

**Victorian Certificate of Education  
2020**

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER           Letter

**VCE VET LABORATORY SKILLS**  
**Written examination**

**Tuesday 1 December 2020**

**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	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 21 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 is the chemical formula for sulfuric acid?

- A.  $\text{HSO}_4$
- B.  $\text{H}_2\text{SO}_4$
- C.  $\text{HVSO}_4$
- D.  $\text{H}_2\text{SO}_3$

**Question 2**

A solution made up in a laboratory procedure is best described as having a

- A. solid solute dissolved in a liquid solvent.
- B. solute that dissolves a solvent.
- C. solute dissolved in an aqueous solvent.
- D. solid, liquid or gas solute dissolved in a solvent.

**Question 3**

Inoculation loops are carefully flamed before sampling and streaking agar plates in order to

- A. encourage the formation of aerosols.
- B. protect the integrity of sample sources for quality control checks.
- C. prevent the formation of aerosols and the contamination of sample sources.
- D. prevent the formation of aerosols and maintain sterility for quality control checks.

**Question 4**

The best example of job ownership in a laboratory situation is

- A. following the correct standard operating procedures (SOP) for an analysis.
- B. ensuring that required equipment calibrations are performed.
- C. making up fresh chemical solutions every time stocks run low.
- D. checking that quality control data indicates that each analysis is reliable.

**Question 5**

Which one of the following should be used to achieve the best results with a compound microscope and a 100× objective lens?

- A. filtered light
- B. an oil immersion
- C. fluorescent light
- D. a cellular histological section

**Question 6**

What is the main reason for using autoclaving routinely as a laboratory procedure?

- A. It effectively kills any spores present in the laboratory air.
- B. It is the only way to dispose of used non-disposable medical glassware.
- C. It uses steam to saturate and clean glassware and media effectively in an allocated time.
- D. It is an efficient method of disinfecting and sterilising glassware, equipment and media.

**Question 7**

A technician examines a wet mount slide of pond water using a compound microscope with a 10× eyepiece and a 4× objective lens. The technician notices a rounded object moving slowly across the field of view.

This object could be a

- A. virus.
- B. bacterium.
- C. bubble.
- D. crack in the glass slide.

**Question 8**

Distilled water is added to 250.0 mL of a 1.6 M sodium chloride, NaCl, solution to make the total volume 800.0 mL.

What is the resulting concentration of NaCl?

- A. 0.10 M
- B. 0.25 M
- C. 0.40 M
- D. 0.50 M

**Question 9**

When viewing specimen slides using a typical compound light microscope, it is important to move the fine focus control in both directions in order to

- A. avoid eye strain.
- B. avoid scratching the objective lens.
- C. ensure the full depth of field is examined.
- D. ensure the lamp does not overheat the slide.

**Question 10**

Laboratory waste, such as solid bacterial samples and blood-contaminated tissues, should be disposed of while wearing personal protective equipment (PPE) and by

- A. placing the waste in a biohazard bin.
- B. autoclaving the waste and placing it in a plastic rubbish bin.
- C. placing the waste directly into a plastic, biodegradable rubbish bin.
- D. treating the waste with 1.0% v/v hypochlorite solution and washing it down the sink.

**Question 11**

To prepare a work area for aseptically inoculating a culture broth on an open laboratory bench, good laboratory practice is to

- A. spray the work area with 70% v/v ethanol solution.
- B. spray the work area with 100% v/v ethanol solution.
- C. swab the work area with 1.0% v/v hypochlorite solution.
- D. expose the immediate vacant laboratory work area to ultraviolet light overnight.

**Question 12**

A stock bottle of nutrient agar that is stored according to good laboratory practice is used daily to prepare culture plates.

The stock bottle must always

- A. be autoclaved again between each batch of plates prepared.
- B. have its remaining contents disposed of at the end of each day.
- C. have its remaining contents checked visually between each batch of plates prepared.
- D. be used with negative control plates in each batch of plates prepared.

