1. **Which of the following are Pyrimidine bases?**

a) Adenine and Guanine

b) Guanine and Cytosine

c) Cytosine and Adenine

d) Thymine and Cytosine

e) None

Correct Answer - D

Ans: (D)Cytosine and Adenine

In **DNA** and RNA, Pyrimidine bases form hydrogen bonds with their complementary purines.

Thus, in DNA, the **purines adenine (A) and guanine (G)** pair up with the **pyrimidines thymine (T) and cytosine (C),** respectively.

In **RNA**, the complement of adenine (A) is uracil (U) instead of thymine (T), so the pairs that form are **adenine: uracil and guanine: cytosine.**

- Two types of bases are found in nucleotides : **(i)** purines and (ii) pyrimidines.

.. Purines : Two major purine bases found both in DNAs as well as RNAs are (i) adenine (A) and (ii) guanine (G).

?. Pyrimidines : Three major pyrimidine bases are (i) cytosine (C), (ii) Uracil (U) and (iii) Thymine (T). Cytosine and uracil are found in RNAs and cytosine and thymine are found in DNAs. Uracil is not found in DNAs Q and thymine is not found in RNAs.

Ref: Rodwell V.W. (2011). Chapter 32. Nucleotides. In D.A. Bender, K.M. Botham, P.A. Weil, P.J. Kennelly, R.K. Murray, V.W. Rodwell (Eds), Harper's Illustrated Biochemistry, 29e

2. Major contribution towards gluconeogenesis is by?

a) Lactate

b) Glyerol

c) Ketones

d) Alanine

e) None

Correct Answer - D
D i.e. Alanine

3. Which of the following is not a pyrimidine base ?

a) Cytosine

b) Uracil

c) Guanine

d) Thymine

e) Adenine

Correct Answer - C
Ans. is 'c' i.e., Guanine

Purines	Pyrimidines
Adenine	Cytosine
Guanine	Uraci I
Thymine	

- Both purines (adenine and guanine) are found both in DNA & RNA.
- Among pyrimidines -
- Li Cytosine and uracil are found in RNA (thymine is not found in RNA).
- Cytosine and thymine are found in DNA (uracil is not found in DNA).
- In DNA, adenine is always paired with thymine by two hydrogen bonds; and guanine always paired with cytosine by three hydrogen bonds.

4. Glycogen storage disorder is-

a) Niemann – Pick disease

b) Gaucher disease

c) Tay- Sacks disease

d) Pompe's disease

e) McArdles disease

Correct Answer - D

- **Glycogen storage disease type II**, also called **Pompe disease**, is an autosomal recessive metabolic disorder[1] which damages muscle and nerve cells throughout the body. It is caused by an accumulation of glycogen in the lysosome due to deficiency of the lysosomal acid alpha-glucosidase enzyme. It is the only glycogen storage disease with a defect in lysosomal metabolism, and the first glycogen storage disease to be identified,
- The disease is caused by a mutation in a gene (acid alpha-glucosidase: also known as acid maltase) on long arm of chromosome 17.
- Most cases appear to be due to three mutations. A transversion (T → G) mutation is the most common among adults with this disorder. This mutation interrupts a site of RNA splicing.
- The gene encodes a protein—acid alpha-glucosidase (EC 3.2.1.20)—which is a lysosomal hydrolase. The protein is an enzyme that normally degrades the alpha -1,4 and alpha -1,6 linkages in glycogen, maltose and isomaltose and is required for the degradation of 1–3% of cellular glycogen. The deficiency of this enzyme results in the accumulation of structurally normal glycogen in lysosomes and cytoplasm in affected individuals.

clinical features:

- Accumulation of glycogen in lysosomes: Juvenile onset variant, muscle hypotonia, death from heart failure by age 2; adult onset variant, muscle dystrophy

5. Which of the following will be more towards the negative pole in gel electrophoresis?

a) 5 bp

b) 50 kbp

c) 150 bp

d) 550 bp

e) 50000 bp

Correct Answer - B:E

Ans. is 'b' i.e., 50 kbp & 'e' i.e. 50000 bp *[Ref Various internet sites]*

- In gel electrophoresis, DNA molecules move towards positive end as they are negatively charged themselves.
- larger molecules (> 500 bp) move slowly as compared to smaller molecules. So, larger the molecule, it is more towards the negative end and vise verse .
- Polyacrylamide gels are usually used for proteins, and have very high resolving power for small fragments of DNA (5-500 bp).
- Aga rose gels on the other hand have lower resolving power for DNA but have greater range of separation, and are therefore used for DNA fragments of usually 50-20,000 bp in size, but resolution of over 6 Mb is possible with pulsed field gel electrophoresis (PFGE)" - wikipedia

6. Beta galactosidase deficiency causes?

a) Goucher disease

b) Krabbe's disease

c) Fabry's disease

d) Neimann Pick disease

e) Metachromatic leukodystrophy

Correct Answer - B

Ans. is 'b' i.e., Krabbe's disease [Ref Harper 30th/e p. 251 & 29thie p. 235]

- Krabbe disease, also known as globoid cell leukodystrophy or galactosylceramide lipidosis, is an autosomal-recessive sphingolipidosis caused by deficient activity of the lysosomal hydrolase galactosylceramide beta-galactosidase (GALC).
- GALC degrades galactosylceramide, a major component of myelin, and other terminal beta-galactose-containing sphingolipids, including psychosine (galactosylsphingosine).
- Beta-galactosidase is a lysosomal enzyme responsible for catalyzing the hydrolysis of gangliosides. The deficiency of this enzyme can lead to 1 of the following conditions: GM1 gangliosidosis, Morquio syndrome B, and galactosialidosis.

7. True regarding phenylketoneurea is?

a) Musty order is due to phenylalanine in sweat

b) Deficient enzyme is phenylalanine hydroxylase

c) Autosomal dominant

d) May be associated with impaired mental development

e) Infants are normal at birth

Correct Answer - B:D:E

Ans. is 'b' i.e., Deficient enzyme is phenylalanine hydroxylase,'d' i.e. May be associated with impaired mental development & 'e' i.e. Infants are normal at birth

[Ref Harper's 30th/e p. 304 & 29th/e p. 288; Chatterjee 5th/e p. 426]

- In Phenylketonuria there is inability of oxidation of phenylalanine into tyrosine. There is defective function of phenylalanine hydroxylase.
- Toxic levels of phenylalanine (and insufficient levels of tyrosine) can interfere with infant development in ways which have permanent effects.
- The disease may present clinically with seizures, hypopigmentation and a "musty odor" to the baby's sweat and urine (due to phenylacetate, a carboxylic acid produced by the oxidation of phenylketone).
- Untreated children develop microcephaly, and demonstrate progressive impairment of cerebral function which can lead to intellectual disability, behavioral problems, and mental disorders.

