# Knowledge Assessment

**Assessment event 1 of 3**

# Trainer & Assessor Marking Guide

## Criteria

### Unit code, name and release number

MSS024016 - Process and present environmental data Release 1

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

MSS50218 - Diploma of Environmental monitoring and technology Release 1

Version: 1.0

Date created: 1 November 2018

Date modified: 13/01/2020

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RTO Provider Number 90003 | CRICOS Provider Code: 00591E

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 |
| --- | --- |
| **Instructions for the trainer and assessor** | This is a written assessment and will be assessing the student on their knowledge of the unit.  This assessment has three Parts;  Part 1 – Metrology (13 questions)  Part 2 – Working with data (4 questions)  Part 3 – Calculating scientific quantities (17 questions)  All questions are short answer and the assessment is open book.  Model answers, sample responses or a criteria for each question are provided below.  Use these to support your judgement when determining a satisfactory result.  The student’s response to each question must contain the information indicated in this marking guide in order for their response to be correct. However, if a student provides information other than indicated below, and in the professional opinion of the assessor it is appropriate and meets the intent of the question, it may be considered correct.  The assessment feedback page must be signed by both the student and the assessor so the student displays that they have received, understood and accepted the feedback.  Arrange a time for each student to view their marked tests and the assessor feedback. Assessors are to retain all tests after students have viewed their results. Students may not keep a copy of their completed test.  Ensure the student’s name appears on the bottom of each page of the submitted assessment. |
| **About this marking guide** | The student’s response to each question must contain the information indicated in this marking guide in order for their response to be correct.  All questions must be answered correctly in order to satisfactorily complete this assessment event.  Assessors will need to make a judgement call as to whether each answer/response meets the criteria based upon the:   * Rules of Evidence:   + Validity – does the answer address the assessment question and does the evidence reflect the four dimensions of competency?   + Sufficiency – is the answer sufficient in terms of length and depth?   + Currency – has the work been done so recently as to be current?   + Authenticity – is this work the student’s own authentic work? * Principles of Assessment:   + Fairness – individual student’s needs are considered in the assessment process   + Flexibility – assessment is flexible to the individual student   + Validity – any assessment decision is justified, based on the evidence of performance of the student   + Reliability – evidence presented for assessment is consistently interpreted and assessment results are comparable irrespective of the assessor conducting the assessment * Dimensions of competency   + Task skills   + Task Management Skills   + Contingency Planning Skills   + Job Role Environment Skills |
| **Student must provide** | Students must provide a pen/s, calculator and their Student Workbook. |
| **Assessor must provide** | One copy of the assessment task per student. |
| **Time allowed** | 3 hours |

## Part 1 - Metrology

Read each question carefully and write your answer in the space provided.

1. What is metrology? Why is it important in laboratory work?

Metrology is the study of the science of measurement.

Laboratories measure things. Any general answer about the importance of measurements to quality outcomes is an acceptable answer.

1. Identify the three key international bodies that contribute to metrology in a laboratory setting.

Acceptable responses would be the acronym and/or the name. Each organisation needs to be in the answer.

Bureau International des Poids et Mesures or BIPM or International Bureau of Weights and Measures

International Organisation for Standardisation or ISO

Organisation for Economic Cooperation and Development or OECD

1. Identify and list the two national bodies associated with the quality of metrology in Australia.

Acceptable responses would be the acronym and/or the name. Each organisation needs to be in the answer.

National Association of Testing Authorities or NATA

National Measurement Institute or NMI

1. a) Define the term **base unit**.

Base units are the primary units from which all other units are derived.

b) In the table below, list all the base units used in the metric system by **physical quantity,** **name** and **symbol** (mass is given as an example).

| Physical quantity | Name | Symbol |
| --- | --- | --- |
| Mass | kilogram | kg |
| Length | Metre | m |
| Time | Second | s |
| Amount of substance | Mole | mol |
| Electric current | Ampere | A |
| Temperature | Kelvin | K |
| Luminous intensity | Candela | cd |

Students need to list all 7 units for a correct answer

1. a) What is a derived unit? Provide the name and notation as an example for one derived unit.

When any of the base units are combined with each other they form what is called a derived unit. Examples would include;

• Area, m2

• Density kg.m3

b) List three examples of derived units and **explain** the type of measurement that the unit relates to. *Example: Decibel (related to noise or signal measurements)*

|  |  |
| --- | --- |
| Derived unit | Type of measurement it relates to |
| Litre | special volume based on length |
| Watts | energy measurements |
| Decibel | noise or signal amplitude |

Correct answer can contain any other unit from Table 1.4 of the Learner resource.

