'O' LEVEL BIOLOGY SUMMARY QNS $ ANSWERS

1.

(a) What is meant by the term species?

(b) Distinguish between the artificial system of classification and the modern system classification.

*(c) The whiptail lizards belong the genus **Chemidophorous** and species called **uniparens,** write down the scientific name of whiptail lizards. Give reasons.*

(d) State the importance of the natural system of classification.

(e) *Outline 10 characteristics of living things*.

SOLUTION:

1. (a). Species refers to a group of closely related organisms, potentially capable of interbreeding to produce fertile offspring.

- **Species is the basic unit of the natural system of classification.**
- **Members of a particular species are identical in structure, behavior and physiology. For instance, all human beings belong to the same species.**

(b). Artificial system of classification, place organisms into groups based on their relationship to man.

- **It uses a few easily observable features like size, how they move, their use to man, where they live e.g;**
  - **Animals could be classified on whether they are domestic or wild, whether edible, or not, calm or ferocious.**
  - **Plants could be classified as, medical, edible, etc.**
- **It is only useful to small local communities.**
- **On the other hand, the modern system of classification groups, organisms based on many natural features, internal, external, physiological and historical evolutionary relationships between organisms.**
- **It places each organism in a series of groups in hierarchy.**
- **Each group is called a taxon and contains organisms sharing basic features.**
- **There are seven taxa including: kingdom, phylum (division, for plants), class, order, family, genus and species, in order of increasing shared characteristics and decreasing numbers in a given succeeding taxon.**
- **Kingdom is the largest taxon and the modern system of classification groups all living things into <u>five</u> kingdoms including monera, protoctista, fungi, plantae and animalia.**
- **It is useful internationally.**

(c) Scientific name of the whiptail lizard is *Chemldophorus uniparens*

Reasons: According to the binomial system of nomenclature each organism is given two names. The first name is of the genus to which it belongs and is written beginning with a capital letter.

The second name is the name of the species to which the organism belongs and written beginning with a small letter.

The two names are separately underlined if hand-written or in italics if printed.

(d) **Importances of the natural system of classification.**

- It simplifies the study of living things.
- It provides organisms with names that have the same meaning to biologist internationally.
- It enables biologist to understand the evolutionary relationship between different organisms.
- It enables biologists to communicate information about organisms around the whole world.
- It makes it easy for a biologist to predict the characteristics of any organism that have not been seen.
- It allows sorting living things into groups for easy reference without confusion.

(e) **Characteristics of living things.**

- Living things move
- Living things control their internal conditions.
- Living things respire
- Living things feed
- Living things reproduce
- Living things grow and develop
- Living things are able to evolve
- Living things excrete their waste products
- Living things are composed of basic units called cells
- Living things respond to their surroundings
- Living things possess various adaptations, which are the characteristics that enhance their ability to survive in a particular environment.

2. (a) State the five specialized plant cells and five specialized animal cells, their functions and give two adaptations of each to its function.

(b) What is an organ system? State five examples of the organ systems and for each name the organs forming the system and its function in animal's body.

(c) Make a well labeled drawing of the transverse section through a young Dicotyledonous stem. Compare it with that of a root.

(d) How are roots adapted to carryout functions other than anchoring the plant and absorption of water and mineral salts? Give examples in each case.

Answer:

(a) Specialized plant and animal cells, their functions and adaptations.

Cell	Function(s)	Adaptations
1. Root hair cell	-Absorption of water and mineral salts from the soil	-Slender and flexible able to penetrate between soil particles -It is thin one cell thick, making absorption easy due to large surface area and short diffusion distance -They are numerous hence large surface area for absorption of water.
2. Sieve tube cell/ phloem cell/ sieve tube element	-Conducts manufactured food from leaves to other parts of the plant	-End walls are perforated to allow passage of continuous cytoplasmic filaments in which translocation occurs. -Arranged end to end of one another to form long continuous columns. -They are living at maturity to allow active transport. -The nucleus and some other organelles disappear to allow passage of the cytoplasmic filaments
3. Xylem cell	-Conducts water and dissolved mineral salts from roots to all other plant parts. -Support the plant	-They are dead at maturity -Arranged end to end of one another to form long continuous columns -Cell wall thickened by impregnation with lignin. -Lignin makes them impermeable to water and solution to avoid leakage. -End walls broken down to form long continuous tubing to form xylem vessel. -Side walls perforated by pits to allow lateral movement of water to surrounding cells. -Lignified walls withstand high pressure without collapsing and give support to the plant.
4. Palisade cell	Carries out photosynthesis	-Has numerous chloroplasts, photosynthesis organelles, containing chlorophyll, which

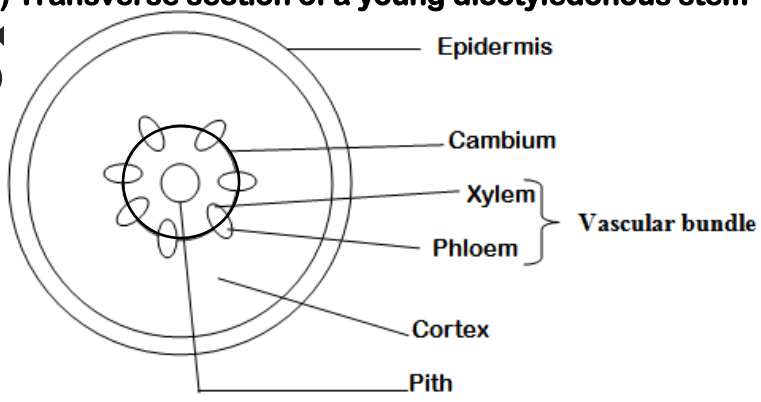
		traps sun light needed for photosynthesis. -Their box-like shape allows many of them to pack together for maximum light absorption. -Chloroplasts can move to suitable places for efficient light absorption
5. Guard cell	-Regulate opening and closing of stomata	-Bean shaped -Contain chloroplast and chlorophyll -Inner cell wall thicker and inelastic that outer cell wall which is thinner and elastic, therefore can change shape to open or close the stomata.
Animal cells		
Cell	**Function**	**Adaptations**
1. Sperm cell	-Fertilizes the egg to form a zygote	-Motile has a tail which enables it to swim to reach the egg -Has the acrosome, which contains hydrolytic enzymes that enable it to penetrate the egg.
2. Red blood cell	-Carries oxygen from lungs to the body parts	-Contains haemoglobin which readily combines with oxygen in the lungs and releases it readily in the tissues. -Have large surface area for gaseous exchange -Has thin cell membrane for rapid diffusion of respiratory gases. -Lack a nucleus for easy carriage of oxygen.
3. White blood cell	-Destroys germs in the body	-Amoeboid in shape can cross capillaries and move from one body part to another. -Has nucleus at maturity to control its activities.
4. Nerve cell	-Transmits nerve impulses from one body part to another	-Myelinated to increase impulse transmission speed. -Has elongated axon and or dendrones to transmit impulse from one part to another part of the body at some distance

5. Skin cell	-Gives protection to body	-Keratinized which makes skin flexible and impermeable to water and gases -Cells pigmented to filter Ultra Violet light

(b). An organ system is made up of several organs which together perform a specific function.

System	Organs	Function
1.Digestive system	-Stomach, ileum, pancreas, liver	-Digestion of food
2.Circulatory system	-Heart, arteries, veins, capillaries	-Transport absorbed food materials from the ileum to the liver and other body tissues. -Transport oxygen from the lungs to respiring tissues. -Transport wastes of metabolism from active tissues to excretory organs -Transport hormones from gland to where they have effect
3.Excretory system	-Kidney, urinary bladder, ureter, urethra, skin, lungs	-Excrete waste products of metabolism from the body
4.Reproductive system	-Ovaries, fallopian tubes, uterus, cervix, in females. -Testes, spermatic cord, in males	-Production of gametes
5.Respiratory system	-Lungs, wind pipe	-For gaseous exchange

(c) Transverse section of a young dicotyledonous stem



Comparison between a dicotyledonous Stem and root

Similarities:

- Both have epidermis, cortex
- Both have vascular bundles
- In both cortex is made up of parenchyma/ packing cells

Differences:

Stem	Root
-Has pith	-Has no pith
-Has cambium	-Has no cambium
-Has cuticle	-Has no cuticle
-Widest tissue is the pith	-Widest tissue is the cortex
-No hairs	-Has root hairs
-Vascular bundle not central	-Vascular bundles are in the centre
-Does not have a piliferous layer.	-Has piliferous layer

(c). Adaptations of roots for functions other than water and mineral absorption and anchorage.

- Breathing roots are aerial, spongy for gaseous exchange
- Buttress roots, large, grow along and into soil for additional support
- Root tubers are swollen, for good storage
- Clasping roots grow around support for additional support.

3. (a). What is a root?

(b). Draw and label a transverse section of a young dicotyledonous root.

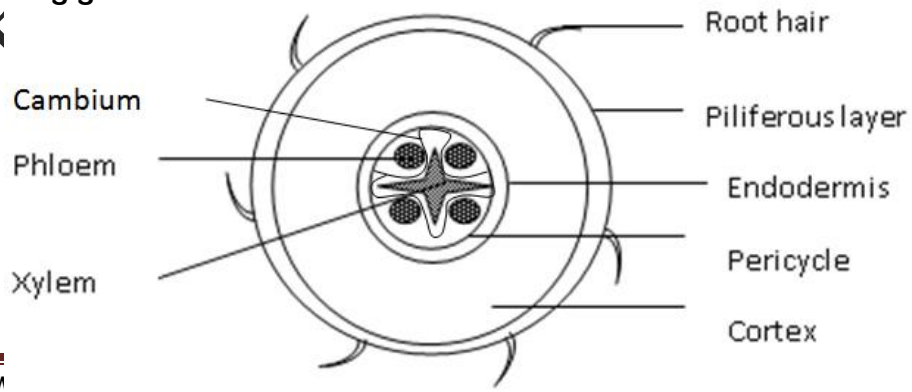
(c). State three differences between the internal structures of a mature monocotyledonous root and a mature root of a woody dicotyledonous plant.

(d). Giving examples in each case, describe how plant roots are modified to perform different functions.

Solution

(a).A root is the descending organ / portion of the plant that develops from the radicle during germination.

(b).



(c).

Mature monocotyledonous root	Mature root of woody dicotyledonous root
Has pith	Lack pith
lack vascular cambium	Has vascular cambium
Lack cork cambium	Has cork cambium
Lack secondary xylem / phloem	Has secondary xylem and phloem
Xylem are arranged in a ring form	Xylem are star shaped

(d).

Modification	Importance	Example
Fleshy / swollen roots/ tubers	Stores food	Cassava
Prop roots	Provides firm support to the plant	Maize
Buttress roots	Provide extra support to the plant	*Ficus* (Rubber plant)
Stilt roots	Provide support to the plant	Red mangroves
Breathing roots	They take in and store air for respiration	White mangrooves
Clasping / epiphytic roots	Secrete sticky juice for firm hold on the support	Epiphytic orchids
Parasitic/ haustorium/ sucking roots	They absorb nutrients from other plants	Dodder
Nodules roots / symbiotic roots	They contain bacteria that fix nitrogen into the soil	Beans
Assimilatory roots(roots containing	They photosynthesize	Water chestnut.

4. An experiment was carried out to determine the volume of water that was drained through each soil sample X and Y at different time intervals. The results obtained are shown in the table below. Study the data carefully and answer the questions that follow.

Time in seconds	*Volume of water drained through soil sample in cm³*	
	Soil X	*Soil Y*
10	*4*	*8*
20	*7*	*13*
30	*9*	*18*
40	*11*	*24*
50	*12*	*33*
60	*12*	*40*
70	*12*	*42*
80	*12*	*42*

(a). Using the same axes, plot a suitable graph to represent the above data.

(b). From the graph, state differences in drainage of the two soil samples.

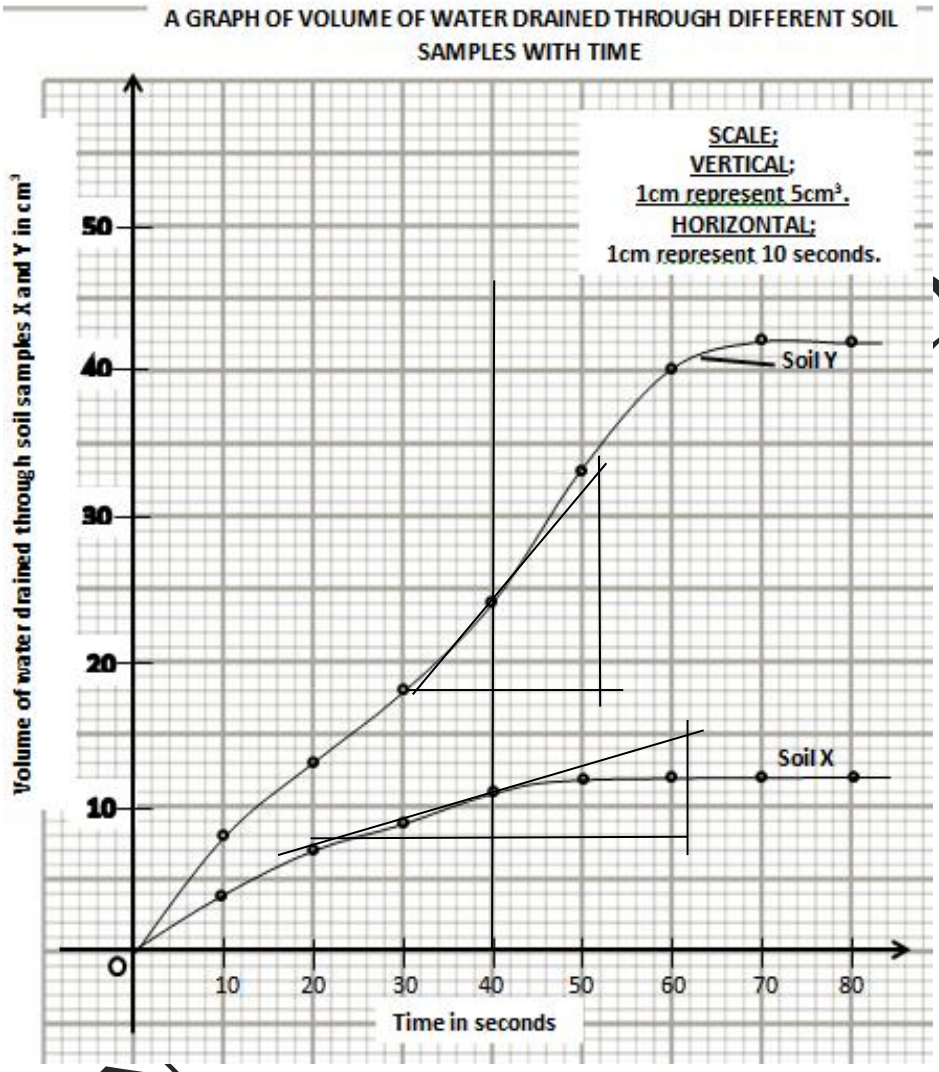
(c). Explain the differences in the rate of drainage stated in (b) above.

(d). calculate the rate of drainage at 40 seconds for each soil sample.

(e). (i). If 100cm3 of water was added to each soil sample, calculate the amount of water retained by each soil sample X and Y.

(ii). Explain the significance of your results in (e)(i) above to the farmer.

Solution (a).



(b). From 0 to 60 seconds, the volume of water drained through soil Y increases rapidly while in soil X it increases gradually. From 60 to 70 seconds, the volume of water drained through soil Y increases gradually while in soil X it remains constant.
More volume of water drains through soil sample Y than in soil sample X

(c). Water drains faster in soil Y than in soil X because soil sample Y has bigger particles than soil X. This causes soil Y to be more porous/ have more and bigger air spaces than in soil X which enables water to pass / drain faster in soil sample Y than in X.

(d). Rate of drainage at 40 seconds in soil Y = $\frac{change\ in\ volume\ of\ water\ drained}{change\ in\ time\ taken}$

$= \frac{33-18}{52-32} = \frac{15}{20} = 0.75\ cm^3/\ sec$

Rate of drainage at 40 seconds in soil X = $\frac{change\ in\ volume\ of\ water\ drained}{change\ in\ time\ taken}$

$= \frac{15-8}{62-23} = 0.179\ cm^3/\ sec$

Note that if asked for the **average rate** of drainage for the first 40 seconds, there you don't draw tangents to the graphs. You just consider the whole time duration up to the stated time i.e. 40 seconds.

(e). (i).Volume of water retained by soil X = volume of water added –volume of water drained.

$= 100 - 12 = 88\ cm^3$

Volume of water retained by soil Y = volume of water added –volume of water drained.

$= 100 - 42 = 58\ cm^3$

(ii). Soil X is more suitable for farming than soil Y because soil X retains more water than soil Y which can be used by crops.

5. Table below shows variation of two steroid hormones during a menstrual cycle of a human

Time (days)		*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*
Concentration of steroid hormones	*Oestrogen*	*3*	*3*	*6*	*9*	*12*	*15*	*7.5*	*3*	*4.5*	*4.5*	*3*	*3*	*3*	*3*
	Progesterone	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*3*	*4.5*	*7.5*	*11.5*	*13.5*	*9*	*6*	*3*

(a). On the same axes, represent the data in the table above on the graph.

(b). (i). From your graph, suggest a day during which ovulation can occur and give a reason for your answer.

(ii). from the graph, give the day when the concentration of oestrogen is at its peak.

(c). State the effect of increased concentration of these hormones to the uterine wall.

