SET II RESOURCEFUL GUIDE.

N.B <u>QUESTION ONE IS COMPULSORY TO ALL CANDIDATES</u>.

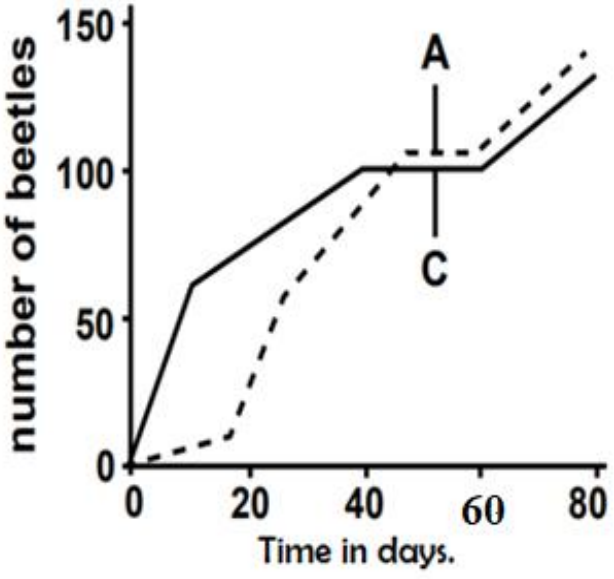
1. In an experiment to study the **interaction of two species of Beetles A and C. Species A was reared with much smaller beetles, Species C,** in **containers of flour in which a number of short lengths of glass tubing had been buried**.

Graph 1: Shows the results using **glass tubing narrower in diameter than the body size of species A** but **wider than that of species C**.

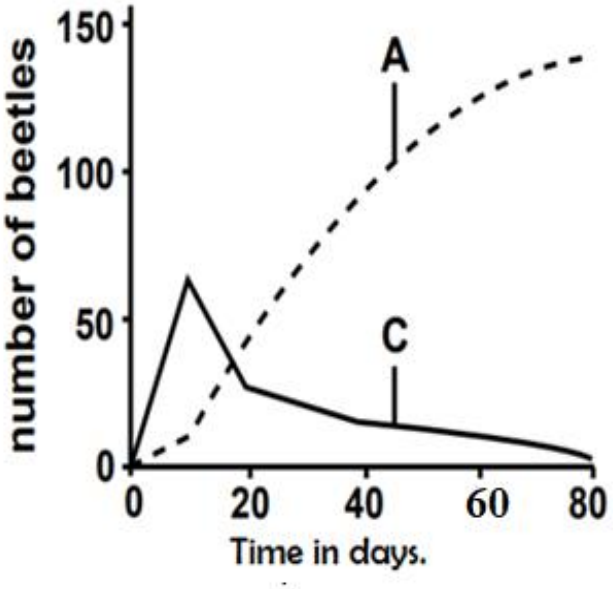
Graph 2: Shows the results **using glass tubing wider than the body sizes of both species A and C.**

Study the graphs and **provide suitable responses**.

Graph 1: (Narrow glass tubes)



Graph 2: (Wide glass tubes)



(a) **Compare** the **number of beetles** during **the time of the** experiment for **species A and C** in:

(i) Graph 1. **(07 marks)**

Similarities.
(In Both) the Number of Beetles: **Rise/increase; At day 0/initially are Zero; attain maximum value; attain a constant; at day 41 are equal/same/equivalent;** **(02)**

Differences. **(05)**	
Species C	**Species A**
Before 41 days, number of beetles were higher	**Number of beetles were lower;**
Above 41 days, number of beetles were lower;	**Number of beetles were higher;**
Number of beetles attain constant earlier	**Number of beetles attain constant later;**
From day 0 to day 10, number of beetles increases rapidly	**Number of beetles increased gradually;**
From day 18 to day 25, number of beetles increased gradually	**Number of beetles increased rapidly;**

(ii) Graph 2. **(07 marks)**

(In Both) Number of beetles:
Attain maximum; equal/same/equivalent at day 18; increase/rise; initially are zero; **(04)**

Species A	**species C**
From day 0 to day 10, number of beetles increased gradually	**Number of beetles increased rapidly;**
From day 10 to day 19, number of beetles increased rapidly	**Number of beetles decreased rapidly;**
From day 19 to day 80, number of beetles increased rapidly	**Number of beetles decreased gradually;** **(03)**

Accept statements with while or whereas used.