8. Methods that can be used to see protein - protein interaction include?

a) Fluorescence life imaging

b) Fluorescence resonance energy transfer

c) Fluorescence polarization

d) Fluorescence complementation

e) All of the above

Correct Answer - E
Ans. is 'e' i.e., All of the above [Ref wiki]
Biochemical methods →
1. Co-immunoprecipitation
2. Bimolecular fluorescence complementation (BiFC)

Biophysical & theoretical methods →
1. Bio-layer interferometry
2. Dual polarisation interferometry (DPI)
3. Fluorescence polarization/anisotropy
4. Fluorescence resonance energy transfer (FRET)
5. Fluorescence lifetime imaging microscopy (FLIM) .

9. Uncouplers of oxidative phosphorelation include?

a) 2, 4 - DNP

b) H2S

c) Cyanide

d) Thermogenin

e) Carboxin

Correct Answer - A:D

Ans. is 'a' i.e., 2, 4 - DNP & 'd' i.e., Thermogenin *[Ref Harper 30th ie p. 132 er 29th Ie p. 339; Vasudevan 6th Ie p. 234, 235; Chatterjea Shinde 7th/e p. 132; Lippincott Ole p. 79]*

- Uncouplers block the coupling of oxidation with phosphorylation. These compounds allow the transfer of reducing equivalents in respiratory chain but prevent the phosphorylation of ADP to ATP by uncoupling the linkage between ETC and phosphorylation.

Uncouplers may be :?

1. Natural :- Thermogenin, thyroxine, long chain FAs
2. Synthetic :- 2, 4-dinitrophenol (2, 4-DNP), 2, 4-dinitrocresol (2, 4-DNC), and CCCP.

- Thermogenin is an uncoupler protein present in mitochondria of brown adipose tissue (brown fat).
- It uncouples oxidation and phosphorylation by acting as a channel for H^+ ions so that hydrogen ion gradient cannot build up

10. Pyridoxine is required for?

a) Decarboxylation

b) Carboxylation

c) Transamination

d) Transsulfuration

e) Oxidative deamination

Correct Answer - A:C:D

Ans. is 'a' i.e., Decarboxylation, 'c' i.e. Transamination & 'd' i.e. Transsulfuration ***[Ref Harper's 30m/e p. 557 & 29th/e p. 536, 537]***

Transamination: PLP acts as coenzyme for transaminases.

Decarboxylation: All decarboxylation reactions (by decarboxylases) require PLP. Thus PLP is involved in generation of important biogenic amines : GABA, Serotonin, Melatonin, Histamine and catecholamines (epinephrine, norepinephrine).

- In pyridoxin deficiency, 3-hydroxykinurenine accumulates and is converted to alternate metabolite xanthurenic acid (xanthurenate). Thus, xanthurenic acid (xanthurenate) excretion in urine is increased in pyridoxine deficiency. Thus pyridoxin may be used in xanturenic aciduria.

11. Amino acids derived from tissues are directed towards?

a) Ammonia formation

b) Ammonium salts

c) Urea cycle

d) Urea formation

e) Amino acid pool of cells

Correct Answer - E

Ans. is 'e' i.e., Amino acid pool of cells [Ref: Harper 30"/e p. 298; Nutrition by Paul Insel, Don Ross, Kimberley Mc¬Mahon 4th/e p. 242]

- When cells break protein, the protein's amino acids return to circulation. These available amino acids, found throughout the body tissues and fluids, are collectively referred to as amino acid pool.
- The available amino acids will be utilized for protein synthesis. Others may have their amino group removed and be used to produce energy or non protein substances such as glucose.

12. Co-factors required for fatty acid synthesis in human are?

a) ATP

b) NADPH

c) Biotin

d) Pyridoxine

e) Pentothenic acid

Correct Answer - A:B:C

Ans. is 'a' i.e., ATP, 'b' i.e. NADPH & 'c' i.e., Biotin *[Ref Harper 30th Ie p. 236 er 29th/e p. 219; Lippincott 4'5/e p. 187]*

- pyridoxal phosphate is needed for elongation of already synthesized fatty acids, not for synthesis itself.
- Extramitochondrial (cytoplasmic) System is concerned with de novo synthesis of fatty acid from acetyl CoA, and is present in cytosaol. Palmitic acid is synthesized.
- Cofactor requirements for fatty acid synthesis are NADPH, ATP, Mn+2, biotin and HCO_3- (as a source of CO2).
- The major product of fatty acids synthesis is palmitate. Longer fatty acids are formed by elongation reactions either in microsomes (endoplasmic reticulum or in mitochondria.

13. All are True statements regarding Okazaki fragment EXCEPT?

a) Requires DNA polymerase

b) Forms on leading strand

c) Forms on lagging strand

d) Requires helicase for opening

e) Requires RNA primer

Correct Answer - B

Ans. is 'b' i.e., Forms on leading strand *[Ref Lippincott's 5thie p. 399, 401, 406; Harper's 30 Ie p. 383 & 25^{0}/e p. 367]*

- DNA polymerases responsible for copying the DNA templates are only able to "read" the parental nucleotide sequence in 3' - 5' direction, and they synthesize the new DNA strands only in 5' - 3' direction. Therefore, 2 newly synthesized chains must grow in opposite directions.
- The DNA chain which runs in the 3' to 5' direction towards replication fork as continued strand is called leading strand. This requires only one RNA primer
- The DNA chain which runs in the 5' to 3' direction away from the replication fork is called lagging strand. It is synthesized discontinuously and requires numerous RNA primers.
- As the replication fork moves, RNA primers are synthesized at specific intervals. **These RNA primers are extended by DNA polymerase III into short pieces of DNA called Okazaki fragments.**

14. All are true regarding satellite DNA EXCEPT?

a) Repeated DNA sequences in tandem

b) Clustered around centromere

c) Clustered around telomeres

d) Transcriptionally active

e) None of the above

Correct Answer - D

Ans. is 'd' i.e., Transcriptionally active *[Ref Harper's 30"'/e p. 377-78; Lippincot 4^{t5} le p. 461]*

- Repetitive sequences in DNAis also called (satellite DNA)
- These consist of *5-500 base pair* lengths repeated many times.
- These are often clustered in centromeres (central protein of chromosomes where sister chromatids join each other) and telomeres (repeated sequence at the end of chromosomes).
- **The majority of these sequences are transcriptionally inactive**and play a structural role
- microsatellite sequences most commonly are found as dinucleotide repeats of AC on one strand and TG on the opposite strand.
- Microsatellite repeat sequences consist of 2-6 bp repeated upto 50 times. The AC repeat sequences occur at 50000-100000 locations in human genome.

