

## Practice Paper - 4

### PART I - BOTANY

1. **Why are eukaryotic genes called split genes ?**

Eukaryotic genes have **coding regions** called **exons** intervened by **non-coding** regions called **introns**.

2. **Name the living mechanical tissue in plants.**

Collenchyma

3. **Define water potential.**

Water potential is the difference in the free energy of water in pure water and the free energy of water in solution.

4. **State the law of limiting factors of Blackman.**

Blackman's law of limiting factors states that "**when a process is conditioned as to its rapidity by a number of separate factors, the rate of the process is limited (determined) by the pace of the slowest factor**".

5. **Name the hormone responsible for apical dominance in plants.**

Auxin

6. **Mention the functions of mRNA and tRNA.**

**mRNA:** It has message from DNA in the form of triplet codons which help in protein synthesis. - 1

**tRNA:** It carries specific amino acids to the ribosomes which are the sites of protein synthesis. - 1

7. **How is a radial vascular bundle different from a conjoint vascular bundle ?**

➤ Radial vascular bundles have xylem and phloem in different radii or alternating with each other. - 1

➤ Conjoint vascular bundles have xylem and phloem in the same bundle. - 1

8. **Differentiate active osmotic and active non-osmotic absorption of water by roots.**

➤ Active osmotic absorption is the absorption of water by root hairs from the hypotonic soil solution along the concentration gradient without the expenditure of energy. - 1

➤ Active non-osmotic absorption is the absorption of water by root hairs from a hypertonic soil solution against the concentration gradient with the expenditure of energy. - 1

9. **Mention any four functions of gibberellin.**

➤ It promotes the elongation of internodes which is responsible for rapid growth.

➤ It induces '**bolting**' in biennial rosette plants like radish, cabbage, cauli-flower etc.,. These plants normally produce flowers in the second year during which the stem elongates and produces branches with flowers.

➤ It promotes the germination of seeds by stimulating the synthesis of enzymes necessary for the digestion of food and weakening of seed coat and thus it helps in breaking the dormancy of seeds.

➤ It induces hybrid vigor in genetically dwarf plants by making them to grow tall like 'hybrids'.

➤ It induces parthenocarpy i.e., development of an ovary into fruit without fertilization.

➤ In certain plants like cucumber, it stimulates the formation of staminate flowers.

Any four:  $\frac{1}{2} \times 4$

10. **Define growth. Mention the phases of growth.**

Growth is a **permanent** or **irreversible** increase in the size of an organism accompanied by an increase in the dry weight.  $\frac{1}{2}$

The three phases of growth are;

➤ Phase of cell division

- Phase of cell elongation
- Phase of cell maturation

½ X 3

**11. Define super-ovulation and artificial insemination.**

**Super-ovulation:** It is the phenomenon of production of a large number of ova (5 – 50) by animals under the influence of gonadotropins like FSH and LH. 1

**Artificial insemination:** It is the introduction or injection of semen of a superior bull of desired character into the reproductive duct of the female. 1

**12. Explain starch hydrolysis theory of stomatal movement.**

During the day time:

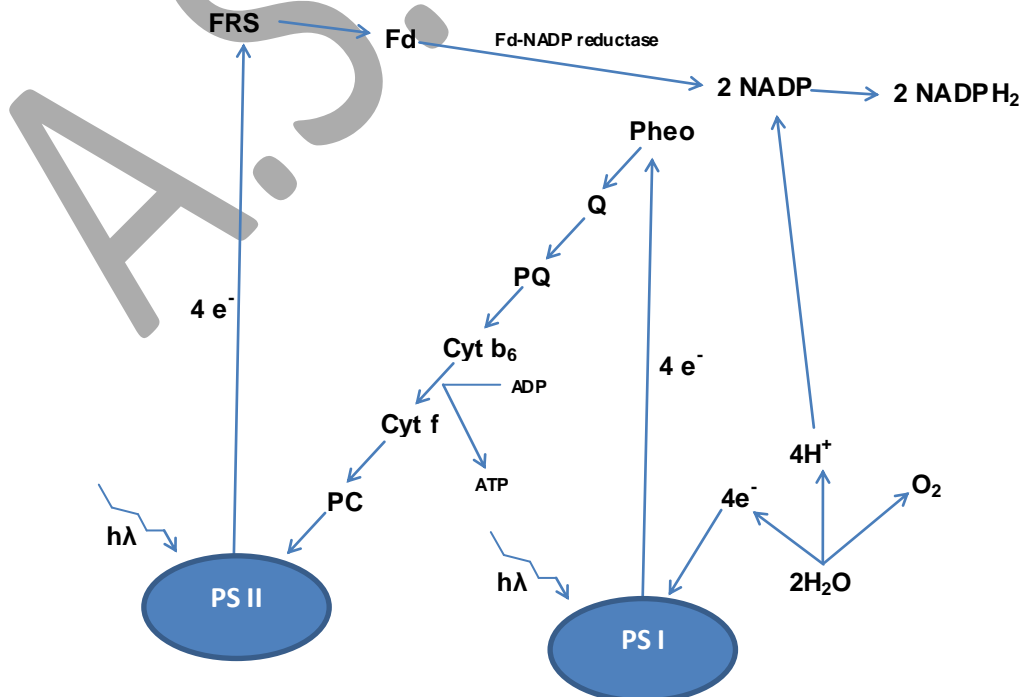
- CO<sub>2</sub> concentration in guard cells is less due to photosynthesis which increases the pH to about 7.
- This favours the conversion of starch into Glucose -1- phosphate in the presence of phosphorylase enzyme and conversion of Glucose-1-phosphate into Glucose-6-phosphate by the enzyme phosphoglucomutase.
- Glucose-6-phosphate is converted into glucose and phosphate in the presence of enzyme phosphatase.
- Osmotic concentration in guard cell increases as glucose is soluble in the cytoplasm resulting in the entry of water into guard cells from the subsidiary cells.
- Guard cells become turgid and the stoma opens. ½ X 5 = 2½

During the night:

- In the absence of photosynthesis, CO<sub>2</sub> accumulates in the guard cells decreasing the pH to about 5.
- This favours the formation of Glucose-1-phosphate in the presence of hexokinase.
- Glucose-1-phosphate is converted into starch in the presence of phosphorylase.
- Osmotic concentration decreases as starch is insoluble in the cytoplasm and water from guard cells move into the subsidiary cells.
- Guard cells become flaccid and stoma closes. ½ X 5 = 2½

**13. Define non-cyclic photophosphorylation. Write the schematic diagram of the same.**

Non-cyclic photophosphorylation is the process of formation of ATP from ADP by the non-cyclic transfer of energy rich electrons through a series of electron carriers during the light reaction of photosynthesis. 1



Correctly and sequentially represented electron carriers with PS I & PS II – 2  
Splitting of water with the electrons being donated to PS II - 1  
ATP production, release of energized electrons from PS I & II, h $\nu$  and enzyme – 1

**14. Explain semi-conservative replication of DNA.**

- Replication begins at a region called '**ori**' (origin of replication site) where the two strands of the molecule unwind in the presence of an enzyme **helicase**.
- Parental strands act as the **templates** or the master copies.
- Due to continuous unwinding, a Y-shaped **replication fork** is formed.
- First, a **RNA primer** of about 5 – 10 nucleotides in length is formed in the presence of enzyme **primase** to give stability to the unwound DNA which attaches to one of the strands at the 5' end.
- **Assembly of nucleotides** takes place on this strand towards the replication fork to form a continuous strand. This template strand is called **leading strand**. Assembly is catalysed by the enzyme **DNA polymerase III**.
- In the other strand called the lagging strand, assembly takes place in opposite direction and fragments of new DNA known as **Okazaki fragments** are formed. Assembly of nucleotides always occurs in 5' → 3' direction.
- Okazaki fragments are joined by enzyme **DNA ligase** to form a complete strand of DNA.
- After the daughter strands are formed, each of the parental strand recoils with a new strand in the presence of **DNA gyrase**. Each daughter DNA will have one parental strand and one new strand.

$\frac{1}{2} \times 8 = 4$

1

**15. What are stem cells ? Mention two of their important characteristic features. Explain the types of stem cells.**

Stem cells are multipotent cells of animals which have the capacity to divide and specialize or differentiate into different tissues.

1

**Characteristic features:**

- These are unspecialized or undifferentiated cells.
- These have a tremendous capacity of division or proliferation and can differentiate or specialize into any kind of tissue.

