

STUDENT NUMBER Letter

VCE VET LABORATORY SKILLS

Written examination

Wednesday 22 November 2017

Reading time: 9.00 am to 9.15 am (15 minutes)

Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	20	20	20
B	14	14	80
			Total 100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

- Question and answer book of 20 pages
- Answer sheet for multiple-choice questions

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – Multiple-choice questions**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

Which one of the following should be used to clean a dusty light microscope lens?

- A. lens paper
- B. wet paper towel
- C. disposable facial tissue
- D. soft clean cloth with 70% ethanol solution

Question 2

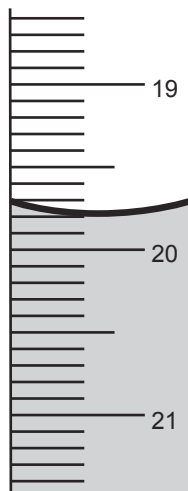
Continuous outcome improvement in a laboratory workplace is important because

- A. it keeps staff busy and focused.
- B. it provides incentives for new staff.
- C. clients only want the latest version of products and services.
- D. it creates opportunities to become more profitable and competitive.

Question 3

An example of continuous improvement in sustainability in a laboratory workplace would be

- A. decreasing the amount of solvent used.
- B. shortening lunchbreaks so staff can increase their output.
- C. prioritising reducing the number of calibration procedures.
- D. always disposing of equipment that is more than several years old.

Question 4

The volume of liquid indicated on the burette above is closest to

- A. 19.80 mL
- B. 19.90 mL
- C. 20.10 mL
- D. 20.20 mL

Question 5

Which one of the following pathways for chemicals entering the body is eliminated by the use of a fume cupboard?

- A. absorption
- B. inhalation
- C. ingestion
- D. injection

Question 6

The correct place to label bottles and tubes used as containers of media is on the

- A. lid of the container.
- B. side of the container.
- C. bottom of the container.
- D. lid and bottom of the container.

Question 7

An experienced laboratory technician has invited an inexperienced technician to learn a laboratory technique. How should the inexperienced technician respond?

- A. Refuse the invitation so they do not annoy their supervisor.
- B. Suggest they discuss this with their supervisor before proceeding.
- C. Accept the invitation and work through their lunchbreak to complete other tasks.
- D. Accept the invitation and hope the experienced technician will be too busy later.

Question 8

An example of an operator error would be

- A. incorrect sampling preparation technique.
- B. use of a reagent that contains an impurity.
- C. poor technique when performing a titration.
- D. selecting equipment that has an unstable electrical supply.

Question 9

Which one of the following is a quantitative delivery vessel?

- A. beaker
- B. bulb pipette
- C. volumetric flask
- D. measuring cylinder

Question 10

How many moles of hydrochloric acid, HCl, are in 25.0 mL of 0.2 M HCl?

- A. 0.005
- B. 0.5
- C. 50
- D. 125

Question 11

When preparing aseptic sample transfers of bacterial broth, a laboratory technician should

- A. freeze all samples until the transfers need to be performed.
- B. first check the date by which the customer requires the results.
- C. perform the transfers quickly to avoid deterioration of the samples.
- D. first check that the sampling procedure conforms with the sampling plan.

Question 12

When flaming a loop for spreading, it is best practice to

- A. use an orange flame.
- B. work from the handle end to the wire loop end.
- C. work from the wire loop end to the handle end.
- D. work in any direction as long as the flame is very hot.

Question 13

After completing any microbiological sampling and transfer procedure, local work areas must be cleaned with

- A. 0.1% v/v hypochlorite solution.
- B. 10% v/v hypochlorite solution.
- C. 70–80% v/v ethanol.
- D. 100% v/v ethanol.

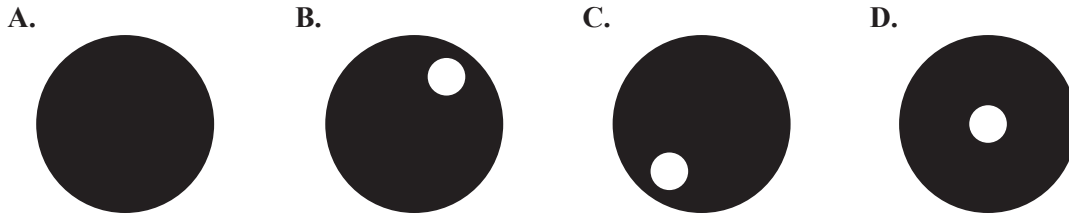
Question 14

On which of the following are chemical disinfectants **least** effective?

