2016 VCE VET Laboratory Skills examination report

General comments

Students' overall performance on the 2016 VCE VET Laboratory Skills examination was good. The multiple-choice section of the examination was particularly well done.

The short-answer questions were generally well answered, although the terminology and calculations involved in the working solutions unit of competency caused students some difficulty.

Question 3, which involved a gram stain reaction, was a poorly understood area for some students. Students should be able to use the scientific and technical terminology commonly used in laboratories.

Students showed good knowledge of hazard symbols and personal protective equipment (PPE) requirements, aseptic techniques, sustainability in the laboratory, and quality systems and recording laboratory information.

Questions on microbiological quality control and subsequent interpretation of results were also poorly answered, with many students answering the questions from a chemistry perspective.

Care must be taken to check all answers before submitting the examination to reduce the chance of errors. Many students answered a question correctly but then contradicted that answer. Some students provided more responses than required for a question; for example, the question required students to list three answers but five answers were given. Assessors accept the relevant number of responses in the order in which they have been written, even if the correct response appears later.

Students should not repeat the stem of the question in their answers.

Specific information

This report provides sample answers or an indication of what answers may have 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 shading.

Question	% A	% B	% C	% D	% No answer	Comments
1	98	2	0	0	0	
2	9	79	7	6	0	
3	0	13	13	73	0	
4	17	49	11	22	0	Both options A and B were accepted for this question. Both follow the correct procedure for dissolving a solid in a liquid by first adding some of the solvent to the flask, adding the solid to dissolve and then making up to the mark. Option A mentioned the use of an ice bath, which would be advisable as the reaction of dissolving NaOH in water is exothermic so an ice bath would counter the increase in temperature of the resulting solution. However, option B was also accepted as the concentration of the prepared 0.1 M NaOH solution was quite dilute, so an ice bath, although best practice, would probably not be used in industry for preparing this concentration.
5	93	1	4	1	0	
6	0	4	0	96	0	
7	72	11	2	15	0	
8	10	73	7	10	0	
9	0	96	3	1	0	
10	71	3	3	22	0	
11	16	10	66	8	0	
12	18	2	20	60	0	
13	9	3	9	79	0	
14	31	19	34	16	0	For this question students needed to recognise the fact that caustic solutions stored in glass containers can cause the stopper on the bottle to fuse. Caustic solutions are to be stored in plastic containers. Some students selected option A, but some simple culture media without perishable ingredients (for example, saline) can be stored in a cupboard.

Question	% A	% B	% C	% D	% No answer	Comments
15	19	58	0	22	0	
16	1	46	37	16	0	The safest and most appropriate way to handle cool glassware is by the sides and bottom. Some students selected option C (at the top around the rim, while using the other hand to support the bottom) but this is not good laboratory practice as there is a greater risk of breakage.
17	0	0	98	2	0	
18	8	6	35	51	1	The calculation required challenged some students. The question was asking for a 1 in 5 dilution of 50 mL of the ethanol solvent (10% v/v) to make a working solution (2% v/v). This is a dilution of 50 mL to a total volume of 250 mL. The question asked how much water is to be added to 50 mL. 50 mL of ethanol plus 200 mL of water (option C) gives a total volume of 250 mL. Option D was incorrect because 250 mL would give a total volume of 300 mL, which is a 1 in 6 dilution.
19	84	3	0	12	0	
20	7	82	7	4	0	

Section B – Short-answer questions

Question 1

Marks	0	1	2	3	4	5	6	Average
%	0	0	3	9	17	26	46	5

Hazard warning: chemical hazard or corrosive

PPE required: safety glasses/goggles, gloves, laboratory coat

Hazard warning: poison or toxic

PPE required: safety glasses/goggles, gloves, laboratory coat

Hazard warning: biohazard or biological hazard

PPE required: safety glasses/goggles, laboratory coat/gown, gloves

Question 1 was answered well, although some students confused the biohazard warning sign as radioactive. Responses needed to include all three PPE items listed.

Question 2

Marks	0	1	2	3	Average
%	3	5	31	61	**2.5**

Any three of:

- examining work practices that use excessive electricity
- switching off equipment when not in use
- recycling and reusing materials where practicable
- minimising process waste
- doing the job ‘right first time’
- batch testing of samples
- bulk ordering of materials
- not over-ordering materials (they may have short expiry dates)
- reducing use of paper.

This question was answered very well by students, with responses showing good knowledge of sustainable principles in laboratories.

Question 3a.

Marks	0	1	Average
%	76	24	**0.3**

Gram-negative (gram –ve) rod or bacilli

Many students answered with gram-negative or rods, not both. Both stain results and shape were required.

