T Level Technical Qualification in Science

Core knowledge and understanding

Paper B

Mark scheme

v1.1: Specimen assessment materials
21 November 2023
603/6989/9

Internal reference: SR51-0003-02

This mark scheme has been written by the assessment writer and refined, alongside the relevant questions, by a panel of subject experts through the external assessment writing process and at standardisation meetings.

The purpose of this mark scheme is to give you:

- examples and criteria of the types of response expected from a student
- information on how individual marks are to be awarded
- the allocated assessment objective(s) (AOs) and total mark for each question.

Marking guidelines

General guidelines

You must apply the following marking guidelines to all marking undertaken throughout the marking period. This is to ensure fairness to all students, who must receive the same treatment. You must mark the first student in exactly the same way as you mark the last.

- The mark scheme must be referred to throughout the marking period and applied consistently. Do not change your approach to marking once you have been standardised.
- Reward students positively giving credit for what they have shown, rather than what they might have omitted.
- Utilise the whole mark range and always award full marks when the response merits them.
- Be prepared to award zero marks if the student's response has no creditworthy material.
- Do not credit irrelevant material that does not answer the question, no matter how impressive the response might be.
- The marks awarded for each response should be clearly and legibly recorded in the grid on the front of the question paper.
- If you are in any doubt about the application of the mark scheme, you must consult with your team leader or the chief examiner.

Guidelines for using extended-response marking grids

Extended-response mark grids have been designed to assess students' work holistically. They consist of bands-based descriptors and indicative content.

Bands-based descriptors: each band is made up of several descriptors for across the AO range AO1–AO3, which when combined provide the quality of response that a student needs to demonstrate. Each band-based descriptor is worth varying marks.

The grids are broken down into bands, with each band having an associated descriptor indicating the performance at that band. You should determine the band before determining the mark.

Indicative content reflects content-related points that a student may make but is not an exhaustive list. Nor is it a model answer. Students may make all, some or none of the points

included in the indicative content as its purpose is as a guide for the relevance and expectation of the responses. Students must be credited for any other appropriate response.

Application of extended-response marking grids

When determining a band, you should use a bottom-up approach. If the response meets all the descriptors in the lowest band, you should move to the next one, and so on, until the response matches the band descriptor. Remember to look at the overall quality of the response and reward students positively, rather than focussing on small omissions. If the response covers aspects at different bands, you should use a best-fit approach at this stage and use the available marks within the band to credit the response appropriately.

When determining a mark, your decision should be based on the quality of the response in relation to the descriptors. You must also consider the relative weightings of the assessment objectives, so as not to over / under credit a response. Standardisation materials, marked by the chief examiner, will help you with determining a mark. You will be able to use exemplar student responses to compare to live responses, to decide if it is the same, better or worse.

Assessment objectives

This assessment requires students to:

AO1: Demonstrate knowledge and understanding of contexts, concepts, theories and principles in science.
AO2: Apply knowledge and understanding of contexts, concepts, theories and principles in science to different situations and contexts.
AO3: Analyse and evaluate information and issues related to contexts, concepts, theories and principles in science to make informed judgements, draw conclusions and address individual needs.

The weightings of each assessment objective can be found in the qualification specification.

Section A: Biology

Total for this section: 45 marks plus 3 marks for quality of written communication (QWC) and use of specialist terminology

1 Identify which of the following is a major component of a bacterial cell wall.

A **Cellulose**
B **Cytoplasm**
C **Peptidoglycan**
D **Phospholipids**

[1 mark]

AO1 = 1 mark

Answer

B. Peptidoglycan (1).

2 Which of the following statements best describes triglycerides?

A **They are the precursors of steroid hormones**
B **They contain one glycerol and three fatty acid molecules**
C **They contain one glycerol, two fatty acid molecules and a phospholipid molecule**
D **They have a hydrophilic tail**

[1 mark]

AO1 = 1 mark

Answer

B. They contain one glycerol and three fatty acid molecules (1).

3 (a) State the name of the type of reaction that produces a dipeptide.

[1 mark]

AO1 = 1 mark

Award **one** mark for stating the type of reaction that produces a dipeptide, up to a maximum of **one** mark:

- condensation (reaction) (1).

3 (b) Figure 1 **below represents a dipeptide.**

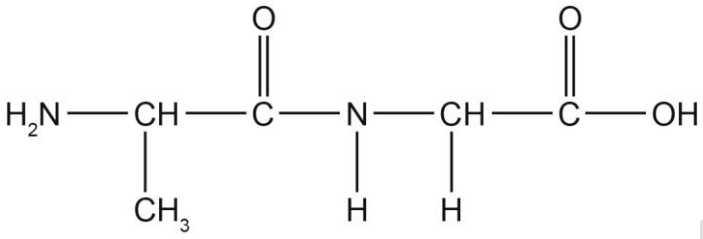


Figure 1

Suggest how many different types of amino acid are present in this dipeptide.

[1 mark]

AO2 = 1 mark

Answer

Award **one** mark for suggesting the correct number of different types of amino acids represented, up to a maximum of **one** mark:

- two (different amino acids) (1).

3 (c) **A particular polypeptide is made up of 250 amino acids.**

(i) State the maximum number of different types of amino acids that could be present in this polypeptide.

(ii) Give the number of water molecules that would be produced in its formation.

[2 marks]

AO1 = 1 mark
AO2 = 1 mark

Answer

(i) Award one mark for stating the correct number of different types of amino acid, up to a maximum of **one** mark:

- twenty (20) (different types of amino acid) (AO1 1).

(ii) Award **one** mark for giving the correct number of water molecules produced, up to a maximum of **one** mark:

- two hundred and forty nine (249) (water molecules produced) (AO2 1).

4 (a) Identify three **organelles only found in plant cells and not in animal cells.**

[3 marks]

AO1 = 3 marks

Answer

Award **one** mark for **each** correct organelle identified, up to a maximum of **three** marks:

- chloroplasts (1)
- cell wall (1)
- large / cell vacuole (1)
- plastids (1)
- plasmodesmata (1).

4 (b) Name one **organelle which is not found in plant root cells.**

[1 mark]

AO2 = 1 mark

Answer

Award **one** mark for correctly naming which organelle would not be found in the roots, up to a maximum of **one** mark:

- chloroplasts (1).

5 (a) A section of a nucleic acid is 120 base pairs long, 45 of the bases are adenine and 45 are thymine.

Give one **piece of evidence, from the information provided, that the nucleic acid is DNA rather than RNA.**

[1 mark]

AO2 = 1 mark

Answer

Award **one** mark for a correct piece of evidence, up to a maximum of **one** mark:

- DNA has base pairs, RNA does not (1)
- RNA has uracil instead of thymine (1).

5 (b) Complete the table in Figure 2**, to show how many cytosine and guanine bases there will be.**

Base	Adenine	Cytosine	Guanine	Thymine
Number of each base	**45**			**45**

Figure 2: **Number of bases**

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for **each** correct number of bases, up to a maximum of **two** marks.

Base	Adenine	Cytosine	Guanine	Thymine
Number of each base	**45**	**75 (1)**	**75 (1)**	**45**

5 (c) Express the number of guanine bases as a percentage of the total number of bases in this section of DNA and give your answer to one **decimal place.**

Show your working.

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for the correct formula, up to a maximum of **one** mark:

- (75/240) x 100 (1)

Note: If the number of guanine bases is incorrect from part (a), but it is used correctly in the formula, the mark **should** be awarded for using the correct method.

Award **one** mark for the correct answer, up to a maximum of **one** mark:

- 31.3 (1)

Note: If the number of guanine molecules is incorrect from part (a) but has been used correctly in the formula and calculation, award the mark (FT), providing the answer is to **one** decimal place.

