2023 VCE VET Laboratory Skills external assessment report

General comments

The 2023 VCE VET Laboratory Skills written examination contained questions covering content from the following four units of competency:

* MSL933006 Contribute to the achievement of quality objectives
* MSL973014 Prepare working solutions
* MSL973061 Perform aseptic techniques
* MSL973019 Perform microscopic examination.

Students demonstrated a good understanding and knowledge across the four units of competency examined. Overall, the multiple-choice questions were well done.

Students need to read the stem of the short-answer questions carefully as the answers must reflect the setting and conditions of the stem. Generalisations in answers will not achieve full marks.

A better understanding of the growth conditions of microorganisms would assist students when deciding on what type of media or preparation techniques would be required.

Many students had difficulty with the types of microscopes and their use in the laboratory. A review of the use of microscopes in the laboratory, and their use in identification of materials, cell types and their internal structures, would be helpful. Resolution and magnification are two different features of a microscope. These terms can be easily confused by students.

There were some students using the term MSDS when SDS (safety data sheet) is now the industry standard, and has been for some years.

Specific information

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

Section A – Multiple-choice questions

Correct answers in the following table are in bold.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Question | Correct answer | % A | % B | % C | % D | Comments |
| 1 | A | 97 | 0 | 3 | 0 |  |
| 2 | B | 27 | 41 | 21 | 11 | Students are required to know the growth requirements of major groups of microorganisms. They should have a good understanding of the types of media preparation and conditions that are indicated by these for the culturing of bacteria. |
| 3 | B | 3 | 56 | 16 | 25 |  |
| 4 | D | 29 | 22 | 24 | 24 | Microscopic resolution refers to the ability of a microscope to distinguish and resolve fine details and structures in a specimen. It represents the level of clarity and precision with which the microscope can visualise and separate closely spaced objects or features. |
| 5 | A | 97 | 3 | 0 | 0 |  |
| 6 | A | 66 | 12 | 14 | 8 |  |
| 7 | A | 68 | 20 | 3 | 8 |  |
| 8 | C | 2 | 30 | 53 | 15 | The choice of the right microscope for different applications in a laboratory is an important skill. Students should be familiar with the different light microscopes and the different magnifications, and have a general understanding of the applications in a laboratory setting. |
| 9 | C | 3 | 31 | 66 | 0 |  |
| 10 | C | 8 | 21 | 67 | 3 |  |
| 11 | D | 39 | 6 | 3 | 53 | ‘Filtrate’ refers to the liquid or fluid that has passed through the filtration process and been separated from the solid particles or impurities. In a typical filtration setup, a mixture is passed through a porous medium (such as a filter paper or membrane); the filtrate is the clarified liquid that exits the filter while leaving behind the solid components. |
| 12 | C | 1 | 0 | 99 | 0 |  |
| 13 | A | 88 | 4 | 1 | 7 |  |
| 14 | B | 6 | 87 | 4 | 3 |  |
| 15 | D | 14 | 3 | 4 | 79 |  |
| 16 | C | 13 | 1 | 72 | 14 |  |
| 17 | D | 2 | 3 | 4 | 92 |  |
| 18 | A | 66 | 14 | 11 | 8 |  |
| 19 | A | 89 | 0 | 10 | 1 |  |
| 20 | A | 87 | 2 | 0 | 11 |  |

Section B

Question 1a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 2 | 6 | 29 | 64 | 2.5 |

Correct responses could be any three of the following:

* Put on PPE.
* Use an autoclave to sterilise the media.
* Swab bench with 70% ethanol.
* Set up Bunsen burner.
* Flame the mouth of the agar container and tubes when opening and closing.
* Use sterile equipment e.g. pipettes and containers.
* Keep all equipment aseptic by not placing it on contaminated surfaces (e.g. a bench).
* Work in an area with minimal traffic.
* Keep windows and doors closed to prevent airflow.
* Take lids off containers for minimal time.
* Work in a Biohazard Class II cabinet (note: fume cupboards are neither suitable nor safe to use for microbiological work).

Question 1bi.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 40 | 60 | 0.6 |

Obligate aerobes require oxygen to survive, so will only grow on the surface of the agar.

Question 1bii.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 51 | 49 | 0.5 |

Strict anaerobes cannot grow if there is oxygen present, so they will grow at the bottom or in the bottom third of the tube only.

