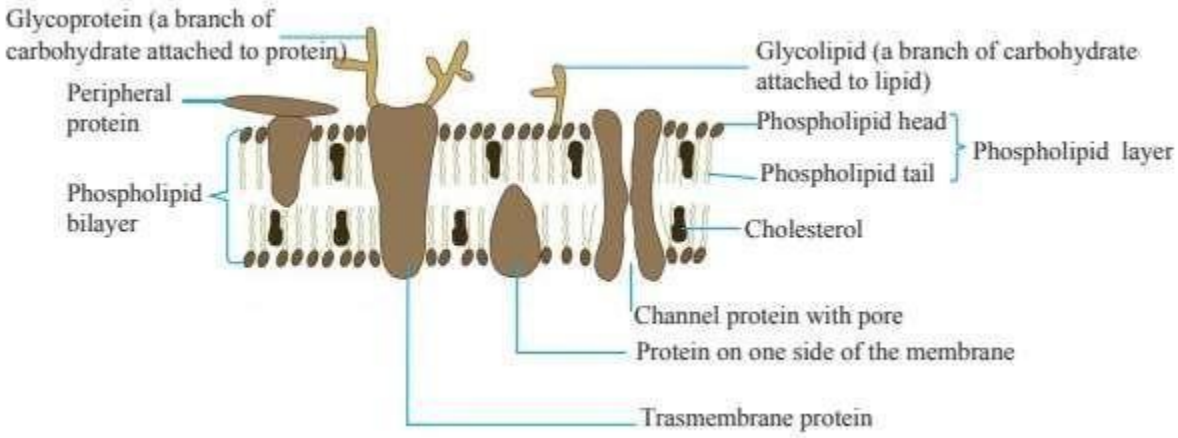
133/1 **F6 MARKING GUIDE BIOLOGY 1**

1. (a) It is true that cell differentiation is known as division of labor. Because.
   - Cell differentiation is referred to as the division of labor because it allows specialized cells to perform specific functions efficiently. For example, nerve cells transmit impulses, muscle cells contract for movement, and red blood cells transport oxygen…….. **(01 Mark)**
   - This specialization optimizes the overall functioning of an organism by distributing tasks among various cell types…….. **(01 Mark)**

   (b) **The structure of the cell membrane according to the fluid mosaic model.**

   - The fluid mosaic model describes the cell membrane as a flexible lipid bilayer composed of phospholipids, proteins, and carbohydrates.
   - The phospholipids form a bilayer with hydrophilic heads facing outward and hydrophobic tails inward.
   - Proteins embedded in the bilayer act as channels, receptors, or enzymes.
   - The "mosaic" refers to the scattered pattern of proteins, while "fluid" indicates the dynamic movement of components. **(Any relevant 4 points 01 Mark@ = 04 Marks)**



Caption = 0.5 Mark Diagram = 0.5 Mark Any 6 labels 0.5 Mark@ = 03 Marks

2. (a) The structure of protein based on the presence of bond formation.

   Proteins are composed of amino acids linked by peptide bonds.

   They have four structural levels which are;

   - **Primary structure**: A sequence of amino acids joined by peptide bonds.
   - **Secondary structure**: Folding of the chain into α-helices or β-sheets due to hydrogen bonds.

- **Tertiary structure**: Further folding into a 3D shape stabilized by ionic bonds, hydrogen bonds, disulfide bonds, and hydrophobic interactions.
- **Quaternary structure**: Association of multiple polypeptide chains via similar bonds.

(1.5 Marks@ = 06 Marks)

(b) Sources of variations

- Both pentoses and hexoses can be used to make polysaccharides 1,4 and 1,6 linkages are common between sugars, hence branching can occur
- Lengths of chains and branches and extent of branching can vary
- The alpha and beta forms of monosaccharides are significant and add value to the variations
- Sugars may be ketoses and aldoses (**Any 4 points 01 Mark@ =04 Marks)**

3. (a) **Demerits of artificial system of classification.**

- Related organisms may be placed in different groups e.g. bat and mammals were placed in different groups.
- Unrelated organisms may be placed in same group e.g. bats and birds were placed in same group because they could fly.
- It considers only few observable characteristics.
- It does not place organisms according to their evolution relationship I. Phylogenic.

(0.5 Mark@ = 02 Marks)

Demerits of natural system of classification.

- It is very difficult to classify
- It is very expensive since it involves scientific researches It is time consuming since it involves many features.
- It is unstable due to new discoveries and findings. **(0.5 Mark@ = 02 Marks)**

(b) The following are the impacts of advancement of science and technology on classification

- Invention of telescopes enabled the astronomers to observe outer space

- DNA technology has allowed scientists to re-examine the relationship between organisms to refine classification system
- Taxonomic change. Some organism's names were seen to change due to technological advancement. This is because current classifications do not reveal evolutionary history
- Development of microscope has allowed the cells to be examined in far more details

(Any related 4 points 1.5 Marks@ = 06 Marks)

4. (a) How the semicircular canal functions in balance and posture in mammals. The semicircular canals detect rotational movements of the head.
   - They are filled with endolymph and have hair cells in the ampullae.
   - When the head moves, the endolymph lags, bending the hair cells.
   - This generates nerve impulses sent to the brain to maintain balance and posture.

   (01 Mark@ = 04 Marks)

   (b) The role of phytohormones
   - **Auxins:** Promote cell elongation and root development.
   - **Gibberellins:** Stimulate stem elongation and seed germination.
   - **Cytokinins:** Promote cell division and delay aging in leaves.
   - **Ethylene**: Regulates fruit ripening and leaf abscission.
   - **Abscisic acid**: Induces dormancy and closes stomata during stress.

   (Phytohormone = 0.5 Mark, role = 01 Mark, i.e 1.5 Marks@ = 06 Marks)

5. (a) Why is it important to detach the leaf before starting the experiment?
   - Detaching the leaf stops photosynthesis, ensuring no further starch production during the experiment.

   (b) Why boil the leaf in alcohol?
   - To remove chlorophyll and decolorize the leaf, making it easier to observe color changes with iodine.

   (c) Why cover the leaf with black paper?
   - To block light and prevent photosynthesis in the covered areas.

   (d) What color is observed after adding iodine?
   - The uncovered area turns blue-black, while the covered area remains unchanged.

   (e) Conclusion:
   - Starch is present in the uncovered area exposed to light, proving light is essential for

photosynthesis. **(02 Marks@ = 10 Marks)**

6. (a)

The main reason why the volume of air exchanged in the alveolus is less than that of pulmonary ventilation is **due to anatomical dead space.** Anatomical dead space refers to the air that stays in the conducting airways (such as the nose, trachea, and bronchi) and does not participate in gas exchange. This air is essentially wasted and does not reach the alveoli.

Another reason is that during inhalation, some of the air that enters the alveoli is not fully utilized for gas exchange. This is because the alveoli are not fully utilized for gas exchange. This is because the alveoli are not completely filled with air and there is still some residual air left from the previous exhalation. This residual air is not exchanged during each breath and therefore, the volume of air exchanged in the alveoli is less than pulmonary ventilation.

(03 Marks)

(b) Reasons to why the metabolic rate of rat is higher than that of elephant.

- **Body size:** The elephant is a much larger animal than the rat, larger animals have a slower metabolic rate due to their larger body mass. This means the rats smaller body requires less energy to function compared to the elephant's larger body.
- **Surface area to volume ratio:** The rat has a higher surface area to volume ratio than the elephant. This means that the rat has a larger surface area relative to its body size, which allows for greater heat exchange and helps to maintain a higher body temperature. In contrast, the elephants larger body has a lower surface area to volume ratio, making it more difficult to regulate its body temperature and resulting in a slower metabolic rate
- **Activity levels**: Rats are highly active animals, constantly moving and foraging for food. This high level of physical activity requires a higher metabolic rate to provide energy for muscle contraction and movement. On the other hand, elephants are relatively sedentary animals, spending most of their time grazing and resting. This lower level of physical activity requires a lower metabolic rate.

(Any two points 01 Mark@ = 02 Marks)

(c) **The factors that govern efficiency of gaseous exchange at the respiratory surface.**

- **Large surface area of the membrane**: There is a direct relationship between the surface area and the rate of gaseous exchange. Generally, the larger the surface area of the membrane, the higher the rate of gaseous exchange. This is because when the surface area is large, more blood and air can circulate, hence increasing the rate of gaseous exchange.

- **Concentration gradient**: Concentration gradient is created when the two sides separated by a membrane have different concentrations of gases. This difference in concentration is actually what facilitates the process of gaseous exchange because gases can move from areas of high concentration to those of low concentration. Therefore, for gaseous exchange to occur there must be a concentration gradient.

- **Availability of high supply of blood capillaries**. The mammalian respiratory surfaces are well supplied with blood by blood capillaries. This enables high uptake of oxygen in the alveoli, which increases the rate of gaseous exchange. In the red blood cells, there is haemoglobin that helps to transport oxygen by combining with it to form oxyhaemoglobin which helps in transportation of oxygen to different parts of the body where it is required.

- **Thickness of the membrane**. The rate of gaseous exchange is affected by the thickness of the membrane across which the gases have to diffuse. A thick membrane reduces the rate at which gases diffuse from areas of high concentration to those of low concentration. This is due to long distance of travel as the result of membrane thickness. Generally, the thickness of the membrane is inversely proportional to the rate of diffusion.

- **Diffusion distance**. The distance across which air, blood, or plasma fluid has to diffuse also determines the rate of gaseous exchange. In single celled organisms, gaseous exchange tends to be faster because the gases have to diffuse through only one cell surface membrane while in multi-cellular organisms, gaseous exchange requires a complex transportation and respiratory system as the gases are transported through a longer distance.
- **Moist surface.** Since respiratory gases are transported in solution form, they must dissolve in liquid before they are carried away from the respiratory surfaces. Thus, an efficient respiratory surface must be moist for rapid exchange and transportation of respiratory gases.
- **Permeability.** Since the membrane form the boundary between organism and its extracellular environment, its permeability affects the rate of gaseous exchange. Therefore, a respiratory surface must be permeable to allow gases to pass through**.**

(Any five points 01 Mark@ = 05 Marks)

7. **Advantages of reproduction by seeds**
   - The plant is independent of water for sexual reproduction, thus better adapted for land environment The seed protects the embryo
   - The seed contains food for embryo (Either in the cotyledons or endosperm)

- The seed may remain dormant and survive adverse conditions
- The seed is physiologically sensitive to favorable conditions **(01 Mark@ =05 Marks) Disadvantages of reproduction by seeds**
- Seeds are relatively large structures because of the extensive food reserves. This makes dispersal more difficult
- Seeds are often eaten by animals for their food reserves
- There is reliance on eternal agents such as wind and insects for pollination and fertilization, hence more dependent on chance.
- There is a large wastage of seeds because the chances of survival of a given seed is limited
- The food supply in a seed is limited
- Two individuals are required in dioecious species, making the process more dependent on chance. **(01 Mark@ =05 Marks)**

SECTION B (30 MARKS) ONLY TWO (02) QUESTIONS TO BE ATTEMPED BY A CANDIDATE

8. (a) Possible outcome if the surfactant chemical is not produced in the walls of alveoli.
   - The alveoli walls might stick together preventing them from expanding and relaxing.
   - It may lower the speed of transportation of carbon dioxide and oxygen between the layer and the liquid lining of alveoli.
   - Risk of infections, poor lung ventilation and mucus clearance due to collapsed alveoli can increase the risk of respiratory infections such as pneumonia. **(02 Marks@ = 06 Marks)**

(b) ATP is used as the universal energy carrier in all living organisms due to the following reasons

- It stores energy in the body cells.
- It releases enough amount of energy.
- It is formed easily and quickly in the cells.
- All living cells can synthesize ATP.
- It can be transported in the body cells.
- It is broken down easily and quickly to release energy.**(Any 5 points = 05 Marks)**

(c) i. **Mitochondria**

Role. It is the power house of the cell i.e it is the site in which energy is released during

aerobic respiration……...

(01 Mark)

ii.**Oxygen**

Role. It the final acceptor of hydrogen ions…… **(01 Mark)** iii.**Cytochrome**

Role. It the electron carrier molecules down the electron transport chain of the aerobic

respiration…… **(01 Mark)** iv.**Glucose**

Role .It is the substrate that is oxidized to yield energy ……...

(01 Mark)

9. **Placenta** is an organ that develops in the uterus during pregnancy. It connects the developing fetus to the uterine wall via the umbilical cord.

Implantation is the process by which a fertilized egg (zygote) attaches to the lining of the uterus (endometrium). This typically occurs about 6-10 days after fertilization

The formation of the mammalian placenta immediately after implantation is crucial for the following reasons:

- **Nutrient Transfer**: The placenta ensures a continuous supply of nutrients from the mother's blood to the developing embryo. This is critical for the growth and development of the embryo, especially in the early stages when its own resources are insufficient.
- **Gas Exchange**: The placenta facilitates the exchange of oxygen and carbon dioxide between the mother and the fetus. Oxygen is vital for cellular respiration, which provides energy for the developing fetus.
- **Waste Removal**: It allows the removal of metabolic waste products, such as urea and carbon dioxide, from the fetus's blood to the mother's circulatory system for excretion.
- **Hormonal Support**: The placenta produces hormones like human chorionic gonadotropin (hCG), progesterone, and estrogen, which are essential for maintaining pregnancy and supporting fetal development.
- **Immune Protection**: The placenta acts as a selective barrier, protecting the fetus from harmful pathogens while allowing the transfer of maternal antibodies, which help in building the fetus's immune system.
- **Structural Anchoring**: The placenta anchors the developing embryo to the uterine wall, ensuring its stability and proper positioning for further growth and development.

Without the timely formation of the placenta, the embryo would face challenges in accessing the resources and protection required for successful development.

Introduction = 02 Marks

Points 02 Marks@ = 12 Marks

Conclusion = 01 Mark

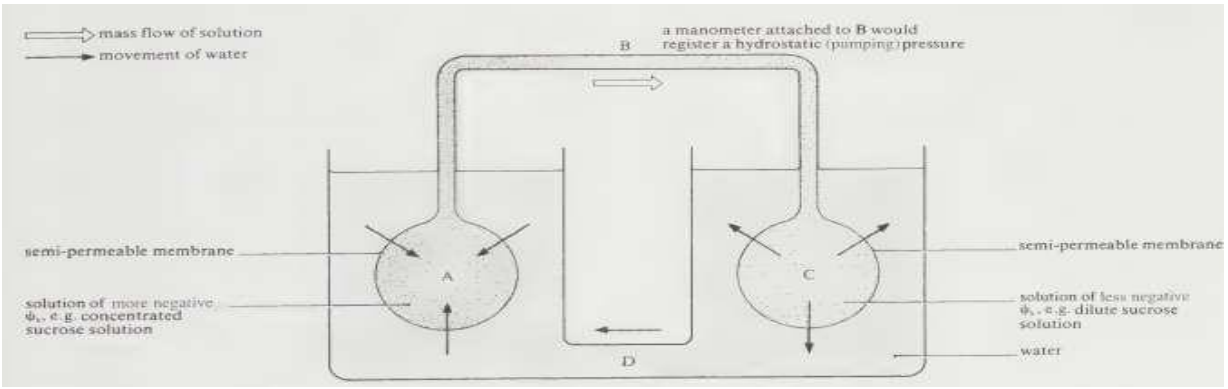
10. **(a)**Leaves contain a very large number of stomata for gaseous exchange and there is little resistance to movement of water vapour through these pores.

Leaves have a large surface area for trapping sunlight and exchanging gases. The greater the surface area, the greater will be the loss of water by transpiration. **(1.5 Marks@= 03 Marks)**

(b) This is a theory which describes how the manufactured food substances are translocated by mass flow from the leaves to the roots. According to this hypothesis, food substances are translocated through the phloem in a mass flow mechanism.

- In his experiment, Munch's prepared a model with two containers A and B each of which contained a sugar solution. The solution in container A was more concentrated than that in container B. Each container had a semi-permeable membrane.
- The two containers were connected by a tube. After being placed in water, the two solutions took up water by osmosis; however, the tendency of water uptake was higher in container A than it was in container B.
- As water entered in container A, the hydrostatic pressure built up in the closed system A-C-B tube, which in turn forces water out of container B.
- The mass flow of solution occurred through tube C along the generated pressure gradient, due to osmotic uptake of water, the osmotic gradient also was built from container A to container B. since the water continued to dilute the contents of container A and solutes accumulated at container B, then the system came into equilibrium.

(04 Marks) **Consider the Munch model bellow:**



(Diagram = 02 Marks)

From the model above

- **Container A represent leaves** which make sugars during photosynthesis. The synthesized sugars lower the water potential of the leaf cells and consequently this causes the flow of water into the leaves by osmosis through the xylem.
- **Container B represents the sink**, which is the area where sugar is used up or stored in insoluble form for example roots.
- **Tube C represents phloem** which transport manufactured food substances from the source to the sink. In the plants, equilibrium is not reached because sugars are

constantly being made at sources (A) and constantly being used at sinks (B)
(02 Marks@= 06 marks)