VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2019

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | | Letter |

VCE VET LABORATORY SKILLS

Written examination

Wednesday 20 November 2019

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

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	12	12	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 23 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

For the initial examination of the body of an intact housefly specimen, it would be **best** to use

A. a compound light microscope with a 10× eyepiece and a 10× objective lens.

B. a compound light microscope with a 10× eyepiece and a 4× objective lens.

C. a stereo (dissecting) microscope or a magnifying glass.

D. an inverted microscope with a 100× objective lens.

Question 2

A laboratory technician has spilt strong acid on a laboratory bench.

Which one of the following is the **best** way to treat strong acid spills in a laboratory?

A. Neutralise with weak acetic acid from a spill kit.

B. Neutralise with sodium carbonate from a spill kit.

C. Clean up with a mop using large amounts of cold water.

D. Neutralise with milk before cleaning the bench with a paper towel.

Question 3

A sample of soil needs to be tested for bacterial contamination. A technician was asked to make 70 agar streak plates from agar powder, using a concentration of 40 g/L and 15 mL of this solution per plate for the testing process.

Assuming no losses, what total volume of heated agar solution does the technician require to make the plates?

A. 1100 mL

B. 1050 mL

C. 1500 mL

D. 2800 mL

Question 4

A sample of a food product that is taken at regular intervals from a production line is a

A. random sample.

B. clustered sample.

C. systematic sample.

D. sample taken on the basis of previous experience.

Question 5

A glass pipette used in the transfer of a contaminated fluid has broken during the transfer, wounding the technician.

Which one of the following would be the **best** order of actions for the technician to take in this situation if he follows standard operating procedures (SOP)?

	Action 1	Action 2	Action 3	Action 4
A.	Use a spill kit for fluid spills.	Inform the supervisor.	Clean up broken glass.	Seek first aid.
B.	Seek first aid.	Inform the supervisor.	Use a spill kit for fluid spills.	Clean up broken glass.
C.	Clean up broken glass.	Seek first aid.	Inform the supervisor.	Use a spill kit for fluid spills.
D.	Inform the supervisor.	Clean up broken glass.	Seek first aid.	Use a spill kit for fluid spills.

Question 6

A concentrated solution of a substance, which can be stored and subsequently used to prepare more dilute solutions of the substance, is called a

A. secondary standard.
B. primary standard.
C. working solution.
D. stock solution.

Question 7

A laboratory technician is to examine a blood smear using compound light microscopy.

Which one of the following series of steps should the technician take before examining the slide?

A. Ensure the 4× objective lens is in place and all lenses are clean, and carefully place oil on the lenses.
B. Check the electrical cord for fraying, and ensure the stage is lowered and all lenses are clean.
C. Check the light source, examine the electrical cord for fraying and add water to the slide.
D. Ensure the 4× objective lens is in place and the stage is lowered, and take note of the time.

Question 8

Petri dishes **must** always be inverted during incubation in order to prevent

A. condensation from collecting on the lid and the sides of the Petri dish.
B. contamination of the agar gel and to prevent heat stress on the lid of the Petri dish.
C. airborne particles from settling on the sample and to prevent condensation collecting on the lid.
D. airborne particles from settling on the sample and to prevent condensation falling on the agar gel.

Question 9

Processes and procedures used in a laboratory to maintain the integrity of both the sample source and the sample by preventing cross-contamination are known as

A. aseptic techniques.

B. sterility procedures.

C. quality control audit reports.

D. workplace health and safety (WHS) protocols.

Question 10

A technician is required to remove a 250 mL bottle of culture medium from an autoclave at the end of its heating cycle.

Which one of the following lists contains the minimum appropriate items of personal protective equipment (PPE) that the technician **must** wear?

A. heat-proof gloves, protective eyewear and an impervious apron

B. nitrile or latex gloves, protective eyewear and a laboratory coat

C. a face mask, an impervious apron and protective eyewear

D. protective eyewear and a laboratory coat

Question 11

An example of a random error is a

A. variable liquid-dispensing apparatus that is calibrated to deliver 20.0 mL at 20 °C but is later used in a 4 °C coldroom.

