

O'LEVEL BIOLOGY

PRACTICAL WORK BOOK

Name:

School:

Activity 1

You are provided with specimen L which is a modified part of a plant.

- (a) Cut specimen L transversely into two parts. Using the bottom part, describe how the leaves are arranged.

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- (b) Giving reasons suggest the great importance of the top most part.

Importance

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Reason

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- (c) Giving reasons suggest the great importance of the bottom part.

Importance	Reason

- (d) Carefully make a clear drawing of the lateral view of the bottom part of the specimen in the space provided

Activity 2

You are provided with specimens P, Q, R, S, T, U and V.

(a) State the identity of each specimen giving reasons for your identify.

P.....

Q.....

R.....

S.....

T.....

U.....

V.....

Reasons

P.....

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Q.....

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R.....

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S.....

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T.....

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U.....

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V.....

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(b) Examine the exposed sections of specimens S, T and U. Describe the seed arrangement of the specimens.

S.....

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T.....

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U.....

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Activity 3

- (a) You are provided with specimens P, Q, and S. Examine the specimens and answer the questions that follow.

Open up **P** longitudinally and also cut transverse sections of Q and S. Observe the sections of **P** and **S** and state three differences between them.

P	S

- (b) Identify the type of fruit each of specimens Q and S, basing on their structure.

Q.....

Reasons.....

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S.....

Reasons.....

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- (c) Describe the seed arrangement in the specimens, and in each case give the biological term.

Specimen P

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Biological term

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Specimen Q

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.....

Biological term

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Specimen S

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Biological term

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(d) Make clear drawings of the cut sections of the specimens Q and S

Activity 4

You are provided with specimens M and N which are fruits.

- (a) State two observable features on the specimens to suggest that they are fruits

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- (b) State the identity of each specimen.

M.....

N.....

- (c) state the differences and similarities between the specimens

Differences

M	N

Similarities

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- (d) Make a clear drawing of specimen N in the space provided. Do not label.
State your magnification.

Activity 5

You are provided with specimen Q which is a plant organ.

- (a) Observe clearly and identify the specimen giving three reasons for your identity.

Identity

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Reasons

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- (b) Describe the seed arrangement in the specimen giving the biological description of the arrangement.

Seed arrangement

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Biological description.

.....

- (c) Make a large well labelled drawing of specimen Q

Activity 6

You are provided with specimens M and N, which are fruits.

- (a) Suggest two observable features on the specimens that suggest that they are fruits.

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- (b) State the type of fruit the specimens are, giving reasons for your answer.
- Type of fruit

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Reasons

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- (c) Observe the specimens carefully and outline the differences between the specimens.

Specimen M	Specimen N

- (d) Make a large drawing of specimen N in the space provided. Include your magnification. Do not label.

Activity 7

Candidates are provided with specimens **H₁** and **H₂**. Examine the specimens and answer the following questions.

a) Identify each specimen.

Specimen H₁.....

Specimen H₂.....

(b) State the mode of dispersal for each specimen.

Specimen H₁

Mode of dispersal.....

Reasons

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.....

Specimen H₂

Mode of dispersal.....

Reasons

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.....

(c) Outline similarities and differences between the specimens.

Similarities

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.....
.....
.....

Differences

H ₄	H ₅

Activity 8

You are provided with specimens **P and Q** which are fruits.

a) What is the biological type of the specimens **P and Q**?

P.....

Q.....

b) Cut a cross specimens **P**, Make a labelled drawing of the interior of the specimen. State your magnification.

Cut specimen Q, observe carefully and state how it differs from P.

P	Q

e) State the point of similarities between P and Q

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.....
.....

f) State the reasons how you would believe specimen P and Q are dispersed

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.....

Activity 9

Study and examine specimens P, Q and S.

a) What is the biological nature of P?

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b) What type of fruit are Q and S biologically?

.....

c) Giving reasons identify specimen P

.....

Reasons

.....

.....

c) Outline the differences between S and P

Specimen S	Specimen P

e) Cut a vertical section of Q. Make a labelled drawing of One half of the specimen.

ii) How is the structure in P dispersed?

.....
.....

f) State the type of placentation observed in each specimen.

S.....

P.....

Activity 10

Study specimens **W** and **X** provided carefully. Answer the questions that follow.

(a) List the structural differences between **W** and **X**

SPRCIMEN W	SPECIMEN X

b) State the similarities between the specimens

.....
.....

c) Suggest with reasons how W and X are dispersed.

Specimen W.....

Reasons

.....
.....

Specimen X.....

Reasons

.....
.....

Activity 11

Specimens J, K, L, M and N are fruits.

a) State what type of fruit each specimen is:

J.

K.

L.

M.....

N.....

(b) Describe how each specimen is dispersed:

Specimen J

.....

.....
Specimen K
.....
.....

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Specimen L
.....
.....

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Specimen M
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.....

.....
Specimen N
.....
.....

(c) Cut cross section of specimens **L**. Draw and label a cross section of specimen in the space provided. State your magnification.

Activity 12

You are provided with specimens **P** and **Q** which are plant structures. Study the specimens and use them to answer the questions that follow.

- (a) Giving three reasons, identify what plants parts the specimens are;

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Reasons

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.....

- (b) State structural differences between **P** and **Q** in the table below

Specimen P	Specimen Q

- (c) Cut open the specimens transversely, describe the arrangement of seeds in each specimen

- (i) Seed arrangement in **p**

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.....

- (ii) Seed arrangement in **Q**

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.....

- (d) Using observable features, describe how each specimen is dispersed

- (i) Specimen P

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- (ii) Specimen **Q**

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(e) Draw and labelled the transverse section of **P**

(d) Draw the cut section of specimen **Q** in the space provided.

Activity 13

You are provided with specimens **O**, **P**, **Q**, **R** and **S** which are fruits.

(a) What type of fruits are specimens Q and R?

.....

Cut a transverse section of specimen **O**

Examine the specimens and give two characteristics features of each specimen

Specimen	characteristics features
O	
P	
Q	
R	
S	

(b) For each of the specimens **O**, **P**, **Q**, and **R** state the agent of dispersal and described how each specimen is adapted to being dispersed by the stated agent

(i) specimen **O**

Agent of dispersal.....

Adaptations

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.....
.....

(ii) Specimen **P**

Agent of dispersal.....

Adaptations

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.....
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(iii) Specimen **Q**

Agent of dispersal.....

