Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA)

DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY

YEAR III

Chemistry Techniques III

Record of Practical Assessment

Learner`s Name:_____

Learner`s NRC no.:_____

Learner`s TEVETA No.:_____

Assessment Period:_____

PREFACE

The Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) is an institution created under the Technical Education, Vocational and Entrepreneurship Training Act Number13 of 1998, as amended by the Technical Education, Vocational and Entrepreneurship Training (Amendment) Act Number 11 of 2005.

The Act among other things provides that TEVETA shall:

(a) regulate and conduct national examinations and assessments relating to technical education, vocational and entrepreneurship training;

(b) charge and collect fees in respect of examinations, assessments and other services provided by the Authority;

(c) award certificates to persons who succeed in examinations and assessments undertaken under this Act

(d) do all such things connected with or incidental to the functions of the Authority under this Act.

Through this mandate, the Assessment and Qualifications Division of TEVETA has developed Practical Assessment Tool Kits to enable learners achieve the competences that are congruent with the demand of the workplace tasks. These tool kits in part are also intended to ensure that similar conditions under which all students in TEVET are assessed and examined apply wherever the course is undertaken in Zambia.

The Trainers shall work with theLearnersto collect evidence of competence, using the benchmarks provided by the unit standards.During the year, the Learners shall be required to undertake a series of practical assessment tasks. It is the sum of all these assessments tasks that deems a Learner to be competent (or not).

This approach to assessment is not a one-off event but one that giveslearners many opportunities to demonstrate skill and allow for the capturing and recording of these demonstrations.

For the Learner to be deemed competent, they must demonstrate competency in every aspect of the practical tasks being undertaken. It must however be understood by the Trainer that Competency does not mean expert. It means that the candidate has attained sufficient skill and knowledge to perform the activity or service to a degree and quality that is acceptable to the industry and the customer in a time within which a competent person at the level could reasonably be expected to perform the task.

While this will be undertaken at institutional level, it is therefore envisaged that the Assessment principles of VALIDITY, RELIABILITY, FAIRENESS and FLEXIBILITY shall at all times be adhered to.

Pre-Assessment

Assessment process explained to the employee (✓ if Yes).	☐
Any appeal relating to the outcome of the assessment or the way in which the assessment was conducted shall be made through the company's *fair treatment policy* as explained to the employee (✓ if Yes).	☐

Employee/Trainee	**Assessor**	
Employee/Trainee name: _____ (Print) Employee/Trainee comments:	Assessor name: _____ (Print) Assessor comments:	
I fully understand the assessment and appeals process.	Theory assessment sighted and checked as satisfactory.	.☐
Signature: _____ Date: _____	Signature: _____ Date: _____	

Signed: Assessor: _____ Trainee: _____

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Prepare for the practical assessment

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Work Health and Safety

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Assessor qualifications

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Expiry status of assessment

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Resources required

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Range of variables

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1PERFORM AN EXPERIMENT ON REDOX REACTIONS	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include: - 12-well Microcell plate - 24-well microcell plate - 1.00mL pipet - 50mL beakers (5) - Forceps - VernierLabPro - TI-84 calculator - Vernier voltage Prob - Steel wool - Filter paper strips - 100.00 mL volumetric flasks (3) - 1.0 *M* $Cu(NO_3)_2$ - 1.0 *M* FeSO4 - 1.0 *M*$Pb(NO_{3)2}$ - 1.0 *M* $Zn(NO_3)_2$ - Iron metal strip (4) - Copper metal strip (4) - Lead metal strip (4) - Zinc metal strip (4)	☐	☐	☐	☐	☐	☐

b. Set up the apparatus correctly. This may include:
- Labeling the beakers as follows:
  - 1.0 *M* $Cu(NO_3)_2$
  - 1.0 *M* $FeSO_4$
  - 1.0 *M*$Pb(NO_3)_2$
  - 1.0 *M* $Zn(NO_3)_2$
- Transferring the liquids into the respective containers
	☐	☐	☐	☐	☐	☐

<table>
<tr>
<td>c. Run the experiment correctly. This may include:

 Filling four cells in each of the four columns of 24-well microcell plate about ¾ full with 1.0 M $Cu(NO_3)_2$, I.0 M $FeSO_4$, 1.0 M$Pb(NO_3)_2$ 1.0 M $Zn(NO_3)_2$ and as shown in the table below

 Polishing small strips (4 each) of Cu, Fe, Pb and Zn with steel wool or sand paper and place them on a paper towel with written labels to insure that the metals are not mixed up with each other. Partially submerging the strips into the cell rows as shown below. Placing only part of the metal into the solution so that any sign of a reaction (such as deposit of a metal on the submerged part of the strip) can be determined by comparison with the unsubmerged portion of the metal strip.
 Recording your observations in a table as shown above in your laboratory notebook.