**Question 13**

An important element of quality control in laboratories is the use of 'check' or 'positive control' samples. 'Check' or 'positive control' samples are best described as

- A. samples of known analyte, with a varying range of concentrations, used when analysing test samples.
- B. random samples of a production batch tested several times in the same manner.
- C. test samples, which are also known as replicates, run several times.
- D. samples containing everything except the analyte tested for.

**Question 14**

The symbol below is displayed on the storage container of a prepared solution.



This symbol indicates that the solution is

- A. an irritant.
- B. an oxidiser.
- C. flammable.
- D. corrosive.

**Question 15**

A cell culture has  $2.50 \times 10^6$  cells/mL and is to be transferred onto a cell culture plate so that each well in the plate has  $0.5 \times 10^6$  cells.

What volume of well-mixed culture would be needed for each well?

- A. 0.2 mL
- B. 0.25 mL
- C. 0.5 mL
- D. 2.5 mL

**Question 16**

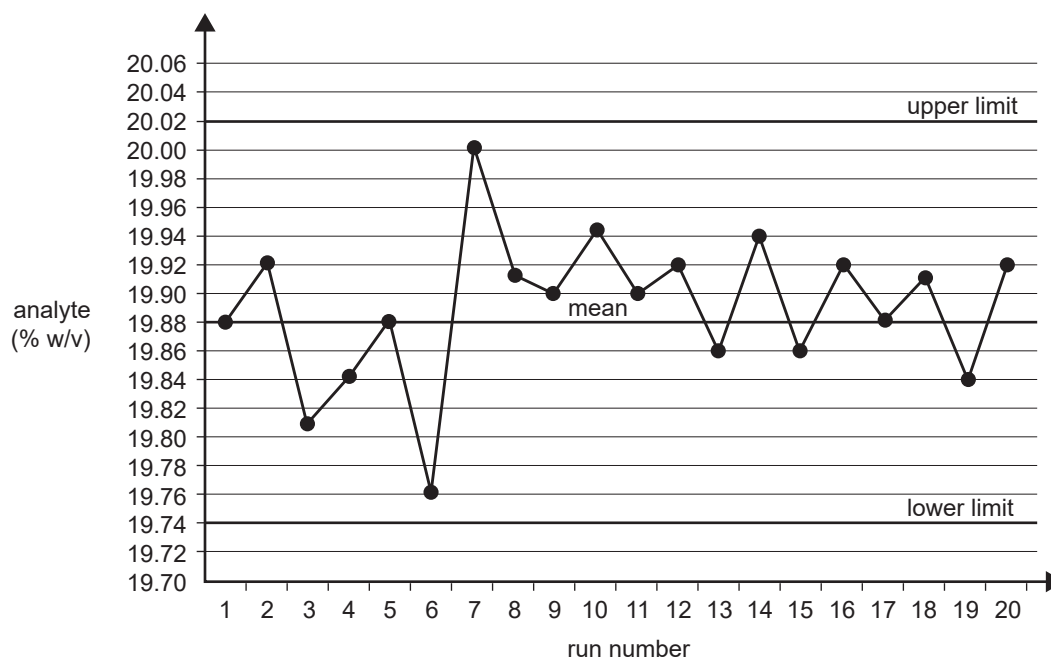
The ethanol used in most laboratories is provided as 95.6% w/v because ethanol with 100% purity is usually too expensive.

What is the amount of 95.6% w/v ethanol that is needed to prepare 100 mL of 70.0% w/v concentration?

- A. 95 mL
- B. 73 g
- C. 73.2 g
- D. 73 mL

**Question 17**

A chart displaying the level of control analyte routinely tested for in production runs of a product is shown below. The mean value of analyte is shown at 19.88% w/v.



Source: Simulab Testing Laboratory, 'PMLQUAL300A – Contribute to the achievement of quality objectives', <[http://toolbox.vetonline.swin.edu.au/412/\\_QUAL300/index.htm](http://toolbox.vetonline.swin.edu.au/412/_QUAL300/index.htm)>; Box Hill Institute of TAFE; © Australian National Training Authority (ANTA) 2002

Based on the results shown in the chart, what action should a technician take?