B. tare or re-zero button on an electronic analytical balance that is always resetting to –0.001 g.

C. top-loading balance that is consistently out by 0.5 g and is later found to be not level.

D. technician estimating the colour change for a titration end point.

Question 12

A technician receives a call from a regular client who is demanding to have the results of his samples returned as soon as possible, even though the samples had been submitted later than usual.

The **most** appropriate response the technician could give in this situation would be to

A. demonstrate a calm and understanding manner with the client and advise him that the results should be available soon.

B. advise the client that the technician will address the situation promptly herself and inform the client of any further delays.

C. advise the client that the supervisor will be asked to hire additional staff to process his samples.

D. inform the client that it is important to submit samples on time to avoid delays.

Question 13

In order to discriminate between different types of bacteria, which one of the following procedures would be the **best** to use?

A. Gram stain

B. smeared slide preparation

C. viability stain and a haemocytometer

D. common glass slide, stain and a cover slip

Question 14

A laboratory technician is required to determine the density of a solution. He uses a 1000 μL pipette to accurately deliver a 1000 μL volume of saturated sodium chloride, NaCl, solution. The technician determines that the volume of saturated NaCl solution has a mass of 1.250 g.

The formula for density is $\text{density} = \dfrac{\text{mass}}{\text{volume}}$.

What is the density of the saturated NaCl solution, in grams per millilitre?

A. 0.000001250 g/mL

B. 12.50 g/mL

C. 1.250 g/mL

D. 0.1250 g/mL

Question 15

A variable dispenser was required to deliver 20.00 mL at 20 °C and was calibrated by measuring the mass of pure water delivered. A top-loading balance of 500.0 g capacity was used. The masses delivered ranged between 19.8 g and 20.2 g.

Which one of the following **best** describes the reliability of this procedure?

A. unreliable, because there are four significant figures required but only three produced by the balance

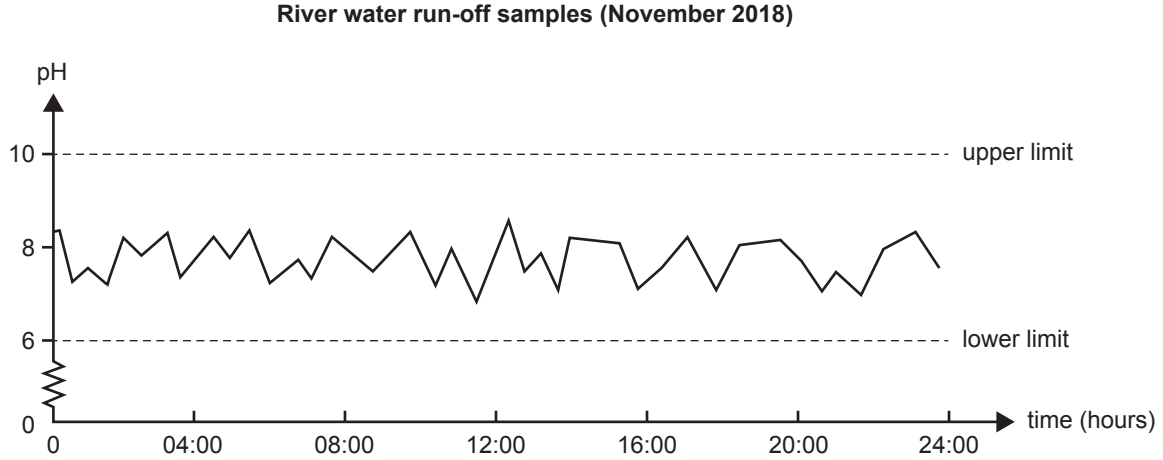
B. reliable, because there are four significant figures in both the volume and the balance's maximum mass capacity measured

C. unreliable, because variable dispensers are used for aqueous solutions and volumes, not just pure water

D. reliable, because variable dispensers are only occasionally used at a 20.00 mL degree of accuracy

Question 16

Shown below is a quality control run chart for samples of river water run-off collected near a pig farm.