Adaptations

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(iv) Specimen **R**

Agent of dispersal.....

Adaptations

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(v) Specimen **S**

Agent of dispersal.....

Adaptations

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- (i) In the space provided, make a clear drawing of specimens **P**. State your magnification.

LEAVES

Activity 14

You are provided with specimens labelled **K, L, M, N, O** and **P** respectively.

(a) Write down the characteristics of each specimen.

K.....
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.....

L.....
.....
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M.....
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N.....
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O.....
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.....

P.....
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From the characteristics listed in (a) above, construct a Biological key to indentify the specimens.

Activity 15

Specimens labeled **A**, **B**, **C**, **D**, **E**, **F** and **G** are provided to you.

List the characteristic features of each specimen.

A.....
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B.....
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C.....
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D.....
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E.....
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F.....
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G.....
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(b) From the characteristics in (a) above, construct a simple identification key classifying the Specimens.

Activity 16

You are provided with specimens **O**, **P**, **Q**, **R** and **S** which are fruits.

(a) What type of fruits are specimens P and R?

.....

(b) Cut a transverse section of specimen **O** longitudinal section of S

Examine the specimens and give two characteristics features of each specimen

Specimen	characteristics features
O	
P	
Q	
R	
S	

(c) Using the characteristics in (b) to construct a dichotomous key to identify the specimens.

FLOWERS

Activity 17

You are provided with specimens **C1**, **C2**, **C3**, **C4** and **C5** which are **flowers**.

(a) List the characteristic features of each specimen

C1

.....

C2

.....

C3

.....

C4

.....

C5

.....

(b) From the characteristics in (a) above, construct a simple identification key classifying the specimens.

Activity 18

You are provided with specimens D1, D2, D3, D4 and D5 which are flowers.

(a) List the characteristic features of each specimen.

D1.....

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D2.....

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D3.....

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D4.....

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(b) From the characteristics in (a) above, construct a simple identification key classifying the specimens.

ARTHROPODS

Activity 19

You are provided with specimens labelled V, **W**, **X**, **Y** and **Z**.

- (a) Outline at least three characteristics in each case.
- (b) State the order to which each of the specimens V, X, Y, and Z belong.

Specimen V

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Specimen X

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Specimen Y

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Specimen Z

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- (c) Using observations of each specimen, construct a Biological key to identify the specimens.

Activity 20

You are provided with specimens P, Q, R and S which are leaves.

- (a) Give two observable features which show that the specimens are leaves

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- (b) (i) Specimens P and Q perform other special functions in addition to their usual functions.

Describe how each of these specimens P and Q is adapted for its special function(s).

Specimen P.

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Specimen Q.

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(ii) Basing on the observable feature, state one function carried out by all the specimens.

Function;

Observable feature;

(c) Describe specimen S.

(d) Using characteristic features of the lamina only, construct a dichotomous key to identify the specimens

(e) Draw and label specimen P. State your magnification.

Activity 21

You are provided with specimens V, W, X, Y, and Z which are plant leaves.

a) State two observable characteristics of the specimen that qualify them to be leaves

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b) Using observable feature state how the specimens are adapted to perform their function

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(b) From the structure of specimen W suggest the habitat in which it grows best and why.

Habitat.....

Reasons

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.....

(c) Examine the petiole of the specimens and state three characteristics of the petiole of each specimen

Leaf V.....

Leaf W.....

Leaf X.....

Leaf Y.....

Leaf Z.....

(d) Using characteristics of the petioles stated in (d) (i) , Construct a dichotomous key to identify the specimens

FLOWERS

Activity 22

You are provided with specimens O and P. Examine them and answer the questions that follow.

(a) Outline the differences and similarities between O and P

Specimen O	Specimen P

Similarities between O and P

- (i)
- (ii)
- (iii)
- (iv)
- (b)

State characteristics that indicate that P is exclusively insect pollinated
- (i)
- (ii)
- (iii)
- (iv)
- (c)

Cut the specimen O longitudinally in order to obtain two identical halves. Draw and label. State the magnification.

Activity 23

You are provided with specimen **A₂**, and **B₂** and **C₂** study them carefully and answer the following questions.

a) (i) List the observable structural differences between **A₂** and **B₂**.

Specimen A₂	Specimen B₂

ii) List the observable structural adaptations which specimen **A₂** and **B₂** have for pollination.

Adaptations of specimen **A₂** for pollination

- i)
- i)
- ii)
- iii)

Adaptations of specimen **B₂** for pollination

- i)
- ii.
- iii.

d) Cut the specimen **C₂** longitudinally into two halves, draw and label one half.

Activity 24

You are provided with specimens **L** and **M** which are flowers. Examine them and answer the questions that follow.

(a) Giving reasons, state the type of pollination in specimens L and M

Type of pollination

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Reasons

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(b) Describe the following parts of specimen L

(i) Calyx

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(ii) Corolla

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(iii) Androecium

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(iv) Gynoecium

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(c) Give four structural differences between L and M on the corolla, and calyx.

Specimen L	Specimen M

(d) Give the importance of corolla arrangement of specimen L

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(e) Using a razor, cut specimen M longitudinally, starting from the flower stalk through the ovary and petals.

Draw and label a longitudinal section of specimen M and state your magnification.



FOOD TESTS

Activity 25

You are provided with solutions A, B, C, D, E and F. Carry out the following test to identify the food substances present in the solutions.

	Procedure	Observation	Deduction
I	To 1cm ³ of solution A in a test tube, add 2-3 drops of iodine solution		
ii	To 1cm ³ of solution B in a test tube, add an equal volume of Benedict's solution and boil for 1 minute		
iii	To 1 cm ³ of solution C in a test tube, add 3-4 drops of dilute hydrochloric acid and boil for 1 minutes, cool and add 3-4 drops of sodium hydroxide and add Benedict's solution and boil		
Iv	To 1cm ³ of solution D in a test tube, add sodium hydroxide solution followed 5 drops copper (II) sulphate.		
V	To 1cm ³ of DCPIP in a test tube, add the solution E drop by drop until in excess.		
VII	To 1cm ³ of the solution F in a test tube; add ethanol and shake vigorously, and then add equal volume of distilled water		

(a) What is the purpose of adding dilute hydrochloric acid in experiment (iii)

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(b) What is the purpose of adding dilute sodium hydroxide in experiment (iii)

.....

Activity 26

You are provided with solution X which contains a mixture of food substances.

(a) Carry out the following tests to identify the food substance in solution X.

