MODEL ANSWER
MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION
B.Sc.(Hons.) Agriculture

Semester	III (NEW)	Academic Year: 2018-2019	
Course No	: BIOCHM-231	Title: Fundamentals of Plant Biochemistry and Biotechnology	
Credits	:3(2+1)	Total Marks	: 80
Day & Date	.	Time	: 3 Hours

Note : 1. Solve **ANY Eight** questions form **SECTION "A"**
2. All questions from **SECTION "B"** are compulsory.
3. All questions carry equal marks.
4. Draw neat diagram wherever necessary

SECTION "A"

Q.1 a) Define bimolecules, Enlist the biomolecules of life and state the characteristics. (4)

Ans. **Definition of Biomolecule :** A **biomolecule** or biological molecule is any molecule that is present in living organisms, including large macromolecules such as proteins, carbohydrates, lipids, and nucleic acids, as well as small molecules such as primary metabolites, secondary metabolites, and natural products.

Biomolecule of life :

1. Water
2. Carbohydrates
3. Proteins
4. Lipids
5. Nucleic acid
6. Enzymes

Characteristics of Biomolecules : -

1) Most of them are organic compounds.
2) They have specific shapes and dimensions
3) Functional group determine their chemical properties.
4) Many of them are asymmetric
5) Macromolecules are large molecules and are constructed from small building block molecules.
6) Building block molecules have simple structure.
7) Biomolecules first gorse by chemical evolution.

b) Give scope and importance of biochemistry in Agriculture.

Ans. **Scope and importance of biochemistry in Agriculture**

1) To evaluate nutritive value of cereals, pulses, poultry and cattle feeds.
2) Development and exploitation of better genotypes.
3) 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.

4) Food preservation and processing technology and post harvest physiology of fruit crops and vegetables and their nutritional quality.
5) Biochemistry of disease and pest resistance.
6) Biochemistry of drought resistance. Proline and hydroxyproline imparts drought resistance to Jowar.
7) Formulation of balanced diet.
8) Use of nonconventional sources of protein foods *viz.*, single cell proteins, fish protein concentrates, mushrooms and leaf proteins.
9) Developments in the field of intermediatory metabolism i.e. synthesis and degradation of constituents of living tissues.

Q.2 a) Define the term carbohydrate. How Carbohydrates are classified on the basis of behavior upon hydrolysis. ?

Ans. Carbohydrates are aldehydic or Ketonic derivatives of polyhydroxy alcohols (4)

Classification.

a) Monosaccharide
   i) Aldoses-Aldotriose, Aldotetrose, Aldopentox, Aldohexcos (2)
   ii) Ketoses-Ketotrose, Kelotetrose, Ketopentore, Keloheptose
b) Oligosacchorides
   i) Disaccharideds i) Reducing ii) Nonreducing
   ii) Trisaccharides – Raffinose
   iii) Tetrasaccharides – Stachyose
c) Polysaccharides – On the basis of functions (2)
   i) Starage polysaccharides – Staren, glycogen
   ii) Structural polysaccharides – Cition Cellulore etc.on the basis of composition.
   i) Hemopolysaccharides, Starch, inullin
   ii) Heteropoly saccharides – Pecting, Gymus etc.

b) Define Fatty acids. Write down the functions of fatty acids (4)

Ans. Definition of Fatty Acids

Fatty acids may be defined as organic acid that occur in a natural triglyceride and is a monocarboxylic acid ranging from C_4 to C_{28} atoms in straight chains and will usually have either a saturated hydrocarbon chain or may contain from one to six double bonds.

Functions of fatty acids:

1) Source of energy in stored forms
2) Solubilize vitamins like A, D, E, and K.
3) Building units of majority of lipids
4) Constituent of phospholipids

3 Q.3. a) What are lipids chemically ? How they are classified (4)

Ans. Chemically lipids are esters of fatty acid with glycerol.

Simple lipid – Fat and Oil – Sterin fat, Waxes – e.g. bee. Wax
Compound lipid – Fatty acid + glycerol + Prospthetic
a) Phospholipid – e.g. Lecithin, Cephalin etc.
b) Glycolipid – e.g. Kerasin, nervon, oxynervon

Derived lipid – e.g. Steroids, terpanes-caretnoids.

b) Define glycoside Give classification of glycoside

Ans Definition . Anaerobic conversion of glucose to pyruvic acid. Sequence of reaction that can operate without oxygen. Conversion of glucose to pyruvic acid and then to either ethyl alcohol or lactic acid.