Question 3b.

Marks	0	1	2	Average
%	47	31	22	**0.8**

- The results appear pink, so gram-negative.
- The oval shape of the drawing indicates a rod or bacilli shape.

Question 3c.

Marks	0	1	Average
%	13	87	**0.9**

Purple, purple/violet or purple/blue

The colours violet and blue on their own were not accepted.

Question 3d.

Marks	0	1	2	3	Average
%	62	15	17	7	**0.7**

The difference is due to the bacterial cell wall. gram-positive bacteria have a thick peptidoglycan layer in the cell wall, while gram-negative bacteria have a thin peptidoglycan layer. The crystal violet stain is not retained by the gram-negative cell wall as it leaches from the thin layer during decolourisation with grams acetone and takes up the red counterstain.

This question was not answered well. Students need to be able to identify what is happening on a cellular level with the gram stain reaction so that they can fully interpret gram stain results.

Question 4a.

Marks	0	1	2	Average
%	29	43	28	**1**

Cross-infection is the transfer of an infectious agent from one living organism to another. Cross-contamination is the unintentional transfer of a microorganism from one area to another (often due to poor aseptic technique).

Most students had a good understanding of cross-infection but some confused cross-contamination with the definition for contamination, which is not linked to microorganisms.

Question 4b.

Marks	0	1	2	3	4	Average
%	8	9	26	12	45	**2.8**

Technique	Example
transfer using an inoculating loop	passing the loop through the inner blue flame of the Bunsen burner until it glows red
flaming mouth of test tube/flasks	flaming the mouth of the flask on opening and closing vessels; for example, serial dilution, bacterial transfer
use of sterile swabs	using a sterile swab in aseptic conditions for plating; for example, lawn culture
use of sterile pipettes	using sterile serological pipettes for transferring liquids aseptically; for example, samples, serial dilutions, pour plates
working in zone of sterility	working in zone of sterility around Bunsen burner blue flame when using aseptic technique
decontamination of laboratory benches	decontamination of laboratory benches with 80% ethanol before and after task

This question was generally answered well and gave students an opportunity to demonstrate their knowledge of scientific terminology relevant to microbiology. Heat-fixing bacteria is a method used in the laboratory to fix a bacterial sample to a slide and not an aseptic technique as many students suggested for this question.

Question 5a.

Marks	0	1	2	Average
%	5	32	63	**1.6**

Possible answers included (any two of):

- to be able to deal with customers and answer their queries
- to understand why they are doing the work they do
- to know the products so they can understand when things are not right
- to improve the products/services and potentially reduce costs.

Question 5b.

Marks	0	1	Average
%	23	77	**0.8**

One of:

- streamlining a method or technique can help save the company time and money

- noticing a problem (for example, contamination) and suggesting ideas can improve sample turnaround times
- improving product quality will flow on to more purchases and increased business.

Although this question was generally answered well, some students restated the question in their answer or made a suggestion for improvement without giving an example of how the suggestion could support the company's goals.

Question 6a.

Marks	0	1	2	Average
%	16	37	48	**1.3**

- The two different cells are elongated, have two small nuclei and look to be creating a new cell membrane to make two cells.
- May be going through the process of cell division.

Responses needed to include a broad explanation of the observation to gain full marks; mentioning cell division alone was not enough. Use of the correct scientific terminology to explain the interpretation was required.

Question 6b.

Marks	0	1	Average
%	37	63	**0.7**

Mitosis

'Fission' was not accepted due to the presence of distinct nuclei in the diagram.

Question 6c.

Marks	0	1	2	Average
%	26	14	61	**1.4**

Yes, because the long thin strands may indicate hair/dust.

Mentioning the presence of bacterial rods was not acceptable, as the strands are larger than the animal cells represented in the diagram and bacterial cells are smaller than animal cells.

Question 7a.

Marks	0	1	Average
%	4	96	**1**

The correct meniscus position has the base of the line touching the 50 mark line.

Most students could correctly identify the correct meniscus position.

Question 7b.

