

**NJOMBE REGION FORM SIX PRE-NECTA EXAMINATIONS
BIOLOGY 2 MARKING GUIDE**

1. a) i) PLASMODIUM.....01 MARKS
Kingdom – Protocista.....01 MARK
Phylum- Apicomplexa.....0.1 MARK

- ii) A- Mature liver Schizont
B-Erythrocyte schizont
C- Ruptured erythrocytes/ Re-inversion of erythrocytes
D-Gametocyte
E-Zygote
F-Mosquito gut/stomach wall
G-Oocyte
H-Sporozoites@ 0.5 MARK= 04 MARKS

iii) Adaptations of plasmodium to its mode of life

- Presence of a well developed chemotactic responses which enable them find their way to the liver cells, then to the human red blood cells, gut epithelium, and eventually, to the salivary glands of mosquitoes.
- They have enzymes which enable them to penetrate through the host cells such as liver and red blood cells of human as well as crop and salivary glands of mosquitoes.
- *Plasmodium* has an extremely simple structure, which enhances its sheltered life within the bodies of the two hosts.
- The ability to adjust their osmotic pressure in relation to the mammalian blood, mosquito's crop, haemocoel and salivary glands assures their existence in the mentioned parts.
- They have gametocytes which can resist mosquito's digestive enzymes.
- They have adapted to high reproductive rate by schizogony in liver cells, repeated schizogony in red blood cells, and sporogony in the mosquito salivary glands, to ensure their survival.Any 5, @ 01 marks = 05 Marks

- b) i) The phylum is Platyhelminthes.....01 mark

Classes of Phylum Platyhelminthes:

- **Class Cestoda:** consists of animals such as the tapeworms *Taenia solium*
- **Class Trematoda:** comprises of *Fasciola hepatica* (Liver fluke)
- **Class Turbellaria:** consists of the free living worms such as Planaria.

(class 0.5 a mark, example 0.5 a mark, =03 marks)

ii) Reptiles possess the following unique features, which differentiate them from other chordates:

- a) They have dry scaly skin with horny scales.
- b) They have two pairs of pentadactyl limbs, except some members, such as snakes, which have no limbs.
- c) They undergo internal fertilization and their fertilized yolky eggs are laid on land or retained until hatching.
- d) They lay amniotic eggs that have a leathery shell to prevent rapid water loss.
- e) Their eyes are located at the front of the head to facilitate binocular vision. Some reptiles can move each eye independently, and this helps them to find food and escape from predators.....any 4, @ 01 Mark =04 marks

2. a) Defining:

i) Microevolution

Microevolution is simply referred to a change in gene frequency within a population over just a short period of time. Evolution at this scale can be observed over short periods of time, such a change might come about because natural selection favored the gene, because the population received new immigrants carrying the gene, because some nonresistant genes mutated to the resistant version etc.....**02 MARKS**

ii) Genetic drift

Genetic drift is the change in the relative frequency in which a gene variant ([allele](#)) occurs in a population due to [random sampling](#). That is, the alleles in the offspring in the population are a random sample of those in the parents.....**02 MARKS**

iii) Disruptive natural selection

Disruptive/Diversifying selection is a form of natural selection in which the extreme values of the trait are favoured over the intermediate/median values, therefore selection pressures act against individuals in the middle of the trait distribution. It is a type of natural selection which occurs when selective pressures are working in favour of the two extremes and against the intermediate trait.**02 MARKS**

iv) Adaptive radiation

This is a phenomenon in which a group of organisms sharing a homologous structure which is specialized to perform a variety of different functions so that the organism may be adapted to different modes of life in different habitats.

In [evolutionary biology](#), **adaptive radiation** is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new [environmental niches](#).**02 MARKS**

b)

② Lamarck's Theory of evolution can be divided into three ideas (subtheory) which are: Theory of need, Law of use and disuse and inheritance of acquired characters.

Theory of need. According to Lamarck an environment creates a need which requires the organisms to adapt with respect to the change in environment. If the organism fails to adapt it will be perished out and those who show better adaptation will survive and reproduce. For example the environment may create a need which is lack of food on land therefore the organisms must adapt for life in water those which will fail to adapt will die and the better adapted will survive and reproduce.

Another theory is the theory of use and disuse. According to Lamarck the body organ which is continuously used will be strong while the one that is not continuously used will be weaker and at last it will disappear. This may be seen to the long-necked giraffes where after continuously stretching of their necks and forelimbs searching for food on higher plants led them to develop a long neck.

Last theory as stated by Lamarck is Inheritance of acquired characters in which the characters obtained by an organism in the course of time are transmitted from

one generation to another. This can be illustrated by the presence of long-necked giraffes which indicates that the acquired characters are inherited from the ancestors to the current giraffes.

(b) Almost all modern biologists reject Lamarck's theory of evolution due to the following reasons:

Lamarck's theory did not distinguish between inheritable and non-inheritable characters. Lamarck's theory did not explain about what is inheritable or what are non-inheritable characters that can or can not be transferred from one generation to another.

Also Lamarck's theory did not explain about role of genetic in variation i.e. recombination and mutation.

Also the use or disuse of an organ of the body does not explain about its existence or disappearance. This also disqualify the Lamarck theory of use or disuse of body organs.

After the experiment done on mice after cutting their tails and the next generation had long tails. It was revealed that acquired characters can not be inherited from generation to generation since they do not affect the genotype.

3. a) The ways/mechanisms through which biotic components determine survival and distribution.

Definition:

Biotic components are the living things that have a direct or indirect influence on other organisms in an environment. For example plants, animals, and microorganisms and their waste materials

Biotic factors refer to the living components that influence population size in an ecosystem.....**0.5 A MARK**

- **Competition for environmental resources**

This can lead to changes in the ecosystem's structure and can have ripple effects on other species in the ecosystem. The outcome of competition can vary depending on the species involved, the amount and type of resources available, and the environmental conditions. Some species may be able to coexist, while others may be driven to extinction.....**02 MARKS**

- **Predation**

Predation is a biological interaction where one organism, the predator, consumes another organism, the prey. In this relationship, the prey is a limited resource for the predator. The predator-prey relationship displays a fluctuating pattern

A reduction in predators can lead to an increase in prey. High numbers of prey can lead to overgrazing, which can reduce biodiversity.....**02 MARKS**

- **Disease**

Pathogens, such as bacteria and parasites, can cause infections that reduce the health and fitness of organisms, negatively affecting their rate of reproduction and survival. This can lead to a decrease in the population size of species that are susceptible to disease. Pathogens can spread between individuals through various means, including direct contact, exposure to contaminated surfaces, or through vectors like insects or other animals. The effect of disease on populations can be significant, as it can result in reproductive failure, increased mortality, and decreased genetic diversity. In some cases, diseases can even cause local extinctions of vulnerable species.

.....**02 MARKS**

- **Food availability**

if there is a limited amount of food available, individuals within a species will compete for access to that food. In this type of competition, the organisms that are best suited to obtain the food will outcompete the others.**02 MARKS**

- **Waste accumulation**

When population numbers are high, organisms tend to produce more waste as a byproduct of their daily activities. In some cases, the accumulation of waste can lead to environmental disasters, such as oil spills, which can have significant negative impacts on wildlife populations and their habitats.**02 MARKS**

- **Grazing** - too little leads to dominant plants outcompeting other species, too much reduces species numbers overall. Both decrease biodiversity **02 MARKS**

b)

(b) Species density: This refers to the total number of organisms of a particular species per unit area of the habitat where they are found. --- **01 Mark**

By using quadrat, the species are identified (the intended species is identified), then the quadrat is thrown/placed either randomly or systematically and the number of organism of the named/intended species is counted in each throw. **02½**

The total number of species is then obtained by normalizing the total area covered by quadrat throws and the total number of organisms encountered, with equivalence to the total intended area. --- **01½**

Species frequency: This is the measure of probability or chance of finding a given species within a single throw of quadrat in a given area. --- **01 Mark**

- It is generally done by recording the presence or absence of a certain species in each random throw of a quadrat in a given area. **02½**

- The number of a given species may be counted in each throw, then a mean can be computed and made equivalent to the total area. --- **01½**

Species cover: This is the measure of the proportion of the ground occupied by a particular species and gives an estimation of the area covered by a species as a percentage of the total area. --- **01**

- Using quadrat, the area of a single quadrat covered by a particular species is estimated in each quadrat throw or placement, then the total area covered by the species will be computed from the total area obtained in all quadrat throws/placement in equivalence to the total study area. --- **01½** **02½**

4. a)

i. Epistasis

This is a situation where the phenotypic expression of one gene is masked by the presence of another gene. When two different genes contribute to a single phenotype and their effects are not merely additive.02 MARKS

ii. Aneuploidy

This is a condition in which half of the daughter cells produced have an extra chromosome, for example, $n + 1$ or $2n + 1$ and the other half have a chromosome missing, $n - 1$ or $2n - 1$. Aneuploidy can arise from the failure of a pair or pairs of homologous chromosomes to separate during anaphase I of meiosis.02 MARKS

iii. Turner's syndrome

This genetic disorder is due to a missing X chromosome in females. The genotype is, therefore, XO instead of the normal XX and the number of chromosomes is 45 ($2n-1$) instead of 46 ($2n$). Turner's syndrome can arise as a result of non-disjunction during meiosis.02 MARKS

iv. Klinefelter's syndrome

This is a non-disjunction of the sex chromosomes, which may occur in meiosis during spermatogenesis in male parents or oogenesis in female parents. This genetic disorder is due to an extra X chromosome and the genotype is XXY instead of normal XY. The number of chromosomes is, therefore, 47 ($2n+1$) instead of 46 ($2n$).02 MARKS

v. Down's syndrome

Down's syndrome or mongolism is a genetic disorder that occurs when chromosome 21 fails to segregate during cell division, thus the gamete produced possesses 24 chromosomes. The fusion of this gamete with a normal one having 23 chromosomes, results in the offspring having 47 ($2n+1$) chromosomes.

.....02 MARKS

b)

Let:

I represent the gene for blood group

A represent the allele A

B represent the allele B

o represent the allele O (recessive)

} (equally dominant)

Parental phenotypes

blood group A

×

blood group B

Parental genotypes ($2n$)

$I^A I^o$

×

$I^B I^o$

Meiosis

Gametes (n)

I^A

I^o

×

I^B

I^o

Random fertilisation

Offspring genotypes ($2n$)

$I^A I^B$

$I^A I^o$

$I^o I^B$

$I^o I^o$

Offspring phenotypes

blood groups AB

A

B

O

(b) There is a probability of $\frac{1}{4}$ (25%) that each child will have blood group A. So the probability that both will have blood group A is $\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$ (6.25%).

Part (i)= 06 marks,

part (ii) 04 marks,

total=10 MARKS

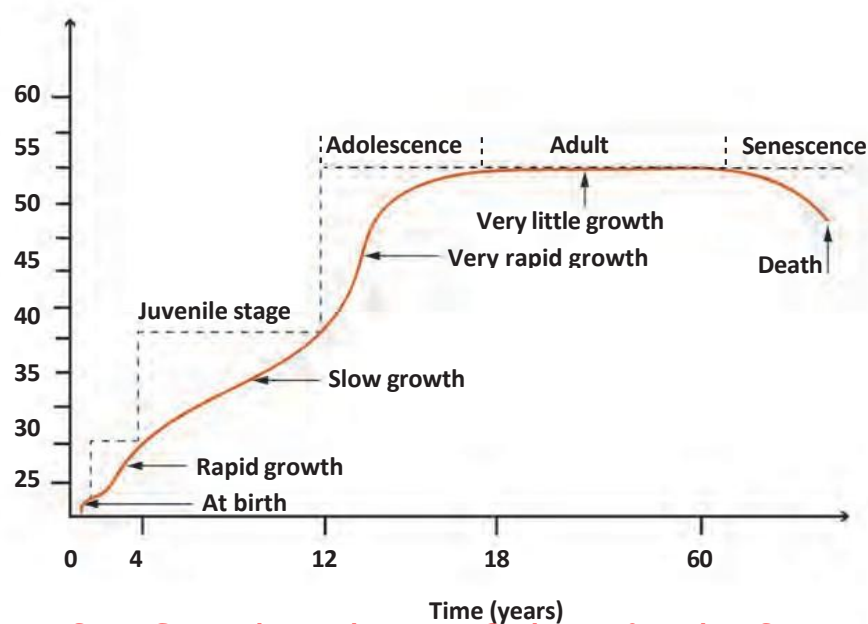
5. a)Explanations

- i. This is simply because Interphase is a period of intensive synthesis of cell organelles and the growth of the cell. DNA replication and proteins synthesis also occur in this phase. Almost 90% of the cell's time in the cycle is spent in this phase.....**01.5 MARKS**
- ii. During mitosis, DNA of parent nucleus replicates, which then divides into two new nuclei each containing an exact copy of the DNA as in the parent nucleus. The number of chromosomes is maintained, similar in both parental and daughter cells.**01.5 M**
- iii. During the infant stage when acquired immunity is still weak and the risk of disease is high, the thymus gland grow rapidly to produce white blood cells, which help to fight infections. At adult age, the mass of thymus gland lessens to half.**01.5 MARKS**
- iv. In perennial plants such as woody plants whose growth curve consists of a cumulative series of sigmoid curves. Each sigmoid curve represents an annual growth. In these plants, growth occurs with respect to seasonal changes. For example, during the wet season, there is a high rate of growth but during the dry season, there is low growth rate.**01.5 MARKS**

b) Phases of human growth:

The human growth curve is characterized by five phases .These phases in ascending order are infant, juvenile, adolescence, adult and senescence.

- **Infant** is the first phase just after birth, which is characterized by rapid growth because of rapid cell division.**02 MARKS**
- **Juvenile** is the second phase, characterized by a relatively slow growth. Juvenile stage spans from age 7 to onset of puberty and adolescence at approximately 10 years for healthy girls and 12 years for boys. A relative slow growth of juveniles is from the fact that, most of the digested foods are spent for the development of reproductive system and its structures.**02 MARKS**
- **Adolescence:** This is marked by the development of secondary sexual characteristics as a sign of sexual maturity. It is also accompanied by the period of very rapid growth. It is characterised by growth spurts because of increased fat composition and distribution, increased size of organs, bones and muscles.**02 MARKS**
- **Adult.** At this stage, growth ceases gradually but development continues.
- **Senescence** is the last phase, characterized by negative growth because catabolism outweighs anabolism. The body gradually losses strength and loss of memory may also occur.**02 MARKS**



A WELL SKETCHED AND LABELED GRAPH = 04 MARKS

6. a) Core functions of the Kidneys:

- **Excretion**

Kidneys filter out toxins, excess salts, and nitrogenous wastes created by cell metabolisms. Urea is synthesised in the liver and transported through the blood to the kidneys for removal in urine.

- **Water balance**

As kidneys are key in the chemical breakdown of urine, they react to changes in the body's water level every minute. As water intake decreases, the kidneys adjust accordingly and leave water in the body instead of helping to excrete it.

- **Blood pressure regulation**

The kidneys need constant pressure to filter the blood. When it drops too low, the kidneys increase the pressure. One way is by producing a blood vessel constricting protein, angiotensin, which also signals the body to retain sodium and water. Both constriction and retention help restore normal blood pressure

- **Red blood cell regulation**

When the kidneys do not get enough oxygen, they send out a distress call in the form of erythropoietin; a hormone that stimulates the bone marrow to produce more red blood cells. This process is called erythropoiesis.

- **Regulation of pH of the blood**

Kidneys excrete hydrogen ions into urine. At the same time, they conserve bicarbonate ions which are an important buffer of hydrogen ions

- **Regulation of the ionic composition of blood**

Kidneys regulate the quantities of ions in the blood. Important examples of ions whose quantities are regulated by the kidneys include sodium, potassium, calcium, chloride and phosphate ions.

- **Synthesis of vitamin D**

Kidneys are involved in the synthesis of calciferol, which is an active form of vitamin D.

.....Any six (06), @ 02 marks = 12 marks

b) Adaptive features of the proximal convoluted tubule.

- Its cells have numerous microvilli and basal channels which increase the surface area for the absorption process
- They have numerous mitochondria to supply energy which is constantly needed for active uptake of substances from the filtrate.
- Their basement membranes are very close to the endothelial lining of blood capillaries to ensure fast uptake and efficient transportation of the reabsorbed substances back into the body
- Channel proteins are present for transportation of substances like amino acids and ions from the cells of the proximal convoluted tubule, to the spaces between these cells and the basal channels.
- At the base of the microvilli, small proteins from the renal fluid are removed by the process of pinocytosis. The proteins are then enclosed in pinocytic vesicles and are finally broken down by hydrolytic enzymes from the lysosomes.

.....Any four (04), @ 02 marks = 08 marks