Hong Kong Diploma of Secondary Education Examination

Biology and Combined Science (Biology part)

School-based Assessment Sample Tasks

Teachers may use the sample tasks for non-profit making educational and research purposes with proper acknowledgement.
Practical Task: Presence of protease in pineapple and / or kiwifruit

Scenario:

Last week, Mary prepared some jelly for her mother’s birthday. In addition to plain jelly, she added fresh fruits into some of the jelly. She found that all the plain jelly set as usual, but jelly with fresh pineapple and fresh kiwi added failed to set. She was intrigued by this observation and she asked Miss Chan, her biology teacher, about it. Instead of telling Mary the answer directly, Miss Chan provided her with a piece of useful information: “Jelly contains a kind of protein called gelatin, which causes the jelly solution to solidify and set after cooling.”

Task:
Propose a hypothesis to explain Mary’s observation, i.e. jelly fails to set with the addition of fresh pineapple and kiwifruit. How would you design and carry out an investigation to test your hypothesis?

Write a full report for your investigation

The following sections should be included in your report where applicable:

- **Aim** of your investigation
- **Introduction** to your investigation report, which should include:
  - **Problem** to investigate (refer to the description above)
  - **Hypothesis** to explain the observation and the prediction based on the design of the investigation (where applicable)
  - **Principles** behind the design of your investigation, which should include:
    - (i) a brief description of the rationale of your design;
    - (ii) identification of the independent and dependent variables, and the ways of manipulating and measuring the variables;
    - (iii) the controlled variable(s); and
    - (iv) the critical assumptions made, if any.
- **Procedure** of your investigation and any precautions to be taken
- **Results** presented in appropriate form(s)
- **Discussion** of your findings including suggestions for any likely sources of error in the investigation, limitations of the experimental design and improvement for future work if applicable
- **Conclusion** drawn from the findings with regard to the aim of the investigation
**Materials and apparatus available to each group**

The materials and apparatus you will need will depend on the design of your investigation. You may choose from the following those materials and apparatus you need for the investigation:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. White tile</td>
<td>1</td>
</tr>
<tr>
<td>2. Knife</td>
<td>1</td>
</tr>
<tr>
<td>3. Pestle and mortar</td>
<td>1 set</td>
</tr>
<tr>
<td>4. Cork borer</td>
<td>1</td>
</tr>
<tr>
<td>5. Filter funnel</td>
<td>1</td>
</tr>
<tr>
<td>6. Filter cloth</td>
<td>10cm x 10cm</td>
</tr>
<tr>
<td>7. Aluminium foil</td>
<td>Around 10cm x 10cm</td>
</tr>
<tr>
<td>8. Bunsen Burner, wire gauze, tripod</td>
<td>1 set</td>
</tr>
<tr>
<td>9. 500 mL beaker</td>
<td>2</td>
</tr>
<tr>
<td>10. 250 mL beaker / 100 mL beaker</td>
<td>4/5</td>
</tr>
<tr>
<td>11. Boiling tube</td>
<td>4</td>
</tr>
<tr>
<td>12. Test tube</td>
<td>4</td>
</tr>
<tr>
<td>13. 10 mL measuring cylinder</td>
<td>2</td>
</tr>
<tr>
<td>14. 100 mL measuring cylinder</td>
<td>2</td>
</tr>
<tr>
<td>15. 1 mL pipette</td>
<td>2</td>
</tr>
<tr>
<td>16. Pasteur pipette</td>
<td>several</td>
</tr>
<tr>
<td>17. Glass rod</td>
<td>1</td>
</tr>
<tr>
<td>18. Fresh pineapple</td>
<td>several slices</td>
</tr>
<tr>
<td>19. Fresh kiwifruit</td>
<td>several</td>
</tr>
<tr>
<td>20. Jelly powder</td>
<td>1 bag</td>
</tr>
<tr>
<td>21. Milk agar plate</td>
<td>1</td>
</tr>
<tr>
<td>22. 75% alcohol</td>
<td>10 mL</td>
</tr>
<tr>
<td>23. Distilled water</td>
<td></td>
</tr>
<tr>
<td>24. Tap water</td>
<td></td>
</tr>
<tr>
<td>25. Boiling water</td>
<td></td>
</tr>
<tr>
<td>26. Cotton ball</td>
<td></td>
</tr>
</tbody>
</table>

Practical task/I (e) Enzymes and enzymatic reactions
Practical Task: Transpiration
Topic: III (a)

Background information:
Transpiration is the loss of water vapour from plants. A major portion of water is lost from the leaves. Apart from environmental conditions, the morphology and internal structure of the leaves also affect the rate of transpiration of a plant.