Question 1biii.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 52 | 48 | 0.5 |

Facultative aerobes can grow both with and without oxygen, so they will grow throughout the agar.

Some students seemed unfamiliar with the growth requirements of bacteria. There seemed to be limited understanding of the choice of media in deeps for different types of bacteria in accordance with their requirements for oxygen.

Question 2a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 0 | 0 | 7 | 93 | 2.9 |

Answers could include (three of):

* laboratory coat or gown
* safety glasses
* latex/nitrile gloves
* closed toe shoes

Question 2b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 20 | 3 | 28 | 3 | 47 | 2.5 |

One mark was awarded for each piece of equipment chosen (any two of the following) and one mark each for the explanation.

|  |  |
| --- | --- |
| Name of equipment or material | Explanation |
| microscope (brightfield or light) | for examination of the samples |
| box of slides (cavity can be mentioned) and coverslips | to place the samples on for observation |
| plastic or glass pipettes | to add sample drops to a slide |
| labels or marker pen | for the slides to match those on the water samples, to label the slide for clear identification and prevent mixing up results. |
| logbook or computer | for recording results; not on the same bench due to contamination issues |
| waste disposal containers | for the used slides to prevent cross contamination |
| stains (dyes) | to allow structures such as bacteria or algae to be more clearly observed |
| SOP | for correct use of the equipment and safety or set up requirements |

It is important that students read the question carefully to give the correct answers. The explanation should be in the laboratory testing context, not field work, as the question’s context is set in the water testing laboratory, not in the field collecting the samples. PPE should not be included as it is included in Part a. Many students named two items but failed to provide a logical reason for the selection.

Question 3a.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 8 | 92 | 0.9 |

The meter may give a reading that is higher or lower than the real value; inaccurate readings or results could occur.

Question 3b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 8 | 51 | 41 | 1.3 |

If the meter is not properly calibrated, nutrient agar and other solutions that require a specific pH will not be accurate.

This may result in rework and wasted technician time in the laboratory. Incorrect results would change the interpretation of the experiment.

This would not meet the ‘right first time’ quality benchmark.

Question 4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 3 | 5 | 20 | 0 | 73 | 3.4 |

|  |  |
| --- | --- |
| Category of laboratory waste material | Option A, B, C or D |
| Microscope slides with bacteria in a beaker of 1% Hypochlorite solution | D: Decant the solution into an appropriate waste container, then rinse in water, dry and reuse. |
| Used disposable gloves, contaminated plastic tubes and caps, pipettor tips in a plastic biohazardous waste bag. | C: Autoclave on wet cycle for 40 minutes to completely sterilise, then discard in the normal waste. |
| Scalpel blades, razor blades and syringe needles in a beaker. | A: Transfer to a sharps waste container for later collection by a waste disposal company. |
| Glass bottles containing unused agar. | B: Heat in microwave or water bath to remelt and pour out, wash and store in cupboard for later use. |

Question 5a.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 21 | 79 | 0.8 |

30 January, 5 Feb.

Students needed to give the two dates to get the full mark.

Question 5b.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 77 | 23 | 0.2 |

One of the following:

* The thermostat has been turned down to correct the rising temperature.
* The thermostat is not working correctly; therefore the refrigerator is cooling excessively.
* The refrigerator is over full or packed too tightly, so the air circulation can’t occur correctly.
* Regular maintenance on the refrigerator was not performed.

Question 5c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 6 | 33 | 61 | 1.6 |

Any two the following:

* The technician should report this to their supervisor. They should NOT turn off the fridge unless instructed to by the supervisor.
* Transfer the vaccines to a second fridge if available.
* Contact the service technician to check the fridge.
* Discard the vaccines if it has been too many days above the ideal storage temperature.
* Record the out-of-range readings in the logbook, or complete a non-compliance report for the refrigerator.

Question 6a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 28 | 20 | 52 | 1.2 |

First find the number of moles using n = cv

n = 0.02 M x 0.25 mL = 0.005 mol

Then find the mass using m = n × M

m = 0.005 mol × 105.99 g/mol = 0.5299 g or 0.5300 g

OR

Calculate mass needed for 1 litre of 0.0200M solution, then divide by 4 for 250 mL

105.99 × 0.0200 = 2.1198 g per L

⸫ 2.1198 ÷ 4 = 0.52995 g

Round to four decimal places = 0.5300 g needed for 250 mL

One mark was awarded for correctly calculating the number of moles; another mark for correctly calculating the mass.

