Paper 2 (Practical)

Paper 2 (Practical) will contain **two** compulsory items. This paper consists of two examination items. Answer all items. The items in the paper will be scenario-based. The paper will take **3 hours**. The items in the paper will be scenario-based. Items in this paper will come from any of the **four constructs** addressing their respective assessment objectives. One item will require the **use of scientific investigations to solve a challenge** presented in the scenario. The second item will require **relating structural and behavioural mechanisms to the survival advantage of the organism**.

The following are the **skills** that are necessary for a biology practical exam:

- ✓ **Measurement** of length using rulers, straight or curved surfaces, volumes, etc.
- ✓ **Serial dilution** techniques
- ✓ **Preparation of slides** of biological tissues
- ✓ **Counting** of structures and cells under a microscope
- ✓ **Drawings** as seen under a microscope
- ✓ **Preparation of extracts** (using a mortar and pestle).
- ✓ **Extraction of enzymes** from animal and plant tissues
- ✓ **Dissection** of a rat

The following are the **competencies** that are assessed in the practical exam:

- ✓ Analyses the properties and functions of chemical compounds (water, lipids, proteins including enzymes from mammals) in a cell, focusing on their roles in maintaining cellular structure and metabolic processes in living organisms. The probable practicals from this competency are **enzyme activity**, **osmosis**, and **food tests**.
- ✓ Operates a light microscope to observe tissues from plants and animals under different magnifications. The probable practical skill assessed is **microscopy**.
- ✓ Analyses the ultrastructure of animal / plant cells, bacterial cells and the plasma membrane, to distinguish prokaryotic and eukaryotic cell characteristics. The probable practical skill is **microscopy**.
- ✓ Analyses the structures of plant (parenchyma, collenchyma, sclerenchyma, xylem and phloem) and animal (epithelial, cardiac, areolar, fibrous, and skeletal) tissues to assess their roles in physiological processes, disease diagnosis, and levels of organisation. The practical skill assessed is **microscopy**.
- ✓ Analyses evolutionary advancements in key life processes (circulation, reproduction, gaseous exchange, coordination, movement and excretion), as well as their suitability for survival across different species. The practical skills assessed is **dissection** and **drawing**.
- ✓ Analyses the pre- and post-germination stages during the growth and development of plants in relation to their significance in crop production. The probable practicals from this competency are **germination physiology**, **primary growth**, **secondary growth** and **microscopy**.

Probable Assessment Areas

Physiology Experiments

- Factors affecting the rate of enzyme activity: pH, temperature, concentration of enzyme / substrate, inhibitors / activators.

- Osmotic properties of water in plants: stomatal opening and support.
- Food tests

Microscopy

- Plant tissues
- Animal tissues
- Cells

Rat Dissection

- Digestive system
- Circulatory system
- Reproductive system
- Excretory system
- Respiratory system
- Locomotory structures
- Coordination system and structures

Item 1: Scientific Inquiry Skills

Bases of Assessment:

1. **Planning**:

The learner states and clearly explains all four key attributes of planning: **aim**, **hypothesis**, **variables**, and **materials**, showing how they interrelate.

- ✓ **Aim of the experiment**, it should contain the description of the experiment (**What** you're doing) and the purpose of the experiment (**Why** you're doing it). Example: "*An experiment to investigate the effect of concentration of solution enzyme from ileum extract and pH of substrate in solution D; so as to determine which ratio of water to enzyme extract and pH solution that can produce the best results*". The aim **should have two variables**.
- ✓ **Hypothesis**, it should contain the independent and dependent variables with a reason. You should **connect all independent variables to the dependent variable and give a reason for the relationship**. Example: "*The ratio of enzyme extract to water of 5:1, and pH solution A, produce better results than ratios 4:2, 3:3, 2:4 and 1:5, and pH solutions B and C causing production of more sugars because at that concentration the enzyme and substrate molecules are closer to each other and at that pH the enzymes are most activated*".
- ✓ **Variables**, it should contain the independent, dependent and controlled variables. The **independent variables** are what the learners are manipulating to cause variation (change) in results. For example, ratios of water to enzyme extract, concentration of enzyme. The **dependent variable** is the outcome of the investigation as seen in the scenario. For example, amount of sugars formed / colour changes of solution, etc. The **controlled variables** are variables that you're to measure more than once in your investigation. It is what is kept **constant** in the practical. For example, volumes of solutions A, B and C, time for incubation, temperature of incubation.
- ✓ **Materials,** the task taker should show competence in use of appropriate apparatus to record a range of quantitative measurements.