Procedure	Observation	Deduction
To 1cm ³ of solution X in a test tube, add 2-3 drops of iodine solution		
To 1cm ³ of solution X in a test tube, add an equal volume of Benedict's solution and boil for 1 minute		
To 1 cm ³ of solution X in a test tube, add 3-4 drops of dilute hydrochloric acid and boil for 1 minutes, cool and add 3-4 drops of sodium hydroxide and add Benedict's solution and boil		
To 1cm ³ of solution X in a test tube, add sodium hydroxide solution followed 5 drops copper (II) sulphate.		
To 1cm ³ of DCPIP in a test tube, add the solution X drop by drop until in excess.		
To 1cm ³ of the solution X in a test tube; add ethanol and shake vigorously, and then add equal volume of distilled water		

(b) Outline the importance of food substance present in X to the body.

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Activity 26

You are provided with solution W.

(d) Carry out the following tests to identify the food substance present in the solution. Record your observations and deductions in the spaces provided.

Procedure	Observation	Deduction
To 1cm ³ of solution W in a test tube, add 2-3 drops of iodine solution		
To 1cm ³ of solution W in a test tube, add an equal volume of Benedict's solution and boil for 1 minute		
To 1 cm ³ of solution X in a test tube, add 3-4 drops of dilute hydrochloric acid and boil for 1 minutes, cool and add 3-4 drops of sodium hydroxide and add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution W in a test tube, add Millon's reagent and boil		
To 1cm ³ of DCPIP in a test tube, add the solution W drop by drop until in excess.		

(e) (i) Which food substances are present in solution W?

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(ii) Outline the functions of the food substance named to the body.

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(iii) Discuss the deficiency of the food substances named in b(i) above.

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Activity 27

You are provided with specimen D. Remove the epicarp and the mesocarp. Squeeze the endocarp to obtain the juice and use it to carry out the following test to identify the food substance present in the specimen.

- (i) To 1cm³ of the solution in another test tube, add a few drops of Iodine

Observation

.....
Deduction

-
(ii) To 1cm³ of the solution in a test tube, add an equal volume of Benedict's solution and boil for 1 minute

Observation

.....
Deduction

-
(iii) To 2cm³ of the solution in a test-tube, add 1cm³ of dilute hydrochloric acid and boil for 1 minute. Cool and add equal amount of dilute sodium hydroxide followed by 1cm³ of Benedict's solution and boil.

Observation

.....
Deduction

-
(iv) To 2cm³ of the solution in a test tube, add 1cm³ of dilute sodium hydroxide followed by few drops of 5% copper (II) Sulphate

Observation

.....
Deduction

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(v) . What conclusion do you draw from your test about the role of Specimen D?

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EFFECT OF DILUTION (CONCENTRATION)

Activity 28

You are provided with specimen X peel it carefully and cut it into 4 equal parts. Crush each part in a mortar and produce 4 different extracts in the beakers and label them X_1 , X_2 , X_3 , and X_4 solutions. And 5cm^3 , 15cm^3 , 25cm^3 and 50cm^3 to solutions X_1 , X_2 , X_3 , and X_4 respectively. Use the solutions to carry out the following tests.

Procedure	Observation	Deduction
To 1cm^3 of DCPIP in a test tube, add solution X_1 drop wise until in excess.		
To 1cm^3 of DCPIP in a test tube, add solution X_2 drop wise until in excess.		
To 1cm^3 of DCPIP in a test tube, add solution X_3 drop wise until in excess.		
To 1cm^3 of DCPIP in a test tube, add solution X_4 drop wise until in excess.		

(a) Explain the results obtained the tests

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(b) Which principle is being investigated?

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Activity 29

You are provided with specimens A and B.

Using a mortar and a pestle crash specimen A, add 10cm³ of water and obtain an extract. Label it A₁. Repeat the same procedure using specimen B and label the extract B₂. Carry out the following tests to determine the food substance contained in each specimen. Record your observations and deductions in the table below.

Test	Observation	Deduction
To 1cm ³ of A ₁ in a test tube add 3 drops of iodine solution		
To 1cm ³ of B ₂ in a test tube add 3 drops of iodine solution		
To 1cm ³ of solution A ₁ in the test tube, add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution B ₂ in the test tube, add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution A ₁ in the test tube, add 1cm ³ of dil. HCl, boil and allow to cool; then add 1cm ³ of dil. NaOH solution followed by 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution B ₂ in the test tube, add 1cm ³ of dil. HCl, boil and allow to cool; then add 1cm ³ of dil. NaOH solution followed by 1cm ³ of Benedict's solution and boil		

b) Giving a reason, suggest which specimens A₂ and B₂ would sprout first if favourable conditions for growth were provided.

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1. EFFECT TEMPERATURE ON FOOD SUBSTANCE

Temperature as one of factors affecting many metabolic processes in the body, affect in one way or the other some food substances e.g. proteins. When subjected to high temperatures, proteins are destroyed and thus may be absent in a food sample which tested positive previously. This phenomenon explains to us why some foods are better eaten raw or half cooked than when fully cooked.

Activity 30

Procedure.

- a) You provided with solution X. Get 1cm^3 of solution X in the test tube, add 1cm^3 of dilute sodium hydroxide solution followed by 5 drops copper(ii) sulphate.

Observation

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Deduction

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- b) To another part of solution X, first boil the part for about 2min, and then carryout the same test as in (a) above.

Observation

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Conclusion

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Explanation

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(f) How is the principle in (a) and (b) be applied by the nutritionists?

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2. DISTRIBUTION OF FOOD SUBSTANCES

Food in food storage organs is distributed differently in different parts, e.g. the bottom part of the fruit compared with the top part using a pineapple and in storage organs of different developmental stages e.g. using a young orange, mature raw one and a mature ripe.

Activity 31

You are provided with specimens W and X.

Using a mortar and a pestle crash specimen W, add 10cm³ of water and obtain an extract. Label it W₁. Repeat the same procedure for W with specimen X and label the extract X₁. Carry out the following tests to determine the food substance contained in each specimen and the amount present. Record your observations and deductions in the table below.

Procedure	Observation	Deduction
To 1cm ³ of solution W ₁ in the test tube, add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution X ₁ in the test tube, add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of W ₁ in a test tube add 3 drops of iodine solution		
To 1cm ³ of X ₁ in a test tube add 3 drops of iodine solution		
To 1cm ³ of DCPIP in a test tube, add solution W ₁ drop wise until in excess.		
To 1cm ³ of DCPIP in a test tube, add solution X ₁ drop wise until in excess.		

