

Strand I: Scientific Investigation

I.1: Introduction to Integrated Science

Section A

1. B
2. C
3. A
4. C
5. C
6. D
7. A
8. B
9. B
10. B

Section B

1. A broad study that involves learning about a number of branches of natural science to help us understand how the world works.
2.
 - (a) Science has improved health care by providing advanced equipment and methods for diagnosing, treating and monitoring diseases, such as MRI machines.
 - (b) One scientific device used in hospitals is an X-ray machine.
3. Grace: Biology; Peter: Physics
4. Health, industry, agriculture, transport, food, textile.
5.
 - (a) Science helped the farmer by testing the soil to identify its nutrient requirements and then selecting the appropriate fertiliser to correct the deficiency, resulting in improved crop growth and yield.
 - (b) Irrigation.
6.
 - (a) Food preservation and processing, making milk safer and extending its shelf life.
 - (b) Science helps reduce food spoilage by using methods such as pasteurisation, refrigeration and drying to slow down or destroy microorganisms that cause food to spoilage.
7. Heating food to destroy harmful microorganisms; Cooling or freezing food to slow the growth of microorganisms; Drying or adding preservatives to reduce conditions that microorganisms need to grow.
8. Pure Sciences; Applied Sciences; Technical sciences

I.2: Laboratory safety

Section A

1. A
2. C
3. C
4. C
5. A
6. C
7. B
8. B
9. A
10. B
11. A

Section B

1.

Highly flammable	The substance can easily catch fire or explode when placed near flames, sparks or heat.
Corrosive	The substance may cause damage to the skin, eyes, clothes and metals.
Toxic	The substance can cause life-threatening effects if ingested or inhaled.
Radioactive	The substance produces radiation energy that can harm body organs.
Carcinogenic	The substance can cause cancer or a serious long-term health effect when one is exposed to them for a period of time.

2.

- (a) The substance is corrosive and can cause serious damage to the skin, eyes or other materials.
- (b) Wear protective gloves when handling the substance; Wear safety goggles to protect the eyes; Handle the substance carefully to avoid splashing or spilling; Do not touch the substance with bare hands.
- (c) It may cause chemical burns, irritation or tissue damage.

3.

- (a) Carcinogenic
- (b) The substance can cause cancer or a serious long-term health effect when one is exposed to them for a period of time.
- (c) Wear appropriate personal protective equipment (PPE), such as gloves and a laboratory coat; Avoid direct contact or inhalation to reduce exposure to the chemical.

4.

- (a) Brian has broken the rule: Do not bring or consume food and drinks in the laboratory.

- (b) The juice may become contaminated with harmful chemicals or microorganisms, making it unsafe to drink; The juice may spill and cause contamination of the working area or react with chemicals, potentially causing an accident.
 - (c) Wear appropriate protective equipment; Read and understand the experimental procedure and safety instructions before starting the experiment.
- 5.
- (a) Slip and fall
 - (b) The accident was caused by a substance that had been spilled on the floor and was not cleaned up.
 - (c) Clean up spills immediately; Keep laboratory floors and working areas clean and dry.
 - (d) So that appropriate action can be taken to prevent further injury or similar accidents.
6. Cuts- Mishandling broken glassware or sharp laboratory equipment; Burns- Contact with hot substances, flames or heated apparatus; Chemical burns - Chemicals spilling or splashing onto the skin; spills and falls - Spilled substances on the laboratory floor.
- 7.
- (a) He pointed the mouth of the test tube towards him.
 - (b) Burns/scalding.
 - (c) The test tube should be held at an angle and its mouth directed away from him.
- 8.
- (a) Sterile gauze; Antiseptic; Plaster/bandage; Cotton wool
 - (b) Wash hands and carefully remove any visible glass fragments using appropriate equipment; Clean the wound with clean running water and apply gentle pressure with sterile gauze to stop bleeding; Cover the wound with a sterile dressing or bandage.
 - (c) To prevent dirt and microorganisms from entering the wound and causing infection.
- 9.
- (a) Poisoning by inhalation of toxic fumes.
 - (b) Inhaling toxic fumes directly from a chemical; Heating or mixing chemicals without adequate ventilation.
 - (c) Work in a well-ventilated laboratory or use a fume cupboard to prevent the accumulation of harmful fumes; Do not inhale chemicals directly; use safe wafting techniques when instructed to identify an odour; Wear appropriate protective equipment, such as a suitable mask or respirator where required, and follow the safety instructions for the chemicals being used.
- 10.
- (a) Using safe wafting techniques to identify an odour.
 - (b) Wearing gloves; wearing closed shoes; working in a room that is well organised, the floor and working area are clean and dry.
 - (c) Prevent accidents and injuries to learners and laboratory personnel; Protect people from harmful chemicals, microorganisms and equipment; Prevent damage to laboratory equipment and property; Ensure experiments are carried out safely and correctly; Prevent contamination of substances and experimental results; Promote a safe and orderly working environment.
- 11.
- (a) Do not rush into the laboratory instead walk calmly and quietly.

Follow the instructions given while carrying out experiments in the laboratory.