(i). Oestrogen hormone

(ii). Progesterone hormone

(d). Give the difference in the concentration of Oestrogen and Progesterone hormone from

(i). Day 4 to day 12

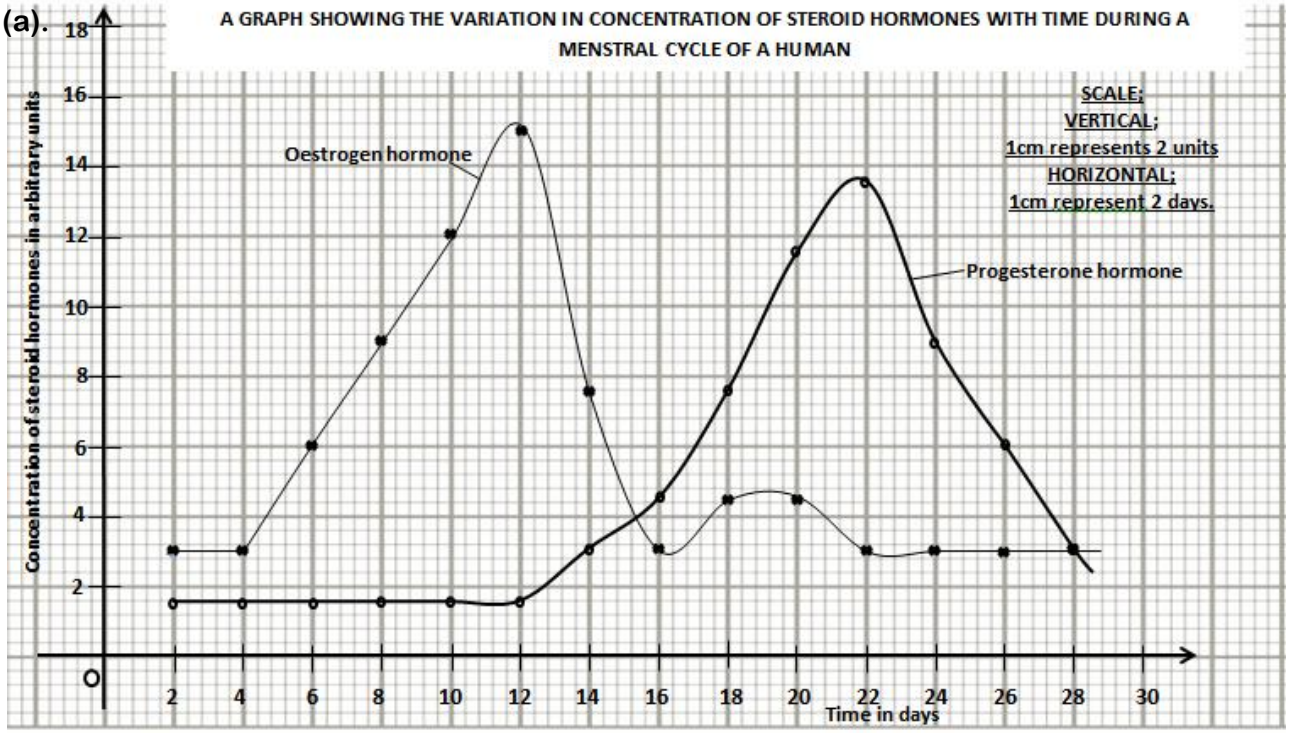
(ii). Day 12 to day 16

(e). (i). Explain what happens on 28th day to the uterine wall if fertilization failed to occur.

(ii). State the hormone that stimulates the release of Oestrogen hormone.

Solution

(a).



(b)(i). Ovulation can occur on the 13th or 14th day.

This is because oestrogen hormone reaches its maximum just before ovulation.

Rising levels of oestrogen are responsible for triggering a surge of luteinising hormone. This luteinising hormone surge triggers ovulation. Oestrogen hormone is secreted mainly by the ovarian follicle though little of it is secreted by the corpus luteum which mainly secretes progesterone hormone.

(ii). 12th Day.

(c). (i). Oestrogen stimulates and supports thickening of uterine lining during proliferative phase.(*It initiates the repair of the uterine wall after menstruation*).

(ii). Progesterone stimulates and supports thickening and increased glandular development of uterine lining during secretory phase.

(In presence of Oestrogen, it promotes repair and growth of uterine lining).

It maintains the structure of the endometrium in a receptive state for the implantation of the fertilized ovum.

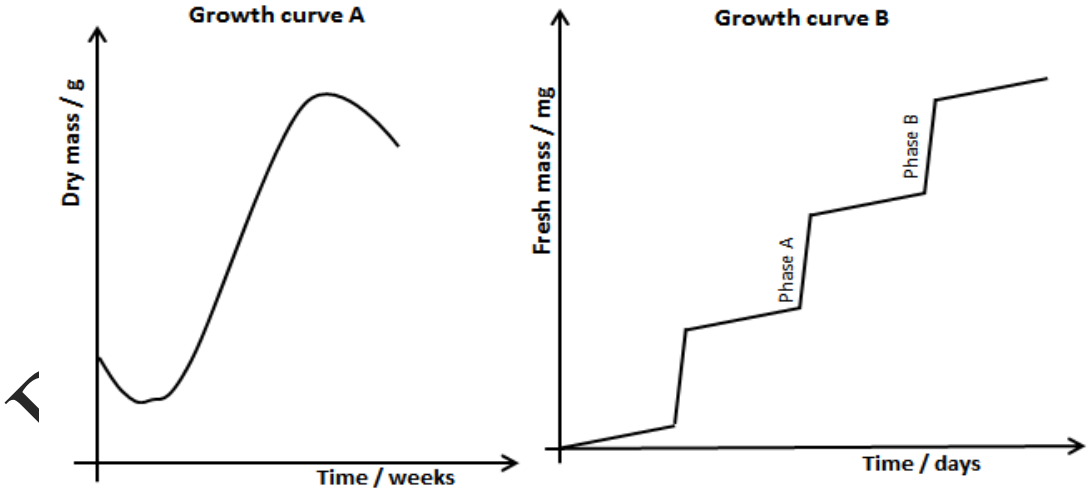
(d). (i). The concentration of Oestrogen increases rapidly while the concentration of progesterone remains constant.

(ii). The concentration of Oestrogen decreases rapidly while the concentration of progesterone increases gradually.

(e).(i). The uterine wall (endometrium) disintegrates and shed off together with a variable amount of blood in the menstrual flow.

(ii). Follicle stimulating hormone.

6. The graphs below show the growth curves for two different organisms: an arthropod and annual plant e.g. pea plant.



(a). Which growth curve represents; (i) an arthropod? (ii) an annual plant?

(b).From the graphs above, which growth parameter is most accurate to estimate growth rate of an organism? Give reason(s) for your answer. State the disadvantage of this virus.

(c). In curve 2; (i). Which process is taking place at phase A and phase B days?

(ii). What special name is given to the growth phase between growth phase A and growth phase B?

(d) Explain the growth pattern in curve A.

(e). State the differences between;

i. Growth in curve A and growth in curve B.

ii. Growth in annual plants and growth in perennial plants.

(f). State two internal factors that affect growth in plants and animals.

Solution

(a).(i). Growth curve B. (ii). Growth curve A

(b). Growth parameter; Dry mass

Reason; It gives the exact increase in the biomass of an organism.

Disadvantage; It requires killing the organism.

(c).(i). Molting / Ecdysis (ii).Instar/ Stationary phase

(d). Initially, the dry mass decreases rapidly as time increases because food reserves in seeds are oxidized to release energy for growth / germination.

Later, the dry mass increased rapidly because the seeds germinated and the cells of the seeds divided up forming stems, roots and leaves.

The plant photosynthesizes food for further growth / cell division and the excess of the manufactured food is stored in the formed fruits and or seeds.

Later the dry mass decreases gradually as the fruits / seeds get dispersed from the plant.

Finally the dry mass decreases rapidly as most cells die resulting into death of the whole plant.

(e).(i).

Growth in curve A	Growth in curve B
Initially mass of the organism decreases	Initially mass of the organism increases.
Then growth of the organism increases continuously	Then growth of the organism is discontinuous. (growth is in spurts interrupted by molts)
Finally growth / mass decreases	Finally growth / mass increases

(ii).

Growth in annual plants	Growth in perennial plants
Growth is limited (Growth does not continue throughout life)	Growth is unlimited (Growth continues throughout life)
There is negative growth after reproduction	There is no negative growth
Growth takes a short time	Growth takes a long period of time

(f). – The genetic makeup of the organism - Food reserves with in the organism

- Hormones - State of turgor pressure - Diseases.

7. Table 1 below shows the amount of sweat and urine produced at different environment temperature.

Environment temperature (°c)	*0*	*5*	*10*	*15*	*20*	*25*	*30*	*35*
Amount of sweat/cm^3 /hour	*0*	*5*	*10*	*20*	*30*	*60*	*120*	*180*

Amount of urine/cm^3 /hour	*100*	*90*	*80*	*70*	*60*	*50*	*40*	*30*

(a) Represent the data in the table on an appropriate graph.

(b) From your graph state the temperature at which the amounts of sweat and urine produced are equal.

(c) Describe the changes in the amounts of sweat and urine produced at different temperatures.

(d) Account for the changes described in (c) above.

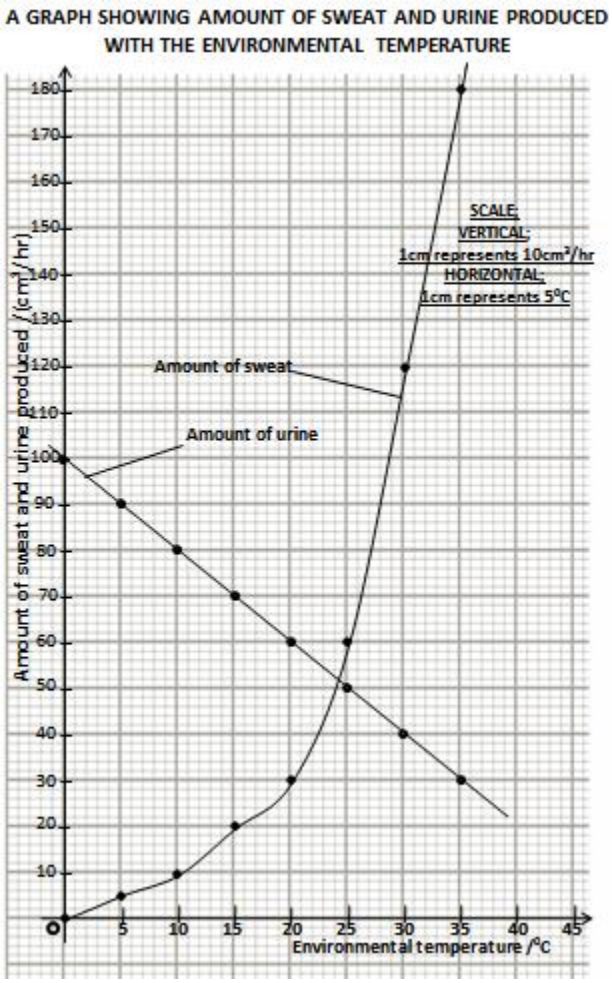
(e) How is the skin adapted for temperature regulation?

(f) (i) Name the part of the brain concerned with temperature regulation in the body of a Mammal

(ii) State the other functions of the part named in (i) above.

Solution

(a) Graph on right of the page.



(b).They are equal at 24^{0}C

(c). The amount of sweat produced increased gradually as environmental temperature increases from 0^{0}C to 20^{0}C beyond which it increases rapidly with increase in environmental temperature.

The amount of urine produced uniformly decreases rapidly as environmental temperature increases.

(d). Explanation / an account

- **Increase in temperature increases the rate of evaporation**
- **More sweat is converted to vapour**
- **The vapour uses latent heat of vaporization from the body hence cooling the body.**
- **The increased sweating, resulting from increasing temperature, raises the osmotic pressure of blood. Hence,**
- **A lot of water is then reabsorbed into the blood in the kidney tubules, resulting in the production of less and concentrated urine as the temperature increases.**

(e). **The skin has the following structures which are involved in temperature regulation as follows:-**

Sweat glands: **These release sweat when it is hot**

- This sweat evaporates, taking the latent heat of vaporization from the body and hence cooling it.
- When it is cold, the sweat glands release less or no sweat. Hence less evaporation and less heat loss.

Hairs: When cold, the erector-pill muscles contract causing the hair stand and trap a layer of air which insulates the body from heat loss, hence keeping it warm.

- When it is hot the erector-pill muscles relax, the hair lies flat on the skin surface trapping less air which reduce insulation of the body and encourages heat loss by convection, evaporation and radiation.

Blood vessels:

- When cold, blood vessels in the skin constrict.
- Less blood flows near the skin surface thereby reducing heat loss by radiation and convection.
- During hot conditions, blood vessels in the skin widen / dilate.
- More blood flows near the skin surface, thereby increasing heat loss by radiation and convention to cause cooling of the body.

Subcutaneous fat:

- The skin has also the subcutaneous fat layer underneath which insulates the body from heat loss and heat gain.

(f). (i) Hypothalamus:

(ii) **Other functions of hypothalamus**

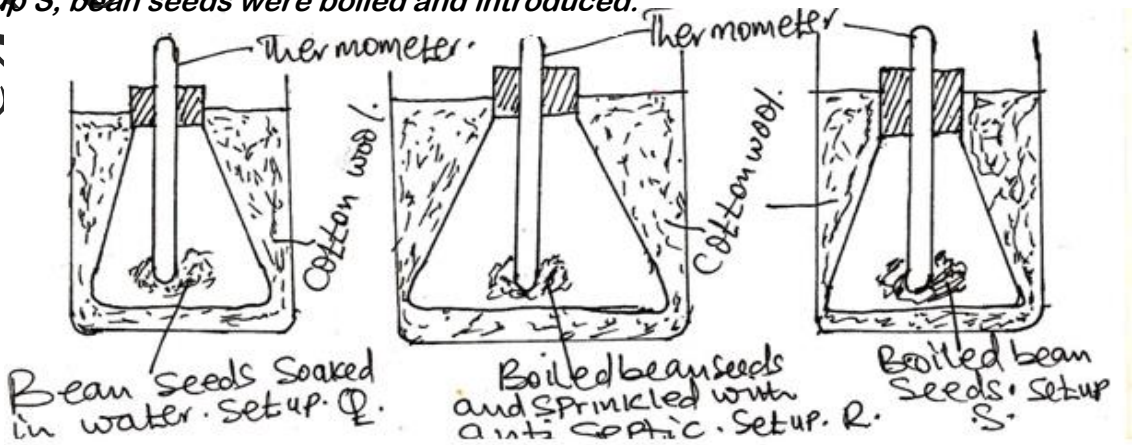
- It is main controlling region for the automatic nervous system.
- It is an endocrine gland produces hormones like ADH, Gonadotrophic releasing hormones
- It has centres that control thirst, appetite, sleep, wakefulness and homeostasis.

8. An experiment was set up as shown to investigate certain physiological processes.

In set up Q, bean seeds soaked in water were introduced.

In set up R, bean seeds were boiled and sprinkled with antiseptic, were introduced.

In set up S, bean seeds were boiled and introduced.



The temperature in each set up as recorded for (9) nine days and results were tabulated.

Time (days)	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Temperature in set up Q/° c	*15*	*20*	*25*	*28*	*30*	*29*	*24*	*20*	*19*	*18*
Temperature in set up R/° c	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*
Temperature in set up S/° c	*15*	*15*	*16*	*17*	*18*	*20*	*24*	*28*	*29*	*30*

(a) Represent the data in the table graphically on one set of axes

(b). State the aim of the experiment using the information on your graph and the set of apparatus.

(c). Account for the differences in the changes in temperature in setup Q and S,

(i) From days zero to 2

(ii). After days 15

(d). Explain why there was no temperature change ins setup R for all the time of the experiment

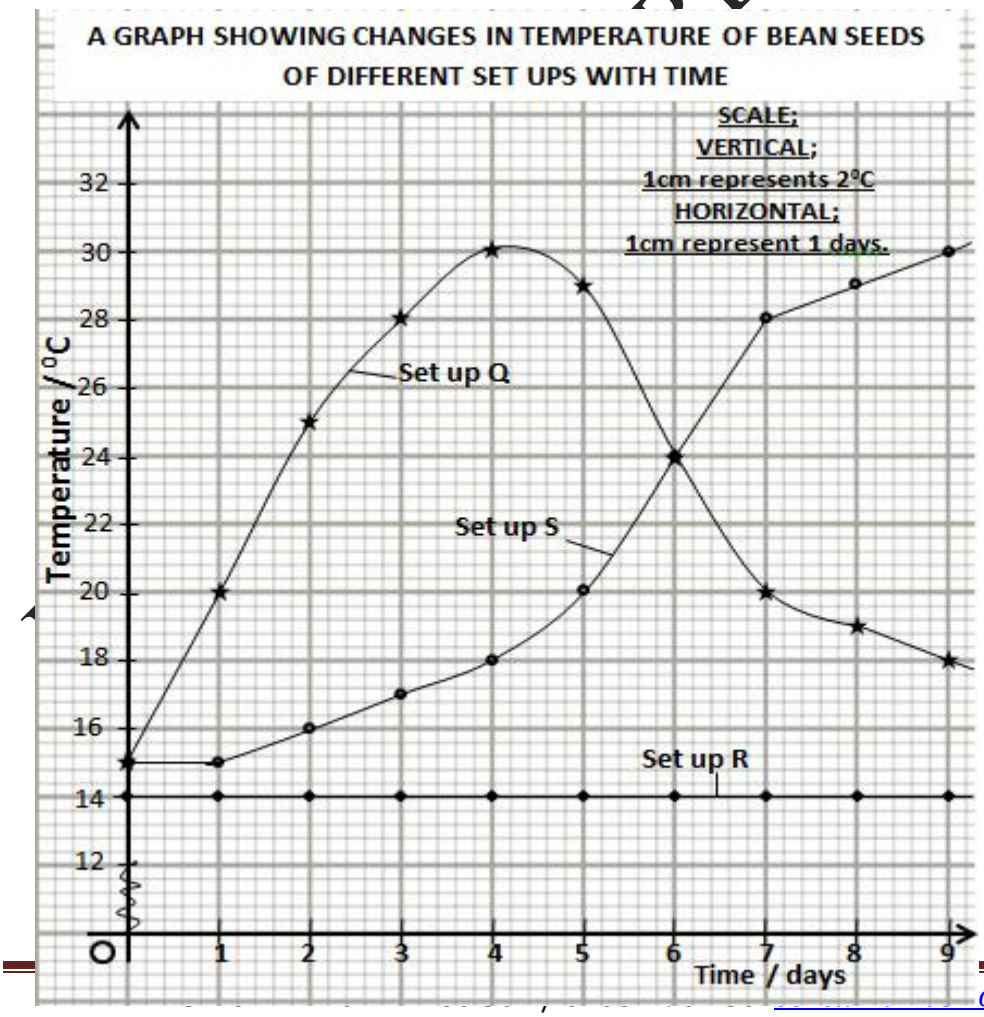
(e). (i) Suggest one way the set up above could be improved for more accurate results. Give a reason for your answer.

(ii) Why was set up R included in the experiment

(f). Explain the biological principle applied to make food in a refrigerator remain unspoilt for longer period than in ordinary conditions.

SOLUTION

a).



(b). To investigate heat production during germination of a seed

To show that heat is produced during respiration

c).(i) Day zero to day 2

Set up Q – temperature kept increasing since seeds were germinating and respiring hence producing heat energy

Set up S – temperature remained

constant within this period, since the seeds were boiled to death and therefore not respiring and have not yet started decomposing

(ii) **After day 2**

Set up Q – temperature reduced slightly and remained constant, rate of respiration was high during germination after which seedlings moderately respire releasing a lesser amount of energy.

Set up S – the temperature begun to rise fast after day 5. Decomposition led to production of heat energy.

d). In set up R seeds were boiled/ killed than treated with antiseptic a disinfectant, ensuring no growth of micro-organisms therefore, no respiration occurred and no decomposition took place.

e). How to obtain accurate results.

(i). By use of vacuum flasks in place of flasks. This would prevent loss or gain of heat

(ii). Control experiment

f).In the refrigerator temperature is kept too low so that any microorganisms present are made inactive.