15. True statement regarding t-RNA is?

a) Contains codon

b) Contains anti-codon

c) Contains blunt ends

d) Acts as a acceptor for amino acids in protein synthesis

e) Gets attached to ribosomes

Correct Answer - B:D:E

Ans. is 'b' i.e., Contains anti-codon, 'd' i.e. Acts as a acceptor for amino acids in protein synthesis & 'e' i.e. Gets attached to ribosomes

[Rep Lippincotese Ie p. 418; Harper's 30'Ve p. **394]**

- tRNA is the Smallest of the three major RNAS having 73 to 93 nucleotide residues. It comprises about 15% of total RNA in the cell.
- **Acceptor arm consists of a base paired stem that terminates in the sequence CCA at the 3' end.** This is the attachment site for amino acids. CCA tail is added during post-transcriptional modification.
- **It contains anticodon that base pairs with the codon of coming mRNA.**Anticodon has nucleotide sequence complementary to the codon of mRNA and is responsible for the specificity of the t RNA.
- **Through TC arm tRNA gets attached to ribosome.**

16. Examples of chaperon include all except?

a) Calreticulin

b) Calnexin

c) Calbindin

d) BiP

e) Ubiquitin

Correct Answer - C:E

Ans. is 'c' i.e., Calbindin & `e' i.e. Ubiquitin *[Ref Harper's 30th /e p. 609; Vasudevan 5thIe p. 17]*

- Chaperones are present in a wide range of species from bacteria to humans. Many so called 'Heat shock proteins' (HSP) are chaperones. They are also known/as stress proteins.
- Some Chaperones and Enzymes Involved in Folding that are Located in the Rough Endoplasmic Reticulum are BiP (immunoglobulin heavy chain binding protein), GRP94 (glucose-regulated protein), GRP-170, GRP-78, Calnexin, Calreticulin PDI (protein disulfide isomerase), PPI (peptidyl prolyl cis-trans isomerase), HSP47, ERp29

17. Vitamin E deficiency in adult causes?

a) Hemolysis

b) Posterior column Involvement

c) Peripheral neuropathy

d) Hair loss

e) Impaired immunity

Correct Answer - A:B:C:D:E

Ans. is 'All' i.e., a, b, c, d & e [Ref : Harper's 30th/e p. 553 & 29th/e p. 532, 541, 543]

- vitamin E deficiency are characterized by axonal degeneration in the posterior columns and a selective loss of large calibre myelinated sensory axons in the spinal cord and peripheral nerves.
- Subacute combined degeneration of spinal cord, also known as Lichtheim's disease, refers to degeneration of the posterior and lateral columns of the spinal cord as a result of vitamin B12 deficiency (most common), vitamin E deficiency, and copper deficiency.
- Vitamin E activiy is present in several tocopherols, the most important being a-, y- and 8- tocopherol. a-Tocopherol is the most abundant and is taken as the standard.
- Selenium and vitamin E supplement each other by their anti-oxidant property.
- Hemolytic anemia -due to oxidative damage to red blood cells, Impairment of the immune response, Digestive problems & Malabsorption leading to liver and pancreatic problems, Dry skin and hair loss

18. Vitamin C deficiency is associated with?

a) Decreased immunity

b) Improper wound healing

c) Epistaxis

d) Seizures

e) Anemia

Correct Answer - A:B:C:E

Ans. is 'a' i.e., Decreased immunity, 'b' i.e., Improper wound healing, 'c' i.e., Epistaxis & `e' i.e., Anemia *[Ref Harper's 30th Ie p. 561-65; Internet]*

- General symptoms include Low grade fever, irritability, tachypnea, digestive disturbances, loss of appetite, weakness, weight loss, vague myalgias and arthritis & arthralgias.
- Anemia Due to defect in utilization of iron & folic acid.
- Dermatological :- Dry skin, Follicular hyperkeratosis, coiled hair, splitting of hair, Poor wound healing
- Impaired immunity leading recurrent infections, Irritability and other psychologic symptoms.

19. True about telomerase is?

a) DNA dependent RNA polymerase

b) RNA dependent DNA polymerase

c) Reverse transcriptase enzyme

d) Increased telomerase activity is seen in somatic cells

e) Telomerase increases the longevity of cells

Correct Answer - B:C:E

Ans. is 'b' i.e., RNA dependent DNA polymerase, 'c' i.e. Reverse transcriptase enzyme & `e' i.e. Telomerase increases the longevity of cells [Ref Harper 29th/e p. 358 & 28`"/e p. 315, 316; Robbin's 8th/e p. 40, 296]

- Telomerase is a reverse transcriptase (RNA dependent DNA polymerase) and is responsible for telomere synthesis and maintaining the length of telomers (replication of end of chromosome). Thus, telomerase provide longevity to the cells which contain this enzyme.
- Telomerase is absent from most of the somatic cells and hence they suffer progressive loss of telomeres and they exit the cell cycle.
- Senscent cells lack telomerase so their telomeres get shortened by critical length and these cells remains in Go phase

20. Which is/are not transport protein?

a) Transferrin

b) Collagen

c) Ceruloplasmin

d) Hemoglobin

e) Albumin

Correct Answer - B
Ans.is'b'i.e., Collagen *[Ref http://www.gastrohep.com/ebooks/rodes/Rodes_2_4_1.pdf]*

- Collagen is a structural protein
- Albumin has circulating transport proteins such as steroids, thyroxine, triiodothyronine, fat soluble hormones, fatty acids to liver, unconjugated bilirubin, many drugs, Calcium, magnesium, cations & anions.
- Ceruloplasmin has Copper
- Hemoglobin → Oxygen from lung to tisuues
- Transferrin → iron ions in the ferric form (Fe3+).

21. Full form of LCAT is ?

a) Lecithin cholesterol acyl transferase

b) Lecithin cholesterol alkyltransferase

c) Lecithin choline acetyltransferase

d) Lecithin choline alcohol transferase

e) Lecithin co A transferase

Correct Answer - A

Ans. is 'a' i.e., Lecithin cholesterol acyl transferase ***[Ref Harper's 30`Ve p. 272; Lippincott 6th Ie p. 234]***

- Lecithin-cholesterol acyl transferase (LCAT) is present in HDL and esterifies the cholesterol in HDL. Major activator of LCAT is Apo-Al. Apo-C1 can also activate LCAT.
- HDL-Cholesterol appears to be the best independent predictor of coronary artery disease (inverse relationship) than any other known risk factor. That means low HDL is a much stronger predictor of coronary artery disease than increased LDL cholesterol or increased total cholesterol
- The intracellular cholesterol activates the intracellular enzyme acyl-CoA cholesterol acyl transferase (ACAT). This enzyme catalyzes transfer of an acyl group from a fatty acid derivative to cholesterol, resulting in the formation of esterified choleserol, and this cholesterol ester is stored for subsequent use.

