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SEMESTER END THEORY EXAMINATION
B.Sc. (Hons.) Agriculture

Semester	: III (New)	**Term: I**	Academic Year: 2020-2021
Course No	**: BIOCHEM-231**	**Title**	**:** Fundamentals of Plant Biochemistry and Biotechnology
Credits	**: 3(2+1)**		
Day & Date	**: 15.01.2021**	**Time: 12.00 to 14.00**	**Total Marks: 80**

	SECTION "A" **(Write the answers in 4-5 sentences only. Each question carries 4 marks)**	**16**
Q. 1	**Define biochemistry. State its importance in agriculture.** **Ans.:** **Biochemistry**: Biochemistry is the branch of science that explores the chemical processes within and related to living organisms. **Scope & Importance in Agriculture :** Biochemistry is the study of life, its importance and it's Scope as wide as life itself. - Development and exploitation of better genotypes. - To evaluate nutritive value of cereals pulses poultry and cattle feeds. - Biochemistry of disease and pest resistance formulation of balanced diet. - Removal and inactivation of toxic or anti nutritional factors present in food grains in general and grain legumes in particular by breeding and chemical treatments. E.g. BOAA in Lakh dal, Trypsin inhibitors of soybean, Aflatoxins of groundnut. - Food preservation and processing technology and post-harvest physiology of fruit crops and vegetables and their nutritional quality. - Biochemistry of disease and pest resistance. - Biochemistry of drought resistance, proline and hydroxyproline imparts drought resistance to Jowar. - Formulation of balanced diet - Use of nonconventional sources of protein foods viz., single cell proteins, fish protein concentrates, mushrooms and leaf proteins. - Developments in the field of inter mediatory metabolism i.e. synthesis and degradation of constituents of living tissues.	
Q.2	Define carbohydrate and classify polysaccharides with suitable examples. **Ans.:** **Carbohydrates**: carbohydrates are defined as polyhydroxy aldehyde or	

polyhydroxy ketones and the substance which yields this derivatives on hydrolysis.

Classification of polysaccharides :

I. nature of branching

a. Linear- having linear glycosidic bond only eg. Cellulose chitin pectin

b. Branched - having branch glycosidic bond eg. Starch amylopectin glycogen extra

II. functional classification

a. Structure polysaccharide- helps in maintaining cell structure eg. Cellulose chitin pectin

b. Storage polysaccharide - helps in storing carbohydrate material in cell eg. Starch glycogen.

III. on the basis of repeating unit /composition

a. Homopolysaccharides - contains the basic same repeating monosaccharide units i.e. starch glycogen

b. Heteropolysaccharides - contains the various basic repeating monosaccharide units i.e. chondroitin sulfates

Q.3 State the various biomolecules of life and describe their properties

Ans.:

Biomolecules of life -

i. carbohydrates
ii. lipids
iii. proteins
iv. nucleic acids

Properties of Biomolecules :

1. Most of them are organic compounds.
2. They have specific shapes and dimensions
3. Functional groups determines their chemical properties
4. Many of them are asymmetrical.
5. Building blocks of molecules have simple structure.
6. Micro molecules are the large molecule and constructed from small building blocks of molecules.

Q.4 What are nucleic acid and differentiate between RNA and DNA

Ans.:

Nucleic acid: a complex organic substance present in living cells, especially DNA or RNA, whose molecules consist of many nucleotides linked in a long chain.

differentiate between RNA and DNA :

	DNA	RNA
1	It usually inside nucleus and sometimes cell organelles	Most of the RNA is found in the cytoplasm
2	DNA is the genetic material	RNA is not genetic material except in certain viruses
3	It is the double strained with the exception of some viruses	RNA is single strained with the exception of some viruses
4	DNA is of only two types intra-nuclear and extra- nuclear	RNA is of three types tRNA, mRNA, rRNA
5	It contain deoxyribose sugar	It contains ribose sugar
6	Nitrogen base in DNA includes- adenine, cytosine, guanine, thymine	Thymine is replaced by uracil in RNA the other three are similar
7	Hydrogen bonds are formed between complementary nitrogen bases on the opposite strands of DNA(A-T, C-G)	Base pairing through hydrogen bonds occur only in the coiled part
8	Unusual bases are very few or absent	Many unusual or modified bases are often present
9	DNA is spirally twisted to produce a regular helix	The strand may get folded at places to produce a secondary helix or pseudo helix
10	It replicates to form new DNA molecules	It cannot normally replicate itself
11	DNA transcribes genetic information to RNA	RNA translates the transcribed massage for forming polypeptides
12	Its quantity is fixed for the cell	The quantity of RNA is varies with cell
13	Purine and pyrimidine base are in equal number	There is no proportionality between number of purine and pyrimidine bases
14	It occurs in the form of prochromosome, chromatin or chromosomes	It occur in ribosome's or forms association with ribosome's
15	It is long lived	Some RNA are very short lived while other have somewhat longer life