9. *(a) Hemophilia is a sex linked characteristic cause by a recessive gene carried on the X-chromosome. A carrier woman married a normal man.*

(i) *Work out the genotype and phenotype of F1 generation.*

(ii) *What is the probability of the couple getting a hemophilic son?*

(b) Fruit flies with red eyes were mated and produced 1568 offspring and 392 of them had brown eyes and the rest had red eyes. Using appropriate symbols:

(i) *State the likely genotypes of the parents.*

(ii) *Predict the outcome of the cross between the red eyed files.*

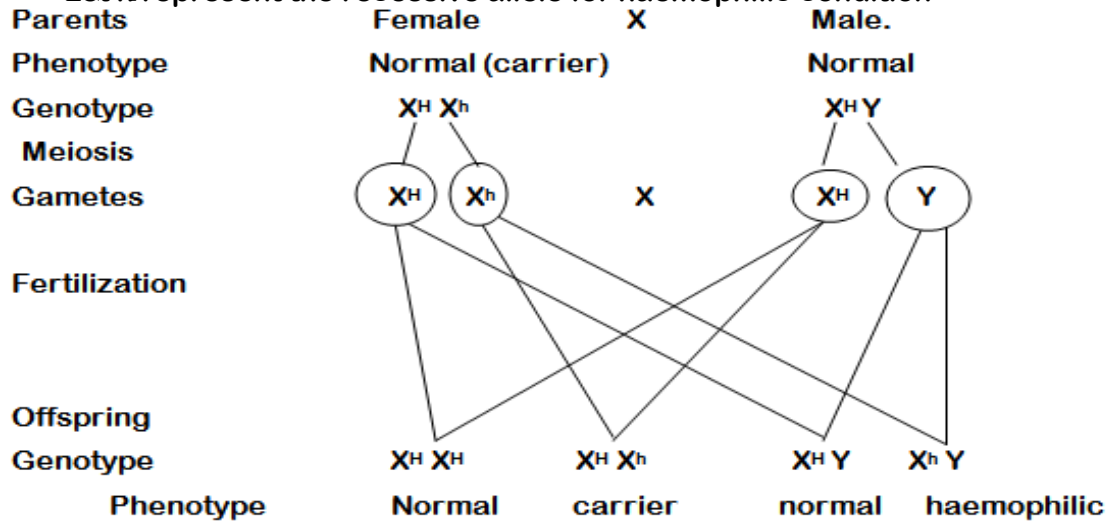
(iii) *State the genotype ratio of the progeny*

(iv) *State how you would identify the genotype of the red-eyed fly.*

Solution:

a). i) Let H represent the dominant allele for normal condition

Let h represent the recessive allele for haemophilic condition



ii) The probability of a haemophilic son is 1/2

b) i) Let R represent the dominant allele for red eye

Let r represent the recessive allele for brown eye

The likely Genotype of the parents is Rr (heterozygous)

ii). Parents Female X Male

Phenotype Red Red

Genotype Rr Rr

Meiosis

Gamètes R r X R r

Fertilization

Offspring;

Genotype RR Rr Rr rr

iii) Genotypic ratio RR : Rr : rr = 1 : 2 : 1

iv) By carrying out a test cross with a homozygous recessive fly. If the parent is heterozygous, offspring will show phenotypic ratio of 1 Red : 1 brown or at least one brown eyed. If homozygous, all the offspring will be Red.

10. *(a) What is a reflex arc?*

(b) Explain the process involved when a person suddenly withdraws a hand from a hot object.

(c) i) Explain how auxins influence the tropic response of a plant shoot

ii) State other roles/effects of auxins in plants.

iii) Outline 4 other plant hormones and their effects

(d) Compare reflex actions and nastic responses

Solution:

a). A reflex arc refers to the path of neurons taken by impulses which bring about the reflex action.

It involves the following components.

- A sensory receptor
- Sensory neuron
- Sometimes an intermediate neuron
- A motor neuron and
- An effector like a muscle or gland

b).Sudden withdraw of a hand from a hot object occurs instantly even before one is consciously aware of what has happened.

- It results from stimulation of pain receptors in the skin.
- This generates an impulse which is conducted by a sensory neuron to the spinal cord
- The impulse is passed to an outgoing motor neuron via an intermediate neuron.
- The impulse travels along the motor neurone to the biceps/ flexor muscle of the arm which cause the arm to bend in a matter of milliseconds from the time of the painful stimulus.
- The sensory neurone is also connected to an ascending neurone which transmits impulse to the brain.
- This makes one to become aware of the pain in a fraction of a second after withdrawal of the hand.

c). i) **Influence of auxins on tropic shoot responses.**

- Auxins are produced at the shoot tips, easily diffuse from one cell to the next
- They promote plant growth by promoting cell elongation
- Under the influence of unilateral light, auxins diffuse away from light and accumulate the darker side.
- In shoots, high auxin concentration stimulates growth by increasing the rate of cell elongation on the darker side, causing the shoot to bend towards light hence phototropism.

ii) **Other roles/ effects of auxins in plants.**

- Apical dominance – inhibition of lateral bud development by the terminal bud. This is due to the fact that the apical bud produces auxins whose concentration is inhibitory to growth of lateral buds immediately below the apical bud. If apical bud is removed, the side branches develop. This is the very biological concept applied in pruning
- Auxins enhance development of adventitious roots from the stem
- Auxins prevent falling of fruits and leaves
- Maintain the structure if cell all.
- Stimulates formation of fruit without fertilization.
- Auxins when used in high concentration they act as weed killers since very high concentration inhibit plant growth.
- High concentration inhibits growth.
- Stimulates cell division.

iii) **Other plant hormones and their effects**

1. **Gibberellins:** Effects:

- Break seed dormancy
- Stimulate fruit development

- Promote cell elongation
- Restores dwarf varieties to normal size
- Promote cell division and differentiation
- Promote flowering in some plants.

2. Cytokinins Effects:

- Delay plant aging
- Promote development of lateral buds
- Promote fruit development

3. Abscisic acid Effects:

- causes seed dormancy
- Promotes leaf and fruit fall.

4. Ethene Effects:

- Promotes fruit ripening
- breaks bud dormancy
- causes flowering in pineapple

d. **Differences between reflex actions and nastism**

Reflex action	Nastism
-Occurs in animals	-Occurs in plants
-Do not involve growth	-May be brought by differential growth or due to rapid changes in cell turgidity
-Do not involve turgor changes	-Usually involves turgor changes
-Response may be dependent on direction/ source of stimulus	-Response independent of direction of stimulus.

Similarities:

-Both are adaptive, protect the organism from danger

-Both part of the organism is involved

-Both involve trigger by minute electrical currents

-Both brought about by similar stimuli like touch, changes in temperature or light intensity.

11. *In an experiment, seven identical potato cylinders measuring 3.0cm in length were each placed in 5cm^3 of different concentration of sugar solution in test tubes. After two hours the potato cylinders were removed from the solutions and the volume of the solutions re-measured using measuring cylinder. Table below shows the results.*

Concentration of sugar solution mol. L^{-1}	*Volume of solution after 2 hours (cm^3)*	*Differences in volume of solution*
0.0	*3.5*	

0.1	*4.2*	
0.2	*4.4*	
0.3	*4.8*	
0.4	*5.2*	
0.5	*5.6*	
0.6	*6.2*	

a. Complete the table by filling in the difference in volume of each solution after two hours the experiment.

b. Plot a graph of the difference in volume of solution after two hours with concentration of sugar solutions.

c. i) Suggest explanations why the volume of sugar solution were effected as stated in a) above.

ii) Suggest other observations that would be made in this experiment

d. i) From your graph state the concentration of sugar solution that would have no change in the volume.

ii) Explain why in such a solution there would be no change in volume.

e. Outline the roles of osmosis in plants.

Solution: a.

Concentration of sugar solution mol. L^{-1}	**Volume of solution after 2 hours (cm^3)**	**Differences in volume of solution**
0.0	**3.5**	**-1.2**
0.1	**4.2**	**-0.8**
0.2	**4.4**	**-0.6**
0.3	**4.8**	**-0.2**
0.4	**5.2**	**0.2**
0.5	**5.6**	**+0.6**
0.6	**6.2**	**+1.2**

(b) Graph on the next page.

c.i) In solution of concentration, 0.0, 0.2 and 0.3 mol L^{-1}, the volume reduced.

- **These solutions were less concentrated than the cell sap in the cells of the potato tissues**
- **Therefore, the solutions lost water by osmosis to the potato tissues**
- **Hence reduction in volume of solutions**
- **In solutions of concentrations 0.4, 0.5 and 0.6 mol L^{-1}, the volume increased.**
- **These solutions were more concentrated than the cell sap in the cells of the potato tissues.**

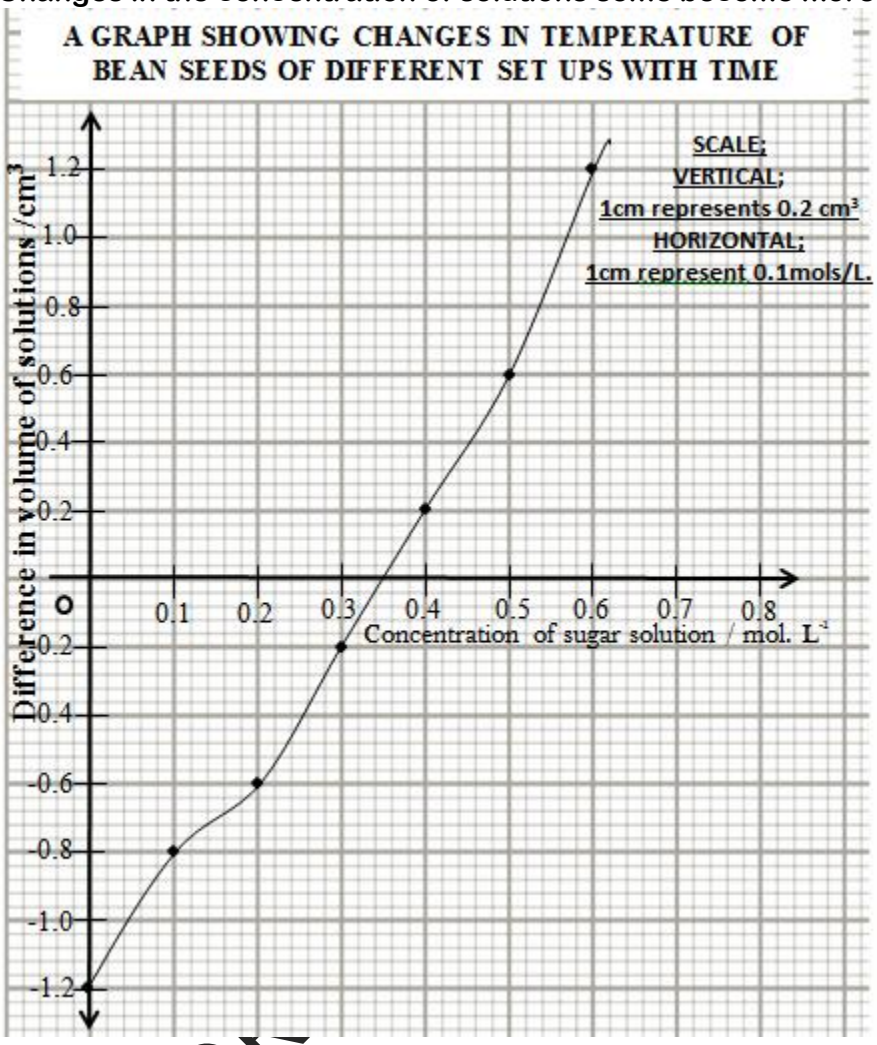
♦ Therefore, the solutions absorbed water by osmosis from the potato tissues; hence increase in volume of the solution.

C ii). Other observations that would be made in this experiment include,

-Changes in the sizes of the tissues. Some reduce as others increase

-Changes in the texture of the tissues, some harder others softer.

-Changes in the concentration of solutions some become more concentrated while others less concentrated.



D i). 0.325 mol L^{-1}

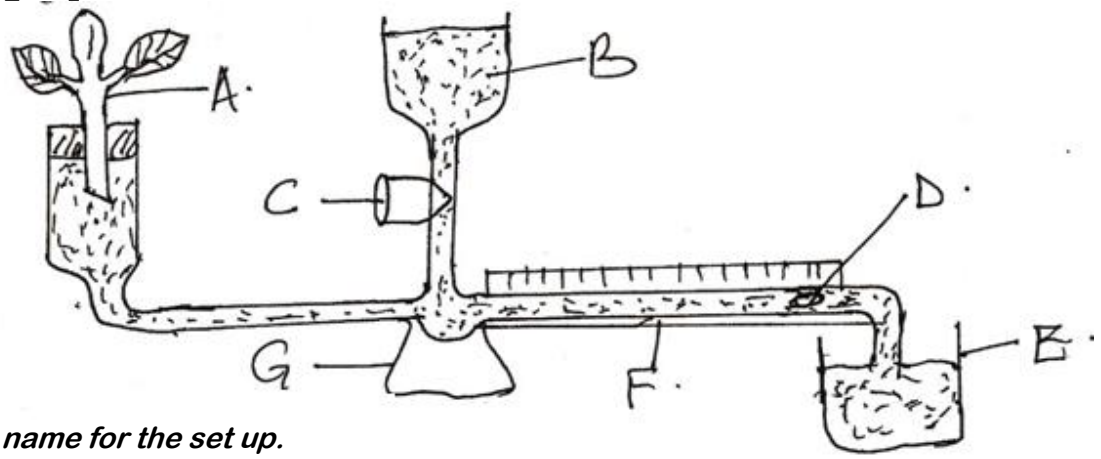
ii). This solution would show no change in volume because it is of the same sugar concentration as the cell sap and therefore no net movement of water by osmosis in either direction.

E. Roles of osmosis in plants

-Uptake of water from the soil into root hairs of plant roots

-Transport of water from epidermal cells of the root to cells at the centre of the root.

12. Figure below is a setup of investigation about a process in plants.



i) Suggest a name for the set up.

ii) Name the parts labeled A to G in the set up.

a) i) Suggest the name of the process in plants.

ii) The setup is used to directly determine

iii) The set is used to indirectly determine

b) State the precautions which should be taken when setting it up.

c) The rate of transpiration was determined under normal laboratory conditions. Giving reasons, explain the differences you would expect to observe if the measurements were repeated under the following conditions.

(i) The setup is placed in the dark.

(ii) Some of the leaves were removed

(iii) The shoot is placed close to the source of lent

(iv) The shoot is enclosed in a polythene bag

(v) The shoot is placed in current of air created by a fan

(vi) The leaves are smeared with Vaseline on both surfaces.

Solution;

(i) Potometer

(ii) A. Plant shoot B. Reservoir C. Tap

D. Air bubble E. Water container F. Capillary tube

G. Base/ support

(b) (i) It measures directly uptake of water by the plant shoot.

(ii) It measures directly the rate of transpiration

(c). Precautions taken when setting up the apparatus.

- **Plant shoot used should be leafy**
- **The joint between shoot and bung should be made air tight by applying Vaseline**
- **The leafy shoot should be cut and fitted in the apparatus in water to avoid air blocking the xylem.**
- **The air bubble should be set to zero.**

(d) (i) In the dark, due to low light intensity, the stomata on the leaves close, resulting in the reduction of the rate of transpiration, therefore; The speed of bubble movement slows down when the apparatus is placed in the dark.

(ii) Removing some leaves reduces on the surface area available for transpiration hence rate of transpiration would reduce if some leaves are removed from the shoot.

The speed of air bubble movement slows down when some leaves are removed.

(iii) Near the source of heat, environmental temperature is high.

This causes an increase in the rate of evaporation of water from the mesophyll cells of the leaves.

Also, the increased temperature lowers the relative humidity of the air outside the leaves. This increases the rate of evaporation; hence the speed of air bubble movement increases.

(iv) In an enclosed polythene bag, the relative humidity builds up and therefore slowing the rate of transpiration and the speed of air bubble movement slows down.

Also, in the enclosed polythene bag, light intensity is reduced hence closure of stomata and therefore rate of transpiration decreases and speed of air bubble movement slows down.

(v) In the current of air created by a fan, relative humidity is lowered thus rate of transpiration is increased. The speed of movement of air bubble increases.

13. ***(a) Giving an example in each case briefly describe what is meant by each of the following***

(i) Parasitism (ii) Commensalism (iii) Saprophytism

b. Distinguish between the following. Give examples in each case.

(i) Obligate parasites and hyperparasites

(ii) Complete parasites and hemi parasites

(iii) Primary host and intermediate host

c. State the adaptation of the following to the parasitic mode of life

(i) Ascaris (ii) Tape worm

d. State the ecological and economic importance of saprophytes

Solution:

(I).Parasitism is an association between two different living organisms of deferent species, in which one called the parasite gains from the association in terms of food and shelter and the other, called the host, doesn't gain in any way and is usually harmed e.g. association between tape worm and man.

(ii).Commensalism is an association between two living organisms of different species, which is beneficial to one, called the commensal and doesn't affect the other called the host e.g. an association between lichen (the commensal growing on a tree (the host), bacterial living on the Skin of man. They feed on secretions of sebaceous gland but do not harm man.

(iii). Saprophytism is a form of nutrition where by an organism lives upon and obtains its food from organic matter derived from dead bodies of animals and plants.

b.(i).Obligate parasites are the parasites which can only survive and reproduce in living host e.g. tape worm, while Hyper parasite is a parasite which lives in another parasite e.g. bacteria in a parasitic worm .

ii).Complete parasites are parasites which depend entirely on the host for their wellbeing e.g. *cuscuta* flowering plants with no chlorophyll therefore cannot make its own food while

Hemi parasite is parasite which depend partly on its host for nutrient because it is able to make its own food e.g. striga.

(iii). Primary host is the host that harbors the adult stage of the parasite e.g. man is primary host for adult tape worm. While secondary host is one that harbors the larval stage of the parasite e.g. cattle is the secondary host for tape worm larvae.

c) i). **Adaptation of *Ascaris* to its parasitic mode of life**

-Body is covered with a cuticle that is resistant to digestion by host's enzymes

-It is highly tolerant to low levels of oxygen in the small intestines of man

-The female lays a large number of eggs that can remain infective for long period of time.

-It has a complete digestion system that enables it to take in partially digested food

ii). Adaptations of tape worms to parasitic mode of life.

-Have suckers and or hooks on their heads for attachment to the intestinal wall of their hosts.

-Have flattened bodies that offer a large surface area for absorption of soluble nutrients across the body wall.

-Secrete a lot of mucus and anti-enzyme substances that protect them from the digest actions of the host's enzymes.

-Each worm can produce millions of eggs that remain infective for long periods of time ensuring successful transmission to the next host.

-Can respire anaerobically and therefore can survive in the very low oxygen concentration in the host's gut.

-They show complete absence or poor development of unnecessary organ systems like of a digestive system and poorly development nervous system.

-Employ intermediate hosts that enhance the efficiency of transmission from one primary host to another.

