2024 VCE VET Laboratory Skills external assessment report

General comments

The 2024 VCE VET Laboratory Skills examination was the first examination with the updated training package, with MSL973027 Perform techniques that prevent cross-contamination replacing MSL973016 Perform aseptic techniques.

The scored program covers the following four units of competency:

* MSL933009 Contribute to the achievement of quality objectives
* MSL973026 Prepare working solutions
* MSL973028 Perform microscopic examination
* MSL973027 Perform techniques that prevent cross contamination.

Students need to read the stem of the short-answer questions carefully as the answers must reflect the setting and conditions of the stem. Many answers with generalisations did not achieve full marks. Repetition between one part of a singular question and another also did not achieve full marks.

When a question asks for multiple answers – such as ‘list two things’, if the student listed three things for example, only the first two answers are considered.

MSDS is no longer accepted as a suitable answer for SDS (Safety Data Sheet). Teachers need to be aware of the correct terminology.

Specific information

This report provides sample answers, or an indication of what answers may have been included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding resulting in a total more or less than 100 per cent.

Section A: Multiple-choice questions

The table below indicates the percentage of students who chose each option. The correct answer is indicated by bold text and shading.

| **Question** | **Correct Answer** | **% A** | **% B** | **% C** | **% D** | **% No Answer** | **Comments** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | D | 1 | 0 | 17 | **82** | 0 |  |
| 2 | B | 22 | **30** | 39 | 8 | 0 | A wet mount is used to examine living specimens. Glycerine is an excellent hydrating liquid. It prevents the specimen from drying out over the course of the examination. It provides a moist medium for the stain, making it easier to see the cell structure. |
| 3 | B | 11 | **79** | 8 | 1 | 0 |  |
| 4 | D | 5 | 46 | 16 | **34** | 0 | A wet mount slide is used to examine living specimens. If water was used as the medium, this often evaporates, killing the sample. |
| 5 | C | 19 | 0 | **45** | 36 | 0 | To prevent contamination, all lids should be open for the least amount of time. D mentioned wiping down ‘at the end’ of the process, not the beginning. |
| 6 | C/D | 32 | 7 | **50** | **12** | 0 | D was the correct answer, but psychometric analysis showed that there was some ambiguity in the question and for that reason the decision was made to award both C and D.  When CaCl2 dissolves in water, the equation is:  CaCl2 (s) → Ca2+ (aq) + 2Cl- (aq)  n = cv  n = 0.500 x 0.250  n = 0.125 mol (125 mmol) of CaCl2  However, the ratio of CaCl2 to Cl- is 1:2, so the number of moles of Cl- will be:  2 x 0.125 = 0.250 mol (250 mmol) |
| 7 | B | 11 | **88** | 1 | 0 | 0 |  |
| 8 | C | 20 | 11 | **67** | 1 | 1 |  |
| 9 | A | **70** | 2 | 2 | 26 | 0 |  |
| 10 | C | 7 | 19 | **65** | 8 | 0 |  |
| 11 | C | 7 | 5 | **78** | 9 | 1 |  |
| 12 | A | **61** | 5 | 28 | 7 | 0 |  |
| 13 | B | 7 | **89** | 4 | 0 | 0 |  |
| 14 | A | **75** | 7 | 6 | 13 | 0 |  |
| 15 | B | 15 | **52** | 17 | 16 | 0 | A primary standard is a substance with a known and precise concentration that is used to calibrate other standards and determine the concentration of secondary standards. |
| 16 | A | **95** | 5 | 0 | 0 | 0 |  |
| 17 | D | 0 | 6 | 7 | **88** | 0 |  |
| 18 | C | 1 | 2 | **94** | 3 | 0 |  |
| 19 | D | 8 | 6 | 7 | **79** | 0 |  |
| 20 | D | 6 | 16 | 2 | **77** | 0 |  |

Section B

Question 1a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 33 | 37 | 30 | 1.0 |

Possible answers included:

* chemical leakage from containers
* reaction of fumes from alkaline and acidic containers stored in the same cabinet
* crystallisation / glacial formation
* a salt being produced in the reaction between an acid and base.

Many students mentioned mould and/or an expiry date. However, this was an acid/base fume cabinet; acids and bases do not have expiry dates marked on them (only the date that they were made), and do not produce mould.

Question 1b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 9 | 11 | 41 | 14 | 25 | 2.4 |

Possible answers included:

* Notify the supervisor or safety officer of the issue; ask them for advice on what should be done before taking any action.
* Read the safety manual or SOP or SDS of specific chemicals for the storage requirement.
* Review the containers in the cabinet and check for any signs of leakage or spills.
* Wearing PPE, wipe bottles and dispose of wipes in a hazardous/corrosives waste container.
* Separate the acids and alkaline containers. If the cabinet has a dividing wall, check if all acids are on one side and alkalis on the other. If not, re-sort the containers accordingly.
* Recommend purchasing a second corrosives cabinet to store the two groups separately.
* Change the type of bottle.
* Make a record of the chemicals that were contaminated.