- A. Continue testing as all results are within the expected upper and lower limits.
- B. Cease testing as five or more points are above the mean.
- C. Cease testing as the results are above and below the mean.
- D. Continue testing as the changes in analyte % w/v have stabilised.

**Question 18**

A 10 ppm solution contains

- A. 1.0 parts per million.
- B. 10 mg per millilitre.
- C. 10 mg per litre.
- D. 10 parts per millilitre.

**Question 19**

A technician has been asked to check the condition of a series of volatile standard solutions in vials being used in an analysis procedure. The technician finds that a number of seals on the vials are not secure and the solutions in these vials have mostly evaporated.

What action should the technician take in this situation?

- A. Complain to their supervisor about the poor condition of the vials.
- B. Make up more solutions and use different sealed vials to complete the analysis procedure.
- C. Make up more solutions and refill the same vials to finish the analysis procedure quickly and efficiently.
- D. Cease the analysis procedure and amend the SOP to include using the appropriate seals on the vials.

**Question 20**

A specimen is to be examined using dark field microscopy.

This would require

- A. inserting an opaque disc in line with the condenser.
- B. decreasing the light intensity setting.
- C. examining the specimen in a darkened room.
- D. opening the iris diaphragm.

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

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

**Question 1 (4 marks)**

- a. What is meant by the term ‘micrometry’? 2 marks

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- b. Graticules are used in microscopy.

- i. What is the purpose of a graticule? 1 mark

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- ii. Where should a graticule be placed? 1 mark

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**Question 2** (7 marks)

A laboratory technician is required to dilute 90 mL of methanol, CH<sub>3</sub>OH, solution with a concentration of 50% v/v by adding 230 mL of distilled water.

- a. The technician refers to the safety data sheet (SDS) and notes that methanol is a hazardous, volatile substance.

Apart from a laboratory coat and safety glasses, name two pieces of safety equipment that the technician should use when preparing the solution. 2 marks

1. \_\_\_\_\_

2. \_\_\_\_\_

- b. Determine the percentage concentration of the final methanol solution described above. Show your working. 2 marks

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- c. The technician accidentally spills some of the methanol onto the laboratory bench.

Provide two appropriate actions that the technician should take. 2 marks

1. \_\_\_\_\_

2. \_\_\_\_\_

- d. After the methanol solution has been used, where should any remaining methanol solution be stored? 1 mark

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**Question 3** (9 marks)

A technician has been following the standard operating procedures (SOP) to prepare blood agar media for use in a testing procedure. The technician wears appropriate personal protective equipment (PPE) and has disinfected the work area using a recommended cleaning fluid.

- a. Apart from Step 3, where blood is added to the agar media, identify four important steps in logical sequential order – Step 1, Step 2, Step 4 and Step 5 – required to prepare the blood agar media according to the SOP and to a satisfactory standard. 4 marks

Step 1 \_\_\_\_\_

\_\_\_\_\_

Step 2 \_\_\_\_\_

\_\_\_\_\_

Step 3 *Add sterile blood and mix well.* \_\_\_\_\_

Step 4 \_\_\_\_\_

\_\_\_\_\_

Step 5 \_\_\_\_\_

\_\_\_\_\_

- b. Explain why Step 3, where blood is added to the agar media, would not be carried out at the beginning of the procedure. 2 marks

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- c. The technician has been asked by the supervisor to regularly check prepared agar media stock that is stored for testing procedures in the laboratory.

What are three key criteria the technician should use to check the prepared agar media stock and why should each criterion be used?

3 marks

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

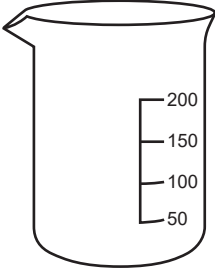
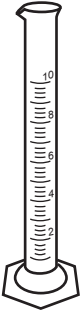

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**Question 4** (9 marks)

Selecting the appropriate glassware for experiments is an important factor in achieving good results.