When stating the dependent variable, state exactly what is being measured rather than the final processed result. For example, number of bubbles formed rather than the rate of photosynthesis. The learner must show how much of the quality of the outcome, i.e. the ***results are quantitative****.*

2. Risks, Sources or Errors and their Mitigation

The learner should identify any **safety hazards** in the practical, and **state the level of risk involved**. For every hazard, suggest a **suitable precaution** to take.

Risks and mitigation

Risks	Mitigation
Burns from hot test tube and hot water	Holding the test tube with a test tube holder

Sources of errors and mitigation:

Source of error	Mitigation
Temperature fluctuations	Closely monitoring temperature using an incubator

3. Procedure of experiment

Some steps of the procedure are guided by the scenario. Measurements such as time, temperature, volumes and length are dictated by the scenario to avoid extreme variations in results.

4. Data presentation

Data should be presented in a table. Data can also be further analysed using a graph for better meaning.

5. Data analysis

This involves a deeper explanation of physiological processes:

- The physiology of enzymes, lock and key hypothesis, active site, competitive and non-competitive inhibition, denaturation of enzymes by temperature and pH.
- Physiology of events leading to germination.
- Physiology of osmosis.

The explanations must finally be linked back to the scenario.

6. Recommendations and advice

Summarises the main points, the item taker is required to consider their **hypothesis**, **results of the investigation**, **task** and **challenge / problem** in the scenario when coming up with the conclusion and recommendations. Investigators can always make recommendations / provides solution to challenge in the scenario given; while at this point. Give reasons for the recommendation.

Item 2: Microscopy and Dissection

This item involves collecting data from two animals.

- One animal is hypothetical and data about it is also hypothetical. Support material may be used. The hypothetical animal has evolutionary disadvantages by virtue of the data collected from its anatomy. The data about the hypothetical animal is provided in the scenario.
- The second animal, the rat, has superior characteristics for survival by virtue of data collected from its anatomy. This data is collected by the learner in the practical. The data collected is used to explain the differences in survival abilities of the two organisms. (Suitability)

The two animals may be related to a certain plant through any life process such as nutrition. This plant is to be examined under the microscope to obtain data that can explain its contribution to the survival of the animals.

Bases of Assessment:

1. Measurements

These can be obtained from:

The external features of the rat such as tail length, body length, eyes, ears, head circumferences, vibrissae, etc.

Internal structures such as length of ileum, stomach, duodenum, caecum, heart, lungs, blood vessels, etc.

2. Procedure of Microscopy

The learner is expected to write the complete and detailed procedure from slide preparation to microscope use.

3. Drawing from Microscope

The drawing to follow the typical rules of biological drawing with title, accuracy, neatness, linear magnification, labelling, etc.

4. Procedure of Dissection

Important steps include:

- Orientation of the rat
- Opening of the skin
- Opening of the body wall muscle
- Displacements to display relevant structures

5. Drawing from Dissection

This involves a deeper explanation of physiological processes:

- The usual rules of biological drawing will hold
- Only relevant structures to be labelled
- Fewer parts to be labelled

The explanations must finally be linked back to the scenario.

6. Suitability for Survival

Explaining the differences in survival abilities of the two animals in their environment based on data collected. This explanation must be clearly linked to the scenario.