# Knowledge Assessment

**Assessment event 1 of 3**

## Criteria

### Unit code, name and release number

MSL973017 - Prepare, standardise and use solutions (1)

### Qualification/Course code, name and release number

MSL40118 - Certificate IV in Laboratory Techniques (1)

MSL50118 – Diploma of Laboratory Technology (1)

\*\*Amend the qualification box before distributing to the student. The information here should only contain the qualification the student is enrolled in.\*\*

## Student details

### Student number

### Student name

## Assessment Declaration

* This assessment is my original work and no part of it has been copied from any other source except where due acknowledgement is made.
* No part of this assessment has been written for me by any other person except where such collaboration has been authorised by the assessor concerned.
* I understand that plagiarism is the presentation of the work, idea or creation of another person as though it is my own. Plagiarism occurs when the origin of the material used is not appropriately cited. No part of this assessment is plagiarised.

### Student signature and Date

Version: 1.0

Date created: 28/08/2019

Date modified: 10/12/2019

For queries, please contact:

Innovative Manufacturing, Robotics and Science SkillsPoint

Hamilton Campus

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This assessment can be found in the: [Learning Bank](https://share.tafensw.edu.au/share/access/searching.do?doc=%3Cxml%2F%3E&in=P7ac4831b-430a-4b8d-8b56-f7b32ed5b9cf&q=&type=standard&sort=rank&dr=AFTER)

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## Assessment instructions

Table 1 Assessment instructions

| Assessment details | Instructions |
| --- | --- |
| **Assessment overview** | The objective of this assessment is to assess your knowledge as would be required to:   * Prepare solutions * Standardise an use volumetric solutions * Calculate and record data * Monitor the quality of ab solutions * Maintain a safe work environment |
| **Assessment Event number** | 1 of 3 |
| **Instructions for this assessment** | This is a written assessment and it will be assessing you on your knowledge of the unit.  This assessment is in 4 parts:   1. Multiple choice questions (Question 1 - Question 15) 2. True or False questions (Question 16 - Question 30) 3. Short answer questions (Question 31 – Question 47) 4. Assessment feedback   You may bring into the examination one double sided A4 sheet of student study notes with information relating to the Unit.  You will be provided with a periodic table and a data sheet that contains relevant information, including a valency table and Potential Equations. These documents are located in the Appendices at the end of the Assessment Task. You can take these off the Paper but must hand them in at the end of the task. |
| **Submission instructions** | On completion of this assessment, you are required to upload it or hand it to your trainer for marking. You should also submit your prepared A4 sheet of information and the Data sheets  It is important that you keep a copy of all electronic and hardcopy assessments submitted to TAFE and complete the assessment declaration when submitting the assessment. |
| **What do I need to do to achieve a satisfactory result?** | To achieve a satisfactory result for this assessment all questions must be answered correctly. |
| **What do I need to provide?** | Calculator, pens, my student study notes |
| **Due date/time allowed** | 3 hours  Date to be arranged |
| **Assessment feedback, review or appeals** | In accordance with the TAFE NSW policy *Manage Assessment Appeals,* all students have the right to appeal an assessment decision in relation to how the assessment was conducted and the outcome of the assessment. Appeals must be lodged within **14 working days** of the formal notification of the result of the assessment.  If you would like to request a review of your results or if you have any concerns about your results, contact your Teacher or Head Teacher. If they are unavailable, contact the Student Administration Officer.  Contact your Head Teacher for the assessment appeals procedures at your college/campus. |

## Multiple choice (Questions 1-15)

Read the question and each answer carefully. Put an X in the table next to your chosen answer.

1. Which of the following sets of data contain an atypical pH value?

Table 2 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 5.0, 4.9, 4.7 |  |
| 1. 5.1, 4.8, 5.0 |  |
| 1. 5.0, 7.6, 4.9 |  |
| 1. 4.9, 5.2, 4.8 |  |

1. The endpoint of a titration occurs when:

Table 3 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. Exactly the correct stoichiometric amount of the two reactants are combined |  |
| 1. The first sign of a permanent colour change is observed |  |
| 1. The burette is empty |  |
| 1. The solution turns colourless |  |

1. Which of the following is classified as a weak acid?

Table 4 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. NH4OH |  |
| 1. HCl |  |
| 1. CH3COOH |  |
| 1. HNO3 |  |

1. A buffer solution is a solution that:

Table 5 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. Prevents rusting |  |
| 1. Resists changes to pH |  |
| 1. Changes colour at the equivalence point |  |
| 1. Changes colour at the end point |  |

1. A buffer solution can be prepared by combining a:

Table 6 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. Strong base with some indicator |  |
| 1. Strong base and a strong acid |  |
| 1. Strong acid with its conjugate base |  |
| 1. Weak acid with a salt of its conjugate base |  |