1. What is the difference between metric and imperial units?

Metric units are derived from base 10. Imperial units are derived from any historical reference.

1. Why is a measurement considered an estimate?

Because we can never know the true value as the decimal places would go on forever. As soon as we truncate (shorten) an answer, it turns into an estimate.

1. What is the difference between accuracy and precision?

Accuracy refers to the closeness of a result to a true or otherwise accepted true value.

Precision refers to the relative closeness of repeated measurements of the same thing.

1. a) What is meant by the term error in metrology? Identify and list four different categories or types of error.

Error can mean several things, but expresses the range of values that an estimate could be.

b) Identify and list four different categories or types of error.

• Operator error

• Equipment error

• Type 1. II error

• Systematic

• Random

• Any other accepted term.

1. a) What is calibration when applied to metrology?

Calibration refers to the use of standard reference materials and processes that a measurement system is aligned to, to ensure that the measurements taken with the system will be as accurate as possible.

b) List two pieces of equipment in your lab that need to be calibrated.

Acceptable responses will vary depending on what equipment the students have been exposed to. Example responses could include: pH meter, DO meter etc.

1. What is traceability when applied to metrology?

Traceability refers to being able to ‘trace’ an analytical result back through to the national testing authority.

1. a) What is **repeatability** when applied to metrology?

Testing the same measurement under the same conditions over and over to ensure the precision of the test procedure meets quality objectives.

b) Why is **repeatability** important?

Repeatability is essential for ensuring quality results in the laboratory.

1. Using an example of where you have measured something in the lab (such as pH, temperature or conductivity), identify three **sources of error** that can occur in this measurement process.

Any of the following

Reagent quality

Operator error

Power supply issues

Lack of calibration

Poor calibration

Equipment malfunction

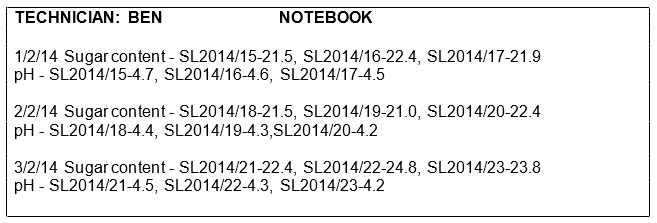
Software malfunction

Span drift

Dirty probe

## Part 2 – Working with data

1. Ben has done some analyses of grape samples, testing for sugar content and pH. Test results were transcribed (copied) from Ben’s notebook to a Laboratory Test Sheet as part of a report. Find and highlight the transcription errors in the table, that is, where the results were not copied correctly from Ben’s notebook.



**Laboratory Test Sheet – Grape Samples**

**Client: Winning Wines**

Table 1 Laboratory test sheet – highlight the results that were not copied correctly

| Date | SL Number | % sugar | pH |
| --- | --- | --- | --- |
| 1/2/14 | SL2014/15 | 21.5 | 4.7 |
| 1/2/14 | SL2014/16 | 22.4 | 4.6 |
| 2/2/14 | SL2014/17 | 22.9 | 4.5 |
| 2/2/14 | SL2014/18 | 21.5 | 4.4 |
| 2/2/14 | SL2014/19 | 21.0 | 4.3 |
| 2/2/14 | SL2014/21 | 22.4 | 4.2 |
| 3/2/14 | SL2014/21 | 22.4 | 4.5 |
| 3/2/14 | SL2014/22 | 24.8 | 4.8 |
| 3/2/14 | SL2014/23 | 23.8 | 4.2 |

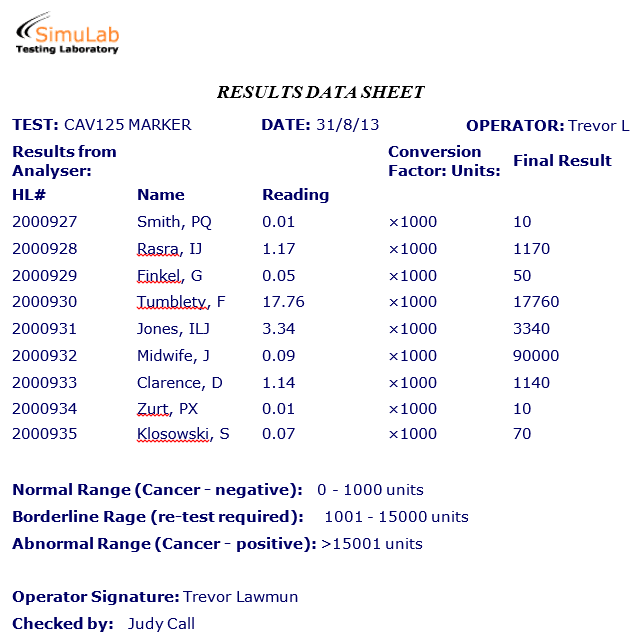
Highlight the results that were not copied correctly from Ben’s notebook.