- A. fungi
- B. prions
- C. bacteria
- D. microorganisms

Question 15

Which one of the following is the most accurate field-of-view setting to optimise the resolution of mounted slide images?

**Question 16**

Which list of pipettes would provide the most accurate results when working with diluted blood samples?

- A. bulb pipette, Pasteur pipette and graduated pipette
- B. bulb pipette, calibrated pipette and Pasteur pipette
- C. bulb pipette, calibrated pipette and graduated pipette
- D. calibrated pipette, Pasteur pipette and graduated pipette

Question 17

A procedure requires three 1 g samples to be weighed. The actual weights recorded were as follows:

- Sample 1 = 0.8004 g
- Sample 2 = 0.8009 g
- Sample 3 = 0.7995 g

The weights recorded for these samples could be described as

- A. accurate and precise.
- B. accurate, but not precise.
- C. precise, but not accurate.
- D. neither accurate nor precise.

Question 18

A serial dilution is performed in two steps:

- Step 1 – Using a bulb pipette, 20 mL of a 2 M hydrochloric acid, HCl, stock solution is transferred into a 100 mL volumetric flask and made up to the required mark.
- Step 2 – 20 mL of the solution made in Step 1 is then transferred into another 100 mL flask and made up to the required mark.

What is the final concentration of the solution after the serial dilution described in steps 1 and 2 has been performed?

- A. 0.08 M
- B. 0.2 M
- C. 0.4 M
- D. 0.8 M

Question 19

Which one of the following is the correct disposal procedure for a liquid microbiological sample?

- A. Treat with strong detergent before flushing it down a sink.
- B. Autoclave until sterile, then dispose of with specialist toxic waste collectors.
- C. Autoclave until sterile, then flush it down a sink according to local regulations.
- D. Treat with 1% hypochlorite solution, dry autoclave, then flush it down a sink.

Question 20

The condenser in a compound light microscope is used to

- A. focus the path of light.
- B. focus images on slides.
- C. provide additional contrast to images.
- D. control brightness to reduce eye strain.

SECTION B – Short-answer questions**Instructions for Section B**

Answer **all** questions in the spaces provided.

Question 1 (6 marks)

Shown below is a diagram of a technician's poorly set up workspace.



- a. On the diagram above, identify **three** areas of potential strain on the technician's body caused by the poor arrangement of the workspace and equipment. Use **three** labelled arrows to indicate the areas of potential strain. 3 marks

- b. What could the technician do to avoid each of the three areas of potential strain identified in **part a.**? 3 marks

1. _____

2. _____

3. _____

Question 2 (7 marks)

A laboratory technician wearing appropriate personal protective equipment (PPE) has to perform culture plate streaking of an *Escherichia coli* broth on a number of agar plates.

- a. List **two** pieces of essential equipment that will need to be collected to carry out this procedure. 2 marks

- b. Give **two** pieces of information that should be included on each agar plate label to identify the streaked culture plate. 2 marks

- c. Name **one** type of spreading technique that could be used in this procedure. 1 mark

- d. The laboratory technician is streaking multiple plates.

Describe **two** important procedural steps that the technician would carry out between the streaking of individual plates. 2 marks

Question 3 (7 marks)

A laboratory technician starts to set up his compound microscope, which has just been removed from the storage cupboard. He notices that the oil immersion lens is over the stage and is wet with oil, so he starts to clean the lens with optical tissue moistened with xylene solvent, as stated in the standard operating procedures (SOP).

- a. Outline **two** further actions the technician should take in this situation. 2 marks

- b. The safety data sheet (SDS) of the xylene solvent states that it is a flammable, hazardous substance that is absorbed through the skin and respiratory tract. (The SDS was formerly known as the material safety data sheet or MSDS.)

Suggest **two** items of appropriate PPE that the technician should wear when using the xylene solvent. 2 marks

The technician disposes of the used optical tissue in the wastepaper bin, which is normally collected by contract cleaners.