-They are Hermaphrodites which enables them to have a reliable faster rate of reproduction

d). Ecological/ economic importance of saprophytes.

Saprophytes are the bacteria and fungi, their economic/ ecological importance include;

-Recycling of nutrients by bringing about decay of dead animals and plants.

-Making of compost manure by breaking down the plant remains, releasing nutrients like nitrates, phosphates and Sulphates.

-Production of antibiotics like penicillin by a fungus called **penicillium**

-Treatment of sewage in which they break down organic materials in sewage

-Food spoilage and poisoning e.g. contamination of bread and other starchy food and fruit leading to decay.

-Manufacture of foods and beverages like yeast bring about fermentation of sugar forming alcohol and carbon dioxide.

-The carbon dioxide released is useful in baking of bread.

-They are used in manufacture of milk products like sour milk, yoghurt and cheese

-Due to their rapid growth, high protein content and ability to use cheap organic materials and mineral salts, these organisms are becoming an important source of food for man and his domestic animals.

-Manufacture of organic acids like acetic acid, citric acid and butyric acid. These acids have several applications in textile and food industries and laboratories.

-Manufacture of enzymes like amylase, invertase, catalase, lipases and proteases.

-Genetic engineering as in manufacturing of insulin hormone and growth hormones.

14. a) State what is meant by the following terms.

(i) Ecological niche *(ii) Carrying capacity* *(iii) Population*

b) Give two examples of natural resources that are:

(i) Un exhaustible *(ii) Renewable* *(iii) Non- renewable*

c) Explain the meaning of the terms:

(i) Exploitation

(ii) Conservation of natural resources

d) Mention the ways how man has affected natural resources.

Solution

a.(i**). Ecological niche** is the particular part of the habitat where an organism lives, its feeding habits and how it interacts with other organisms in that habitat.

ii). **Carrying capacity** is the total number of members of a given species that an ecosystem can support without depleting the various resources.

iii). **Population** is the total number of the members of a given species occupying particular area as a specified time.

b.(i). Air, water, sunlight

ii) Forest, fish, soil, wildlife, shelter

iii). Mineral, fuel, energy

c i). **Exploitation** of natural resource is the use of these resources for man's use, domestically, individually and for scientific and recreational purposes.

ii). **Conservation of natural resource** is the sustainable use and preservation of these resources.

d). - Pollution - Fire - Encroachment on habitats - Over fishing

- Introduction of species where they haven't been. - Cutting down of trees

15. a) What is meant by the following terms as applied to genetics and evolution?

i) Sex linkage *iv) DNA*

ii) Chromosome mutation *v) Reciprocal cross*

iii) Continuous variation

(b).In an experiment, a short winged female drosophila was crossed with a long winged male drosophila. All the offspring in the F1 generation were long winged. When two members of this generation were crossed, they produced F2 generation which consisted of long winged flies and short winged flies.

b) i). What is meant by F1 and F2 generation?

ii). Suggest an explanation why all the F1 generation flies were long winged.

c) i) State the phenotype of flies that would develop from mating between short winged flies of the F2 generation.

ii) Give reasons for your answer.

d) Mating between a short winged fly in F2 generation with a long winged fly in F2 generation produced 120 flies. How many of them were short winged? Show your working

Solution

a. i) **Sex linkage** is where genes, other than sex genes are carried on sex chromosome using X chromosome and therefore inherited with sex characters e.g.

-Eye colour in fruit flies is sex linked character

-Colour blindness and haemophillia show sex linkage in humans.

ii). **Chromosome mutation** refers to a change in the structure of number of chromosomes in a cell.

iii). **Continuous variation**. Is where a particular characteristic in a population, show gradation from one extreme to another without a distinct break.

-Such a characteristic is shared by all individuals but at different degrees

-It is a result of an interaction between many genes and environment

-And show normal distribution e.g. skin colour in humans, height and weight

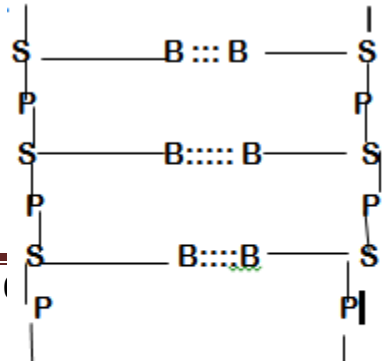
iv). DNA in full, stands for De oxyribose Nucleic Acid, which is a long chain molecule consisting of organic bases linked up in a particular sequence with phosphates and de oxyribose sugar.

-It consists of two strands, each made up of organic base, sugar and a phosphate molecule.

-In a strand, a sugar is linked to a phosphate and a base is attached to a sugar.

The two strands are linked together by hydrogen bonds between bases pairing in a particular order.

-The bases are thymine T pairs with adenine A and guanine G pairs with cytosine C as illustrated below



S= Sugar.

P= Phosphate

B=Base

:::::: Hydrogen bonds.

-The simplest unit of DNA is called a nucleotide consisting of a base, sugar and a phosphate.

-DNA is enveloped in a protein coat called histone and together form what is known as the chromosome.

-Particular portion of DNA that determines a particular characteristic is called the gene.

(v). **A reciprocal** cross is a breeding experiment designed to test the role of parental sex on a given inheritance trait.

Or **A reciprocal** cross is a cross with a phenotype with each sex reversed as compared with the original cross to test the role of parental sex on inheritance party or trait. E.g. male A X female B and male B X female A.

b. i) **F1 generation** is the first filial generation which refers to the offspring given rise to, by crossing two genetically dissimilar pure breeding individuals showing contrasting characters.

F2 generation is the second filial generation which refers to the offspring given rise by crossing two hybrids of the F1 generation.

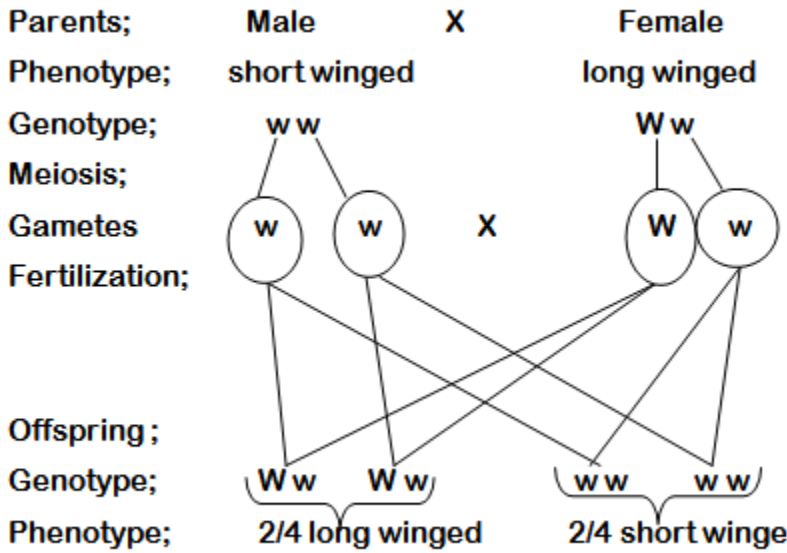
ii) All files of F1 generation were long winged because the allele determining long winged characteristic is dominant to that determining short winged characteristic.

c.(i) Phenotype – all will be short winged

(ii) Reason: Short wingedness is determined by a recessive allele/gene, and therefore, short winged individuals must be homozygous recessive and pure breeding; If such flies are crossed with one another, all the offspring would be short winged flies.

(e). -Let W represent the dominant allele for long wing.

-Let w represent the recessive allele for short wing.



Phenotypic ratio: 1 long winged: 1 short winged

Therefore number of short winged flies among 120 offspring = ½ x 120 = 60 flies

NB: Always when showing a genetic cross remember to:

☞ Define the symbols used as the first step, then show

- ☞ **Parents, with a cross between, then**
- ☞ **Parent's phenotype then,**
- ☞ **Parents' genotype, then**
- ☞ **Meiosis, followed by**
- ☞ **Gametes, then**
- ☞ **Offspring genotype, and lastly**
- ☞ **Offspring phenotype in that order as is done above.**

16.

(a) (i) Name three accessory gland associated with the region of sperm tract in male mammals.

(ii) State the nature and function of the secretions produced by each of the glands named in (a) i) above.

(b) Name the parts which make up the spermatic cord

(c) Differentiate between Dizygotic and monozygotic twins

(d) Outline the events which occur during the menstrual cycle in human female reproductive system.

(e) what is meant by the term "safe period"?

Solution:

(a) i) Seminal vesicle / vesicular seminalis

- ☞ **Prostate gland**
- ☞ **Cowper's/ bulbourethral gland**

ii) Seminal vesicle produces a thick, clear, watery alkaline fluid that contains sugar fructose which nourishes the sperm.

- ☞ **It also secrets mucus that enhances mobility of the sperm.**
- ☞ **Also stores sperms until copulation occurs.**
- ☞ **Prostate gland produces a milky/ creamy slightly alkaline secretion which neutralizes the acidity of any urine in the urethra as well as aiding sperm mobility.**

The secretion also protects the sperm from the acidic secretions in the female reproductive tract.

- ☞ **Cowper's gland secrets a sticky, alkaline lubricating fluid and mucus in the urethra which also enhances sperm mobility and protection from acidity in the urethra.**

NB: The combination of sperm and all these secretion is known as semen.

b) Parts of the spermatic cord

- ☙ **Nerves**
- ☙ **Artery**
- ☙ **Vein**
- ☙ **Lymph vessel**
- ☙ **Vas deferens (sperm duct)**

c. Dizygotic twins also called fraternal twins result from simultaneous release of two ova and both become fertilized to form two zygotes that develop independently.

- Such twins may be of the same or different sex, and genetically different.
- **Monozygotic twins** also called identical twins result from the same fertilized egg which at some stage during early development divides into two independent parts.
- Each of these parts develops into an embryo.

d. Events which occur during menstruation in the human female reproductive system

- On average, the cycle takes 28 days and is regulated by hormones.
- It immediately starts at the time (day), menstruation begins.
- During the first 14 days of the cycle, Follicle Stimulating Hormone (FSH) and Luteinising Hormone (LH) are secreted by pituitary, the two work together to promote maturation of an ovum.
- FSH and LH also stimulate secretion of oestrogen by the ovary.
- The rising levels of oestrogen stimulate healing and development of the uterine wall
- The rising level of oestrogen stimulates further secretion of more FSH and LH.
- Around the 14th day, LH surge causes release of the egg (ovum) i.e. ovulation occurs.
- After ovulation, a yellow body called corpus luteum is formed from the cells that were surrounding the ovum.
- Corpus luteum begins to secrete progesterone hormone.
- Presence of oestrogen and progesterone inhibits further secretion of LH and FSH from the pituitary. Thus no more follicular development.
- Progesterone causes a great proliferation/ further development of uterine wall
- If the egg cell is not fertilized, the corpus luteum degenerates, thus progesterone drops.
- Rapidly falling levels of progesterone and oestrogen cause shrinkage of the uterine walls.
- At day 28, another menstruation cycle starts again when cell debris and blood is discharged.

(e). **Safe period** refers to the days when fertilization is unlikely to occur even if unprotected copulation takes place.

It occurs approximately between day 17th of one cycle and 11th day of the next cycle.

17. *a. Describe how locomotion is brought about in bony fish.*

b). What are the adaptations of bony fish for movement in water?

c). In what ways do the following adaptations help a bird to fly?

(i) High metallic rate

(ii) Large keel

(iii) Hollow bones

(iv) Flight feathers

(v) Rigid skeleton

Solution:

(a) How locomotion is brought about in bony fish.

- ♠ Locomotion in bony fish is brought about by side to side movement of the tail
- ♠ Movements of the tail are due to contraction of muscle groups called myotomes on the right and left side of the tail
- ♠ Myotomes contract alternatively pushing the tail to the right or to the left.
- ♠ Movement of the tail to one side pushes water backwards and sideways.
- ♠ The backward push on water results in a forward reaction or push on the fish.
- ♠ The reaction effects of sideways push on water is cancelled when the tail moves to the other side, thus the fish is propelled forwards in the straight course.
- ♠ Changes in direction and speed are effected through the action of the paired pectoral and pelvic fins.
- ♠ These fins also bring about downwards or upwards movement; depending on the angles at which they are held against the water.
- ♠ Paired fins also reduce pitching movement.
- ♠ The unpaired dorsal and anal fins prevent the fish from rolling and yawing by increasing the vertical surface.
- ♠ Bony fish have an air filled swim bladder.
- ♠ Air content of the swim bladder can be increased or decreased to regulate the density of the fish and therefore it's depth in water.

(b) Adaptation of bony fish for movement in water.

- ♠ They have strong tail muscles which contract to move the tail side to side during swimming.
- ♠ They have a stream lined body which reduces resistance of water to motion
- ♠ The scales overlap with one another pointing posteriorly. This enhances the streamlined shape.
- ♠ Presence of air-filled swim bladder allows buoyancy and the fish does not spend energy to keep it from sinking.
- ♠ The tail fin has a large surface area which increases the amount of water that is displaced hence increased forward thrust.
- ♠ They have a highly flexible vertebral column which allows the tail to move from side to side against the water.
- ♠ Paired pectoral and pelvic fins are used for steering while changing direction of motion
- ♠ These fins are also used as breaks and prevent pitching.
- ♠ They have unpaired dorsal and anal fins which increase the vertical surface area and stabilize the fish preventing it from rolling or yawing.

(c)

(i) High metabolic rate produces the energy required for flight

(ii) Large keel provides a large surface area for the attachment of flight muscles, pectoralis major and pectoralis minor muscles.

(iii) Hollow bones make the body light during flight.

(iv) Flight feathers increase the surface area of the wing without increasing its weight considerably.

(v) Rigid skeleton allows transmission of force of flapping wings to the rest of the body.

18. *a) Using examples, describe the methods of fruit and seed dispersal.*

b) State the importance of dispersal to the plant.

Solution:

Agent of dispersal	Adaptations of fruit / seed for dispersal and example	Mode / mechanism of dispersal
-Water	-Have air spaces -Spongy -Water proof -Fibroids layer -Buoyant -Able to float on water e.g. water, fruit, coconut fruit	-The fruit/ seeds float on water and carried by water currents to long distances and dispersed far from the parent plant.
-Wind	-Have parachute like hair structure -Seeds are light e.g. seeds of some grass -Have wing like structure e.g. jacaranda -Cotton seeds have fine hair -Have large surface area able to be carried by wind.	-The seeds float in air, the increased surface area offer extra resistance to air movement and is carried by wind/ air currents to long distances and dispersed far from parent plant.
-Wind	-Seeds are light e.g. tobacco	-In tobacco, the dry ovary splits into partially separated carpals and when wind blows the seeds fall out and get scattered to far distances from parent.
-Animal	-Sticky e.g. mistletoe hooked e.g. blackjack, desmodium -Succulent fruit	-They catch in the fur of animals passing in the clothing of man and may be carried for long distances.

	-Have brighter attraction colour	-Succulent fruits are eaten by animals and their seeds are discarded some distance from the parent plant e.g. mangoes by man. -In others, the fruit together with seeds swallowed, the seeds being hard and indigestible are passed out with faeces while still capable of germinating e.g. guavas, tomatoes. Etc. -In others, seeds are covered by sticky material and are carried on feet/ skins of birds as of mistleatoe and discard to another area.
-Explosive mechasism	-Pericarlus lines of weakness (sutures). -Borne on long pedicel e.g. poppy, bean, pea, crotalaria)	-When the fruit dries, it splits open along the lines of weakness, two halves curl back suddenly and flick the seeds out to some distance

b). –it prevents overcrowding among members of the same species.

-It prevents the competition for light, air, mineral salts, water and space that would result if all the seeds germinated near the parent plants.

-It results in colonization of new areas.

- Plant species have an increased chance of survival if the seeds are scattered/ dispersed as far as possible from the plant.

- It prevents and reduces spread of diseases from the parent plant to the seedlings.

19. *a). Describe an experiment to show that enzyme activity is affected by temperature*

b). State the roles of the contents of gastric juice in the process of digestion.

c).What are the functions of the stomach?

d).State the adaptations of small intestine to its functions.

Solution

AN EXPERIMENT TO SHOW THAT ENZYME ACTIVITY IS AFFECTED BY TEMPERATURE

Requirements;

-4 test tubes, labels, source of heat, pepsin enzyme, dilute hydrochloric acid, water bath.

Procedure:

1. Four test tubes A, B, C and D are prepared as below;

Tube A: 2cm^3 of pepsin solution placed in boiling water bath for 10 minutes

Tube B: 2cm^3 of pepsin solution placed in water bath at 60^0 c 10 minutes

Tube C: 2cm^3 of pepsin solution placed in water bath at 35^0 c for 10 minutes

Tube D: 2cm^3 of pepsin solution placed in ice bath for 10 minutes.

2. To each of the four test tubes add 2cm^3 of hydrochloric acid and shake to mix thoroughly well.
3. Then add 3cm^3 of egg white suspension to each of the four test tubes and again mix thoroughly.
4. Place tubes A, B and C in a water bath at 37^{0}c for 10 minutes and tube D in an ice bath for 10 minutes.

Observation

In tube C, the cloudy suspension changes to a clear solution.

In the other test tubes, cloudy suspension persists/ remains.

Interpretation:

At 37^0 c, pepsin digests/ hydrolyses the insoluble protein of egg white to soluble products

At higher temperatures, above 60^0 c, the enzyme becomes denatured, losing its catalytic action.

At low temperature, the enzyme is inactivated.

Conclusion:

Enzyme activity is affected by temperature.

NB: When describing an experiment the following should not be missed out.

(i) Aim of the experiment

(ii) Materials/ apparatus and chemicals to use in the experiment

(iii) Procedures with illustrating diagram, where necessary indicate the control and time.

(iv) Observation/ result

(v) Conclusion/ interpretation

c) Roles of the contents of gastric juice in the process of digestion.

Contents of gastric juice include;

- ♣Hydrochloric acid
- ♣Enzyme rennin
- ♣Enzyme pepsin
- ♣Mucus
- ♣Water

Roles of hydrochloric acid in the process of digestion

-It destroys certain bacteria which may be present in the food.

-Prevents food going bad in the stomach

-It unfolds proteins enabling pepsin to act on them.

-It hydrolyses sucrose to glucose and fructose

-It increases the acidity of the stomach contents to provide the optimum PH for the action of pepsin

-It activates pro rennin to active rennin

-It activates inactive pepsinogen to active pepsin

-It stops the action of salivary amylase.

Roles of enzyme rennin

-Mainly produced in young mammals

-It coagulates/ precipitates soluble milk protein **caseinogen** to insoluble curd **casein** which is then acted upon by pepsin.

Roles of mucus

-Protects the stomach wall and gastric wall from the action of hydrochloric acid and enzyme pepsin.

-It lubricates food for easy passage through the gut.

Roles of pepsin:

-Hydrolyses proteins into smaller peptides

c. **Functions of the stomach**

-Stores food temporarily after meals

-It releases food slowly into the rest of the gut for efficient digestion.