$1 \times 2 = 2$

**Types of stem cells:**

- a. Embryonic stem cells:

$\frac{1}{2}$

These are stem cells derived from embryos which are 4 - 5 days old, developed out of *in vitro* fertilization. 1/2

**b. Adult stem cells:** 1/2

These are stem cells occurring among differentiated tissues or organs of an individual. These occur in bone marrow, peripheral blood vessels, skin, liver, brain, etc.,. 1/2

**16. Describe the different kinds of xylem vessels based on lignifications with diagrams.**

Vessels or tracheae are lignified in various ways. They are;

**Annular:** Lignin is deposited as rings or annuli 1/2

**Spiral:** Lignin is deposited as a continuous spiral. 1/2

**Scalariform:** Lignin is deposited in the form of transverse bands. 1/2

**Reticulate:** Lignin is deposited in the form of a network. 1/2

**Pitted:** Lignification is uniform except in some non-thickened areas called pits which occur as depressions. They may be simple or pitted. 1/2

5 Diagrams - 1/2 X 5 = 2 1/2

**17. What are monoclonal antibodies ? Explain the technique involved in their production. Mention two of their applications.**

Monoclonal antibodies are chemically and immunologically pure and similar antibodies produced through a clonal culture of hybridomas. 1

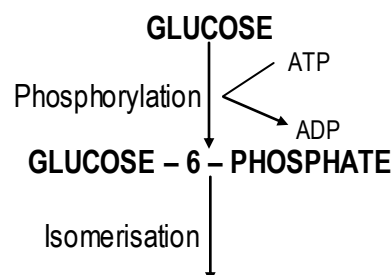
**The technique of production of monoclonal antibodies involves the following steps;**

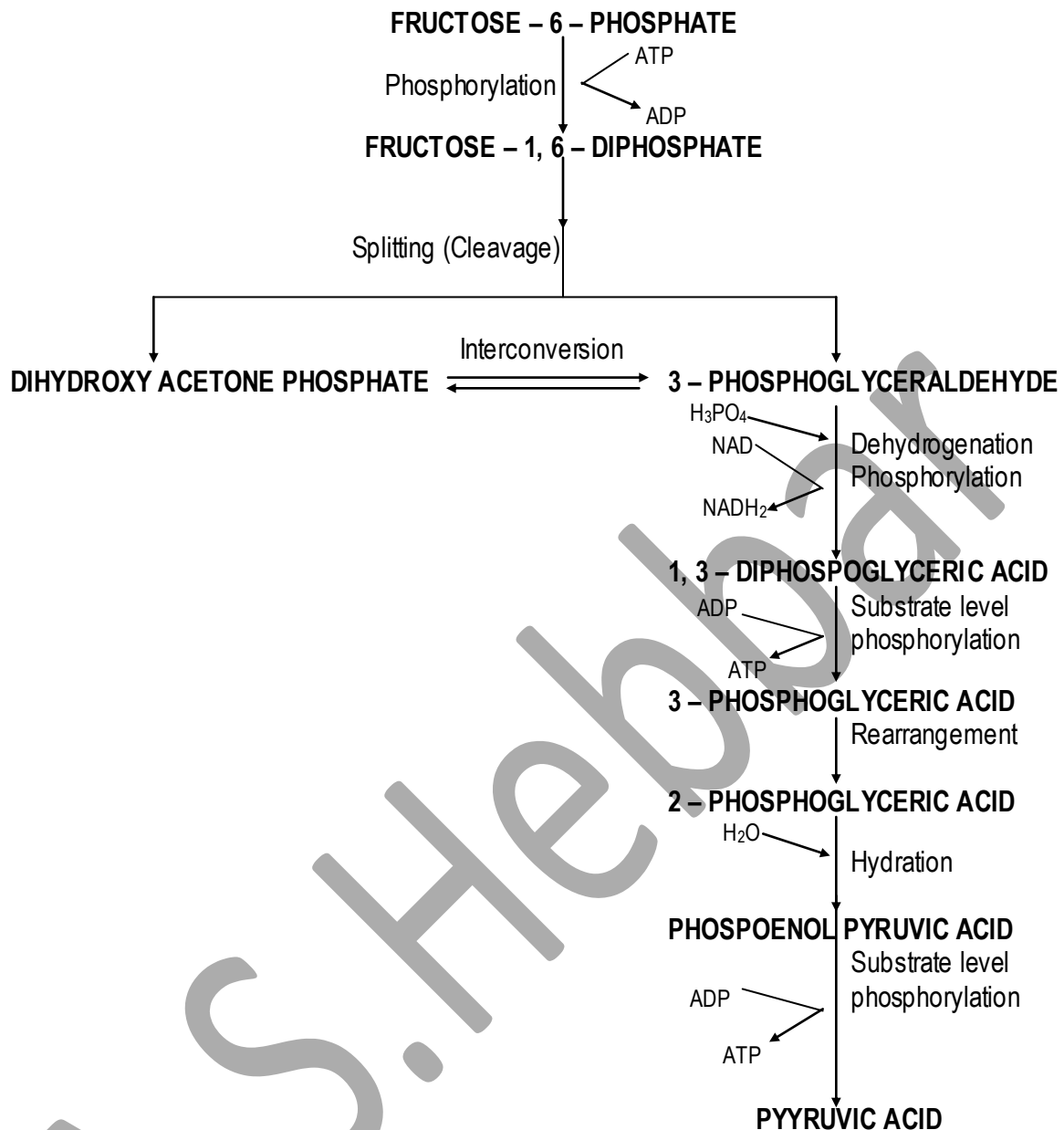
- Mice are injected with a specific antigen and their spleen is removed after a few days to isolate antibody producing cells (B - lymphocytes).
- Antibody producing cells are mixed with myeloma cells of mice.
- The two kinds of cells are made to fuse *in vitro* in the presence of polyethylene glycol (PEG) to get hybridomas.
- Hybridomas are separated, cultured and cloned to get antibodies which are later isolated and purified. 1/2 X 4 = 2

