T-LEVELS | Institute for Apprenticeships & Technical Education

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

Paper A Elements 1–10

Paper number: **P001926**
Assessment date: **Monday 19 June 2023**
Time allowed: **2 hours 30 minutes**
Time: **9:00am – 11:30am**

Student instructions

- Use black or blue 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 **5**, **10**, **15** and **22**, 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 quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

1 Which **one** of the following states one purpose of a disciplinary policy?

[1 mark]

A Eliminates discrimination

B Ensures consistent and fair treatment

C Facilitates feedback to improve performance

D Sets out rights and responsibilities

Answer _____

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2 As part of an audit by a regulatory body, a laboratory specialising in biological pathogen testing has been asked to supply their standard operating procedures (SOPs).

(a) Give **two** reasons why SOPs are important in a workplace.

[2 marks]

(b) For **each** of your reasons, explain how SOPs ensure the laboratory is working to the required standard.

[4 marks]

3 The management team of a research company is attending health and safety training.

The health and safety officer delivering the training states, “It is the responsibility of the laboratory staff to ensure they are working in a safe manner because training has been provided by the employer.”

Explain how the health and safety officer’s statement might be partially correct.

[2 marks]

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4 A buyer for a research company is assessing suppliers for a reagent that is required for a project. The project requires 200L of the reagent per month. The buyer has identified two suppliers, **A** and **B**, who can supply the reagent.

Supplier B is significantly cheaper than **A**, and as a result the buyer is planning on ordering from **supplier B**.

A colleague suggests that **supplier B** would not be the best option as there would be waste product at the end of each month**.**

Table 1: Reagent supplier comparison

Supplier	Cost per litre	Delivery size	Delivery cost	Lifespan of product	Total cost
A	£18	200L	£25	3 months	£3,625
B	£5	500L	£1	1 month	£2,501

Discuss the research team member's statement showing reasoned judgements about which supplier the company should use.

[4 marks]

5 A scientific research company is looking to establish a new pharmaceutical research facility. As part of the work, a wide variety of flammable chemicals, acids, bases and toxic chemicals will need to be brought onto the site.

A manager has suggested buying a single, large, metal cabinet in which all of the above chemicals could be stored in a separate storage room. They have stated that they are unsure about how to dispose of the chemicals and have said they are going to assume staff know how to deal with all chemicals.

Focusing on the safe storage, use and disposal of the chemicals:

Evaluate the manager's proposal and make any recommendations for additional safety measures that may be required.

Your response should demonstrate reasoned judgements about the required processes that may be introduced.

[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 quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

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6 Which **one** of the following is a form of quantitative data?

[1 mark]

A A case study looking at the feelings surrounding vaccines among different ethnic groups

B Follow-up notes written by a nurse about an examination of a patient

C The rate a specific bacterial infection spreads across a hospital

D Visual observations made of a laboratory animal's behaviour following a drug intervention

Answer _____

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7 A senior metrologist wants the company they work for to deliver an ICT training course to all employees. They feel it will build confidence in using certain programs and free up their working day to concentrate on their own workload.

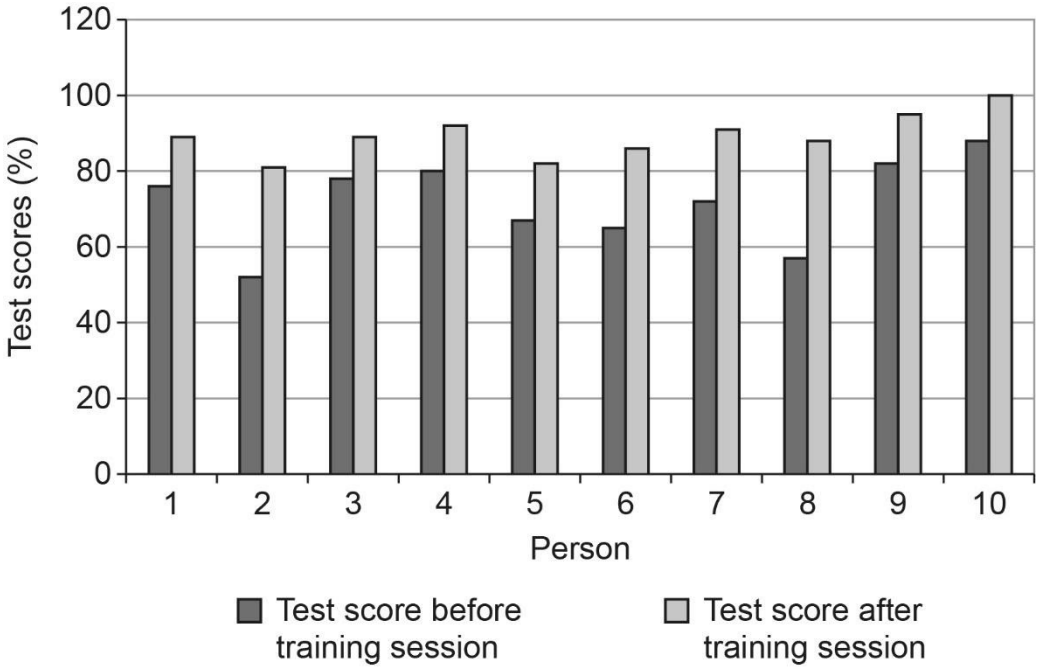
The course will cost a large amount of money, so the owner of the company wants some evidence that this will have a significant impact. To gather this evidence, the senior metrologist has had a small number of employees take a test assessing their ability to use the programs before and after the training.

