Item 1

A farmer would like to buy land to plant beans on a large scale for sale. A land broker has suggested to her two plots for her to make a better choice. Her bean variety does not grow well in extremely water logged soils.

You are provided with soil **samples A and B** which have been obtained from the two plots of land.

Task

Design and conduct a scientific investigation on the soil samples and suggest a suitable recommendation to the farmer.

Aim.

An investigation to determine the soil water drainage of soil samples A and B for the better growth of beans. ✓ 2a

Hypothesis.

Soil sample A has a higher soil water drainage than soil sample B. ✓ 2b
Or. Soil sample A has a lower soil water drainage than soil sample B.
Or. More water is drained from soil sample A than soil sample B.

Variables.

Dependent variables: Volume of water collected. ✓ c

Independent variables: Time ✓ c
Controlled variables: Volume of soil samples used. Volume of water added to the soil samples. ✓ c

Requirements.

Soil samples A and B. ✓ d water. measuring cylinders. ✓ d cotton wool. beakers. ✓ digital watch.

Procedure.

- Cotton wool was plugged in the two necks of two filter funnels. ✓ e1 ✓ e2
- Equal volumes (e.g. 30cm³ or 40 cm³ or 50 cm³) of dry soil samples A and B were measured using a measuring cylinder and transferred into/ put into the two funnels plugged with cotton wool. ✓ e1 ✓ e2 ✓ e3
- The funnels were carefully tapped on the bench until air spaces are filled with soil. ✓ e1 ✓ e2
- Each funnel was then stood in the open end of a measuring cylinder, and equal volumes (e.g. 30cm³ or 40 cm³ or 50 cm³) of water measured using a measuring cylinder were poured into the funnels containing each soil sample at the same time. ✓ e1 ✓ e2 ✓ e3

02	a
02	b
03	c
03	d
02	e₁
02	e₂
02	e₃
02	f₁
02	f₂
03	g
03	h

- The set up was allowed to settle for 40/50/60(minutes) and the volume of water that dripped through each soil sample was recorded after every 10 minutes. ✓ e1 ✓ e2

Results/ observations

Time (minutes)	Volume of water collected from the two soil samples (cm³)	
	Soil sample A	Soil sample B
0		
10		
20		
30		
40		
50		
60	X	Y
✓ f1 ✓ f2	✓ f1 ✓ f2	✓ f1 ✓ f2

Interpretation/analysis/Observation of results

Interpretation/Analysis/Observation 1:
After every 10 minutes, the volume of water that dripped from soil sample A is lower than that of soil sample B. ✓ g
Or, *Award if learners plot the graph to interpret/analyse data*

Interpretation/Analysis/Observation 2:

Volume of water that dripped from soil sample A = X cm³ ✓ g
(Learners may further processes results into percentage of water drained).

E.g. $(\frac{\Box}{30/40/50} \times 100)$ %

Volume of water that dripped from soil sample A = Y cm³ ✓ g
(Learners may further processes results into percentage of water drained).

E.g. $(\frac{\Box}{30/40/50} \times 100)$ %

ALTERNATIVELY
If the learner's aim, was to investigate on soil water retention,
Volume of water retained in soil sample A
Volume of water poured in soil sample A = 30/40/50 cm³
Volume of water that dripped from soil sample A = X cm³
∴ Volume of water retained in soil sample A = (30/40/50 − X) cm³
Learners may further processes results into percentage of water retained.

$(\frac{(30/40/50) - Y}{30/40/50} \times 100)$ %

- The set up was allowed to settle for 40/50/60(minutes) and the volume of water that dripped through each soil sample was recorded after every 10 minutes. ✓ **e1** ✓ **e2**

Results/ observations

Time (minutes)	Volume of water collected from the two soil samples (cm³)	
	Soil sample A	Soil sample B
0		
10		
20		
30		
40		
50		
60	X	Y
✓ **f1** ✓ **f2**	✓ **f1** ✓ **f2**	✓ **f1** ✓ **f2**

Interpretation/analysis/Observation of results

Interpretation/Analysis/Observation 1:
After every 10 minutes, the volume of water that dripped from soil sample A is lower than that of soil sample B. ✓ **g**
Or, *Award if learners plot the graph to interpret/analyse data*

Interpretation/Analysis/Observation 2:

Volume of water that dripped from soil sample A = Xcm³ ✓ **g**
(*Learners may further processes results into percentage of water drained*).

E.g. $(\frac{\square}{30/40/50} \times 100)$ %

Volume of water that dripped from soil sample A = Ycm³ ✓ **g**
(*Learners may further processes results into percentage of water drained*).

E.g. $(\frac{\square}{30/40/50} \times 100)$ %

ALTERNATIVELY
If the learner's aim, was to investigate on soil water retention,
Volume of water retained in soil sample A
Volume of water poured in soil sample A = 30/40/50cm³
Volume of water that dripped from soil sample A = Xcm³

∴Volume of water retained in soil sample A = (30/40/50 – X) cm³

Learners may further processes results into percentage of water retained.

$(\frac{(30/40/50) - Y}{30/40/50} \times 100)$ %

Volume of water retained in soil sample B

Volume of water poured in soil sample B = 30/40/50cm³

Volume of water that dripped from soil sample A = Ycm³

∴Volume of water retained in soil sample A = (30/40/50 – Y) cm³

Learners may further processes results into percentage of water retained.

$$\left(\frac{(30/40/50) - Y}{30/40/50} \times 100\right) \%$$

Conclusion

Soil sample A has a lower water drainage while soil sample B has a higher water drainage. ✓ ^{h} Therefore, the farmer should choose to plant her beans on plot A instead of plot B. ✓ ^{h}

Item 2

Although many insects destroy plants and leads to poor yields, some are beneficial to farmers by improving crop yield. Tomato farmers are advised to use selective insecticides in their gardens mostly during the flowering stage, however some lack knowledge on which insects to be targeted by selective insecticides.

You are provided with **specimens O, P and Q** which are usually found in gardens.

Task

(a) Construct a dichotomous key to identify the specimens.

1 (a) Specimen with wings...go to 2

   (b) Specimen without wings.................................O ✓ ^{a}

2 (a) Specimen with pollen basket on hind legs.............Q ✓ ^{a}

   (b) Specimen without pollen basket on hind legs......P ✓

| 02 | a |

(b) Explain the suitability of the beneficial specimen to its role in the garden.

Numerous hairs on the body, for trapping pollen grains ✓ ^{b} ✓ ^{c}

Pollen basket on its limbs, for carrying pollen ✓ ^{b} ✓ ^{c}
Large compound eyes, to increase field of view during

flight/locomotion ✓ ^{b} ✓ ^{c}

| 03 | b |

| 03 | c |

Pair of wings, to provide maximum force during flight. ✓ ^{b} ✓ ^{c}

(c). Draw and label the hind limb of beneficial specimen.

MASAKA DIOCESAN EXAMINATIONS BOARD
Uganda Certificate of Education
JOINT MOCK EXAMINATIONS 2024
BIOLOGY
Paper 3
PRACTICAL

CONFIDENTIAL:

Each student should be provided with:

50 g of dry loam soil labelled A

50 g of dry sand soil labelled B

Specimen O — Worker termite

specimen P — Cockroach

Specimen Q — Worker bees

Access to:

- 50 ml / 25 ml measuring cylinder
- Filter paper
- filter funnel
- Hand lens
- Source of heat
- Labels
- Cotton wool
- Water
- Beakers
- Digital watch