 Table
<table>
<tr><th></th><th>$Cu(NO_3)_2$</th><th>$FeSO_4$</th><th>$Pb(NO_3)_2$</th><th>$Zn(NO_3)_2$</th></tr>
<tr><td>Cu(s)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pb(s)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fe(s)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Zn(s)</td><td></td><td></td><td></td><td></td></tr>
</table>
</td>
<td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td>
</tr>
<tr>
<td>d. Interpreting the results correctly. This may includes:

 After 5 minutes examining each cell carefully to see if any metal displacement redox reaction has occurred.
 Then re-polishing and rinsing the strips and return them to labeled paper towels located at the rear of the lab.</td>
<td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td>
</tr>
<tr>
<td>e. Identify the errors that may affect the experiment and how they are avoided.</td>
<td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td>
</tr>
</table>

Assessor comments:

Signed: Assessor: Trainee:

2 PERFORM AN EXPERIMENT ON REDOX POTENTIALS	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include. ☐ 12-well Microcell plate ☐ 24 -well microcell plate ☐ 1.00mL pipet ☐ 50mL beakers (5) ☐ Forceps ☐ VernierLabPro ☐ TI-84 calculator ☐ Vernier voltage Prob ☐ Steel wool ☐ Filter paper strips ☐ 100.00 mL volumetric flasks (3) ☐ 1.0 *M* $Cu(NO_3)_2$ ☐ 1.0 *M* $FeSO_4$ ☐ 1.0 *M* $Pb(NO_3)_2$ ☐ 1.0 *M* $Zn(NO_3)_2$ ☐ Iron metal strip (4) ☐ Copper metal strip (4) ☐ Lead metal strip (4) ☐ Zinc metal strip (4) ☐ Potassium nitrate solution ☐ Permanent marker	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may includes: ☐ Before constructing the galvanic cells, set up the Vernier system in DATAMATE with the voltage probe connected to channel 1 of the LabPro interface. ☐ Hitting CLEAR on the main screen of DATAMATE and the program will check for sensors. Once the voltage probe has been identified, and a reading near 0 volts is shown, you are ready to record data from the main screen. Obtain a 1.5 V battery from the instructor's desk and connect the red lead of the voltage probe to the (+) end of the battery (the cathode) and the black lead to the (−) end (the anode). If the voltage reading is not 1.5 V +/− 0.2 V, inform you instructor.	☐	☐	☐	☐	☐	☐

c. Run the experiment correctly. This may include: • Wetting a 5 – 8cm long strip of filter paper with KNO_3 solution. • Removing excess liquid gently (the paper easily rips when wet !) by blotting it on a paper towel and fold the paper into a U-shape; this will serve as your salt bridge. • Placing the salt bridge so that it will be immersed into each of two solutions in adjacent wells of a 12-well microcell plate • Record the positive cell potential, in volts. • Repeating steps in the first 4 bullets in (iii)- for galvanic cells of **Fe (in 1.0 *M* $FeSO_4$) – Zn** and **Pb(in 1.0 *M* $Pb(NO_3)_2$) – Zn.** Use a freshly prepared filter paper strip for the salt bridge of each	☐	☐	☐	☐	☐	☐
d. Interpret the results correctly. This may include: • Comparing the values of voltages obtained known ones • Commenting on the values obtained	☐	☐	☐	☐	☐	☐
e. Identify the errors that may affect the experiment and how they are avoided.	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor: Trainee:

3 PERFORM AN EXPERIMENT ON THE NERNST EQUATION FOR VARYING Cu^{2+}CONCENTRATIONS	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include: ➢ 1.0 $M\mathrm{CuSO_4}$ solution ➢ Distilled water ➢ Small beakers (3) ☐ 1.00mL pipet ☐ 100.00 mL volumetric flasks (3) ☐ Permanent marker ☐ Refer to apparatus as in practical 1 and 2	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may include: ☐ Labeling the volumetric flask as follows: ➢ $0.01MCuSO_4$ ➢ $0.0001\ MCuSO_4$ ➢ $0.000001MCuSO_4$ ☐ Preparing three dilute solutions of $\mathrm{CuSO_4}$ by serial dilution from a 1.0 *M* $\mathrm{CuSO_4}$stock solution as follows: ➢ Transferring1.0 mL of 1.0 *M* $\mathrm{CuSO_4}$stock solution into a labeled (with tape) 100.00 mL volumetric flask and dilute to the mark with de-ionized water to form a 0.01 *M* solution. ➢ Rinsing the pipet with a small volume of the solution to be transferred prior to use. ➢ Next take the 0.01 *M* solution just formed and transfer 1.0 mL of it into a labeled 100.00 mL volumetric flask. ➢ Diluting to the mark with de-ionized water to form the 0.0001 *M* solution. ☐ Repeating one more time so that you have the following set of solutions in labeled flasks: ➢ Solution A $1.0\ M\mathrm{CuSO_4}$ (stock solution) ➢ Solution B $0.01\ M\mathrm{CuSO_4}$ ➢ Solution C $0.0.0001M\mathrm{CuSO_4}$ ➢ Solution D $0.000001\ M\mathrm{CuSO_4}$	☐	☐	☐	☐	☐	☐

<table>
<tr><td>c. Run the experiment correctly. This includes:
a. Preparing a half-cell of Cu^{2+} by placing the copper solution D into a 12-microcell well.
b. Removing the copper and zinc electrodes from the half-cells used previously and clean and re-polish them.
c. Placing 1.0 M $Zn(NO_3)_2$in a cell next to the Cu^{2+} half-cell. Connecting the two half-cells with a freshly prepared salt bridge. Connecting the copper and zinc electrodes to the correct voltage probe leads. Measuring and record the cell potential in your laboratory notebook using the same technique (5-10 second immersion) with the voltage probe as in Experiment 2.
d. Removing the $CuSO_4$solution with a disposable pipet and repeat the measurement of E_{cell}(steps b-c) for the remaining three copper solutions in order of increasing concentration. Then, in the same way, measure the $E_{cell}$for the unknown Cu^{2+}solution. Recording the measured values in a table as shown below
<table>
<tr><td>Solution</td><td>D</td><td>C</td><td>B</td><td>A</td><td>unknown</td></tr>
<tr><td>Cu^{2+}</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Volts</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>d. Interpret the results correctly. This includes:
Commenting on the values of E_{cell} measured</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>e.Identify the errors that may affect the experiment and how they are avoided.</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
</table>

Assessor comments:

Signed: Assessor: Trainee:

<table>
<tr><th>4 PERFORM AN EXPERIMENT THE E° FOR A VOLTAIC CELL USING COPPER AND UNKNOWN METAL</th><th colspan="3">Satisfactory</th><th colspan="3">Not Satisfactory</th></tr>
<tr><td colspan="7">During observation of work activities, the candidate demonstrated that they can:</td></tr>
<tr><td>a. Identify the apparatus correctly. This may include:
☐ The apparatus is as in experiment 1
☐ Unknown sample 1.0 MX</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>b. Set up the apparatus correctly: This may include:
☐ Obtaining a small amount of the unknown electrolyte solution labeled “1.0 M X ion” and the corresponding metal strip, “X”. This metal is one of the metals in the table of Standard Reduction Potentials at the end of the In-Lab section</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>c. Run the experiment correctly. This may include:
☐ Using a disposable pipet to transfer a small amount of 1.0 M X ion solution to a well adjacent to the 1.0 M $CuSO_4$solution in a 12-microcell-test plate.
☐ Making a new salt bridge by soaking a short length of filter paper in the KNO_3solution.
☐ Connecting the X and Cu half-cells with the filter paper. Measuring the positive potential of the X- Cu voltaic cell using the same technique as in Part B (Red lead to the Cu, which is the cathode).
☐ After recording the potential once (5-10 seconds), removing both electrodes from the solutions and clean and polish each electrode.
☐ Setting up the galvanic cell again.
☐ Connecting the voltage probe as before.
☐ Recording the potential again. If the two measured potentials do not agree within .1 volts, test the galvanic cell a third time and record the potential immediately after making the connection with the voltage probe.</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>d. Interpret the results correctly. This may include:
☐ Calculating the average of the measured potentials to use.
Standard Electrode Potentials
<table>
<tr><th>Electrode</th><th>E^o</th></tr>
<tr><td>$Ag^+ + e^- \rightarrow Ag$</td><td>$+0.80V$</td></tr>
<tr><td>$Cu^{2+} + e^- \rightarrow Cu$</td><td>$+0.34V$</td></tr>
<tr><td>$Pb^{2+} + e^- \rightarrow Pb$</td><td>$-0.13V$</td></tr>
<tr><td>$Fe^{2+} + e^- \rightarrow Fe$</td><td>$-0.44V$</td></tr>
<tr><td>$Zn^{2+} + e^- \rightarrow Zn$</td><td>$-0.76V$</td></tr>
<tr><td>$Al^{3+} + e^- \rightarrow Al$</td><td>$-1.66V$</td></tr>
<tr><td>$Mg^{2+} + e^- \rightarrow Mg$</td><td>$-2.37V$</td></tr>
</table></td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>e. Identify the errors may affect the experiment and how they may be avoided</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
</table>

Assessor comments:

Signed: Assessor: Trainee:

5 PERFORM AN EXPERIMENT THE RATE OF HYDROLYSIS OR 'INVERSION' OF SUCROSE, BY POLARIMETRY	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include: - Polarimeter - Sucrose solution - Water - Stop watch - 2.0 $Mhydrochloricacid$ - Heat source - Pipettes - Polarimeter tube - Thermometer - Analytical balance - Weighing pan	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may include: - Putting the analytical balance on the horizontal surface. - Cleaning the analytical balance - Cleaning the weighing pan - Weighing the 50g sucrose by method of difference. - Transferring the sucrose power into a $250\ mL$ volumetric flask - Cleaning the polarimeter	☐	☐	☐	☐	☐	☐
c. Run the experiment correctly. This may include: - Dissolving 50 g of sucrose in water and make up to a final volume of $250\ \mathrm{mL}$ The resulting solution contains 0.2 g of sucrose per mL or 20% sucrose by mass. - Taking $40\ \mathrm{mL}$ of the above solution and dilute to $100\ \mathrm{mL}$. Determining the zero reading of the polarimeter with water in the polarimeter tube and determine the angle of optical rotation, α_o, of the light for the 8% sucrose solution. Calculate the specific optical rotatory power of sucrose. - Diluting $40\ \mathrm{mL}$ of the 20% sucrose solution to $100\ \mathrm{mL}$ by using $2M$ hydrochloric acid and start the clock. Wash the polarimeter tube twice with this (reacting) sucrose-acid solution. Then fill the tube and follow the angle of optical rotation, α_t, as a function of time. Note the angle of optical rotation, α_t, and time, t, every 15 minutes. - Ensuring that there are no air bubbles in the tubes. - Recording all the readings taken - Specifying the temperature for which this rate constant is valid.	☐	☐	☐	☐	☐	☐

d. Interpret the results correctly. This may include: • Determining α_4, the angle of optical rotation corresponding to the mixture at the end of the reaction, by heating the remaining sucrose-acid mixture for about 30 minutes at 60 to 70 °C. • Determining the rate constant k, from a plot of ln{(α_t - α_4)/rad} against time/s. The units of k are s^{-1}.	☐	☐	☐	☐	☐	☐
e. Identify the errors that may affect the experiment and how they may be avoided.	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor: _____ Trainee: _____