**Applications of monoclonal antibodies:**

- ELISA technique to diagnose AIDS employs monoclonal antibodies
- Monoclonal antibodies produced against T - lymphocytes can be used to prevent tissue rejection reactions in organ transplantations 1 X 2 = 2

**18. Write the schematic diagram of glycolysis.**





Glucose to DHAP and 3PGAL - 2  
 3PGAL to 2PGA - 1½  
 2PGA to Pyruvic acid - 1½

(Enzymes involved in the reaction need not be mentioned)

19. Give reasons for the following in one sentence each:

(a) RQ of proteins is less than 1.

During the oxidation of proteins, the volume carbon dioxide released is more than the volume of oxygen utilized.

(b) An mRNA molecule has always AUG as its first triplet codon.

AUG is the triplet codon without which protein synthesis can not occur even if the message is present on the mRNA.

(c) Maize is considered as a C<sub>4</sub> plant.

The first stable compound formed in maize during carbon fixation is a 4 carbon compound called oxalo-acetic acid.

**(d) Dry grapes (raisins) kept in water swell.**

Dry grapes contain a large quantity of sugar and therefore, endosmosis occurs from the surrounding hypotonic solution.

**(e) Meristems used in tissue culture are considered to be totipotent.**

Meristems have the capacity to divide and differentiate into an entire plant.

**20. (a) Draw a labeled diagram of the T.S. of monocot root.**

6 Correct labellings -  $\frac{1}{2} \times 6 = 3$   
Neat and correct (scientific) diagram - 1

**(b) Name the specialized cells in the upper epidermis of monocot leaf which help it to roll inwards.**

Bulliform cells or motor cells

**21. Describe an experiment to demonstrate the separation of leaf pigments in plants.**

**Aim:**

To demonstrate the separation of leaf pigments by paper chromatography

**Principle:**

Chromatography is a technique used for the separation of substances present in a mixture. It is based on the principle of differential rate of migration of different substances according to their densities. Different pigments in the pigment extract like chlorophyll 'a', chlorophyll 'b', xanthophylls and carotenoids separate at different levels based on their densities.

**Requirements:**

Fresh green leaves of Tecoma or paalak, mortar and pestle, petroleum ether, 80% acetone, Whatman filter paper No.1, beaker, hair drier and chromatography jar (column)

**Procedure:**

Small pieces of a few fresh Tecoma or paalak leaves are ground with little sand in about 5ml. of acetone in a mortar. The homogenate is filtered to get green filtrate which is then transferred to a small beaker.

