
    1. Keep feet parted – one along the side of and one behind the object.
    2. Keep back straight – nearly vertical.
    3. Tip your head upward to straighten your back.
    4. Grip the object with the whole hand.
    5. Tuck elbows and arms in.

6. Keep body weight directly over feet.
7. Lift slowly.

- Make sure you can clearly see.

Record all materials handling related incidents / accidents on the Incident / Accident Report Control Form "DKS-REC-INC".

8. Related Documents

- "DKS-REC-INC" Incident / Accident Report Control Form.

9. References

N/A

10. Status of Document

Comments / Changes made	Date	Responsible Person

SECTION C

Optimise, control and supervise all industrial water treatment processes

QUESTION 3

Time: 50min

Scenario:

Refer to Question 1 and assume the plant failed due to desludge valve failure on Settler 2

1. How / to whom would the failure need to be communicated and how would you change operational monitoring to ensure process performance is tracked more diligently while repairs are underway? (8)

2. Upon investigation it was found that the equipment failed due to someone overriding the actuator and forcing the valve closed thereby damaging the valve. How would you initiate disciplinary procedures against the person responsible? (5)

3. Would coaching / mentoring of personnel assist in preventing a similar failure? Suggest focus areas for coaching. (5)

4. How could a failure like this be prevented? Suggest any physical checks the Process Controller should perform and indicate how automation could assist in preventing out-of-spec water from being released to either downstream processes or into the final supply. (6)

5. With this failure in mind, the Certificate of Analyses needs to be scrutinized to identify any other areas of concern. Which parameters are close to exceeding the set standard and how can the situation be rectified? Refer to the attached troubleshooting guide and recommend optimization steps. Also include information around additional treatment processes that might have to be considered to ensure sustainable compliance – mention advantages and disadvantages of these. (26)

50 marks

SECTION D

Applicable control systems and online analysers to control the industrial water treatment plant

QUESTION 4

Time: 18min

Refer to Question 1 and assume there is no process failure, but that internal quality control (both on on-line monitoring and physical measurements) was inadequate. Provide recommendations and corrective action (10)

10 marks

TOTAL MARKS: 100