1. The mass of NaCl in a 25 mL aliquot of a 5.00g/L standard solution of NaCl is:

Table 7 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 5 x 25 x 1000 g |  |
| 1. (25 / 1000) x 5 g |  |
| 1. (5 x 1000) / 25 g |  |
| 1. 5 / (25 x 1000) g |  |

1. Select the statement that is **true**:

Table 8 Multiple choice

| Answer choices | | Put X next to your answer |
| --- | --- | --- |
| 1. A **reductant** (reducing agent) gains electrons and is itself reduced |  | |
| 1. An **oxidant** (reducing agent) loses electrons and is itself oxidised |  | |
| 1. A **reductant** (oxidising agent) loses electrons and is itself oxidised |  | |
| 1. An **oxidant** (oxidising agent) gains electrons and is itself reduced |  | |

1. Which of the following would be the most accurate piece of equipment for the quantitative transfer of 50 mL of solution?

Table 9 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 50 mL beaker |  |
| 1. 50 mL measuring cylinder |  |
| 1. 50 mL burette |  |
| 1. 50 mL conical flask |  |

1. Which of the following items of personal protection is required at all times during routine laboratory work that involves the dilution of concentrated acids or base solutions?

Table 10 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. Safety goggles |  |
| 1. Enclosed footwear |  |
| 1. Laboratory coat |  |
| 1. Rubber gloves |  |
| 1. All of these |  |

1. Which of the following is the most appropriate to measure out approximately 25 mL of solution?

Table 11 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 25 mL measuring cylinder |  |
| 1. 25 mL pipette |  |
| 1. 25 mL volumetric flask |  |
| 1. 100 mL conical flask |  |

1. The sign below is the GHS symbol that would be used for:



Table 12 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. An organic solvent |  |
| 1. Recycled plastics |  |
| 1. Corrosive material |  |
| 1. Detergents |  |

1. The correct balanced equation for the stoichiometric analysis of ethanoic acid (CH3COOH) with sodium hydroxide is:

Table 13 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. CH3COOH + NaOH 🡪 CH3COONa + H2O |  |
| 1. 2CH3COOH + Na2CO3 🡪 2CH3COONa + CO2 + H2O |  |
| 1. H2O + CO2 🡪 H2CO3 |  |
| 1. There is no reaction |  |

1. The redox reaction between iodine and thiosulfate relies on the following two half equations:

I2(aq) + 2 é 🡪 2I-  and

2S2O32-  🡪 S4O62-  + 2 é

The reaction ratio between I2 and S2O32- is:

Table 14 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 2 : 1 |  |
| 1. 1 : 1 |  |
| 1. 1 : 2 |  |
| 1. 2 : 4 |  |

1. The diprotic acid H2SO4 ionises in solution according to the following equations

H2SO4 + H2O 🡪 H3O+  + HSO4-

HSO4-  + H2O 🡪 H3O+ + SO42-

Which of the following species is an amphoteric (amphiprotic) substance

Table 15 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. H2SO4 |  |
| 1. HSO4- |  |
| 1. SO42- |  |
| 1. H3O+ |  |

1. The mass of Ca(OH)2 required to prepare 500 mL of a 0.2M solution is:

Table 16 Multiple choice

| Answer choices | Put X next to your answer |
| --- | --- |
| 1. 7400 g |  |
| 1. 7.4 g |  |
| 1. 5.7 g |  |
| 1. 5.8 g |  |

## True or false (Question 16-30)

Read the question and then write **True** or **False** in the space provided.

Table 17 True or false

| Question | Write *True* or *False* |
| --- | --- |
| 1. An amphoteric (amphiprotic) species is one that is able to accept or donate protons in a reaction. |  |
| 1. Technical grade reagent is the most appropriate chemical grade to use as a primary standard. |  |
| 1. The equivalence point of a reaction is when exactly the correct stoichiometric amount of the two reactants are combined. |  |
| 1. All measurements taken in the laboratory are estimates only, as each measuring piece of equipment has a degree of uncertainty. |  |
| 1. The small spill (25 mL) of 5 M HCl would be best cleaned up by sprinkling over the spill sodium hydrogen carbonate powder until the reaction has ceased. |  |
| 1. A secondary standard is one that has had its concentration determined by titration using a primary standard. |  |
| 1. Information regarding the correct disposal of chemical wastes would typically be found in the Standard method or the applicable Safety Data Sheet. |  |
| 1. The actual storage container for all solutions is irrelevant as long as the concentration is correct. |  |
| 1. Repeating a titration until you have three consistent titration values is routine practise to increase the precision of the result. |  |
| 1. The choice of indicator for a titration is irrelevant as they will all change colour. |  |
| 1. A dirty burette is an example of a systematic error that could lead to an incorrect titration volume and therefore an error in the final concentration. |  |
| 1. Solubility of solids and liquids can be increased by increasing the temperature. |  |
| 1. The % v/v concentration of an ethanol solution prepared by diluting 18 mL of ethanol to a final volume of 2545 mL with water is 0.71 %v/v. |  |
| 1. A solution contains 9.00g glucose (C6H12O6) in 150 mL of solution. The % w/v of the final solution is 6 % w/v |  |
| 1. Fe3+ forms because iron gains 3 electrons |  |

## Short answer (Question 31- question 46)

Read the questions carefully. Your answers should be no longer than 150 words for any part. For all calculation questions show your working.