Marks	0	1	Average
%	39	61	**0.6**

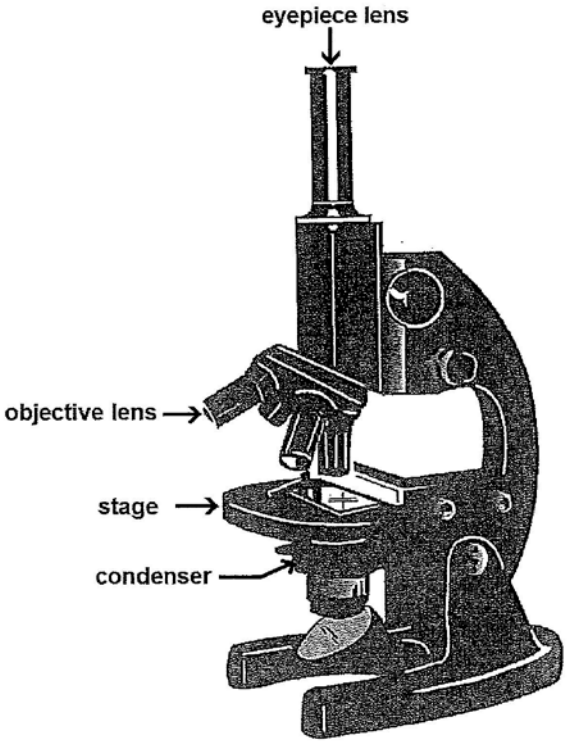
Not use the solution. Contact the supervisor or re-measure the solution.

Some students answered that the technician could take out the extra 2 mL from the cylinder, but this is not good laboratory practice. It is possible to add liquid up to the mark but once the volume has gone over, the solution needs to be remade.

Question 8a.

Marks	0	1	2	3	4	Average
%	1	0	2	14	83	**3.8**

The correctly labelled parts of the microscope are shown below.



Question 8b.

Marks	0	1	2	Average
%	11	62	27	**1.2**

- Objective lens: magnification of the sample
- Condenser: to focus the light onto the specimen

For the condenser purpose, ‘control the amount of light’ was not acceptable, as other parts of a microscope do this (for example, the light intensity knob).

Question 9

Marks	0	1	2	Average
%	3	32	65	**1.6**

Possible answers included (any two of):

- reducing electricity use
- correct disposal of wastes
- doing the job ‘right first time’

- minimising process waste by refining procedures
- batch-testing of samples.

Students demonstrated good knowledge in this area.

Question 10a.

Marks	0	1	2	Average
%	38	31	31	1

Possible answers included (any two of):

- known molecular formula when in anhydrous form
- high solubility
- dissolves readily in water
- high purity and stability
- does not react with moisture, oxygen or carbon dioxide from the air
- inexpensive
- non-toxic/safe.

Most students were able to give only one reason.

Question 10bi.

Marks	0	1	Average
%	68	32	0.4

To remove traces of water so the exact molecular mass is known

Question 10bii.

Marks	0	1	Average
%	97	3	0.1

In order to evaporate water, the temperature needs to be above 100 °C, so any temperature in the range of 102 °C to 110 °C was acceptable.

Higher temperatures were not accepted as the chemical may be degraded.

This question was not answered well. While a few students could correctly answer why the Na_2CO_3 was dried, they could not apply this knowledge to correctly predict the temperature required to evaporate water from a chemical.

Question 10biii.

Marks	0	1	Average
%	92	8	0.1

Store in a dessicator.

Students were required to mention the name of the equipment in their answer. Knowledge of various laboratory equipment and its use is important for laboratory technicians.

Question 11a.

Marks	0	1	2	Average
%	2	19	79	**1.8**

Possible causes included (any two of):

- cluttered work space
- use of non-sterile equipment
- poor storage of agar plates
- not working in zone of sterility
- sneezing near plates by technician
- working near operating fans/open windows
- incorrect handling of sterile materials (for example, lids off, touching inside petri dishes).

Question 11b.

Marks	0	1	2	Average
%	12	40	48	**1.4**

Possible answers included (any two of):

- wear correct PPE
- have a clean working area
- work in zone of sterility near a Bunsen burner blue flame or in a biosafety cabinet
- use sterile equipment at all times
- correctly store agar plates – refrigerated and in sealed containers
- follow appropriate laboratory procedures.

High-scoring responses related the suggestion in part b. to possible causes listed in part a. and demonstrated good laboratory practice.

Question 12a.

Marks	0	1	Average
%	50	50	**0.5**

A sampling plan is a procedure to follow when collecting samples aseptically, including when, where and how many samples are to be taken.

Question 12b.

Marks	0	1	Average
%	42	58	**0.6**

Any of:

- to provide conformity between different technicians and laboratories
- to ensure samples are representative and valid
- so acceptable decisions about test sample quality can be made.

Students needed to show some understanding about sampling plans in their answer. Single words such as ‘accuracy’ were not accepted.

Question 12c.

Marks	0	1	2	Average
%	14	45	41	**1.3**

Any two of:

- sample register or LIMS (laboratory information management system)
- sample label on container
- laboratory logbook.