(b) **Explain** the **differences in the number of the Beetle species** in:

(i) Graph 1. **(07 marks)**

Before 41 days, the population of species C was higher than A because species C is smaller in size than A hence requires little/Fewer nutrients and small breeding space/sites; resulting into a reproductive advantage/edge over A/higher productive rates/potential/growth rate; Species C being smaller than A, enters the narrow glass tubings which prevents/reduces stiff interspecific competition with species A; hence giving it an advantage to compete with species A;

Above 41 days, population of Species A was higher than C because the narrow glass tubings resources were fewer/limited; and got depleted easily; which increased intra-specific competitions among species C; and began to die;

Some members left the tubings back into container were they faced stiff interspecific-competition with species A; Species A is larger in size hence an advantage of obtaining more food than C; hence reproductive advantage;

Species C attains constant earlier than Species A because higher reproductive potential causes attainment of the carrying Capacity; due to increased intraspecific competition and accumulation of toxic-wastes; ;

From day 0 to day 10, number of beetles of species C increased rapidly while that of A increased gradually because species C adapts easily to the environment; **(14 halves)**

(ii) Graph 2. **(07 marks)**

From day 0 to day 10, number of beetles of Species C increased rapidly while that of A increased gradually because species C being smaller in size, adapts rapidly to environment; reproduces faster than A; hence a better competitor;

Above day 10, Population of beetles of species C decreased to minimum while that of A increased to maximum because both species can access the tubing's; leading to very stiff interspecific competition; Species A is large in size hence more effective in obtaining nutrients than C; whose members starve and die to almost extinction or fail to reproduce/reduced reproductive potential; **(07)**

AVP- Species A feeds/eats Species C.

(c) **Suggest** what is shown by the **interaction of Species A and C in wide glass tubing.** **(03 marks)**

Gauase's competitive exclusion principle or Competitive exclusion Principle; different species with Identical/same/similar ecological niche; compete for the same limited resource; cannot co-exist; weaker one is out competed to extinction; one with competitive advantage increases in number; **(6-halves)**

(d) From interaction of species in **Graph 1** and **Graph 2,** explain the **effect of interspecific competition.** **(05 marks)**

Harmful to both species; do not maximally utilize resources; some members die/extinction; and some migrate away; spacing individuals in areas they can obtain resources; allows niche Differentiation/specialization preventing niche overlap; **(05)**

(e) Suggest what **would happen** if the

(i) Experiment in Graph 2 continued for some time.

(02 marks)

Population of Species A will continue to rise/increase; while that of Species C will continue to fall; population of both Species A and C decreases to extinction; due to resources becoming scarce and wastes accumulating; (04 halves)

(ii) Species C grown alone.

(02 marks)

Population of Species C increases rapidly; to maximum/carrying capacity; stabilizes/remains constant; decreases due to food scarcity; (04 halves)

SECTION B (60 MARKS)

Answer Three Questions from this Section.

2**(a)** Explain the:

(i) Term Heterozygote Superiority. **(05 marks)**

Condition in which heterozygote is more fitter than either of the homozygotes; eg sickle cell anaemia in areas with high Malaria prevalence /Malaria infested/Malaria endemism; homozygous (abnormal) recessive have severe sickle cell symptoms and die early; heterozygotes are protected from malaria with mild sickle cell symptoms; homozygous (normal) dominant are prone to malaria with no sickle cell symptoms;

(05)

(ii) Relationship between Speciation and Gene Migration.