.....

(a) Sarah has a problem for her wounds taking long to heal. Which of the above fruits would you advise Sarah to take?

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Which of the two specimens can someone with diabetes problem be advised to take?

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CHEMICAL TESTS INVOLVING STARCH DIGESTION OR HYDROLYSIS

Activity 32

1. You are provided with suspension W.

(a) Carry out the tests on the suspension W for the presence of starch and reducing sugar. Use the reagent provided. Record the test, observations and deduction in the table below.

Solution

FOOD TYPE	TEST	OBSERVATION	DEDUCTION
STARCH			
REDUCING SUGAR			

(b) Rinse your mouth with clean water and obtain 5 cm³ of saliva in clean test tube.

Add 5 cm³ of distilled water to prepare a saliva solution

- Add 2 cm³ of solution W to each test tube labelled 1 to 5
- Add 2 cm³ of saliva solution to test tube 1 to 5. Boil the content of the test tube 5 for two minutes
- To test tubes 3 and 4, add 1 cm³ of dilute sodium hydroxide and dilute hydrochloric acid respectively
- Incubate the test tubes in a water bath at 40°C for 20 minutes
- Add 2 drops of iodine solution to test tube labelled 1 to 5
- Record your observation and deduction in the table below

Test tube	Observation	Deduction
1		
2		
3		
4		
5		

(i) Explain the results in each test tube.

Test tube 1

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Test tube 2:

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Test tube 3:

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Test tube 4:

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Test tube 5:

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(b) (i) state two properties of the active substance investigated in (b) above

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(ii) State one other factor which would affect the rate of the active substance in saliva

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Activity 33

You are provided with solution X and Y, test tube, heat source, thermometer, dropper; a water bath maintained at 35-40°C, Benedict's solution, 0.1 M HCl, 0.1 NaOH.

(a) Using the reagents and apparatus provided, carry out the following test on the solution X and Y and record your results.

(i) And 1cm³ of Benedict's solution to 1cm³ of solution X and boil for 1 minute.

Observation

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Deduction

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(ii) To 1cm³ of solution Y, add 1cm³ of Benedict's solution and boil for 1 minute.
Observation

Deduction

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(iii) To 1cm³ of solution X, add 1cm³ of hydrochloric acid and boil for 2 minutes cool in water and add 1cm³ of sodium hydroxide solution, shake and add 1cm³ of Benedict's solution and boil for 1 minute.
Observation

Deduction

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(iv) To 1cm³ of solution Y and 1cm³ of hydrochloric acid and boil for 2 minutes. Cool in water and add 1cm³ of sodium hydroxide. Shake and then add 1cm³ of benedict's solution and boil for 1 minute.
Observation

Deduction

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(b) Rinse your mouth with water and collect 2cm³ of saliva in a test-tube, add 2cm³ of water. Divide the solution into two parts 1 and 2. Add solution X to part 1 and solution Y to part 2. Put the two test tubes in a water bath maintained at 35-40°C for 15 minutes. After 15 minutes, remove the test tubes, add 1cm³ of Benedict's solution and boil for one minute.

(i) Test tube 1

Observation

Conclusion

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(ii) Test tube 2

Observation

.....
.....

Conclusion.

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(c)(i) Explain what was responsible for the observations you made in (b) above

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.....
.....
(ii). In (b), why was the solution with saliva placed in the water bath?

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.....
(d) (i) Name the food substances present in solution X and Y.

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.....
(iii) Name the natural sources of the food present in solution Y.

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Activity 34

You are provided with solution D. Use it to carry out the following investigation.

(a) Test solution D as indicated in the table below and records your observation and deduction.

No	Test	Observation	Deduction
1	To 2cm ³ of D in a test-tube, add 2-3 drops of iodine solution.		
2	To 2cm ³ of D in a test tube, add 2cm ³ of Benedict's solution and boil		

(b) Rinse the mouth with water, and then collect 2cm³ of saliva by spitting in a clean test tube. Add 2cm³ of solution D in a test tube; leave the mixture to stand in a water bath at 35°C-40°C for 10 minutes.

(a) To 2cm³ of D in a test-tube, add 2-3 drops of iodine solution

Observation

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Conclusion

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Add 1cm³ of benedict's solution to 1cm³ of the mixture above and boil.

Observation

.....

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Conclusion

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(c) Explain the differences in results in (a) and (b)

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Activity 35

You are provided with solutions A, B, C and D. Solution A contains food nutrients. You are required to determine the food nutrients in A and investigate the action of solution B, C, and D on A.

(a) Carry out the following tests and record your observation and deduction in the table below

Test	Observation	Deduction
(i) To 1cm ³ of A, add 2 drops of iodine solution		
(ii) To 1cm ³ of A, add 1cm ³ of Benedict solution and boil.		

(b) Label three test tubes as 1, 2, and 3 and add contents in to each test tube indicated in the table 01.13 below

Test tube	Contents
1	1 cm ³ of B + 1 cm ³ of distilled water, shake to mix add 1 cm ³ of A
2	1 cm ³ of B + 1 cm ³ of C shake to mix then add 1 cm ³ of A
3	1 cm ³ of B + 1 cm ³ of D, shake to mix then add 1 cm ³ of A

Place the test tubes in a water bath at 35-40°C for 15 minutes. After 15 minutes carry out Benedict's test on the contents of each test tube and record your observations and deductions in the table below

Test tube	Observation	Deduction
1		
2		
3		

(c) Explain your results in the test tubes 1-3

Test tube 1

.....

Test tube 2

.....

Test tube 3:

.....

(d) Giving a reason in each case, suggest the identity of;

i) Solution A.....

Reason.....

.....

ii) Solution B.....

Reason.....

.....

iii) Solution C.....

Reason.....

.....

Solution D.....

Reason.....

(e) which principle is being investigated?

.....

.....

Activity 36

You are provided with solutions **X** and **Y**.

(a) Carryout the tests in the table below to determine the food nutrients present in solution X. Record your observations and deductions in the table below.

Test	Observation	Deduction
To 1cm ³ of solution X, add 3 drops of iodine solution		
To 1cm ³ of solution X in the test tube, add 1cm ³ of Benedict's solution and boil		
To 1cm ³ of solution S in the test tube, add 1cm ³ of dil. NaOH solution followed by 4 drops. of copper (II) sulphate solution		

- (b) Put 3cm³ of solution X into a test tube and add 2cm³ of solution Y and incubate in water bath maintained at 35°C – 40°C for 20 minutes.