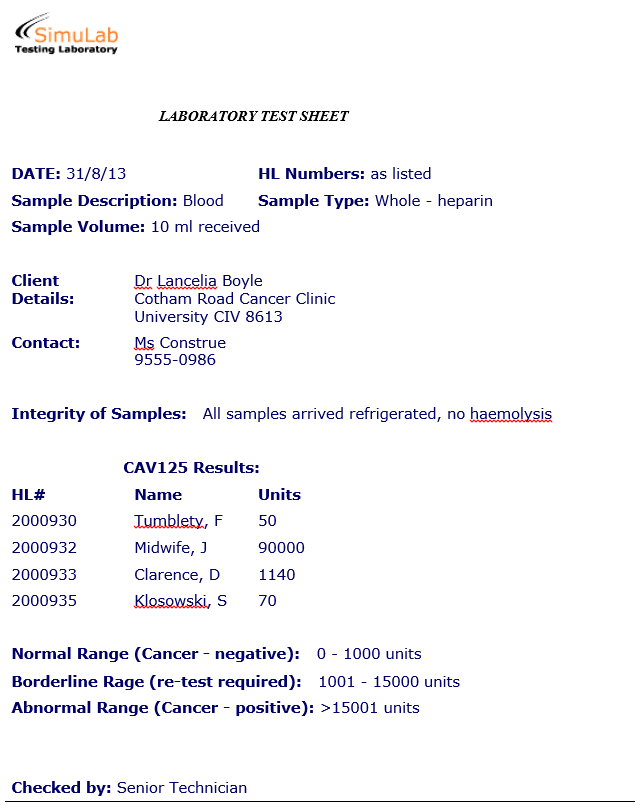
Answer correct ☐ Yes ☐ No

1. Test results must be checked to ensure they are copied correctly into final reports. Read the typical scenario below and perform the task and answer the questions on the next page.

Dr Lancelia Boyle medical specialist (oncology) calls the biological laboratory about a number of CAV125 (cancer marker results). She will not say if there is a problem or why exactly she is calling, but she wants you to check the results for the following patients (all tested on the same day - 31/8/13):

|  |  |
| --- | --- |
| Francis Tumblety | Duke Clarence |
| Severin Klosowski | Jillian Midwife |





Check the Results Data Sheet (used in the laboratory to record results and perform calculations) and the transcript of these results to the Laboratory Test Sheet (the result sheet sent to the customer).

1. Have any calculation mistakes been made? If so, what were they?

Line 2000932 should be 90, not 90000

1. Have any transcription errors occurred? If so, what were they?

Tumblety should be 17760, Midwife should be 90

1. The liquid dispensed from an automatic pipette set at 500 µL is weighed to check it is dispensing the right amount as part of a calibration exercise. This is done 3 times. Identify the suspicious value from the list below and place an X in the column on the right.

Table 2 Multiple choice

| c | Put X next to your answer |
| --- | --- |
| 1. 0.5010g |  |
| 1. 0.5002g |  |
| 1. 0.5501g | X |

1. The table below shows how the readings from an instrument change as different concentrations of known standard solutions of caffeine are put into it.

Look at the pattern in the data of how the absorbance increases as the concentration increases.

Identify (highlight or circle) the suspicious data point in the table.

**Analysis of caffeine by HPCL**

Table 3 Analysis of caffeine by HPLC

| Caffeine Standard mg/L | | Absorbance |
| --- | --- | --- |
| 20 | 0.09 | |
| 40 | 0.21 | |
| 60 | 0.88 | |
| 80 | 0.39 | |
| 100 | 0.52 | |

## Part 3 – Calculating scientific quantities

1. **Round off** the *problem* values in the table below correct to the nearest figure shown in the *criteria* column. Record your answer in the *Answer* column.