About 50ml. of the solvent, a mixture of 9:1 petroleum ether and acetone is taken in the chromatography jar. Whatman filter paper No.1 is cut into a strip of required size. One end of the strip is cut in the form of 'V' to get pointed end. A line is drawn transversely with a pencil at a distance of about 2.5cm. above the pointed end. The pigment extract is loaded at the centre of pencil mark (loading spot) using a capillary tube and immediately dried using a hair drier. The process is repeated 4 to 5 times.

The loaded Whatman paper strip is then kept in a hanging position in the chromatography jar. Care is taken to see that the loading spot remains a little above the solvent. The entire apparatus is made air-tight and kept undisturbed.

**Observation:**

The leaf pigments like chlorophyll 'a', chlorophyll 'b', xanthophylls and carotenoids get separated into distinct bands depending upon their density.

**Inference:**

Carotenoids with least density form a band at the top followed by xanthophylls, chlorophyll 'a' and chlorophyll 'b'.

Diagram (chromatography column having chromatogram with four pigments correctly located) – 1

Explanation in the above format – 4

(If the explanation is not in the above format – only 2 marks for explanation)

## PART II - ZOOLOGY

**22. What is an endemic species ?**

Endemic species is a species which is localized or restricted to a particular region.

**23. Mention the phenotypic ratio of a dihybrid cross.**

9 : 3 : 3 : 1

**24. What is reflex action ?**

It is the sudden, rapid and stereotypic response to any kind of stimulus brought about by the spinal cord.

**25. Name the pattern of cleavage in frog's egg.**

Holoblastic and unequal

**26. What is a biodiversity hotspot ?**

Biodiversity hotspot is the richest and the most threatened reservoir of plant and animal life on earth with a high degree of endemism.

**27. What is soil erosion ? Mention any two methods of conservation which prevents soil erosion.**

- Soil erosion is the removal of top layer of soil which is fertile. 1
- Two methods of conservation which **prevent soil erosion** are;  
Contour farming, terracing and bunding, mulching, Strip cropping, prevention of overgrazing, afforestation, cover crops and shelter belts, Gully control, basin listing, dry land farming, reduced tillage, trenching, stream bank protection  
Any two -  $\frac{1}{2} \times 2 = 1$   
(Other methods are not to be considered as they only maintain the fertility of soil and do not prevent soil erosion)

**28. What is contraception ? What is the role of IUDs in contraception ?**

- Contraception is the prevention of conception. 1
- IUDs cause irritation in the endometrium of uterus and thereby, prevent implantation of the blastocyst. 1

**29. Mention four symptoms of epilepsy.**

- Discharge of foamy saliva
- Biting and swallowing of tongue
- Involuntary movement of skeletal muscles
- Loss of consciousness
- Limb jerking
- Incontinence (loss of urinary and bowel control)

- Dyspnoea (difficulty in breathing) and shortness of breath

Any four -  $\frac{1}{2} \times 4 = 2$

**30. Mention the role of NK cells in body defence.**

- NK cells are non-phagocytic large granular lymphocytes that target virus infected & tumor cells.  $\frac{1}{2}$
- They release chemicals called perforins or porins.  $\frac{1}{2}$
- The porins make the cell membrane porous.  $\frac{1}{2}$
- Water and salts enter the cell and the cell subsequently bursts.  $\frac{1}{2}$

**31. Differentiate active immunity from passive immunity.**

Active immunity:

It is the immunity developed when specific antibodies are produced by B-lymphocytes against infection by any antigen. The immune response is slow but long lasting.  $\frac{1}{2} + \frac{1}{2} = 1$

Passive immunity

It is the immunity developed in an individual by introducing antibodies obtained from an already immunized organism. The immune response will be rapid, but temporary.  $\frac{1}{2} + \frac{1}{2} = 1$

**32. What is Y – linked inheritance ? Mention an example.**

Y – linked inheritance is the inheritance of characters due to the genes present on the Y – chromosome.  $1$

Ex: Hypertrichosis of the ears in man  $1$

**33. Explain the mechanism of transport of gases by the blood.**

Transport of Oxygen:

Oxygen from the lungs is transported to the tissues by haemoglobin. Each molecule of haemoglobin combines with 4 molecules of oxygen to form an unstable compound called oxyhaemoglobin. At the region of tissues, oxyhaemoglobin dissociates into oxygen and haemoglobin.  $1$

