BIOLOGICAL ANALYTICS
Item 1

Case 1

A certain farmer wishes/intends to buy land to plant rice(yams) on a large scale for scale.

A land broker has suggested to her two plots of land for her to make a better choice. Her rice variety grows well in extremely water logged soils (with slightly acidic pH). You are provided with soil samples L and M which have been obtained from the two plots of land.

TASK: Plan/design and conduct/carry out a scientific investigation(s) on the soil samples and suggest a suitable recommendation to the farmer.

SUGGESTED RESPONSE

Aim: *To determine volume of water retained by soil sample L and M at different time intervals.*

If pH mentioned in the scenario: *To determine volume of water retained by soil sample L and M at different time intervals and their respective pH.*

Hypothesis: *Soil sample M retains more water than soil sample L.*

If pH mentioned in the scenario: *Soil sample M retains more water and is more acidic than soil sample L.*

Variables

Independent variable: *Time taken for water to pass through the soil sample.*

Dependent variable: *Volume water retained/volume of water collected.*

Controlled variable: *Volume of soil sample used/ volume of water added, controlled by maintaining it constant.*

Materials/requirements

*Soil sample L and M, measuring cylinders (2), beakers (2), water, filter funnel, stop clock, cotton wool (blue litmus paper and red litmus paper [**in case pH is mentioned**]).*

Procedure

(i) *A piece of cotton wool was placed into the neck of a filter funnel.*

(ii) *The filter funnel with the cotton wool was placed/mounted on top of a measuring cylinder.*

(iii) *Using a measuring cylinder, $35cm^3$ of soil sample L were measured and placed into the filter funnel on top of the measuring cylinder.*

(iv) *$35cm^3$ of water were measured and poured into the soil sample L using a measuring cylinder. Immediately (at the same time) a stop clock was started.*

(v) *The set up was allowed to stand for **7 minutes/**5 minutes until the dripping stopped.*

(vi) *The volume of water collected in the measuring cylinder was read and recorded every after a minute for 7 minutes.*

(vii) *The volume of water retained calculated using the formula,*
$Volume\ of\ water\ added\text{-}volume\ of\ water\ collected.$

(viii) *$3cm^3$ of collected water were added into a test tube and a blue and red litmus paper were separately dipped into the water in the test tube and colour changes were observed and recorded(observations made were also recorded).*
[Ignore this step if pH is not mentioned in the scenario]

(ix) *The procedure/steps (i) to (viii) above was/were repeated using the same volume of water and soil sample M.*

(x) *The results obtained were recorded in the table of results below.*

Data presentation

Table of results

Time/minutes	***Soil sample L***		***Soil sample M***	
	Volume of water collected/cm^3	***Volume of water retained/cm^3***	***Volume of water collected/cm^3***	***Volume of water retained/cm^3***
0	*0.0*	*35.0*	*0.0*	*35.0*
1	*15.0*	*20.0*	*0.0*	*35.0*
2	*16.5*	*18.5*	*0.0*	*35.0*
3	*17.0*	*18.0*	*1*	*34.0*
4	*17.0*	*18.0*	*2*	*33.0*
5	*17.0*	*18.0*	*3*	*32.0*
6	*17.0*	*18.0*	*5*	*30.0*
7	*17.0*	*18.0*	*6*	*29.0*

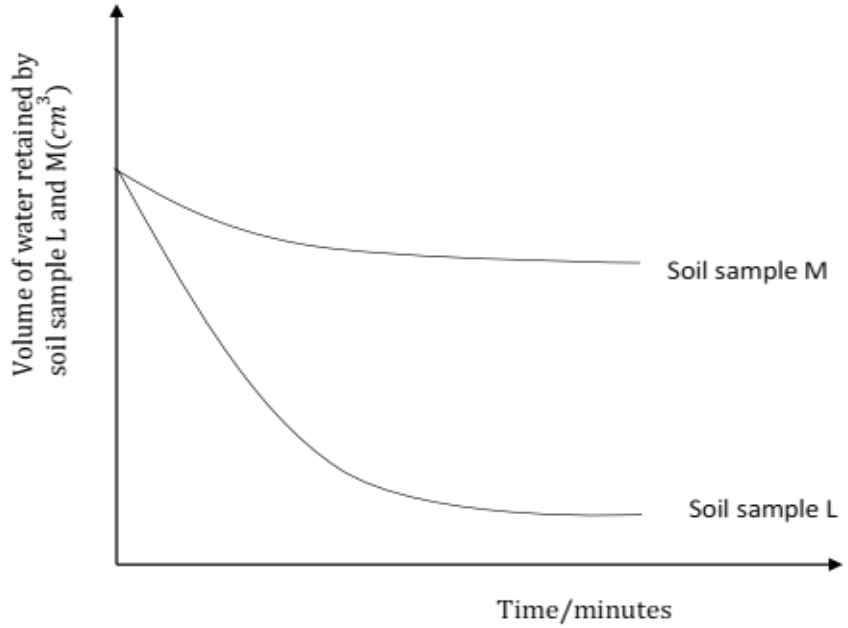
ACC: *Time recorded in seconds e.g. 30 seconds interval.*