-It continues mechanical digestion by its churning or peristaltic action.

-Its wall is glandules: It secretes mucus which lubricates food and prevents self-digestion.

-Gastric glands in its walls secrete gastric juice which contain digestive agents like pepsin, rennin, HCl

-The stomach wall also contains endocrine cells which secrete a hormone called gastric which stimulates production of gastric juice from gastric glands.

d) Adaptation of small intestine to its functions

Functions of the small intestines include;

♣Completion of digestion of food, and

♣Absorption of soluble products of digestion

Its adaptations include;

♣Its walls are muscular, by peristaltic movements, cause movement of food and mixing it with digestive enzymes.

♣It has openings through which it receives digestive agents from the pancreas and gall bladder.

♣The small intestine is long; this offers large surface area for digestion and absorption

♣The inner lining of the small intestine is highly folded to increase the surface area.

- **The inner wall has villi and microvilli which also further increase the surface areas for absorption**
- **It has Brunner glands and goblet cells that secrete mucus for lubrication and protection of the wall from digestive enzymes.**
- **It has intestinal glands that secrete digestive enzymes that complete digestion of all types of food.**
- **The Brunner's glands secrete an alkaline fluid which maintains a pH of about 8 which is optimum for the action of intestinal enzymes.**
- **It has a rich vascular network that supplies oxygen and removes absorbed food materials.**
- **The villi have thin epithelial wall that allows faster absorption of digested food material.**
- **The villi have lacteals into which lipids are absorbed and transported in the lymph.**
- **The villi have numerous blood capillaries which transport absorbed nutrients.**

20. (a). Distinguish between a seed and a fruit?

(b). Giving one example in each case, describe how simple true fruits are classified into different types.

Solution

(a). A seed is a fully developed and fertilized ovule while a fruit is a fully developed and fertilized ovary.

A seed has one scar while a fruit has two scars.

(b

Type of fruit	Characteristic	Example
(a).DRY INDEHISCENT FRUITS	**These are dry fruits with pericarps that do not split open at maturity**	
Achene	A small dry fruit with thin (membranous) close fitting pericarp. Has a single seed.	Black jack Sunflower fruit
Nut	A dry fruit with a hard thick and tough pericarp. Has a single seed.	Cashew nut.
Caryopsis (grain)	A small dry fruit with a thin pericarp fused with the seed coat of a single seed.	Maize
Samara	This is a one or two seeded fruit with winged pericarp	Marple
Cypsela	A fruit with persistent calyx forming a pappus of hairs	Tridax
Schizocarp/ loment / lomentum	A dry fruit with transverse sutures. When mature it splits up into mericarps(parts with one or more seeds)	Desmodium
(b). DRY DEHISCENT FRUITS	**These are dry fruits usually with many seeds. Their pericarps split or dehisce**	
Follicle	This is a dry fruit with many seeds. It splits open a long a single suture when mature.	Acacia
Legume	A dry elongated fruit with many seeds and splits open along two sutures.	Bean pod
Capsule	A dry fruit with several seeds which splits open at maturity along more than two sutures.	Dutchman's pipe

21. Giving examples in each case explain the following terms as applied to evolution

(i) Divergent evolution

(ii) Homologous structures

(iii) Mimicry

(iv) Adaptive radiation

(v) Vestigial organs

(vi) Analogous structure

(vii) Convergent evolution

Solution:

i) Divergent evolution: Is the process whereby related organisms evolve/ develop different structures due to the fact that they occupy different environment e.g. duck foot and that of domestic chicken.

ii) Homologous structures: Are organs of different species of organisms that have the same evolutionary origin but have been modified to serve different purposes due to divergent evolution. e.g. wings and hands are homologous.

iii) Mimicry: Is the situation where one species of animal resemble another that is not palatable to its predator in order to avoid predation e.g. some beetles many look like wasps.

iv) Adaptive radiation: Is the evolutionary divergence or development of many forms of animals or plants from a single ancestral stock to fill or occupy many ecological niches e.g. insects have under gone adaptive radiation into many different types for aquatic life, burrowing, flying, crawling etc…

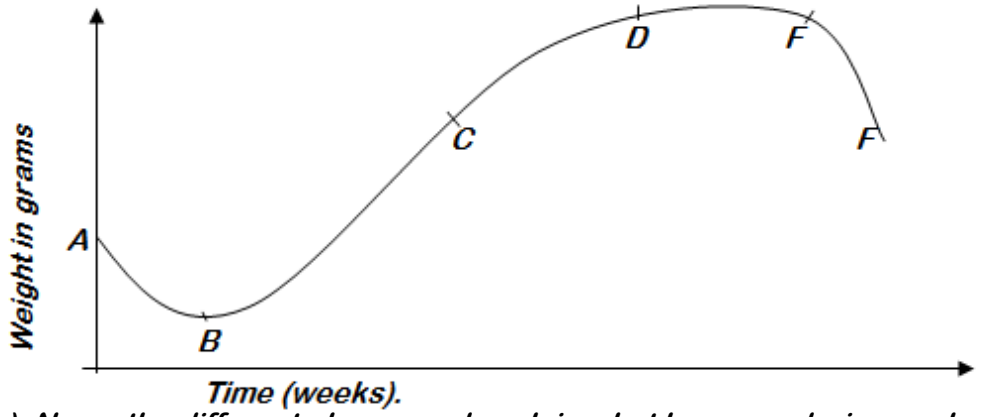
v) Vestigial organs are organs that have become reduced and functionless because the organism no longer require them e.g. body hairs in man, snake limbs.

vi) Analogous structure are organs developed in un related organisms that evolve to look alike because they are adapted for a similar function or environment e.g. wings of birds, bats and insects, stream lined shape of fish, birds.

The process by which they evolve to resemble each other is called **convergent evolution**

vii) Convergent evolution is the process by which different organisms develop similar structures to exploit the same environment.

22. The graph below shows the changes in dry weight of a germinating seed.



a). Name the different phases and explain what happens during each phase.

b(i) What is germination?

(b) State the conditions necessary for germination.

(c) Explain how each of the conditions stated is important in germination

(d) Describe the different types of germination you know.

c) i) What is seed dormancy?

ii) State the causes of seed dormancy.

iii) How can seed dormancy be broken?

iv). What is the importance of seed dormancy to plants?

Solution:

a) AB-lag growth phase

- ☒ BC-log/ exponential growth phase
- ☒ CD- decelerating growth phase
- ☒ DE- stationary phase
- ☒ EF- decline phase

Phase AB: During lag phase the dry weight of seed decreases because the food reserves are hydrolyzed and used in respiration to produce energy needed for cell division for growth.

Phase BC: During log/exponential growth phase

- ☒ First green leaves appear.
- ☒ Seedling photosynthesizes food.
- ☒ Some of the food manufactured is built into tissues or stored.
- ☒ There are more cells produced by cell division than those that die, thus exponential increase in dry weight.

Phase CD: During this phase the plant gradually approaches full growth size

- ☒ Some of the cells differentiate and loose the power to divide
- ☒ The region of new cell formation becomes localized.
- ☒ Formation of new cells is no longer proportional to the number of those already present

☒ Growth proceeds more slowly

☒ The rate of photosynthesis reduces due to aging of leaves; all reduces the rate at which the plant increases in dry weight.

Phase DE: During this phase, the number of new cells formed is equal to the number of cells dying.

☒ Rate of photosynthesis is equal to that of respiration hence no growth and dry weight remains constant.

Phase E F. Senescence has reached, and the Plant has reached maximum growth size.

☒ Number of cells dying is greater than those being formed. The dry weight of the plant decreases.

☒ The plant loses much weight quickly as it's flowers produces seed and fruits. Some of the floral whorls, drop off and eventually the seeds and fruit drop too.

☒ Once mature, the seeds and fruits are dispersed.

☒ The plant gradually dies at point F.

a) i) **Germination** is the process by which the seed embryo emerge, and develops into a young plant/ seedling which is capable of establishing itself as a new independent plant under favourable conditions for germination.

ii) Germination conditions include;

☒ Adequate moisture

☒ Suitable temperature/ optimum temperature

☒ Availability of oxygen.

Adequate moisture is necessary for the activation of enzymes involved in germination process.

-Water is also a reactant in the hydrolysis of stored food substances.

-Water also acts as a medium for transport of soluble food materials to the growing points of the embryo.

-It softens the seed coat, making it easier for the radicle and plumule to come out.

-Water also softens the seed coat making it easier for diffusion of oxygen to reach the actively respiring tissues.

-Too much water/ moisture cuts off oxygen supply making seed to rot.

-Too little water initiates germination but stops it abruptly and seeds die.

Suitable temperature / optimum temperature is necessary for the action of enzymes involved in mobilization of food reserves

-At higher or lower temperature than optimum, germination will not occur.

Availability of oxygen

-Oxygen is necessary for respiration which produces/ releases energy needed for germination process.

-Energy released enables the embryo to carry out various metabolic processes.

ii) **Types of germination;** There are two types of germination.

1) **Epigeal germination.**

♣ This is the type of germination in which the cotyledons are brought above the ground due to rapid elongation of the hypocotyl than the epicotyl e.g. cow peas.

♣ Its due to relatively little food store to support the seedling for longer period of time.

2) **Hypogeal germination.**

♣ Epicotyl elongates faster than the hypocotyl, resulting in the plumule being pushed upwards above the ground, leaving the cotyledons still enclosed within the seed coat below the soil surface.

♣ Seeds, which germinate in this way normally have much stored food in their large cotyledons or endosperm e.g. maize grain, broad bean.

c)

(i) **Seed dormancy** is the state in which viable seeds fail to germinate under normal favourable germination conditions.

OR; This is a state in which growth and development ceases and the metabolic rate falls to the point which is only sufficient to keep the seed alive.

(ii) **Causes of seed dormancy**

♣ Presence of germination inhibitors in the soil or within the seeds e.g. as in mangoes, tomatoes.

♣ Impermeable seed coat to water and oxygen

♣ Too hard seed coat the embryo to break

♣ Presence of waxy cuticle, rendering seed coat resistant to hydration

♣ Embryos of some seeds require a period of after ripening

♣ Embryos of some seeds require a period of low temperature after absorbing water to allow some physiological and physical changes to take place.

♣ Embryos of some seeds are still rudimentary/ immature and undifferentiated hence require a period of after ripening to undergo such differentiation.

(iii) **Methods of breaking dormancy in seeds**

♣ Using alcohol to dissolve the waxy cuticle for easy hydration

♣ Allthe seed to undergo after ripening period for any required differentiation to take place.

♣ Passing the seeds through animal gut, the enzymes in the guts often soften the seed coat by digesting it.

♣ Using microbial treatment, bacteria and fungi in the soil naturally digest the seed coat and perforate it making it more permeable to water and respiratory gases.

♣ Filling/ abrasion of seed coat to make it wear so that it can easily break.

♣ Chopping the seed coat into pieces without demanding the embryo and cotyledons or endosperm

♣ Cracking the seed coat by exposing the seed to alternating high and low temperatures that cause expansion and contraction of the seed.

♣ Using concentrated sulphuric acid increases porosity of the seed coat

♣ Exposing the seed to cold.

♣ Treating the seed with chemicals that destroy germination inhibitors

♣ Under natural conditions, the inhibitors are washed out of the seed by rain water or they disintegrate naturally with time.

(iv) Importance of dormancy to plants

♣ It enables the plant to withstand un favorable conditions like winter, drought, food shortage

♣ It allows seed and fruit dispersal by agents of dispersal for the plant species to colonise new environment.

♣ Allows necessary internal changes to reach completion before the plant can start full time growth.

23. a) What is photosynthesis?

b) Describe an experiment to show that a plant has been photosynthesizing.

c) State the conditions necessary for photosynthesis.

d) Describe how a dicotyledonous plant leaf is adapted for photosynthesis.

Solution

a). Photosynthesis is the process by which living green plant cells manufacture their own food/ complex organic materials mainly in form of carbohydrates from simple inorganic materials like carbon dioxide and water using sunlight energy trapped by chlorophyll releasing oxygen as a by-product.

b). Experiment to show that a plant has been photosynthesizing.

Requirements:

♥ Beaker, boiling tubes, tripod stand, wire gauze, white tile, dropper, ethanol, iodine solution, source of heat.

♥ Potted plant that has been in sun light for 6 hours

♥ Potted plant that has been in the dark for 48 hours.

Procedure

♥ A leaf from a green potted plant that has been in sun light for 6 hours is taken and dipped in boiling water bath for one minute.

♥ This treatment has the following purposes

-It kills all the living tissues in the leaf

-All further chemical reactions are prevented

-Starch granules present are ruptured

♥ The leaf is then removed and transferred into boiling tube containing ethanol in a water bath after extinguishing the Bunsen burner. Ethanol boils, and dissolves the chlorophyll of the leaf.

♥ The leaf is then removed from the ethanol and softened by dropping it in a beaker of cold water.

♥ The leaf is then placed on a white tile and iodine solution applied on it.

♥ A control is carried out using a leaf from the plant that has been kept in a dark for 48 hours.

Results:

Parts of the leaf containing starch turn blue/black starch present and therefore the plant has been photosynthesizing

While that obtained from the one that was kept in the dark for 48 hours, turn brown.

c. Conditions necessary for photosynthesis.

♥ Carbon dioxide
♥ Chlorophyll
♥ Light
♥ Temperature
♥ Water
♥ Oxygen
♥ Mineral salts.

Carbon dioxide is a raw material for the process of photosynthesis. Supply of carbon dioxide increases the rate of photosynthesis.

Chlorophyll is the pigment which traps sun light. The amount of chlorophyll present in a leaf is directly related to the rate of photosynthesis under normal conditions.

Light supplies the energy required by the process. Rate of photosynthesis is influenced by light intensity and wave length.

Temperature affects the enzymes which control the process of photosynthesis

Temperature beyond 40^0 c lowers the rate of photosynthesis but below this temperature, the rate doubles for every 10^0 c rise in temperature

Water is a raw material for the process but has an indirect effect because it is required for many other processes, however its scarcity slows down the rate of photosynthesis.

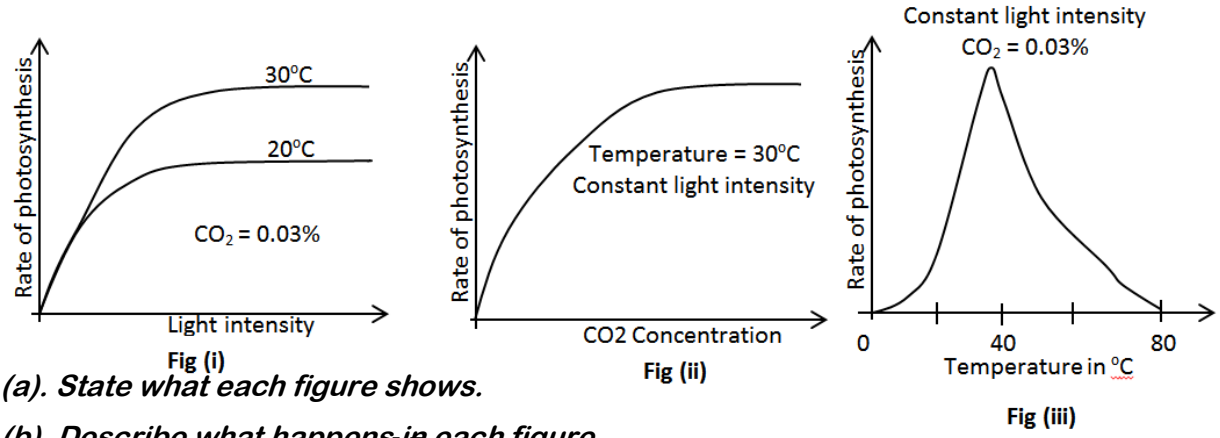
Oxygen being a byproduct of the process its increase in the photosynthetic cells slows down the rate of photosynthesis.

Availability of mineral salts like those of nitrogen, magnesium influences the rate of photosynthesis since they are important constituents of chlorophyll.

d. Adaptation of dicotyledonous leaf for photosynthesis

- ♥ Dicotyledonous leaf is broad and flat in shape. This offers a larger surface area which allows maximum amount of light to fall on them and it also allows rapid diffusion.
- ♥ It is thin, hence small diffusion distance for carbon dioxide from the atmosphere to the innermost cells where photosynthesis takes place.
- ♥ It has intercellular air spaces in the spongy mesophyll layer which allows rapid diffusion of carbon dioxide into the cells and oxygen out of the cells.
- ♥ It has branching network of veins which supply water and mineral salts to the photosynthetic cells and carry the manufactured food away to other parts of the plant.
- ♥ Presence of numerous stomata the lower epidermis allows carbon dioxide to enter and oxygen to leave.
- ♥ Presence of numerous chloroplasts especially in the palisade mesophyll cells located on the upper surface enables maximum trapping of light energy.
- ♥ The mosaic pattern of leaf arrangement allows maximum light absorption.

24. Figure show the rate of photosynthesis under different conditions.



(a). State what each figure shows.

(b). Describe what happens in each figure.

(c). Explain the shape of figure (iii).

(d). From figures above, state the factors that affect the rate of photosynthesis.

Solution

(a). **Figure (i):** Shows the effect of increasing light intensity on the rate of photosynthesis at varying temperature (30°C and at 20°C) at a constant carbon dioxide concentration of 0.03%.
Figure (ii): The effect of increasing carbon dioxide concentration on the rate of photosynthesis at a constant temperature and constant light intensity.
Figure (iii): Effect of increasing temperature on the rate of photosynthesis at a constant light intensity and a constant carbon dioxide concentration of 0.03%.

(b).**Figure (i):** Initially as light intensity increases, the rate of photosynthesis increases rapidly at the same rate for both temperatures. It then increases slowly / gradually and finally remains constant first under 20°C and finally under 30°C with the rate of photosynthesis being highest at 30°C and lowest at 20°C.

Figure (ii): Initially as carbon dioxide concentration increases, the rate of photosynthesis increases rapidly then slowly/ gradually and finally remains constant under the same temperature and light intensity.

Figure (iii): From 0^0C to 20^0C, the rate of photosynthesis increases slowly / gradually. From 20^0C to 40^0C the rate of photosynthesis increases rapidly with an increase in temperature and finally the rate of photosynthesis decreases rapidly as temperature increases from 40^0C to 80^0C.

(c). At 0^0C the rate of photosynthesis was zero as enzymes responsible for the process were inactive. As the temperature increases to 20^0C, some enzymes are being activated resulting into a gradual increase in the rate of photosynthesis.

As the temperature increases from 20^0C to 40^0C, the rate of photosynthesis increase rapidly due to most enzymes being activated until it reaches a maximum at 40^0C when all enzymes are fully active (optimum temperature).

From 40^0C, the rate of photosynthesis reduces rapidly to zero at 80^0C. This is because from 40^0C, enzymes get denatured by the higher temperatures.

(d).- light intensity. – Temperature. – Concentration of carbon dioxide.