Some students mentioned the SOP or the quality manual in their answer but the question asked for where information is recorded, not accessed.

Question 13a.

Marks	0	1	2	Average
%	7	22	72	**1.7**

Possible answers included (any two of):

- chemical name
- chemical concentration
- name of the technician preparing the solution
- date the solution was made
- batch number of the solution
- expiry date of the solution
- class label (hazard's class)
- volume prepared.

Question 13bi.

Marks	0	1	Average
%	73	27	**0.3**

In a locked or secure chemical storage area or in a corrosives cabinet

This question was not answered well by most students. Laboratory technicians must know that, due to regulatory requirements, highly concentrated hazardous solutions must be secure and accessed only by trained personnel.

Question 13bii.

Marks	0	1	Average
%	14	86	**0.9**

Any of:

- chemical name
- chemical concentration
- date of purchase
- batch number
- class label (hazard's class).

Students showed a good knowledge of information that must be recorded in logbooks for working solutions and laboratory chemicals.

Question 14a.

Marks	0	1	2	Average
%	38	33	28	**0.9**

An uninoculated medium that is treated in the same way as the test sample

It is required:

- to indicate any cross-contamination occurring during the test process
- to ensure sterile work practices.

Question 14b.

Marks	0	1	Average
%	48	52	**0.5**

Either of:

- quality manual
- SOP manual
- methods manual
- technical handbook.

The question asked where the acceptance criteria were to be found, not where the results of acceptance testing were to be recorded, so answers such as laboratory logbook were not accepted.

Question 14c.

Marks	0	1	2	3	4	Average
%	23	11	39	6	21	**1.9**

Possible answers included any two factors and explanations from the table.

Factor	Explanation
not working in aseptic zone	cross-contamination of blank by environmental sources
incorrect labelling	sample containing bacteria incorrectly labelled as blank, giving a false positive result
bench not decontaminated	cross-contamination of blank
control blank contaminated during storage	poorly sealed media, incorrect storage temperature or use-by date expiring can cause bacterial or fungal growth
technician not following SOP	technician could inoculate blank with sample, giving a false positive result
contamination when opening lids	cross-contamination of blank by environmental sources

Many answers related to a chemical and not a microbiological quality perspective. High-scoring answers related the explanation to the factor.

Question 15

Marks	0	1	2	3	4	Average
%	9	21	40	23	7	**2**

Any one of the following examples for each of these disposal methods was required.

- Add 0.5% hypochlorite solution: blood spills, body fluids, bacterial spills, microscope slides, cell-counting chambers.
- Soak in 80% ethanol for five minutes: microscope slides, pipettes, glass spreaders, glassware.
- Expose to ultraviolet light in a biosafety cabinet: disinfects surfaces of equipment or objects.
- Autoclave at the correct temperature and pressure for the recommended time: biohazardous waste/media.

Question 16a.

Marks	0	1	Average
%	2	98	**1**

Cross-contamination of sample on microscope slide from Max's sneeze

Question 16b.

Marks	0	1	Average
%	11	89	**0.9**

No. Max may have contaminated the client's slides with bacteria through sneezing.

Question 16c.

Marks	0	1	Average
%	29	71	**0.7**

Repeat tests and/or inform supervisor

Most students recognised the potential of cross-contamination from the analyst to the client's sample and that the test results were not viable.

Question 17a.

Marks	0	1	Average
%	54	46	**0.5**

A solution of high concentration used to make more dilute solutions for routine analysis

This question was not well answered by students. Many students confused a 'stock solution' with a 'standard solution'.

Question 17b.

Marks	0	1	2	Average
%	38	0	62	**1.2**

Average titre = (19.45 + 19.35 + 19.40)/3 = 582/3 = 19.4

Question 17c.

Marks	0	1	2	3	Average
%	33	20	8	38	**1.5**

$n(KC_8H_5O_4) = cV = 1.00 \times 20 \times 10^{-3} = 0.020$ mole

$n(KC_8H_5O_4) = n(NaOH)$

Thus $[NaOH] = n/V = 0.020/19.4 \times 10^{-3} = 1.031$ M

Three significant figures is 1.03 M

Question 17d.

Marks	0	1	2	3	Average
%	36	7	18	39	**1.6**

- A range of 5% of 1.00 M NaOH means 1.00 M $\pm$ 5%
- 5% of 1.00 is 5/100 × 1.00 = 0.05 M
- The lower range is 1.00 – 0.05 = 0.95 M
- The upper range is 1.00 + 0.05 = 1.05 M

The calculated concentration 1.03 M falls within the acceptable range of 0.95–1.05 M.