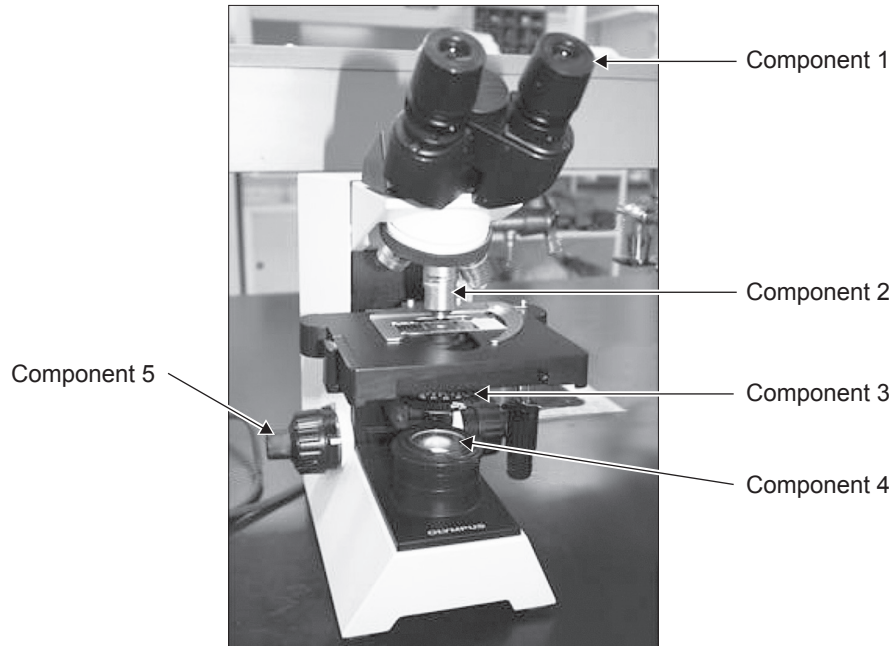
For each of the laboratory items shown in the table below, give its technical name and a description of its use, and indicate whether it is used for quantitative or qualitative testing.

Laboratory item	Technical name	Description of use	Used for quantitative or qualitative testing?
			
			
			

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**Question 5** (10 marks)

An image of a compound microscope is shown below. Components of the compound microscope have been labelled 1 to 5.



- a. In the table below, write the technical name for each component labelled 1 to 5. 5 marks

Component	Technical name
1	
2	
3	
4	
5	

- b. Which component allows the full depth of field of a sample to be viewed? 1 mark

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- c. Explain the function of Component 5. 2 marks

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- d. Explain the function of Component 3. 2 marks

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**Question 6** (4 marks)

It is important to dispose of laboratory waste material using an appropriate waste disposal method. Some common waste disposal methods, labelled with the letters A to G, are listed in the table below.

Letter	Waste disposal method
A	Depending on the waste material, use an aqueous or organic solvent waste container.
B	Incinerate the waste material immediately. No prior treatments required.
C	Heavy metals should be collected in residue bottles and disposed of according to local regulations.
D	Store solid waste materials for the required period and then send to landfill.
E	Neutralise and then wash down the sink with a large quantity of water.
F	Autoclave the waste material prior to disposal.
G	Place in sharps disposal container with an appropriate disinfectant.

For each waste material listed below, identify the **most** appropriate waste disposal method from the table above and write its corresponding letter in the box provided. Each waste disposal method may be used only once. Some waste disposal methods will not be used. The waste disposal method for Waste material 1 has been identified.

- Waste material 1 – Laboratory items such as Pasteur pipettes, syringes and disposable scalpel blades

Waste disposal method

**G**

- Waste material 2 – Biohazardous, biological and biomedical waste materials

Waste disposal method

- Waste material 3 – Liquid laboratory waste materials

Waste disposal method

- Waste material 4 – Strong acids, such as concentrated nitric acid

Waste disposal method

- Waste material 5 – Residue liquid waste material containing lead and cadmium

Waste disposal method

**Question 7** (6 marks)

A technician is following the SOP for preparing 250 mL of a 0.1 M glucose standard solution. The glucose bottle is labelled 'analytical reagent (AR)', and indicates that the molar mass is 180.16 g/mol and the percentage purity is 95.0%.