Transport of carbon dioxide:

Transport by plasma:

About 5% of  $\text{CO}_2$  combines with water of the plasma to form carbonic acid. This is transported from the tissues to lungs where it dissociates into carbon-dioxide and water.  $1$

Transport by haemoglobin:

About 25% to 30% of carbon dioxide combines with haemoglobin to form an unstable compound called carbaminohaemoglobin and is transported from the tissues. In the lungs, carbaminohaemoglobin dissociates into carbon dioxide and haemoglobin.  $1$

Transport as bicarbonates:

About 70% of  $\text{CO}_2$  is transported by blood as bicarbonates of sodium and potassium.  $\text{CO}_2$  and water first combine to form carbonic acid in the RBC. Carbonic acid dissociates into  $\text{H}^+$  and  $\text{HCO}_3^-$  in the presence of carbonic anhydrase. The bicarbonate ions from the RBC move into the plasma of blood and combine with  $\text{Na}^+$  and  $\text{K}^+$  to form sodium bicarbonate and potassium bicarbonate respectively. To maintain electrical neutrality in RBC, chloride ions from the plasma enter into it. This phenomenon is known as '**chloride shift**' or '**Hamburger's phenomenon**'.

$\text{CO}_2$  is transported to the lungs in the form of these bicarbonates, where they dissociate into bicarbonate ions,  $\text{Na}^+$  and  $\text{K}^+$ . Bicarbonate ions combine with  $\text{H}^+$  (formed due to the dissociation of H.Hb i.e., Haemoglobinic acid) to form carbonic acid. This again dissociates into water and  $\text{CO}_2$ .  $2$

**34. Define homeostasis. Mention the role of pancreas in maintaining blood sugar level.**

Homeostasis is defined as the maintenance of a relatively constant internal environment within a narrow range or tolerable limits.  $1$

The normal blood sugar level in man is 80 – 100 mg / 100 ml. of blood.  $\frac{1}{2}$

**Whenever the blood sugar level is high** (after a meal), insulin is secreted by the islets of Langerhans which decreases the concentration of glucose in the blood by

- Enhancing the cell permeability to glucose  $\frac{1}{2}$
- Promoting the conversion of glucose into glycogen (glycogenesis)  $\frac{1}{2}$
- Promoting conversion of excess sugar into lipids (lipogenesis)  $\frac{1}{2}$



- Inhibiting glycogenolysis (breakdown of glycogen) and gluconeogenesis (synthesis of glucose from non – carbohydrate sources) 1/2  
(Therefore, it is referred to as a hypoglycemic factor)  
When the blood sugar level decreases (as in fasting),  $\alpha$ -cells secrete glucagons which increases the concentration of glucose in blood by
- Mediating the conversion of glycogen into glucose (glycogenolysis) 1/2
- Promoting the synthesis of glucose from non – carbohydrate sources (gluconeogenesis) 1/2
- Inhibiting glycogenesis (conversion of glucose into glycogen) and lipogenesis (conversion of excess sugar into lipids) 1/2  
(Therefore, it is referred to as hyperglycemic factor)

**35. Describe the conducting system of human heart and the mechanism of origin and conduction of heart beat.**

Human heart is myogenic. The origin of heart beat and its subsequent conduction is due the conducting system. The conducting system consists of the following structures ;

- a) **Sinu-atrial node:**  
It is a mass of specialized cardiac tissue present in the wall of right auricle where the superior vena cava opens. It is also known as pacemaker as it sets the pace for heart beat. 1/2
- b) **Auriculo- ventricular node:**  
It is a nodal tissue present in the lower part of the inter-auricular septum very close to the ventricles. 1/2
- c) **Bundle of HIS:**  
It is a bundle of muscle fibres arising from the AVN. It runs along the inter-ventricular septum and divides into two branches, the left and the right. 1/2
- d) **Purkinje fibres:**  
These are very fine thread like muscle fibres which arise from the branches of bundle of HIS. They are profusely branched and spread throughout the wall of the ventricles. 1/2
- e) **Internodal pathways:**  
These are groups of cardiac muscle fibres which connect the SAN and AVN. These are three in number. 1/2