6 Figure 3 **below shows a diagram created using a photomicrograph of a stained slide of various bacteria viewed under a light microscope.**

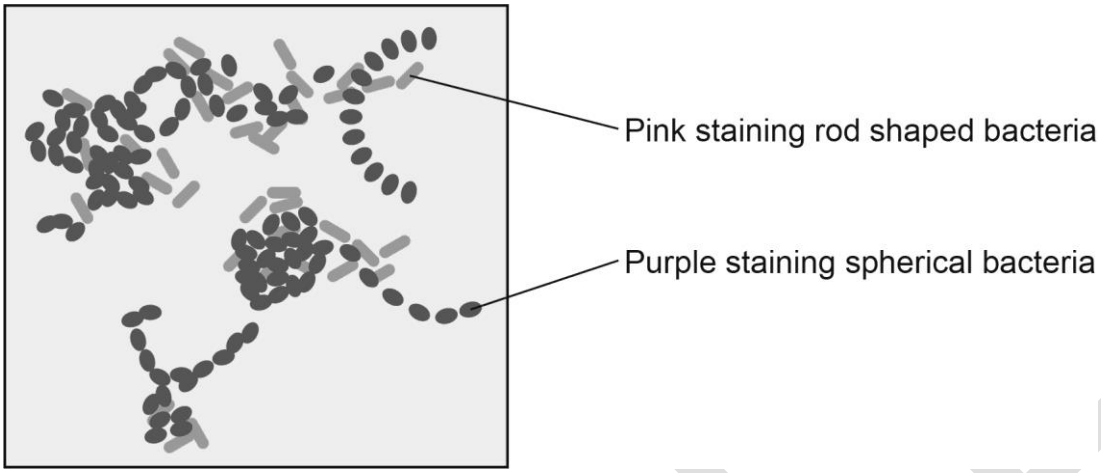


Figure 3: **Stained slide**

6 (a) **(i) State one advantage of using a light microscope over an electron microscope when studying bacteria.**

(ii) Give the name of the staining technique used to prepare the slide in figure 3.

[2 marks]

AO1 = 1 mark
AO2 = 1 mark

Answer

(i) Award **one** mark for a correct advantage, up to a maximum of **one** mark**:**

- low cost (AO1 1)
- easy to use / requires little training (AO1 1)
- can be used to study live cells (AO1 1).

(ii) Award **one** mark for giving the correct name of the staining technique, up to a maximum of **one** mark:

- gram stain (AO2 1).

6 (b) **The length of one of the rod-shaped bacteria on the original photomicrograph in figure 3 was 6 mm, the actual length was 4 µm.**

The equation used to calculate magnification is:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of object}}$$

Calculate the magnification used in the photomicrograph.

1mm = 1000µm.

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for the correct method (M), up to a maximum of **one** mark:

- 6/0.004 or 6000/4 (1).

Award **one** mark for the correct answer (CA), up to a maximum of **one** mark:

- 1500x (1).

Note: If the correct answer only is given, award both marks, as we can assume that the correct method has been applied where one method only is used.

7 **Give the names of** two **disaccharides.**

[2 marks]

AO1 = 2 marks

Answer

Award **one** mark for each correct identification, up to a maximum of **two** marks:

- sucrose (1)
- maltose (1).

8 **Bacteria can be grown on agar plates. Agar is a gel that contains the nutrients bacteria require to grow. The type of nutrients in the agar gel can be changed depending on the investigation.**

Molten agar is poured into a sterile petri dish and left to cool and set forming an agar plate. As the bacteria grow, they form round colonies on the surface of the agar.

A student investigated the ability of a non-pathogenic species of bacteria to grow using different carbohydrate sources.

They used the following method:

1. **Prepared an agar plate with glucose as the energy source**
2. **Added 0.1 ml of a suspension of the bacteria to the centre of the agar plate**
3. **Placed the lid on the agar plate**
4. **Incubated the agar plate at 37 °C for 48 hours**
5. **Measured the diameter of the bacterial colony, if present, after 48 hours**
6. **Repeated steps 1 to 5 with four other carbohydrates.**

The results are shown in Figure 4 **below:**

Carbohydrate	Diameter of colony after 48 hours (mm)
Glucose	**12**
Fructose	**11**
Sucrose	**8**
Maltose	**8**
Starch	**2**

Figure 4: **Results**

The student made the following conclusion:

‘Glucose is the best energy source for bacteria, as it is a monosaccharide and therefore the easiest for bacteria to use.’

Evaluate this conclusion.

Your response should demonstrate:

- **reasoned judgements and / or conclusions.**

[6 marks]

AO1 = 1 mark
AO3 = 5 marks

Answer

Award **one** mark for a correct descriptive point, up to a maximum of **one** mark:

- carbohydrates are used as an energy source by organisms (AO1 1)
- glucose is the main energy source for aerobic respiration (AO1 1).

Award **one** mark for each suitable evaluative point, up to a maximum of **five** marks:

- although glucose is a monosaccharide, so is fructose, this does not support the conclusion (AO3 1)
- as sucrose and maltose are disaccharides and the diameter of the colonies was smaller with these carbohydrates than with glucose, this does support the conclusion (AO3 1)
- as the diameter of the colony on the glucose agar plate is the highest of all the substrates investigated, this does support the conclusion (AO3 1)
- as the diameter of the colony on the glucose and fructose agar plates only differ by 1 mm, this is unlikely to be significant and therefore does not support the conclusion (AO3 1)
- as the colony produced on the starch agar plate was much smaller than any of the other carbohydrates / only 2 mm, this does support the conclusion (AO3 1)
- as the student's conclusion was not confined to the bacteria used in the investigation / referred to bacteria rather than the bacteria used in the investigation, neither statement is supported as the investigation only used one species of bacteria (AO3 1)
- as the investigation was not repeated, the results may not be reliable, and therefore may not support the conclusion (AO3 1)
- as the agar plates were only checked after 48 hours, the rate of growth of the colony over this period was not observed / measured if this had been observed / measured it may have led to different conclusions (AO3 1).

9 **Mitosis and meiosis are both types of cell division employed by a range of organisms. To promote a discussion among their students a biology teacher made the following statements:**

- **for the survival of an individual member of a species, mitosis is more important than meiosis**
- **for the survival of the species, meiosis is more important than mitosis.**

Evaluate the extent to which the statements can be justified.

Your response should demonstrate reasoned judgements and conclusions.

[6 marks]

AO1 = 2 marks
AO3 = 4 marks

Answer

Award **one** mark for correctly stating the purpose of mitosis, up to a maximum of **one** mark:

- mitosis is for growth and repair of the organism (AO1 1)
- mitosis can be used by some organisms for asexual reproduction (AO1 1).

Award **one** mark for correctly stating the purpose of meiosis, up to a maximum of **one** mark:

- meiosis is for the production of gametes (AO1 1).

Award **one** mark for each suitable evaluative point, up to a maximum of **four** marks:

- as mitosis provides cells for growth and repair, an individual would not be able to survive without mitosis, which supports the first statement (AO3 1)
- as mitosis produces cells identical to the parent cell, this ensures that the tissues produced can carry out the same function as the parent cell (during growth and repair) which is vital for survival, which supports the first statement (AO3 1)
- as meiosis is for the production of gametes (for reproduction), a lack of meiosis would not prevent an individual from surviving, which supports the first statement (AO3 1)
- as mitosis is required for an individual to survive, it must also be required for survival of the species, which does not support the second statement (AO3 1)
- as many organisms can only reproduce sexually / using gametes, meiosis is required for the survival of these species, which supports the second statement (AO3 1)
- there are many organisms that can reproduce without gametes / asexually (many plants, microbes and some animals); for these organisms, meiosis is not required for the survival of the species, which does not support the second statement (AO3 1)
- there are several processes during meiosis that can give rise to variation, this variation could benefit a species and help it survive better, which supports the second statement (AO3 1)

- as meiosis halves the number of chromosomes when producing gametes, it prevents the number of chromosomes doubling each generation that would not be sustainable / possible, this supports the second statement (AO3 1).

