

UNIVERSITY OF LONDON  
INSTITUTION OF BIOLOGICAL SCIENCES  
MEDICAL LABORATORY SCIENCE  
Belt 202.

Question

1) Classify Vitamins. Hence write on the biochemical significance of Vitamins.

Vitamins can be classified based on

1) Water-soluble Vitamins

2) Fat Soluble Vitamins

Water-soluble vitamins are Vitamin B & C Complex which are Vitamin B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>5</sub>, B<sub>6</sub>, folate, Vitamin B<sub>12</sub> Vitamin C, Biotin

While fat soluble vitamins are Vitamin A, D, E and K

Biochemical Significance are

A) Vitamin acts as a regulator of cell and tissue growth and differentiation

B) Vitamin D provides a hormone-like function, regulatory mineral metabolism for bones and other organs.

C) B-complex vitamins function as enzymes cofactors or the precursor for them.

2) Water soluble vitamins are precursor of coenzymes, with the aid of two named vitamins, describe the role of coenzymes in metabolism = (1) Riboflavin (2) Niacin.

1) Riboflavin: is a precursor of coenzymes flavin mononucleotide and flavine adenine dinucleotide are required by several oxidation-reduction reactions in metabolism e.g. Carbohydrate, protein, lipid, nucleic acid metabolism and electron transport chain.

2) The role of coenzymes in metabolism - Coenzymes play a role in group-transfer reactions such as ATP, coenzymes are frequently consumed and recycled.

3) Describe the nomenclature of Nucleosides, Nucleotides and nucleic acid.

Nomenclature of Nucleosides, Nucleotides

When ribose sugar is combined with a purine or pyrimidine base, then the combination is called nucleoside.

Nucleotide is a combination of base or 2-deoxyribose sugar with phosphate group or a nucleoside with a phosphate group attached.

Nucleoside	Base	Purines (Adenine & Guanine)		Pyrimidines	
	RNA	Adenosine	Cytidine	Cytidine	Cytosine, Uracil, Thymine, Uracil
Nucleotide	DNA	Deoxyadenosine	Deoxyguanosine	Deoxycytidine	Deoxythymidine
		RNA	Adenylate (Amp)	Guanylate (Gmp)	Cytidylate (Cmp)
	DNA	Deoxyadenylate (dAmp)	Deoxyguanylate (dGmp)	Deoxycytidylate (dCmp)	Thymidylate (dTMP)

### Nomenclature of Nucleic Acid.

There are two main types of nucleic acids namely Deoxyribonucleic acid and Ribonucleic acid.

RNA is actually the blueprint of our DNA, while the DNA is always inside the nucleus of our cells. The RNA travels outside the nucleus of our cell to perform its function which are

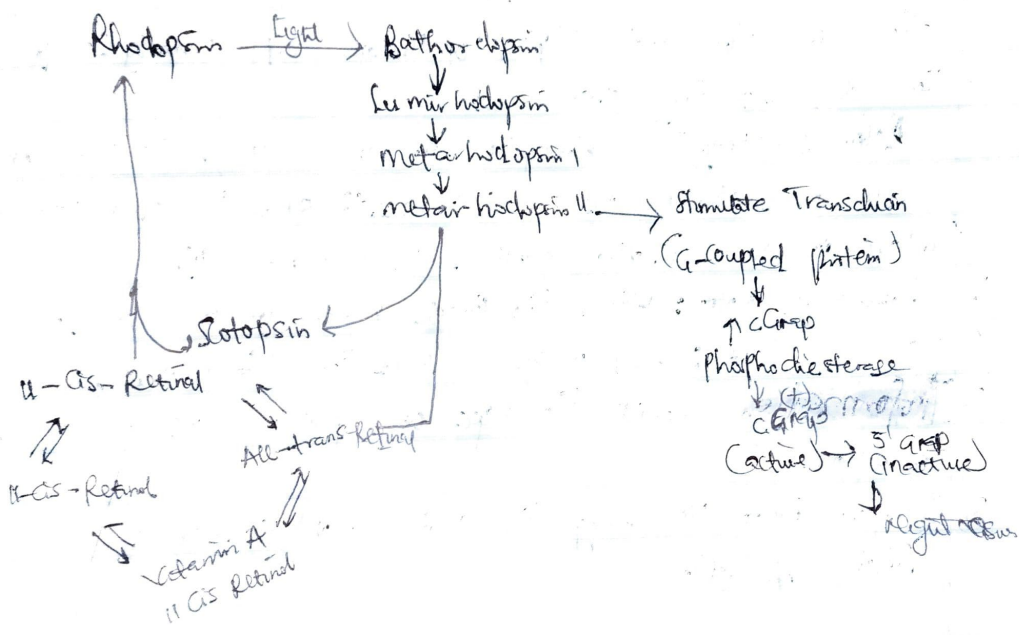
1. Ribosomal RNA: Where the protein maker of our bodies (main part)
2. Messenger RNA: Carries message outside from the nucleus to copy
3. ~~Information~~ **Information**: about the type of protein cells are to be manufactured.
3. Transfer RNA: It brings the amino acid to the ribosome for protein production.

With the aid of an adequate pathway, discuss the involvement of Vitamin A in vision.

Vitamin A is well-known fat soluble. Vitamin found in many supplements and foods as it relate to eyesight, Vitamin A also called all-trans-retinol. It is very useful in helping with vision especially night vision.