Many responses mentioned disposing of the chemicals; however, it was not necessary to do so. The chemicals can still be used, but the concentration would need to be re-measured.

Question 2a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 4 | 27 | 69 | 1.7 |

Any two of:

* Thank them for their call.
* Explain that the samples arrived in the laboratory after the cut-off time to process them.
* Express that you understood that in this case the results were needed urgently.
* Confirm you would call back once you knew the expected time for the results to be released.
* Apologise – take ownership.

Question 2b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 15 | 49 | 37 | 1.2 |

Any combination of:

* Mark the samples as ‘very urgent’. Check if all the samples had been processed; try to squeeze these into the testing run.
* Speak to the laboratory supervisor about the issue. Explain it is a very urgent result that is needed; ask them for advice on what to do.
* Access the sample condition to check they are still suitable for testing. If not, ask the doctor’s surgery to request a re-collection from the patient.
* Conduct basic processing of samples.
* Have all equipment needed for processing ready to go as soon as the samples arrive.

Many responses referred to contacting the courier to tell them that the sample was urgent, but this is not appropriate for a technician to do.

Question 3a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 30 | 42 | 21 | 6 | 1.1 |

Students were awarded one mark for each suggested equipment *and* explanation.

|  |  |
| --- | --- |
| **Equipment** | **Explanation** |
| 70% ethanol | to spray the outsides of the containers before opening and to spray all internal surfaces before and after working in the cabinet |
| culture flasks | to place the sterile culture media into, to prevent any contaminants entering the flasks |
| pipette | to transfer the liquid culture media from stock bottle to flask without contamination |
| incubator | to grow the cultures / maintain temperature |
| media | cell culture media to support cell growth |
| Bunsen burner | to flame the mouth of the flask |

To achieve full marks, the answers must include both equipment and a correct explanation.

Students should read the stem of the question carefully. Many responses answered that the Bunsen burner was used to sterilise the inoculating loop. However, this work was conducted with liquid cell cultures in a tissue culture cabinet, not working on the bench with bacteria.

A Bunsen burner was accepted if the explanation revolved around flaming the mouth of the flask; however, there are safety concerns with having a Bunsen burner in a tissue culture cabinet. Many cabinets do not have gas taps.

An inoculating loop was not a correct answer. It would not be used for this task because it involves working with liquid cell cultures.

Question 3b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 6 | 4 | 35 | 17 | 38 | 2.8 |

Two different actions were required, each with an explanation of why it was required. Students were awarded one mark for the action and one mark for a correct explanation. Possible answers included:

* Spray surfaces and containers with 70% ethanol / disinfectant to disinfect area.
* Only open containers when you are ready to use them and close them immediately after use to prevent foreign DNA getting into containers.
* Do not put the pipette down between transfers; if you do, change it for another sterile one.
* Do not put the lids onto the bench surface; if you do, place them downwards to prevent contaminants getting into the containers.
* Keep away from air/windows to prevent aerosols.
* Work near a Bunsen burner to create a zone of sterility.
* Flame the mouth of the flask to make sure no foreign material can get in.
* Autoclave media to make sure it is sterile.

Responding with ‘using aseptic techniques’ was not detailed enough to be awarded 2 marks. Many students could not explain how the action prevented cross-contamination. Many responses also mentioned using 70% ethanol to ‘sterilise the workplace’. The entire workplace cannot be sterilised/disinfected. Students should note the difference between a ‘workplace’ and a ‘workspace’.

Question 3ci.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 19 | 81 | 0.8 |

Contamination / cross-contamination.

This question was answered well.A reminder that if students provided two answers, only the first answer was considered, even if the second was correct.

Question 3cii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 12 | 34 | 53 | 1.4 |

Either can provide two separate actions, or an explanation of the action.

* Dispose of the container and pipettes in the biohazard bag (to be autoclaved before disposal).
* Record this in the media logbook.
* Inform/show the supervisor.
* If you have placed the contaminated pipette into the stock bottle, you will need to dispose of that as well and make up a fresh stock solution.
* Repeat test.
* Do not use the media.

Responses that provided ‘dispose of the media’ without an explanation of how to do it were not awarded full marks.

Question 4a.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 61 | 13 | 26 | 0.7 |

These steps were copied from a laboratories SOP and had part of the step removed.

* Label the microcentrifuge tube.
* How much blood to transfer.



Many students missed the part in the stem of the question where it refers to ‘Step 3’. Many incorrectly answered about disinfecting the workplace, putting on PPE, or sterilising equipment. These would have been addressed *before* Step 3.