10 **A year 12 student examined a root tip squash of an onion to observe the stages of mitosis.**

They used the following procedure:

- **placed the root tip onto a clean slide**
- **broke up the root tip using mounted needles**
- **added a stain readily absorbed by chromosomes**
- **covered the stained root tip with a coverslip and pressed this down firmly**
- **examined the slide using a light microscope.**

The total number of cells observed was 188.

The student recorded the number of cells at each stage of mitosis, as well as the number of cells where the observation was not clear.

The results are shown in Figure 5 **below.**

Stage	Number of cells observed at each stage	Percentage of cells at each stage (%)
Interphase	**56**	**30**
Prophase	**29**	**15**
Metaphase	**8**	**4**
Anaphase	**9**	**5**
Telophase	**13**	**7**
Cells where observation was unclear	**73**	**39**

Figure 5: **Table showing number of cells at each stage of mitosis**

The student concluded that during mitosis in a root tip:

- **the majority of cells will be undergoing mitosis**
- **most cells will be in interphase.**

Evaluate the method used to observe mitosis and **the student's conclusions.**

Your answer should include reasoned judgements and conclusions.

[12 marks, plus 3 marks for QWC]

AO1 = 4 marks
AO2 = 4 marks
AO3 = 4 marks
QWC = 3 marks

Band	Marks	Descriptor
4	10–12	**AO3** Evaluation of the conclusions is **comprehensive, effective** and **relevant**, showing **detailed** understanding and **logical** and **coherent** chains of reasoning **throughout**. Makes informed conclusions that are **fully supported** with rational and balanced reasoned judgements. **AO2** Applied **all** relevant knowledge of light microscopy, staining and mitosis **effectively,** answer shows a **detailed** functional understanding. **AO1** The response demonstrates a **wide range** of relevant knowledge and understanding of light microscopy, staining and mitosis. A **wide** range of **appropriate** scientific terms is used.
3	7–9	**AO3** Evaluation of the conclusions is in **most parts effective** and **mostly relevant**, showing **mostly logical** and **coherent** chains of reasoning. Makes **mostly well-informed** conclusions, **mostly** supported by reasoned judgements that consider **mos**t of the relevant arguments. **AO2** Applied **mostly** relevant knowledge of light microscopy, staining and mitosis that is **mostly** effective, answer shows a **reasonably detailed** functional understanding. **AO1** Knowledge and understanding of light microscopy, staining and mitosis of is in **most parts clear** and **mostly** accurate, although there may be **some** errors. A range of **appropriate** scientific terms is used.
2	4–6	**AO3** Evaluation of the conclusions is in **some parts effective** and of **some relevance,** with **some** understanding and reasoning taking the form of **generic statements** with some development. Conclusions are **basic** and **brief**; conclusions will have **limited** rationality and balance. **AO2** Applied **limited** but **some** knowledge of mitosis. Answer is **limited** and may show a **lack** of functional understanding of mitosis.

Band	Marks	Descriptor
		AO1 Knowledge and understanding of light microscopy, staining and mitosis is **limited**. A **limited** range of scientific terms is used and **often** inappropriately**.**
1	1–3	**AO3** Evaluation of the conclusions is **minimal** and **very limited** in effectiveness and relevance. Conclusions, if present, are **brief**, and is supported by judgements that consider only **basic** arguments and show **little relevance** to the question aims. **AO2** Applied **very limited** knowledge of light microscopy, staining and mitosis, showing a **very limited** functional understanding. **AO1** Knowledge and understanding of light microscopy, staining and mitosis shows **very minimal** accuracy, focus and relevance. Appropriate scientific terms are **rarely** used and **mostly** inappropriately.
	0	No creditworthy material.

Indicative content

Examiners are reminded that the indicative content reflects content-related points that a student may make but is not an exhaustive list, nor is it a model answer. Students may make all, some or none of the points included in the indicative content as its purpose is as a guide for the relevance and expectation of the responses. Students must be credited for any other appropriate response.

AO1 and AO2 may be implicit through the level of analysis and reasoned judgements and conclusions that the student provides.

AO1 Knowledge and understanding of light microscopy, staining and mitosis may include:

- a light microscope would have sufficient resolution / magnification to observe the stages
- interphase is not a stage of mitosis
- staining enables better observation of materials on the slide
- the arrangement of the chromosomes indicates the stage of mitosis.

AO2 Application of knowledge and understanding of light microscopy, staining and mitosis may include:

- a root tip will be growing rapidly and therefore should contain many cells undergoing mitosis
- the percentage of cells that could be observed in a stage of mitosis was 31%
- no information is provided to show whether the student observed all the cells on the root tip squash
- the root tip was squashed to get a thinner layer of cells / enable more cells to be seen
- for 39% of cells the stage of mitosis could not be observed
- the largest number / percentage of cells that could be observed were in the interphase
- there is no evidence that the procedure was repeated

- this observation was only carried out on onion root tips
- the observation was only carried out on one root tip
- the difference in number of cells at metaphase and at anaphase is only one / is small.

AO3 Conclusions and / or reasoned judgements may include:

- as 39% of the cells observed could not be observed clearly, it is impossible to tell if these cells are undergoing mitosis or at what stage, therefore making the conclusions unreliable
- as there is no information provided to show whether the student observed all the cells on the root tip squash, the conclusions are not valid
- as the student only observed mitosis in onion root tips, it is not possible to make a conclusion based on all root tips / root tips in general
- as the observation was only carried out on one root tip, the results may not be repeatable / reliable therefore the conclusions are not valid
- as it would not be easy to accurately count the cells on the slide, there could be human error leading to the results being unreliable
- as one stage of mitosis runs into the next stage, it will be difficult to decide at which stage mitosis is, therefore making the results unreliable
- as interphase is not a stage of mitosis, the second conclusion cannot be justified.

Accept any other suitable response.

QWC = 3 marks

Mark	Descriptor
3	The answer is **clearly expressed** and **well-structured**. The rules of grammar are used with **effective control** of meaning overall. A **wide range** of appropriate technical terms are used effectively.
2	The answer is generally **clearly expressed** and **sufficiently structured**. The rules of grammar are used with **general control** of meaning overall. A **good range** of appropriate technical terms are used effectively.
1	The answer **lacks some clarity** and is generally **poorly structured**. The rules of grammar are used with **some control** of meaning and any errors do not significantly hinder the overall meaning. A **limited range** of appropriate technical terms are used effectively.
0	There is **no answer** written or none of the material presented is creditworthy. **or** The answer does not reach the threshold performance level. The answer is **fragmented** and **unstructured**, with **inappropriate use of technical terms**. The errors in grammar severely hinder the overall meaning.

Section B: Chemistry

Total for this section: 27 marks plus 3 marks for QWC and use of specialist terminology

11 **Citric acid is a chemical found naturally in exotic fruits such as lemons and limes, and is what gives them their tart, sour flavour.**

Which one of the following pH ranges would you expect the juice of a lemon to fall in?

A **pH 4–6**
B **pH 7–9**
C **pH 10–12**
D **pH 13–15**

[1 mark]

AO2 = 1 mark

Answer

A. pH 4-6 (1).

12 (a) **Helium-4 (He) is a light atom found in group 8 of the periodic table, it is often used to fill carnival and party balloons.**

Describe the arrangement of the $^{4}_{2}$He atom.

[3 marks]

AO2 = 3 marks

Answer

Award **one** mark for **each** valid description, up to a maximum of **three** marks:

- helium-4 contains two neutrons (1)
- neutrons are neutral or possess no charges (1)
- helium-4 contains two protons (1)
- helium-4 protons are positively charged, or the net charge of the nucleus is positive two (1)
- helium nucleus is a composite of the neutrons and protons (1)
- the helium nucleus is orbited by two surrounding electrons (1)
- these electrons are negatively charged (1)
- the charge of the electrons cancels the charge of the nucleus (1)
- as a result the atom is neutral (1)

- these electrons pair up and occupy shells or energy levels, or two electrons occupy an inner shell (1).