Source: adapted from Australian Government, Department of Education, Science and Training, 'MSL933002 Contribute to the achievement of quality objectives', learning guide, March 2006, p. 26

The quality control run chart shown above for samples of river water run-off collected near a pig farm is an example of a

A. process that is trending up.

B. process that is trending down.

C. non-conforming process with excessive spikes.

D. steady process that is operating within specified limits.

Question 17

A technician is using a haemocytometer, or Neubauer cell-counting chamber, to count both viable and non-viable stained cells in a stained plant sample.

The technician should count the cells using

A. all of the corner grid squares to ensure the greatest accuracy.

B. all of the corner grid squares as this process can be executed quickly.

C. at least the four corner grid squares, using more if the cell density appears low.

D. the least number of corner grid squares in order to save time and prevent cells from dying.

Question 18

Autoclaving is an effective method of sterilisation.

What two conditions does autoclaving use to kill microorganisms and render biohazardous material inactive?

A. high-pressure and high-temperature steam

B. low-pressure and high-temperature steam

C. ultraviolet (UV) light and high-temperature steam

D. strong chemicals at high pressure and high-temperature steam

Question 19

A technician has been asked to prepare 200 mL of 0.15 M solution of sodium hydroxide, NaOH, from a standardised solution of 1.0 M NaOH.

Which formula should the technician use in order to make the 0.15 M solution of NaOH?

A. $PV = nRT$

B. $n = \frac{C}{V}$

C. $n = \frac{m}{M}$

D. $C_1V_1 = C_2V_2$

Question 20

What mass of glycerol is required to prepare 220.0 g of a 25% w/w solution of glycerol?

A. 25 g

B. 27.5 g

C. 55 g

D. 220 g

END OF SECTION A

SECTION B – Short-answer questions

Instructions for Section B

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

Question 1 (5 marks)

A laboratory technician is to dilute 100.0 mL of a 15 mg/mL stock solution of ethidium bromide to 250.0 mL.

a. Determine the concentration, in mg/mL, of the final working solution from this dilution. Show your working. 2 marks

_____

_____

b. The technician notices that the label on the stock solution indicates that the stock is out of date.

Name two appropriate actions that the technician could take to address the issue of out-of-date stock. 2 marks

1. _____

2. _____

c. In the process of performing the dilution with a fresh stock solution, the technician spills a small amount of the ethidium bromide, which is a known carcinogen.

What document should the technician refer to for advice on how to deal with this spill? 1 mark

_____

Question 2 (4 marks)

A laboratory technician is required to make up 500.00 mL of 7.50% w/v calcium carbonate, $CaCO_3$, solution using $CaCO_3$ powder (molar mass M = 100.0869 g/mol) and deionised water.

a. In the context of making chemical solutions, state the meaning of each of the following terms. 2 marks

- Solute _____
- Solvent _____

b. What does '7.50% w/v' $CaCO_3$ solution refer to? 2 marks

_____

Question 3 (9 marks)

A technician has been asked to prepare a stained wet mount of an imported weed species for analysis.

a. The six steps for preparing a wet mount are shown in the table below.

Indicate the order in which these steps should be performed by writing the numbers 2 to 6 in the column 'Step number'. Step 1 has been completed as an example. 5 marks

Step number	Steps for preparing a wet mount
	Pipette two drops of deionised water onto the sample.
	Place the sample on the slide.
	Place the cover slip on the sample, minimising any air bubbles.
	Stain the sample.
1	Clean the slide with alcohol and a lens tissue.
	Cut a thin layer of cells from the sample.

b. After analysis of the wet mount using microscopy, the technician must correctly dispose of the materials used.

Describe the correct method of disposal for each of the following items and indicate the potential hazard that may result from incorrect disposal. 4 marks

- Disposal of cover slip _____

Hazard _____

- Disposal of imported weed species sample _____

Hazard _____

Question 4 (5 marks)

A technician has been asked to perform a titration to determine the concentration of a brand of vinegar, in which the active constituent is acetic acid, CH_3COOH, using 0.300 M sodium hydroxide, NaOH.

a. Name the type of chemical reaction that is involved in the titration described above. 1 mark

_____

b. Complete the following chemical equation that represents the reaction between CH_3COOH and NaOH. 2 marks

$$CH_3COOH + NaOH \rightarrow \_\_\_\_\_ + \_\_\_\_\_$$

c. During the titration, the technician measures the pH of the solution using a pH probe. The results of the titration, including the pH measured and the indicator colour observed, are shown in the table below.