22. Which organ cannot use ketone bodies ?

a) Brain

b) RBC

c) Muscle

d) Heart

e) Liver

Correct Answer - B:E

Ans. is 'b' i.e., RBC & `e' i.e., Liver *[Ref Harper's 30th/e p. 227; Vasudevan ele* p. *145]*

- Liver itself cannot utilize ketone bodies as it lacks the enzyme CoA-transferase which is required for activation of ketone body .
- Beside liver, RBCs also do not utilize ketone bodies (only glucose is the sole fuel for RBCs).
- Acetoacetate and p-hydroxybutyrate are used in preference to glucose as energy source by certain tissues, e.g. heart, muscle, intestinal mucosa and renal cortex. Brain also switches to using predominantly acetoacetate in starvation.
- In extrahepatic tissues, acetoacetate is activated to acetoacetyl CoA by succinyl-CoA-acetoacetate CoA transferase (thiophorase).

23. HGPRT are involve, and gout can be a feature.

a) HGPRT deficiency

b) HGPRT overactivity

c) PRPP synthetase deficiency

d) Glucose 6- phosphatase deficiency

e) Glucose phosphate dehydrogenase deficiency

Correct Answer - A:D

Answer. (a) HGPRT deficiency, (d) Glucose 6- phosphatase deficiency

[Ref: Harper 30th/354-56; Satyanarayan 4th/269-70,394-951

- Von Gierke's disease (Type 1 glycogen storage disease): Hyperuricemia occurs due to Glucose 6-phosphatase enzyme defect.
- HGPRT deficiency(as seen in Lesch-Nyhan syndrome): Increased production of purines
- Glucose 6-phosphatase deficiency:Purine overproduction.
- Gout is usually preceded and accompanied by hyperurlcemta (plasma uric acid level >0.4I mmol/L).
- Hlperuricemia is caused by dacreased renal extretlon, lncreased productlon" or increased intake oturlc acid

24. Hyperphenylalaninemia occurs due to:

a) Phenylalanine hydroxylase deficiency

b) Phenylalanine hydroxylase overactivity

c) Dihydrobiopterin reductase deficiency

d) Tyrosine hydroxylase deficiency

e) Defect in dihydrobiopterin biosynthesis

Correct Answer - A:C:E

Answer: (a) Phenylalanine hydroxylase..., (c) Dihydrobiopterin reductase..., (e) Defect in dihydrobiopterin biosynthesis

- Hyperphenylalaninemias arise from defects in phenylalanine hydroxylase itself (type I, classic phenylketonuria or PKU), in dihydrobiopterin reductase (types II and III), or in dihydrobiopterin biosynthesis (types IV and V) . Alternative catabolites are excreted.
- PKU is caused by a dcficiency otphenylalanine hydroxyl.as e, is the most common clinicallv encountered inborn error of amino acidmetabolism.
- Hyperphenylalaninemia may also be caused by deficiencies in any of the **several enzymes required to synthesize BH4,** or in **dihydropteridine reductase,** which regenerates BH4 from BH2.
- BH4 is also required for tyrosine hydroxylase and tryptophan hydroxylase, which catalyze reactions leading to the synthesis of neurotransmitters, such as serotonin and reverse the central nervous system (CNS) effects due to deficiencies in neurotransmitters.

25. During DNA replication which bond breaks:

a) Phosphodiester bonds

b) Phosphate bond

c) Hydrogen bond

d) Glycosidic **bonds**

e) None

Correct Answer - C

Answer:c. Hydrogen bond [Ref: Lippincott 6th/397-400; Harper 30th/381-86; Satyanarayana 4th/524-29]

- When DNA replicates, a helicase enzyme "unzips" the double helix, breaking the hydrogen bonds that hold it together in the center
- The two strands of the double helix separate when hydrogen bonds between the paired bases are disrupted. Disruption can occur in the laboratory if the pH of the DNA solution is altered so that the nucleotide bases ionize, or if the solution is heated.

26. Oxidative phoephoryletlon not inhiblted by:

a) Fluoride

b) 2, 4-dinitrophenol (DNP)

c) Oligomycin

d) Carboxin

e) Ouabin

Correct Answer - A:D:E

Answer: (a) Fluoride, (d) Carboxin, (e) Ouabin (Ref: Harper 30th/132-33; Lippincott 6th/79; Satyanarayan 4th/233-34; Chatterjea 7th/132-341

- There are three sites in respiratory chain where ATP is formed by oxidative phosphorylation. Three sites are- Site l(Complex-I), Site ll(Complex III) and Site lll(Complex IV). Complex ll(Succinate dehyfuogenase FAD) is not involved in oxidative phosphorylation.
- **2,4-dinitrophenol(DNP)**Dinitrocresol, Trifluorocarbonylcyanide phenylhydrazone, Pentachlorophenol
- Aspirin(in high dose), High concentration of thermogenin, thyroxine and long chain free fatty acids, Antibiotics- valinomycin, gramicidin A and nigercin are inhibitores of oxidative phosphorylation
- Carboxin inhibit complex II, which is not involved in oxidative phosphorylation(so not included in answer)"? Chatterjea 7h/134
- **"Ouabain** is a cardiac glycoside that acts by inhibiting the NW/IC - ATPase sodium-potassium ion pump"-Harper 30th/ 491
- **Fluoride:** It inhibits the activities of certain enzymes. Sodium fluoride inhibits enolase(of glycolysis) while fluoroacetate inhibits

aconitase(of citric acid cycle)"- Satyanarayan 4th/420.

27. True about Apolipoproteii.

a) **Constitute peripheral region of** plasma lipoproteins

b) Divided into A, B, C only

c) Apo A-I is the major protein component of high density lipoprotein (HDL)

d) Apo A,B and C are further divided

e) Role in enzyme activation

Correct Answer - A:C:D:E

Answer. (a) Constitute peripheral region of..., (c) Apo A-I is the major protein..., (d) Apo A,B and C are..., (e) Role in enzyme ... [Ref: Harper 30th/254-55; Satyanarayan 4th/318; http://noprniscairres.in/bitstream; onlinelibrary.wiley.com]

- Apolipoproteins (apo) play very important roles in the synthesis and catabolism of plasma lipoproteins, in lipid transport, and as activators of certain enzymes associated with lipid and lipoprotein metabolism
- Apolipoproteins are the protein component of **plasma lipoproteins** which consist of a core of triglycerides and cholesterol esters and a peripheral region of phospholipid, sphingolipid and protein.
- **Apo A-I is the major protein component of high density lipoprotein (HDL)** and a minor component of chylomicrons and very low density lipoprotein (VLDL).
- **Apolipo proteins are divided by structure and function into five major classes, A through E, with most classes having subclasses, for example, apolipoprotein (or apo) A-I and apo C-II.**