Task:
You are going to design and carry out an investigation to find out how the leaf surface area affects the transpiration rate. The following materials are provided:

4-5 mung bean seedlings at a similar stage of growth to be put in a beaker of water eosin solution in a plastic vial
a white tile
a razor blade
2 pieces of graph paper
microscope and glass slides
boiling tubes
Vaseline

(N.B.: DO NOT run the experiment for too long.)

Write a full report of your investigation.

The following sections should be included in your report where applicable:

- **Aim** of your investigation
- **Introduction** to your investigation report, which should include:
  > **Problem** to investigate (where applicable)
  > **Hypothesis** to explain the observation and the prediction based on the design of the investigation (where applicable)
  > **Principles** behind the design of your investigation, which should include:
    (i) a brief description of the rationale of your design;
    (ii) identification of the independent and dependent variables, and ways of manipulating and measuring the variables;
    (iii) the controlled variable(s); and
    (iv) the critical assumptions made, if any.
- **Procedure** of your investigation and any precautions to be taken
- **Results** presented in appropriate form(s)
• **Discussion** of your findings including suggestions for any likely sources of error in the investigation, limitations of the experimental design and improvement for future work if applicable

• **Conclusion** drawn from the findings with regard to the aim of the investigation
Practical Task: Vitamin C content in fruits

Topic: III (b)

Scenario:

“Oranges are one of the richest sources of vitamin C” is a common concept held by many people including Michael, who has held onto this idea since he was a child. This is one of the reasons why he eats an orange everyday. Recently some of his friends told him that there are many fruits with higher vitamin C content than oranges. He wondered whether he should change his eating habits and eat other fruits instead.

Task:

To find out if Michael’s friends are right, you are going to design and carry out an investigation to compare the vitamin C concentration in the juices of some common fruits. The following materials and apparatus are provided:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tray (to hold the small apparatus)</td>
<td>1 pc</td>
</tr>
<tr>
<td>2. Towel</td>
<td>1 pc</td>
</tr>
<tr>
<td>3. Marker pen</td>
<td>1 pc</td>
</tr>
<tr>
<td>4. Razor blade</td>
<td>1 pc</td>
</tr>
<tr>
<td>5. White tile</td>
<td>1 pc</td>
</tr>
<tr>
<td>6. Mortar &amp; pestle</td>
<td>1 set</td>
</tr>
<tr>
<td>7. Filter funnel</td>
<td>4 pcs</td>
</tr>
<tr>
<td>8. Filter cloth</td>
<td>4 pcs</td>
</tr>
<tr>
<td>9. Test-tube</td>
<td>8 pcs</td>
</tr>
<tr>
<td>10. Boiling tube</td>
<td>8 pcs</td>
</tr>
<tr>
<td>11. Metallic test-tube rack</td>
<td>2 pcs</td>
</tr>
<tr>
<td>12. 100-mL beaker for collecting distilled water</td>
<td>1 pc</td>
</tr>
<tr>
<td>13. 250-mL beaker for discarding waste</td>
<td>1 pc</td>
</tr>
<tr>
<td>14. 10-mL pipette</td>
<td>1 pc</td>
</tr>
<tr>
<td>15. 1-mL pipette</td>
<td>5 pcs</td>
</tr>
<tr>
<td>16. Pipette filler</td>
<td>1 pc</td>
</tr>
<tr>
<td>17. Teat pipette (long enough to collect liquid from the bottom of a boiling tube)</td>
<td>1 pc</td>
</tr>
<tr>
<td>18. ~30 mL DCPIP solution in stoppered boiling tube</td>
<td>1 tube</td>
</tr>
<tr>
<td>19. Kiwifruit *</td>
<td></td>
</tr>
<tr>
<td>20. Orange *</td>
<td></td>
</tr>
<tr>
<td>21. Honeydew melon *</td>
<td></td>
</tr>
<tr>
<td>22. Green grape *</td>
<td></td>
</tr>
</tbody>
</table>

On side bench: (for the whole class)

23. Distilled water

* Note:

(1) 1 kiwifruit, 1 orange, ~1/8 honeydew melon and 5 green grapes are provided to each group of 4 students.
(2) Each member of a group will be responsible for preparing juice from one kind of fruit.
Write a full report of your investigation.