Change in pH values during titration

Volume of NaOH added (mL)	Measured pH	Indicator colour
0.00	2.7	colourless
4.00	3.3	colourless
8.00	6.6	colourless
10.00	8.3	light pink
12.00	9.9	pink

Using the results given in the table above, estimate the volume of NaOH that would have been added to achieve the end point. Give your reasoning. 2 marks

Volume of NaOH _____ mL

_____

_____

Question 5 (4 marks)

Pour plates are one method of testing liquid samples for bacterial contamination. As part of this method, a small volume of sample is added aseptically to about 15 mL of sterile molten nutrient agar, mixed, allowed to solidify and then incubated for 24 hours at 37 °C.

a. How does an aseptic technique assist in ensuring that test results are accurate? 1 mark

A technician prepared a pour plate of a liquid sample. The next day, he observed that some growth of colonies had occurred inside as well as on the surface of the agar media. The technician concluded that the sample was contaminated with bacteria.

b. Comment on whether the technician's conclusion was correct and give your reasoning. 1 mark

c. The technician attempted to count the colonies but found that there were too many colonies to ensure accuracy. He decided to repeat the technique with another sample.

Suggest two variations to the method described above that the technician could discuss with his supervisor before preparing another sample. 2 marks

1.

2.

Question 6 (5 marks)

A microbiology technician is required to prepare a growth medium of nutrient agar for culture plates. Two steps in the preparation of nutrient agar for culture plates are:

- dissolve the agar by heating
- sterilise the solution.

a. What is a common sterilisation procedure that is likely to be on the standard operating procedures (SOP) for preparing the nutrient agar? 1 mark

_____

b. Apart from the autoclave, name **one** piece of equipment or material that the technician could use to ensure that the growth medium is successfully sterilised. 1 mark

_____

c. The growth medium requires the further addition of a heat-sensitive antibiotic component that acts on specific bacteria.

i. Give **one** reason why the technician would **not** add the antibiotic component to the growth medium before sterilisation. 1 mark

_____

_____

ii. Name and describe a method that the technician could use to add the antibiotic component to the prepared growth medium. 2 marks

_____

_____

_____

Question 7 (6 marks)

Blood smear and bacterial smear preparations are common procedures in pathology laboratories.

a. For a blood smear preparation to be successful, a number of conditions need to be met. The criteria for preparing a successful blood smear are:

- 30–50 mm long
- well-rounded tail
- parallel edges
- no streaks or patches
- microscopic examination of head and tail.

Give two reasons why these criteria are necessary for preparing a successful blood smear. 2 marks

1. _____

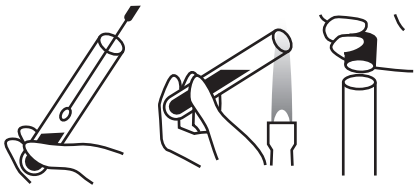
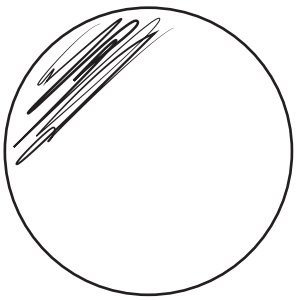
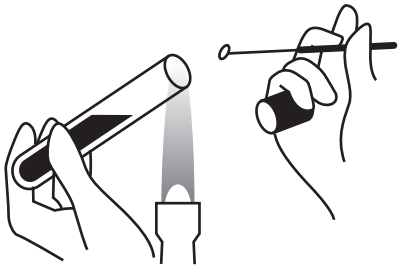
_____

2. _____

_____

b. Figures 1 to 4 below represent some of the techniques used in the preparation of a bacterial smear from a culture broth.