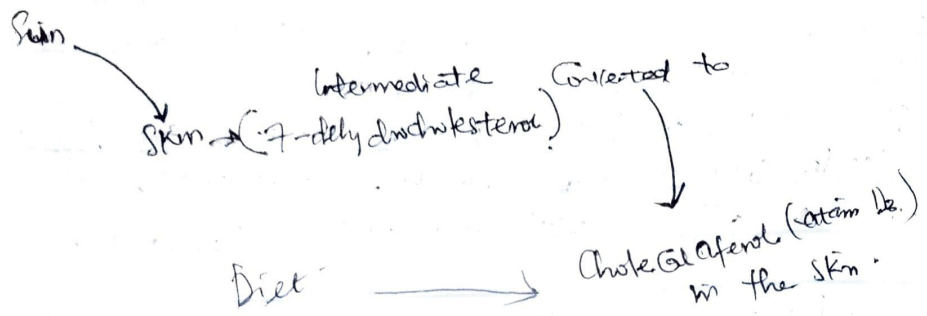
Our ability to see is dependent on two main photoreceptors that sit in the posterior aspect of the eye the rods and cones. Vitamin A is one of the required precursor for the formation of rhodopsin, the photopigment found in rods. Rhodopsin helps us to see at night and without Vitamin A, rhodopsin cannot

form and night blindness occurs. In order for rhodopsin to be formed, Vitamin A must be converted to 11-cis-retinal. This can occur in one of two ways, Vitamin A (all-trans-retinol) can be converted to 11-cis-retinal by isomerase. This 11-cis-retinal can then be converted to 11-cis-retinal. Alternatively now that 11-cis-retinal has been formed, it can combine with scotopsin to form the rhodopsin. As rhodopsin absorbs light in the rods, a conformational change occurs in 11-cis-retinal to become all-trans-retinal. A conformational change also occurs in opsin fragment to form metarhodopsin II, which is activated form of rhodopsin.



Account for the response of an individual's vision on exposure to bright light and dim light. On sudden exposure to bright light, there is a spasm of sensation primarily due to the contraction of the pupils. Fortunately this is almost always temporary until the eyes adjust to the new level of light. On exposure to dim light, the circular muscles contract while the radial muscle relax. This causes the pupil to contract and less light enters the eye. In dim light, pupil expands to allow more light to enter the

6) Describe the biosynthetic pathway involving the exposure of sunlight on skin and its relation to a named vitamin.



7) Comment on the effects of acids and alkalis on nucleic acid.  
Effect of Alkali (pH > 7)

- DNA is not hydrolysed by alkali pH because it does not contain the 2'-OH for base catalysed hydrolysis mechanism
- Although at high pH, there is more concentration of negatively charged hydroxide ions (OH<sup>-</sup>) which pulls the hydrogen from DNA towards it and make it deprotonated
- the higher the pH (> 10) there is extensive deprotonation and this result in denaturation of double stranded DNA. the alkali lysis method is used in isolation of plasmid DNA from bacteria cell, where this principle is applied

Effect of Acid

Hydrolysis occurs

- Depurination (hydrolysis of glycosidic bonds only) at pH > 3 and complete hydrolysis (also cleaving of phosphodiester bond) into component at pH < 2 + heat

the hydrolysis and depurination proceeds by "acid-catalysed S<sub>N</sub>1" reaction mechanism. Nucleophilic centers on Guanine and adenine are N1, N3, N7 and 6th position in which the acid attacks electrophilicity on N7 position. Extremely low pH digest the DNA completely and this is why our stomach pH is low.

8) Write on the contributions of water trick in the structure of DNA

Watson and Crick showed that each strand of the DNA molecule was a template for the other. During cell division the two strands separate and on each strand a new "other half" is built. This way DNA can reproduce itself without changing its structure, except for mutation or occasional errors.

Watson and Crick took a crucial conceptual step suggesting the molecule was made of two chains of nucleotides, each in a helix as other scientists like Franklin had found.

9. In a tabular form, differentiate between DNA and RNA

DNA	RNA
(i) It is a double strand molecule	(i) It is a single stranded molecule
(ii) Contains deoxyribose sugar	(ii) Contains ribose sugar
(iii) Stable under alkaline	(iii) Not stable under alkaline
(iv) DNA is made up of Adenine, Thymine, Cytosine and Guanine	(iv) RNA uses Adenine, Uracil, Cytosine and Guanine

10. Discuss the function of Nucleotides

(i) A nucleotide is a building block of DNA and RNA

(ii) It has a function related to cell signaling, metabolism and enzymes reaction.

#### Discussion

Nucleotide as a build block of DNA and RNA. Nucleotide is made up of three parts, a phosphate group, a 5-carbon sugar and a nitrogenous base. The four nitrogenous bases in DNA are adenine, cytosine, guanine and thymine. RNA contains uracil, instead of thymine. A nucleotide within a chain makes up the genetic material of all known living things.

Free nucleotides play important roles in cell signaling and metabolism, serving as convenient and universal carriers of metabolic energy and high energy electrons.

A nucleotide can be a base on other molecule

~~Such as~~ Adenosine triphosphate (ATP) which is the main energy molecule of the cell. They are also found in Coenzymes like NAD and NADP, which come from ADP. These molecules that contain a nucleotide is cyclic AMP (cAMP), a messenger molecule that is important in many processes including the regulation of metabolism and transporting chemical signals to cell.