Question Bank with Solution T 2.4.5 Pharm Chem-V (Biochemistry)

Carbohydrates

1. Define carbohydrates.

Ans. Carbohydrates are defined as polyhydroxy derivatives of aldehydes or ketones. For example: Glycerol on oxidation is converted to D-glyceraldehyde, which is a carbohydrate derived from the trihydric alcohol (glycerol).

2. What are epimers explain with examples.

Ans. When the stereo isomers (sugars) differing in the orientation of H+ and OH– groups in a single 'C' atom they are called epimers.

Example: Glucose and galactose are epimers at 4th 'C' atom. Because they differ in the spatial configuration of OH and H at 4th 'C' atom. Similarly glucose and mannose are epimers of 2nd 'C' atom.

3. What is mutarotation?

Ans. The gradual change in the specific rotation (optical activity) of a freshly prepared solution of monosaccharide until it remains constant on standing is called muta rotation.

Example:

α–D-glucose → Glucose at → β–D-glucose + 19°
+ 112° (specific rotation) equilibrium + 52.5° (specific rotation)

4. What is the composition of disaccharides and explain how the monosaccharide units are joined in their structures. Explain the biological importance of disaccharides.

Ans.

Sr. No.	Sugar	Composition and linkage	Biological importance
1	Sucrose (non reducing disaccharide)	α D–glucose and β D–fructose linked by α 1 β 2 glycosidic linkage.	Table sugar
2	Maltose (reducing disaccharide)	2 α D–glucose units α 1, 4 glycosidic linkage.	Obtained by hydrolysis of starch
3	Lactose (reducing disaccharide)	b D–galactose and β D–glucose. β 1, 4 glycosidic linkage	Present in milk

5. What are the soluble and insoluble portions of the starch?

Ans. Starch is physically separated into two components. They are amylose and amylopectin. Amylose is soluble portion of starch (10–20 %) and amylopectin is insoluble portion of starch (80–90 %).

Lipids

1. Define Lipids.

Ans. The lipids are heterogeneous group of compounds which are insoluble in water but soluble in non-polar solvents such as ether, chloroform and benzene. All lipids invariably contain fatty acids.

2. Give the classification of fatty acids. Give examples.

Ans. Fatty acids are classified into

(1) Saturated fatty acids, (2) Unsaturated fatty acids, (3) Cyclic fatty acids.

Saturated fatty acids: All the naturally occuring fatty acids have even number of 'c' atoms. Most predominant fatty acids which occur in nature are:

(i) Palmitic acid (C16 fatty acid) (ii) Stearic acid (C18 fatty acid)

Unsaturated fatty acids: These contain one or more than one double bonds in them. They are: (i) Oleic acid (most common unsaturated fatty acid)

Polyunsaturated fatty acids: Linoleic acid (2 double bond), Linolenic acid (3 double bond) and Arachidonic acid (4 double bond).

3. Give the classification of lipids.

Ans. Lipids are classified into three groups:

1. Simple lipids (Alcohol + Fatty acids i.e. glycerol + 3 FA's)

2. Complex lipids (Compound lipids) (Alcohol + FA's + groups)

(a) Phospolipids (Alcohol + FA + Phosphoric acid + 'N' base/other group.

(b) Glycolipids [Sphingosine (Alcohol) + FA + Carbohydrate].

3. Derived lipids: These are obtained by the hydrolysis of simple and complex lipids. Examples: Fatty acids, Glycerol, Steroids etc.

4. Define Phospholipids. Discuss in brief functions of phospholipids.

Ans. Phospholipids are made up of alcohol, fatty acid, phosphoric acid and a nitrogenous base or other group.

Sr. No.	Phospholipid	Nitrogen base or other group	Functions
1	Phosphatidyl inositol	Inositol	By hormone agonist it is cleaved to DAG and IP3 which act as second messengers in signal transduction.
2	Cephalin	Ethanolamine	Present in the biomembranes.
3	Cardiolipin	PA–glycerol –PA	Present in mitochondrial membranes.
4	Lecithin	Choline	(*a*) Present in cell membranes. (*b*) Involved in the formation of lung surfactant (dipalmitoyl lecithin) and the defect in its synthesis results in the development of respiratory distress syndrome. (*c*) Involved in the formation of cholesterol esters and lipoproteins.
5	Phosphatidyl serine	Serine	Present in the biomembranes.