The senior metrologist gathers the data shown in **Table 2** and **Figure 1** and decides that the best statistical test to use would be the Chi-square test.

Table 2: Test scores before and after training

Person	Test score before training session (%)	Test score after training session (%)	Difference in score (%)
1	76	89	13
2	52	81	29
3	78	89	11
4	80	92	12
5	67	82	15
6	65	86	21
7	72	91	19
8	57	88	31
9	82	95	13
10	88	100	12
Mean	71.7	89.3	17.6

Figure 1: Bar chart comparing test scores before and after training



(a) By comparing T-tests and Chi-square tests, give **one** reason why a T-test might be a more appropriate choice for this data.

[2 marks]

(b) Using **Figure 1**, suggest how useful the training would be for the company.

[4 marks]

8 A scientist is performing a study on the biodiversity of species of mice within a local park. In order to correctly classify the species of mouse, the scientist must collect the mice.

Explain **one** way the scientist could ensure the collection of mice is in line with the key aims of ethical scientific practices.

[2 marks]

9 A quality control (QC) scientist at a pharmaceutical company has noticed that a certain department is producing work with repeated results that are out of line with expected results. They now need to plan an investigation to determine the potential sources of the errors, allowing them to minimise any future errors.

The QC scientist states, "Checking record keeping is the most important place to start our investigation, because then we can see which employees are not following company policy."

Discuss the advantages and disadvantages of the QC scientist's plan.

Your answer should include a reasoned judgement on whether the QC scientist's plan will identify the root cause of the problem.

[4 marks]

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10 A research scientist has just started a new job in an animal testing laboratory and is having lunch with friends. A friend does not like the idea of testing on animals.

The research scientist states, “As long as animal experimentation is beneficial to humans, it should be allowed to be carried out, and all employees of the animal testing laboratory follow ethical scientific practices as outlined in ‘Rigour, Respect, Responsibility: A Universal Ethical Code for Scientists 2007.”

Considering the key aims of this code of practice and the need for integrity in a scientific setting, evaluate the research scientist's statement.

Your response should include reasoned judgements and conclusions about the validity of the statement.

[12 marks, plus 3 marks for QWC]

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Section C: Health and safety in the science sector

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

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11 Choose the correct definition of a category three biohazard:

[1 mark]

A Can cause human disease and may be a hazard to employees, unlikely to spread to the wider population and there are usually effective vaccines or other treatments available

B Can cause human disease and may be a serious hazard to employees, it may spread to the wider population but there are usually effective vaccines or other treatments available

C Causes severe human disease and is a serious hazard to employees, it is likely to spread to the wider population and there are usually no effective vaccines or other treatments available

D Is unlikely to cause human disease or be a hazard to employees, unlikely to spread to the wider population so no treatments needed

Answer _____

12 A piece of machinery in a chemical plant gives off 90 decibels of noise on a consistent basis.

Identify **two** steps the employer could undertake to ensure the protection of their employees working with the machinery.

[2 marks]

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13 A physics research building is using a piece of equipment that generates a high intensity electromagnetic field.

Outline **two** requirements for minimising the risk to employees.

[2 marks]

Please turn over for the next question.

14 A research laboratory is planning to begin a new project carrying out research on an airborne category two biohazard.

The laboratory manager has suggested that in order to ensure the scientists and others carrying out work in the area are safe, the following protocols need to be implemented.