Table 2 rounding off questions

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Problem | Criteria | Answer |
| a) | 0.003682 | 4 decimal places | 0.0037 |
| b) | 5.20196 | 2 decimal places | 5.20 |
| c) | 463.9 | Round to tens | 460 |
| d) | 8,420 | to nearest 100 | 8400 |
| e) | 68,420 | to nearest 10 000 | 70000 |
| f) | 4,724,361 | to nearest 1 000 000 | 5000000 |

1. Give the number of **significant figures** for each of the *problem* values in the table below and record your answer in the *Answer* column.

Table 3 Significant figures

|  |  |  |
| --- | --- | --- |
| Question | Problem | Answer |
| a) | 478 200 | 4 |
| b) | 0.01003 | 4 |
| c) | 3 000 | 1 |
| d) | 863.9462 | 7 |
| e) | 21.00 | 4 |
| f) | 0.00053 | 2 |

1. Use your skills and knowledge to **transpose** the following formulae to make a new subject.

Table 4 Transpose formula

|  |  |  |  |
| --- | --- | --- | --- |
| Question | Problem | Make this the subject | Answer |
| a) | V=Lbw | w | w=V/Lb |
| b) | A=πr2 | r |  |
| c) | V2 = m2 + 2as | a | a = (v2-m2)/2s |
| e) | C1V1=C2V2 | C2 | C2=C1V1/V2 |

1. Choose (highlight or circle) the best **estimation** A, B or C for these calculations

Table 5 Estimates

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Question | Calculations | Identify the best estimate below | | |
| A | B | C |
| a) | 6.93 x 11.2 | 7.76 | 77.6 | 776 |
| b) | 7.82 x 5.03 | 39.3 | 393 | 3930 |
| c) | 0.31 x 0.186 | 5.77 | 0.577 | 0.0577 |
| d) | 5.91 x 20.14 | 11.9 | 119 | 1 190 |
| e) | 0.00467 x 3.175 | 0.0148 | 0.00148 | 0.148 |

1. **Substitute** the data into the provided formulae and **calculate** the answer correct to the appropriate number of significant figures (which you need to determine).
   1. when *b* =3.4 106 and *h* = 7.0 104

1.19x1011

* 1. when h = 5.0 10-1 , m= 3.2 106, v= 2.7 103

4.22x10-4

* 1. V = *u* + *at* when *u* = 2.7 104, *a* = 5, *t* = 3.0 103

42000

1. Express each ratio in its lowest terms
   1. 132 : 12

11:1

* 1. 4.8 : 1.6

3:1

* 1. 50g : 0.05kg

1:1

1. The ratio of the length of the tail of a mouse to that of the rest of its body is 6:5 and its total length is 132mm. Calculate the length of the tail and the body, expressing your answers in millimetres.

Tail = 72 mm

Body = 60 mm

1. An aspirin mixture composed of the three compounds A, B and C in the ratio 7:3:2 has a mass of 2 kg. Calculate the masses of each compound, expressing your answers in kilograms.

A = 1.17 kg

B = 0.5 kg

C = 0.33kg

1. Liquids A and B are mixed in the ratio 2:7 (by volume). What volume of liquid A would be present in 72 mL of the mixed solution?

A = 16 mL

1. How much salt is weighed to make 2 L of 8% w/v salt brine?

160 grams

1. How much 10% w/v salt brine is needed to prepare 200 mL of 2% w/v salt brine?

40 mL

1. If 40 g of NaCl is dissolved in 2 litres of water what is the %w/v of the solution?

2% w/v NaCl

1. Convert each of the following
   1. 8200 µg to g

0.0082 g or 8.2 x 10-3 g

* 1. 0.000056 km to mm

56 mm

* 1. 2.9 x 109 nL to ML

0.0000029 ML

* 1. 8.5 m2 to mm2

8 500 000 mm2

* 1. 246 µm3 to m3

2.46 x 10-16

* 1. 9.4 x 10-5 L to mm3

52000000

1. Calculate the volume of stock solution (10 mg/100mL) required to prepare 20 mL of three standard solutions containing 1, 2 and 5 mg/100mL of tartrazine by dilution of the stock with 2-propanol.

1=2 mL

2=4mL

5=10 mL

1. In the determination of ethanol (%v/v), a brandy sample was diluted 1/5. What is the dilution factor?

DF = 5/1 = 5

1. How much 2M NaOH is required to make up 1000mL of a 0.01M NaOH solution?

5 ml

1. If there were 120 micro-organisms on a pour plate of a 10-2 dilution, how many micro-organisms were there per mL of the original sample?

DF = 10/2 = 5

CFU=5\*120 = 600