After 20 minutes, repeat the tests in table below.

Test	Observation	Deduction
(i) Iodine test		
(ii) Benedict's test		
(iii) Biuret's test		

- (c) (i) State the effect of solution Y on solution X

.....

- (ii) Give two reasons to support your answer in c(i) above.

.....

.....

.....

- (d) Why was the solution:

- (i) Incubated in water bath for 20 minutes.

.....

.....

- (ii) Incubated in water bath at 35°C – 40°C.

.....

.....

- (e) State the factor which is being investigated in this experiment.

.....

Activity 37

You are provided with solutions S, dil. HCl, dil. NaOH, invertase solution Benedict's and distilled water. Use the solutions to carry out the following tests.

- (a) (i) To 1cm³ of S in a test tube, add 1cm³ of dilute hydrochloric acid boil and cool. Then add 1cm³ of dilute sodium hydroxide followed by 1cm³ of Benedict's solution and boil or heat for one minutes

Observation

.....
.....

Conclusion

.....

- (f) To 1cm³ of S in a test tube, add 1cm³ of Benedict's solution and boil for one minute

Observation

.....
.....

Conclusion

.....

- (b) To 2cm³ of S in a test tube, and 1cm³ of invertase solution and shake. Keep the test tube in a water bath at 40°C for 15 minutes. After 15 minutes, remove the test tube and add Benedict's solution, boil for one minute.

Observation

.....
.....

Deduction

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Explanation

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(c) To 1cm³ of the food sample solution S in a test tube, add 1cm³ of enzyme invertase. Leave the experiment for 15 minutes (do not incubate the test tube). After 25 minutes, remove the test tube and add 1cm³ of Benedict solution and boil or heat for one minute.

Observation

.....
.....

Deduction

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Explanation

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.....
.....

(d) To 1cm³ of S in a test tube, add 1cm³ of boiled invertase and shake. Keep the test tube in a water bath at 40°C for 15 minutes. After 15 minutes, remove the test tube; add Benedict's solution and boil or heat for one minute

Observation

.....
.....

Deduction

.....

Explanation

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.....
.....

(e) To 1cm³ of the food sample solution S in a test tube, add 1cm³ of yeast extract and shake keep the test tube in a water bath at 40°C for 15 minutes. After 15 minutes, remove the test tube; add Benedict's solution boil or heat for one minute.

Observation

.....
.....

Deduction

.....

Explanation

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.....
.....

CHEMICAL TESTS INVOLVING PROTEIN DIGESTION/HYDROLYSIS

Activity 38

You are provided with **egg albumen**, four test tubes, dilute HCl and enzyme pepsin. Read the procedure below carefully and answer the questions, which follow.

- (i) Take a beaker of distilled water and warm to about 37°C.
- (ii) Take four test tubes and into each place 5cm³ of egg albumen suspension.
Label test tubes as A, B, C and D.
- (iii) Add 1cm³ of 1% boiled pepsin in test tube D and 1cm³ of 1% unboiled pepsin in test tubes A and C.

(iv) Add 4 drops of dilute HCl acid to test tube B, C and D

(v) Place all the four test tubes in a water bath maintained at 35-40°C

(a) After 10 to 15 minutes, remove the four test tubes from the water bath and place them in a test tube rack then examine the content of each test tube and record your observations in the table below.

expt	Contents	Appearance at the beginning of experiment	Appearance at the end of experiment.
A	Albumen + pepsin		
B	Albumen + HCl		
C	Albumen + pepsin + HCl		
D	Albumen + boiled pepsin + HCl		

b) i) In which test tube does the content have a different appearance after 10 minutes or more?

.....

ii) What has happened to the egg albumen suspension?

.....

b) i) How is the enzyme affected by boiling?

.....

ii) What evidence leads you to this conclusion?

.....

iii) What other hypothesis could you advance to account for the result in test tube C?

.....

d) What is P^H conditions in which the enzyme pepsin can act?

.....

Activity 39

You are provided with solutions Q, R and S.

- (a) Identify solution Q by carrying out the following tests. Record your observations and deductions in the table below.

Test	Observation	Deduction
To 2cm ³ of solution Q in a test tube, add 3 drops of Iodine solution		
To 2cm ³ of solution Q add 1cm ³ of Benedict's solution and boil		
To 2cm ³ of solution Q in test tube, add 5 drops of dilute sodium hydroxide solution followed by 5 drops of copper sulphate solution		

- (b) Get 4 test tubes labelled 1 to 4. Put 1cm³ of Q in test tubes 1-4. Add 1cm³ of R in test tubes 1 and 2. Add 1cm³ of S in test tubes 3 and 4. . Add 1cm³ of HCl in test tubes 1 and 3. Add 1cm³ of NaOH in test tubes 2 and 4. Place the mixture in water bath maintained at about 35 - 40°C and leave for 15 minutes. After 15minutes, test the mixture for presence of proteins.

Procedure for test tube 1-4

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.....
.....

Test tube 1

Observation

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.....

Deduction

.....

Explanation

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.....
.....

Test tube 2
Observation

.....

.....

Deduction

.....

Explanation

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Test tube 3
Observation

.....

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Deduction

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Explanation

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Test tube 4
Observation

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Deduction

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Explanation

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ACTION OF ENZYME CATALASE WITH HYDROGEN PEROXIDE (H₂O₂) SOLN

Activity 40

You are provided with the following. Hydrogen peroxide solution, Solution X, Solution Z, pieces of liver tissues, litmus, dropper, test tubes.

- (a) Carry out the following tests and record your observations and deductions in the table below. Label four test tubes 1, 2, 3, and 4 place a piece of liver tissues provided in each test tube.

Test tube		Test	Observation	Deduction
1	i)	Add solution X to completely cover the piece of liver tissue and add 1cm ³ of hydrogen peroxide		
	ii)	Test the mixture with red and blue litmus paper		
2	i)	Add solution Z to completely cover the liver tissue and add 1cm ³ of hydrogen peroxide		
	ii)	Test the mixture with red and blue litmus paper		
3	i)	Add distilled water to cover the liver tissue, and add 1cm ³ of hydrogen peroxide		
	ii	Test the mixture with red and blue litmus paper		
4	i)	Add distilled water to cover the liver tissue, boil and add 1cm ³ of hydrogen peroxide		
	ii)	Test the mixture with red and blue litmus		

(b) In which test tube was reaction most vigorous?