They have suggested that these protocols will be sufficient for any category two biohazards worked on in the laboratory:

- personal protective equipment (PPE) including gloves and lab coats must be worn at all times
- all work should be carried out in a fume cupboard fitted with a HEPA filter
- all contaminated waste will have its own specified labelled waste stream and will be incinerated.

(a) Explain how **two** elements of the above protocols will protect the scientists performing the work on category two biohazards.

[4 marks]

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(b) Discuss whether the manager's protocols will be sufficient to fully protect scientists working in the laboratory.

[4 marks]

Please turn over for the next question.

15 An accident has occurred in a chemical manufacturing facility.

A report states:

- an employee has been injured by a chemical spill
- the employee has severe chemical burns across 15% of their body
- the employee was not wearing appropriate PPE
- it is thought the spill was caused by overfilling a container
- all documentation, including Control of Substances Hazardous to Health (COSHH) forms and standard operating procedures (SOPs) are correct and up to date.

As a result of the accident, the health and safety (H&S) officer has decided to run a course on the correct protocols for cleaning up chemical spills. Other than this no other steps have been taken. The H&S officer is not aware if they have complied with all the required legislation and company policies but thinks this will be enough.

Evaluate how effective the response of the H&S officer is in terms of complying with legislation and regulations, and in preventing similar incidents occurring in future.

Your response must 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 quality of written communication (QWC) and use of specialist terminology.
Answer **all** questions in the spaces provided.

16 Which **one** of the following would be an example of a negative control when preparing microbiological plates?

[1 mark]

A Adding a known quantity of bacteria to the plate in combination with the unknown sample

B Adding an equivalent volume of pure water instead of sample to the plate

C Adding an unknown quantity of bacteria to the plate in combination with the unknown sample

D Ensuring the plate is incubated overnight at room temperature

Answer _____

17 A laboratory technician is preparing for an experiment in which animal cells will be cultured. They are preparing a cell culture medium that needs to be autoclaved.

(a) Describe how an autoclave will sterilise a cell culture medium.

[1 mark]

(b) Name **one** piece of equipment that could be used to accurately measure and transfer the culture medium to an agar plate.

[1 mark]

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18 An apprentice is working with a substance known to be corrosive and that can potentially release harmful gas.

Explain **one** appropriate technique the apprentice should employ when working with this substance.

[2 marks]

19 A laboratory technician is making up 1M sodium hydroxide solution. They add 40g of solid sodium hydroxide to 0.5L of water in a volumetric flask and stir. Once the solid sodium hydroxide is dissolved, they dilute to 1L. This solution should have a pH of 13.

However, the pH meter shows the solution has a pH of 12.

Discuss how the technician could confirm that the inconsistencies in the pH are due to something other than the balance or the pH meter.

[4 marks]

20 A researcher is finding it difficult to focus their light microscope. They are viewing a Gram-stained sample using a x100 objective lens and immersion oil.

Describe **two** things the researcher should check to ensure they are correctly using the microscope to view the sample.

[2 marks]

21 A reagent manufacturing laboratory is seeking International Organisation for Standardisation (ISO) accreditation. They have only ever sold their products to a limited number of companies in their area and the director is wondering if seeking accreditation would be a good use of time and money.

Explain how ISO accreditation will help them when selling their products locally and abroad.

[2 marks]

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22 Pharm Ltd. are looking to start a new project focused on the purification of a drug. They have contracted JJS and Co. to help them get the new project started.

The experimental plans for the work to be undertaken need to be agreed by both companies. Pharm Ltd. have a current process they are using and want JJS and Co. to perform the same process to ensure the drug can be purified at different sites.

The current outline for the stages of the work is as follows:

1. specify the overall objective of the work
2. define the scope of the experiments to be carried out
3. agree a budget for the cost of the work
4. transfer the protocol over and confirm it works on site
5. carry out the work.

Points 1–3 will be established in an initial meeting and the work will then be carried out before any further contact between the two companies.

Evaluate the company's plan.

Your response should demonstrate reasoned judgements about the steps outlined and conclusions about the effectiveness and reliability of the plan.

[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		12	
2 (a)		13	
2 (b)		14 (a)	
3		14 (b)	
4		15	
5		16	
6		17 (a)	
7 (a)		17 (b)	
7 (b)		18	
8		19	
9		20	
10		21	
11		22	
		TOTAL MARK	