Accept any other suitable response.

Note: you may accept the word orbital instead of shell or energy level.

12 (b) **Much like the other gases in group 8, $^{4}_{2}He$ is a noble gas and is considered unreactive.**

With reference to the electronic structure of $^{4}_{2}He$, explain why this atom is unreactive.

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for **each** valid explanation, up to a maximum of **two** marks:

- electrons like to pair up in shells / energy levels (1)
- helium-4 has two electrons surrounding the nucleus (1)
- helium-4 has one full shell / energy level (1).

Accept any other suitable response.

Note: You may accept the word orbital instead of shell or energy level.

13 **Scientists were interested in studying the effect of heat on a reaction flask containing $^{4}_{2}He$ They took a 2 L flask containing 1 L of $^{4}_{2}He$ at 373 K and heated this to 473 K.**

Calculate to two **decimal places the volume within the flask that $^{4}_{2}He$ occupies at this new temperature. Show your working.**

The equation for this calculation is:

$$V_1/T_1 = V_2/T_2$$

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for using Charles' law and rearranging to, up to a maximum of **one** mark:

$$V_1/T_1 = V_2/T_2$$

$$1 \times 373 = V_2 \times 473$$

Award **one** mark for correctly calculating, up to a maximum of **one** mark:

$$V_2 = (1 \times 373) / 473$$
$$V_2 = \underline{1.27\ L}$$

Note: If the correct answer only is given, award both marks, as we can assume that the correct method has been applied where one method only is used.

14	**The acidity of two solutions in a laboratory is determined by analysing the concentration of hydrogen ions (H^+). Scientists record the following pH values for the two different solutions:** **Solution A: pH 1** **Solution B: pH 4** **With reference to acid / base equilibrium, explain the pH differences between these solutions.** [2 marks]

AO2 = 2 marks

Answer

Award **one** mark for **each** discussion point, up to a maximum of **two** marks:

- describing solution 'A' as being more acidic to that of solution B (1), or solution B being more basic than that of solution A (1)
- stating that solution B is 1000x more acidic than that of solution A (1), this can be expressed as 10^{4-1} that is 10^3 (1)
- explaining that the pH scale is logarithmic (1), or every pH unit difference is an order of magnitude in free 'H^+' concentration (1).

Accept any other suitable response.

15 (a)	**The group 1 elements in the periodic table are the alkali metals. They are found as the first vertical column on the left-hand side of the periodic table. The second metal within this group is sodium (Na).** **Give the balanced symbol equation for the chemical reaction to describe what happens when Na is dropped into water (H_2O).** [2 marks]

AO2 = 2 marks

Answer

Award **two** marks for a correctly balanced equation:

$$2Na + 2H_2O \rightarrow 2NaOH + H_2 \text{ or, } Na + H_2O \rightarrow NaOH + {}^1/_2H_2 \text{ (2).}$$

Note: If no other marks are awarded, give **one** mark for the following:

- describing the reaction scheme as $Na + H_2O \rightarrow NaOH + H_2$ (1).

15 (b)	**A scientist states that: 'reactions between group 1 metals and water become more reactive as you move down the group'.** **Evaluate this statement.** [3 marks]

AO3 = 3 marks

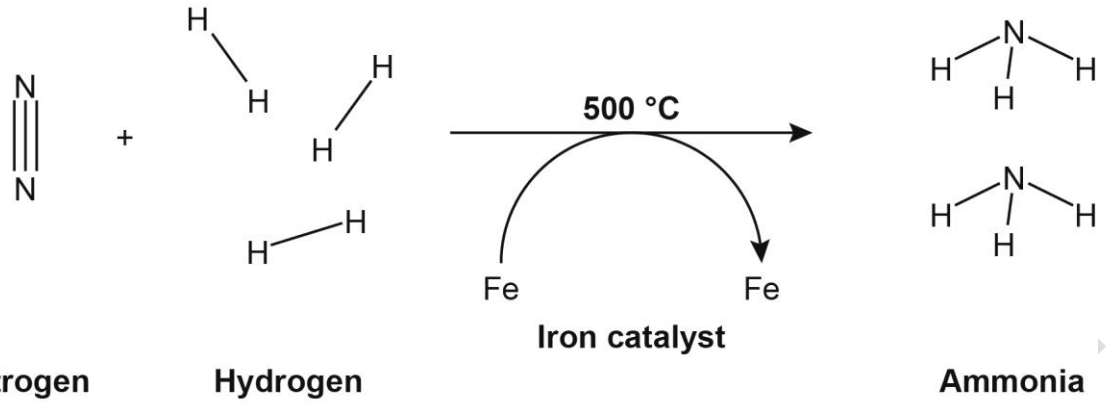
Answer

Award **one** mark for **each** explanation, up to a maximum of **three** marks:

- the number of electron shells increases going down group 1, these shield / screen the nucleus attraction, which supports the statement (1)
- the affinity of the electrons to the nucleus decreases going down group 1, which supports the statement (1)
- the outer electron is less tightly held by the associated nucleus that then makes the atom more reactive, which supports the statement (1)
- metals increase in proton count going down group 1; however, this is offset by the screening / shielding effect of the associated electrons, which supports the statement. (1).

Accept any other suitable response.

16 **The Haber process is an industrial method of producing ammonia (NH_3). This involves the combination of atmospheric nitrogen (N_2) with hydrogen (H_2). The chemical process is depicted in** Figure 6 **below:**



Conditions	Rate (gs^{-1})
With catalyst	2.5
Without catalyst	1.5

Figure 6: The Haber process

gs^{-1} = grams per second

During reactions on an industrial scale, an iron (Fe) catalyst is often incorporated into this reaction.

With reference to Figure 6 **and the effect of a catalyst, discuss the use of iron in the Haber process.**

[3 marks]

AO3 = 3 marks

Answer

Award **one** mark for **each** discussion point, up to a maximum of **three** marks:

- iron remains unchanged during the entire process; this means it is a catalyst / iron is reusable (1)
- iron lowers the activation energy for this process meaning it can be carried out at 500° Celsius / a lower temperature than if iron was not used which increases cost efficiency (1)
- the use of a catalyst increases the rate of reaction from 1.5 gs-1 to 2.5 gs-1 which will lead to an increased overall amount of ammonia produced (1).

Accept any other suitable response.

17 **A team of scientists has potentially synthesised the compound phenylethanone pictured in** Figure 7 **below. The team need to confirm the skeletal structure of the compound and are considering mass spectrometry as the analytical technique.**

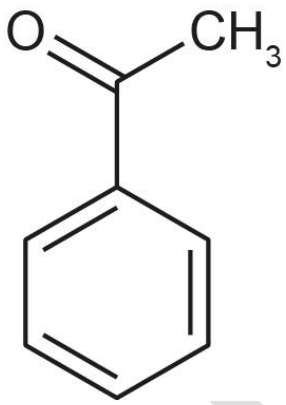


Figure 7**: Chemical structure of phenylethanone**

Considering other analytical techniques, evaluate the suitability of mass spectrometry in this instance.

Your answer should include reasoned judgements and conclusions.

[9 marks, plus 3 marks for QWC]

AO1 = 3 marks
AO2 = 3 marks
AO3 = 3 marks
QWC = 3 marks

Band	Marks	Descriptor
3	7–9	**AO3** Evaluation of the potential analytical techniques used to confirm the compound is phenylethanone is **comprehensive**, **effective** and **relevant**, showing **detailed** understanding and **logical** and **coherent** chains of reasoning throughout. Makes informed conclusions that are fully supported with rational and balanced reasoned judgements. **AO2** Applied **relevant** knowledge of how each technique can be used to analyse the compound. Shows a **detailed** functional understanding of the scientific methodology involved. **AO1** The response demonstrated a **wide range** of relevant knowledge and understanding of analytical techniques which is **accurate** and **detailed**. The answer demonstrates **comprehensive** breadth and / or depth of understanding.

Band	Marks	Descriptor
2	4–6	**AO3** Evaluation of the potential analytical techniques used to confirm the compound is phenylethanone is in **most parts effective** and **mostly relevant**, showing **mostly logical** and **coherent** chains of reasoning. Given conclusions supported by reasoned judgements that consider most of the relevant arguments. **AO2** Applied **mostly** relevant knowledge of how each technique can be used to analyse the compound that is in most parts appropriate, showing **some** functional understanding of the scientific methodology involved. **AO1** Knowledge and understanding of analytical techniques in this context are in **most parts clear** and **mostly accurate**, although on occasion **may lose** focus. The answer demonstrates **reasonable** breadth and / or depth of understanding, with **occasional** inaccuracies and / or omissions.
1	1–3	**AO3** Evaluation of the potential analytical techniques used to confirm the compound is phenylethanone is in **some parts effective** and of **some relevance**, with some understanding and reasoning taking the form of **generic statements** with some development. Judgements are basic and brief; conclusions will have **limited** rationality and balance. **AO2** Applied **limited** knowledge of how each technique can be used to analyse the compound and may show a **lack** of functional understanding of the scientific methodology involved. **AO1** Knowledge and understanding of analytical techniques in this context show **some** but **limited** accuracy, focus and relevance. The answer is **basic** and shows **limited** breadth and / or depth of understanding, **with** inaccuracies and omissions.
	0	No creditworthy material.

Indicative content

Examiners are reminded that the indicative content reflects content-related points that a student may make but is not an exhaustive list, nor is it a model answer. Students may make all, some or none of the points included in the indicative content as its purpose is as a guide for the relevance and expectation of the responses. Students must be credited for any other appropriate response.

AO1 and AO2 may be implicit through the level of analysis and reasoned judgements and conclusions that the student provides.

AO1 Knowledge and understanding of analytical techniques in this context may include:

- gas chromatography can be used to separate compounds which can be vaporised / are volatile
- high performance liquid chromatography can be used to separate substances based on their affinity for specific solvents
- mass spectrometry is used to separate and identify substances due to their mass to charge ratio
- mass spectrometry can be used to identify molecular ions and ion fragments
- mass spectrometry can be used to identify unknown substances based on molecular weight:
  - molecular weight is detectable as a mass to charge ratio (m/z)
  - main ion peak is the overall molecular weight
  - different m/z ratios 'travel' at varying speeds down a mass spectrometer
  - typically, molecules with larger m/z ratios take longer to reach the mass spectrometer sensor than molecules with smaller m/z.

AO2 Application of knowledge and understanding to how techniques can be used to analyse the compound may include:

- ionising energy is used in a mass spectrometer, this causes fragmentation
- fragmentation of a molecule can occur in a mass spectrometer, with each fragment being detected in the spectrometer
- these peaks can be used to form building blocks for the molecular structure
- gas chromatography and / or high-performance liquid chromatography cannot be used to determine chemical structure
- certain fragments may be more stable than others leading to more intense peaks should an intensity versus m/z ratio graph be plotted during data analysis.

AO3 Evaluation evidenced with reasoned judgements and conclusions that may include:

- mass spectrometry is the most suitable technique as it can identify the molecular ion and molecular fragments based on their mass to charge ratio (molecular weight)
- mass spectrometry would be the best analytical means of characterising this specific compound as gas chromatography requires phenylethanone to be volatile so that it can be vaporised
- high performance liquid chromatography would be better suited to determining the number of components within in a complex mixture such as phenylethanone, rather than their chemical structure
- both chromatography methods could only characterise phenylethanone as an R_f value and its affinity for specific solvents, unlike mass spectrometry, they cannot quantify a chemical structure, therefore they would be unsuitable.

Accept any other suitable response.

QWC = 3 marks

Mark	Descriptor
3	The answer is **clearly expressed** and **well-structured**. The rules of grammar are used with **effective control** of meaning overall. A **wide range** of appropriate technical terms are used effectively.
2	The answer is generally **clearly expressed** and **sufficiently structured**. The rules of grammar are used with **general control** of meaning overall. A **good range** of appropriate technical terms are used effectively.
1	The answer **lacks some clarity** and is generally **poorly structured**. The rules of grammar are used with **some control** of meaning and any errors do not significantly hinder the overall meaning. A **limited range** of appropriate technical terms are used effectively.
0	There is **no answer** written or none of the material presented is creditworthy. **or** The answer does not reach the threshold performance level. The answer is **fragmented** and **unstructured**, with **inappropriate use of technical terms**. The errors in grammar severely hinder the overall meaning.

Section C: Physics **Total for this section: 18 marks**

18 **Which one of the following is a type of electromagnetic radiation commonly used in radiotherapy treatment to kill cancerous cells and shrink tumours in patients who have been diagnosed with cancer?**

A **Gamma rays**

B **Microwaves**

C **Radio waves**

D **X-rays**

[1 mark]

AO1 = 1 mark

Answer

A. Gamma rays (1).

19 Figure 8 **below shows an explosion deep below the surface of the sea occurring at point A.**

The energy released during the explosion creates a shock wave that travels out in all directions and reaches a submarine positioned at point B.

The wave causes the submarine to oscillate in the directions indicated by the arrows.

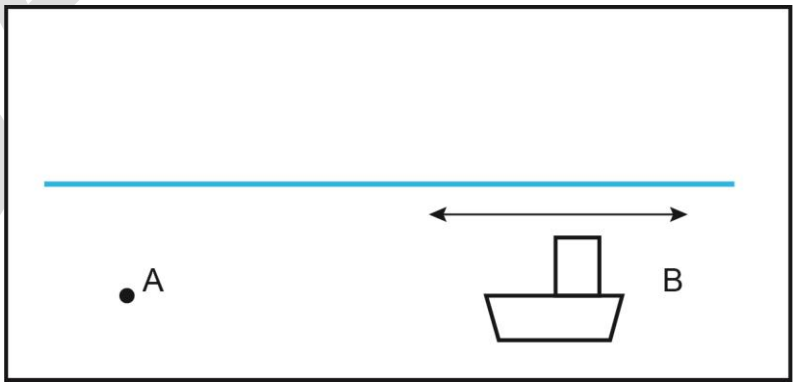


Figure 8: A diagram to show position of an underwater explosion and submarine

19 (a) **Identify what type of wave the shockwave is.**

[1 mark]

AO1 = 1 mark

Answer

Award **one** mark, up to a maximum of **one** mark for:

- longitudinal wave (1).

19 (b)	**Give a reason for your answer to part (a).** [1 mark]

AO2 = 1 mark

Answer

Award **one** mark for an appropriate reason, up to a maximum of **one** mark:

- the submarine oscillates in the same axis of the direction of travel of the wave; this is consistent with a longitudinal wave, that moves in the same direction in which the particles are vibrating (1)
- a transverse wave would cause the submarine to move at right angles to the direction of travel of the wave (1).

Accept any other suitable response.

20	**When a violinist plays a note of a certain pitch, the violin string vibrates and omits a sound wave with a unique frequency.** **Middle C is a musical note with a frequency of 262 Hz.** **Assuming the speed of sound is 330 m/s, calculate the wavelength of the wave that is produced when the violinist plays a middle C.** **The wave equation is v = fλ** **Show your working and give your answer to** two **decimal places**. [4 marks]

AO2 = 4 marks

Award **one** mark maximum for the correctly rearranging the equation:

$v = f\lambda$
to
$\lambda = v/f$.

Award **one** mark maximum for using the following method correctly:

λ = 330/262

Award **one** mark maximum for the calculation of the correct answer:

λ=1.26

Award **one** mark maximum for the use of correct unit of measure:

1.26 m

21 **Describe** one **difference between direct and alternating current.**

[2 marks]

AO1 = 2 marks

Award **one** mark for **each** of the following, up to a maximum of **two** marks:

- direct current travels in one direction, (1) while alternating current switches direction (1)
- direct current has either a positive or negative voltage (1) while alternating current changes between positive and negative potentials (1).

Accept any other suitable response.

22 **A scientist is characterising how an unknown radioactive isotope decays in the laboratory.**

A Geiger counter is positioned at varying distances from the sample, ranging from 0–50 cm, and the activity is recorded. The scientist then repeats this experiment, but this time covers the sample in tissue paper.

The readings on the Geiger counter at each distance are shown in Figure 9 **below.**

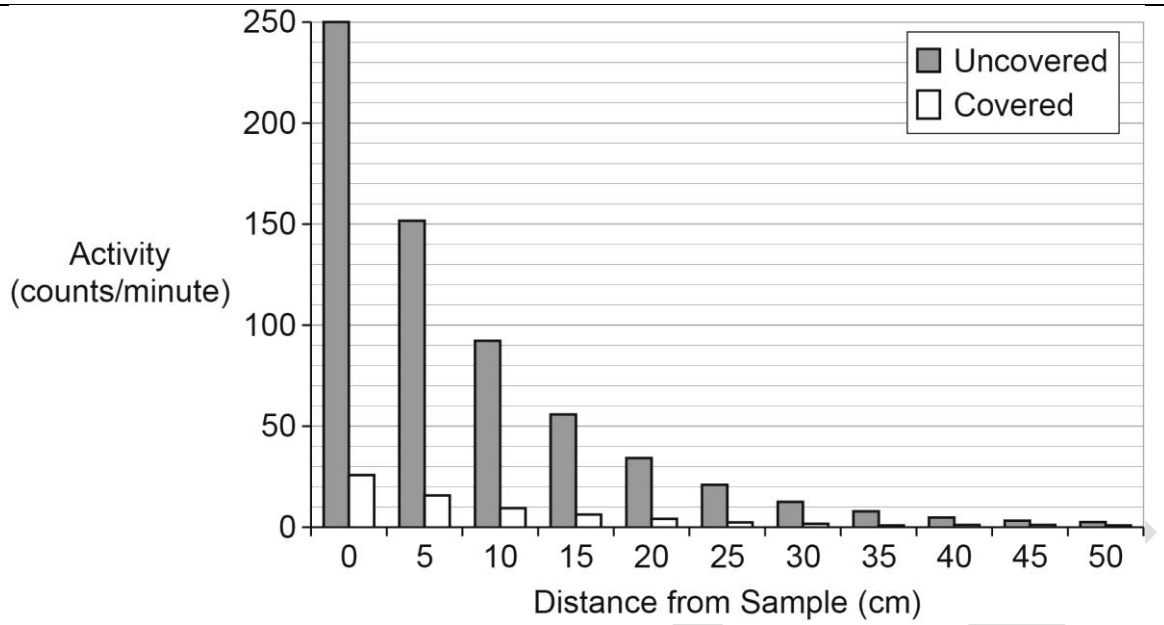


Figure 9: **A graph to show levels of radioactivity at different distances from a source**

Based on these findings, the scientist concludes that the sample emits beta radiation, and not alpha or gamma.

Evaluate this conclusion.

[3 marks]

AO3 = 3 marks

Award **one** mark for **each** of the following points, up to a maximum of **three** marks:

- much of the radioactivity is blocked by longer distances travelling through the air; this is inconsistent with gamma radiation, suggesting that alpha or beta radiation is being emitted (1)
- the radioactivity is able to be detected through several centimetres of air, although not longer distances; this may be mostly consistent with a beta particle being detected (1)
- covering the sample with tissue reduces the radioactivity detected significantly; this is consistent with alpha and beta radiation, both of which are blocked (1)
- beta is likely to be emitted, but alpha particles may also be emitted as products of further decay; alpha decay therefore cannot be ruled out (1).

Accept any other suitable response.

23 **A scientist is comparing two small bar magnets, magnet 1 and magnet 2.**

Each magnet is passed through a coil of wire. A current in the wire is then measured using an ammeter. Graphs showing these currents are given in Figure 10**.**

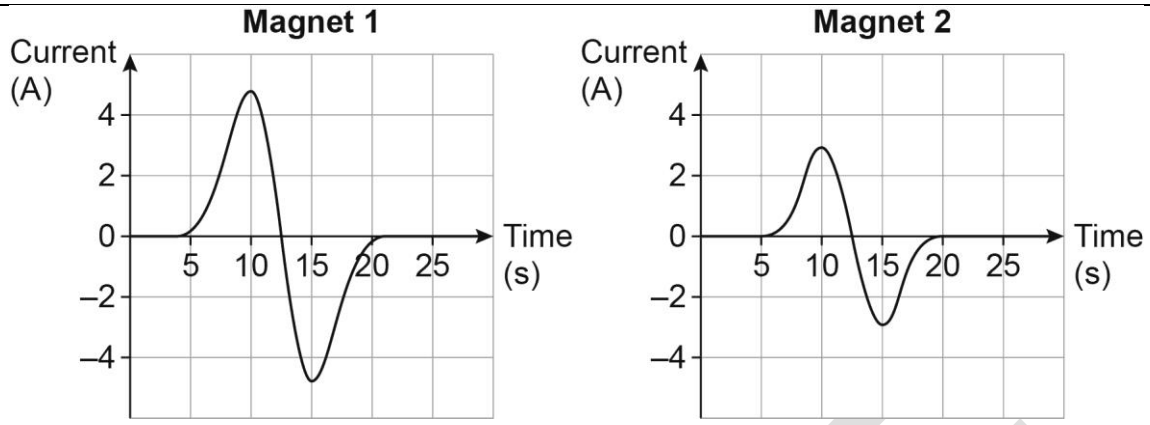


Figure 10**: Currents generated by passing two different magnets through a coil of wire**

Based upon these observations, the scientist concludes that magnet 1 is a stronger magnet than magnet 2.

Explain how the scientist reached this conclusion.

Your answer should include:

- **a description of the process of electromagnetic induction**
- **a comparison of the two graphs**
- **reasoned judgements and / or conclusions about the strength of the two magnets**.

[6 marks]

AO1 = 2 marks
AO2 = 2 marks
AO3 = 2 marks

Award **one** mark for **each** description, up to a maximum of **two** marks:

- moving a magnet through a coil of wire will generate an electrical current (AO1 1)
- the direction of the current is determined by the direction of movement of the magnet and the direction of the magnetic flux (AO1 1)
- the direction of the current will change as the magnet enters and exits the coil (AO1 1).

Award **one** mark for **each** comparison, up to a maximum of **two** marks:

- the peak current produced is greater for magnet 1 than for magnet 2 (AO2 1)
- the current starts being generated sooner for magnet 1 than for magnet 2 (AO2 1)
- the area under the curve is greater for magnet 1 than magnet 2 (AO2 1).

Award **one** mark for **each** valid reasoned judgement / conclusion, up to a maximum of **two** marks:

- as the time between the two peaks is the same for both magnets (10 and 15 seconds), the speed of both magnets was the same in each experiment (AO3 1)
- as the coil of wire and speed of the magnets is the same, the only variable is the strength of the magnet, and so magnet 1 must be a stronger magnet (AO3 1).

Accept any other suitable response.

Section D: Scientific concepts

Total for this section: 20 marks plus 3 marks for QWC and use of specialist terminology

24 (a) Iron is a transition metal, describe four **ways in which the properties of transition metals differ from the properties of group 1 metals.**

[4 marks]

AO1 = 4 marks

Answer

Award **one** mark for each difference, up to a maximum of **four** marks:

Transition metals:

- have higher density (1)
- have a higher melting point (1)
- have higher strength (1)
- are harder (1)
- are less reactive with water (1)
- are less reactive with oxygen (1)
- are less reactive with chlorine (1).

24 (b) Explain how one **of these differences makes iron a useful building material.**

[1 mark]

AO2 = 1 mark

Answer

Award **one** mark for a suitable explanation, up to a maximum of **one** mark:

- higher density / strength / hardness means it is able to support weight / withstand pressure / mechanical shock (1)
- higher melting point means it can be used in areas where temperatures are relatively high (1)
- lower reactivity with water / oxygen means it will corrode / rust slowly and therefore retain its strength (1).

25 **Biological oxygen demand (BOD) is a concept used to measure the levels of organic pollutants in waterways. This represents the oxygen consumed by microorganisms as they decompose the organic pollutants under aerobic condition. The rate of oxygen consumption can be used as a direct measure of the level of pollutant.**

A student set up the apparatus shown in Figure 11 **to measure BOD:**

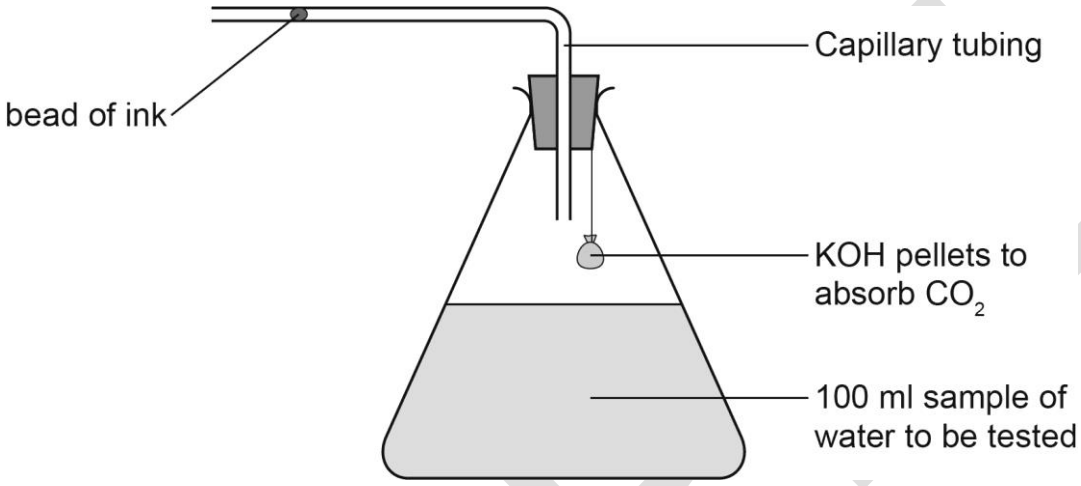


Figure 11**: The student's apparatus for measuring BOD**

The student planned to measure the BOD of the water sample by measuring the rate at which the bead of ink moved along the capillary tube in one **minute.**

As the microorganisms respired, they would use up the oxygen in the apparatus and the bead of ink would move to the right. Carbon dioxide (CO_2) produced in respiration would be absorbed by the potassium hydroxide (KOH).

25 (a) **Suggest** one **external independent variable which would need to be controlled. Explain why it is important to control this variable.**

[2 marks]

AO2 = 2 marks

Answer

Award **one** mark for correctly identifying the external variable, up to a maximum of **one** mark**:**

- temperature (1).

Award **one** mark for the correct explanation, up to a maximum of **one** mark:

- if the temperature increases, the volume of air in the apparatus will increase, this will move the bead of ink (1)
- if the temperature decreases, the volume of air in the apparatus will decrease, this will move the bead of ink (1).

25 (b) Explain why it is important to remove the CO_2 produced during this investigation.

[1 mark]

AO2 = 1 mark

Answer

Award **one** mark for the correct explanation, up to a maximum of **one** mark:

- the CO_2 produced (from respiration) would cause the bead to move to the left in the tubing (1)
- the CO_2 produced from respiration could stop the bead moving at all, as it will balance the O2 being used (1).

25 (c) The student used the apparatus to measure the BOD of water from four different ponds (samples A to D) and of sterile water sample E. The results are shown in Figure 12 **below:**

Sample	A	B	C	D	E
Rate of movement (mm per minute)	**9**	**10**	**4**	**2**	**2**

Figure 12**: Shows the results from four different ponds and sterile water**

The student concluded that sample B was the most polluted.

To what extent do the results support this conclusion?

Your response should include reasoned judgements and / or conclusions.

[3 marks]

AO3 = 3 marks

Answer

Award **one** mark for each suitable evaluative point, up to a maximum of **three** marks:

- the bead of ink in sample B did move the fastest, this suggests that respiration was the quickest in this sample, this supports the conclusion (1)
- the difference in the rate between sample A and sample B was only one / very small, and this may not be significant enough to support the conclusion (1)

- as there is no evidence that the investigation was repeated, the results may not be valid (1)
- as the investigation was only carried out for one minute, this may not be a reliable representation of the rate of respiration (1)
- the rate of respiration will be dependent on the amount of organic pollutant and the number of microorganisms; although sample D had a lower rate of movement, it may have more organic pollutants but less microorganisms to respire it (1)
- the bead also moved by 2 mm per minute in the sterile water, this suggests that another factor may be affecting the rate of movement, which renders the results / any conclusions unreliable (1).

26 **An investigation was carried out into the rate of the aerobic respiration of maltose by brewer's yeast at different temperatures:**

- **a mixture of 100 ml of 2% yeast suspension in 5% maltose solution was prepared**
- **10 water baths were prepared at temperatures increasing at 5 ˚C intervals from 15 to 60 ˚C**
- **the yeast maltose mixture was divided into 10 x 10 ml quantities and placed into 10 boiling tubes**
- **a boiling tube was placed into each of the water baths and after 10 minutes the number of bubbles of CO_2 were counted in each tube**
- **the process was repeated five times.**

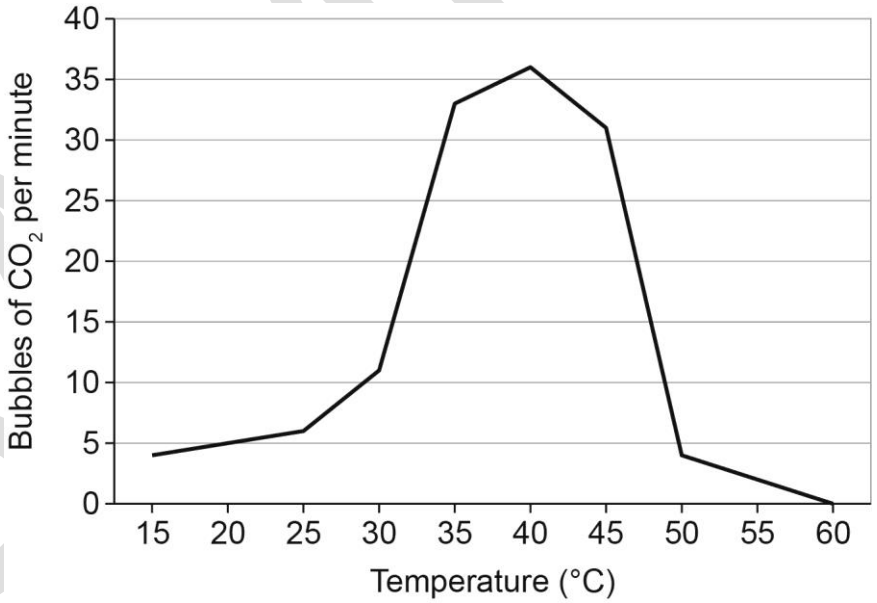


Figure 13**: Mean number of bubbles of CO_2 per minute at different temperatures**

The results from each repetition were similar, and a graph of the mean number of bubbles per minute at each temperature is shown in Figure 13 **above.**

When the investigation was complete a second short investigation was carried out as described below:

- **after 15 minutes the boiling tube at 60 ˚C was placed into the water bath at 45 ˚C for 10 minutes, and no bubbles were produced.**

Analyse the information provided to explain the results.