.....

(c) What is the nature of

(i) Solution X?

.....

(ii) Solution Z?

.....

(d) In what medium is the active substance in the liver tissues most active?

.....

(e) What is the effect of heat on the active substance in the liver?

.....

(f) Identify the active substance in the liver tissue; give reasons for your identity.

.....

Reasons.

i)

ii)

(g) Which factors are being investigated in this experiment?

.....

.....

Activity 41

You are provided with four unboiled pieces and one boiled piece of liver and solutions P, X, Y and Z (P is 6% hydrogen peroxide, X is 2M HCl, Y is 2M NaOH, and Z is water).

- (a) Carry out the following tests using the liver and the solution. Record your observations and deductions in the following table.

	Test	Observation	Deduction
i)	To 3cm ³ of solution P in a test tube, add one piece of unboiled liver		
ii)	To 2cm ³ of solution P in a test tube, add 1cm ³ of solution X and test the mixture with litmus paper then add one piece of unboiled liver.		
iii)	To 2cm ³ of solution P in a test tube, add 1cm ³ of solution Y. test with litmus paper then add one piece of unboiled liver		
iv)	To 2cm ³ of solution P in a test tube, add 1cm ³ of solution Z, test with litmus paper then add one piece of unboiled liver		
	To 2cm ³ of solution P in a test tube, add one piece of boiled		

- (b) From your results. Suggest the nature of solution P.

.....

- (c) What conclusion can you make from the results of tests (ii), (iii) and (iv)

.....

- (d) What is the importance of test in (i)?

.....

- (e) Explain the result in test (v)

.....

.....

Activity 42

Study the specimens U and V provided to answer the questions that follow.

a) State the observable differences and similarities between U and V.

Specimen U	Specimen V

Similarities between Monocot plants and Dicot plant

- (i)
- (ii)
- (iii)
- (iv)

b) Which specimen would be better adapted if both of them were growing in soil with water shortage? Give a reason for your answer

.....

.....

.....

1. KINGDOM ANIMALIA

Activity 43

You are provided with specimens **W, X , Y and Z** which are animals. Using a hand lens, where necessary examine the specimens and answer the questions that follow.

a) State the class of each specimen.

W.....
X.....
Y.....
Z.....

b) Observe the specimens and complete the table below.

Specimen	Number of Legs	Number of wings
W		
X		
Y		
Z		

c) Using only the characteristics of the specimens in (b) above, construct a dichotomous key to identify the specimens.

d) Describe how specimen Y is adapted to its habitat.

.....
.....
.....
.....

e) Draw outer wing of Y at a magnification of $\times 2$. Do not label

Activity 43

You are provided with specimens C, D, E. and F .Using a hand lens, examine the specimens and answer the questions that follow.

a) Describe the mouthparts, wings and legs of each specimen.

Specimen	Mouth parts	Wings	Legs
C			
D			
E			
F			

b) State how;

i) The mouthparts of E and F are suitable for the modes of life of the specimens.

Mouthparts of E

.....

.....

Mouth parts of F

.....

.....

ii) The wings of specimens C and D are suited for the modes of life of the specimens.

Wings of C

.....

.....

wings of D

.....

.....

iii) The legs of specimen D and E are suited for the modes of life of the specimens.

Legs of D

.....

.....

Legs of E

.....

.....

- c) Remove the inner wing of specimen D, draw and label the wing. State your magnification.

Activity 44

You are provided with specimens A, B, C, D and E.

- a) Examine the specimens and give five observable features of each specimen.

Specimen A

.....

Specimen B.....

.....

Specimen C.....

.....

specimen D.....

.....

Specimen E.....

.....

- a) Using only the characteristics in (a) above, construct a dichotomous key to identify the specimens.

Activity 45

Specimens P, Q, R, S and T are animals belonging to the same class.

(a) State the observable common characteristics of the specimens.

.....

.....

.....

(b) Using a hand lens, examine the thorax of each specimen.

i) List the characteristic features of the thorax of each specimen

Specimen p

.....

Specimen Q

.....

Specimen R

.....

Specimen S

.....

Specimen T

.....

c) Using the characteristics of the thorax of the specimens listed construct a dichotomous key to identify the specimens.

Activity 46

You are provided with specimens **D, E, F, G, H** which are animals.

Use a razor and cut off one hind limb of **F** as close to the body as possible.

c) Draw and label the last six segments from the tip/end of the limb.



(b) Examine the wings of specimens **F** and **G** and give three differences between them.

Wings of specimen F	Wings of specimen G

(c) List three observable features common to all specimens.

.....

.....

.....

(d) Using observable structures state how specimen **H** is adapted to its mode of life.

.....

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- (e) Examine the specimens and using the number of body parts, number of legs and number of wings, construct a dichotomous key to identify them.

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Activity 47

You are provided with specimens **P**, **Q**, **R** and **S**.

- (a) Examine the specimens and giving two reasons, state the class to which they belong.

Class;

.....

Reasons;

.....

.....

- (b) (i) Using a hand lens, examine one antenna of specimen P and describe it

.....

.....

.....

- (ii) Measure the length of one antenna and length of the body of specimen P and calculate the ratio of length of antenna to length of the whole body

Length of the antenna.....

Length of the body.....

Ratio of length of the antenna to length of the body.

.....

.....

- (iii) State the significance of the ratio obtained in b(ii) above.

.....

.....

- (c) Place specimen P, Q, R and S ventral side uppermost and examine their limbs using a hand lens. Write down two characteristics of limbs of each specimen in the table below.

Specimen	Characteristics of limbs
P	
Q	
R	
S	

- (d) Using the characteristics in the table above, construct a dichotomous key to identify the specimens.

.....

.....

.....

.....

.....

.....

.....

- (e) Draw and label the ventral side of the head of specimen R. State your magnification.

(d) PHYLUM CHORDATA

Activity 48

Observe specimen W provided carefully and answer the following questions.

(a)(i) Identify specimen W

.....

(ii) Give reasons for your answer in a (i) above.

.....

.....

(b) (i) Suggest the habitat in which the specimen W would live.

.....

(ii) Name the features on the body of the specimen, which enable the specimen to move easily in the habitat you have suggested.

.....

.....

.....

.....