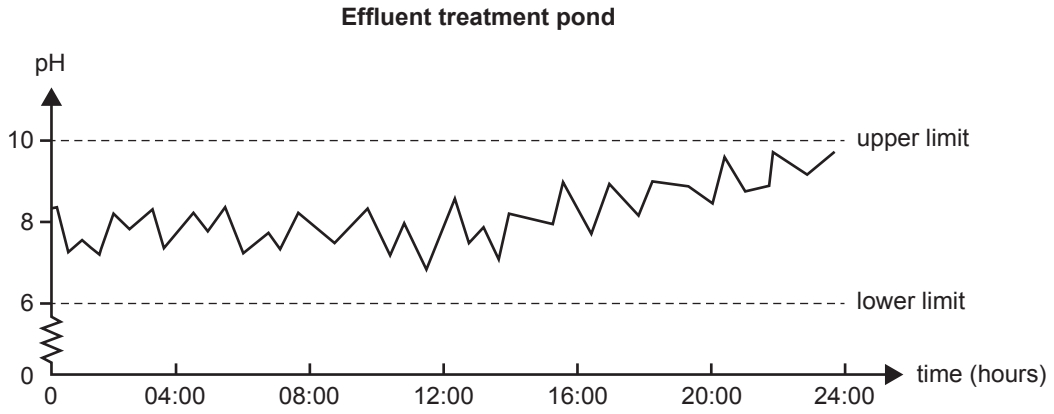
Describe the technique being used in each figure. 4 marks

Figure		Technique
1		
2		
3		
4		

Source: adapted from Australian Government, Department of Education, Science and Training, 'MSL973004 Perform aseptic techniques', learning guide, March 2006, pp. 46 and 47

Question 8 (5 marks)

A quality control process chart for an effluent treatment pond at a sewerage plant is shown below. The chart shows the upper and lower process limits.



Source: adapted from Australian Government, Department of Education, Science and Training, 'MSL933002 Contribute to the achievement of quality objectives', learning guide, March 2006, p. 27

a. **i.** What parameter or condition is being monitored by the chart? 1 mark

ii. Over what period of time is the effluent measured? 1 mark

b. The local environmental agency regulations state that the pH of the effluent treatment pond must be between 6 and 10 in order to be discharged from the plant.

Using the chart provided, indicate whether this effluent treatment pond can be discharged and why. 1 mark

c. What feature of the chart indicates that a response is required by a technician monitoring the sewerage plant? 2 marks

Question 9 (5 marks)

A laboratory technician sets an autoclave on a 60-minute wet cycle at 121 °C for a mixed load of apparatus and media. After 50 minutes have elapsed, the technician notices that the temperature gauge reads 78 °C.

a. Describe three actions that the technician should take in the situation described above. 3 marks

1. _____

_____

2. _____

_____

3. _____

_____

b. The technician removes the apparatus and media from the autoclave and proceeds to use the media for a preparation.

What is a likely consequence of the technician's actions? 1 mark

_____

_____

c. Suggest why a wet cycle was selected in the situation described above. 1 mark

_____

_____

Question 10 (13 marks)

A technician is required to prepare a series of standard solutions of sodium ions, Na^+, for an analytical procedure. The standard method in the laboratory specifies the following initial steps to prepare a standard solution of Na^+ from sodium chloride, NaCl:

1. Prepare a standard solution of Na^+ with a concentration of 1.0 mg/mL of analytical reagent (AR) grade NaCl.
2. Heat the NaCl at 600 °C for about one hour and then cool in a desiccator.
3. Weigh 2.542 g of NaCl and dissolve in approximately 900 mL of deionised water.
4. Mix in 8.5 mL of concentrated hydrochloric acid, HCl, and accurately dilute the solution with deionised water up to 1000 mL.

a. Apart from personal protective equipment (PPE), specify three other items of equipment that the technician would require in order to prepare the standard solutions of Na^+ using the standard method described above. 3 marks

1. _____

2. _____

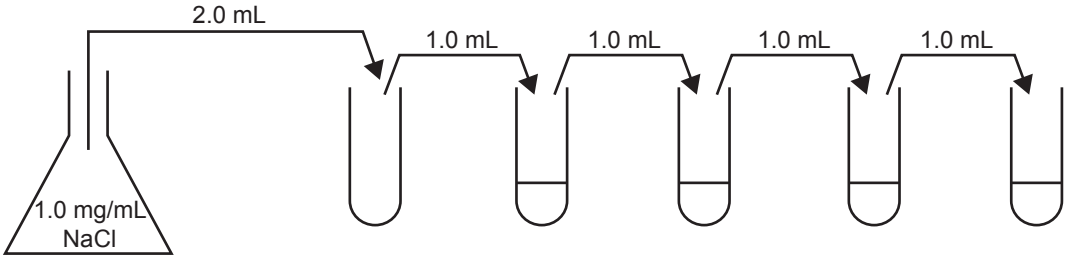
3. _____

b. In the standard method described above, why is the use of an AR specified? 1 mark