Classification of the glycoside as follows. (4)

1. Cynophoric glycoside or cynogenic – e.g. Amygdation (yield HCH)
2. Mustered oil glycosides e.g. Digitalis (Yield is otherocynate)
3. Saponins...e.g. Digitalis (on hydrolysis yield different sugars)
4. Phenolic glycosides e.g. arbutin, salicin, indicant (Containing phenolic group)

Q.4.a) What is mean by essential amino acids ? Classify amino acids on the basis of composition with suitable examples (4)

Ans. **Definition :** Amino acids are organic acids which contain both basic (amino - NH_2) and acidic (carboxyl COOH) groups .

Classification on the basis of composition as.

1. Simple amino acid
2. Hydroxy anino acid
3. Sulphur containing amino acids
4. Acidic or discorboxycylic amino acid.
5. Basic amino acids
6. Aromatic amino acids
7. Aromatic amino acids
8. Heterocyclic amino acid
9. Non protein amino acid

b) Describe ß- oxidation of fatty acids with generation of ATP molecules

Ans. Beta oxidation of fatty acid (5 steps) (4)

1. Activation of fatty acid
2. Formation of unsaturated Acyl. COA
3. Formation of Beta hydroxyl Acyl-COA
4. Formation of Beta – Ketoacyl-COA
5. Thiolytic cleavage of acyl-COA

Q.5 a) What are proteins ? Classify proteins on the basis of composition with suitable Examples.

Ans. **Definition** : any of a class of nitrogenous organic compounds which have large molecules composed of one or more long chains of amino acids and are an essential part of all living organisms, especially as structural components of body tissues such as muscle, hair, etc., and as enzymes and antibodies. (4)

Protein classified as

Simple protein – subclassified on solubility
Complex protein-subclass on prosthetic gross
Derived protein – subclass on rgdrolysis stage

b) Define nucleic acids ? State the functions of nucleic acids.

Definition : The nucleic acids are biopolymers of high molecular weight with mononucleotide as their repeating units.

Functions of nucleic acids

1) Transmission of hereditary Characters (DNA)
2) Synthesis of proteins (RNA)

DNA - Store house of genetic information control prote n synthesis in cell. Direct synthesis of RNA

RNA - Direct synthesis of specific proteins.

m-RNA - To take genetic massage from RNA

t- RNA - Transfer the activated amino acids to the site of protein synthesis.

r- RNA - Function not clearly understood. Mostly present in ribosomes and responsible for stability of m-RNA.

Q.6. a) Classify enzymes as per IUB system of classification. Explain any four (4) factors which affects enzyme activities.

Ans. Enzymes are classified as per IUB system into six classes.

i) Oxidoreductase e Ascorbic oxidase, succinicadehy drogenase
ii) Transferase –e.g. ransketolase,transmethylase
iii) Hydrolases-e.g. l. pase, urease, pepsin, amylase,
iv) Lyases-e.g. carbo ,lases, aldolases, fumarase
v) Isomerases-e.g. T iosephosphate Isomerase, epimerase, alanine recimased
vi) Ligase-Succinic t iokinase, Glutamine synthetase.

Factors affecting enzyme activity

1. pH 2. Temperature 3. Substrate concentration
4. Enzyme concentration 5. Concentration of activation
6. Cone of Inhibitor 7. Ionic strength
8. Redox potential

b) Differentiate between reducing sugar and non-reducing sugar. (4)

Reducing sugar	Non reducing sugar
1. Posses free aldehyde or ketone Group (which reduces meta. ions Under alkaline condition)	1. Not posses free aldehyde or ketone group
2. They are in hemiacetal or hemiketal forms	2. They are in acetal or ketal forms
3.Forms osazone when react with phenyl hydrazine	3.Does not form osazone
4.Exhibit mutarotation	4. Does not exhibit mutarotation
5. Ex. Glucose, fructose,lactose,maltose	5. Ex Sucrose,starch,glycogen cellulose

Q.7 a) Enlist various methods of gene transfer

Ans: **Ans** : The various gene transfer methods are as follows :

1. Electroporation
2. Particle bombardment
3. Macroinjection
4. Microinjection
5. Liposome-mediated transformation
6. Pollen transformation
7. Fiber mediated gene transfer.
8. *Agrobacterium* mediated gene transfer

b) Explain in detail *agrobacterium* mediated transformation with suitable diagram.

Ans : 1) *Agrobacterium* mediated gene transfer : The gene transfer through *agrobacterium* is achieved in the following two ways : A) Co-culture with tissue explants B) *In planta* transformation.