(07 marks)

Gene migration leads to exchange of alleles of genes between populations of a single species; loss of alleles of genes by one population and gain by another; changes the gene pool of both; Continuous/sustained interbreeding cause populations to share

common/similar/Identical gene pool; if gene migration is interrupted/disrupted/isolation occurs ,gene pools differ/diverge; Natural selection influences populations to adapt differently to different environmental conditions; mutations and genetic drift cause further divergence of gene pools;

(07)

(b) **In Guavas**, flower colour is determined **by a gene that has two alleles**, one producing **yellow flowers** and the other **white flowers**. Another gene determines the **colour of fruit**. Gene has two alleles, one producing **red fruit** and other producing **yellow fruits**. A Guava plant with **yellow flowers** and **red fruit** is **crossed** with a **Guava plant with white flowers** and **yellow fruits**. All F1 offspring had **yellow flowers** and **red fruits**. A plant from F1 was **self-pollinated**.

(i) If the two genes **are linked or unlinked**. Predict the ratios **for F2 generations**. **(02 marks)**

Linked genes

3 yellow flowers and red fruit: 1 white flowers and yellow fruit;

(01)

Unlinked genes

9 yellow flowers and red fruit: 3 yellow flowers and yellow fruit: 3 white flowers and red fruit: 1 white flowers and yellow fruit;

(01)

(ii) When **a plant** in **F1 generation** was **self-pollinated**, the **actual results** were.

Yellow flowers and red fruit	**68**
Yellow flowers and yellow fruit	**07**
White flowers and red fruit	**07**
White flowers and yellow fruit	**18**

Using your **knowledge of genetics**, suggest what might have happened that would explain the **appearance** of the **unexpected varieties**.

(06 marks)

F2 ratio obtained is 10:1:1:3; different from Mendel dihybrid ratio, 9:3:3:1; genes were incompletely/partially linked; no independent

assortment; genes are passed to same gametes; recombinants were due to crossing over; **(06)**

3(a) Explain the advantages of **carrying haemoglobin inside red blood** cells than in **the plasma solution.** **(08 marks)**

Much greater volume of Haemoglobin carried in cell than plasma;
Haemoglobin is kept under favourable chemical environment; to allow faster loading and unloading of oxygen;
Haemoglobin of particular age kept together; and can easily be replaced when worn out/old;
Small molecular mass; prevents loss due to ultrafiltration in kidney nephron;
Prevents lowering blood solute potential; which could interfere with normal blood circulation;
Prevents increase in blood viscosity; which would interfere with fast delivery of nutrients and oxygen or Constrains the heart;
(08)

(b) (i) Describe the process of **unloading haemoglobin with Oxygen** at the **Mitochondrion of a metabolically active tissue.**
(12 marks)

Co2 produced in mitochondrion diffuse out of the cell into red blood cells/erythrocyte;
Combines with H2O to form weak carbonic acid; (H_2CO_3) catalyzed by carbonic anhydrase enzyme/Carbonate dehydratases;
Weak carbonic acid dissociates into protons (H^+) and Bicarbonate ions/hydrogen carbonate ions (HCO_3^-);
Hydrogen ions combine with Oxyhaemoglobin; destabilize the Oxyhaemoglobin; causing each molecule to release its four oxygen molecules; which diffuse into the mitochondrion;
H.Hb (Haemoglobinic acid) formed; Hydrogen carbonate ions diffuse out of the red blood cell into plasma; creating a net positive charge on the red blood cell;

Chloride ions diffuse into red blood cell/chloride shift occurs maintaining the electro-chemical neutrality of RBCs;

Accept annotated Scheme. (12)

4(a)(i) Describe how the **electrons from water** are used to form Reduced **Nicotinamide Adenine Dinucleotide Phosphate (NADPH2).** **(10 marks)**

Non-cyclic photophosphorylation; (Z-scheme)

Light shines/strikes on PSII and PSI; passed to reaction centre chlorophyll or chlorophyll-a; excited electrons from P680 and P700; reduce primary electron acceptors; ie Plastoquinone and Ferrodoxine respectively.

P680 and P700 are positively charged/oxidized/unstable;

P680 is neutralized by electrons from water; and P700 neutralized by electrons moving downhill from Plastoquinone via chain of electron carriers; and the energy released is coupled into ATP formation;

Electrons from Ferrodoxine combine with oxidized NADP and hydrogen ions forming reduced NADP catalyzed by $NADP^{+}$-reductase enzyme;

Accept annotated Z and Cyclic-Schemes.