1. The primary standard sodium carbonate can be used to standardise hydrochloric acid. A technician conducted four titrations using 25.0 mL aliquots of 0.0479M Na2CO3. The average volume of the unstandardized acid was 18.16 mL. The indicator used was screened methyl orange.
2. Write the balanced equation for the reaction
3. Calculate the concentration of the HCl solution.
4. What are three things that a technician should look for when making a visual inspection of stock solutions for signs of deterioration
5. Explain the characteristics required of a reaction for determining the concentration of a solution using the process of titration?
6. What characteristics are required for a chemical to be suitable as a primary standard? (you should provide at least 3).
7. What is the function of an indicator in titration and how is the appropriate indicator chosen?
8. Explain how the equivalence point of a titration reaction can be determined using a pH probe. Use a sketch of the titration of 0.1 M HCl with 0.1 M NaOH solution in your explanation.
9. Titration of 20.0 mL 0.100M ammonia with 0.0500 M HCl had the following titration curve:

**Typical pH indicator ranges**

|  |  |  |
| --- | --- | --- |
| Indicator | pH range | Colour (low pH – high pH) |
| Thymol blue (1st change) | 1.2 – 2.6 | Red - yellow |
| Methyl orange | 3.1– 4.4 | Red - yellow |
| Azolitmin | 5.0 – 9.0 | Red - blue |
| Thymol blue (2nd change) | 6.0 – 9.6 | Yellow - blue |
| Phenolphthalein | 8.3 – 10.0 | Colourless – violet |
| Alizarin yellow | 10.7 – 12.0 | Yellow - violet |

1. The volume of the 0.050M HCl required to reach equivalence point is:
2. The most suitable indicator for this reaction is and why?
3. If the indicator Alizarin yellow had been used, what colour would it be when the reaction mixture is at a pH of 7.0
4. Explain how each of the following pieces of glassware would be prepared and used in this titration and the typical errors associated with each.

**20.0 mL bulb pipette**:

**Burette:**

**Conical flask (titration vessel):**

**Beaker holding the HCl:**

**Beaker holding the ammonia:**

1. In the following reaction the precipitation of silver bromide is quantitative.

AgNO3(aq) + NaBr(aq) 🡪 AgBr(s) + NaNO3(aq)

If 23.45 mL of 0.0457 M AgNO3(aq) reacts exactly with a 25.0 mL aliquot of NaBr(aq), what is:

1. The concentration of the sodium bromide solution in moles/L?
2. What mass of silver bromide is formed?
3. Write the name or formula and determine the formula weight for the following elements and compounds.

| Formula | Name | Formula mass/Atomic Mass |
| --- | --- | --- |
| Pb |  |  |
|  | Sulfur trioxide |  |
|  | Magnesium nitrate |  |
| Fe2(SO4)3 |  |  |

1. Explain the difference between the following grades of chemical:

* Analytical reagent
* Technical
* Laboratory
* Spectrograde
* Food Grade

Which would be the most suitable for use as a primary standard.

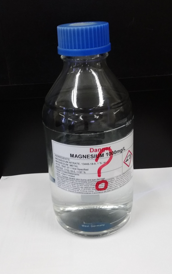
1. A 20.0 ml aliquot of a sample of Na2SO3 is titrated to a colourless endpoint by 17.82 mL 0.0100 M acidified KMnO4. Determine the concentration of the thiosulfate ion in the sample. Show your working.

2MnO4-(aq) + 16H+(aq)  + 10S2O32-(aq) 🡪 2Mn2+(aq) + 8H2O(aq)  + 5S4O62-(aq)

1. Outline the labelling requirements for stock solutions in your workplace.
2. Use the front and back labels shown on a single bottle identified in a laboratory check to highlight any quality or safety issues.

