BIOCHEMISTRY FINAL EXAMINATION 2012
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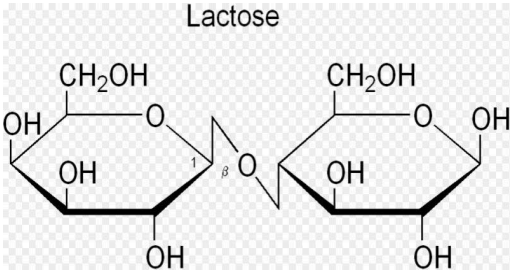
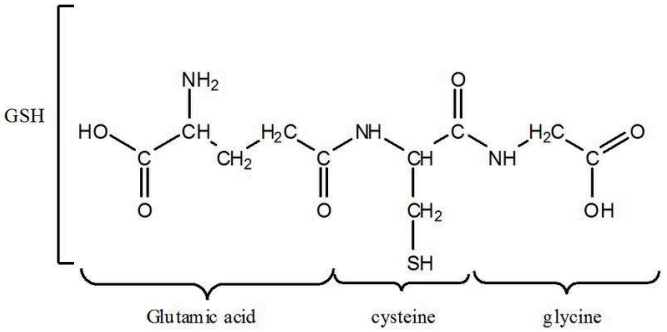
p.s: Each questions will have a complete page so that it easy to be read.

1. Write the structural formula of the following: (6m)

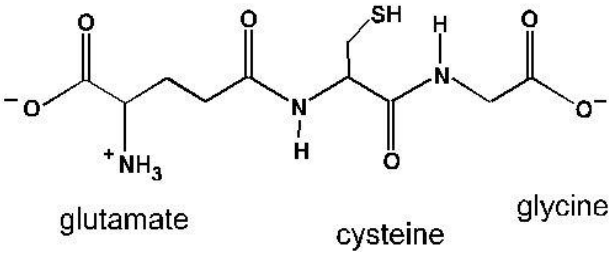
a. Lactose



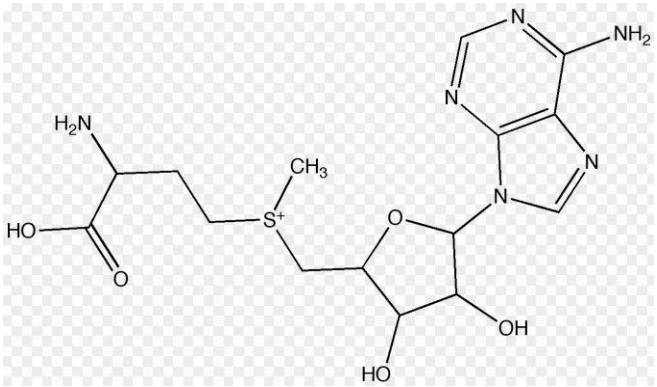
b. Glutathione



or



c. S-adenosyl methionine



d. Lecithin *sorry couldn't find it on the web.

2. Define each of the following: (6m)

a. Invert Sugar

It is the sugar that contains equal number of both glucose and fructose molecules (unbound).

b. Zwitter ion

It is the amino acid that carries both positive and negative charges. It is electrically neutral (= net charge is zero) and cannot migrate in electric field.

c. Ecosanoid

Cyclic compound that derived from arachidonic acid after cyclization of its carbon chain to form a ring.

d. Elution

It is the recovery of adsorbed material from adsorbing agent.

3. What is the biochemical role of the following: (8m)

a. 53 protein

It is the tumor suppressor protein. It functions are:

- *Regulate cell cycle.*
- *Control damage DNA and repair.*
- *Apoptosis.*
- *Protection against viral infection.*

b. Vitamin K

- *Synthesis of some blood clotting factors in liver: prothrombin, factors VII, IX, X.*
- *Synthesis of osteocalcin (calcium binding proteins) in bones.*

c. Pepsin Enzyme

- *It is endopeptidase i.e acts on the amino acids in the middle of polypeptide chains.*
- *It hydrolyze the bonds formed by aromatic amino acids e.g tyrosine*
- *Pepsin releases large polypeptides and few free amino acids from dietary proteins.*

d. Coenzymes

- *Acts as hydrogen carriers.*
- *Carriers of groups other than hydrogen.*
    1. *Coenzyme A: acid carrier*
    2. *Thiamine diphosphate (TPP): CO2 and ketol group carrier.*
    3. *Biotin: CO2 carrrier.*
    4. *Phyridoxal phosphate: Amino group carrier.*
    5. *Folic acid: One carbon group carrier.*
    6. *Cobalamine: Methyl group carrier.*

4. Compare between the following and mention two differences only: (10m)

a. Leading and lagging strand

Leading Strand	***P.O.C***	***Lagging Strand***
Towards the replication fork.	***Direction of Copying***	*Away from the replication fork.*
Almost continuously.	***Synthesized***	*Discontinuously.*
No.	***Okazaki Fragments***	*Yes.*
Few.	***RNA Primers***	*Common.*

b. Non competitive and competitive inhibitors

Non competitive	***P.O.C***	***Competitive***
Yes.	***Structural similarity with substrate***	*No.*
Catalytic site of the enzyme.	***Binding site***	*Different sites on the enzyme.*
Same.	***Effect on V_{max}***	*Decreases.*
Increases.	***Effect on K_m***	*Same.*

c. Denaturation of protein and DNA

Protein	***P.O.C***	***DNA***
Unfolding and loss of secondary, tertiary and quarternary structure.	***Definition***	*Separation of the two strands of DNA.*
Heat, Organic Solvents, Detergents, Mechanical Mixing, Strong Acid or Bases, Heavy Metals, Alkaloidal Reagents, Enzymes, Urea, Ammonium Sulphate, Sodium Chloride and repeated freezing and thawing.	***Causes***	*Change of pH.* *Heat: about 100C.*
May be reversible (rare).	***Effect***	*Reversible when renaturation occurs.*