TABLE II OF RESULTS [Ignore this table if pH is not mentioned in the scenario]

Water from soil sample	***Red litmus paper***	***Blue litmus paper***	***Deduction***
L	*Remained red* ***OR*** *Turned from red to blue*	*Remained blue*	*Is neutral* ***OR*** *Is alkali*
M	*Remained red*	*Turned from blue to pink/red*	*Is slightly acidic/ is acidic.*

DATA ANALYSIS

<u>A GRAPH SHOWING THE VARIATION OF VOLUME OF WATER RETAINED BY SOIL SAMPLE L AND M WITH TIME</u>



INTERPRETATION

- *Soil sample M retained more water because it has many smaller particles that are closely packed with small/tiny spaces in-between, so is poorly drained and highly water logged. Therefore, it is suitable for rice growing.*
- *Soil sample L retained little water because it has many bigger particles that are loosely packed with large spaces in-between, so it is well drained with lower water retention capacity. Therefore, it is not suitable for rice growing.*

RECOMMENDATION

- *The farmer should buy the plot (piece of land) from where soil sample M was obtained since it has a higher water retention capacity (with acidic pH;[* ***in case pH tested****]).*

Case 2

Crops grown by farmers in Malindi village require soils with good drainage (well drained soils it slightly alkaline pH) to produce good yields. Musisi owns two pieces of land L and M which he intends to use this season. Soil samples L and M were picked from the two plots of land respectively.

Task: Plan/design and carry out a scientific investigation(s) on the soil samples to advise Mr. Musisi on which plot to use for better yields.

SUGGESTED RESPONSE

Aim: *To determine volume of water drained by soil sample L and M at different time intervals.*

If pH mentioned in the scenario: *To determine volume of water drained by soil sample L and M at different time intervals and their respective pH.*

Hypothesis: *Soil sample L drains more water than soil sample M.*

If pH mentioned in the scenario: *Soil sample L drains more water and is more alkaline than soil sample M.*

Variables

Independent variable: *Time taken for water to pass through the soil sample.*

Dependent variable: *Volume of water collected/drained.*

Controlled variable: *Volume of soil sample used/ volume of water added, controlled by maintaining it constant.*

Materials/requirements

*Soil sample L and M, measuring cylinders (2), beakers (2), water, filter funnel, stop clock, cotton wool (blue litmus paper and red litmus paper [****in case pH is mentioned****]).*

Procedure

(i) *A piece of cotton wool was placed into the neck of a filter funnel.*

(ii) *The filter funnel with the cotton wool was placed/mounted on top of a measuring cylinder.*

(iii) *Using a measuring cylinder, $35cm^3$ of soil sample L were measured and placed into the filter funnel on top of the measuring cylinder.*

(iv) *$35cm^3$ of water were measured and poured into the soil sample L using a measuring cylinder. Immediately (at the same time) a stop clock was started.*

(v) *The set up was allowed to stand for* ***7 minutes/****5 minutes until the dripping stopped.*

(vi) *The volume of water collected in the measuring cylinder was read and recorded every after a minute for 7 minutes.*

(vii) *$3cm^3$ of collected water were added into a test tube and a blue and red litmus paper were separately dipped into the water in the test tube and colour changes were observed and recorded(observations were also recorded).* ***[Ignore this step if pH is not mentioned in the scenario]***

(viii) *The procedure/steps (i) to (vii) above was/were repeated using the same volume of water and soil sample M. [The procedure was repeated using soil sample M]*

(ix) *The results obtained were recorded in the table of results below.*

DATA PRESENTATION

TABLE OF RESULTS

Time/minutes	***Volume of water collected from soil sample L /cm^3***	***Volume of water collected from soil sample M /cm^3***
0	*0.0*	*0.0*
1	*15.0*	*0.0*
2	*16.5*	*0.0*
3	*17.0*	*1*
4	*17.0*	*2*
5	*17.0*	*3*
6	*17.0*	*5*
7	*17.0*	*6*

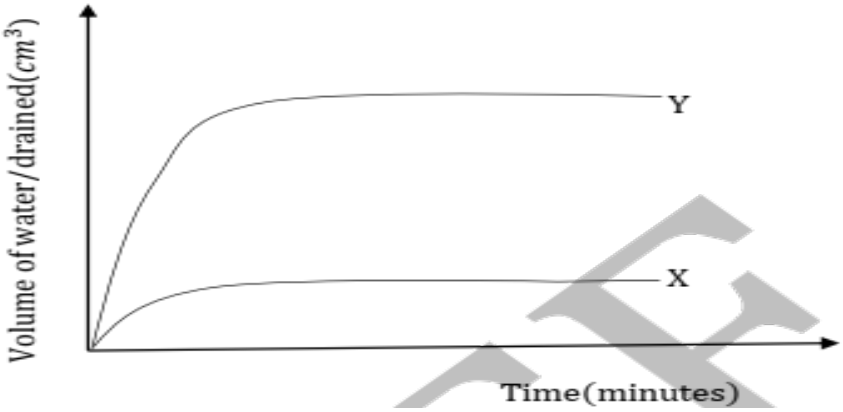
ACC: *Time recorded in seconds e.g. 20/30 seconds interval.*