5. What are eicosanoids and what are their functions.

Ans. The compounds derived from arachidonic acid are called Eicosanoids. These are

(a) Prostaglandins (PGs) : They cause contraction of pregnant uterus and therefore they can be used in the induction of labor or medical termination of pregnancy.

(b) Prostacyclins (PGI2): These prevent platelet aggregation and act as vasodialators.

(c) Thromboxanes (TX2): These cause platelet aggregation and forms thrombus.

(d) Leucotrienes: These are formed as the products of mast cell degradation.

6. Define rancidity. What are causes of rancidity.

Ans. Rancidity is the term used to represent the deterioration of fats and oils resulting in an unpleasant taste.

Rancidity occurs when fats and oils are exposed to air, moisture, light, bacteria. Hydrolytic rancidity occurs due to partial hydrolysis of triacylglycerols by bacterial enzymes. Oxidative rancidity is due to oxidation of unsaturated fatty acids. This results in the formation of unpleasant products such as dicarboxylic acids, aldehydes, ketones etc. Rancid fats and oils are unsuitable for human consumotion.

7. Enlist the tests used to check the purity of oils and fats.

Ans. Tests are iodine number, acid number, saponification number, peroxide number, Reichert-Meissl (RM) number etc.

8. What are Glycolipids and what are their important functions?

Ans. Glycolipids contain ceramide (Sphingosine + FA) and sugar. These are:
(*a*) Cerebrosides (Galacto or glucoceramides).
(*b*) Sulfatides (Sulpho galacto ceramide) present in myelin.
(*c*) Gangliosides (Glucosyl ceramide + sialic acid). Glycolipids are present in the nervous tissues and cell membranes.

9. Discuss the functions of phospholipids.

Ans.

- In association with proteins, phospholipids form the structural components of membranes and regulate membrane permeability.
- Participate in the absorption of fat from the intestine.
- Essential for the synthesis of different lipoproteins, and thus participate in the transport of lipids.
- Arachidonic acid, an unsaturated fatty acid liberated from phospholipids, serves as a precursor for the synthesis of eicosanoids (prostaglandins, prostacyclins thromboxanes).
- Participate in the reverse cholesterol transport and thus help in the removal of cholesterol from the body.

10. Name the fused ring system present in cholesterol.

Ans. A Cyclo-pentano-per hydro-phenanthrene ring.

11. In which form are the fats stored in the body for long-term storage of energy.

Ans. Triacylglycerol.

12. What are the uses of Liposomes?

Ans. They act as drugcarriers for the specific target sites without causing side effects. Also used for gene therapy.

13. Give two examples of unsaturated fatty acids.

Ans. Oleic. Linoleic,Linolenic acid etc.

14. Which alcohol is generally present in waxes?

Ans. The Cetyl alcohol is present in waxes.

15. Which phospholipid in a reservoir for second messenger?

Ans. PhosphatidylInositol.

16. What are neutral lipids?

Ans. Because they are uncharged, Acylglycerols (glycerides), cholesterol, and cholesteryl esters are termed neutral lipids.

Vitamins

1. Which vitamin deficiency is associated with egg white injury?

Ans. Raw egg whites contain Avidin, a glycoprotein that strongly binds to biotin and prevents its absorption. Thus, the ingestion of large quantities of raw egg white over a long period can result in a biotin deficiency.

2. Which vitamin participates in the absorption of calcium from gut?

Ans. Vitamin D has an active role in the absorption of calcium from gut. Vitamin D promotes the synthesis of calbindin protein that promotes the absorption of calcium from gut. This action is brought about through nuclear receptors. it acts like a steroid hormone, binding to nuclear receptors and enhancing gene expression, although it also has rapid effects on calcium transporters in the intestinal mucosa.

3. Name an FMN dependent enzyme.

Ans. L- amino acid oxidase that catalyzes the oxidative decarboxylation of amino acids requires the presence of FMN as a coenzyme.