Question 4b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 5 | 31 | 64 | 1.6 |

Any two of:

* Wear PPE.
* Use a Class II Biological Safety Cabinet or Bunsen burner.
* Follow aseptic procedures throughout the transfer of samples and when adding solutions.
* Use sterile equipment to prevent contamination.
* Follow SOP.

This question was generally answered well.

Question 4c.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 25 | 75 | 0.8 |

Electrical hazard from centrifuge, chemical hazard from detergent or biological hazard from blood.

Many responses did not specifically address the hazard, and some answered generically, such as ‘DNA’. DNA is not inherently a hazard.

Question 5a.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 2 | 98 | 1.0 |

Standard Operating Procedure (SOP).

Question 5b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 8 | 28 | 64 | 1.6 |

Any two of:

* steam/water
* time
* temperature
* pressure
* size of the load.

Question 5c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 5 | 39 | 56 | 1.5 |

The tape not changing means that the autoclave did not get to the right temperature or pressure for sterilisation. The contents are possibly not sterile. It could mean that there is something wrong with the machine.

Possible solutions included:

* The technician could re-run the autoclave with a fresh load and the same indicator tape to check there wasn’t an operator error in setting the autoclave to the correct settings.
* Organise the machine to be serviced.
* Let the supervisor know and discard the agar.
* Record it in logbook.
* Mark as out of service / tag.
* Biological monitoring (spore testing).

Many responses suggested to re-sterilise the media. Media is heat sensitive, so trying to re-sterilise it is not ideal. It should be discarded and a fresh batch made.

Question 6a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 5 | 36 | 58 | 1.6 |

* D – Volumetric flask
* E – Burette

If responses named the equipment correctly but got the letters incorrect, this was taken as correct. Using just the correct letters was also taken as correct.

Some responses incorrectly identified E as a pipette.

Some responses also named the conical flask or pipette. These were not accepted. The question asked for ‘volumetric’ pieces of equipment, not just equipment used in a titration.

Question 6b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 0 | 4 | 18 | 20 | 58 | 3.3 |

Any two of:

* funnel – used to fill the burette with solution
* conical flask – contains the aliquot and the indicator
* volumetric flask – the equipment used to make up the standard solution
* burette – holds the solution and measures the titre that is placed into the conical flask for the titration end point.

One mark for the name and one mark for the explanation.

A number of responses tried to use ‘titrant’ and ‘analyte’; however, there were some mix-ups with which one was the unknown and which the known concentration. The analyte is the solution that has the unknown concentration, and while it can be placed in the burette or the flask, it is more commonly placed into the conical flask. The aliquot is what goes into the conical flask.

Question 7ai.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 30 | 70 | 0.7 |

Symbol: Corrosive.

Students did not need to draw the diagram to achieve the mark if the word corrosive was clear. Many students answered ‘flammable’, which is not listed in the Safety Data Set (SDS).

Question 7aii.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 11 | 89 | 0.9 |

Any one of:

* date
* technician’s initials
* the safety labels
* the name of the solution
* concentration.

Question 7bi.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 59 | 41 | 0.4 |

H2SO4

Question 7bii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 5 | 19 | 76 | 1.7 |

A compound because it is made up of more than one element. One mark for responding ‘compound’ and one for the explanation.

Question 7c.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 23 | 77 | 0.8 |

Safety Data Sheet (SDS) or risk assessment.

MSDS was not taken as correct. Please be aware of the updated terminology.

Question 7d.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 0 | 2 | 98 | 2.0 |

Any two of:

* gloves
* eye goggles
* safety glasses
* lab coat
* enclosed shoes
* face shield.

Question 7e.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 18 | 69 | 13 | 1.0 |

Possible answers included:

* preparation date on the label
* if the solution is cloudy, discoloured or contaminated
* right concentration
* correctly stored – bottle, cabinet.

Many responses mentioned an expiry date. As this is an acid, there would only be a date of preparation, not a date of expiry.

Question 7fi.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 23 | 8 | 69 | 1.5 |

c1v1 = c2v2

c2 = 1 M, v2 = 2 L, c1 = 5 M

v1 = c2v2 / c1

v1 = 1 x 2 / 5

v1 = 0.4 L, or 400 mL

Partially incorrect responses involved the incorrect rearrangement of the equation. If students got the formula and the numbers correct (that is, the first three steps above), one mark was given.

Question 7fii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 6 | 45 | 49 | 1.5 |

Any two of:

* fume cupboard
* beaker
* funnel
* measuring cylinder
* volumetric flask.

Some students wanted to use a balance/scale. As the task involved diluting an acid, this was not required.