Working out needed to be shown and units correct.

Question 6b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 8 | 9 | 28 | 13 | 42 | 2.7 |

The volumetric flask is required to make an accurate standard solution. The calibrated bulb pipette is required to accurately transfer an aliquot of solution to each flask for titration.

Question 6c.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 38 | 8 | 21 | 33 | 1.5 |

Correct initial and final burette readings for titrations 1, 2 and 3 (+/- 0.05), AND all readings recorded to two decimal places. Students achieved full marks even if they reversed initial and final readings in the table but the titration volume was correct.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Titration | Trial | Titration 1 | Titration 2 | Titration 3 |
| Final burette reading mL | 22.65 | 25.70 | 47.69 | 36.70 |
| Initial burette reading mL | 0.50 | 3.19 | 25.70 | 15.01 |
| Titre mL | 22.15 | 22.51 | 21.99 | 21.69 |

One mark for each correct column of two readings and titre.

Question 6d.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 5 | 39 | 57 | 1.5 |

Students needed to refer to these concepts in their answers:

* repeatability / reliability / reproducibility
* mean calculations
* possibility of errors and anomalous results

Possible answers included (two of):

* Initial trial result is not included in final titration calculations; instead this is used as a benchmark for further titrations.
* More titrations improves the reliability of the experiment / makes it more reliable.
* More titrations reduces the effect of errors, enabling removal of outliers to improve accuracy.
* To calculate a mean/average and thus improve the precision of results.
* Three concordant results for precision.

Question 6e.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 6 | 94 | 0.9 |

One of:

* safety data sheet (SDS); material SDS was accepted
* standard operating procedure (SOP)
* laboratory manual.

Question 7a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 2 | 20 | 78 | 1.8 |

Any two of the following:

* Follow SOPs and minimise errors.
* Make sure equipment is calibrated properly etc.
* Re-use packaging from items coming into the lab when sending things out of the lab.
* Stop using single-use items when possible, e.g. use glassware, autoclaving or washing them, instead of plastic.
* Reduce energy/power/light use in lab by switching equipment and lights off when not in use.
* Correctly dispose of wastes to prevent extra cost of in-house processing of full autoclave bags or unnecessarily paying for specialised disposal.

Or anything else that is suitable and that reduces the loss of materials due to carelessness etc.

Question 7b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 3 | 19 | 78 | 1.8 |

Possible explanations include (two of):

* Doesn’t use as much solution, so saves time in preparing, and saves money on not having to buy/make new solutions each time.
* Uses less materials if you follow the directions properly.
* Ensure SOPs are written so that the most efficient methods are used.
* The initial outlay to purchase reusable equipment may be higher but over time less will have to be purchased and there will be a decrease in waste to be disposed of.

Question 8a.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | Average |
| % | 3 | 11 | 29 | 36 | 21 | 2.6 |

Answers:

|  |  |  |
| --- | --- | --- |
|  | Name | Function |
| Part A | Eyepiece | It consists of two eye lenses, providing binocular vision; it may be adjustable for eye width and will magnify image further (usually 10x). |
| Part B | Objective lens turret | Has various objective lenses with different magnification powers. |
| Part C | Light Source | Provides illumination of the sample from above. |
| Part D | Base | The lower part of the microscope that supports the other parts of the microscope, thus providing stability during the examination. It has clips to hold the specimen in place. |

Many students were unsure about the parts of a dissecting or stereo microscope.

Students were required to provide both names and functions of parts to receive full marks.

Question 8b.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 3 | 4 | 38 | 56 | 2.5 |

Any three of the following:

* Place in a suitable position on the bench at the correct working height for the user. Do not place too close to the edge of the bench.
* Check the power cord is in good order and plug it in if not already plugged into a power socket.
* Switch on the power at the socket and on the microscope; check the light bulb is operating.
* Rotate the objective lens turret to place the 4x objective lens (or lowest magnification) in position over the light source.
* Clean all refracting surfaces (lenses) to remove dust and grease.
* Fill in the microscope user's book with your name, date and time you used the instrument, and note any comments on its performance.
* Check the SOP for correct set up and use.
* Check microscope work surfaces, e.g. the stage, are clean.
* Test and tag in date, or electrical safety check, last service date.