Front Label Back label

(Magnesium) (Manganese)

1. What strategies are used in your laboratory for minimising waste when using chemicals to make solutions and perform tests?
2. Describe the chemical waste disposal system in place in your laboratory.
3. How would the following be disposed of in your laboratory:

* 500 mL of dilute nitric acid (0.15M)
* 150 mL of silver ion solution
* 75 mL of ethanol
* 125 mL of 0.1 M Pb2+ solution
* 350 mL of 5 % v/v solution

1. The following information relates to a sample analysis that was done in triplicate using a titration method. Use the data supplied to explain the following:

* Sources of error in titration,
* Precision
* Accuracy
* Significant figures

The laboratory technician performed three titrations on a sample using the approved method. A known standard was also run to check the accuracy of the analysis. The required indicator was not available so the technician used a different indicator solution. The label for the titrant indicated the solution was out of date and required restandardisation. The solution was not standardised. The technician calculated and reported the result from the values obtained.

Titration 1 23.9 mL

Titration 2 23.8 mL

Titration 3 23.8 mL

Standard (average) 24.5253 mL Standard expected titration = 29.4 mL

## Part 4: Assessment Feedback

*NOTE: This section* ***must*** *have the assessor signature and student signature to complete the feedback.*

### Assessment outcome

Satisfactory

Unsatisfactory

### Assessor Feedback

Was the assessment event successfully completed?

If no, was the resubmission/re-assessment successfully completed?

Was reasonable adjustment in place for this assessment event?  
*If yes, ensure it is detailed on the assessment document.*

Comments:

### Assessor name, signature and date:

### Student acknowledgement of assessment outcome

Would you like to make any comments about this assessment?

### Student name, signature and date

***NOTE: Make sure you have written your name at the bottom of each page of your submission before attaching the cover sheet and submitting to your assessor for marking.***

### APPENDICES

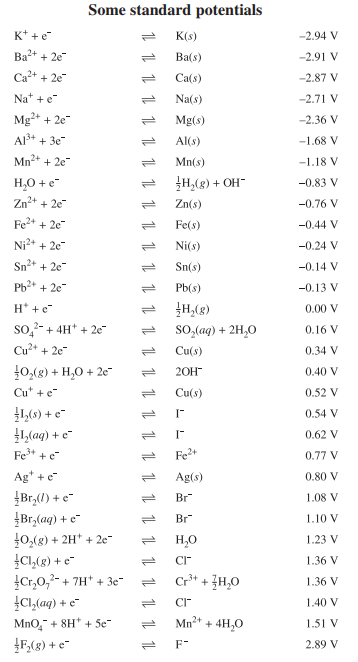
**Data Sheet**

|  |  |
| --- | --- |
| Mass (g) = | Conc x V(L) x Formula mass |
| Molarity = | Mass ÷ V(L) x Formula mass  or  No of mole ÷ V (L) |
| Moles = | Mass / Formula mass  or  C x V (L) |
| Dilution Factor = | Final Volume  Initial Volume |
| Average = | Sum of readings  No. of readings |
| Range = | (highest Value – lowest Value) |
| Absolute precision = | Range  2 |
| Relative precision = | (absolute precision) x 100%  average |
| Accuracy = | [(True Value – Average Value)] ÷ True x 100 |
| % w/w = | (grams of solute / grams of sample) x 100 |
| % v/v = | (mL of solute / mL of solution) x 100 |
| % w/v = | (grams of solute/ mL of solution) x 100 |
| ppm = | (mg of analyte / mL of solution) x 1000 |

Appendices

***Common ions and their charges***

| +1 | +2 | +3 | +4 | -1 | -2 | -3 |
| --- | --- | --- | --- | --- | --- | --- |
| ammonium  NH4+ | barium  Ba2+ | aluminium  Al3+ | Lead (IV)  Pb4+ | acetate (ethanonate)  CH3COO - | carbonate  CO32- | phosphate  PO43- |
| potassium  K+ | calcium  Ca2+ | iron (III)  Fe3+ | tin (IV)  Sn4+ | bromide  Br - | chromate  CrO42- | phosphide  P3- |
| silver  Ag+ | Copper (II)  Cu2+ |  |  | chlorate  ClO3 - | dichromate  Cr2O72- | nitride  N3- |
| sodium  Na+ | iron (II)  Fe2+ |  |  | chloride  Cl - | oxide  O2- |  |
| Hydrogen  H+ | lead (II)  Pb2+ |  |  | fluoride  F - | peroxide  O22- |  |
|  | magnesium  Mg2+ |  |  | hydrogen carbonate HCO3- | sulfate  SO42- |  |
|  | mercury(II)  Hg2+ |  |  | hydrogen sulfate  HSO4 - | sulfite  SO32- |  |
|  | nickel  Ni2+ |  |  | hydroxide  OH - | sulfide  S2- |  |
|  | tin (II)  Sn2+ |  |  | iodide  I - |  |  |
|  |  |  |  | nitrate  NO3 - |  |  |
|  |  |  |  | nitrite  NO2 - |  |  |
|  |  |  |  | permanganate  MnO4- |  |  |



Aylward and Findlay, SI Chemical Data (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