6PERFORM AN EXPERIMENT ON PARTITION COEFFICIENT	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include: - Saturated solution of iodine in hexane - 6 Stoppered bottles - Distilled water - 2 burettes (25 ml) - Hexane liquid - 0.12 molL^{-1}KI solution - 0.02 molL^{-1} sodium thiosulphate $Na_2S_2O_3.5H_2O$ solution - Starch indicator - Pipette filler	☐	☐	☐	☐	☐	☐

b. Set up the apparatus correctly. This may include:
- Label the six stoppered bottles as follows
  ➢ 200 cm^3 water, 25cm^3 iodine solution (A)
  ➢ 200 cm^3 water, 20cm^3 iodine solution and 5 cm^3 hexane (B)
  ➢ 200 cm^3 water, 15 cm^3 iodine solution and 10 cm^3 hexane(C)
  ➢ 100 cm^3 potassium iodine, 25 cm^3 iodine solution (D)
  ➢ 100 cm^3 potassium iodine, 20 cm^3 iodine , 5 cm^3 hexane (E)
  ➢ 100 cm^3 potassium iodine, 15 cm^3iodine, 10 cm^3hexane (F)
- Measuring out the liquids into respective stoppered bottles
	☐	☐	☐	☐	☐	☐

c. Run the experiment correctly. This may include:

- Adding about $200\ cm^3$ of water to three of the stoppered bottles. Use two burettes to add $25cm^3$ of the iodine solution to one bottle; $20\ cm^3$ of solution and $5\ cm^3$ of pure hexane to the second; and $15\ cm^3$ of solution and $10\ cm^3$ of pure hexane to the third.
- Adding about $100\ cm^3$ of the accurately made up $0.12\ molL^{-1}KI$ solution to a further three stoppered bottles and add iodine solution and pure hexane as before.
- Shaking the bottles well but avoid heating the solutions with your hands. Allow the layers to separate.
- Titrating the aqueous layer against the $0.02\ molL^{-1}$ sodium thiosulphate solution by using starch as indicator.
- Adding starch indicator solution towards the end of the titration. Pipetting $50\ cm^3$ of aqueous layer for the first three mixtures and pipetting $25\ cm^3$ for the second three.
- Titrating $5\ cm^3$ of the hexane layer in each case against the sodium thiosulphate solution.
- Recording the volumes used for titrants used and enter them in a table

First three solutions (aqueous)	Vol. of $Na_2S_2O_3$ used
A (50 cm^3)	
B (50 cm^3)	
C (50 cm^3)	
Av. vol. of $Na_2S_2O_3$ used	
Second three solutions (KI)	Vol. of $Na_2S_2O_3$ used
D(25 cm^3)	
E (25 cm^3)	
F (25 cm^3)	
Av. vol. of $Na_2S_2O_3$ used	
First three solution (Hexane)	Vol. of $Na_2S_2O_3$ used
B (5 cm^3)	
C(5 cm^3)	
Av. vol. of $Na_2S_2O_3$ used	
Second three solutions (Hexane)	Vol. of $Na_2S_2O_3$ used
B (5 cm^3)	
C(5 cm^3)	
Av. vol. of $Na_2S_2O_3$ used	

☐ ☐ ☐ ☐ ☐ ☐

d. Interpret the results correctly. This may include: - Calculating the partition coefficient, $D = \frac{[I_2]\text{hexane}}{[I_2]\text{ water}}$ from the data obtained in the absence of I^-, and find the mean value. - Using this value, calculate the equilibrium constant for each of the three determinations involving I^-in the aqueous phase, and quote a mean value to the appropriate number of significant figures. - Note the temperature.	☐	☐	☐	☐	☐	☐
e. Identify the errors that may affect the experiment and how they can avoided	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor:_____ Signed: Trainee: _____

7 PERFORM AN EXPERIMENT ONTHE GRAVIMETRIC DETERMINATION OF SULPHATE IN WATER	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly. This may include: - Desiccator - Hotplate - Measuring cylinder - Muffle furnace - Funnel - 9 or 11 cm ashless filter paper - Conical flask - Glass rod for stirring - Portable pH meter - Beakers - Watch glass - Oven - 30 % - 50 % hydrochloric acid - Barium chloride dehydrate - Silver nitrate - Nitric acid - Distilled water - Tap water as sample	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may include: - Weighing out 100 g of barium dehydrate - Weighing out 85. g of silver nitrate - Measuring 0.5 ml nitric acid and 500 ml distilled water	☐	☐	☐	☐	☐	☐