4. Name the vitamin that acts as a coenzyme for the post translational modifications of prothrombin.

Ans. The post translational modifications of prothrombin are carried out by gamma carboxylation of its glutamic acid residues. The reaction is catalyzed by carboxylase enzyme which requires vitamin K as a coenzyme. CO 2 and O2 are also required for this carboxylation process.The ability to bind calcium ions (Ca2+) is required for the activation of the seven vitamin K-dependent clotting factors, or proteins, in the coagulation cascade. Vitamin K-dependent gammacarboxylation of specific glutamic acid residues in those proteins makes it possible for them to bind calcium.

5. Name a water-soluble vitamin that is required for the synthesis of collagen.

Ans. Vitamin C is required for the synthesis of collagen. The enzymes Prolyl and lysyl hydroxylases require vitamin C for their actions to form hydroxy proline and hydroxy lysine from proline and lysine respectively. These post translational modifications are required for the formation of triple helical structure of collagen. Deficiency of vitamin C leads to impaired hydroxylation reactions with the resultant formation of a weak collagen.

6. What are folate antagonists? Enlist a few clinically important Folate antagonists.

Ans. Folate antagonists were originally developed as antileukemic agents, but are now being used and/or investigated in the treatment of a wide range of cancerous and non-cancerous

diseases. Sulfanilamide and Trimethoprim are antibiotics, Pyrimethamine is antimalarial while Methotrexate is an anticancer drug.

7. Name the coenzyme for the reaction for the conversion of Pyruvate to alanine.

Ans. Pyruvate to Alanine conversion is catalyzed by Transaminase (SGPT- Alanine transferase), that requires vitamin B6-P as a coenzyme.

8. Name the active form/forms of Riboflavin.

Ans. Riboflavin (B2) exists in two active forms FMN (flavin mono nucleotide) and FAD (flavin adenine dinucleotide). In the body, riboflavin occurs primarily as an integral component of the enzymes. These coenzymes participate in a large majority of the reactions in the body.

9. Which vitamin is required for the absorption of amino acids from the gut?

Ans. Vitamin B6 is required for the active absorption of amino acids from the gut.

10. What are Fat soluble vitamins?

Ans. Fat soluble vitamins are A, D, E and K.

11. What are water soluble vitamins?

Ans. Water soluble vitamins are B group vitamins (B1, B2, niacin, B6, pantothenic acid, Biotin, lipoic acid, folic acid, B12) and Vitamin C.

12. What are the clinical manifestations of B12 deficiency?

Ans. The hallmark of symptomatic vitamin B12 deficiency is megaloblastic anemia. The megaloblastic state also produces changes in mucosal cells, leading to glossitis, as well as other vague gastrointestinal disturbances such as anorexia and diarrhea. Cobalamine deficiency also can present with numerous neurologic manifestations including: numbness, paresthesias, weakness, ataxia, abnormal reflexes.

13. What are the functions of calcitriol?

Ans. Calcitriol causes the formation of CBP by stimulating the transcription and translation processes in the intestinal cells. CBP in turn causes absorption of Ca++ and phosphate at brush border of intestine. The translocation of calcium takes place by CT against the concentration gradient.

14. Which vitamin is required as coenzyme for the activity of lactate dehydrogenase enzyme?

Ans. Lactate dehydrogenase catalyzes the interconversion of pyruvate and lactate. Niacin in the form of NAD+ is required as a coenzyme for the activity of lactate dehydrogenase enzyme.

15. What are the co-enzymes containing B group vitamins.

Ans.

Co-enzyme B group	**Vitamins**
(*a*) TDP	B1
(*b*) FMN and FAD	B2
(*c*) NAD and NADP	Niacin
(*d*) Pyridoxal phosphate	B6
(*e*) Co-enzyme – 'A'	Pantothenic acid
(*f*) Tetrahydro folic acid (FH4)	Folic acid
(*g*) Methyl cobamide co-enzyme	B12
(*h*) Biotin	Biotin
(*i*) Lipoic acid	Lipoic acid

16. Name the synthetic form of vitamin K?

Ans. Three compounds have the biological activity of vitamin K phylloquinone, the normal dietary source, found in green vegetables; menaquinones, synthesized by intestinal bacteria, with differing lengths of side chain; and menadione and menadiol diacetate, synthetic compounds that can be metabolized to phylloquinone.