Your response should demonstrate:

- **an understanding of respiration, enzymes and collision theory**
- **reasoned judgements and / or conclusions.**

[9 marks, plus 3 marks for QWC]

AO1 = 3 marks
AO2 = 3 marks
AO3 = 3 marks
QWC = 3 marks

Band	Mark	Descriptor
3	7–9	**AO3** Analysis of the information provided is **comprehensive, effective** and **relevant**, showing **detailed** understanding and **logical** and **coherent** chains of reasoning **throughout**. **Informed** conclusions that are **fully supported** with rational and balanced reasoned judgements are included. **AO2** Applied all **relevant** knowledge of respiration, enzymes and collision theory that is **effective, highly appropriate** and shows a **detailed** functional understanding of the scientific methodology involved. **AO1** A **wide** range of relevant knowledge and understanding of respiration, enzymes and collision theory in this context is demonstrated, that is **accurate** and **detailed**. A **wide** range of **appropriate** scientific terms is used.
2	4–6	**AO3** Analysis of the information provided is in **most parts effective** and **mostly relevant**, showing **mostly logical** and **coherent** chains of reasoning. Conclusions supported by reasoned judgements that consider **most** of the relevant arguments are presented. **AO2** Applied **mostly relevant** knowledge of respiration, enzymes and collision theory that is in **most parts appropriate**, showing **some** functional understanding of the scientific methodology involved. **AO1** Knowledge and understanding of respiration, enzymes and collision theory in this context is in **most parts clear** and **mostly** accurate, although on occasion **may lose** focus. A range of **mostly appropriate** scientific terms is used.

Band	Mark	Descriptor
1	1–3	**AO3** Analysis of the information provided is in **some parts effective** and of **some relevance**, with some understanding and reasoning taking the form of **generic** statements with **some** development. Judgements are **basic** and **brief**; conclusions will have **limited** rationality and balance. **AO2** Applied **limited** knowledge of respiration, enzymes and collision theory and may show a **lack** of functional understanding of the scientific methodology involved. **AO1** Knowledge and understanding of respiration, enzymes and collision theory show **some** but limited accuracy, focus and relevance. A **limited** range of scientific terms is used, that may **often** be inappropriate.
	0	No creditworthy material.

Indicative content

Examiners are reminded that the indicative content reflects content-related points that a student may make but is not an exhaustive list, nor is it a model answer. Students may make all, some or none of the points included in the indicative content as its purpose is as a guide for the relevance and expectation of the responses. Students must be credited for any other appropriate response.

AO1 and AO2 may be implicit through the level of analysis and reasoned judgements and conclusions that the student provides.

AO1 Knowledge and understanding of respiration, enzymes and collision theory may include:

- aerobic respiration produces CO_2
- CO_2 will produce bubbles
- the rate of bubbling can be measured
- aerobic respiration involves a series of reactions (oxidation and reduction)
- for any reaction to occur, the reactants / molecules involved in the reaction, have to collide with sufficient energy
- an increase in temperature will make the reactants / molecules involved in the reaction move faster
- the faster the molecules move the more collisions there are
- the more collisions there are the faster the rate of reaction
- reactions in organisms are usually controlled by enzymes
- enzymes are globular proteins
- enzymes have an active site that interacts with the reactants
- the shape of an enzyme's active site is complementary to the shape of the reactants
- the shape of the active site is maintained by bonds.

AO2 Application of knowledge and understanding of respiration, enzymes and collision theory may include:

- the rate of bubbling / respiration increased slowly between 15 and 30 ˚C

- the rate of bubbling / respiration increased rapidly between 30 and 35 ˚C
- the rate of bubbling / respiration reached a peak at 40 ˚C
- the rate of bubbling / respiration declined rapidly after 45 ˚C
- there was no bubbling / respiration by 60 °C
- leaving the boiling tubes in the water baths for 10 minutes before counting the bubbles would enable the temperature of the boiling tube to reach the temperature of the water bath
- the results of each of the five trials showed reproducibility
- bubbles of CO_2 are not likely to be all the same size – this may affect the validity of the results.

AO3 Explanations of their analysis may include:

- the optimum temperature for respiration of brewer's yeast appears to be 40 ˚C
- the optimum temperature could be between 40 and 45 ˚C as these temperatures were not investigated
- as the investigation was repeated five times and the results showed repeatability / were similar, this suggests that the results are valid
- as the same procedure was used for each trial this suggests that the results are valid
- the optimum temperature for the enzymes which control aerobic respiration in brewer's yeast is 40 ˚C
- the optimum temperature for the enzymes could be between 40 and 45 ˚C as these temperatures were not investigated
- the enzymes that control aerobic respiration are destroyed / denatured at temperatures above 45 ˚C this is shown by the second investigation
- the destruction / denaturation of the enzymes is not reversible
- although the size of the bubbles will vary, as the five trials showed a similar pattern of results the results are likely to be valid
- if the student had used a gas syringe to collect the CO_2 this would have made the results more reliable.

Accept any other suitable responses.

QWC = 3 marks

Mark	Descriptor
3	The answer is **clearly expressed** and **well-structured**. The rules of grammar are used with **effective control** of meaning overall. A **wide range** of appropriate technical terms are used effectively.
2	The answer is generally **clearly expressed** and **sufficiently structured**. The rules of grammar are used with **general control** of meaning overall. A **good range** of appropriate technical terms are used effectively.
1	The answer **lacks some clarity** and is generally **poorly structured**. The rules of grammar are used with **some control** of meaning and any errors do not significantly hinder the overall meaning. A **limited range** of appropriate technical terms are used effectively.
0	There is **no answer** written or none of the material presented is creditworthy. **or**

	The answer does not reach the threshold performance level. The answer is **fragmented and unstructured**, with **inappropriate use of technical terms**. The errors in grammar severely hinder the overall meaning.

Assessment objective grid

Section A Biology

Question number	AO1	AO2	AO3	Maths	QWC	Total
1	1					1
2	1					1
3 (a)	1					1
3 (b)		1				1
3 (c)	1	1				2
4 (a)	3					3
4 (b)		1				1
5 (a)		1				1
5 (b)		2				2
5 (c)		2		(2)		2
6 (a) (i)	1					1
6 (a) (ii)		1				1
6 (b)		2		(2)		2
7	2					2
8	1		5			6
9	2		4			6
10	4	4	4		3	15
Total	**17**	**15**	**13**	**(4)**	**3**	**48**
Totals required	**17-22 marks**	**11-16 marks**	**11-16 marks**	**8-10 across Sec A-C**	**3 marks**	**48 inc QWC**
Kil	**4**					

Section B Chemistry

Question number	AO1	AO2	AO3	Maths	QWC	Total
11		1				1
12 (a)		3				3
12 (b)		2				2
13		2		(2)		2
14		2				2
15 (a)		2				2
15 (b)			3			3
16			3			3
17	3	3	3		3	12
Total	**3**	**15**	**9**	**(2)**	**3**	**30**
Totals required	**3-7 marks**	**11-16 marks**	**6-11 marks**	**8-10 across Sec A-C**	**3 marks**	**30 inc QWC**
Kil	**0**					

Section C Physics

Question number	AO1	AO2	AO3	Maths	QWC	Total
18	1					1
19 (a)	1					1
19 (b)		1				1
20		4		(4)		4
21	2					2
22			3			3
23	2	2	2			6
Total	**6**	**7**	**5**	**(4)**		**18**
Totals required	**3-7marks**	**3-7 marks**	**3-7marks**	**8-10 across Sec A-C**	**0**	**18 marks**
Kil	**4**					

Section D Scientific Concepts

Question number	AO1	AO2	AO3	Maths	QWC	Total
24 (a)	4					4
24 (b)		1				1
25 (a)		2				2
25 (b)		1				1
25 (c)			3			3
26	3	3	3		3	12
Total	**7**	**7**	**6**	**0**	**3**	**23**
Totals required	**3-7 marks**	**6-11 marks**	**6-11 marks**	**0**	**3 marks**	**23 inc QWC**
Kil	**4**					

Document information

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of Issue
v1.0	Additional specimen assessment materials		November 2022
v1.1	Sample added as a watermark	November 2023	21 November 2023