T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Core knowledge and understanding

Paper A

Mark scheme

v1.2: Specimen assessment materials
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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) 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 levels-based descriptors and indicative content.

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

The grids are broken down into levels, with each level having an associated descriptor indicating the performance at that level. You should determine the level 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 level, you should use a bottom up approach. If the response meets all the descriptors in the lowest level, you should move to the next one, and so on, until the response matches the level 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 levels, you should use a best-fit approach at this stage and use the available marks within the level 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: Working within the science sector

This section is worth 25 marks, plus 3 marks for the quality of written communication (QWC) and use of specialist terminology.

1 (a) In a company's storage facility, heavy items should be stored:

A On a reinforced area of the floor near to the entrance.
B On shelves which are strong enough for the weight and at elbow height.
C On shelves which are strong enough for the weight and at any level.
D On shelves which are strong enough for the weight at the back of the shelves.

[1 mark]

AO1 = 1 mark
AP Reference = A.8.10.0.5

Answer

B On shelves which are strong enough for the weight and at elbow height.

1 (b) A section of a job advert states that each applicant must be:

- qualified to level 3 or higher in at least one science subject
- innovative and confident with excellent communication skills.

Explain whether the information provided is a person specification or a job description.

[2 marks]

AO1 = 1 mark
AO2 = 1 mark
AP Reference = A2.4.0.1, A2.4.0.2 and A.8.10.0.5

Answer

Award **one** mark for correctly identifying what the bullet points relate to and **one** mark for a valid explanation of why.

This is a person specification. (1) (AO2), as the information provided is (part of) a list of personal attributes/skills. (1) (AO1) **OR** as the information provided is not a list of roles and responsibilities. (1) (AO1).

1 (c) A school science department purchases a container of a protease enzyme.

It is stored in its original container on a shelf in the science department prep room.

The shelf is directly opposite a south facing window.

The prep room is used for preparing all materials for class practical experiments, and cleaning and sterilisation of equipment.

Name **two** properties of enzymes and for **each** explain why the conditions described may not be suitable.

[4 marks]

AO1 = 2 marks
AO2 = 2 marks
AP Reference = A.8.10.0.2, A.8.10.0.4, and A.8.10.0.5

Answer

Explanation

Award **one** mark for each property of enzymes named, up to a maximum of **two** marks (AO1).
Award **one** mark for each explanation given for unsuitability of storage area described in the question scenario, up to a maximum of **two** marks (AO2).

- Enzymes are limited stability products (1) (AO1) prep room activities could lead to moisture in the air encouraging microbial growth on the enzyme (therefore causing degradation). (1) (AO2)
- Enzymes are thermolabile/broken down by high temperatures (1) (AO1) and the container could be subjected to direct sunlight and/or excessive temperatures, from the south facing window. (1) (AO2)
- Protease enzymes are irritants (1) (AO1) and should be stored inside a secure locked cupboard/storeroom to prevent accidental exposure. (1) (AO2)

Accept any other suitable response.

1 (d) A buyer for a company has the chance to purchase a bulk order of a raw material every 20 weeks, at a reduced price.

Using the information in the table below, calculate the cost of the raw material and storage over a 20 week period at both the **bulk order price** and the **normal price**.

Show your working.

Normal unit price	Normal order size. 4 weekly	Average usage rate per week	Bulk order unit price	Bulk order size 20 weekly	Lifespan of product.	Storage cost per unit for 4 weeks	Storage cost per unit for 20 weeks
£5.75	1,000	250	£5.25	5,000	20 weeks	£0.50	£0.60

[4 marks]

AO2 = 4 marks
AP Reference = A.8.9.0.1, A.8.9.0.2, A.8.9.0.3 and A.8.9.0.4

Answer

Calculation

Award **one** mark for each correctly identified calculation, up to a maximum of **two** marks, and award **one** mark for each correct answer, up to a maximum of **two** marks:

Award a **maximum** of **four** marks**:**

- (total cost of purchase and storage over 20 weeks at £5.75/)normal price = 20 ÷ 4 x 0.50 x 5000 + 5000 x 5.75 (1) =. £41,250 (1) (AO2)
- (total cost of purchase and storage over 20 weeks at £5.25/)reduced price = 5000 x 5.25 + 5000 x 0.6 (1) = £29,250 (1) (AO2)

1 (e) Below is a new company's approach to implementing SOPs:

- human resources write all SOPs
- the SOPs are placed on the company intranet and website
- highly visible posters are also placed at the sites where the procedures will be carried out.

Assess what may be missing from the company's approach to implementing SOPs.

Your response should demonstrate:

- reasoned judgements about what may be missing from the company's approach.

[5 marks]

AO3 = 5 marks
AP Reference = A.2.6.0.3, A.2.11.0.1, A.2.11.0.2, A.2.11.0.3 and A.8.1.0.1

Answer

Award up to **one** mark for each reasoned additional process/procedure for implementing SOPs, up to a maximum of **five** marks:

- staff training will need to be carried out to ensure that SOPs are understood (1)
- staff training will need to be carried out to ensure SOPs are used consistently (1)
- the company must introduce an effective monitoring procedure to ensure SOPs are used consistently (1)
- staff training will need to be carried out to ensure the monitoring procedure is used consistently (1)
- staff training will need to be carried out to ensure outcomes of the monitoring procedure are actioned (1)
- the company must introduce an effective monitoring procedure to ensure consistently (1)
- HR may not be experts and therefore the SOP may not comply/be fit for purpose as they need to be written by experts (1)
- as SOPs need to be constantly updated, review dates will need to be added and the SOPs re-written by experts in that field at that review date (1)
- the company is new, as it develops it may need more SOPs for new procedures. (1)

Accept any other suitable response.

2 A consultant is responsible for the medical care of a 13 year-old child with learning difficulties who has a severe leg injury.

The consultant wants to give an immediate blood transfusion and amputate the leg to prevent further suffering.

If untreated, the injury will leave the leg paralysed, cause continuous pain throughout life and cause secondary damage to other areas of the body.

Only one parent is at the hospital with the child and their religious beliefs prevent them from consenting to the procedures.

Evaluate the consultant's proposed actions, considering the key principles below:

- autonomy and informed consent
- beneficence
- nonmaleficence.

Your response should demonstrate:

- reasoned judgments about the consultant's proposed response.

[9 marks, plus 3 marks for QWC]

AO1 = 3 marks
AO2 = 3 marks
AO3 = 3 marks
QWC = 3 marks
AP Reference = A.1.3.0.1, A.1.3.0.3 and A.1.3.0.4

This is a band marked question.

Band	Mark	Descriptor
3	7–9	**AO3** Evaluation of the consultant's proposed actions and how these key principles apply in this context 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 evident. **AO2** Applied all **relevant** knowledge of these 3 key principles of ethical practice (autonomy and informed consent, beneficence and nonmaleficence) to the given context and shows a **detailed** functional understanding of the diagnostic tools involved. **AO1** A **wide range** of relevant knowledge and understanding of the key principles of ethical practice which and is **accurate** and **detailed**. The answer demonstrates **comprehensive** breadth and/or depth of understanding.

2	4–6	**AO3** Evaluation of the consultant's proposed actions and how these key principles apply in this context 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 evident. **AO2** Applied **mostly relevant** knowledge of these 3 key principles of ethical practice (autonomy and informed consent, beneficence and nonmaleficence) to the context, showing **some** functional understanding of how they can be applied in this scenario. **AO1** Knowledge and understanding of the key principles of ethical practice is **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 consultant's proposed actions and how these key principles apply in this context is in **some parts effective** and of **some relevance,** with some understanding and reasoning taking the form of **generic statements** with some development. Brief conclusions supported by reasoned judgements that consider only basic arguments and show little relevance to the question aims are evident. **AO2** Applied **limited** knowledge of these 3 key principles of ethical practice (autonomy and informed consent, beneficence and nonmaleficence) to the context and may show a **lack** of functional understanding of the diagnostic tools. **AO1** Knowledge and understanding of the key principles of ethical practice shows **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

AO1 and AO2 will be implicit through the level of evaluation and reasoned judgements/and or conclusions that the learner provides.

(AO1) Key principles

Autonomy and informed consent:

- the right of a patient to make informed decisions regarding their care (even if this contradicts the consultant advice).

Beneficence:

- beneficence is the balancing of the benefits of treatment against the risks and costs involved.

Nonmaleficence:

- nonmaleficence is avoiding the causation of harm.

(AO2) Application of knowledge

Autonomy and informed consent:

- (according to law) children under the age of 16 can give consent if they are deemed to have sufficient capacity (intelligence, competence and understanding) to fully appreciate what's involved in their treatment. In this case the patient may not have capacity (to give informed consent)

OR

- (according to law) children under the age of 16 can give consent if they are deemed to have capacity (sufficient intelligence, competence and understanding) to fully appreciate what's involved in their treatment. In this case the learning difficulties may be minor and the child may have the capacity (to give informed consent).

Beneficence:

- the treatment will (prevent the death of the child and) prevent further suffering due to pain from the damaged leg. However, there is a risk/cost of the effect of a limb amputation on the child's mental health
- there is a risk/cost of potential legal action from the parent present, if the consultant proceeds against the parent's wishes.

Nonmaleficence:

- not carrying out the blood transfusion would cause the child to die, which is harm
- not carrying out the amputation would cause the child continued pain, which is a form of harm
- if the child shared the religious beliefs of the parent, the consultants proposed actions would save their life, but could damage their mental health which is harm.

(AO3) Evaluation/Reasoned judgements/conclusions:

- the child's learning difficulties may be minor (and not affect their capacity to give informed consent.) Following the wishes of the parent would be denying the child's autonomy as a patient, therefore the proposed approach needs to be discussed with the child
- the consultant's proposal (will save the life of the child but) will go against the parent's wishes. If the child's learning difficulties prevent them from having the capacity to give informed consent, this may be denying the parent's autonomy and therefore the proposed approach needs to be discussed with the parent
- if the consultant is successful in seeking a court order to overrule the parent's wishes, the time this

takes may result in the death of the child
- amputation is causing harm (and may cause mental health problems), but the benefits of preventing further suffering (and further potential damage) may well outweigh the harm caused
- as only one parent is present, not carrying out the procedure according to the wishes of the parent present will lead to the death of the child, which may lead to the other parent taking legal action against the consultant for not treating their child when this was possible.

Accept any other suitable response.

QWC mark scheme

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: Ethics, data and managing personal information in the science sector

This section is worth 25 marks, plus 3 marks for QWC and use of specialist terminology.

3 Which of these market research mechanisms would produce qualitative data?

A. Asking consumers how many disinfectant products they bought per month.
B. Asking consumers to rate a range of disinfectant products by giving each one a score from 1–10.
C. Asking consumers why they preferred one disinfectant product more than another.
D. Asking consumers how much they spent on disinfectant products per month.

[1 mark]

AO1 = 1 mark
AP Reference = A.6.2.0.1 and A.6.2.0.2

Answer

C. Asking consumers why they preferred one disinfectant product more than another.

4 (a) Company A produces a disinfectant spray called 'Germsnomore' and has not registered the trademark.

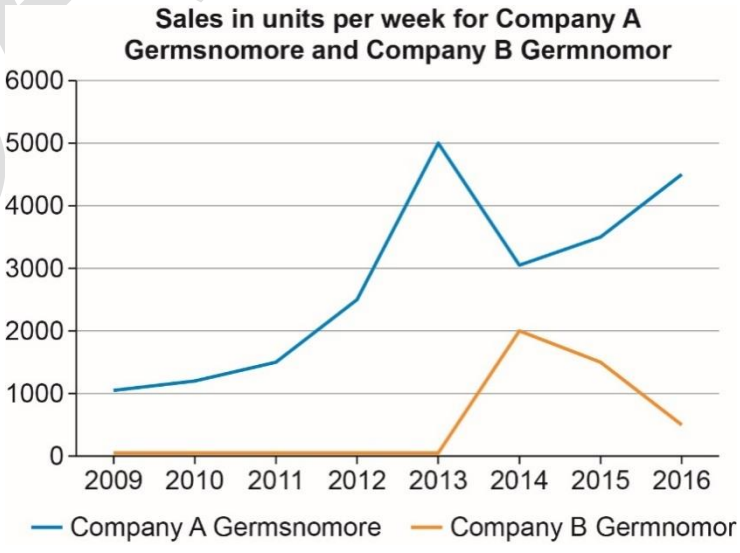
After 5 years company B starts to produce a disinfectant called 'Germnomor' marketed in very similar packaging.

The graph shows the sales of each disinfectant as units sold per week over 8 years.

Give **one** possible reason for the change in sales of Company A:

i) between 2013 and 2014

and
ii) between 2014 and 2016



[2 marks]

AO2 = 2 marks
AP Reference = A.7.5.0.2

Answer

Possible reasons for change, 2013 to 2014:

Award a maximum of **one** mark from this section**.**

- Large numbers of customers mistake Germnomor for Germsnomore and buy it therefore Germsnomore sales fall. (1)
- Germnomor is sold at a lower price than Germsnomore therefore more customers buy it and Germsnomore sales fall. (1)

Possible reasons for change, 2014 to 2016:

Award a maximum of **one** mark from this section.

- Customers discover Germnomor is an inferior product to Germsnomore and revert to buying Germsnomore therefore sales rise. (1)
- There may be (a link to) health effects from using Germnomor so customers have reverted back to using Germsnomore and therefore a rise in sales. (1)
- Company A adopts a more successful marketing strategy for Germsnomore and therefore sales rise. (1)

Accept any other suitable response.

4 (b)i How can the company protect a new antibiotic to prevent other companies from producing it?

[1 mark]

AO1 = 1 mark
AP Reference = A.7.5 .0.1

Answer

Award a maximum of **one** mark.

- Patent the drug. (1)

Accept any other suitable response relating to patenting the drug.

4 (b)ii On average it is a 5 year process to bring a new antibiotic to market.

Describe **two** aspects of this process which could be considered to be intellectual property.

[2 marks]

AO1 = 2 marks
AP Reference = A.7.6.0.1, A.7.6.0.2, A.7.6.0.3, A.7.6.0.4 and A.7.6.0.5

Answer

Award up to **one** mark for each valid aspect that could be considered intellectual property, to a maximum of **two** marks:

- the research papers and any records produced during the research and development (1)
- any equipment bespoke to/designed for the research and development (1)
- the mechanism of production of the final product (1)
- anything with a potentially commercial application (for example, product/formulation/recipe). (1)

5 (a) Researchers planted five wheat plants with a companion bean plant and five wheat plants without, to see if companion planting increased yield.

The seeds from the five plants in each condition were collected, dried and weighed.

The weights of these seeds are shown in the table below.

	Weight of seeds in grams					Mean
A. With companion plant	52	12	3	31	2	20
B. Without companion plant	17	23	19	17	24	20

Researchers concluded that companion planting does not increase yield.

Evaluate the researcher's conclusions.

Your response should demonstrate:

- reasoned judgements and/or conclusions.

[6 marks]

AO2 = 3 marks
AO3 = 3 marks
AP Reference = A.6.9.0.1, A.6.12.0.1, and A.9.2.0.2.3

Award a maximum of **three** marks (AO2) and **three** marks (AO3).

- The sample size is very small. (1) (AO2)
- The sample size would need to be increased significantly to enable statistical analysis (to increase validity of the conclusions). (1) (AO3)
- There are no controlled variables identified. (1) (AO2)
- Variables would need to be identified and controlled to ensure that the presence/absence of the companion plant is the factor causing any observed affect. (1) (AO3)
- They only investigated one type of companion plant. (1) (AO2)
- A range of companion plants would need to be investigated, as other types may have increased yield (before this conclusion can be made). (1) (AO3)
- They only investigated one type of crop plant. (1) (AO2)
- A range of crop plants would need to be investigated, as other types may have benefited from the companion plant (before this conclusion can be made). (1) (AO3)

Accept any other suitable response.

5 (b) Two companies carry out clinical trials of a hay fever drug.

In both, the participants were either given the drug or a placebo.

Company A had 1000 participants, neither the researchers nor the participants are aware of who was receiving the drug or the placebo. The participants were screened for other drugs in their system, which could affect the trial.

Company B had 100 participants, and the researchers knew who had received the drug or placebo, the participants did not. The participants were not screened.

Explain which of the two trials is more likely to lead to reliable conclusions about the effects of the drugs.

[4 marks]

AO2 = 4 marks
AP Reference = A.6.11.0.1, A.6.12.0.1, A.6.12.0.5 and A.6.13.0.2

Award **one** mark for each valid explanation, up to a maximum of **four** marks**.**

- The Company A trial is more likely to lead to reliable conclusions, as it prevents bias. (1)
- Knowing who had received the drug or the placebo may affect the interpretation of the results, (leading to inaccurate/unreliable conclusions). (1)
- Knowing who had received the drug or the placebo may affect how participants are treated (leading to inaccurate conclusions). (1)
- Company A had a much larger sample size increasing accuracy of results (and enabling more reliable conclusions). (1)
- Company A, screened participants (as a control), to ensure any response shown could be linked to the trial drug (and not any other drug). (1)

Accept any other suitable response.

6 A director of a petrochemical company states that, "Companies gain more from the positive effects of social media than they lose from the negative effects."

Evaluate this statement.

Your response should demonstrate:

- consideration of the impact of social media
- reasoned judgements and/or conclusions about the statement.

[9 marks, plus 3 marks for QWC]

AO1 = 3 marks
AO2 = 3 marks
AO3 = 3 marks
QWC = 3 marks
AP Reference = A.5.8.0.1.1, A.5.8.0.1.2, A.5.8.0.1.3, A.5.8.0.1.4, A.5.8.0.1.5, A.5.8.0.1.6, A.5.8.0.1.7, A.5.8.0.1.8, A.5.8.0.2.1 and A.5.8.0.2.2

This is a band marked question.

Band	Mark	Descriptor
3	7–9	**AO3** Evaluation of the director's statement in relation to the positive and negative effects of social media for companies 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. **AO2** Applied all **relevant** knowledge of the positive effects of social media to establish the negative effects to the given context and shows a **detailed** functional understanding. **AO1** A **wide range** of relevant knowledge and understanding of the positive effects of social media, which is **accurate** and **detailed**. A **wide range** of **appropriate** technical terms are used.

2	4–6	**AO3** Evaluation of the director's statement in relation to the positive and negative effects of social media for companies 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 evident. **AO2** Applied **mostly relevant** knowledge of the positive effects of social media to establish the negative effects, showing **some** functional understanding of the impact of these. **AO1** Knowledge and understanding of the positive effects of social media **is in most parts clear** and **mostly accurate**, although on occasion **may lose** focus.
1	1–3	**AO3** Evaluation of the director's statement in relation to the positive and negative effects of social media for companies 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 the positive effects of social media to establish the negative effects to the context and may show a lack of functional understanding. **AO1** Knowledge and understanding of the positive effects of social media show **some** but **limited** accuracy**,** focus and relevance.
	0	No creditworthy material.

Indicative content

AO1 and AO2 will be implicit through the level of evaluation and reasoned judgements/and or conclusions that the learner provides.

(AO1) Positive effects:

- contacting huge numbers of people quickly
- contacting people who are difficult to reach through more traditional methods (for example, newspapers and TV advertising)
- information/awareness campaigns can be disseminated/made available
- information/awareness campaigns can be targeted to particular groups of people who have a certain profile
- fake news/misinformation can be corrected/countered/challenged
- communication can be very rapid in a crisis situation
- data can be gathered about a huge range of factors important to the company business
- it can be used as an effective recruitment tool
- it can be used for marketing/advertising.

(AO2) Negative effects:

- inaccurate and/or non-evidence-based information and/or deliberate misinformation and/or fake news can be spread quickly and widely
- professional boundaries and/or relationships with clients and/or service users can be eroded
- sensitive and/or personal information can be posted, potentially damaging the company
- customers are free to talk about the problems/issues they face when dealing with your company on social media
- an overreliance on social media can leave a company vulnerable to future changes that might be made to how the sites work and/or operate.

(AO3) Evaluation of effects

- People who increasingly look to social media as a way of finding products and/or investigating reliability of products and/or businesses and are difficult to reach through traditional mechanisms.
- As analysis of social media habits can lead to the identification of groups who may be potential consumers of a particular product survey-based market research may not be necessary.
- Due to the speed and wide reach of social media, information can be transmitted rapidly to large numbers enabling a rapid response to a particular situation.
- Due to the speed and wide reach of social media negative/fake information can be transmitted rapidly to large numbers which can cause lasting damage (even if the business succeeds in making the social media company take the post down).

(AO3) Reasoned judgements/conclusions about the overall positive effects

- If a company does not have a social media presence it will be increasingly difficult to remain competitive and innovative.
- Advertising through social media will become more important for businesses to reach their potential consumers as more people are accessing advertising through social media (and this may grow over time).
- Although there can be negative effects, businesses can employ strategies to minimise the impact of this, mitigating the negative effects on the business and retaining any positive impact.
- Although there can be negative effects on businesses from the use of social media, these are outweighed by the larger number of positive effects.
- Advertising can be targeted to groups who are likely to be potential consumers, this increases efficiency, thus raising profit.

(AO3) Reasoned judgements/conclusions about the overall negative effects

- There are large groups of people who do not have access to and/or choose not to access social media, so if a business relies only on social media for communication it will lose this section of its potential client base which will negatively affect profit.
- As some people resent social media companies accessing their online activities, they will use search engines which do not allow profiling, depriving businesses access to this section of its potential client base and negatively affecting profit.
- Some traditional businesses may regard not having a social media presence as being a

benefit, as more traditional methods of advertising (TV and newspapers) may be a better fit for their products. For these companies a social media presence may be detrimental to their profits.

- Damaging social media posts can be rapidly amplified, and if these posts are memorable or become popular, it can become difficult for the company to distance themselves and may damage their reputation, thus negatively affecting profits.

Accept any other suitable response.

QWC mark scheme

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: Health and safety in the science sector

This section is worth 25 marks, plus 3 marks for QWC and use of specialist terminology.

7 Below is a selection of work regulations:

w. Personal Protective Equipment (Enforcement) Regulations 2018
x. Control of Substances Hazardous to Health (COSHH) Regulations 2002
y. The Special Waste Regulations 1996
z. Health and Safety at Work etc Act 1974

A company needs a procedure to manage waste products that it regards as special waste.

Which of the regulations listed would the company need to consider?

A z only
B w, x, y and z
C y only
D w and z only

[1 mark]

AO1 = 1 mark
AP Reference = A3.1.0.1, A3.1.0.3, A3.1.0.4, and A3.1.0.7

Answer

B w, x, y and z

8 (a) Bacteriophages are viruses that infect bacteria. They have adapted to only infect bacterial cell walls and cannot attach to any other type of cell. They attach to the cell wall, inject their DNA, the virus reproduces and the cell dies.

Based on this information, explain whether bacteriophages should be regarded as a biohazard.

[2 marks]

AO1 = 1 mark
AO2 = 1 mark
AP Reference = A4.5.0.1

Award **one** mark AO1 and **one** mark AO2 only.

They should not be regarded as a biohazard (1) (AO1) as they cannot infect human cells/cause infection in humans. (1) (AO2)

Accept any other suitable response.

8 (b) Pathogen X caused an epidemic in 2003, resulting in around 8000 cases with 774 deaths.

The epidemic was brought under control using containment measures.

Pathogen X is regarded as a biohazard level 3.

In 2004, there was another smaller outbreak linked to a medical research facility.

Pathogen Y caused an epidemic in 2020 with 13 000 000 cases and 600 000 deaths.

Explain why Pathogen Y is also designated a biohazard level 3.

[2 marks]

AO2 = 2 marks
AP Reference = A.4.6.0.1, A.4.6.0.2, A.4.6.0.3 and A.4.6.0.4

Award **one** mark for each valid explanation given below, up to a maximum of t**wo** marks.

- Pathogen Y had a much higher number of cases and/or a much higher number of deaths than Pathogen X, however most people infected did not develop severe symptoms and/or die (therefore it is level 3). (1)
- Although Pathogen Y had a much lower percentage of deaths than Pathogen X, it still caused deaths (and therefore is level 3). (1)
- Although there were a very large number of cases, most people recovered (therefore it is level 3). (1)

Accept any other suitable response.

8 (c) A research laboratory is working to produce a vaccine to protect against a virus. Cultures of the virus are stored in the laboratory.

Below are two possible containment measures the laboratory could use:

- the laboratory could be kept at an air pressure negative to atmosphere
- the laboratory must contain all of its own equipment needed for the research.

Evaluate these measures to determine their effectiveness in virus containment.

Your response should demonstrate:

- reasoned judgments and/or conclusions about the effectiveness of the measures.

[6 marks]

AO2 = 4 marks
AO3 = 2 marks
AP Reference = A.4.8.0.2 and A.4.8.0.3

Negative internal air pressure AO2

Award **one** mark for each point below, up to a maximum of **two** marks.

- If the laboratory air pressure is negative to atmosphere, air will move in rather than out, ensuring airborne virus particles are less likely to escape. (1) (AO2)
- A negative air pressure does not prevent virus particles escaping in other ways (attached to researchers' clothing and/or apparatus being moved to other labs). (1) (AO2)
- A negative internal pressure would require air to be pumped out. (1) (AO2)
- A negative pressure would require the laboratory to be hermetically/completely sealed. (1) (AO2)
- A negative pressure would require an airlock entrance chamber which would be expensive. (1) (AO2)
- Pressure would require an airlock entrance chamber which would be expensive. (1) (AO2)

Conclusion

Award a maximum of **one** mark.

- Although this reduces the chance of viral escape (from the laboratory), it requires additional strategies to be effective, including HEPA filtering and/or hermetic and/or complete sealing to ensure it contained no virus particles. (1) AO3

Laboratory contains all its own equipment AO2

Award a maximum of **two** marks.

- If the laboratory has all its own equipment, staff will not need to leave to borrow equipment. (1) (AO2)
- Entry/exit of staff could be limited to the start and end of shifts. (1) (AO2)
- This may require expensive equipment, which is normally shared between labs, to be replicated in each lab. (1) (AO2)
- Staff from other labs may seek access to this equipment. (1) (AO2)

Conclusion

Award a maximum of **one** mark.

- Although this reduces the chance of the viral escape, it requires additional strategies to be effective (such as additional equipment and/or strict protocols on who can enter). (1) (AO3)

Accept any other suitable response.

8 (d) Five strategies for promoting health and safety at work are shown below:

- encouraging individuals to take reasonable care of their own and others' safety
- following organisational policies and standard operating procedures (SOPs), including site-specific emergency procedures
- completing statutory training
- ensuring working environments are clean, tidy and hazard-free
- modelling good practice (for example, washing hands and wearing appropriate PPE).

Evaluate the effectiveness of **each** strategy for keeping staff healthy and safe in the workplace.

Your response should demonstrate:

- reasoned judgements and/or conclusions about the effectiveness of each strategy.

[5 marks]

AO3 = 5 marks
AP Reference = A3.3.01, A3.3.02, A3.3.03, A3.3.08, A3.3.09 and A3.3.0.10

Award **one mark for each of the following** up to a **maximum** of **five** marks**.**

Response to 1st strategy:
- Although individuals taking reasonable care should enhance/increase safety, the effectiveness of this depends on their knowledge of how to keep safe. (1)

Response to 2nd strategy:
- Although individuals following organisational policies and SOPs should enhance/increase safety this is dependent on the quality of the organisational policies and SOPs, (which need to be well designed). (1)

Response to 3rd strategy:
- Individuals completing statutory training should enhance/increase safety by ensuring they understand organisational procedures and/or SOPs. (1)
  OR
- The quality of the staff training will determine how effective this is in promoting health and safety. (1)

Response to 4th strategy:
- If the working environment is clean, tidy and hazard free, this should enhance/increase safety, as the environment should be free of trip/slip hazards. (1)
  OR
- If the working environment is clean, tidy and hazard free, this should increase safety, as safety notices are more likely to be visible. (1)

Response to 5th strategy:

- Management modelling good practice creates a culture of good practice and should enhance/increase safety. (1)
  OR
- Management modelling good practice may not work in smaller organisations or where staff carry out lone work as they may not observe good practice. (1)

Accept any other suitable response.

9 A chemical spill has taken place. A 50 litre container of a liquid was kept in a laboratory storeroom at the back of a busy laboratory. Someone knocked over the container and the lid was damaged. Approximately 15 litres of the liquid spilled and some entered a drain.

A science technician described how they would clean up a chemical spill. Below is a list of bullet points which summarises the science technician's description:

- put on PPE
- lift the container and replace the lid
- place a spill sock around the spillage
- spread absorbent pellets all over the spillage
- transfer the pellets from the spill into a suitable bag
- clean the area with spill pads
- transfer the used spill socks and pads into the same bag
- seal securely and label as hazardous
- place the bag in the designated waste management area
- inform supervisor.

Evaluate the techniques stated by the science technician, in relation to the regulations below.

- Control of Substances Hazardous to Health (COSHH) 2002.
- Hazardous Waste (England and Wales) 2005.

Your response should demonstrate:

- reasoned judgements and/or conclusions about the techniques.

[9 marks, plus 3 marks for QWC]

AO1 = 3 marks
AO2 = 3 marks
AO3 = 3 marks
QWC = 3 marks
AP Reference = A.3.4.0.1, A.3.4.0.2, A.3.4.0.3, A.3.4.0.4, A.3.4.0.5 and A4.2.0.1

Band	Mark	Descriptor
3	7–9	**AO3** Evaluation of the trainee technician's response is **comprehensive**, **effective,** and **relevant**, showing **detailed** understanding and **logical** and **coherent** chains of reasoning throughout. **Effectively** informed reasoned judgements that are **fully** supported and rational and balanced conclusions are evident. **AO2** Application of knowledge of techniques in relation to the Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002 and the Hazardous Waste (England and Wales) Regulations 2005 is **highly appropriate** and shows a **detailed** functional understanding of how these can be applied in this specific situation. **AO1** A **wide range** of relevant knowledge and understanding of Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002, and the Hazardous Waste (England and Wales) Regulations 2005, which is **accurate** and **detailed**. A **wide range** of **appropriate** technical terms are used.
2	4–6	**AO3** Evaluation of the trainee technician's response is **in most parts effective** and **mostly relevant**, showing **mostly logical and coherent** chains of reasoning. **Mostly accurate** reasoned judgements and **mostly rational** and **balanced** conclusions are evident. **AO2** Application of knowledge of techniques in relation to the Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002, and the Hazardous Waste (England and Wales) Regulations 2005 is **in most parts appropriate**, showing **some** functional understanding of how these can be applied in this specific situation. **AO1** Knowledge and understanding of Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002, and the Hazardous Waste (England and Wales) Regulations 2005 **is in most parts clear** and **mostly accurate**, although on occasion **may lose** focus.

1	1–3	**AO3** Evaluation of the trainee technician's response is in **some parts effective** and of **some relevance,** with some understanding and reasoning taking the form of **generic statements** with some development. Reasoned judgements are **basic** and **brief;** conclusions will have **limited** rationality and balance. **AO2** Application of knowledge of techniques in relation to the Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002, and the Hazardous Waste (England and Wales) Regulations 2005 is **limited** and may show a lack of functional understanding of how these can be applied in this specific situation. **AO1** Knowledge and understanding of Control of Substances Hazardous to Health (COSHH) Regulations 1994 and subsequent amendments 2002, and the Hazardous Waste (England and Wales) Regulations 2005 show **some** but **limited** accuracy**,** focus and relevance.
	0	No creditworthy material

Indicative content

AO1 and AO2 will be implicit through the level of evaluation and reasoned judgements/and or conclusions that the learner provides.

Techniques may include:

(AO1) Key principles

Control of Substances Hazardous to Health (COSHH)

- Assess the risks that the spilled chemical substances pose to people's health.
- Communicate the hazard (to people working in the immediate area, supervisors, emergency services if appropriate).
- Isolate and evacuate the immediate area.
- Assess the type of PPE required to ensure it is appropriate.
- Control the spill, to stop any further spillage.
- Control the spill to stop any further spread (by placing a spill sock around the spill and absorbent pellets onto the it).
- Clean up the spill (with absorbent pellets and spill pads).
- Transfer the used pellets and pads into a suitable plastic bag.

Hazardous Waste (England and Wales) Regulations 2005

- Dispose of the waste using a suitable bag labelled as hazardous and sealed securely.
- Pack waste securely in line with carriage regulations (using a suitable bag, labelled as hazardous and sealed securely).
- Store waste securely in the designated area.
- Select appropriate treatment or waste disposal method.

(AO2) Techniques in relation to the Control of Substances Hazardous to Health Regulations (COSHH) may include

- Assess the risks the chemical spill poses to people's health. Risk assessments of all materials and equipment should be readily available to ensure that staff can make an informed and appropriate response.
- Communicate the hazard to people working in the immediate area, (supervisors, emergency services if appropriate), to ensure that staff are aware of the spill, the potential risks and how to mitigate these.
- Isolate and evacuate the immediate area, if appropriate. To ensure that staff are not exposed to unnecessary risk.
- Ensure that the type of PPE required is assessed and appropriate for the risk identified, ensuring that the staff member dealing with the spill is appropriately protected (and risk minimised).
- Control the spill to stop any further spillage. Lifting the container back up and replacing the lid would prevent further spillage.
- A barrier spill sock placed around the spill would prevent further spread and enter the drain.
- Spreading absorbent pellets onto the spill would slow evaporation into the atmosphere, and/or slow the flow of the liquid (so that the clean-up procedure can begin).
- Selecting a suitable bag and transferring clean up materials (used pellets, spill sock and spill pads) into it, would prevent further contamination.

(AO2) Techniques in relation to the Hazardous Waste (England and Wales) Regulations 2005 may include

- Selecting an appropriate bag would prevent leakage and further contamination.
- Sealing the bag securely would prevent leakage and further contamination.
- Labelling the bag would ensure that it was handled appropriately (by the lab staff and the waste management service).
- Storing waste securely on site in the designated area, would ensure that the materials were not interfered with and any leakage would be contained.
- Selecting an appropriate treatment or waste disposal method would ensure that lab staff and/or waste management service were not put at unnecessary risk (different materials will require specific treatment and disposal).

(AO3) Evaluation/reasoned judgements and/or conclusions: in relation to the Control of Substances Hazardous to Health Regulations (COSHH)

- They showed a generic response to the spill, with some clear knowledge of how to deal with a spill and their procedure may well have worked, however as they did not carry out a risk assessment this could have led to injury or further contamination.
- They did not assess the level of risk of the spill, therefore their choice of PPE and/or clean up mechanisms may not have been appropriate. This would have put themselves and others at risk.
- They did not communicate with people in the immediate area; if the liquid had been dangerous, this would have put others at risk.
- They did not evacuate the area; if the liquid had been dangerous, this would have put others at risk.
- They did not report the spill to the environment agency; this could lead to legal action being taken (against the company and the individual).

- They did not report the spill to the environment agency; this could lead to environmental damage and legal action being taken (against the company and the individual).
- They did not complete RIDDOR/accident forms detailing the incident; this could lead to repeat of the incident and/or legal action being taken (against the company and the individual).

(AO3) Evaluation/reasoned judgements and/or conclusions in relation to the Hazardous Waste (England and Wales) Regulations 2005

- They did appear to comply with all the hazardous waste management procedures, however as no initial risk assessment was completed, it is unclear if the treatment and disposal method was appropriate.

Accept any other suitable response.

QWC mark scheme

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 D: Scientific methodology, equipment and techniques

This section is worth 25 marks, plus 3 marks for QWC and use of specialist terminology.

10 A technician uses light microscopy to examine material.

They place the material on a microscope slide. They then stain the material to make the image clearer and to highlight particular features.

What is the name of this method?

A Differential staining
B Gram staining
C Simple staining
D Mordant staining

[1 mark]

AO1 = 1 mark
AP Reference = A.10.6.0.1

Answer

C Simple staining

11 (a) A medical technician is using a haemocytometer slide to carry out a blood cell count.

What assumptions must the technician make about the distribution of cells in the counting area before the count takes place?

[2 marks]

AO2 = 2 marks
AP Reference = A6.12.01 and A10.6.0.4

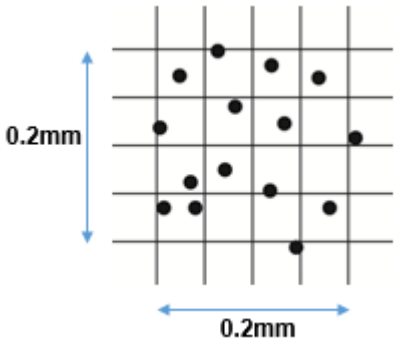
Answer

Award **one** mark for each assumption, up to a maximum of **two** marks.

- That the blood cells are evenly distributed throughout the sample. (1)
- The sample is representative of the whole sample. (1)

11 (b) The diagram below shows a haemocytometer slide and the distribution of red blood cells.

How many red blood cells would be included in the count? Explain your answer.



[2 marks]

AO1 = 1 mark
AO2 = 1 mark
AP Reference = A6.12.0.1 and A10.6.0.4

Answer

Award **one** mark for correct total (AO1) and **one** mark for valid explanation (AO2), up to a maximum of **two** marks only.

- 13 (1) (AO1)
- Count any cell touching/straddling the left and top lines of the 16 squares as in, and those touching the bottom and right as out. (1) (AO2)

OR

- 12 (1) (AO1)
- Count any cell touching/straddling the right and bottom lines of the 16 squares as in, and those touching the top and left as out. (1) (AO2)

11 (c) The blood sample being counted has come from a patient with the disease hepatitis C.

Using your knowledge of aseptic technique, identify **two** actions the technician could take to protect herself in this situation and explain why these actions would be effective.

[4 marks]

AO1 = 2 marks
AO2 = 2 marks
AP Reference = A10.6.0.4, A.10.8.0.7, A.10.8.0.8, A.10.8.0.9, A.10.8.0.10, A.10.8.0.11 and A.10.8.0.12

Answer
Award a maximum of two marks for valid actions and two marks for valid explanations.

Action
Wear appropriate PPE including disposable gloves, mask and eye protection. (1) (AO1)

Explanation
As the blood could contain hepatitis C, pathogens/virus masks and eye protection prevent infection, gloves would prevent transmission to the mouth, nose and eyes later. (1) (AO2)

Action
Reducing draughts by closing doors and windows and turning off fans. (1) (AO1)

Explanation
The blood could contain the pathogen/virus, moving air could cause airborne blood droplets which could enter the nose, eyes or mouth. (1) (AO2)

Action
Not consuming food or drinks in the laboratory. (1) (AO1)

Explanation
Any contamination of the hands or work surfaces could be transmitted to the food and therefore enter the body when the food is eaten. (1) (AO2)

Action
Placing used equipment into a suitable sterilising solution/environment. (1) (AO1)

Explanation
Prevents accidental contamination by the pathogen/virus on or in used equipment. (1) (AO2)

Accept any other suitable response.

11 (d) **Cryogenic equipment** and **glove boxes** are two pieces of equipment commonly used in laboratories.

Describe their use when undertaking scientific techniques.

[2 marks]

AO1 = 2 marks
AP Reference = A10.3.03 and A10.3.08

Answer

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

- Cryogenic equipment is used to produce exceptionally low temperatures (well below what a freezer could produce). (1)
- Glove boxes provide a contained and controlled environment (sealed atmosphere) for manipulating samples and/or substances and/or objects, (preventing contamination/escape of toxins or microbes etc). (1)

12 Two examples of scientific literature sources are:

Source 1
A scientific paper published in 'Nature', an established and respected scientific journal.

Source 2
A scientific article published in a national newspaper, written by a respected university professor.

A teacher working with their class states that the first source is much more reliable than the second, and that the second has no value.

Evaluate the teacher's statement.

Your response should demonstrate:

- reasoned judgements and/or conclusions about the validity of the teacher's statement.

[5 marks]

AO3 = 5 marks
AP Reference = A.9.6.0.4 and A.9.6.0.5

Answer

Reasoned judgements and/or conclusions

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

- Source 1 has been peer reviewed and a newspaper has no such requirement. This should ensure that source 1 is more reliable than source 2. (1)
- Although source 2 is less reliable, this does not mean it has no value, it has been written by a respected university professor (but has not been peer assessed to prove or disprove its reliability). (1)
- Reliability and quality vary across newspapers, being less reliable does not mean it has no value. (1)
- Scientific journals should not show bias (increasing the reliability of source 1), most newspapers have some form of bias decreasing reliability of source 2.
- Bias will not be shown in every article that a newspaper publishes, therefore source 2 may not be subject to bias and therefore have value. (1)
- The newspaper may have commissioned the professor to write source 2 in a more accessible format than in a scientific journal, which would be unsuitable for a journal but may still have value. (1)

Accept any other suitable response.

13 Tributyltin (TBT) is used on the hulls of ships. It is toxic to most marine life.

A biology student investigated the effects of different concentrations of TBT on the reproductive rate of dog whelks.

Dog whelks inhabit rocky seashores and feed on mussels, barnacles and limpets.

The research method is described below:

Five 50 litre glass aquariums containing sea water with different concentrations of TBT were set up next to a large window as shown in the table below:

	1	**2**	**3**	**4**	**5**
Concentration of TBT ngL^{-1}	0	3	6	9	12

10 male and 10 female whelks collected from a shore close to a busy port, were placed in each aquarium.

Each aquarium contained the same number of live mussels.

The water is collected from the same shore and is constantly filtered, aerated and maintained at $10^{o}C$.

The aquariums were inspected daily, and any hatchlings removed and counted.

The investigation ran from January 1st to December 31st in one year.

Evaluate the student's methodology to determine if this approach would produce reliable results.

Your response should demonstrate:

- reasoned judgements about the outlined methodology and/or conclusions about the effectiveness and reliability of this methodology.

[9 marks, plus 3 marks for QWC]

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

AP Reference = A6.12.0.1, A6.12.0.2, A6.13.0.2, A.9.11.0.1, A.9.11.0.2, A.9.11.0.3, A.9.11.0.4 and A9.2.0.2.1, A9.2.0.2.2 and A9.2.0.2.3

This is a band marked question.

Band	Mark	Descriptor
3	7–9	**AO3** Evaluation of the biology student's methodology in relation to the effects of TBT on the reproductive rate of dog whelks 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 judgements are evident. **AO2** Applied all **relevant** knowledge of the techniques used in the methodology to the given context and shows a **detailed** functional understanding of the methods used with suggested amendments/improvements. **AO1** There is a **wide range** of relevant knowledge and understanding of the relevant factors used in the methodology which is **accurate** and **detailed**. A **wide range** of **appropriate** technical terms are used. The answer demonstrates **comprehensive** breadth and/or depth of understanding.
2	4–6	**AO3** Evaluation of the biology student's methodology in relation to the effects of TBT on the reproductive rate of dog whelks 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 evident. **AO2** Applied **mostly relevant** knowledge of the techniques used in the methodology to the context showing **some** functional understanding of the methods used and how these are applied in this specific situation. **AO1** Knowledge and understanding of the relevant factors used in the methodology **is 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 biology student's methodology in relation to the effects of TBT on the reproductive rate of dog whelks is **in some parts effective** and of **some relevance,** with some understanding and reasoning taking the form of **generic statements** with some development. Brief conclusions supported by judgements that consider only basic arguments and show little relevance to the question aims are evident. **AO2** Applied **limited** knowledge of the techniques used in the methodology to the context and may show a lack of functional understanding of the diagnostic tools. **AO1** Knowledge and understanding of the relevant factors used in the methodology 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

AO1 and AO2 will be implicit through the level of evaluation and reasoned judgements/and or conclusions that the learner provides.

AO1 Relevant factors/reference in evaluation and/or reasoned judgements

Relevant factors may include:

- sample size is sufficient to enable statistical analysis
- sampling technique is appropriate
- control variables are identified and controlled
- the appropriate independent variable is identified
- the appropriate dependent variables are identified
- the use of known standards or literature reviews
- reflecting on experimental design
- the reliability of the methods.

AO2 Techniques used in methodology

- The student **did** collect the water in the aquarium from the same site as the whelks, mimicking their natural habitat.
- The student **did** provide a range of concentrations of TBT including an aquarium with no TBT.
- The student **did** provide the whelks with a food source that they would consume in their natural habitat.
- The student **did** expose the aquariums to natural light, thus creating the changing light conditions they would experience throughout the year in their natural habitat.
- The student **did** conduct the investigation over one year, which is likely to allow for any seasonality in reproduction.
- The student **did** inspect the aquariums daily for hatchlings which were removed and counted.
- The student **did** control the possible variables in each aquarium (for example, food source, temperature) and maintained them at the same level.
- The student **did not** attempt to agitate the water to mimic the wave action found in their natural habitat.
- The student **did not** provide the whelks with a range of food sources they would consume in their natural habitat, which may affect reproductive rate.
- The student **did not** adjust the temperature of the aquariums each month to create temperatures found in their natural habitat (seasonally changing factors are reproductive triggers for many organisms), this may affect reproductive rate.
- The student **did not** provide other natural materials from their natural habitat, eg weeds, rocks etc, these may be necessary as egg laying sites.
- The student **did not** take into account the effect of artificial light in the laboratory. Seasonally changing factors are reproductive triggers for many organisms, this may affect reproductive rate.
- The student **did not** explain how they would record their results which could affect reliability.

AO3 Evaluation/reasoned judgements/conclusions

- TBT was likely to have been in the water due to its proximity to the busy port; this would alter the TBT levels the student attempted to create and invalidate all results.
- The student attempted to create some of the conditions found in the natural habitat, (natural light, mussels as food source and water from the collection point). There were (five) more conditions that they did not create (seasonal temperature changes, range of food sources, weed, rocks, agitation to represent wave action). The significant differences between the investigation and the natural environment may invalidate all the results.
- The lack of any statistical analysis would mean that the significance of any observed differences (between the different levels of TBT) could not be judged, thus affecting the reliability of the results.
- The student **did not** select a large enough sample size to ensure reliability of the results.
- The student **did not** provide any data (from a literature search) to justify the concentrations of TBT they have selected, which may have all been above or below the threshold to affect reproduction. This may invalidate all results.
- The student **did not** provide any data (from a literature search) on the typical reproductive rate of the dog whelk (to enable comparison), thus the student would not know if any variations (in reproductive rates) were due to the TBT concentrations or to naturally occurring variation, thus affecting the reliability of the results.

Accept any other suitable response.

QWC mark scheme

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
Working within the science sector

Question Number	AO1	AO2	AO3	Maths	QWC	Total
1(a)	1					1
1(b)	1	1				2
1(c)	2	2				4
1(d)		4		(4)		4
1(e)			5			5
2	3	3	3		3	12
Total	**7**	**10**	**8**	**0**	**3**	**28**
Totals required	**5–10 marks**	**8–14 marks**	**5–12 marks**	**0**	**3**	**28**
KiL	**1**					

Section B
Ethics, data and managing personal information in the science sector

Question Number	AO1	AO2	AO3	Maths	QWC	Total
3	1					1
4(a)		2				2
4(b)i	1					1
4(b)ii	2					2
5(a)		3	3			6
5(b)		4				4
6	3	3	3		3	12
Total	**7**	**12**	**6**	**0**	**3**	**28**
Totals required	**5–10 marks**	**8–14 marks**	**5–12 marks**	**0**	**3**	**28**
KiL	**4**					

Section C
Health and safety in the science sector

Question Number	AO1	AO2	AO3	Maths	QWC	Total
7	1					1
8(a)	1	1				2
8(b)		2				2
8(c)		4	2			6
8(d)			5			5
9	3	3	3		3	12
Total	**5**	**10**	**10**	**0**	**3**	**28**
Totals required	**5–10 marks**	**8–14 marks**	**5–12 marks**	**0**	**3**	**28**
KiL	**1**					

Section D
Scientific methodology, equipment and techniques

Question Number	AO1	AO2	AO3	Maths	QWC	Total
10	1					1
11(a)		2				2
11(b)	1	1				2
11(c)	2	2				4
11(d)	2					2
12			5			5
13	3	3	3		3	12
Total	**9**	**8**	**8**	**0**	**3**	**28**
Totals required	**5–10 marks**	**8–14 marks**	**5–12 marks**	**0**	**3**	**28**
KiL	**3**					

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Document information

The T Level Technical Qualification is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of Issue
v1.0	Published.		2020
v1.1	NCFE rebrand.		September 2021
v1.2	Sample added as a watermark	November 2023	22 November 2023