17. Which vitamin/vitamins participate in the synthesis of catecholamines?

Ans. Vitamin C and B6 are required for the synthesis of catecholamines. B6 is required for the decarboxylation and vitamin C is required for the hydroxylation reactions.

18. Name the inhibitors of vitamin K that act as anticoagulants.

Ans. Although vitamin K is a fat-soluble vitamin, the body stores very little of it, and its stores are rapidly depleted without regular dietary intake. The oral anticoagulants, such as Dicumarol and warfarin, inhibit coagulation through antagonism of the action of vitamin K.

19. What is the function of lipoic acid?

Ans. Lipoic acid is one of the co-enzymes required for the conversion of pyruvic acid to acetyl CoA. Its role is that it carries the acyl radical in the form of S–acetyl lipoate.

20. Name a vitamin, the deficiency of which is detected by Reduced Red cell Glutathione reductase activity.

Ans. The deficiency of vitamin B2 is detected by estimating RBC Glutathione reductase enzyme.

21. What are the biochemical functions of ascorbic acid.

Ans. Vitamin C is required for the hydroxylation of proline to hydroxy proline and lysine to hydroxy lysine. By this reaction pro-collagen is converted to collagen, which is required for the formation of intercellular cement substance of capillaries and other tissues. Vitamin C acts as antioxidant in reducing oxidised Vitamin E and thus prevents free radical formation.

22. Name the vitamin that is required as a coenzyme for the conversion of Acetyl co A to Malonyl co A?

Ans. The conversion of Acetyl co A to malonyl co A , the first step of fatty acid synthesis, is catalyzed by Acetyl coA carboxylase enzyme, that requires biotin as a cofactor. It is a carboxylation reaction.

23. What are the functions of Vitamin E.

Ans. It is an antioxidant and prevents the free radical formation. Vitamin E and selenium act synergistically against lipid peroxides. Selenium is a cofactor required for GSH peroxidase.

24. Which out of the two oxidases, L-Amino acid Oxidase or D- amino acid Oxidase, require FMN as a prosthetic group?

Ans. L-amino acid oxidases require FMN while FAD is required by D- Amino acid oxidases.

25. Which vitamin participates in decarboxylation reactions of amino acids?

Ans. Decarboxylation reactions of amino acids are catalyzed by decarboxylases that require B6 as a coenzyme. The neurotransmitters serotonin, GABA, Dopamine, norepinephrine and epinephrine are produced by decarboxylation of amino acids.

26. Name the antioxidant vitamins.

Ans. An antioxidant is a substance that significantly decreases the harmful effects of “reactive species”, such as reactive oxygen and nitrogen molecules that disrupt normal physiological function on a cellular level in humans. Examples include the antioxidant vitamin C, vitamin E, and the carotenoids (vitamin A).

27. What are the target organs /tissues for the action of vitamin D ?

Ans. The target organs for vitamin D are bone, intestine and kidney. The basic function of vitamin D is to promote the reabsorption of calcium so as to maintain the serum calcium levels and to promote the mineralization of bones.

28. What is the active form of vitamin B6?

Ans. Vitamin B6, also called pyridoxine is active in the pyridoxal-phosphate form. There are six forms of vitamin B6: pyridoxal (PL), pyridoxine (PN), pyridoxamine (PM), and their phosphate derivatives: pyridoxal 5′-phosphate (PLP), pyridoxine 5′-phosphate (PNP), and pridoxamine 5′-phospate (PNP). PLP is the active coenzyme form, and has the most importance in human metabolism.

29. Which vitamin deficiency is known to cause bleeding gums?

Ans. Vitamin C deficiency causes bleeding gums. Gums may become swollen, purple, spongy, and friable; they bleed easily in severe deficiency.

30. Which vitamin deficiency is associated with Burning feet syndrome?

Ans. Mostly deficiency of Pantothenic acid is associated with burning feet syndrome.

31. Total non vegetarian diet can produce scurvy, is it true or false?

Ans. It is true. Vitamin C is mainly present in citrus fruits and green leafy vegetables. Hence a pure non vegetarian diet can precipitate vitamin C deficiency.