28. which nNA contalne abnormal purine and pyrimidine:

a) tRNA

b) 23SrRNA

c) 16SrRNA

d) 5SrRNA

e) mRNA

Correct Answer - A

Answer: a. tRNA

- tRNA molecule contain a high percentage of unusal bases, for example, dihydrouracil and have extensive intra-chain base pairing that leads to characteristic secondary and tertiary structure"- Lippincott 6th/ 418.
- The tRNA molecules contain a high percentage of unusual bases (for example, dihydrouracil) and have extensive intrachain base-pairing that leads to characteristic secondary and tertiary structure.
- **Transfer RNA** is unique among nucleic acids in its content of "unusual" bases. An unusual base is any purine or pyrimidine ring except the usual A, G, C, and U from which all RNAs are

29. Amino acids containing hydroxyl group:

a) Threonine

b) Tyrosine

c) Serine

d) Tryptophan

e) Valine

Correct Answer - A:B:C

Answer: (a) Threon ine, (b) Tyrosine, (c) Serine Lippincott 6th/4

- **Serine, threonine, and tyrosine** each contain a **polar hydroxyl group** that can participate in hydrogen bond formation.
- The side chains of asparagine and glutamine each contain a carbonyl group and an amide group, both of which can also participate in hydrogen bonds"-

30. Cytochrome P45O is/are involved In:

a) Hydroxylation of xenobiotics

b) Methylation of xenobiotics

c) Deamination reaction

d) Involved in hydroxylation of steroids

e) Drug interaction

Correct Answer - A:C:D:E

Ans. (a) Hydroxylation of xenobiotics, (c) Deamination reaction, (d) Involved in hydroxylation of steroids, (e) Drug interaction [Ref: Harper 30th/584-85; KDT 7th/23-26;Lippincott 6th/; Satyanarayan 4th/639-40]

- **Cytochrome P450s are involved in phase I(hydroxulation) of the metabolism of xenobiotics, not in phase II. Methylation of xenobiotics occur in phase II by methyltransferase**

31. Component of 50S ribosomal zubunit:

a) 16S RNA

b) 18S RNA

c) 5.8 RNA

d) 5S RNA

e) 23S RNA

Correct Answer - D:E

Answer d. 5S RNA, (e) 23S RNA (Lippincott 6th/436):

- The 50S subunit is primarily composed of proteins but also contains single-stranded RNA known as ribosomal RNA (rRNA). rRNA forms secondary and tertiary structures to maintain the structure and carry out the catalytic functions of the ribosome.
- It includes the 5S ribosomal RNA and 23S ribosomal RNA.
- 50S includes the activity that catalyzes peptide bond formation (peptidyl transfer reaction), prevents premature polypeptide hydrolysis, provides a binding site for the G-protein factors (assists initiation, elongation, and termination), and helps protein folding after synthesis.

32. True about role of phospholipids:

a) Cell to cell recognition

b) Cell signaling

c) Precursor of Second Messengers

d) Mediators of inflammation

e) Regulate membrane permeability

Correct Answer - B:C:D:E

Answer: (b) Cell signaling, (c) Precursor of Second Messengers, (d) Mediators of inflammation, (e) Regulate membrane permeability

(Ref: Harper 30th/212,216,253-54; Robbins 9th/83-84; Satyanarayan 4th/36-37)

- Glycoprotein(fibronectin, laminin) is involve in **cell-cell recognition** and adhesion.
- The inositol is present in **phosphatidylinositol** as the stereoisomer, myoinositol. Phosphorylated phosphatidylinositols **(phosphoinositides)** are minor components of cell membranes, but play an important part in **cell signaling and membrane trafficking.**
- **Sphingomyelins are also found in large quantities in the myelin sheath that surrounds nerve fibers. They are believed to play a role in cell signaling and in apoptosis.**
- **Phosphatidylinositol is the source of second messengers-inositol triphosphate and diacylglyceol, that are invoved the action of some horomones.**

33. Correct statement about membrane:

a) **Phospholipids undergo** rapid lateral diffusion

b) Transverse movement of lipids across the membrane **is** faster than protein

c) Hydrophobic core of the phospholipid bilayer remains constantly in motion because of rotations around the bonds of lipid tails

d) Phospholipds that have one fatty acyl group, cannot form the bilayer

e) Phospholipids span whole bilayer

Correct Answer - A:C:D

Ans. a) Phospholipids undergo..., (c) Hydrophobic core of the phospholipid..., (d) Phospholipds that have one fatty acyl... (Ref: Harper 30th/215-17,478-90; Satyanarayan 4th/650-51; en.wikibooks.org]

- Membranes are mainly made up of lipids, proteins and small amount of carbohydrate. Phospholipids are the most common lipids present and they are amphipathic in nature.
- The hydrophobic core of the phospholipid bilayer **is** constantly in motion because of rotations around the bonds of lipid tails. Hydrophobic tails of a bilayer bend and lock together. However, because of hydrogen bonding with water, the hydrophilic head groups exhibit less movement as their rotation and mobility are constrained.This results in increasing viscosity of the lipid bilayer closer to the hydrophilic heads.
- The lysophosphollpi.ds have only one fatty acyl group, it cannot form the bilayer as the polarheads are too large, similarly cholesterol also cannot form bilayers as the rigid fitsed ring systenxs and additional

nonpolar tails are too large".

34. True about Chromatin, remodeling:

a) Energy *is* required to displace the histone octamers from DNA or translocate them onto neighboring DNA segments

b) Histone modifications by specific enzyme

c) Do not involve enzymes

d) Aberrations in chromatin remodeling proteins may be associated with cancer

e) None

Correct Answer - A:B:D

Answer:a Energy is required to displace the histone..., (b) Histone modifications by..., (d) Aberrations in chromatin ...
[Ref: Harper 30th/735,438-39; Lippincott 6th/422,460; Harrison 19th/102e-7]

- **Chromatin remodeling is the dynamic modification of chromatin architecture to allow access of condensed genomic DNA to the regulatory transcription machinery proteins, and thereby control gene expression.**
- **chromatin remodeling complexes displace the histone octamers from DNA or translocate them onto neighboring DNA segments, thereby exposing underlying DNA sequences to sequence specific regulatory factors .**
- **histone acetylase and other enzymatic activities are associated with the coregulators involved in regulation of gene transcription.**
- **Aberrations in chromatin remodeling proteins are found to be associated with human diseases, including cancer.**

35. Best assessment of protein binding regions on a DNA molecule can be done by:

a) DNA footprinting

b) RT PCR

c) Microarray

d) Western blotting

e) Northern blotting

Correct Answer - A

Answer-(a) DNA footprinting [Ref: www.biotecharticles.com; www.biologyexams4u.com Lippincott 6th/473]