Q.5	**Differentiate between reducing and non-reducing sugars**		
	BASIS OF COMPARISION	**REDUCING SUGARS**	**NON-REDUCING SUGARS**
	Description	Reducing sugars is any carbohydrate which is capable of being oxidized and causes the reduction of other substances without having to be hydrolyzed	Non-reducing sugars are any type of carbohydrate which are unable to be oxidized and do not reduce other substances
	Role	Reducing sugars are carbohydrates that can act as reducing agent due to the presence of free aldehyde group or free ketone group	**Non-**reducing are carbohydrates thtat cannot act as reducing agents due to the absence of free aldehyde group or free ketone group
	Sweet taste	Reducing sugars have a sweet taste	**These** are less sweet compaire to reducing sugars
	Sugar Classes	**Most of the reducing sugars are monosaccharide**	**Most of the non reducing sugars are polysaccharides while others are disaccharides**
	Reaction with benedict solution	Reducing sugars gives dark red color (brick like) when they reacts with Benedict solution	These don't give a red color , instead they remains as green in color
	Fehling test	Reducing sugars gives positive reactions towards the Fehling test	Non reducing sugars give negative reaction towards the Fehling test
	Presence of aldehyde or ketonic group	Reducing sugars has a free aldehyde (-CHO) or ketonic group (-CO) group	Non-reducing does not have a free aldehyde or ketonic group
	Ability to reduce cupric ions	Reducing sugars have the capacity to reduce cupric ions of Benedicts or Fehling's solutions to cuprous ions	Non reducing sugars fail to reduce the cupric ions of Benedict solution to cuprous ions
	Tests	Presence or absence of reducing sugars can be identified by carrying out different tests	The presence or absence of non-reducing sugars cannot be identified different tests
	Molecular weight	The molecular weight of reducing sugars is relatively low	The molecular weight of reducing sugars is relatively high when compared to the reducing sugars

Q.6 **Define cell and explain the functions of cell organelles**

Ans: a unit of independent, tiny o microscopic mass of protoplasm enclosing in it dense spherical or oval shaped body called nucleus and surrounded by distinct wall called as cell wall

A cell may be defined as Structural and functional unit of all living organism

The word cell was coined by Robert hooke with the help of compound microscope. Cell is the basic unit of life

The plant cell has three basic distinct regions

a. Cell wall
b. Protoplasm
c. Vacuole

Cell wall and vacuole are considered as non-living substances. The protoplasm which is living has two components

1. Cytoplasm
2. Nucleus

The cytoplasm contains several organells such as mitochondria, chloroplast, ribosome's, endoplasmic reticulum, Golgi complex(body) kysosomes, plastids etc

Plant cell and organelles:

The brief description of the plant cell and various organelles and their functions are as follows

Important plant cell -organelles and their functions

1) **Cell Wall -** It Provides support, prevent cells from swelling and rupture or shrinkage, gives definite shape to cell.

Cell wall: cell wall is non living component of the cell and is secreted and maintained be the living portion of the cell, called protoplasm. A typical cell wall is composed of three different regions

1. Middle lamella
2. Primary cell wall(1-3um thick and classic)
3. Secondary cell wall(5-10 um thick and rigid

Functions of cell wall:

1. It protects the inner contents of the cell
2. It gives definite shape to the cell
3. It provides mechanical supports to the tissues and act as a skeletal framework of plants
4. It helps in transport of substances between two cells
5. The cell wall is hydrophilic in nature and imbibes water and helps in the movement of water and solutes towards protoplasm. It also acts as a permeable structure during absorption of minerals and solutes

2) **Nucleus -** Store of genetic information, which issue appropriate signal at proper time during different stages.

3) **Mitochondria** - Power house of energy, contain m-tRNA and DNA and protein synthesizing machinery, synthesis of ATP required for anabolism.

4) **Chloroplast -** The sites of photosynthetic phosphorylation. The stroma

is the site of the carbon photosynthetic enzymes involved in CO_2 fixation, ribosomes, nucleic acid-synthesizing enzymes, and fatty acid synthesizing enzymes.

5) **Ribosome's** - Site of protein biosynthesis.

6) **Golgi apparatus** - Participate in the early stage of cell wall synthesis in higher plants. Site of secretions of proteins and polysaccharides and coupling of these two components to form glycoproteins. Intense phospholipid biosynthesis observed in these organelles.