- a. Calculate the initial number of moles of glucose required to prepare the solution. Use the formula  $n = \text{concentration} \times \text{volume}$ . Show your working. 2 marks

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- b. Using the value obtained in **part a.** for the number of moles of glucose, calculate the initial mass of glucose, in grams, required to prepare the solution. Use the formula  $n = \frac{\text{mass}}{\text{molar mass}}$ . Show your working. 2 marks

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- c. What could the technician do to take into account the percentage purity of glucose? 2 marks

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**Question 8** (6 marks)

A technician receives a phone call from a regular client querying the results from a previous analysis. The client says the results appear to be incorrect. The first action that the technician takes is to note the date, time, client's name and contact details.

- a. List three further actions that the technician should take following the initial discussion with the client. 3 marks

Action 1 \_\_\_\_\_

\_\_\_\_\_

Action 2 \_\_\_\_\_

\_\_\_\_\_

Action 3 \_\_\_\_\_

\_\_\_\_\_

- b. An investigation conducted by the technician's work team determines that a laboratory sample identification label was placed incorrectly over the client's sample code, causing a mismatch of test results.

How should the work team respond to the results of the investigation? Provide three appropriate responses. 3 marks

Response 1 \_\_\_\_\_

\_\_\_\_\_

Response 2 \_\_\_\_\_

\_\_\_\_\_

Response 3 \_\_\_\_\_

\_\_\_\_\_

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**Question 9** (6 marks)

A technician is required to make a standard solution of hydrochloric acid, HCl. To make the standard solution, the technician first transfers 20.0 mL of concentrated HCl into a volumetric flask by completing the following actions:

1. The technician rinses a 20.0 mL pipette with distilled water.
2. The technician inserts the pipette directly into the bottle of HCl to draw up the liquid.
3. The technician overshoots the meniscus and drains the excess into a beaker until 20.0 mL is obtained.
4. The technician transfers the 20.0 mL of HCl from the pipette to the volumetric flask.
5. The technician pours the excess HCl solution back into the HCl bottle and immediately caps it.

The technician's supervisor notices that the technician has not followed the correct procedure to transfer the concentrated HCl into the volumetric flask.

From the list of the technician's actions above, select three that the supervisor would identify as inappropriate and provide an appropriate alternative action.

- Inappropriate action number \_\_\_\_\_

Appropriate action \_\_\_\_\_

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- Inappropriate action number \_\_\_\_\_

Appropriate action \_\_\_\_\_

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- Inappropriate action number \_\_\_\_\_

Appropriate action \_\_\_\_\_

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**Question 10** (7 marks)

Two indicators of the health status of animal cell cultures are the percentage cell viability and the cell density. These indicators can be determined using:

- an exclusion dye
- a cell-counting chamber slide
- a microscope.

Trypan blue dye has a blue appearance in aqueous solution and is an exclusion dye that can access the interior of cells with a broken or ruptured cell membrane, but the dye is excluded from healthy cells.

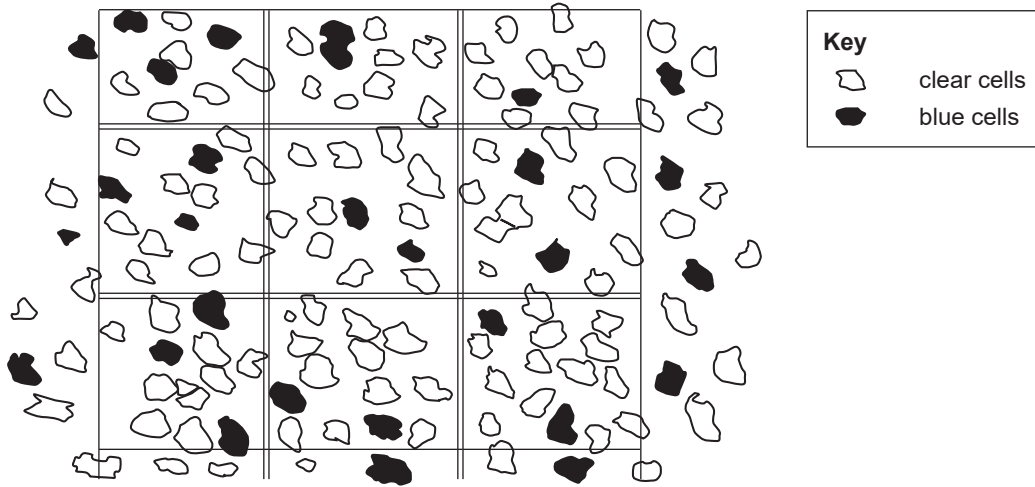
- a. If trypan blue dye is used, what colour would a cell with a broken cell membrane or a non-viable cell most likely be when viewed under a compound light microscope?