Question 9a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | Average |
| % | 2 | 16 | 50 | 32 | 2.1 |

Any three of the following:

* Taking the opportunity for skill development, recognising this would open new opportunities, continuously improving your own performance etc.
* Increasing future job prospects or reclassification.
* Importance of awareness of any safety procedures or hazards associated with using this equipment for your own safety in the laboratory.
* May be asked to use this equipment if someone else is away from work.
* By seeing how the equipment works you might be able to see a use for it in your own work, even if it doesn’t seem related to your role directly.

Answers should relate directly to the stem, which asked for reasons why you could benefit by taking this opportunity to be trained.

Question 9b.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 36 | 64 | 0.6 |

One of:

* service technicians
* equipment manual
* instruction booklet
* company web page
* SDS of chemicals used in the procedure.

Question 10ai.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 44 | 56 | 0.6 |

A working solution is a solution made up from a stock or standard solution ready to be used in the lab immediately.

Question 10aii.

|  |  |  |  |
| --- | --- | --- | --- |
| Mark | 0 | 1 | Average |
| % | 48 | 52 | 0.5 |

A standard solution is a solution of accurately known concentration prepared from a primary standard that is weighed accurately and made up to a fixed volume.

OR

A standard solution is used to determine the concentration of an unknown solution and can be used to prepare working solutions of exact concentration.

Some students seemed unsure of these terms and confused the definitions of stock, standard and working solutions.

Question 10b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 21 | 24 | 56 | 1.4 |

Dilute the 2M solution as it is in stock and a safer concentration than the glacial or concentrated acetic acid.

* It is preferred not to use the 0.5M because it is out of date.
* It is possible to prepare a 0.1M standard solution from glacial acetic acid; however, diluting the glacial or concentrated acid poses a greater safety risk and would require more equipment (fume cupboard) to do so.

One mark was awarded for naming the correct solution and one mark for the explanation of which stock solution to use.

The term ‘glacial’ was not understood by many students.

Question 11a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 67 | 9 | 24 | 0.6 |

Convert the 40% w/v concentration of ethanol (molar mass 46.07 g/mol) into mol/L and ppm. Show all your working.

40% w/v = 40 g/100mL = 400 g/1L

n = m/M

n = 400 / 46.07

n = 8.68 mol

Concentration = 8.68 (or 8.7) mol/L

One mark was awarded for converting the % w/v into a mass per litre and one mark for the calculation into moles.

Question 11b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 70 | 9 | 21 | 0.5 |

ppm = mg/L

40% w/v = 40 g/100 mL = 400 g/L

= 400 000 mg/L

= 400 000 ppm

= 4.0 × 105 ppm

Or

40% = 40/100.

Multiply by 1000000 for ppm.

40/100 × 1 000 000

= 400 000 ppm

= 4.0 × 105 ppm

One mark for converting % w/v into mass per litre and one mark for knowing ppm = mg/L.

Students should practise these calculations as they are important laboratory skills.

Question 11c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 4 | 18 | 78 | 1.7 |

Any two of:

* solution name
* concentration
* chemical formula
* dangerous goods class, e.g. flammable with symbol
* date made
* technician name.

Question 12a.

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

Oxidiser or Corrosive (causes corrosion), depending on the symbol selected.

Most students answered this question well; however, some students failed to indicate which of the two symbols they had selected. This caused the assessors some confusion and they were unable to award the mark.

Question 12b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 10 | 43 | 47 | 1.4 |

* The waste disposal method is inappropriate because (one of):
* The contents should not be poured down the sink – the liquid is flammable and toxic to the environment; it may cause environmental damage and aquatic toxicity. It could cause fire or explosion.
* It is essential to follow proper safety procedures and protocols when working with hazardous chemicals.
* It is never safe to pour chemicals down the sink without knowing what they are and how they should be handled.
* If the label on the concentrated nitric acid bottle is faded, the technician should not assume that the chemical is safe to dispose of down the sink.
* Possible alternatives (one of):
* The technician should consult the Safety Data Sheet (SDS) or SOP, or contact a supervisor or a chemical safety specialist to determine the proper disposal method for the chemical.
* Inform the laboratory supervisor and place the bottle in a designated area for safe disposal later (do not store it in a fume cupboard).
* If advised to do so, neutralise with sodium carbonate, and wash down the sink with copious amounts of water.

One mark was awarded for stating that the disposal method used was inappropriate or incorrect, and one mark for giving an alternative.