7) **Importance of water:** i) serve as a medium in which substances undergo fundamental changes. ii) Provides hydrogen for the reduction of CO_2 in photosynthesis. iii) Water is necessary reactant for the hydrolytic splitting of carbohydrates, fats and proteins. iv) Water is solvent and dispersion medium for all protoplasmic constituents. v) Acts as a transporting medium for all the cell nutrients. vi) Absorption, secretion and excretion would not be possible without water.

Q.7 **Enlist the different techniques of plant tissue culture and explain any one**

Ans: Plant tissue culture is a technique of growing plant cells, tissues, organs, seeds or other plant parts in a sterile environment on a nutrient medium.

Techniques/types :

Types of tissue culture

- **Callus culture**
- **Organ culture**
- **Single cell culture**
- **Suspension culture**
- **Embryo culture**
- **Anther culture**
- **Pollen culture**
- **Somatic Embryogenesis**
- **Protoplast Culture**
- **Shoot tip and Meristem culture Explant Culture**

Callus Culture: Callus - This is the term used to refer to unspecialized, unorganized and a dividing mass of cells. A callus is produced when explants (cells) are cultured in an appropriate medium - A good example of this is the tumor tissue that grows out of the wounds of differentiated tissues/organs. In practice, callus culture involves the growth of a callus (composed of differentiated and non-differentiated cells), which is the followed by a procedure that induces organ differentiation. For this type of tissue culture, the culture is often sustained on a gel medium, which is composed of agar and a mixture of given macro and micronutrients depending on the type of cells. Different types of basal salt mixtures such as murashige and skoog medium are also used in addition to vitamins to enhance growth.

Q.8	**Explain in brief micro pro-propagation of plants** **Ans:** Micropropagation is one of the most popular techniques of tissue culture. It is the practice of rapidly multiplying stock plant material to produce a large Number of progeny plants, using modern plant tissue culture methods. Micro propagation is used to multiply novel plants, such as those that have been Genetically modified or breed through conventional plant breeding methods. It is also used to provide a sufficient number of plantlets for planting from a stock plant which does not produce seeds, or does not respond well to Vegetative reproduction. Generally interest in the use of this technique for clonally propagation of crop plants originated from the success in this area With orchids, the credit for which goes to French botanist G. Morel (1960). During last three decades progress in this field has been such that multiplication of many ornamental and fruit cultivars is being practiced on Commercial feasible method of clonal propagation. Micropropagation can be defined as a technique in which any vegetative (meristmatic) part of plant such as shoot tip, shoot bud etc is excised aseptically and cultured on sterile media under controlled conditions to give rise to plantlet which is exact copy Of its donor plant. In Simple words, it can be defined as clonal propagation *in Vitro.* Among the various applications of plant tissue culture, micro propagation of plant species has attained the status of large plant based study. The development in the study of various aspects of plant growth and differentiation were rapid during 1960s and 70s. The technique of culturing plants becomes a wide subject embracing morphology, physiology, biochemistry, molecular biology and genetic engineering. **General Technique of Micropropagation:** The process of plant micropropagation aims to produce clones (true copies of a plant in large numbers). The process is usually divided into the following stages: **Stage 0: Pre-propagation Stage** **Stage 1: Initiation of Aseptic Culture:** **Stage 2: Multiplication of Culture:** **Stage 3: *In Vitro* Rooting of Shoots** **Stage 4: Hardening and Acclimatization of Tissue Culture Plantlets**	
Q.9	**Describe the agrobacterium mediated method of gene transfer for transgenic development** **Ans:** 1. Agrobacterium chosen due to natural genetic engineer and narutary gram negative soil 2. The Ti-plasmid of agrobacterium are large circular DNA molecule up to 200 kb(kilo bases) in length 3. Ti-plasmid have major regions a. T-DNA region b. Virulence region (uir region) c. Origin of replication (ori) d. Conjugation e. Oncogenicity(one) region	

	f. Catabolism of opines 4. It is achieved in a. infection of wounded plants b. Co-culture / co-cultivation with protoplast c. Leaf disk method d. In plant transformation	

Section B

Q. write down the answer in one sentence only

A	**What is protein?** **Ans:** Are the large biomolecules which contain one or more long chain of amino acids **Or** A protein is a naturally occurring, extremely complex substance that consists of amino acid residues joined by peptide bonds.
B	**Define lipids** **Ans**: Lipids are molecules that contain hydrocarbons and make up the building blocks of the structure and function of living cells.
C	**Define essential amino acids** **Ans**: An essential amino acids an amino acid that cannot be synthesized by the organism fast enough to supply its demand, and must therefore come from the diet **Or** It may be define as the naturally occurring amino acid which cannot be synthesized in animal body which external supplements is needed
D	Who has introduced the term biochemistry? **Ans:** Carl Newberg
E	Give the example of conjugated protein **Ans:** Albumin, Hemoglobin, Nucleoprotein
F	Who is considered as the father of biochemistry? **Ans**: Antoine Lavoisier
G	**Who is the father of enzymology?** **Ans:** J.B.Sumner (1926)
H	State the example of introvert sugar **Ans**: Honey, brown sugar , centric acid
I	What is the amylase content in starch? **Ans**: 15-20%
J	What is the example of keto hexose? **Ans**: fructose
K	State the example of storage polysaccharides **Ans**: starch, glycogen
L	What is bioenergetics? **Ans:** It is the field in biochemistry and cell biology that concerns with energy flow through living organism
M	What is the example of structural polysaccharides? **Ans:** cellulose and chitin
N	**What is the example of aldo hexose?** **Ans:** Glucose