c. Run the experiment correctly. This may include: • Dissolving 100 g of barium chloride dehydrate in 1 litre of distilled water • Dissolving 8.5 g of silver nitrate and 0.5 ml of nitric acid in 500 ml of distilled water • Drying a crucible in an oven for 2 hours and cool in a desiccator to a constant weight, m_1. • Measuring out 100 ml of tap water into a 600 ml beaker • Adjusting the pH to 4.5 to 5 using a portable pH meter and a fraction of a drop of the acid and then add 2 ml of 30% - 50 % hydrochloric acid. • Placing this solution on a hotplate and let it boil • Placing 25 ml of barium chloride solution in a 50 ml beaker and put it on a hotplate to warm. • While stirring the sample solution, slowly add enough barium chloride solution until precipitation stops. Add an extra 2 ml of barium chloride solution to ensure complete precipitation. Rinse the beaker wall inside and the glass rod with distilled water and then cover with a watch glass. • Moving the beaker to the cooler edge of the hotplate and digest the precipitate for about 1 hour. • Removing the beaker from the hotplate and let the precipitate settle. • Filtering through a 9 or 11 cm ashless filter paper. • Washing the precipitate with hot distilled water until the filtrate test negative for chloride. Carefully lift the filter paper from the funnel and transfer it to pre-weighed crucible. • Carefully fold the filter paper into the crucible. • Using tongs, place the crucible close to the entrance to the muffle furnace. Leave the door to the furnace partly open until the filter paper chars. Then push the crucible into the centre of the furnace and close the door. The ashless filter paper burns off and leaves no ash apart from the barium sulphate which was on the filter paper. • Igniting for 20 minutes and then remove the crucible and place it in a desiccator to cool. • Re-weighing the crucible after it has cooled enough, m_2.	☐	☐	☐	☐	☐	☐

d. Interpret the results correctly. This may include: Using the net ionic equation: $$Ba^{2+}_{(aq)} + SO_4^{2-} \rightarrow BaSO_4(aq)_{S)}$$ The sulphate ion concentration can be calculated from: - $[SO_4^{2-}]$ = 0.41X(m_2 – m_1)X1000/volume of water sample in litres (in this case the volume is 100 ml) - Taking note that, for this method instrumental methods of analysis also exist.	☐	☐	☐	☐	☐	☐
e. Identify the error that may affect the results and how they can be avoided.	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor: _____ Trainee: _____

8 PERFORM AN EXP[ERIMENT ON MEASURING TOTAL SUSPENDED SOLIDS, TSS	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
a. Identify the apparatus correctly: This may include: - Analytical balance - Beakers - Filter paper, quantitative type and cut into circular shapes to fit the inside of the Buchner funnel and then dried in an oven for 2 hours. Then cool in a desiccator. - Oven - Measuring cylinder - Desiccator - Buchner funnel - Thick-walled flask with a side arm - Vacuum pump - Forceps - Watch glass - Thick and flexible rubber tube - Water with suspended solids eg from a well or stream - Distilled water.	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may include: - Using a forceps, pick one of the prepared filter papers and weigh it on an analytical balance, m_1. - Transferring the weighed filter paper to the Buchner funnel ensuring that it is completely flat and has covered all the small holes. You can wet the filter paper with a little distilled water to make sure it remains flat and loosely stuck to the inside base of the funnel. - Agitating the water sample and quickly measure out 1 litre using a measuring cylinder. - Fixing the tapered part of the funnel in a rubber cork and fix this assembly into the mouth of the thick-walled flask. - Connecting to the vacuum pump using the flexible rubber tube.	☐	☐	☐	☐	☐	☐

c. Run the experiment correctly. This may include: • Pouring some distilled water into the Buchner funnel and switch the vacuum pump on. • Agitating the measured water sample and pour part of it onto the Buchner funnel. Agitate each time before pouring out. • At the end, rinse out the inside of the measuring cylinder and pour this onto the Buchner funnel. • Letting the vacuum pump run for some time so that the filter paper is drained of water for easy removal. • Switching the vacuum pump off and using forceps, carefully lift the filter paper onto to a clean dry watch glass. • Placing the watch glass into an oven and leave to dry for at least 5 hours. • Removing the watch glass with filter paper from the oven and place in a desiccator to cool. • Using forceps remove the filter paper from the watch glass and weigh it on an analytical balance, $m_{2.}$	☐	☐	☐	☐	☐	☐
d. Interpret the results correctly. This may include: TSS (mg/l) = $(m_2 – m_1)$X1000/volume of sample in litres	☐	☐	☐	☐	☐	☐
e. Identify the errors that may affect the experiment and how they can be avoided	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor: Trainee:

9 PERFORM AN EXPERIMENT ON MEASUREMENT OF TOTAL DISSOLVED SOLIDS, TDS.	Satisfactory			Not Satisfactory		
During observation of work activities, the candidate demonstrated that they can:						
i. Identify the apparatus/ material correctly. This may include: - Analytical balance - Beakers - Watch glass - Measuring cylinder - Tongs - Hotplate - Desiccator - Water sample from a domestic source	☐	☐	☐	☐	☐	☐
b. Set up the apparatus correctly. This may include: **NOTE: This is a very sensitive method. Hence handling of beakers should not be done with bare hands but with clean dry paper.** - Weighing a 500 ml clean dry beaker and fitting watch glass accurately, mass m_1 - Filtering ml of the water sample into a clean dry beaker - Measuring out 250 ml of the filtered water sample using a measuring cylinder - Carefully transferring the water to the weighed beaker. Avoid any spillage. - Covering the beaker with a watch glass	☐	☐	☐	☐	☐	☐

c. Run the experiment the experiment correctly. This may include: - Placing the beaker on a hotplate and boil to dryness. - Avoiding prolonged heating after all the water has evaporated. - Removing the beaker from the hotplate and put it in a desiccator to cool - Removing the beaker from the desiccator after it has cooled and weigh it again on the analytical balance, mass m_2. - **This is a very accurate method. However, meters exist which measure TDS indirectly by measuring conductivity and then using factors to calculate TDS. Therefore, these measurements are approximations.**	☐	☐	☐	☐	☐	☐
d. Interpret the results correctly. This may include: - Calculating the amount of TDS - Results for total dissolved solids are usually expressed in parts per million, ppm - TDS = $(m_2 – m_1)$x1000/volume of water sample in litres.	☐	☐	☐	☐	☐	☐
e. Identify the errors that may affect the experiment and how they can be avoided.	☐	☐	☐	☐	☐	☐

Assessor comments:

Signed: Assessor: Trainee:

10PERFORM AN EXPERIMENT ON GRAVIMETRIC DETERMINATION OF CHLORIDE IN WATER	Satisfactory			Not Satisfactory	
During observation of work activities, the candidate demonstrated that they can:					
a. Identify the apparatus / materials correctly. This may include: - Beaker, 50 ml and 500 ml - Analytical balance - Buchner funnel - Oven - Vacuum flask or filtering flask - Vacuum pump - Measuring cylinder - Filter paper - Watch glass - Wash bottle - Glass rod for stirring - Aluminium foil - Medicine dropper - 0.01 M silver nitrate solution - 0.2 M silver nitrate solution in a dark or covered container - Concentrated nitric acid - Chlorinated water sample - Distilled water	☐	☐	☐	☐	☐	☐
b. Set up the experiment correctly. This may include: - Assembling the apparatus and reagent correctly	☐	☐	☐	☐	☐	☐

c. Run the experiment correctly. This may include:Part I: Precipitating of chloride • All glassware should be rinsed with distilled water and dried if necessary. • Measuring out 200 ml of the chlorinated water sample using a measuring cylinder. • Transferring the water sample to the 500 ml beaker. • Adding approximately 1 ml of 1:1 nitric acid or 0.5 ml of concentrated nitric acid to the water sample in the beaker. • Using a clean medicine dropper and slowly add 0.2 M silver nitrate solution, drop by drop, while stirring continuously until no more precipitate is formed. Avoid adding excess silver nitrate solution. • Placing the beaker on the cooler part of the hotplate (near the edge) while continuously stirring the solution. Do not heat for more than 2 minutes after it reaches boiling**.** • Removing the beaker from the hotplate and allow the precipitate to settle. • Testing for complete precipitation by adding a few more drops of 0.2 M silver nitrate solution. A white cloudiness at this point means that you should add more 0.2 M silver nitrate solution, you should stir and heat the solution as you did before (avoid excess silver nitrate). • Covering the beaker, wrap it in aluminium foil or carbon paper and let it stand for 2 hours or until the next laboratory period. The reaction is sensitive to light, so store the beaker in a dark cabinet. Part II: Filtration and weighing of the precipitate • Cutting a quantitative filter paper to fit the inside of the Buchner funnel completely. • Placing the cut filter paper on a clean dry watch glass and dry it for 1 hour in an oven. • Removing the watch glass and the filter paper from the oven and place them in a desiccator to cool. (Note: this could be done in advance to save time). • Using a clean forceps, place the filter paper on a clean pan on the analytical balance and	☐	☐	☐	☐	☐	☐