To achieve full marks students needed to have a reason for why the disposal method was incorrect and to suggest an alternative.

Question 13a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 33 | 42 | 25 | 0.9 |

Any two of the following:

* The cells need to be spread out thinly on the slide with no overlapping. Too much banana was added, too thickly spread. Spread the banana more thinly on the slide to prevent clumping or overlapping of cells.
* Use an inoculating loop to spread the sample more evenly.
* Mix banana in a drop of distilled water on the slide to disperse cells more widely.
* Insufficient stain was added to the slide, so the tissue was not fully stained, or the stain was not evenly distributed and all in one area.
* Add more iodine stain and leave it for longer before removing with the tissue.

Question 13b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 72 | 7 | 21 | 0.5 |

A magnification of 400x is best to observe the cell details and starch granules. If students suggested 100x the explanation must be logical, e.g. plant cells are large and therefore visible under 100x. Higher magnification (1000x oil) would not be required for visualising starch granules in cells.

One mark was awarded for the magnification and one mark for the reason. Students needed to give the total magnification (ocular lens x objective lens magnification) to get full marks.

Some students demonstrated a limited knowledge of the light microscope.

Question 13c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 64 | 20 | 16 | 0.5 |

Iodine stains starch blue-black or purple; it is a specific stain for starch. The banana cells contain starch granules which are made visible by iodine.

One mark was awarded for description of cells that include starch, one mark for the correct colour.

Many students were not familiar with the use of this kind of stain. It would be highly beneficial if students had exposure to staining techniques other than the Gram stain.

Question 14

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Average |
| % | 7 | 2 | 11 | 17 | 22 | 16 | 25 | 3.9 |

Students were asked to identify two reasons why pure culture techniques and aseptic transfer are critical for the successful microbiological investigation and correct interpretation of laboratory results, and explain their response. Possible answers:

* Reason: Isolation of individual microbial species
* Explanation: Pure culture techniques allow for the isolation of individual microbial species from a mixed population. This is important because it allows for the identification and characterisation of specific organisms, which is necessary for understanding their properties and functions.
* Reason: Quality control
* Explanation: The use of pure culture techniques and aseptic transfer is essential for maintaining the quality of laboratory results. By ensuring that cultures are pure and uncontaminated, laboratory workers can have confidence in their results and avoid false positive or false negative findings.
* Reason: Accurate identification
* Explanation: Aseptic transfer ensures that cultures are not contaminated with unwanted microbes that may interfere with the accurate identification of the target organism. Accurate identification is crucial for correctly interpreting laboratory results and for making informed decisions regarding diagnosis, treatment and control measures.
* Reason: Reproducibility of results
* Explanation: Aseptic techniques ensure that the same culture can be used consistently throughout a series of experiments, providing reproducible results. This is particularly important for research studies, where consistency and accuracy are essential.
* Reason: Safety
* Explanation: Aseptic transfer techniques are important for ensuring safety in the laboratory. By minimising the risk of contamination, they help prevent the spread of infectious agents and protect laboratory workers from exposure to harmful pathogens.

One mark was awarded for each reason and two each for the short explanation of why each applies.

Question 15a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 57 | 24 | 19 | 0.6 |

Students were asked to identify two essential components that would allow bacteria to grow on an agar plate. Any two of the following:

* carbon or carbohydrate (usually in the form of a sugar, e.g. glucose)
* a nitrogen source
* various mineral salts (e.g. calcium, trace metals)
* growth factors such as purified amino acids
* vitamins
* purines and pyrimidines (nucleic acids)
* beef extract
* peptone
* yeast extract
* water, as moisture is in the solid media

No marks were given for just stating ‘agar’. Agar is not an ingredient that is required by the bacteria for growth; it is inert and only there to make the media solid.

‘Nutrients’ was too general an answer; students needed to specify the category, such as carbon source or protein.

Question 15b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mark | 0 | 1 | 2 | Average |
| % | 24 | 42 | 35 | 1.1 |

Students were asked to identify two tests the technician would need to do to ensure the prepared media was suitable for use.

* Incubate for 24 hours at 37 °C for sterility check, to test that there are no contaminants in the media.
* Growth check of a positive control culture to ensure bacteria will grow; grow a reference culture on the prepared plates.
* Test gel strength, i.e. that agar has solidified correctly.
* Visual tests for clarity, imperfections, bubbles and contaminants.

Many students struggled to give two different types of tests.