Section C

Choose the correct option (each question carry 1 mark)

1	Genetic codons are always…….= **Triplet**	
	a. Single	b. Double
	c. Triplet	d. Quadruplet
2	PCR is invented be……..= **Kary Mullies**	
	a. Friedrich miesceher	b. Carl Newberg
	c. Kary Mullies	d. J.B. Sumner
3	DNA was first isolated by……..= **Friedrich miesceher**	
	a. Watson and Crick	**b. Friedrich miesceher**
	c. J.B. Sumner	d. None of these
4	Co-dominant DNA molecular marker is = **AFLP**	
	a. RAPD	b. ISSR
	c. SSR	**d. AFLP**
5	The important tool used in rDNA technology include….= **All of these**	
	a. Enzyme for DNA manipulation	b. Vectors
	c. Expression tool	**d. All of these**
6	The tool for cutting DNA molecules is/are…= **Restriction endonucleases**	
	a. Restriction endonucleases	b. Ligases
	c. Both a and b	d. None of these
7	Plasmids DNA is……..= **All of these**	
	a. Self replicating	b. Double stranded
	c. Circular	**d. All of these**
8	Taq polymerase is……= **Thermostable**	
	a. Thermostable	b. Thermounstable
	c. Thermoliable	d. None of these
9	Enzyme cut DNA at specific locations based on the nucleotide sequence are known as = **Restriction enzymes**	
	a. Restriction enzymes	b. DNA ligase
	c. Nucleases	d. None of these
10	Flavr-SavrTM is the GM variety of…= **Tomato**	
	a. Potato	**b. Tomato**
	c. Cotton	d. Brinjal
11	Commonly used plant tissue culture media for in vitro micropropagaion of banana is…. = **MS Media**	
	a. Woody plant media	b. White media
	c. Gramborgs B-5	**d. MS Media**
12	Plant tissue culture technique used to overcome embryo abortion in distant hybridization is = **Embryo rescue**	
	a. Embryo rescue	b. DH
	c. Suspension	d. None of these
13	The optimum pH of plant tissue culture media is =**5.8**	
	a. 5.0	**b. 5.8**
	c. 7.0	d. 7.8
14	The process of bringing in vitro raised bottled plant outside open environment is known as…. = **Acclimatization**	
	a. Acclimatization	b. Adaptation
	c. Hardening	d. Regeneration
15	For solidification of plant tissue culture media,……..is added = **Agar-agar**	

	a. Coconut water	b. Sucrose
	c. Gelatene	**d. Agar-agar**
16	The chemical covalent bond present in DNA molecules is known as…… = **Phosphodiester bond**	
	a. Peptide bond	b. Glycosidic bond
	c. Ketodenic bond	**d. Phosphodiester bond**
17	Southern blot is a method used to check for the presence of ……. = **DNA**	
	a. DNA	b. RNA
	c. Protein	d. None of these
18	Inherent ability of cell to give rise a whole or complete plant is known as.. = **Totipotency**	
	a. Proliferation	**b. Totipotency**
	c. Rejuvenation	d. None of these
19	Plant cell without cell walls is called as……..= **Protoplast**	
	a. Hybrid	b. Karyoplast
	c. Protoplast	d. Cybrid
20	Chemical used for doubling the chromosome…..= **Colchicines**	
	a. Ethidium bromide	b. Sadium azide
	c. Colchicines	d. EMS
21	The variation or differences caused due to tissue culture is known as = **Somaclonal variarition**	
	a. Phenotypic variation	b. Genotypic variation
	c. Environmental variation	**d. Somaclonal variarition**
22	Which cell organelles help in protein synthesis?= **Ribosomes**	
	a. Mitochondria	**b. Ribosomes**
	c. Lysosomes	d. Centrosomes
23	The natural genetic engineer is = ***Agrobacterium tumefaciens***	
	a. Agrobacterium tumefaciens	*b. Bacillus subtillis*
	c. E. coli	d. None of these
24	Which of the following favors high rate of rooting in plants tissue culture = **Auxin**	
	a. Cytokinin	**b. Auxin**
	c. GA3	d. Ethelele