_____

_____

c. The procedure further states that dilutions of the prepared solution are to be carried out in a series, with two-fold serial dilutions. The dilution ratios are shown in the diagram below. Initially, the 1.0 mg/mL Na^+ standard solution is used for Tube 1 and then diluted with 1.0 mL of 0.1 M HCl to create the dilutions in Tubes 2–5.



	Tube 1	Tube 2	Tube 3	Tube 4	Tube 5
Volume of 0.1 M HCl	0	1.0 mL	1.0 mL	1.0 mL	1.0 mL
Dilution ratio	1:1	1:2	1:4	1:8	1:16
Concentration	1.0 mg/mL				

Source: adapted from OpenWetWare, <https://openwetware.org/wiki/Main_Page>

In the diagram above, Tube 1 is shown as having a concentration of 1.0 mg/mL.

Determine the concentrations in Tubes 2 to 5 and write the appropriate concentration for each tube in the spaces provided above. You may use the space below for your working. 4 marks

d. The dilutions may need to be kept for several days in sealed containers.

Identify three types of information that should be displayed on each container label. Write them on the sample label below. 3 marks

1. _____

2. _____

3. _____

e. The technician is required to repeat this task later in the day but observes that the NaCl AR bottle is nearly empty. She searches on the internet and finds a reliable source that indicates sodium nitrate, $NaNO_3$, may be used as an alternative to prepare the standard Na^+ solution.

Suggest one appropriate action that the technician should take before using this information to prepare a standard solution of Na^+ from $NaNO_3$. Give your reasoning. 2 marks

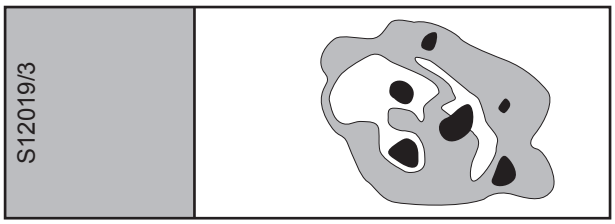
Action _____

Reasoning _____

_____

Question 11 (12 marks)

Microscopic examination of smears, or thin films, of samples is used to assist in the precise identification of an unknown organism. Shown below is the image of a poorly prepared smear of a sample.



a. Identify why the smear preparation shown in the image above was poorly performed. Give your reasoning. 2 marks

_____

_____

A technician has prepared a number of smeared slides, each relating to separate samples. She notes that one slide has had the identification symbols washed off it.

b. What are two actions the technician should take to address this situation? 2 marks

1. _____

2. _____

c. The technician's samples were taken from a variety of sources and may be examined using different types of microscopes or conditions, and with or without the use of different stains.

Table 1 below lists different microscope options and Table 2 lists some types of samples.

Select the correct microscope option from Table 1 for each type of sample in Table 2. Write the selected microscope option number in the space provided in Table 2. Note that there are more microscope options listed than types of samples. Microscope options may be used more than once and not all options need to be used for this task. 5 marks

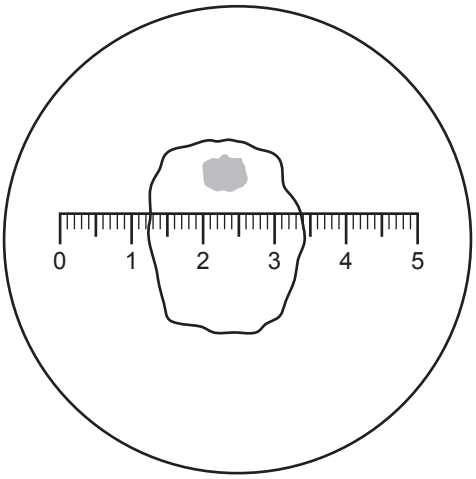
Table 1. Microscope options

Microscope option number	Microscope option
1	compound light microscope – bright field
2	phase contrast light microscope
3	inverted light microscope
4	stereo microscope
5	compound light microscope – dark field
6	compound light microscope – bright field rhodamine stain
7	compound light microscope – Gram stain