- **DNA footprinting- An in-vitro technique to find out protein binding regions on a DNA molecule. The technique is also called as DNAse I footprinting.Thousands of proteins (enzymes) are interacting with DNA in the nucleus for regulating activities like replication, transcription, translation etc.**
- **DNA Footprinting is a molecular technique used to identify the specific DNA sequence (binding site) that binds to a protein.**
- **This technique mainly used to identify the transcription factors which bind to promoter, enhancer or silencer region of gene to regulate its expression. Therefore the regulation of transcript ion of a gene can be studied using this method.**

36. Nucleosome contains:

a) DNA

b) RNA

c) Chromatin

d) Histone

e) None

Correct Answer - A:D

Ans: a. DNA d. Histone [Ref Harper 30th/371-72; Lippincott 6th/ 409]

- Histones are highly alkaline proteins found in eukaryotic cell nuclei that package and order the DNA into structural units called nucleosomes.
- They are the chief protein components of chromatin, acting as spools around which DNA winds, and playing a role in gene regulation.
- When the histone octamer is mixed with purified dsDNA under appropriate ionic conditions, the same x-ray diffraction pattern is formed as that observed in freshly isolated chromatin. Biochemical and electron microscopic studies confirm the existence of reconstituted nucleosomes.
- In the nucleosome, the DNA is super coiled in a left handed helix over the surface of the disk-shaped histone octamer

37. Enzyme used in DNA repair is/are:

a) DNA gyrase

b) DNA polymerase

c) Restriction endonuclease

d) DNA ligase

e) None

Correct Answer - B:D

Ans: b. DNA poly..., d. DNA (Ref Harper 30th/382, 389-92; Lippincott 6th/ 411-131

- When the strand containing the mismatch is identified, an endonuclease nicks the strand and the mismatched nucleotide(s) is/are removed by an exonuclease.
- Additional nucleotides at the 5'- and 3'-ends of the mismatch are also removed. The gap left by removal of the nucleotides is filled, using the sister strand as a template, by a DNA polymerase.
- The 3'-hydroxyl of the newly synthesized DNA is joined to the 5'-phosphate of the remaining stretch of the original DNA strand by DNA ligase

38. All are Urea cycle enzymes except:

a) Ornithine transcarbamylase

b) Carbamoyl-phosphate synthetase I

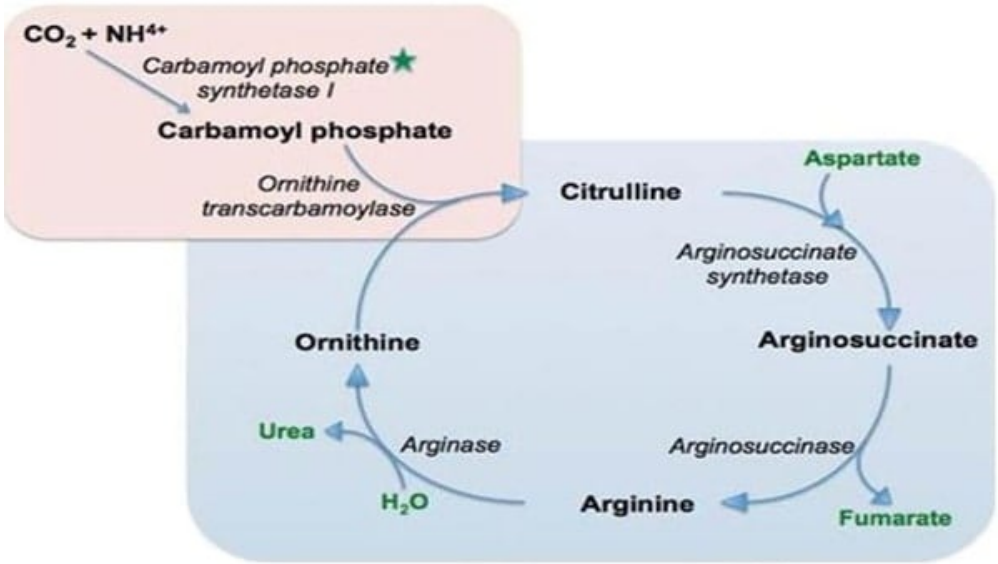
c) Argininosuccinase

d) Citrulline synthase

e) Argininosuccinic acid synthetase

Correct Answer - D

Answer: (D) Citrulline synthase [Ref Harper 30th/290-96, 29th/274-88; Lippincott



39. Phospholipase A2 act on:

a) Phosphoglyceric acid

b) Phosphate

c) Ca+

d) Phosphatidyl-inositol

e) None

Correct Answer - D

Ans: d. Phosphatidyl-inositol

- Phospholipases hydrolyze the phosphodiester bonds of phosphoglycerides, with each enzyme cleaving the phospholipid at a specific site.
- Phospholipases release molecules that can serve as messengers (for example, DAG and IP3), or that are the substrates for synthesis of messengers (for example, arachidonic acid.
- *P*hospholipases are responsible not only for degrading phospholipids, but also for "remodeling" them. For example, phospholipases AI and A2 remove specific fatty acids from membrane-bound phospholipids; these can be replaced with alternative fatty acids using fatty acyl CoA transferase**.**

40. Non-polar amino acids are:

a) Proline

b) Lysine

c) Isoleucine

d) Arginine

e) Asparginine

Correct Answer - A:C

Ans: a. Proline c. Isoleucine [Ref Harper 30th/16-22; Lippincott 6th/1-9; Satyanarayan 4th/ 48]

- Acidic and Polar side chains Aspartic Acid→ Glutamic Acid
- Basic and Polar side chains→ Arginine, Lysine, Histidine
- Uncharged & Polar side chains→ Asparginine, Glutamine, Serine, Threonine, Tyrosine
- Non Polar Amino Acids with Non Polar side chains→ Glycine, Alanine, Valine, Leucine, Isoleucine, Proline.

41. True about squalene:

a) Present in subhuman primate only

b) It is one of the major carbohydrates of body

c) It involves in the synthesis of cholesterol

d) It involves in the synthesis of steroids

e) None

Correct Answer - C:D

Ans: (C) It involves in synthesis of cholesterol, (D) It involves in synthesis of steroids

- Squalene is a hydrocarbon and a triterpene, and is a natural and vital part of the synthesis of all plant and animal sterols, including cholesterol, steroid hormones, and vitamin D in the human body.
- Squalene is used in cosmetics, and more recently as an immunologic adjuvant in vaccines.
- It is a natural 30-carbon organic compound originally obtained for commercial purposes primarily from shark liver oil (hence its name), although plant sources (primarily vegetable oils) are now used as well, including amaranth seed, rice bran, wheat germ, and olives.
- Squalene and omega 2 fatty acid has unlike omega 3 fish oils more complete and effective chemical groups.