Do not eat, drink or taste anything in the laboratory.

Always ensure that the laboratory windows are open to allow for air circulation.

Know the location of safety equipment such as the fire extinguisher and how to use them.

Always tie long hair at the back, avoid hanging tie, wear closed shoes and personal protective equipment.

Do not smell a gas directly from a gas jar. Instead, waft it towards your nose with your hand.

When heating liquids, ensure that the mouth of the apparatus you are using is facing away from you and other learners.

Dispose of the laboratory waste appropriately.

In case of an accident, report immediately to the teacher or laboratory technician.

Always ensure that the room is well organised and that the floor and working area are clean and dry.

Always put out flames and ensure all gas taps are closed after use and switch off sockets that are not in use.

- (b) Prevent accidents and injuries to learners and laboratory personnel; Protect people from harmful chemicals, microorganisms and equipment; Prevent damage to laboratory equipment and property; Ensure experiments are carried out safely and correctly; Prevent contamination of substances and experimental results; Promote a safe and orderly working environment.

- (c) Proper laboratory safety protects the environment by:

Preventing chemical spills and leaks that could contaminate soil and water.

Ensuring proper disposal of chemical and biological waste, preventing harmful substances from entering the environment.

Reducing air pollution by controlling the release of toxic fumes and gases.

Preventing fires and explosions that could release harmful substances into the environment.

Encouraging responsible use of chemicals and laboratory materials, reducing unnecessary waste.

12.

- (a) Seek medical assistance immediately and inform the teacher or laboratory technician; Rinse the victim's mouth with clean water and remove any remaining chemical from the mouth, without swallowing the water.
- (b) Forcing the victim to vomit may cause the chemical to enter the lungs or cause further burns to the mouth, throat and oesophagus as it comes back up.
- (c) It ensures that the victim receives appropriate treatment quickly, reducing the risk of serious injury or death.

13. Safety goggles – protect the eyes from chemical splashes and flying particles.

Laboratory coat – protects the skin and clothing from spills and splashes.

Protective gloves – protect the hands from harmful chemicals.

Face mask – helps protect against inhalation of harmful particles or substances.

Closed shoes – protect the feet from spills, broken glass and falling objects.

14.

- (a) Antiseptic.

- (b) Gloves protect the person giving first aid from contact with blood and reduce the risk of transferring germs to the wound.
- (c) Sterile dressing/gauze.
- (d) So that minor injuries and accidents can be treated promptly before further medical attention is obtained. (1 mark)

I.3: Laboratory apparatus and instruments

Section A

1. D
2. D
3. B
4. C
5. C
6. C
7. C
8. C
9. B
10. B
11. B
12. A
13. C
14. B
15. C
16. C

Section B

1.
 - (a) A- eyepiece; B- Objective lens; C- Mirror
 - (b) F- it brings the image into rough focus by raising and lowering the body tube slowly over short distances. D- Supports the body tube and stage. It is also used when carrying the microscope. E- A platform where the specimen on the slide is placed.
 - (c) The learner should use both hands to support the microscope securely and prevent it from falling or being damaged. One hand should hold the arm while the other supports the base.
 - (d) Clean the lenses with lens tissue and remove any dirt or moisture; Cover the microscope and store it in a safe, dry place.
2. Observation – He used a hand lens to observe and identify visible features of the housefly and spider.
 Comparison – He compared the characteristics of the two organisms, such as the number of body segments and legs.
 Classification – He grouped or distinguished the organisms based on their observable characteristics.
3.
 - (a) Beaker, Bunsen burner
 - (b) Kelvin
- 4.

- (a) There was insufficient air entering the burner due to the air hole being closed or partly closed.
- (b) Luminous flame.
- (c) Open the air hole to allow more air (oxygen) to mix with the gas before combustion. This produces a blue, non-luminous flame that burns more completely and does not blacken the beaker.

5.

- (a) Hand lens
- (b) Light microscope

6.

- (a) Metre rule or ruler.
- (b) Length = 5 cm
Volume = length $\times$ width $\times$ height
= $5 \times 5 \times 5$
= 125 cm^3
- (c) The SI unit of volume is m^3 .
 $5 \text{ cm} = 0.05 \text{ m}$
Volume = $0.05 \times 0.05 \times 0.05$
= 0.000125 m^3 or $1.25 \times 10^{-4} \text{ m}^3$
- (d) Volume is a derived quantity.
- (e) A quantity obtained by combining two or more fundamental quantities using mathematical operations. Examples include area, volume, speed and density.

7.

- (a) It is less hazardous than mercury, making it safer for use in school laboratories; It has a lower freezing point than mercury, so it can measure lower temperatures.
- (b) Do not allow the bulb of the thermometer to touch the bottom or sides of the container while taking the temperature.

8.

- (a) Volume of a liquid.
- (b) To keep it upright and ensure accurate reading of the liquid level.

9.

- (a) Observation, manipulative skill, communication, conclusion.
- (b) It magnifies cells, making their small structures visible for observation and study.

10.

- (a) Metre (m)
- (b) Kilogram (kg)
- (c) Kelvin (K)
- (d) Second (S)