25. a) Define the following ecological terms

(i) Food web (ii) Food chain (iii) Tropic level (iv) Community (v) Ecosystem

b) The following information refers to feeding relationship in a small fresh water lake, read it carefully and answer the questions that follow:

- *Small crustaceans, tadpoles and insect larvae feed on aquatic plants.*
- *Water beetles feed on insect larvae, tadpoles and small crustaceans.*
- *Roach (species of fish) feeds on small crustaceans and insect larvae.*
- *Frogs feed on insect larvae and small crustaceans.*
- *Perch (species of fish) feeds on roach, water beetles and frogs.*
- *Pike (a species of fish) feeds on roach, perch and frogs.*

(i) Draw a food web for the ecosystem.

(ii) Name five trophic levels you know

(iii) What tropic level does Roach occupy?

(iv) Name the organism that occupies two trophic levels and name the levels.

(v) Suggest the short term effect of removing perch from the habitant

(vi) Write down two food chains from the food web with four consumers including frogs

(vii) Suppose the water got contaminated with DDT, giving reasons, name the organism in which you would expect the highest concentration of DDT after several weeks.

(viii) State the ways in which man may interfere with the lake explaining how each of the ways affect life in the lake.

b) The table below shows the number of organisms in the various tropic levels in a certain food chain.

Quaternary consumer	*10*
Tertiary consumer	*2,000*
Secondary consumer	*100,000*
Primary consumer	*3,000,000*
Producers	*20,000,000*

i) Draw a pyramid of numbers for the food chain

ii) Explain why the numbers of organisms usually decreases at each successive trophic level.

iii) Below is a typical food chain, draw the kind of pyramid of numbers you would expect.

Trees ⟶ Caterpillars ⟶ Beetles ⟶ Insectivorous birds ⟶ Hawks.

iv) State the difference between a pyramid of numbers and a pyramid of biomass.

v) Why is a pyramid of biomass a more accurate way of representing the amount of organic matter present in each trophic level as compared to a pyramid of numbers?

Solution

(a) **i) Food web** is a feeding relationship between organisms of various species, showing the food sources of each species in a community.

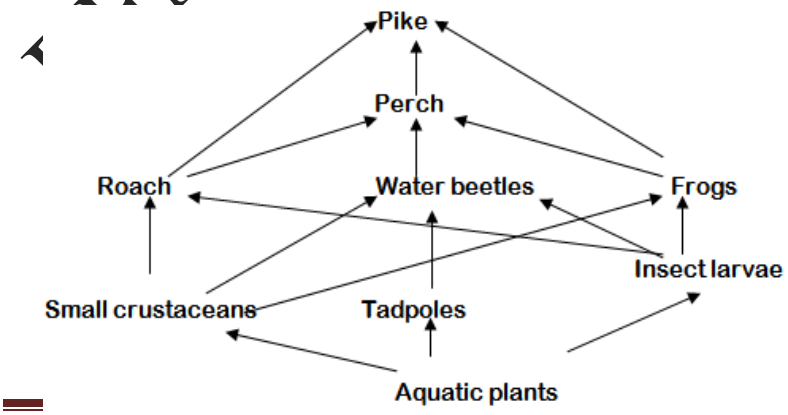
ii) **Food chain** is a linear feeding relationship involving several organisms usually starting with a producer and ending with a top consumer in which each organisms is a food of the next one in the chain.

iii) **Tropic level** is a stage in the food web at which the organism obtains their food in the same general way.

iv) **Community** is a collection of populations/ species of various organisms(plants and animals) occupying/ living together in a given area at a particular time, e.g. a fishpond, forest. Etc.

v) **Ecosystem** is a natural unit in an area containing a relatively self-sustaining community of organisms interacting with their non-living surroundings e.g. a fishpond, forest.

(b) i) **Food web for the ecosystem**



ii) The five trophic levels

-Producers , -Primary consumers ,-Secondary consumers , -Tertiary consumer

-Quaternary consumer

iii) Roach occupies the secondary consumer trophic level

iv) Pike occupies two tropic levels of **tertiary consumer** and **quaternary consumer**

v) **Effects of removing perch from the habitat.**

- Water beetles will be left with no predator
- They will therefore multiply very fast
- They will eat up most of the insect larvae, tadpoles and small crustaceans
- This will leave very little food for the frog and roach which feed on small crustaceans and insect larvae.
- The result will be a rapid decline in the number of roach and frogs as well as pike, without feeding on them.

vi) Food chains including frogs:

Aquatic plants ⟶ Insect larvae ⟶ Frogs ⟶ Pike.

Aquatic plants ⟶ Insect crustaceans ⟶ Frogs ⟶ Perch ⟶ Pike.

vii) If the lake was contaminated with DDT, the Pike would have the highest concentration of DDT.

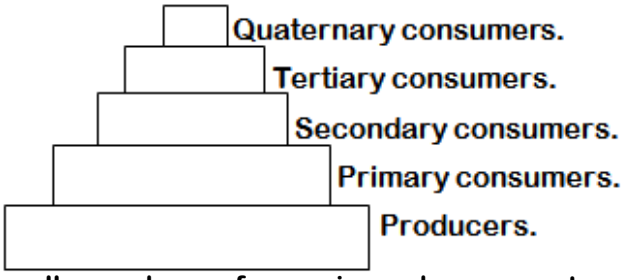
- This is because DDT is very poorly excreted and not digested.
- Therefore it accumulates along the food chains with top carnivores having highest concentration.
- This is due to the fact that top carnivores feed on organisms that already accumulated DDT.

viii) **Ways in which man interfere with the lake ecosystem**

- Pollution with toxic chemicals this may kill some organism and break food chains
- Pollution with fertilizers (Eutrophication) this may lead to proliferation/ growth of aquatic plants, after death of which decomposition by saprophytic bacteria uses up all dissolved oxygen resulting into death of aquatic organisms.
- Pollution with sewage this leads to growth of saprophytic bacteria that use up dissolved oxygen.
- The result of this is death of fish and other organisms that require oxygen.
- Siltation due to soil erosion as man cultivate around the lake, soil erosion takes place and erodes soil into the lake.
- This reduces light penetration which in turn reduces the productivity of the water plants.
- This causes a reduction in the number of all other organisms since they are depending either directly or indirectly on water plants for food.
- Silt may also block the gills of fish and stomata of plants preventing gaseous exchange with subsequent death.

- **Fishing** this will leave the crustaceans, water beetles and frogs with few predators thus their numbers will multiply forcing them to eat more aquatic plants, tadpoles and insect larvae hence upsetting the balance of nature in the lake.
- **Removal of water for irrigation.** This may reduce the volume of water in the lake, making the ecosystem less habitable for the various organisms.
- **Introduction of new species.** These may eat up some or the entire fish species or compete with them for food. The result in both cases is upsetting the balance of nature in the lake.

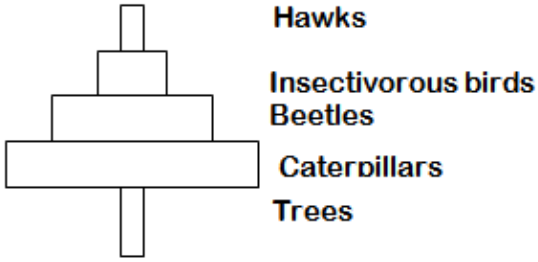
c) i) **Pyramid of numbers**



ii) Usually numbers of organisms decrease at each successive trophic level in a pyramid of numbers because:

- Most of the food materials consumed by organisms are either lost in faeces or used in respiration for energy production.
- Only a small proportion of the food is incorporated into the tissues of the organisms
- The result is that a given mass can only support a smaller mass/ number of organisms in the next trophic level as also the size of organisms usually increase at each higher level.

iii) **Pyramid of numbers**



This is called an **inverted pyramid** of numbers.

iv) In pyramid of numbers, the actual number of organisms at each trophic level is represented by a rectangle of proportional length in the pyramid while the pyramid of **biomass,** the dry weight of organisms at each trophic level is represented by a rectangle of proportional length in the pyramid.

v) **Difference between pyramid of numbers and pyramid of biomass.**

- A pyramid of numbers does not take into account the size of the various organisms e.g. a huge tree and tiny algae are all given the same value of one.
- In the pyramid of biomass, the actual dry mass of each organism is considered

♦ **Therefore, a pyramid of biomass gives a more accurate of the amount of organic matter available at each trophic level.**

26. a) (i).What is soil erosion?

(ii). Name and describe five types of soil erosion

(iii). State the agents of soil erosion

b) Describe how man's activities lead to soil degradation

c) Briefly describe the various methods of conserving and renewing soil fertility and structure.

d) A soil sample weighing 200g was placed in a crucible and heated in an oven at 105°C until constant weight of 160g was obtained. It was then heated under a strong Bunsen burner flame until a constant weight of 134g was obtained.

i) Calculate the percentage water content of the soil.

ii) What component of soil was removed by heating under the Bunsen burner?

iii) What is the percentage composition of the component you have named in (d) (ii) above in the soil sample.

iv) State the importance of the soil component that was removed by heating under the Bunsen burner and for major component which was left after heating under the Bunsen burner in the soil.

v) State three other components of soil and their importance.

e) i) What is pollution?

ii) Give an outline of the human activities in Uganda which may result in environmental pollution.

iii) Give effects of four air pollutants on living things

Solution

i) **Soil erosion** is the process by which top soil of bare ground is washed away by rainwater or wind.

ii) **Types of soil erosion**

- **Sheet erosion** – top soil is removed evenly over the whole surface of the soil
- **Rill erosion** is when small channels in which run offs concentrate appear
- **Gulley erosion** – channels widen and deepen forming gulley/ steep sided channels.
- **Splash erosion** or **rain drop** is due to raindrops which fall with force splitting loose soil particles creating small depression on the ground surface.
- **Stream bank** erosion is due to flowing of water bodies. Soil particles at the banks are carried away, widening the water body.

iii) **Agents of soil erosion**

- Wind - Running water - Rain water - Animals

Man's activities and soil degradation

- Cutting of trees and other vegetation covers leave the soil bare making it prone to soil erosion by rainwater and wind. This makes the soil lose its fertility and structure
- Overgrazing: Man tend to keep too many animals on a small piece of land. The animals eat away the vegetation exposing the topsoil making it prone to water and wind erosion
- Cattle tracts running downhill, become the starting points for gully erosion
- Excessive use of artificial organic fertilizers destroys soil structure which makes it easily for agents of erosion to operate.
- Over cultivation destroys soil structure and reduces the soil humus content. Soil particles become easy to remove by agents soil erosion.
- Deep ploughing up and down slopes creates routes for water to run when it rains. This increases surface run offs.
- Burning of bush to prepare land for cultivation makes the soil dry and leaves it bare hence increasing surface run offs.
- Burning decreases the water retaining capacity of the soil
- Use of polyethylene papers which are poorly disposed. The polyethylene papers are impermeable and not decomposed. They make soil infertile and dry, unable to support plant growth.
- Through his farming activities, man introduces various chemicals such as pesticides and fertilizers onto soil
- In addition to killing the target organisms, pesticides kill other soil organisms which play part in making soil structure and aerating it.
- By killing such soil organisms the soil structure is degraded.

Methods of conserving and renewing soil fertility and structure

- Planting trees to restore the vegetation cover through re-forestation and a forestation
- Planting cover crops like legumes
- The legumes add nitrogen to the soil by bacteria in their root nodules which fix nitrogen in the soil.
- Mulching which act as barrier and prevents soil and water from being carried down the slope
- Covering waterways with grass to reduce speed of water and water wash
- Intercropping allow the soil remain covered throughout the year since the different crops grown on the same piece of land at the same time mature at different times therefore harvested at different times.
- Roots plants grown hold the soil particles firmly hence maintaining soul structure
- Crop rotation prevents soil exhaustion which would result in poor crop growth and yield, since different crops grown have different demands of nutrients from the soil.
- Terracing reduce effect of soil erosion

- Contour ploughing and plantings so that much water is absorbed by the soil enhance checking on soil erosion and its effects.
- Making heaps of soil called **bunds** along contours also checks on soil erosion
- Planting lines of grass across the slopes, the grasses reduce the speed of water down slopes.
- When cutting trees in a forest use selection methods where only mature trees are harvested. This is also effective method of soil conservation for greatest productivity
- Replenishing the material and organic matter in the soil
- Maintenance of the natural vegetation cover on steep slopes and land of low fertility
- Wind breakers, rows of all trees are planted to act as wind breaks to reduce the speed of wind and prevent soil being blown or wash away.
- Use of barriers in gullies to control soil erosion

d) i) Soil sample weight 200g

Soil weight after heating 160g

Water weight in soil sample .....(200 - 160) = 40g

$$\% \text{ of water} = \frac{\text{weight of water}}{\text{Original weight of soil sample}} \times 100$$

$$= \frac{40}{200} \times 100 = 20\%$$

ii) Humus

iii) Humus weight = (160 – 134)g = 26g

$$\text{Percentage of humus} = \frac{\text{weight of humus}}{\text{Original weight of soil sample}} \times 100$$

$$= \frac{26}{200} \times 100 = 13\%$$

iv) **Importance of humus**

- Gives soil its black or grey colour
- Insulates the soil against the extremes of cold and heat
- It forms a coating over inorganic soil particles making them stick together in crumbs, this improves drainage and aeration of the soil
- Humus increases the water holding capacity of the soil
- On complete decomposition, humus adds nutrients.
- Humus reduces leaching and drying of soil
- It aerates clay soil
- It is a source of energy and materials for micro-organisms in the soil

Other soil components and their importance

Soil organisms

- They open up channels for air and water in the soil
- They improve on soil texture and related properties
- They mix soil as they migrate between the upper and lower soil layers
- Their excreta add fertility to the soil
- Their death and decay add humus to the soil
- Bacteria fix nitrogen into the soil
- Some cause diseases to the plants
- Play part in soil weathering

Soil water:

- Dissolves mineral ions to be absorbed by plant roots
- Softens soil for easy root growth
- Cools plants during transpiration as water vapor lost escapes with latent heat of vaporization.
- It is the medium of transport in plants
- It is a raw materials for photosynthesis
- It is the medium of metabolism in organisms
- Softens the soil for plant root penetration

Mineral matter:

- Provides a rigid frame work improving soil structure for anchorage of plant roots
- They provide a surface for anchoring plant roots hence providing support to the plants
- It provides mineral ions essential for plant growth.

Soil air:

- Provides oxygen for respiration of plant roots.
- Provides the source of nitrogen for fixation.
- Provides oxygen required for germination of planted seeds.
- Provides carbon dioxide needed to lower soil pH to ease dissolving of soil mineral nutrients and their absorption by plant roots.
- Provides oxygen needed for respiration by soil living organisms.

e) **Pollution is addition of harmful substances/ or energy to the environment through human activities to an extent that they directly or indirectly cause some harm to the environment.**

These harmful substances are called pollutants and may be deposited in air, water or on land.

Pollutants include;

- Noise,
- Heat,
- Radiation,
- Chemicals and
- sewage.

ii) **Human activities in Uganda which may result into environmental pollution**

- Burning of fossil fuels such as coal oil and petrol in factories and in motor vehicle adds lager amounts of carbon monoxide, sulphur dioxide, nitrogen dioxide and soot to the atmosphere resulting in air pollution.
- When inhaled all these are hazardous to the health of humans and animals.
- When sulphur dioxide and nitrogen dioxide react with water, form sulphuric acid and nitric acid respectively.
- This results in acid rain which destroys terrestrial plants and aquatic organisms
- Smoke from factories and motor vehicle exhausts may mix with fog forming smog.
- This leads to formation of a thick yellow mass that reduces visibility to even short distances during daylight. This usually leads to severe accidents.
- Through man's farming activities various chemicals such as pesticides are introduced onto land.
- In addition to killing the target organisms other organisms such as bacteria and earth worms in the soil as well as insects and birds are killed.
- Some pesticides are absorbed by plants where they may accumulate in large amounts and get into the human body when he consumes the plant products. These are some of the causes of increased infertility in human population.
- Careless disposal of garbage is land pollution. The garbage act as the breeding ground for disease vector such as flies, mosquitoes and rodents.
- Chemical such as fertilizers and pesticides applied on farms may be washed into rivers and lakes by rainwater.
- In this way drinking water as well as fish environment is contaminated
- People drinking such water or eating such fish may get poisoned
- Fertilizers may lead to the enrichment of the water with mineral salts/ nutrients, this is called eutrophication which stimulates growth of algae and other water plants
- Large green masses are formed. When these die, saprophytic micro-organism act on them using up dissolved oxygen thus water becomes deoxygenated killing fish and other aquatic animals by suffocation.
- The remains provide food to the decomposers which utilize any remaining oxygen
- When all the oxygen is used up anaerobic bacteria start breaking down the dead remains
- Activities of anaerobic bacteria lead to production of gasses like methane and hydrogen sulphide.
- Sewage, oil and industrial wastes discharged in water are harmful
- Poorly treated or untreated sewage may lead to spread of water borne diseases such as cholera, amoebic dysentery and infectious hepatitis.

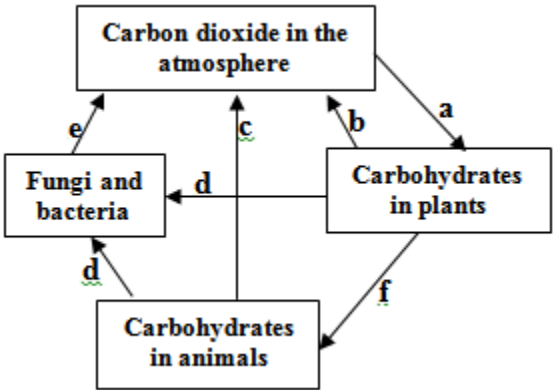
- Decomposition of sewerage in rivers or lakes may lead to a decrease in dissolved oxygen leading to death of fish and other aquatic organisms that required oxygen.
- Un discharged from vehicles into rivers poisons aquatic animals
- Industrial wastes including cellulose when discharged in water bacteria act on the fibre releasing offensive odors.
- Other industrial wastes are heavy metals like lead, mercury, copper and cyanide. If these are discharged in water they accumulate in bodies of fish no apparent damage. However, people eating such fish may be poisoned.
- Excessive sound produced by factories, industries and vehicles is also pollution
- X-ray treatment exposes individuals to some levels of ionization. This is called radioactive pollution.
- Ionizing radiation is pollution which damages biological molecules
- High levels of exposure to such radiations may lead to immediate death
- Low levels of exposure may lead to cancer and gene mutations
- Radiation sickness is characterized by nausea, fever, diarrhea, decrease in number of blood cells, hemorrhages on the skin and gastro intestinal tract.

iii) **Air pollutants and their effects on living organisms**

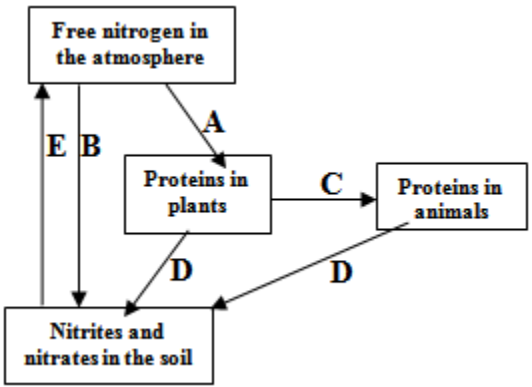
- Nitrogen dioxide causes septic pneumonia
- Smoke resulting from a combination of carbon monoxide, nitrogen dioxide and sulphur dioxide, blocks stomata in plants reducing such processes like transpiration and gaseous exchange hence stoping photosynthesis.
- Some of the fuels contain lead which can cause lead poisoning
- Sulphur dioxide and nitrogen and carbon monoxide are all poisoning gases
- Carbon monoxide leads to global warming
- Sulphur dioxide and nitrogen react with water forming sulphuric and nitric acid respectively resulting in acid rain. Acid rain destroys terrestrial plants and aquatic organisms.
- Smoke from factories and motor vehicles exhausts may mix with fog forming smog.