A) Co-culture with tissue explants : The appropriate gene construct is inserted within the T-region of a disarmed Ti plasmid; either a co-integrate or a binary vector is used. The recombinant DNA is placed in *Agrobacterium* which is the co-cultured with the plant cells or tissues to be transformed for about 2 days. In case of many plant species, small (a few mm diameter) leaf discs are excised from surface sterilized leaves and used for co-cultivation. E.g. tomato, tobacco, petunia etc.

The use of leaf disc for co-culture is better than that of protoplasts or cultured cells since last two are likely to show somaclonal variation

Q.8 Define somaclonal variation.

Ans : Somaclonal variation: The heritable variation for quantitative traits present in the cell cultured *in vitro* is called as somaclonal variation.

b) Give the applications and causes of somaclonal variation.

Applications of somaclonal variation:

1. Novel variants can rise and these can be agronomically used. (New breeding lines)
2. It is useful in diseases resistance.
3. It is useful in abiotic stress resistance.
   a. Salt tolerance
   b. Aluminum tolerance.
   c. Drought tolerance.
   d. Herbicide tolerance.

Causes of somaclonal variation.

1. Changes in the chromosome structure
2. Changes in the chromosome number
3. Genetic mutation
4. Cytoplasmic genetic changes
5. Mitotic crossing over
6. Increased amount of DNA content

.9 Define molecular marker

Ans . A DNA sequence used to mark or track a particular location (locus) on a particular chromosome is called as molecular marker.

Write down molecular marker applications.

Ans .Applications of molecular markers in crop improvement are as below.

1. Resistance breeding

2 Pyramiding of major/minor genes into cultivars for development of durable resistance multiple resistance
3 Improvement of qualitative characters
4 Molecular markers for hybrid vigor.
5 The MAS is especially useful for the traits such as male fertility restoring genes and for cytoplasmic male sterility
6. Molecular markers and abiotic resistance

Q.10.. Define micropropagation.

Ans. Clonal propagation through tissue culture is called micropropagation. Shoot tip or meristem culture of many plant species can successfully be used for micropropagation.

b) Explain in detail the applications of micropropagation.

Application :

1) The first application of micropropagation is to obtain virus free plants. It can be also used for obtaining plants free from mycoplasma, fungi and bacteria in a range of crops. In India some valuable clones of potato, sugarcane etc. have been freed from virus infection through meristem culture. This application is of great value particularly in maintenance of breeding materials and Germplasm exchange which are invaluable for any breeding programme.
2) Micropropagation technique is highly suited for rapid multiplication of rare genotypes.
3) The plants obtained are free from bacteria, fungi while conventional methods propagate disease as well.
4) Plants are easy to export since there is no contamination. So quarantine problem and their packing is easy.
5) In dioecious species, plants of the desired sex can be selectively multiplied by micropropagation.

SECTION "B"

Q.11 Define the following terms. (8)

1. **Buffer** A **buffer solution** is one that resists a change in pH on the addition of acid (H^+) or base (OH^-), more effectively than an equal volume of water.
2. **Rancidity** In lipids or oilsa oxidative spoilage of oils or fatty acids with foul smell or bad odor.
3. **Mutarotation** The change in specific rotation of a pyranose or furanose sugar or glycoside accompanying the equilibration of its alpha and beta anomeric forms.
4. **Disachharides** Disachharides yield two monosaccharide's on hydrolysis.
5. **Phospholipids** : A lipid composed of two fatty acids linked through glycerol phosphate to one of a variety of polar grops.
6. **Restriction enzyme** : An endonuclese, which cut (cleaves) a DNA molecule within certain specific sites that have specific base sequence.
7. **Callus** : An unorganized mass of cells is called as callus

8. **Cybrid** : A somatic hybrid in which nucleus is derived from one parent and cytoplasm is derived from both the parent is called as Cybrid.

Q.12. **Give the contribution of following scientists** (8)

Ans :

1. Antoine Lavoisier: Father of Biochemistry.
2. Berzelius: Sugested the name proteins.
3. F.Laibach: Used the embryo culture technique to raise viable plants from unsuccessful crosses
4. H. G. Khorana : He developed the artificial gene for the first time
5. G. Haberlandt: Father of plant tissue culture
6. Guha & Maheshwari: They developed haploid plants in *Datura*
7. Waston & Crick : Helical model of nucleic acid.
8. Louis Pasteur : Identified organisms responsible for fermentation.

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