Table 2. Sample types

Type of sample	Microscope option number
pond water sample for protozoa	
butterfly	
yeast culture	
flask of cultured animal cells	
smeared slide of suspected bacteria-contaminated water	

d. The technician must assess the size of an observed specimen. She uses a reticle in the eyepiece lens of the microscope, as shown in the field-of-view diagram below. The scale of the reticle is 5 mm and it has 50 divisions. Each small reticle division is 0.01 mm.



Source: adapted from MicroscopeWorld, <www.microscopeworld.com/default.aspx?>

Using the formula given below, calculate the size of the cell-like object shown in the field-of-view diagram that was observed using a 10× objective lens. Show your working. 3 marks

$$\frac{\text{reticle division}}{\text{objective lens value}} = \text{distance between lines on reticle at this objective value}$$

Question 12 (7 marks)

A technician from the Environment Protection Authority (EPA) Victoria collected water samples from several public drinking fountains to determine the concentration of copper in the samples. Elevated levels of copper in drinking water can cause health problems.

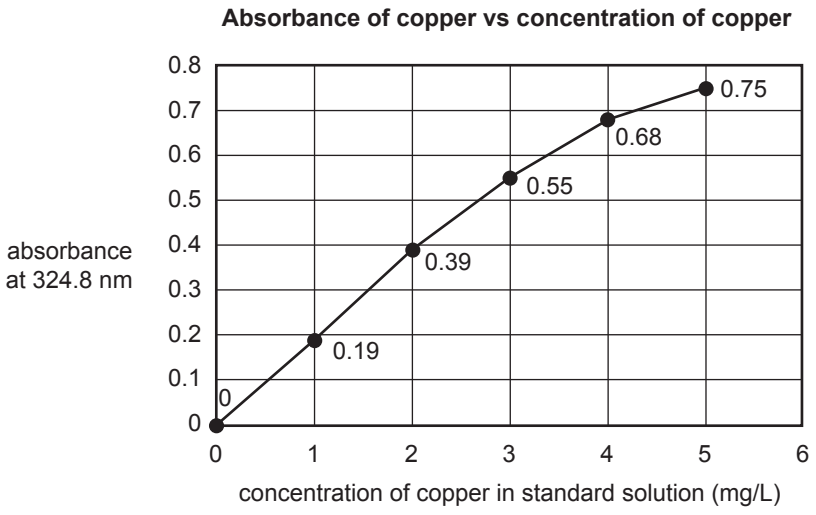
The water samples were analysed using the absorbance of a series of known standard solutions of copper. These were first measured using atomic absorption spectroscopy at 324.8 nm. The water samples were each then tested in triplicate and their absorbances measured.

The results are shown in the table below.

Absorbance of copper at 324.8 nm

Solution	Absorbance	Concentration of copper (mg/L) in the standard solution
Standard 1 (reference sample)	0	0.00
Standard 2	0.19	1.00
Standard 3	0.39	2.00
Standard 4	0.55	3.00
Standard 5	0.68	4.00
Standard 6	0.75	5.00
Water sample A – Test 1	0.45	?
Water sample A – Test 2	0.64	?
Water sample A – Test 3	0.46	?

The graph below shows absorbance of copper versus concentration of copper from the data in the table.



a. Mark the position of the result for Test 1 of Water sample A on the graph above with an 'X'. 1 mark

b. **i.** Which of the results for Water sample A – Test 1, Test 2 or Test 3 – would the technician be likely to question? Give your reasoning. 2 marks

ii. Based on your response to **part b.i.**, suggest two actions the technician should take in response to the results obtained for Water sample A. 2 marks

1.

2.

c. The SOP for the use of the atomic absorption spectrometer requires the instrument to be re-zeroed against the reference sample, Standard 1, between the testing of each sample.

Explain why this step is included in the SOP. 2 marks

END OF QUESTION AND ANSWER BOOK