27. *The figures below show the carbon and the nitrogen cycles. Study them carefully and answer the questions that follow.*

CARBON DIOXIDE CYCLE



NITROGEN CYCLE



(a). Name the processes labeled **a, b, c, d, e,** *and* **f** *in the carbon cycle.*

(b). Name the processes labeled **A, B, C, D** *and* **E** *in the nitrogen cycle.*

(c). State organisms that cause the labeled processes to occur in the nitrogen cycle

(d). Explain why water logged soils always lack nitrates.

Solution

(a). **a**. Photosynthesis **b**. Plant respiration

c. Animal respiration **d.** Death

e. Decay / Decomposition **f**. Heterotrophic nutrition

(b). **A**. Nitrogen fixation and absorption. **B**. Nitrogen fixation. **C**. Heterotrophic nutrition

D. Decay of plant and animal remains **E**. Denitrification.

(c). **A**. Nitrogen fixing bacteria / *Rhizobium*

B. Nitrogen fixing bacteria / *Azotobacter*

D. Putrefying / Saprophytic bacteria / *Nitrosomonas/Nitrobacter*

E. Denitrifying bacteria / *Thiobacillus denitrificans*

(d). Water logged soils are oxygen deficient which allows denitrifying bacteria to respire anaerobically to convert nitrates into gaseous nitrogen.

Nitrates are also too soluble in water which increases their loss in water logged areas by leaching process.

28. a) Explain,

(i) How carbon dioxide is transported from tissues to the alveoli

(ii) How oxygen is transported from lungs to the tissues

(iii) The role of the alveolus in gaseous exchange

(iv) Why an amoeba does not necessarily have a respiratory system and transport system.

b) i) Name the muscles that are involved in breathing movements in mammals. For each muscles named, indicate the role it plays in breathing.

ii) *How does gaseous exchange in a cockroach differ from that in a bony fish <u>Tilapia.</u>*

Solution:

ii) How carbon dioxide is transported.

- Carbon dioxide produced by respiring cells in the active tissues, diffuses into blood
- In the blood some carbon dioxide diffuses into the red blood cells.
- In the red blood cells, it reacts with water to form carbonic acid (H_2CO_3)
- This reaction is catalyzed by an enzyme called carbonic anhydrate.
- Carbonic acid then dissociates to form hydrogen ions, and hydrogen carbonate ions HCO_3 which are transported to the lungs.

- Some carbon dioxide also combines with haemoglobin to form carbomino haemoglobin compounds H_oCO and transported in this form.
- A small amount of carbon dioxide dissolves in blood plasma forming carbonic acid which dissociates to H^+ and HCO_3 ions.
- In the lungs, the presence of very low carbon dioxide concentration causes the hydrogen carbonate ions HCO_3, in the red blood cells and those in plasma and the carbomino compounds to dissociate and release carbon dioxide in gaseous form.
- Carbon dioxide diffuses into the alveoli to be voided during exhalation.

ii). How oxygen is transported

✌ Oxygen in the alveoli diffused into the capillaries of the lungs along the concentration gradient

✌ In the capillaries, it diffuses into the red blood cells and combines with haemoglobin to form oxyhaemoglobin.

✌ Oxyhaemoglobin is carried by the red blood cells through pulmonary vein, left atrium, the left ventricle, the aorta and into capillaries of the body tissues.

✌ In the tissues, due to high carbon dioxide and low oxygen content, oxyhaemoglobin breaks down and form oxygen and haemoglobin.

✌ Oxygen diffuses out of red blood cells and capillary walls into body cells.

✌ In the body cells, it is used for oxidation of food substances to release energy.

iii) The role of alveolus in gaseous exchange

✌ They increase surface area to enhance faster gaseous exchange.

✌ Due to presence of the film of moisture, it enhances diffusion of respiratory gases.

✌ It warms up incoming air and therefore raises the rate of diffusion.

✌ To pass oxygen to blood supply and take carbon dioxide from the blood.

✌ It offers a short diffusion distance due to its thin walls.

iv) -Amoeba is single called organism.

✌ All parts of it are close to the surface.

✌ The cell surface is in contact with the water medium where amoeba lives

✌ Oxygen and other simple soluble food molecules dissolve in water and are able to diffuse directly through the cell membrane into the cytoplasm and to all parts of the organism.

✌ Carbon dioxide and other waste products of metabolism are also able to diffuse directly from the organism to the exterior.

iii) Muscles involved in breathing

- Intercostal muscles
- Diaphragm and abdominal muscles

How they are involved in breathing

- **During inhalation, the intercostal muscles contract, raising the ribs upwards and outwards.**
- **The diaphragm also contracts and flattens out**
- **These muscular activities increase the volume of the thoracic cavity**
- **Pressure lowers below atmospheric pressure and air enters the lungs from region of high pressure to the region of low pressure.**
- **During exhalation, the intercostal muscles relax, causing the ribs to move downwards and inwards.**
- **The diaphragm also relaxes and assumes a convex shape upwards.**
- **Volume of thoracic cavity lowers but its pressure increases above atmospheric pressure and therefore air is expelled out.**
- **Abdominal muscles may be used during forced breathing to push the diaphragm upwards and thus expel more air out.**

29. a) A food sample was made into a suspension and few drops of iodine was added into A blue black colour developed,

A Benedict's test on the sample produced a clear blue colour

Another sample of the same food was made into a suspension with warm water.

Some millet seeds which had been soaked for 48 hours were crushed and mixed with the suspension. The mixture was incubated in a warm water bath for 6 hours

After incubation, the suspension gave a negative test with iodine and a positive test with Benedict's solution.

ii) What does the dark blue colour that develops on addition of iodine indicate?

iii) What is meant by a negative iodine test?

iv) Explain why the iodine test was negative after the incubation

v) What is a positive Benedict's test and what does it show?

vi) i) Why was it necessary to soak the millet seeds first?

ii) What is the purpose of incubating the mixture of crushed soaked millet seeds and food suspension, in warm water bath for 6 hours?

vii) Suggest two control experiments for this investigation.

Solution

a) The dark blue colour indicates the presence of starch.

b) A yellow brown colouration.

c) Because starch was hydrolyzed by amylase and maltase enzyme released by the activated seeds.

d) A positive Benedict's test gives a green solution, a yellow precipitate followed by an orange precipitate. It shows the presence of reducing sugar.

e) i) The seeds had to be soaked to initiate the germination process which mobilizes the enzymes.

ii) -To ensure that the contents of each tube attained the temperature of the water bath.

- To allow time for the enzyme to hydrolyze starch.

f)

✓A suspension of the food sample is incubated with crushed seeds which have been killed by boiling. In this hydrolysis of starch would not take place.

✓A suspension of the sample is incubated with the crushed seeds which had not been soaked.

30. a) i) Distinguish between ectotherms and endotherms. Give examples in each case.

ii) Give one advantage endortherm has over an ectotherm.

iii) Give four ways in which an ectotherm reacts to the lowering of external temperature.

b) i) State the ways in which the mammalian body loses and gains heat and water.

ii) How does the mammalian body maintain a constant temperature?

iii) Describe how water balance in the body is maintained.

iv) State the importance of water in the body.

v) Describe how blood sugar/ glucose level is regulated in man.

Solution.

. Differences between ectotherms and endotherms.

Ectotherms	Endotherms
☞ Regulates their body temperature by behavioral means	☞ Regulates their body temperature by behavioral means, structural means and physiologically
☞ Their metabolic rate is lower	☞ Metabolic rate is higher
☞ Their body temperature varies with that environment they are physiologically adapted to tolerate a wide range of body temperature	☞ Their body temperature is maintained fairly constant irrespective of that of the environment
☞ They are physiologically adapted to tolerate a wide range of body temperatures	☞ Not adapted to tolerate a wide of body temperatures
☞ Food taken is not on body temperature regulation	☞ More food is spent on body temperature regulation
☞ They are unable to produce heat within their bodies	☞ They are able to produce heat within their bodies by physiological means in order to maintain constant body

☞ Their activity is determined by environment temperature ☞ They include protozoan, invertebrates, fish, frogs and reptiles	temperature. ☞ Their activities are not determined by environment temperature ☞ They include mammals and birds.

ii) – It allows animals to live in a wide range of environments, irrespective of the prevailing temperature.

- It allows enzyme controlled reactions to proceed efficiently at optimum body temperature.

-Endothermic animals can maintain a high metabolic rate. With the resulting energy they respond to stimuli faster and move faster both of which are important for their survival.

iii) **Reaction of ectotherms to lowering of external temperature**.

☞ Going into a state of rest when it is cold until warmer condition are realized (This is called hibernation.

☞ Burrowing into cracks in walls by lizards during cold.

☞ Some lizards can change their skin colour by means of pigmented cells. This produces a dark colour which conserves heat that would be lost by radiation.

b) i) **Ways by which a mammal loses heat**

☞ Through urine and faeces.

☞ Through exhaled air by evaporation.

☞ Through the skin by radiation.

☞ Through the skin by evaporation on sweating

☞ Through the skin by convection.

Ways by which a mammal gain heat

☞ From the sun and the ground surface by radiation.

☞ Through an increase in metabolism.

☞ Through increased muscular activity.

Loss of water by mammalian body

☞ Through exhaled air by evaporation.

☞ Through the skin by sweating.

☞ Through urine and faeces.

Gain of water by mammalian body

☞ Through drinking and eating.

☞ Metabolic water produced as by product of metabolic reaction.

b ii). Changes in the body temperatures are detected by the hypothalamus of the brain.

When the body temperature drops below normal, the following takes place /occurs;

✍ Little or no sweat is produced to minimize heat loss by evaporation.

- Vasoconstriction occurs in the skin's superficial capillaries. They become smaller in diameter which restricts blood flow near the surface and so reduces heat loss by radiation through the skin to a minimum.
- The erector pill muscle contracts raising the hair almost to a vertical position. The air trapped (since it is a bad conductor of heat) insulates the body against heat loss.
- There is a general increase in the rate of metabolism which increases the heat out put and helps to maintain a constant body temperature. The increase in metabolic rate is brought about by the release of adrenaline hormone from adrenal gland and thyroxin hormone from thyroid gland under the influence of the hypothalamus.
- There is a general reduction in the volume of blood in circulation by storage in the body's reservoirs e.g. the spleen to reduce heat losses to the surface.
- There is rapid contraction of skeletal muscles (shivering) which generates more heat for temperature regulation.

When the body temperature rises above normal, the following takes place;

- Vasodilation occurs in the skins superficial blood vessels so that more blood flows through them (near the surface) hence losing its heat by radiation through the skin which cools the body.
- There is increased sweating .sweat is the production of a watery fluid containing dissolved salts from sweat glands in the skin. As it evaporates from the skin, it carries away the body heat thus leading it to cool.
- The erector pill muscle relaxes and this causes the hair to lie flat on the body. In this position they offer the **least** possible insulating layer to heat loss by radiation and convection.
- Panting takes place majorly in animals of the dog family. They open there mouth with their tongue hanging out so that evaporation in the mouth and lungs can take place fully. This cools down there body temperature to normal.
- There is a general decrease in the rate of metabolism, in order to reduce the amount of heat production in the body hence lowering its temperature and this in turn reduces appetite for food.

NOTE; Behavioral methods may not be included as the question is demanding only for body responses to temperature extremes.

b.iii). Changes in water concentrations in the body are detected by the osmo-receptors in the hypothalamus of the brain.

- When the amount of water in the blood is low, the concentrations of salts increases, leading to an increase in osmotic concentration of blood.
- The osmo-receptors in the hypothalamus of the brain detect this change and send messages to the pituitary gland to increase the production of anti-diuretic hormone (ADH).

- **The increase in A D H increases the permeability of the walls of the collecting duct thus re-absorbing much water from urine into the blood.**
- **There is also feeling of thirst and increased taking in of drinks and food.**
- **This normalizes the amount of water content in the blood.**
- **If there is a decrease in osmotic concentration of blood (dilute/has much water),the osmo-receptors detect the change and send messages to the pituitary gland to release less ADH.**
- **This decreases the permeability of the cells of the collecting ducts hence less water is re-absorbed from urine to the blood leading to production of dilute urine.**
- **There is also a reduction in taking drinks and foods which together leads to reducing the amount of water in blood to normal.**

b.iv).Importances of water in the body are;

- **It is a universal solvent in which all the absorbed foods, wastes and hormones are dissolved in the blood of the body.**
- **It is a medium for all chemical reactions in the body.**
- **It is a medium of transport of various substances like hormones, foods and wastes in the body.**
- **It participates in many metabolic processes as a raw material .e.g. cell respiration and digestion.**
- **It helps in cooling of the body in hot days since it is a constituent of sweat.**
- **It is the largest constituent of the protoplasm of body cells.**

V). Describe how blood sugar/ glucose level is regulated in man.

BLOOD SUGAR/ GLUCOSE LEVEL REGULATION

The normal Human blood glucose concentration is between 80mg and 110mg of glucose per 100cm3 of blood /(4-6Mols/l) of blood.

Changes in the blood glucose level are detected by the **hypothalamus** of the brain.

When the blood glucose level rises above normal, it is detected by the cells of the hypothalamus in the brain which stimulate the **Beta cells of the islets of langerhans** in the pancreas to secrete more **insulin** hormone which causes the following;

- Causes conversion of soluble glucose to insoluble glycogen which is stored in the liver.
- Causes conversion of the excess glucose to lipids (fats) which are stored in the storage deposits.
- More glucose is converted to proteins which are used up by the body.
- In the respiring tissues like muscles, more glucose is oxidized to energy, water and carbon dioxide.
- One feels satisfied and less or no food is taken in to reduce on the glucose level.
- To be broken down to release energy at higher rate. This energy is stored in a form of high energy compound called ATP.

All these result in lowering the blood glucose level to normal.

When the blood glucose level falls below normal, the cells of the hypothalamus in the brain detect this and stimulate secretion of more glucagon hormone by the **Alpha cells of the islets of langerhans in the pancreas**. More glucagon hormone results in the;

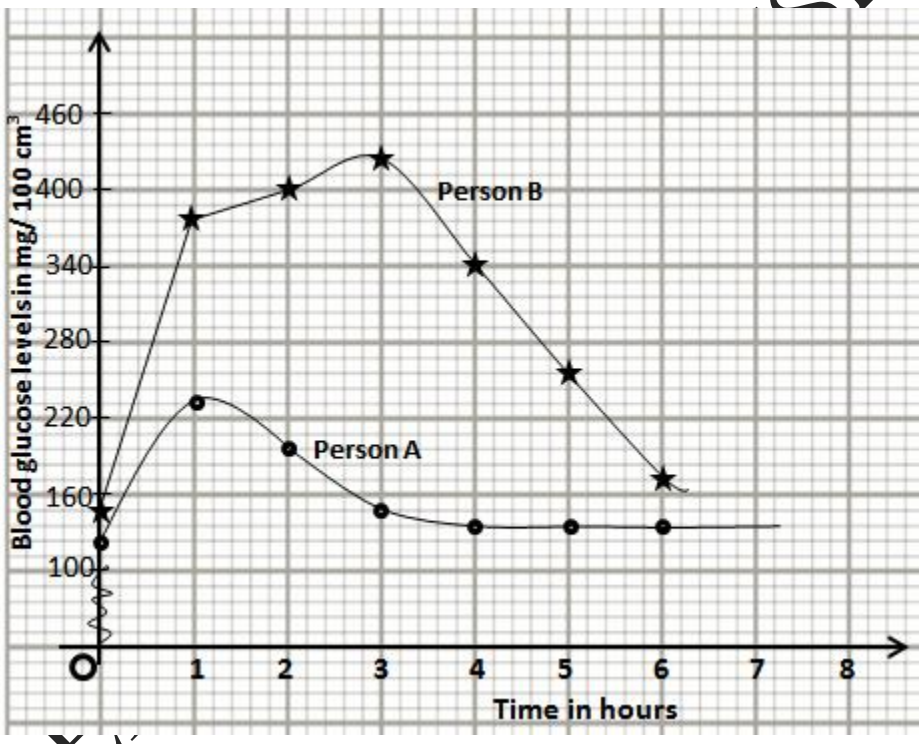
- Conversion of Glycogen to glucose.
- Conversion of more proteins and lipids to glucose.
- Less glucose being oxidized in the respiring tissues.
- There is feeling of hunger and more food is taken to raise the glucose level.

These result in the rising of the blood glucose level to normal.

NB: when the glucose level rises abnormally, it appears in urine. This condition is known as Diabetes mellitus.

- Too much insulin hormone either from an over active pancreas or an over dose from insulin injection may result in a severe reaction called the insulin shock. The brain becomes over irritated; convulsions may occur followed by unconsciousness and often death.

31. ***In an investigation, two persons A and B drank the same amount of glucose solution. Their blood sugar levels were determined immediately and thereafter at intervals of one hour for the next six hours. The results obtained are as shown on the graphs below.***



(a). Describe the trends of the graphs for;

(i). person A.

(ii). person B

(b). Give reasons for the trends of blood glucose levels in person A between

(i) 0 and 1 hour.

(ii). 1 and 4 hours

(c). suggest a reason for the high glucose levels in person B.

(d).What is the biological importance of maintaining a relatively constant sugar level in human body?

Solution

(a) (i). From 0 to 1 hour, the blood glucose level increases rapidly.

From 1 to 3 hours, the blood glucose level decreases rapidly.

From 3 to 4 hours, the blood glucose level decreases gradually

From 4 to 6 hours, the blood glucose level remains constant.

(ii). From 0 to 1 hours, the blood glucose level increases rapidly.

From 1 to 3 hours, the blood glucose level increases gradually / slowly.

From 3 to 6 hours the blood glucose level decreases rapidly.

(b) (i). The blood glucose level increases rapidly because glucose solution was absorbed by the epithelium of the ileum into the blood capillaries of the villi then into hepatic portal vein which carry glucose from the ileum to the liver and finally glucose is taken to the general blood circulatory system causing the general blood glucose level to increase.