42. Molecular weight of protein can be determined/estimated by:

a) SDS-PAGE

b) Gel filtration chromatography

c) Agarose gel electrophoresis

d) Ultracentrifugation

e) FRET microscopy

Correct Answer - A:B:D

Ans: (A) SDS-PAGE (B) Gel filtration chromatography (D) Ultracentrifugation *[Ref Harper 30th/28; Shinde 7th/772-74; Satyanarayan 4th/ 725, 60; Vasudevan 5th/482-851*

- "SDS-PAGE is commonly used for molecular weight determination of proteins" (Vasudevan 5th/482)
- "SDS-PAGE is a popular technique for determination of molecular weight of proteins" (Satyanarayan 4th/ 725)
- " Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) is a reliable method for determining the molecular weight **(MW)** of an unknown protein".
- "The gel filtration chromatography technique is used for "Separation of protein molecules, purification of proteins & molecular weight determinations" **Ultra centrifugation** is an indispensable tool for the isolation of subcellular organelles, proteins, & nucleic acids. In addition, this technique is also employed in determination of molecular weight of macromolecules\

43. Gel used in RNA electrophoresis:

a) Agarose gel

b) Polyacrylamide plain gel

c) Polyacrylamide SDS (Sodium dodecyl sulphate) impregnated Polyacrylamide gel

d) A & C

e) None

Correct Answer - A

Ans: a. Agarose gel

- Separation of RNA in agarose gels is used for a number of different purposes, including Northern blots to monitor RNA expression levels, checking RNA integrity and size selection of RNA for cloning experiments.
- Separation of RNA based on fragment length requires conditions that are different from DNA analysis.
- The most frequently used denaturants for RNA agarose gel electrophoresis are formaldehyde, formaldehyde/formamide, and glyoxal plus DMSO.
- The most efficient RNA denaturant is methylmercury hydroxide. Because of the hazards associated with this denaturant, it is the least used system for RNA

44. Which of following releases/provide energy:

a) Conversion of ADP to ATP

b) Breaking of high energy bond to low energy bond

c) Conversion of pyruvate to lactate

d) Electrical gradient across inner & outer side of mitochondria] membrane

e) Passage of e- through FAD in electron transport chain

Correct Answer - B:D:E

Ans: (B) Breaking of high... (D) Electrical gradient across ... (E) Passage of e- through FAD...

- In absence of 0xygen pyruvate is reduced to lactic acid (without producing ATP). In anaerobic glycolysis, pyruvate acts as a temporary H-store.
- It dehydrogenation (oxidizes), the reduced NADH + H+ back to oxidized NAD+, so that glycolysis can continue even in the absence of 02. In presence of 02, lactic acid can be oxidized into pyruvic acid again.
- Electron transport is coupled to the phosphorylation of ADP by the transport ("pumping") of protons (H+) across the inner mitochondrial membrane from the matrix to the inter membrane space at Complexes I, III, and IV.
- This process creates an electrical gradient (with more positive charges on the outside of the membrane than on the inside) and a pH gradient (the outside of the membrane is at a lower pH than the inside).

- The energy generated by this proton gradient is sufficient to drive ATP synthesis. Thus, the proton gradient serves as the common intermediate that couples oxidation to phosphorylation.

45. Restriction endonuclease cleaves:

a) dsDNA

b) RNA

c) Histone

d) Protein

e) ssDNA

Correct Answer - A
Ans: a. dsDNA

- Restriction endonucleases (restriction enzymes), which cleave *double-stranded (ds) DNA* into smaller, more manageable fragments, has opened the way for DNA analysis"
- Restriction enzyme (RE or Restriction Endonuclease) is an enzyme that *cleave double-stranded DNA*Q *at specific recognition nucleotide known as restriction sites*Q
- The cut DNA fragments by RE may have *sticky ends (cohesive ends)*° or *blunts ends*° depending on the mechanism used by enzyme
- DNA fragments with sticky ends are particularly useful for recombinant DNA experiments (hybrid or chimeric DNA molecules)
- Restriction enzyme is *named according to the organism from which it was isolated*

46. True about genetic code:

a) Follow Mendelian law

b) It is total number of chromosome in the body

c) It is nucleotide sequence which codes for amino acids

d) It codes for DNA

e) None

Correct Answer - C

Ans: c.It is nucleotide sequence which codes for amino acids

- **M**endelian Genetics is widely regarded as the cornerstone of classical genetics. It is a set of primary beliefs relating to the transmission of hereditary characteristics from parent organisms to their offspring
- The genetic code is a dictionary that identifies the correspondence between a sequence of nucleotide bases and a sequence of amino acids.
- The Nucleotide Sequence of an mRNA Molecule Consists of a Series of Codons That Specify the Amino Acid Sequence of the Encoded Protein

47. Which of the following is feature(s) of diabetic ketoacidosis:

a) Decreased triglyceride level

b) Increased fatty acid level

c) TLipoprotein

d) Decreased ketone bodies

e) High Anion gap acidosis

Correct Answer - B:C:E

Ans: (B) Increased fatty acid level (C) TLipoprotein (E) High Anion gap acidosis *[Ref Harper 30th/ 231; Lippincott 6th/339, 345; Satyanarayan 4th/481, 682; Harrison 19th/2417-18]*

- DKA is characterized by hyperglycemia, ketosis, and metabolic acidosis (increased anion gap) along with a number of secondary metabolic derangements, Leukocytosis, hypertriglyceridemia, and hyperlipoproteinemia are commonly found as well
- Increased lactic acid production also contributes to the acidosis. The increased free fatty acids increase triglyceride and VLDL production. VLDL clearance is also reduced because the activity of insulin-sensitive lipoprotein lipase in muscle and fat is decreased.
- Hypertriglyceridemia may be severe enough to cause pancreatitis.
- Reduced insulin levels, in combination with elevations in catecholamines and growth hormone, increase lipolysis and the release of free fatty acids. Normally, these free fatty acids are converted to triglycerides or very-low-density lipoprotein (VLDL) in the liver.

48. Second messenger is/are:

a) Ca2+

b) DNA

c) Histone

d) *cDNA*

e) None

Correct Answer - A

Ans: a. Ca2+ [Ref Harper 30th/501, 91-92, 179, 343; Lippincott 6th/94-951

- Nucleotides, such as cyclic adenosine mono-phosphate (cAMP) and cyclic guanosine monophosphate (cGMP), serve as second messengers in signal transduction pathways.
- Two of the most widely recognized second messenger systems are the calciumlphosphatidy linositol system, and the adenylyl cyclase system, which is particularly important in regulating the pathways of intermediary metabolism.