(ii) Explain why **Bundle sheath cells** have **Poorly** developed **grana.** **(05 marks)**

No light-dependent reactions occur in these cells; because Ribulose-1,5-bishosphate carboxylase/oxygenase; unselectively catalyses fixation of both oxygen and carbondioxide; due to absence of light reaction, oxygen is not evolved; resulting into efficient fixation of carbondioxide; **(05)**

(b) Explain the role of **chemo-autotrophic bacteria in the Nitrogen cycle.** **(05 marks)**

Nitrification; converting ammonia to nitrates through oxidation reactions; Ammonia or ammonium compounds oxidized to nitrites; by Nitrosomonas; Oxidation of Nitrites to nitrates; by nitrobacter/nitrococcus;

5(a) Explain the **interaction** between the **products of digestion** and the **activities** of the **liver and pancreas.** **(10 marks)**

Excess blood glucose above the norm/normal level/set point; is detected by pancreas/Beta cells of Islets of Langerhans; which secretes Insulin hormone; hepatocytes are stimulated to convert excess glucose to Glycogen and lipids;

At low levels of glucose/ below the norm, alpha cells of Islets of Langerhans secrete glucagon; which stimulates hepatocytes to convert fatty acids, glycerol and amino-acids to Glucose (Gluconeogenesis);

Fatty acids are used by the Liver to synthesize Phospholipids and Cholesterol;

Excess amino acids are deaminated in the liver forming Keto-acid and ammonia; transamination forming new amino-acids and keto acids; protein synthesis; synthesis of plasma proteins;
(10)

(b) Relate the methods of **nitrogenous waste excretion to the energy requirements and** control of the **water potential** in variety of animals. **(10 marks)**

Desert animals excrete non-toxic Uric acid dry crystals; have little access to water hence need for conservation; high energy demand during its production;

Aquatic organisms excrete very toxic ammonia; which requires much water for dilution; low energy for formation;

Marine invertebrates Conserve water because body fluids are isotonic to the surrounding and ammonia diffuses out; OR Fresh water animals steadily pump out water containing ammonia to maintain water potential constant due to low solute potential of body fluids compared to surroundings;
Terrestrial mammals excrete moderately toxic Urea; which requires medium amount of water for dilution; high amount of energy during its production;

(10)

6(a) Outline the **Major skeletal tissues** and **relate** their **distributions to Function** in organisms. **(12 marks)**

Major skeletal tissue.	**Distribution**	**Function**
Compact bones;	**Diaphyses/shaft of long bones eg Femur;**	**Weight bearing support;** **Resistance to Comprehensive forces;** **Protection of internal organs from damage;** **(03)**
Award half to major skeletal tissue identification and distribution **Two halves awarded to 2 functions and each tissue must =03 marks.**		
Cancellous/spongy bones/trabecular bone;	**End of compact bones/Epiphyses of long bones eg Femur;**	**Provide light weight support;** **Allow flexibity and shock absorption;** **Red bone marrows produce red blood cells;** **(03)**
Cartilage;	**joints, ends of bones, rib cage, ear, nose, trachea;**	**Smooth movement and articulation;** **Shock absorption ;** **Support and cushioning;** **(03)**
Ligaments;	**Points of articulation of bones;**	**Stability and support for joints;**

		limiting movements; Absorption of shock and distributing forces; (03)
Tendons;	Where muscles connect to bones;	Enable locomotion and movement; Storing elastic energy for efficient movement; Transmitting forces from muscles to bones; (03)

(b) Explain the role of the **properties** of the **skeletal Muscles in Man.** **(08 marks)**

Property	Roles
Contractibility;	Muscles generate force and move joints; Contact and relax to allow movement;
Extensibility;	Allow muscles to accommodate changes in joint angle and length;
Elasticity;	Allow recover from deformation and maintain their function;
Tonicity;	Enables muscles to maintain posture, support and regulate movement;
Voluntarity;	Allows muscle to perform voluntary movements, such as walking, talking and writing;
conductivity;	Allows muscles to work together for coordinated movements;

Any four well explained.

CC- Comprehensive Biology Transformation Initiative.

Transforming Biology Pedagogy.

Contributions made by MUGWE MARTIN.