TABLE II OF RESULTS [Ignore this table if pH is not mentioned in the scenario]

Water from soil sample	***Red litmus paper***	***Blue litmus paper***	***Deduction***
L	*Remained red* ***OR*** *Turned from red to blue*	*Remained blue*	*Is neutral* ***OR*** *Is alkali*
M	*Remained red*	*Turned from blue to pink/red.*	*Is slightly acidic/ is acidic.*

DATA ANALYSIS

A GRAPH SHOWING THE VARIATION OF VOLUME OF WATER COLLECTED/DRAINED BY SOIL SAMPLE L AND M WITH TIME



- ***Change Y to L and X to M.***

INTERPRETATION

- *Little water was collected from soil sample M because it has many smaller particles that are closely packed with small/tiny spaces in-between, so is poorly drained and highly water logged. Therefore, it won't give better yields.*
- *More water was collected from soil sample L because it has many bigger particles that are loosely packed with large spaces in-between, so it is well drained. Therefore, it is can produce better yields.*

RECOMMENDATION

- *Mr. Musisi should use the plot (piece of land) from where soil sample L was obtained since it has a good drainage (with alkaline pH;[* ***in case pH tested****])*

Case 3

An agricultural investor wishes/intends to establish/set a commercial sugar cane/wheat/tea/millet/coffee/Hass avocado/ irish potatoes cultivation/growing scheme/project in Uganda. He was informed that sugar canes/wheat/tea/ millet prefers/grows well in well drained soils with (low water content and) slightly acidic pH. The government has two pieces of land **L** and **M** from which to allocate the investor for the project/scheme. Through their investigations, the soil analysis experts have confirmed that soil samples from both pieces of land have adequate soil air, humus and microorganisms to support the crop.

However, further investigations are required to determine the suitable piece of land for the scheme/project. As a strong biology student, you have been contacted for help.

You have been provided with the following;

- Soil sample, L and M from the two pieces of land L and M respectively.
- And other apparatus/materials required.

TASK: Plan/design investigation(s) that you can carry out to help the government/investor and use your results to advise the government/investor accordingly.

[Use the same idea above]

Item 2

Case 1

Herdsmen/ cattle farmers in Uganda are face with the challenge of ectoparasites that spread red water disease known as *Babesiosis*. The disease is responsible for absorption of pregnant cows and low milk yields in the cattle farmers thus severe economic losses. Specimen A and B provided are the most common small organisms observed associating with the farm animals, that were collected by the cattle farmers.

TASK:

(a) Giving reasons, classify the specimens into the following taxonomic groups.

Specimen	Taxonomic group	Reasons
A	Phylum: ……	
	Class: ……..	
B	Phylum: ……....	
	Class: ……	
	Order: ……....	

(b) With reasons, identify the specimens and give their structural/observable differences.

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(c) With reasons, identify the specimen responsible for the spreading of the disease.

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(d) Explain how the specimen is suited/adapted for the spreading of the disease in the cattle.

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(e) Advise the cattle farmers on how to control the spreading for the disease.

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(f) Draw and label dorsal view of the specimen responsible for the disease/economic losses.

(g) Make a well labelled drawing of the external features of the specimen responsible for spreading of the disease.

Case 2

Kitezi land fill is a domestic waste damping site in Kampala. Surrounding communities have registered high cases of cholera and the ministry of health is investigating the potential causes and spreading of the disease. The ministry has collected a few vectors from the area for study labelled A, B, C, believed to be the transmitter of the germs.

TASK

(a) Classify the specimens upto the least shared taxonomic level. Giving reasons for the last level.

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(b) With reasons, identify the specimen responsible for the spreading of the disease.

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(c) Explain how the identified specimen is suited/adapted for the spreading of the disease.

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(d) Advise the community on how to control the spreading of the disease.

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(e) Cut off the hind limb of the identify specimen at the base. Make a well labelled drawing of the hind limb of the specimen responsible for spreading of the disease.

(f) Make a well labelled drawing of the dorsal view of the head of the specimen responsible for spreading of the disease.

Case 3

A certain farmer visited his garden and found/observed a huge loss after finding that most of his young maize plants were cut and lying on the ground. He developed a thought to spray the garden so as to reduce on the loss. He is challenged on the type of the pesticide to buy so as to target the exact pest. Specimen **A, B** and **C** provided have been collected from his garden.

Task:

(a) Giving reasons, classify the specimens into the following taxonomic groups.

Specimen	**Taxonomic group**	**Reasons**
A	Phylum: ……	
	Class: ……..	
B	Phylum: ……..	
	Class: ……	
	Order: ……..	
C	Phylum: ……	
	Class: ……..	
	Order: ……..	

(b) Using relevant observable features, construct a dichotomous/biological key to identify the specimens and help him identify the pest responsible for the loss/damage, giving reasons for your identity.

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(c) Explain the suitability of the identify pest in causing the effect (how is the pest adapted to cause the effect/loss/damage).

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(d) Draw and a label the dorsal view of the head of the pest identified.

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