Decanting the solution in the 500 ml beaker through the Buchner funnel by pouring the solution down a clean stirring rod. Make sure that the precipitate is disturbed very little. Washing the precipitate in the beaker by adding about 25 ml of 0.01 M solution of nitric acid. Stirring the solution, let the precipitate settle down and then decant again through the Buchner funnel. Repeat this washing two more times. Putting the 0.01 M nitric acid solution in a clean wash bottle. Transferring the precipitate to the Buchner funnel. Using a clean glass rod with a rubber policeman and a jet from the wash bottle. Removing any solid particles still left in the beaker with the rubber policeman. Finally use the jet from the wash bottle to wash all the particles from the rubber policeman to the Buchner funnel. Washing the precipitate in the funnel several times with the 0.01 M nitric acid solution (you may have to test the filtrate for the presence of silver ions). Running the vacuum system a little longer to remove most of the water or solution from the filter paper. Weighing a clean dry watch glass, m_2. Using forceps, remove the filter paper from the funnel and place it on the pre-weighed watch glass. Leave to dry in a dark undisturbed place. Make sure no dust settles on it. After the filter paper has dried enough, re-weigh the watch glass and the filter paper together on the analytical balance, m_3.	☐	☐	☐	☐	☐	☐

<table>
<tr>
<td>d. Interpret the results correctly. This may include:

Entering the data in table like below.
<table>
<tr><td>Mass of empty filter paper, m_1</td><td>In grammes</td></tr>
<tr><td>Mass of watch glass, m_2</td><td>In grammes</td></tr>
<tr><td>Mass of filter paper+watchglass+AgCl, m_3</td><td>In grammes</td></tr>
<tr><td>Mass of AgCl</td><td>In grammes</td></tr>
<tr><td>Gravimetric factor</td><td>0.25</td></tr>
<tr><td>ppm chlorine in sample</td><td></td></tr>
</table>

Calculations:

Cl (ppm) = $0.25X(m_3 - m_2 - m_1)X1000$/volume of water sample, 200 ml in this case expressed in litres

Take note that for this method, instrumental methods of analysis also exist.</td>
<td></td><td></td><td></td><td></td><td></td><td></td>
</tr>
<tr>
<td>e. Identify the errors that affect the experiment and how they can be avoided</td>
<td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td>
</tr>
</table>

Assessor comments:

Signed: Assessor: Trainee:

Final Assessment Summary

Note: refer to mapping document if required

Practical assessment summary		**Satisfactory**	**Not Satisfactory**
1.	Redox reactions	☐	☐
2.	Redox potentials	☐	☐
3.	Nernst equation for varying concentration of copper ion	☐	☐
4.	*E*° for a voltaic cell using copper and unknown metal	☐	☐
5.	Rate of hydrolysis of sucrose	☐	☐
6.	Partition coefficient	☐	☐
7.	Gravimetric determination of sulphate ion in water	☐	☐
8.	Measurement of total suspended solids, tss	☐	☐
9.	Measurement of total dissolved solids, tds**.**	☐	☐
10.	Gravimetric determination of chloride in water	☐	☐

Assessor comments:

	Assessor:	Trainee:
Signed:	_____	_____

Assessment Outcome

Satisfactory ☐

Not Satisfactory ☐

Employee/Trainee	**Assessor**
Employee/Trainee name: _____ (Print)	Assessor name: _____ (Print)
Employee/Trainee comments:	**Assessor comments:**
Signature: _____ Date: _____	Signature: _____ Date: _____

VALIDATION OF THE ASSESSMENT

NAME:…….. DATE:……..

POSITION: **PRINCIPAL/HEAD OF INSTITUTION** SIGNATURE:……..

NAME INSTITUTION:…….

STAMP: