T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science (603/6989/9)

Paper A Elements 1–10

Paper number: **P002410**
Assessment date: **Monday 11 December 2023**
Time allowed: **2 hours 30 minutes**
Time: **9:00am – 11:30am**

Student instructions

- Use black ink.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.
- Read each question carefully.
- You **must** write your responses in the spaces provided. There may be more space than you need.
- You may do rough work in this answer book. Cross through any work you do not wish to be marked.

Student information

- The marks available for each question are shown in brackets. This is to help you decide how long to spend on each question.
- The maximum mark for this paper is **112**.
- In questions **6**, **11**, **15** and **20**, you will be assessed on your quality of written communication (QWC) and use of specialist terminology. Specifically, your ability to:
  - use good English
  - express and organise ideas clearly and logically
  - use appropriate technical terms.
- You may use a calculator.

Do not turn over until the invigilator tells you to do so.

Please complete / check your details below

Student Name:

Provider Name:

Student Number: Provider Number:

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For the multiple-choice questions, write **A, B, C** or **D** in the answer space. Do **not** circle **A, B, C** or **D** in the question.

For example:
Answer **C**

If you change your mind about an answer, you must put a cross through your original answer and then write your new answer next to it.

For example:
Answer ~~C~~ **B**

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

1 Which **one** of the following outlines the purpose of a person specification?

[1 mark]

A A detailed description of the role, including responsibilities, objectives and requirements

B A profile of the necessary skills and attributes required for an individual to succeed in the role

C The organisational policies and procedures which are relevant to the role being advertised

D The relevant legislation an individual must apply specific to the role within a science laboratory

Answer _____

2 State the purpose of safeguarding policies in scientific workplaces.

[1 mark]

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3 Give **two** reasons why it is important to adhere to quality standards, quality management and audit processes when working within the science sector.

[2 marks]

Please turn over for next question.

4 CheckCrete is a company that tests the composition of concrete. They have updated their employee handbook to include information about career development within the industry, as shown below:

> At CheckCrete we actively support our colleagues' continuing development by providing access to the following development opportunities, subject to availability:
>
> - option to enrol on a higher apprenticeship within the company
> - professional registration with the appropriate organisation.

(a) Explain how accessing **one** of the development opportunities given in the handbook might support progression within this workplace.

[2 marks]

(b) An employee suggests that the company should start offering internships for young people leaving school or college.

Justify the employee's suggestion.

[3 marks]

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5 Scientific workplaces frequently use highly sensitive and expensive equipment. The manufacturers of this equipment provide a schedule for maintenance checks, which include cleaning and servicing for this equipment.

An employee decides not to carry out their maintenance check this week as they are too busy.

Explain **two** potential impacts of the employee not following the maintenance schedule correctly.

[4 marks]

Please turn over for next question.

6 A company undertaking commercial research and development in a range of scientific disciplines, including health, food and energy, has been taken over by a new chief executive. During a presentation to staff they make the following statement:

> 'As an organisation we should spend more time and money on innovation within the disciplines we work in.'

Shareholders and the chief executive's colleagues are concerned that this could reduce productivity.

Evaluate the statement made by the chief executive.

Your response should include reasoned judgements and conclusions.

[12 marks, plus 3 marks for QWC]

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This is the end of section A.
Please turn over for the next section.

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

This section is worth **25** marks, plus **3** marks for the quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

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7 Which **one** of the following is an application of artificial intelligence in the recording and reporting of information and data?

[1 mark]

A Analysing and processing large data sets using bioinformatics tools

B Blending data from multiple datasheets in preparation for analysis

C Presenting research findings to a non-technical target audience

D Storing information in cloud-based systems to enable easier data sharing

Answer _____

8 Give **two** data collection methods which can be used in scientific investigations.

[2 marks]

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9 A local laboratory, testing the strength of wires, is taken over by a larger company. The chief scientist from the larger company wishes to convert the existing paper-based physical lab notebook system into an electronic laboratory information management system (LIMS), so that they can have easier data visualisation and searching.

The site is spread across a large area, so employees working on the same project in different departments may be across the site from each other.

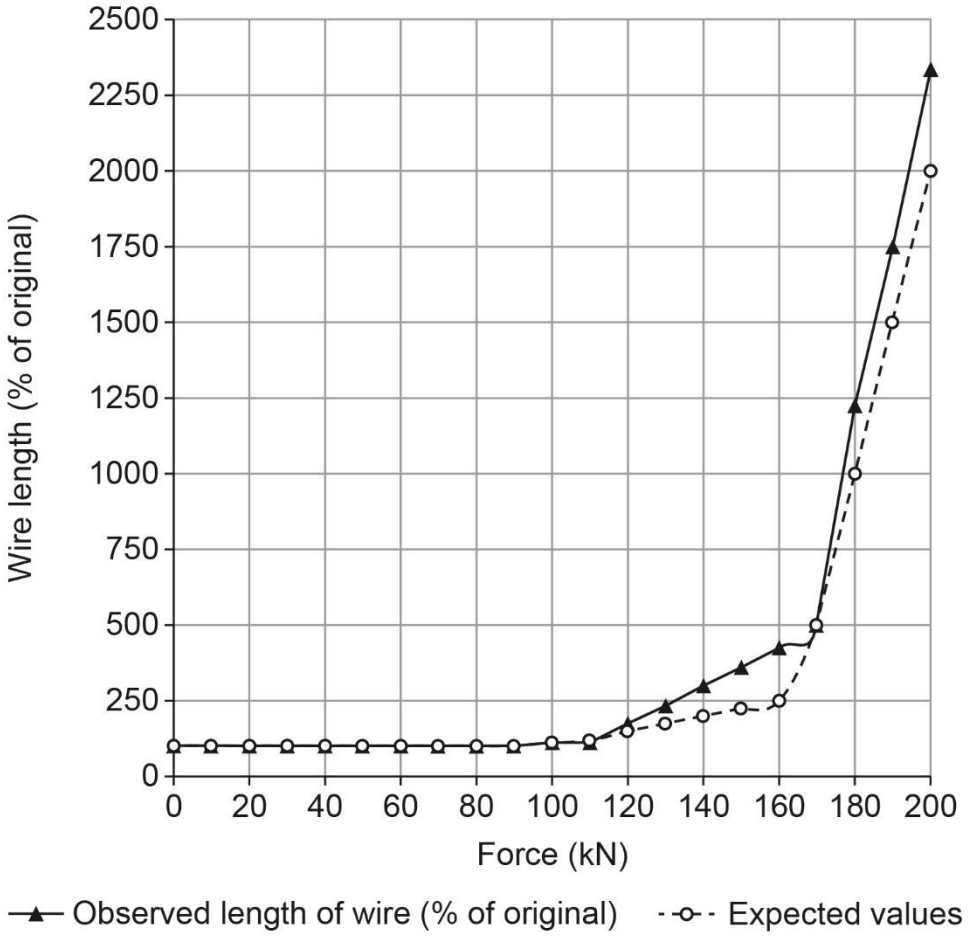
(a) Explain an advantage and a limitation of using LIMS.

[4 marks]

Please turn over for question 9 (b).

(b) In testing batches of wire, the company measures the force at which the wire begins to deform and the force at which the wire breaks. An example of their data is shown in **Figure 1.**

Figure 1: Observed results and expected results for force against wire length.



(i) Identify which statistical test should be used on these data.

[1 mark]

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(ii) The chief scientist notices a potential anomaly in the data at a force of 170 kN and suggests that the team compares their data to published work before moving onto the next stage of the investigation.

Assess the chief scientist's suggestion to compare their data to published work.

Your response should include reasoned judgements and a conclusion.

[3 marks]

Please turn over for next question.

10 In 1998, a published paper from a study suggested a link between the MMR (measles, mumps, and rubella) vaccine and autism. The study was later discredited as it was believed that the author had not acted with integrity within his work. The journal that had published this issued a complete retraction of this paper.

Explain how researchers who disproved this paper would have demonstrated integrity whilst working in their scientific research.

[2 marks]

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11 Whilst working in a research laboratory a scientist is not following company policies relating to responsible use of IT systems.

Using your knowledge and understanding of relevant legislation, confidentiality, and security measures, evaluate the importance and potential impact of responsible use of IT systems in a research laboratory.

Your response should include reasoned judgements and conclusions.

[12 marks, plus 3 marks for QWC]

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This is the end of section B.
Please turn over for the next section.

Section C: Health and safety in the science sector

This section is worth **25** marks, plus **3** marks for the quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

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12 Which **one** of the following is the correct purpose of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR)?

[1 mark]

A Controls the storage, transport, and disposal of hazardous waste (waste stream) to ensure it is appropriately managed and any risks are minimised

B Defines employers' duties to report serious workplace accidents, occupational diseases and specified dangerous occurrences ('near misses')

C Defines employers' responsibilities to provide appropriate personal protective equipment (PPE) to reduce harm to employees, visitors, and clients

D To reduce death, damage and injury caused by fire by placing legal responsibilities on employers to carry out a fire risk assessment

Answer _____

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13 The Health and Safety Executive publish a 5-step process for risk assessment.

(a) Give steps 4 and 5 of the Health and Safety Executive's 5 steps to risk assessment.

[2 marks]

Please turn over for question 13 (b).

13 A scientist working in a commercial microbiology laboratory has begun to assess the risks associated with following aseptic technique. Part of the risk assessment is shown in **Figure 2**. The risk matrix (**Figure 3**) is also shown on page 19, for reference.

(b) Complete the risk assessment using the table in **Figure 2**.

[4 marks]

Figure 2: Risk assessment

Person carrying out risk assessment:	J Mitchell Junior scientist
Venue:	Microbiology lab
Work activity:	Aseptic technique

Those at risk	Key
Own staff	OWN
Venue staff	VEN
Organisers	ORG
Visitors	VIS
Public	PUB
Contractors	CON
All persons on site	AOS

Hazard	Who might be harmed?	Likelihood	Severity	Total risk	Control measures	Likelihood	Severity	Total risk
Skin irritation caused by use of sterilisation fluids.	OWN	4	1	4	Use most dilute solutions available. PPE – disposable gloves to be worn	3	1	3
Burns caused by use of Bunsen burner to flame wire loop.	OWN	4	2	8				

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Figure 3: Risk matrix

Likelihood							Action
Almost certain	**5**	5	10	15	20	25	**20 - 25 STOP**
Highly likely	**4**	4	8	12	16	20	**12 - 16 URGENT**
Likely	**3**	3	6	9	12	15	**8 - 10 ACTION**
Unlikely	**2**	2	4	6	8	10	**4 - 6 MONITOR**
Extremely improbable	**1**	1	2	3	4	5	**1 - 3 NO ACTION**
		1	**2**	**3**	**4**	**5**	
		Minimal	**Minor injury**	**7 day + Injury**	**Serious injury**	**Severe / fatal injury**	
		Severity					

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14 A trainee school laboratory technician comes into the preparation room and discovers a broken bottle on a wooden bench. There is a liquid spilled on the bench, the benchtop is bubbling and a vapour is being emitted.

The technician immediately gets paper towels and places them onto the spillage to soak up the liquid. They dispose of the paper towels in the general waste bin and return to their previous work.

Assess the actions of the technician.

[6 marks]

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15 A biosafety manager is in charge of a food science laboratory that handles biohazardous material. They are writing a biohazard safety statement to outline the key features relating to health and safety when working with biohazards. The first draft has been circulated to colleagues for comments **(Figure 4).**

Figure 4: Biohazard Safety Statement

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Biohazard Safety Statement
Ebele Popoola, Biosafety Manager

When working with potential biohazards it is important to note a range of precautions which must be taken to ensure both safety and compliance with relevant legislation.

Legislation defines a biohazard as an organism which may cause a hazard to human health. These can be categorised, and the restrictions and precautions necessary depend on the category of the biohazard.

It is important that all colleagues understand the potential implications of not adhering to relevant regulations, and the containment and decontamination procedures in use.

Please ensure you have read this statement and fully understand your responsibilities when working with potentially biohazardous materials.

This statement is scheduled for review every 6 months.

With reference to health and safety, evaluate the extent to which this statement covers the most important aspects of working in a biohazardous environment.

Your response should include reasoned judgements and conclusions.

[12 marks, plus 3 marks for QWC]

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Section D: Scientific methodology, equipment and techniques

This section is worth **25** marks, plus **3** marks for the quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

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16 Which **one** of the following states the purpose of a negative control when identifying faults in experimental techniques?

[1 mark]

A To confirm that no other variable is responsible for positive results in the test

B To identify if there is a relationship between two variables in which one variable increases as the other decreases, and vice-versa

C To minimise the effects of unwanted variables on the outcome of the test

D To produce a known result which can be used to ensure that any negative results are true negatives and not a result of an issue with equipment or reagents

Answer _____

17 A new technician is working in a laboratory which uses a range of different chemicals in different experiments. The work they are initially asked to undertake includes handling phenol (a toxic and corrosive crystalline solid) and another experiment requiring them to handle compressed chlorine gas (a toxic oxidising agent which is also harmful to the environment).

Explain how the technician should handle these chemicals.

[4 marks]

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18 A metrology technician has been asked by a scientist working in their laboratory to investigate an analytical balance which has been showing inconsistent results. By comparing this to other balances, the scientist has determined that this one is faulty and asks the technician if they can help resolve this.

(i) Explain the potential causes of these faults.

[2 marks]

(ii) Explain how the technician should isolate and solve the fault the scientist is experiencing.

[2 marks]

Please turn over for the next question.

19 Whilst discussing the use of aseptic technique, a student makes the following statement:

> 'Aseptic technique is essential when working with microorganisms because it protects the scientist from contamination with dangerous microorganisms.'

Discuss the accuracy of the student's statement.

Your response should include reasoned judgements and a conclusion.

[4 marks]

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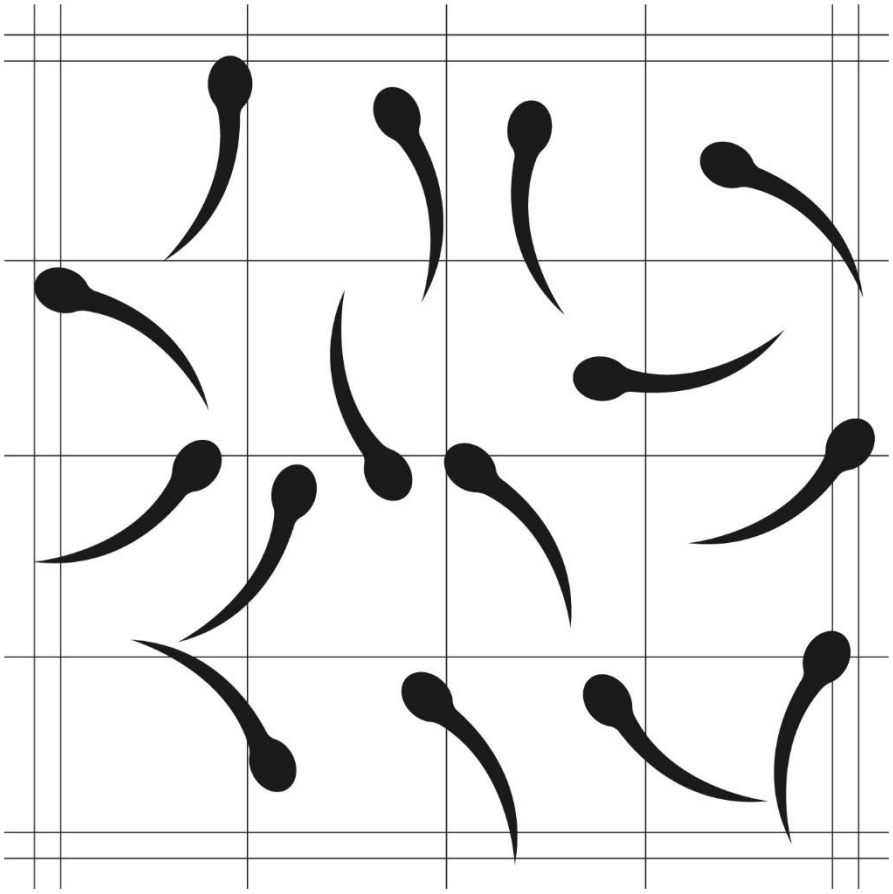
20 In a scientific investigation a scientist is attempting to count sperm cells from patient samples using a light microscope. The standard operating procedure is shown below:

1. Dilute the sample by taking 0.01 ml and adding this to 99.99 ml of sterile saline solution.
2. Use a micropipette to transfer 10 µl of the diluted sample to haemocytometer chamber.
3. Place the haemocytometer onto the microscope stage and count the number of sperm cells visible.
4. Calculate the number of sperm cells per ml of the original sample.

The results obtained from the microscopy is shown below, in **Figure 5**:

Figure 5: view of sperm sample in haemocytometer under light microscopy. Visible volume = 1 µl.



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The scientist calculates the sperm count as shown below:

Number of sperm cells visible: 15
Volume of haemocytometer: 1 µl
Cell count per ml of diluted sample: (15 ÷ 1) × 1000 = 15,000 cells per ml
Dilution of sample: 0.01%
Cell count per ml of original sample = 15,000 × 10,000 = 150,000,000 cells per ml

Using your knowledge of experimental design and sampling techniques, evaluate the scientist's methodology and analysis of results.

You **do not** need to include any additional knowledge relating to sperm or sperm counts.

Your response should include reasoned judgements and conclusions.

[12 marks, plus 3 marks for QWC]

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Document information

Owner: Head of Assessment Design

To be completed by the examiner			
Question	Mark	Question	Mark
1		11	
2		12	
3		13 (a)	
4 (a)		13 (b)	
4 (b)		14	
5		15	
6		16	
7		17	
8		18 (i)	
9 (a)		18 (ii)	
9 (b) (i)		19	
9 (b) (ii)		20	
10			
		TOTAL MARK	