1 mark

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- b. The diagram below shows one chamber of a cell-counting slide with a small sample of an animal cell culture that has been diluted 1:10 in trypan blue dye, mixed and placed onto the slide. The diagram displays a large outer square that has been divided into nine intermediate squares.



The formulas for percentage cell viability and cell density are given below.

$$\text{percentage cell viability} = \frac{(\text{number of viable cells})}{(\text{total number of viable and dead cells})} \times 100$$

$$\text{cell density} = \frac{(\text{number of viable cells}) \times 10^4 \times \text{dilution factor}}{(\text{number of corner squares counted})} \text{ in cells per mL}$$

Refer to the diagram above and use the formulas provided to answer the following questions.

- i. Calculate the percentage cell viability of the sample of the animal cell culture. Show your working. 3 marks

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- ii. Calculate the cell density of the sample of the animal cell culture. Show your working. 3 marks

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**Question 11** (5 marks)

A technician was asked to prepare 1 L of a growth medium containing several components, with a final pH of 7.4. The technician measures 900 mL of distilled water, adjusts the pH to 7.4, adds the required components and stirs until dissolved, and then dilutes the solution with distilled water up to the final 1 L volume.

- a. Identify three essential pieces of equipment required to prepare the growth medium in the initial stage described above. 3 marks

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

- b. Apart from autoclaving, what method could be used to sterilise the growth medium? 1 mark

\_\_\_\_\_

\_\_\_\_\_

- c. The technician measures the final pH of the growth medium and discovers that the pH is 7.1  
Give **one** reason why this might occur. 1 mark

\_\_\_\_\_

\_\_\_\_\_

**Question 12** (7 marks)

A laboratory registered by the National Association of Testing Authorities (NATA), Australia, was notified of an upcoming laboratory audit by NATA.

- a. i. What is the main purpose of laboratory audits, such as the audit by NATA mentioned above? 1 mark

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- ii. Why would this audit be generally described as an external audit? 1 mark

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- b. The laboratory manager directs a technician to check the calibration status of their automatic pipettes (pipettors). The technician notes that the 200  $\mu\text{L}$  pipettors used by the laboratory have a manufacturer's specification of a 198–202  $\mu\text{L}$  accuracy range and a coefficient of variation (CV) value of 1.5% when correctly used at the 200  $\mu\text{L}$  setting. The technician also notes that the most recent calibration data of one 200  $\mu\text{L}$  pipettor stated a 199  $\mu\text{L}$  average delivery over 20 deliveries, with a standard deviation (SD) of 4.2

- i. Is the pipettor delivering a sufficiently accurate amount at the 200  $\mu\text{L}$  setting? Give your reasoning. 1 mark

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- ii. The CV value is a measure of precision and is defined by  $CV = \left( \frac{SD}{\text{average}} \right) \times 100$  and expressed as a percentage (%).

Determine the precision of the pipettor at the setting used during the calibration. Show your working. 2 marks

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- iii. What feedback could the technician provide to their laboratory manager regarding this pipettor? 1 mark

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- iv. What is the meaning of the term 'precision' in laboratory work? 1 mark

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**END OF QUESTION AND ANSWER BOOK**