(iii) With the left side of the specimen W facing you, make a labelled drawing of the head region. State your magnification.

c) Cut away the operculum to show the gills of specimen W, Examine carefully using a hand lens.

i) State the function of the gills to the life of the organism in which it is found.

.....

.....

d) What are the observable features of the gill that make it suited for its functions?

.....

.....

.....

ii) State how these features make the gill suited for its function.

.....

.....

.....

iii) How is the gill protected in living organism?

.....

(a) Draw the gill in lateral view and label. Indicate on the drawing the anterior and posterior end of the gill.



Activity 49

You are provided with specimen B.

(a) make a drawing of

i) dorsal fin

ii) Caudal fin

(b) From the size, shape and possible movement of these three fins suggest the use to the fish in swimming.

i. Dorsal fin:

.....

ii. Pectoral fins:

.....

ii. Caudal fin:

.....

(c) Write a brief statement of your observations on the skin of B, referring especially to the scales and pigmentation.

.....

.....

.....

Activity 50

You are provided with specimen P which is a plant tissue and sucrose solutions of varying concentrations of 0%, 1%, 5%, 10%, 15%, 20%, 25%, & 30% in different test tubes.

d) Peel specimen P and use a cork borer to bore the tissue to produce cylinders of uniform length of 4cm. Drop one cylinder in each test tube and leave to stand for 20 minutes.

(i) After 20 minutes, remove the cylinders and place them on a filter paper, then measure their length, record the results in the table below.

Length	Sucrose concentrations(%)							
Initial lengths(cm)	0	1	5	10	15	20	25	30
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Final length(cm)								
Difference in lengths(cm)								

(ii) Obtain the differences in lengths of cylinders between the initial and final length, then record the results in the table above.

(iv) Plot a graph of concentration against difference in length.

e) Explain why;

(i) There may be a difference in length.

.....

.....

.....

(ii) there may be a difference in length of more than 0.0 cm

.....

.....

.....

(iii) there may be a difference in length of less than 0.0cm

.....

.....

.....

f)(i) Feel the texture and the stiffness of the cylinders and record your observations in the table below.

Sucrose concentration	Texture of cylinder	Stiffness of cylinder
0%		
1%		
5%		
10%		
15%		
20%		
25%		
30%		

(i) explain why texture of some tissue is;

- Smooth

.....

.....

- Rough

.....

.....

(ii) explain why some cylinders are;

- Stiff

.....

.....

- Flabby

.....

.....

Activity 51

You are with specimen **M** and solution **X**.

- (a) Carry out the following tests to establish the food nutrients in **X**.

Tests	Observations	Deductions
(i) To 1cm ³ of X in a test tube, add 2 drops of iodine.		
(ii) To 1cm ³ of X in a test tube, add 1cm ³ of Benedict's solution and boil.		

- (b) Label 3 test tubes as A₁ B₁ and C₁. Pour 5cm³ of distilled water in test tube A₁ and 5cm³ of solution X in each test tube B₁ and C₁.

Using a cork borer, cut out three cylinders from specimen M, each measuring 3cm long. Put one cylinder in each of the test tubes A₁ and C₁. Cut up the third cylinder into 5 smaller pieces then add them to test tube B₁. Leave the set up for 15 minutes.

Label 3 other test tubes as A₂, B₂ and C₂ and add 4cm³ of distilled water to each of them. After 15 minutes, remove the cylinder in A₁, dip it in distilled water and immediately remove it and transfer it to test tube A₂.

Remove the pieces in test tube B₁, and drop them in distilled water and immediately remove them and transfer them to test tube B₂ and finally remove the cylinder in C₁, dip it in distilled water and immediately remove it and transfer it to test tube C₂. Leave the set up for 15 minutes.

After 15 minutes, remove the cylinders from the test tubes leaving the solutions. Carry out tests in the table below on solutions A₂, B₂ and C₂.

Tests	Observations	Deductions
(i) Take 1cm ³ of the solution from test tube A ₂ , and put it into another test tube, add 1cm ³ of Benedict's solution and boil.		
(ii) Repeat test (i) using the solution in test tube B ₂		

(iii) Repeat test (i) using the solution in test tube B ₂		
--	--	--

(c) Name the biological process investigated in (b).

.....

(d) Explain the results in tests (ii) and (iii)

Test (ii)

.....

.....

.....

.....

Test (iii)

.....

.....

.....

.....

(e) Explain the purpose of

(i) cutting up one cylinder of M into smaller pieces before adding to test tube B₁.

.....

.....

(ii) dipping the pieces of M from test tubes A₁, B₁ and C₁ into distilled water before transferring them to test tubes A₂, B₂ and C₂

.....

.....

Activity 52

You are provided with liquids **A** and **B**. You are required to carry out tests on the liquids using visking tubes, following the instructions provided, and then answer the questions that follow.

Tightly tie one end of each of the visking tubes provided using a thread.

Measure 30cm³ of liquid **A** and transfer it into a boiling tube labelled A and 30cm³ of liquid B and transfer it into a boiling tube labelled B.

Now measure 5cm³ of liquid A and carefully transfer it to one of the visking tubes and tightly tie the remaining end of the visking tubes leaving the thread hanging. Similarly measure 5cm³ of liquid B into the second visking tube and in the same way tie the remaining end of the visking tube.

Transfer the visking tube containing liquid **A** into boiling tube **B** and the visking tube containing liquid **B** into boiling tube **A** as shown below and leave the set-up for 30 minutes.

- (a) After 30 minutes, remove and examine the visking tubes. Describe the condition of each visking tube.

(i) Visking tube from boiling tube A

.....

(ii) Visking tube from boiling tube B

.....

- (b) Transfer the liquid in boiling tube **A** into a 10cm³ measuring cylinder and record its volume in the table below. Repeat the procedure to measure and record the volume of liquid in boiling tube **B** and complete the table.

	Boiling tube A	Boiling tube B
Final volume (cm ³)		
Initial volume (cm ³)		
Difference in volume (cm ³)		

- (c) Explain your results in the table above for boiling tubes A and B

(i) Boiling tube A

.....

(ii) Boiling tube A

.....

- (d) (i) What process is being demonstrated in the tests?

.....

(ii) What was the role of the visking tube in the experiment?

.....

SKELETON

Activity 53

You are provided with specimens A and B.

- (a) Outline structural **differences and similarities between A and B**

SPECIMEN A	SPECIMEN B

Similarities between specimen A and B

.....