- c. Provide **two** reasons why this is not a recommended procedure. 2 marks

- d. Suggest how the technician should have safely disposed of this waste. 1 mark

Question 4 (6 marks)

The two most common methods used to decontaminate clinical and biological waste are autoclaving and liquid chemical treatment.

- a.** State two extreme environmental conditions that are created during the autoclaving process. 2 marks

1. _____

2. _____

- b.** Give an example of waste material that must go through an autoclaving decontamination procedure in a pathology laboratory before its disposal, indicating the method used. 1 mark

- c.** List three factors that will reduce the effectiveness of disinfectants. 3 marks

1. _____

2. _____

3. _____

Question 5 (7 marks)

A technician in a pathology laboratory has been given 12 bottles of bacterial broth, with six of these labelled *Bordetella pertussis* and the other six labelled *Bacillus cereus*.

The technician needs to confirm the purity of the two bacterial cultures. A Gram stain test was performed on the strain of culture in each bottle. The results are shown in Table 1 and Table 2 below.

Table 1. *Bordetella pertussis*

Bottle number	Gram stain result
1	-ve
2	-ve
3	+ve
4	-ve
5	-ve
6	+ve

Table 2. *Bacillus cereus*

Bottle number	Gram stain result
1	+ve
2	+ve
3	+ve
4	+ve
5	+ve
6	+ve

- a. What objective and eyepiece lens would need to be used to perform the Gram stain test? 2 marks

Objective _____

Eyepiece lens _____

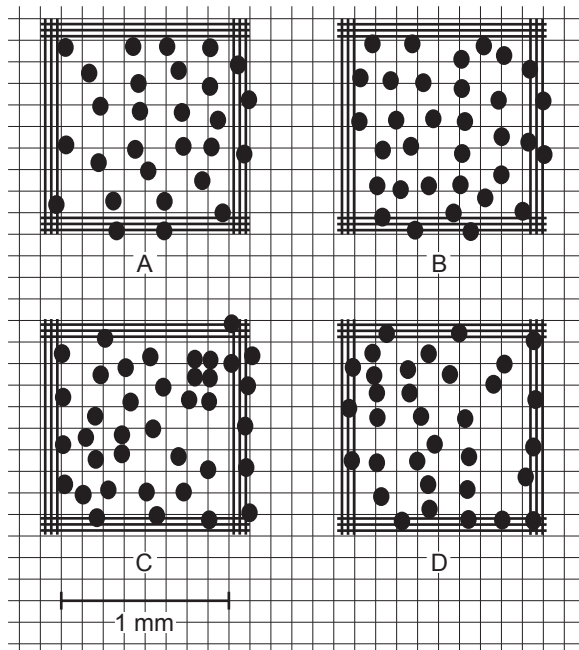
- b. Which table of results would raise concerns for the technician? Give a reason for your answer. 2 marks

- c. List **two** actions that would need to be carried out upon getting these results. 2 marks

- d. What disposal method should be used for the 12 bottles of bacterial broth once all work has been completed? 1 mark

Question 6 (7 marks)

A white blood cell (WBC) count is conducted on a blood sample using a Neubauer chamber, or haemocytometer, and the SOP specifies using four of the large corner squares or grids. The blood sample was diluted 1:20 with acetic acid solution, then one side of the test chamber was filled with the mixture and the cells were counted. The results are shown on grids A to D below.



a. Using grids A to D above:

- i. count the WBC and record your readings in the table below 4 marks
- ii. calculate the total number of WBC counted and record your answer in the space provided in the table below. 1 mark

Grid	WBC
A	
B	
C	
D	
Total	

- b. Calculate the WBC count per millilitre of the blood sample using the formula provided below. Show your working. 2 marks

$$\text{cells/mL} = \frac{\text{total number of cells} \times 10^4 \times \text{dilution factor}}{\text{number of corner squares (grids)}}$$

dilution factor = 1:20

Question 7 (4 marks)

A partly completed document used in a laboratory quality program is shown below. Program 1 has already been entered.