Labelled diagram - 1 1/2

**Mechanism of origin and conduction of heart beat:**

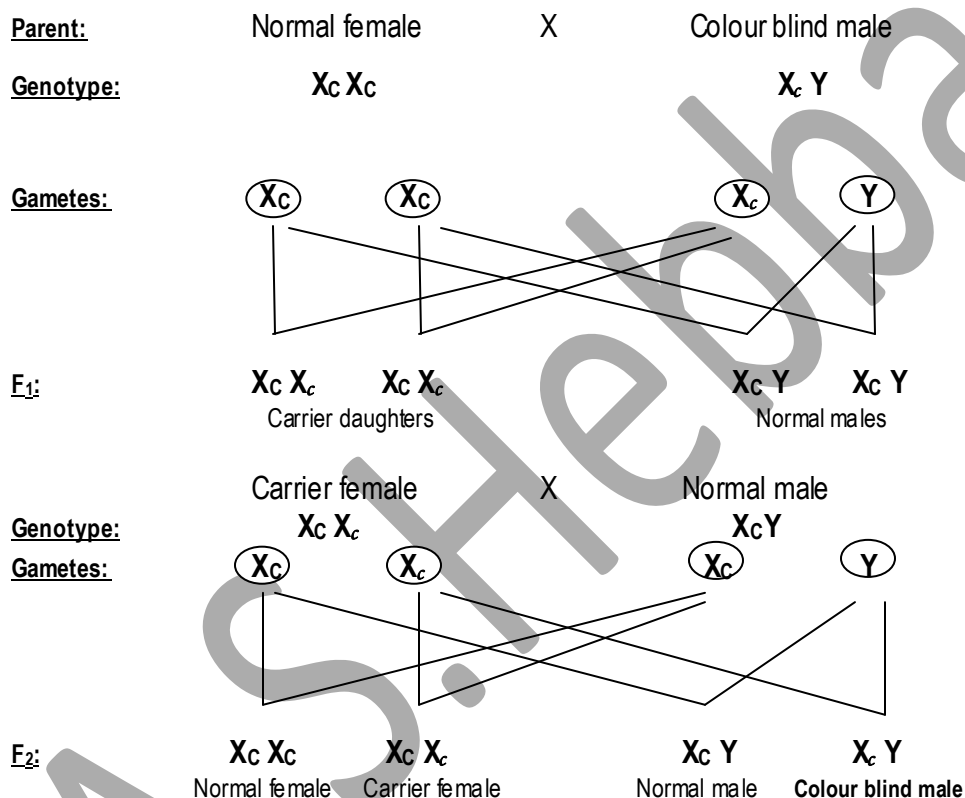
- The entry of blood into the right auricle stimulates the SAN to produce 70 – 80 electrical signals per minute. The electrical impulses move in all directions over the atrial wall causing their simultaneous contraction. 1/2
- The electrical signals are transmitted to AVN by the internodal pathways with a delay of about 0.4 seconds (to ensure that ventricles contract only after the atrial systole). The signals from the AVN are transmitted to the wall of ventricles by bundle of His and Purkinje fibres causing their simultaneous contraction. 1/2

**36. Define criss cross inheritance. Explain it with respect to the inheritance of colour blindness in man.**

It is a type of inheritance where during the transmission of a sex linked gene, there is alternation

from one sex to another (Inheritance of sex linked gene from parental grandfather to F<sub>2</sub> grandson through the F<sub>1</sub> daughter). 1

- When a colour blind man marries normal woman, all the children are normal in F<sub>1</sub>, because, gene for normal vision is dominant over colour blind gene. When F<sub>1</sub> female marries a normal man, in the F<sub>2</sub>, all the daughters are of normal vision, 50% of the sons are normal, while the remaining 50% of the sons are colour - blind. 1/2
- This suggests that colour blind gene is X - linked. The daughters (F<sub>1</sub>) act as carriers of colour - blind gene. Since the recessive gene appears only in males, colour blindness is not expressed in females of F<sub>2</sub> generation (because of the presence of a dominant gene on the other X - chromosome). 1/2
- During the transmission of the colour blind gene, there is alternation from one sex to another. The gene is transmitted from the grandfather to the grandson through the daughter. 1/2
- The male is hemizygous for colour blind gene as a single recessive gene on his only X - chromosome is sufficient for the expression of colour blindness. 1/2



Flow chart – 2

### 37. Explain the structure of human sperm with a neat labeled diagram.

**Head:**

It is oval or pear shaped and consists of the nucleus, cytoplasm and acrosome. Nucleus is a compact mass of chromatin consisting of paternal set of chromosomes. Anteriorly, the nucleus is covered by cap - like acrosome which is derived from Golgi bodies.