Where applicable, your report should include:

- **Aim** of your investigation
- **Introduction** to your investigation report, which should include:
  - **Problem** to investigate (refer to the description above)
  - **Hypothesis** to explain the observation and the **prediction** based on the design of the investigation (where applicable)
  - **Principles** behind the design of your investigation, which should include:
    (i) a brief description of the mechanism of a test or an activity used (where applicable);
    (ii) identification of the **independent and dependent variables**, and ways of manipulating and measuring them;
    (iii) the **controlled variable(s)**; and
    (iv) the critical **assumptions** made, if any.
- **Procedure** of your investigation and any **precautions** to be taken
- **Results** presented in appropriate form(s)
- **Discussion** of your findings including suggestions for any likely sources of error in the investigation, limitations of the experimental design and improvement for future work if applicable
- **Conclusion** drawn from the findings with regard to the aim of the investigation
Practical Task: Examining the cross section of a young dicotyledonous stem

Topic: III (a)

Introduction:
Lignin is a complex aromatic compound and is usually found in the cell wall of some thick-walled cells (e.g. sclerenchyma, xylem vessels or tracheids) in plants. Lignin strengthens the cell wall and makes it impermeable to water and solutes. The location of the lignified cells in a young dicotyledonous stem can easily be identified by staining the cross section of the stem with aniline dye, which stains lignin yellow.

Task:
1. Prepare thin sections of a young dicotyledonous stem for making temporary mounts for microscopic examination.
2. Draw a labelled low-power diagram to show the structure of the dicotyledonous stem. Identify the stained tissue(s) and briefly describe how the structure(s) of the stained tissue(s) is / are related to its / their functions.

Materials & Apparatus:
- a dicotyledonous stem
- 1% aniline dye
- distilled water / glycerine
- razor blade
- petri dish
- paint brush
- slides
- cover slip
- dropper
- microscope

Procedure:
1. Using free-hand sectioning skill, cut several thin transverse sections from the dicotyledonous stem provided.
2. Stain the stem sections by putting them in 1% aniline dye for 2 - 5 minutes. *(Note: Aniline dye can stain the parts containing lignin yellow.)*
3. Prepare a temporary mount of one of the stained stem sections using water / glycerine as the mounting medium.
4. Observe the stem section under a microscope with suitable magnification. Leave your temporary mount on the stage for assessment.
5. Make a labelled low-power diagram of the stem section. Identify the tissue(s) stained and briefly describe how the structure(s) of the stained tissue(s) is / are related to its / their functions.

Safety precautions:
Aniline dye is toxic,
- wear gloves when handling aniline to avoid contact with your skin;
- cover the petri dish while staining the stem sections to avoid inhaling the fumes; and
- collect used aniline dye in a waste bottle for proper disposal.
Useful websites:
1. Video clips demonstrating free-hand sectioning skills and skills in staining and making temporary mounts are available for download at: 
   http://cd1.edb.hkedcity.net/cd/science/biology/resources/content_resources_e.htm
2. 準備樣本玻片：http://www.hkbiology.net/index.php/biology-experiment-technique-info/biology-prepare-microscopic-slide
Practical Task: Skin and Body Defence
Topic: IV (c)

Introduction:
Skin plays a role in non-specific defence as its structure provides both a physical and chemical barrier against pathogens.

Task:
1. Observe under the microscope a vertical section of mammalian skin.
2. Draw a labelled low-power diagram to show the structure of the skin and annotate the parts involved in body defence.
Practical Task: Rat Dissection – Breathing System
Topic: III (b)

Task:
Dissect the rat provided to display:
1. the organ where gas exchange takes place;
2. the path through which air passes from the outside into the organ for gas exchange;
3. the muscles and the structures involved in the breathing action.

*Draw a labelled diagram of the dissected rat to show the organs, muscles and structures referred to in 1 to 3.*