Question 7fiii.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 30 | 24 | 20 | 19 | 6 | 1.5 |

Steps similar to:

* Step 1: Working in a fume cupboard. Collect 2 L volumetric flask and 500 mL measuring cylinder.
* Step 2: Fill up the 2 L flask approximately halfway with deionised/distilled water.
* Step 3: Pour some of the 5 M acid into a beaker and, using a funnel, fill the 500 mL measuring cylinder up to the 400 mL mark with the acid.
* Step 4: Add the 400 mL of acid into the 2 L volumetric flask that contains the water. Once all the acid is in, fill the 2 L volumetric flask up to the mark/meniscus with deionised/distilled water. Invert flask with stopper to mix.

Responses must mention the specific steps that are used to dilute acidic or basic solutions: you must add the acid to the water and make the solution ‘up to the mark’ or ‘up to the meniscus’ in the volumetric flask. The flask also needed to be inverted to mix, not shaken.

Many responses referred to wiping the bench with 70% ethanol. As the question refers to the preparation of an acid dilution, this is not required.

Question 7g.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 35 | 36 | 29 | 1.0 |

Follow the SDS procedure. As this spill is on the bench, neutralise the acid by using a solid such as Na2CO3 (sodium carbonate) or NaHCO3 (sodium bicarbonate), then collect and pour down sink with running water, or place in chemical bin. Sodium hydroxide is not appropriate to neutralise an acid.

Phrases such as ‘neutralise the spill’ were awarded one mark.

Pouring water on the spill on the bench to dilute it is not an appropriate method.

If responses mentioned a spill kit but did not mention specifics about neutralising the spill with an alkali/base, no marks were awarded. Using an ‘acid’ spill kit gained one mark.

Question 8a.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 64 | 36 | 0.4 |

The control plate that had not been inoculated had growth.

The evidence was **not** that the growth was different sizes and colours, but that the control plate also had growth.

Question 8b.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 4 | 21 | 42 | 33 | 2.1 |

Any three of:

* disinfect benches (with 70% ethanol)
* personal hygiene; use of face mask and hand washing, PPE
* working near a Bunsen burner
* keeping lids off Petri dishes for a minimum amount of time
* remove clutter / housekeeping
* flame lid of bottle
* storing agar plates upside down due to possible contamination from condensation
* sterile / sterilising equipment – autoclaving.

As the stem of the question mentioned that the technician was preparing agar, an inoculating loop would not be required in this step.

Question 8ci.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 51 | 38 | 11 | 0.7 |

Disinfectants are stronger than antiseptics. Disinfectants destroy and prevent most pathogenic micro-organisms from colonising. Antiseptics are used to clean skin/hands, whereas disinfectants are used to clean a surface.

Many responses demonstrated that students did not know the difference between the two. Some responses also mentioned sterilisation – neither disinfectants nor antiseptics sterilise; they only remove most organisms.

Question 8cii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 32 | 52 | 16 | 0.9 |

Disinfectants are applied to benches and laboratory instruments before carrying out a procedure.

Antiseptics would be used for washing hands before carrying out the procedure.

This question **did not** ask for an example of a disinfectant or antiseptic – students should be sure to read all the stem of the question.

Question 9a.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 0 | 0 | 1 | 7 | 92 | 3.9 |

As long as the diagram was labelled correctly, the letters did not need to be added in alphabetical order to achieve the marks.

A close-up of a microscope

Description automatically generated

Some responses did not use the correct letters (B to E) as instructed.

Question 9bi.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 17 | 83 | 0.9 |

Sample answers included:

* neck strain
* eye strain
* electrocution
* cuts from broken glass
* chemical hazard from stains.

Question 9bii.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 18 | 82 | 0.9 |

Sample answers included:

* high bench
* high stool
* take regular breaks
* stand on rubber mat
* check cord for fraying before use.

Students were expected to link parts 1 and ii of Question 9b.

Question 9c.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 0.5 | 8 | 30 | 41 | 21 | 2.7 |

Steps similar to:

* Step 1: Lower stage and rotate objective over stage.
* Step 2: Clean the objective using the special lens cleaning fluid and paper.
* Step 3: Secure the cord by wrapping it around the microscope and replace dust cover.
* Step 4: Carry using two hands (ergonomically) and return to its storage area.

Question 9d.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 41 | 55 | 4 | 0.6 |

The idea that an object being viewed appears upside down and backwards (reversed and inverted).

Most responses mentioned only that it was upside down/inverted and not reversed. Repeating the word ‘inversion’ did not receive any marks.

Question 10

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 9 | 18 | 39 | 22 | 11 | 2.1 |

Answers needed to include two points that related to the points shown in the diagram.

Point 1 could include items such as:

* checks for the sterility of media before stalk added
* check of culture containers for sterility before pouring media
* the keeping of sample records or logs
* checks for plant rot.

Point 2 needed to focus on monitoring of the growth conditions:

* temperature
* light
* plant quality
* disease
* soil moisture
* pH.

Generic answers such as ‘monitoring of growth conditions’ were not awarded full marks.