Program	Input	Process	Output
1	blood serum	SOP I: Preparation of albumin standard protein solution	laboratory test report
2			

- a. Using the entries provided below, fill in the input, process and output for Program 2 in the document above:
- absorption reading
 - SOP II: Preparation of standard glucose solution
 - urine sample
- 1 mark
- b. Suggest **one** other program that could be implemented to improve the laboratory's services and its approach to dealing with customers. In your answer, use the terms 'input', 'process' and 'output', and explain your suggested program. 3 marks

Question 8 (5 marks)

While performing a two-point buffer calibration, a laboratory technician notices that pH readings are taking a longer time to stabilise.

- a. Once they have advised the supervisor, what **two** checks should the technician carry out? 2 marks

- b. The calibration buffers that the technician uses for the pH meter are usually pH 4.00 and pH 7.00. The technician later needs to measure a series of solutions around pH 9.

Would using these calibration buffers be good practice? Justify your answer. 1 mark

- c. The SOP for calibrating the pH meter has the following instruction: 'Immerse the electrode bulb into the calibration buffer, note the buffer reading and adjust to the required value.'

What is **one** change that the technician could suggest to their supervisor that would improve the SOP? Justify your answer. 2 marks

Question 9 (3 marks)

Errors occur when performing any scientific work. Most laboratory errors can be categorised as one of the following types of errors:

- operator
- equipment
- method

For each of the errors recorded below, indicate the type of error it is by ticking (✓) the appropriate box in the table.

Error	Type of error		
	Operator	Equipment	Method
loss of a substance when transferring materials during weighing			
analytical scale is not weighing accurately			
use of a reagent that is past its use-by date			

Question 10 (4 marks)

A pathology laboratory is required to store its specimens below 4 °C. Currently, a routine check is done at 9.00 am each day to record the laboratory refrigerator's temperature and this is written in a manual log.

- a. Suggest two reasons why this method might be inadequate as a check to ensure specimens are stored below 4 °C. 2 marks