.....

.....

.....

- b) State the ways in which anterior of specimen B can be discovered.

.....

- c) What are the functions of the specimen A and B to the animals?

.....

.....

- d) Make a well labeled drawing of the anterior view of specimen A

Activity 54

You are provided with specimens **A, B, C and D**. Observe the specimens and answer the questions that follow.

(a). Identify the specimen.

A.....

B.....

C.....

D.....

(b). State the two bones that each specimen A and B articulates with and the type of joints formed at each articulation

.....

.....

c) State the structural differences between specimens C and D.

Specimen C	Specimen D

d) Draw and label the anterior view of specimen C. State your magnification.

Activity 55

You are provided with specimens L and M.

(a) Identify the specimens

L

M

(b) Suggest with reasons the part of the animal from which L and M were obtained.

SPECIMEN	REGION	REASON
L		
M		

(c) State two functions of L and M giving observable adaptations of each of the specimen to its function.

L

Functions

.....

Structural adaptations

.....

M

Functions

.....

Structural adaptations

.....

(c) State the structural differences between L and M

Structural differences between L and M

Specimen L	Specimen M

(e) State the **similarities between L and M**

Similarities between specimen L and M

.....

.....

.....

(f) Draw the anterior view of specimen M in the space provided.

MAMMALIAN TEETH

Activity 56

Study specimens L and M which are structures from the same animal.

a) With reasons, identify the specimen.

Specimen L.....

Reasons

.....

.....

Specimen M.....

Reasons

.....
.....

b) ve reason and state the function of each specimen.

Function of L:

.....

Reason:

.....

Function of M:

.....

Reason:

.....

c) tline differences and similarities between L and M

Differences between L and M

Specimen L	Specimen M

Similarities between L and M

i.

ii.

iii.

d) Suggest the diet of animal from which the specimen L and M were obtained. Use observable features on this specimen.

Feature of L.....

Diet.....

Feature of M.....

Diet.....

e) Make a labelled drawing of each as seen from the side.
Side view of L

Side view of M

Activity 57

You are provided with specimen D and E both obtained from the same animal.
Basing on the observable features, identify each specimen.

Specimen	Identity of specimen	Observable features
D		
E		

(a) Giving two reasons, suggest the class of the animal from which specimens D

and E were obtained.

Class;.....

Reasons;

.....
.....

(b) Explain how the features of the specimen E adapt it for its function.

.....
.....
.....
.....

(c) Observe the two specimens and state four structural differences between them.

Specimen D	Specimen E

(d) Draw and label the upper region of specimen E. State your magnification.

FEATHERS

Activity 58

You are provided with specimens M and N study them carefully and answer the questions that follow.

(a) Identify the specimens M and N

Specimen M

Specimen N

(b)(i) Name the possible functions of the specimen M

i) List the observable features of specimen M which make it suited for its function.

ii) List the observable features of the specimen N which make it suited for its function

(c) (i) In which parts of the bird were the specimen **M** and **N** taken?

Specimen **M**.....

Specimen **N**.....

(ii) Take the specimen **M** between your fingers. Brush them towards the base, what happen?

(iii) Brush specimen **N** forward to the tip, what happen?

(d)(i) Explain this by what you see when looking at the vane through the specimen M under lens.

(ii) Outline the adaptations of specimen M to its function.

.....

.....

.....

.....

(iii) Using a hand lens, study specimen M carefully, draw its base and label, state your magnification.

(e) How is the organism (bird) from which the specimen **M** and **N** are picked adapted for flight?

- i.
- ii.
- iii.
- iv.
- v.
- vi.
- vii.

Activity 59

You are provided with specimen K and L.

(a) Identify specimens giving reasons in each case

i) Specimen K.....

Reasons

.....
.....

(ii) Specimen L.....

Reasons

.....
.....

(b) From the structure of the specimens state the part of the animal's body each specimen was taken

{i) Specimen k.....

(ii) Specimen L

(b) i) Pour little water on the specimen one at a time and state what is Observed

.....
.....

(ii) What is the significant of your observation in Specimen K

.....

Specimen L

.....

d) How were specimens suited for their function on the animal from which they were removed?

Specimen K

.....

.....

.....

Specimen L

.....

.....

THE SOIL

Activity 60

You are provided with soil samples Q_1 , Q_2 , Q_3 .

Procedure

Measure 20 cm^3 of sample Q_1 and put into a funnel lined with filter paper.

Place the funnel into the measuring cylinder.

Measure 20 cm^3 of water and pour into soil in the funnel.

(a) Read the volume of water collected after 30 seconds for 2 minutes and record the results in the table below. Repeat the procedure with soil samples Q_2 and Q_3 .

Sample	Volume of water (cm^3) every 30 seconds			
	30 seconds	60 seconds	90 seconds	120 seconds
Q_1				
Q_2				
Q_3				

(b) In the space below, sketch a graph of volume of water collected against time for each soil sample.

(c) Explain the differences in the shapes of the curves.

.....

.....

.....

(d) Basing on your results, suggest how suitable each sample is for crop growth.

Q1.....

Q2.....

Q3.....

Activity 61

You are provided with soil samples **U** and **M**.

Procedure

Label the two measuring cylinders provided **U** and **M**.

Place a small piece of cotton wool at the bottom of each of the funnels provided and place the funnels on the labelled measuring cylinders.

Measure 40cm³ of soil sample **U** and pour it into the funnel placed on measuring cylinder **U**. Repeat the procedure with soil sample **M**. Add 100cm³ of water, pour at once to each soil sample in the funnels.

(a) Record the volume of water that goes through each soil sample after 5 minutes, in the table below. Complete the table by calculating the volume of water retained by each soil sample.

Soil Sample	Volume of Water added (cm ³)	Volume of Water that goes through the soil (cm ³)	Volume of Water retained by soil (cm ³)
U			
M			

Note

(i) That the volume of water that goes through the soil sample **U** should be greater than the volume of water that goes through the soil sample **M**; and the reverse is true for the volume of water retained by soil.

(ii) The volume of water retained by soil (in cm³), is calculated by Subtracting the volume of water that goes through the soil from the volume of water added (100cm³).

(b) State the soil properties being investigated in this experiment.

.....
.....

c) From the results of your experiment, state with reasons, which of the two soil samples is more suitable for crop production?

Soil sample.....

Reasons

.....
.....
.....

d) How would you improve on the soil you consider less suitable for crop growth?

.....
.....
.....