**Middle piece:**

It is separated from the head by a narrow neck consisting of a proximal centriole and a distal centriole. From the distal centriole, the axial filament or the axoneme arises which forms the axis of the tail. Middle piece is elongated and broader than the neck. It is surrounded by a sheath of mitochondria called nebenkern. It provides energy for the movement of sperm. The condensed cytoplasmic sheath around the axoneme in the midpiece is called manchette.

**Tail:**

It is differentiated into the main piece (principal piece) and the end piece. The axial filament in the main piece is surrounded by a protoplasmic sheath. The end piece lacks protoplasmic sheath. Tail helps in the movement of sperm.

Discription - 3

Neat, correct diagram which is correctly labeled - 2

**38. (a) What is green house effect ? Mention one cause and three effects of green house effect. (3)**

It is a natural phenomenon of heating up of the earth due to the trapping of sun heat by certain natural gases in the atmosphere. 1

**Cause:**

- Green house gases like CO<sub>2</sub>, nitrous oxide, sulphur hexafluoride, etc., released by industries, automobiles and burning of fossil fuels
- CFCs (chlorofluorocarbons) used in refrigerators, air conditioners, aerosols, industrial solvents, etc.,
- Methane released by decomposition activity of methanogenic bacteria
- Ozone released by photoactive reactions in the stratosphere Any one - 1/2

**Effects:**

- Polar ice caps and glaciers melt and there will be thermal expansion of water which rises the sea level and submerges coastal land.
- Surface temperature of earth increases by 1.5° - 4.5°C which alters weather condition, changes rainfall pattern
- Productivity of agricultural land decreases as land becomes too dry or hot to support the growth of crops
- Extensive damage to the ecosystem and biodiversity occurs and therefore, sensitive wildlife may be threatened
- Increased temperature increases the demand for water which results in over - exploitation of water resources Any three - 1/2 X 3 = 1 1/2

**(b) What is watershed ? (1)**

Watershed is a well defined area of land from the periphery of which water drains out into a common body of water like stream or river. **OR**

It is a land area that guides all rain water and run - off water to a common water body. 1/2

**(c) What is a sacred species ? (1)**

Sacred species is a traditionally protected or conserved species of plant or animal which is of religious or cultural importance. 1/2

**39. Draw a labeled diagram of the human digestive system.**

8 Correct labellings -  $\frac{1}{2} \times 8 = 4$   
Neat and correct (scientific) diagram - 1

40. Give reasons for the following in one sentence each:

(a) **Bacterial fermentation does not occur in the stomach.**

Gastric juice in the stomach contains HCl which makes the environment highly acidic, kills the bacteria and thus, prevents bacterial fermentation.

(b) **Secondary immune response is quicker and more intense.**

It is because of immunological memory. The memory B cells produced during primary immune response start producing the antibodies against antigens immediately.

(c) **Increase in the amount of CO<sub>2</sub> in the atmosphere causes global warming.**

Carbon dioxide accumulated in the atmosphere traps the heat radiations of the sun and results in global warming.

(d) **I<sup>A</sup> and I<sup>B</sup> alleles are considered as codominant alleles.**

Both I<sup>A</sup> and I<sup>B</sup> alleles express when they are present together in an individual on the homologous chromosomes.

(e) **Vitelline membrane is a primary egg membrane.**

Vitelline membrane is an egg envelope produced by the egg itself and therefore, it is a primary egg membrane.

41. (a) **Draw a neat labeled diagram of the areolar tissue.**

4 Correct labellings -  $\frac{1}{2} \times 4 = 2$   
Neat and correct (scientific) diagram - 1

(b) Name the nourishing cells present in the seminiferous tubules.

Sertoli cells / sustentacular cells

(c) Name the test to detect albumin in urine.

Biuret's test

42. (a) Draw a neat labeled diagram of the V.S. of graafian follicle.

6 Correct labellings -  $\frac{1}{2} \times 6 = 3$   
Neat and correct (scientific) diagram - 1

(b) Name the connective tissue covering of liver.

Glisson's capsule

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