(ii). Blood glucose level decreases because excess glucose in blood stimulates the β cells of islets of Langerhans of the pancreas to produce insulin hormone which does the following;

- Causes conversion of soluble glucose to insoluble glycogen which is stored in the liver.
- Causes conversion of the excess glucose to lipids (fats) which are stored in the storage deposits.
- More glucose is converted to proteins which are used up by the body.
- In the respiring tissues like muscles, more glucose is oxidized to energy, water and carbon dioxide.

(c). The β cells of islets of Langerhans of the pancreas in person B are defected/ malfunctioned. They produce little or no insulin hormone causing little or no conversion of excess glucose to glycogen or fats.

(d). – To maintain a constant osmotic pressure / potential of blood so preventing cells from taking in or losing more water by osmosis.

- To provide a continuous supply of glucose for respiration to release energy for normal body functioning.

32. **a)** ***Describe the mechanism involved in the ventilation of mammalian lungs.***

b) i) Describe the essential features of a respiratory surface.

ii) In what ways are the mammalian lungs adapted for their function.

iii) Describe the process of gaseous exchange in the mammalian lungs.

c) i) Distinguish between Aerobic and Anaerobic respiration.

ii) State the economic importance of anaerobic respiration to man.

iii) How does aerobic respiration differ from photosynthesis?

Solution:

(a). Mechanism involved in ventilation of mammalian lungs is brought about by changes in the thorax resulting from inspiration and expiration as illustrated below.

During inspiration	During expiration
☜ External intercostal muscles contract	☜ External intercostal muscles relax
☜ Internal intercostal muscles relax	☜ Internal intercostal muscles contract
☜ Ribs move upwards and outwards	☜ Ribs move downwards and inwards
☜ Diaphragm muscle contract	☜ Diaphragm muscle relax
☜ Diaphragm becomes flat	☜ Diaphragm assumes down shape
☜ Volume of thorax increases	☜ Volume of thorax decreases
☜ Pressure in the lungs falls below	☜ Pressure in the lungs rises above

atmospheric pressure ☜ Air rushes into the lungs via the nostrils, nasal cavity, pharynx, trachea and bronchi.	atmospheric pressure ☜ Air is expelled of the lungs via the bronchi, trachea, pharynx, nasal cavity, and nostrils.

(b). (i). **Essential features of a respiratory surface**

- ☜ It must be kept moist all the time since oxygen and carbon dioxide must dissolve in water to diffuse across cells membranes.
- ☜ It must be thin since diffusion only takes place efficiently over short distance
- ☜ It must have relatively large surface area to ensure efficient diffusion of gases
- ☜ It must be close to the active cells of the body or well supplied with blood which transports the respiratory gases to and from the active respiring cells.
- ☜ There must be a ventilation mechanism for bringing in fresh air/ medium rich in oxygen and for expelling used respiratory medium rich in carbon dioxide.

ii) **Adaptation of mammalian lungs for their function**

- ☜ The alveoli in the lungs that form the respiratory surface are very many thus offering a large surface area for exchange of respiratory gases.
- ☜ The barrier between the alveolar cavity and blood is very thin thus allows faster diffusion of respiratory gases.
- ☜ The inner surface of the alveolar linings is covered with a thin a thin layer of moisture in which oxygen dissolves enabling it to diffuse into blood.
- ☜ There is an efficient ventilation mechanism that brings in fresh air rich in oxygen and removes used air rich in carbon dioxide.
- ☜ An oxygen diffusion gradient is maintained throughout as deoxygenated blood flows into the alveolar capillaries and oxygenated blood flows away from the lungs.

(iii). In mammalian lungs, gaseous exchange takes place in the alveoli. The alveoli are the many small air sacs in the lungs and are in very close contact with blood vessels (blood capillaries).

The walls of the alveoli and the blood vessels are in close contact and both are moist aiding easy diffusion of gases to and from the alveoli.

Oxygen which is at a higher concentration in the alveolus than in the blood, dissolves in the alveolar fluid and diffuses into the blood plasma where it is picked up by the haemoglobin of red blood cells and is transported a way from lungs as oxyhaemoglobin.

Carbon dioxide which is at a higher concentration in the blood is normally carried as bicarbonate ions in the plasma.

This breaks down and releases carbon dioxide which diffuses into the alveoli and is later expelled from the body during expiration

(c). (i). Differences between aerobic and anaerobic respiration.

Aerobic respiration	Anaerobic respiration
☜ Occurs in presence of oxygen	☜ Occurs without oxygen
☜ More energy is released per glucose molecule	☜ Little/less energy is obtained/released by this method per glucose molecule
☜ There are no such products formed	☜ It results in formation of products like lactic acid in animals and alcohol in fungi
☜ It involves complete oxidation of substrate used.	☜ It involves incomplete breakdown of the substance involved.

ii) Economic importance of anaerobic respiration

- ☜ Fossil fuel and biogas formation is due to exposure of anaerobes to organic matter
- ☜ Commercial production of alcohol like beer wine and spirits is by fermentation using selected yeast cells.
- ☜ Bread production for domestic and commercial use. During fermentation of sugar by yeast, carbon dioxide produced in the dough mixtures causes the dough to rise as bubbles of gas are formed. This causes bread to be soft and easy to digest.
- ☜ Production of silage is by allowing bacteria to ferment grass to give it flavor for some animals to feed on it.
- ☜ Sewage and industrial effluent treatment is by allowing anaerobes to break down the wastes to reduce any hazard that organic wastes would create to life.
- ☜ Used in manufacture of dairy products including butter, cheese and yogurt
- ☜ Used in commercial production of oxalic, citric acid and vinegar.

Differences between anaerobic respiration and photosynthesis

Aerobic respiration	Photosynthesis
☜ Occurs in all living cells of both plants and animals	☜ Occurs in only plant cells that contain chlorophyll
☜ Take place continuously both in the presence and in the absence of light	☜ Take place only in the presence of light
☜ It involves break down of complex organic compounds	☜ It involves synthesis of complex organic molecules from simple inorganic compounds.
☜ Use oxygen	☜ Release oxygen
☜ Release energy	☜ Store energy in the chemical bounds of complex organic molecules
☜ Release carbon dioxide and water	☜ Uses carbon dioxide and water
☜ Take place in mitochondria	☜ Take place in chloroplast

33. An experiment was performed to find the effect of temperature on the rate of digestion of sucrose by an enzyme.

Nine test tubes, each containing an equal amount of enzyme solution were placed in separate water baths each maintained at a different temperature for the duration of the experiment. Nine test tubes each containing an equal amount of sucrose solution were prepared and one was placed in each water bath.

After 15 minutes the contents of each pair of tubes were mixed.

The test tubes containing the mixture were replaced in the water baths

The rate of reaction was determined by finding the mass of the products formed each minute.

Results are shown in the table below:

Temperature	*5*	*15*	*25*	*30*	*35*	*40*	*45*	*50*	*60*
Rate of reaction (mg) of products (min)	*0.5*	*1.3*	*2.4*	*3.1*	*3.7*	*4.1*	*4.1*	*2.7*	*0.0*

a) Why were the enzymes and sucrose solutions separately placed in each water bath, 15 minutes before mixing?

b) Plot the graph using the data in the table

c) At which temperature range is the enzyme most active

d) Suggest a reason for the result obtained at 60°c.

e) If the temperature of the mixture previously kept at 60°c was lowered to 35°c, what would you expect the result to be? Explain your answer.

f) i) What products are formed by the digestion of sucrose?

ii) Describe a chemical test to show the presence of these products

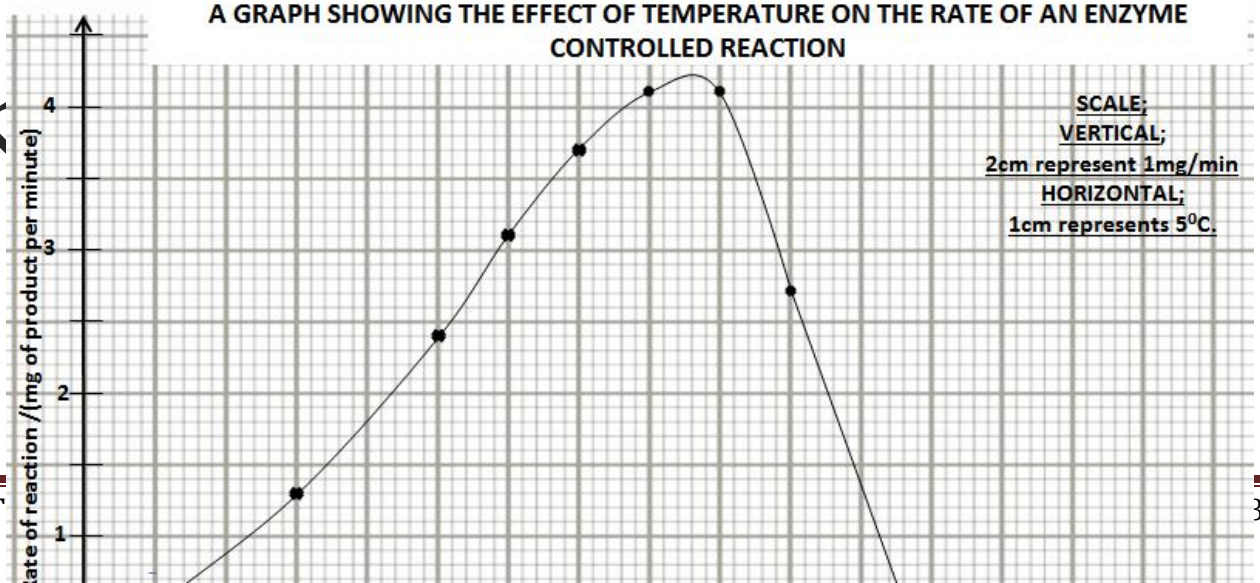
g) Which enzymes are responsible for the digestion of sucrose?

h) State other factors which affect the rate of an enzyme controlled reaction.

Solution:

a) To ensure that the contents of each tube attained the temperature of the water bath.

b)



c) 40^{0}C to 45^{0}C

d) At 60^{0}C the rate of reaction was zero meaning that no any hydrolysis took place since all the enzyme had gotten denatured by the high temperatures.

e) There would be no reaction. This is because the enzyme was denatured by the excessive heat when the mixture was kept at 60^{0}C and therefore it did not hydrolyze sucrose. Once an enzyme is denatured by excessive heat, it cannot be reactivated.

f) i) Glucose and fructose (reducing sugars)

ii) Test for reducing sugar

Reagent used is Benedict's reagent.

Procedure ; To 1cm^3 of the mixture in a test tube add of 1cm^3 of Benedict's solution and boil for one minute.

Observation

Presence of reducing sugars is indicated when the blue colour of Benedict's solution change to green, to yellow, orange and finally to brown depending on the concentration of the reducing sugars.

Absence of reducing sugars is when the mixture retains the blue colour of benedict's solution on boiling.

Enzymes used to hydrolyse sucrose

Sucrase and invertase

g) –The concentration of the substrate.

-The pH of the medium.

-Presence of inhibitors.

-Presence of activators like co-factors and co-enzymes.

34 a). What are the economic importance of fungi?

b). With aid of diagrams describe sexual reproduction in mucor.

c). What are similarity (ies) and differences between asexual and sexual reproduction in the spirogyra?

d). What is the advantage of asexual reproduction to a spirogyra?

Solution

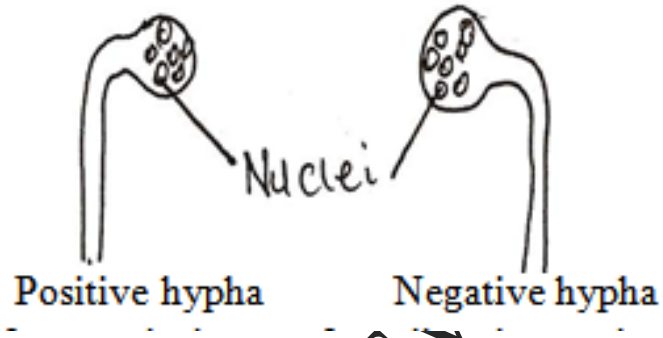
a). **Economic importance of fungi**

- ✓ Fungi decay dead organic materials to release materials needed by green plants
- ✓ Yeast respiring anaerobically, provides alcohol for brewers and wine makers.
- ✓ Yeast cells are a source for vitamin **B** extract

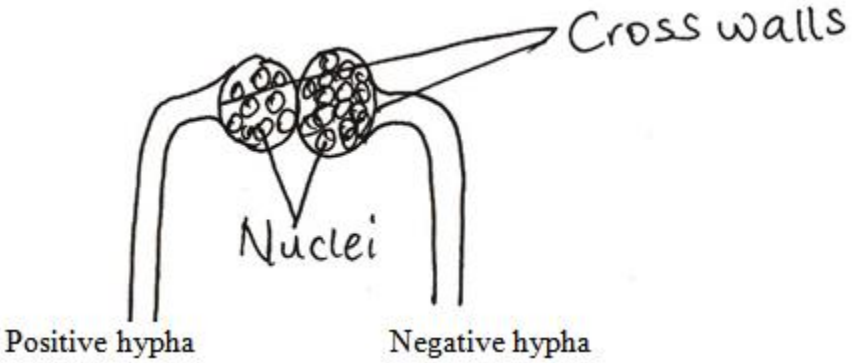
- ✓ Fungi produce antibiotics e.g. penicillum.
- ✓ Fungi provide food e.g. mushroom also used in making cheese.
- ✓ Fungi can spoil food e.g. Rhizopus and penicillum on the bread, cakes, fruits and jam.
- ✓ Fungi causes plant disease e.g. rust, white bright and smut.
- ✓ Dry rot fungus attacks the timber of houses.
- ✓ Fungi cause diseases to man e.g. ringworm, athlete's foot.
- ✓ Fungi can be used by military to prepare biological weapons to be used in the war fare.
- ✓ Fungi when fully grown they die and rot creating manure in the soil

b). **Sexual reproduction in mucor.**

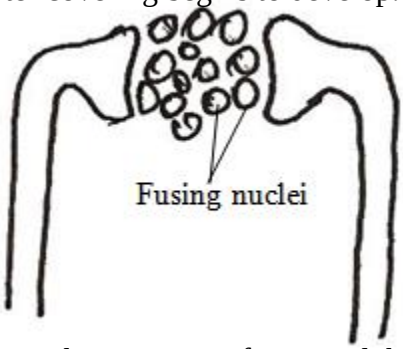
- This takes place when conditions are unfavorable.
- The tips of two hyphae of different Mycelia (positive and negative) become swollen and grow towards each other until they touch.



- Cross walls form at the bases of swollen tips so that they enclose several nuclei.

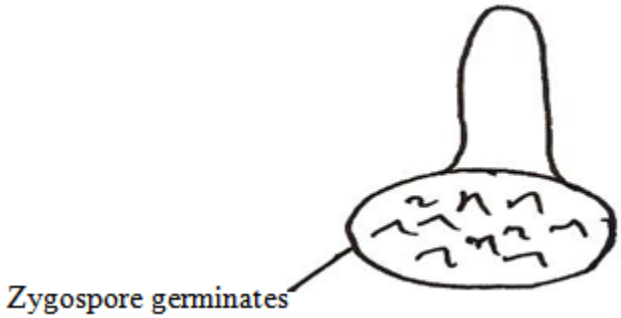


- The end walls of the hypha where they touch disappear and the positive and negative nuclei fuse in pairs and outer covering begins to develop.



- A thick and rough outer cover forms and the resulting body is called the zygospore.

- The zygospore may remain dormant for a while (when conditions are unfavourable) but when conditions become suitable, it germinates.



c). Similarities:
- Both lead to increase in number of cells.
- Both involve mitosis.

Differences:

ASEXUAL	SEXUAL
1. Reproduction is by fragmentation 2. No zygospore forms 3. Involves mitosis only 4. A piece of the filament breaks off and grows as a separate filament 5. Involves one filament 6. Occurs during favorable conditions 7. Results in a greater number of off springs 8. There is no variation in off springs	- Reproduction is by conjugation - Zygospore forms - Involves mitosis and meiosis - Each of the two adjacent cells produces an out growth - Involves two filaments - Occurs under un favorable conditions - Results in fewer number of off springs - There is variation in off spring.

d).
- The original characteristics of a plant are maintained.
- The plant can reproduce faster and so increases faster in number.

35. (a). Explain why insects are very successful animals on land.

(b). Describe the life cycle of anopheles mosquito.

(c). How is the anopheles mosquito adapted for transmission of malaria?

Solution

(a). Insects have a water proof waxy cuticle (exoskeleton) which reduces water loss.
- They have jointed flexible legs for swift (fast) movement away from predators.
- They have a variety of colours for camouflage from predators.
- They lay numerous viable eggs which results into a high reproductive rate ensuring their survival.
- They are generally small in size which allows them to occupy all places even small places.
- Insects have highly modified mouth parts for feeding on a variety of food materials.
- They have wings for swift flight to escape a way from predators and disperse to new areas.

- They excrete less toxic waste products like uric acid which requires less water to remove. This helps them to conserve water.
- They have an efficient tracheal respiratory system which supplies oxygen directly to the active muscles.
- They have large compound eyes that provide a wide field of view for food and enemies.

(b). Life cycle of anopheles mosquito.

- The male and female anopheles mosquitoes mate and fertilization of eggs is internal.
- After mating, the female mosquito lays about 200 to 300 fertilised eggs.
- The eggs are laid singly floating on damp soil or on vegetation that are flooded by water.
- The eggs are boat shaped and have air in them to enable them float.
- In 2 to 3 days, eggs hatch into small wriggling larvae.
- The larvae remain floating lying parallel to the water surface.
- The larval head has mandibles and two brush-like structures for feeding.
- The larvae takes in oxygen from atmosphere through spiracles and it uses hairs on the last segment as gills to obtain oxygen from the water.
- In 14 to 22 days, the larva molts about 4 times and it changes to a comma shaped pupa which has a narrow curved abdomen used for swimming.
- The pupal head bears a pair of respiratory tubes lined with hairs to prevent water from entering.
- The pupa does not feed but it is actively making tumbling motions to avoid predators.
- After 2 days, the cuticle between the two respiratory tubes split open and the adult mosquito emerges out.

(c). Adaptations of the female anopheles mosquito for transmission of malaria.

- They have mandibles and maxillae which form sharp stylets which cut through the skin of a mammal.
- They have proboscis (labrum) for sucking blood from mammals.
- Have hypopharynx which releases anticoagulants into the wound to prevent blood from clotting.
- The labium is bent back to support stylets during piercing through the skin.
- They have large compound eyes for a clear sight.
- They have palps and antennae which are sensitive to carbon dioxide in animal's breath for easy identification of the mammal.
- They are secondary hosts for plasmodium which causes malaria.
- Mosquitoes have very long and thin legs for swift/ fast movement.
- They have wings which allow them to move faster by flight to visit different places and hosts.