d. Collagen and Hemoglobin

Collagen	***P.O.C***	***Hemoglobin***
Fibroblasts	***Formation***	*Heme and Globin*
• *Provides the framework for various organs such as kidney.* • *Gives great support and strength to structure such as bones.*	***Functions***	• *Carries O2 to tissues and removes CO2 from them to the lungs.* • *Acts as blood buffer*

e. Eukaryotic and prokaryotic

Eukaryotic	***P.O.C***	***Prokaryotic***
Organism whose cells contain limiting membrane around nuclear material.	***Definition***	*Organism whose cells contain no mitochondria and its DNA not enclosed within a membrane and does not undergo mitosis during replication.*
Human Cells.	***Example***	*Bacterial cells.*
1. Nucleus *2. Mitochondria*	***Site of DNA***	*There is a single chromosome that contains DNA.*

5. On biochemical basis, explain the following: (8m)

a. Phospholipids are ampiphatic.

<u>Structure of phospatidic acids:</u>
Glycerol + Saturated Fatty Acid + Unsaturated Fatty Acid + Phosphoric acid residue.

Phospholipids arrange themselves in bilayers.
Positioning their polar groups towards the surrounding aqueous medium, and their lipophilic chain toward inside the bilayer.

b. Racemic mixture shows no optic activity.

It is the mixture containing equal number of molecules of 2 optically active sugars, one is dextro-rotatory and other is levo-rotatory. Thus, it shows no optical activity (provided that the angle of rotation is equal in both sides).

c. Cancer of the skin may be caused by ultra-violet rays.

It cause cancer through:
- *Direct contact on DNA → DNA damage → Cancer formation.*
- *Formation of free radicals e.g superoxide → DNA damage → Cancer formation.*

d. Puromycin inhibits protein synthesis.

Its structure resembles the structure of aminoacyl-tRNA.
It becomes encorporated into the growing peptide chain,
thus causing inhibition of further elongation.

6. Give a short account of the following: (12m)

a. Post transciptional modification of mRNA.

This occur only in Eukaryotic messenger RNA.

Primary RNA = Hetergenous RNA (hnRNA) is modified into mature RNA in the nucleus by 3 steps.

i- 5' capping

- *5' end requires a cap (7 methyl-guanosine trisphospate).*
- *Attached by 5' to 5' trisphospate linkage.*
- *Enzyme: Guanyl Transferase*
- *Function:*
  1. Facilitate the initiation of translation
  2. Protects the 5'end of mRNA from attack by 5' exonucleases.

ii- Addition of poly A tail

- *Requires 40 to 200 adenine nucleotides added at 3' end.*
- *Enzyme: poly A polymerase enzyme.*
- *Function:*
  1. Protect the 3' end of mRNA from 3' exonucleases attack.

iii- Splicing (Removal of introns)

- *Exons – translated into amino acids.*
- *Introns – will not be translated and must be removed before translation takes place.*
- *Requires: Spliceosomes.*
- *Spliceosomes consist of:*
  1. primary hRNA.
  2. More than 50 proteins.
  3. Five small nuclear RNAs (U1, U2, U5 and U4/U6)
  The role of snRNP is to bind each end of the introns by forming base pair with each other.
- *Spliceosomes also facilitates the transport of mature mRNA from the nucleus to the cytoplasm.*

b. Ideal tumour markers.

Properties of ideal tumour markers:

- *High disease sensitivity.*
  It should be positive in all patients with particular cancer.
- *High disease specificity.*
  It should be negative in all normal population.
- *Its level reflects the stage of disease.*
- *Its level must be stable.*
  Not subjected to marked fluctuation in stable state diseases.
- *Organ specific.*
  Positive only in certain organ tumour.

c. Visual cycle.

Rhodopsin consists of protein called opsin bound to 11-cis retinal (double bond at position 11 in cis form, while other double bonds are in trans form.)

When rhodopsin is exposed to dark light, 11 cis retinal is converted into all trans retinal (all double bonds are in trans form).

All retinal changes the permeability of cell membrane of rod cells. This allows the calcium ions to pass out of the cell membrane. This stimulates the nerve impulse in optic nerve. Thus the brain perceives light.

d. Isoenzyme

<u>Definition:</u>
Isoenzymes are different molecular forms of the enzyme that

- *activate the same reaction,*
- *use the same coenzyme and*
- *same substrate*
- *but they are different in chemical properties structure.*

This leads to:

- *Different immunology reactions.*
- *Different K_m and V_{max}.*
- *Different physical properties.*

<u>Example:</u>

- *Lactate dehydrogenase enzyme (LD)*
  There are 5 isoenzymes of LD: LDI_1, LDI_2, LDI_3, LDI_4, LDI_5.

7. Clinical case: (5m)

A 38 years old vegetarian female with gradually worsening fatigue, neurologic and gastro intestinal symptoms and megaloblastic anemia.

a. What is the most reliable diagnosis?

Megaloblastic Anemia

b. What is the most probable cause?

Deficiency of Vitamin B12.

- *Atrophy of gastric mucosa → due to lack intrinsic factor → anemia.*
- *Antibodies against gastric parietal cell.*
- *Antibodies against intrinsic factor.*
- *Defective absorption as in sprue or regional enteritis.*

c. What are the proper treatments?

Administration of Vitamin B12 by injection.

d. What is the biological basis of megaloblastic anemia?

It is macrocytic hyperchromic anemia.

- *Abnormal replication of DNA in hematopoietic tissue.*
- *Direct insufficiency of folate or indirectly to a cobalamin deficiency.*