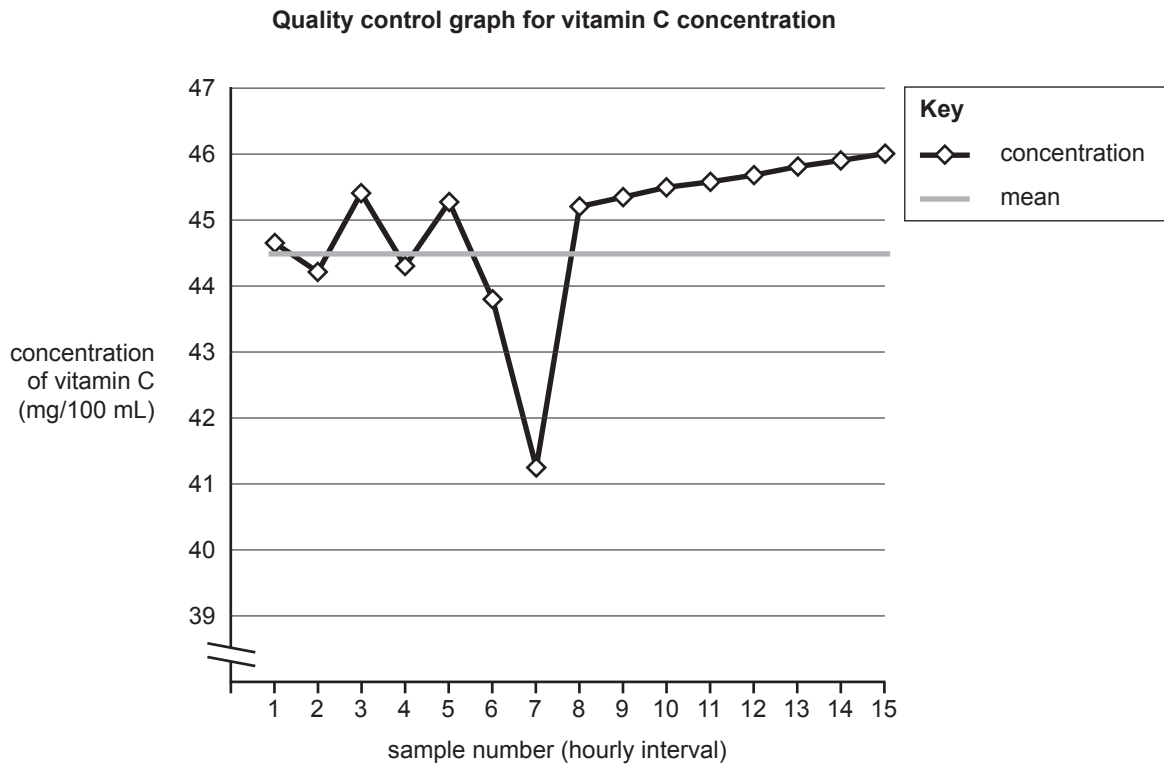
1. _____

2. _____

- b. Provide a better alternative to the routine check described above to ensure specimens are stored below 4 °C. Your response must consider the reasons suggested in **part a**. 2 marks

Question 11 (6 marks)

Consider the following quality control graph that has been used to monitor the vitamin C concentration of orange juice produced by a manufacturing company. The packaging label states that the concentration of vitamin C is 45 mg/100 mL.



- a. Referring to the graph above, what is the mean concentration of vitamin C in the orange juice? 1 mark

The lower control limit (LCL) is 42 mg/100 mL and the upper control limit (UCL) is 47 mg/100 mL.

- b. Draw and label a line on the graph above to represent each of these limits. 2 marks
- c. From the graph, identify the sample numbers that would indicate possible sources of error and why. 2 marks

- d. Which sample numbers could indicate a systematic error? 1 mark

CONTINUES OVER PAGE

Question 12 (7 marks)

A technician performs a titration to determine the concentration of a solution of sodium hydroxide, NaOH, which has an approximate concentration of 0.1 M. The technician uses 25.00 mL of a hydrochloric acid, HCl, standard solution with a known concentration of 0.1025 M.

The following volumes of NaOH were obtained.

Titre	Volume of NaOH
1	24.65 mL
2	24.65 mL
3	24.55 mL
4	24.60 mL
5	24.80 mL

- a. List the three titres that are within 0.1 mL of each other. 1 mark

- b. Calculate the average titre volume. 1 mark

- c. Write a balanced equation for this acid-base reaction. 1 mark

- d. The technician uses a 50 mL burette with a scale that has a smallest increment of 0.1 mL.

- i. What is the basic measurement principle used when taking readings from a 50 mL burette with this scale? 1 mark

- ii. How many decimal places could be accurately measured when using this burette? 1 mark

- e. A reading of 25.38 mL was also recorded for the titration described on page 18.

Can this reading be considered accurate? Give your reasoning.

2 marks

Question 13 (6 marks)

A technician has been asked to perform a serial dilution using the following procedure:

- Step 1 – Pipette 20 mL of 5 M sodium hydroxide, NaOH, stock solution into a 200 mL volumetric flask labelled Solution A and make up to the mark.
- Step 2 – Pipette 20 mL of Solution A into a 200 mL volumetric flask labelled Solution B and make up to the mark.
- Step 3 – Pipette 20 mL of Solution B into a 200 mL volumetric flask labelled Solution C and make up to the mark.

- a. Calculate the concentrations of solutions A, B and C.

3 marks

- b. What is the dilution factor in each step?

1 mark

- c. Before performing the serial dilution, what steps should be taken to ensure that the glassware is clean and free of contaminants?

2 marks

Question 14 (5 marks)

A technician has been asked to prepare a standard solution of hydrochloric acid, HCl.

- a. The technician uses an aqueous solution of 36% concentrated HCl that has a molarity of approximately 11.6 M.

Calculate the volume of stock solution required, in millilitres, to prepare 20 L of 0.1 M HCl. Show your working.

2 marks

- b. Does the resultant standard solution need to be standardised before use? Give your reasoning. 1 mark

- c. After viewing the relevant SDS, the technician becomes aware that using concentrated HCl has the following risks:

- causes severe skin burns and eye damage
- causes respiratory irritation

The laboratory has a hierarchy of hazard control, as shown below.

Hierarchy of hazard control
 elimination → substitution → engineering controls → administrative controls → PPE

Choose one hazard control from the hierarchy above and describe the control measures that should be undertaken within the laboratory to minimise the risks associated with the preparation of the solution.

2 marks

Hazard control _____

Control measures _____