49. Nucleic acid amplification techniques are:

a) PCR

b) Real time PCR

c) DNA Cloning

d) Next generation DNA sequencing

e) None

Correct Answer - A:B

Ans: a. PCR ..., b. Real time ....[Ref Harper 30th/458; Robbins 9th/180; Lippincott 6th/479;Harrison 19th/ 150e-7; http://link. springer. corn]

- Real-time PCR automates the laborious process of amplification by quantitating reaction products for each sample in every
- Cycle.
- There are several methods for amplification (copying) of small numbers of molecules of nucleic acid to readily detectable levels.
- These NAATs include PCR, LCR, strand displacement amplification, and self-sustaining sequence replication.
- The amplified nucleic acid can be detected after the reaction is complete or (in real-time detection) as amplification proceeds. The sensitivity of NAATs is far greater than that of traditional assay methods such as culture.

50. Which of the following is/are true about pH of solution:

a) Absolute concentration of acid & salt

b) Relative concentration of acid & salt in solution

c) Increase of temperature increases pH

d) A rise in H+ concentration decreases pH

e) None

Correct Answer - B:D

Ans: (B) Relative concentration..., (D) A rise in H* concentration....

- "When pH measured at room temperature there is no direct correlation between pH and temperature.
- A rise in H+ concentration decreases pH while a fall in H+ concentration increases pH. The reverse is true for OH- concentration
- The ratio of salt to acid concentration- Actual concentrations of salt a acid in a buffer solution may be varying widely, with no change in pH, so long as the ratio of the concentrations remains the same

51. True statement(s) about Magnetic-activated cell sorting:

a) It is a method to separate specific cell from complex mixture

b) Fluorescent dyes are uses

c) Antibody-coated magnetic nanoparticles are used

d) Antibodies used are specific for certain cell surface markers

e) Magnetic field is applied

Correct Answer - A:C:D:E

Ans: (A) It *is* a method..., (C) Antibody-coated magnetic..., (D) Antibodies used are..., (E) Magnetic field is appli...

- MACS, is a procedure developed by Miltenyi Biotec to separate cells from complex mixtures using antibody-coated magnetic nano particles.
- The antibodies are specific for certain cell surface markers, either expressed on your population of interest (positive selection), or expressed on undesired cell types (negative selection).
- After adding the antibody-coated beads to the cell mixture and incubating, the suspension is added to a special single-use separation column affixed to a magnet, to which the beads stick, while unlabeled cells flow through.

52. Which of the following is/are true about Translation:

a) N-formyl methionine is first amino acid in prokaryotes

b) Uses energy in form of GMP

c) Elongation factor EF-1 & EF-2 used in prokaryotes

d) Elongation factor P is used in eukaryotic organism

e) Three initiation factors are required in prokaryotes

Correct Answer - A:E

Ans: a. N-formylmethionine..., *e.* Three initiation *[Ref Harper 30th/419-23; Lippincott 6th/438-42; Satyanarayan 4th/554-60]*

- In eukaryotes, the first amino acid incorporated is methionine (AUG codon). But in prokaryotes, the same codon attracts N-formyl methionine, which is the first amino acid" *(Vasudevan 5th/432)*
- "Elongation factor P is a *prokaryotic protein translation factor* required for efficient peptide bond synthesis on 70S ribosomes from fMet-tRNAf Met. It probably functions indirectly by altering the affinity of the ribosome for aminoacyl-tRNA, thus increasing their reactivity as acceptors for peptidyl Steps in Protein Synthesis
- In prokaryotes, *three initiation factors are known (IF-1, IF-2, and IF-3),* whereas in *eukaryotes, there are over ten (designated eIF to indicate eukaryotic origin).* Eukaryotes also require ATP for initiation.

53. Two strands of DNA is/are held by:

a) Glycosidic bond

b) Hydrogen bond

c) Covalent bond

d) Ionic bond

e) Van der waal force

Correct Answer - B

Answer(b) hydrogen bond *[Ref Harper 30th/359; Lippincott 6th/396-97; Satyanarayan 4th/75]*

- The two strands are held together by *hydrogen bond* formed by *complementary base pairs" (Satyanarayan 4th/75)*
- "The *base pairs are held together by hydrogen bonds:* two between A and T and three between G and C. These *hydrogen bonds,* plus the hydrophobic interactions between the stacked bases, *stabilize the structure of the double helix.*

54. Silver staining is done for:

a) DNA

b) RNA

c) Karyotyping analysis

d) Protein

e) Collagen

Correct Answer - A:B:C:D:E

Answer- (A) DNA (B) RNA (C) Karyotyping analysis (D) Protein (E) Collagen

- Silver staining is a highly sensitive method for detecting proteins and nucleic acids (dsDNA & RNA) in polyacrylamide slab gels.
- Silver staining is the use of silver to selectively alter the appearance of a target in microscopy of histological sections; in temperature gradient gel electrophoresis; and in polyacrylamide gels.
- Silver staining is the most sensitive method for permanent staining of proteins or nucleic acids in polyacrylamide gels.
- Histological characterization: Silver staining aids the visualization of targets of interest, namely intracellular and extracellular cellular components such as DNA and proteins, such as type III collagen and reticulin fibres by the deposition of metallic silver particles on the targets of interest.

55. Polymerase III synthesizes:

a) Fragment 28S of rRNA

b) Fragment 23S of rRNA

c) Fragment 5 S of rRNA

d) tRNA

e) mRNA

Correct Answer - C:D

Ans: c. and d *[Ref Harper 30th/395-98; Lippincott 428]*

- "RNA polymerase III synthesizes tRNA, 5S rRNA, and some snRNA and snoRNA" *(Lippincott 428)*

56. Non-coding RNA is/are:

a) miRNA

b) Si RNA

c) tRNA

d) mRNA

e) rRNA

Correct Answer - A:B:C:E

Ans: a. miRN..., b. Si RNA..., c. tRNA..., e. rRNA..., *[Ref Harper 30th/394-95, 368; en. wikipedia. org; Lippincott 6th/417]*

- All eukaryotic cells have two major classes of RNA, the protein coding RNAs, or messenger RNAs (mRNAs), and two forms of abundant non-protein coding RNAs delineated on the basis of size: the large ribosomal RNAs (rRNA) and long noncoding RNAs (lncRNAs) and small noncoding RNAs transfer RNAs (tRNA), the small nuclear RNAs (snRNAs) and the micro and silencing RNAs (miRNAs and siRNAs).
- The mRNAs, rRNAs and tRNAs are directly involved in protein synthesis while the other RNAs are participate in either mRNA splicing (SnRNAs) or modulation of gene expression by altering mRNA function (mi/SiRNAs) and/or expression (lncRNAs). These RNA differ in their diversity, stability, and abundance in cells

57. True about succinate dehydrogenase defect -

a) Deficiency of complex II

b) Tumorigenesis

c) Defect in krebs cycle

d) Defect in ETC

e) Mitochondrial encephalopathy

Correct Answer - A:B:C:D:E

ANSWER- (A) Deficiency of complex II (B) Tumorigenesis (C) Defect in krebs cycle (D) Defect in ETC (E) Mitochondrial encephalopathy

- Mitochondrial succinate dehydrogenase (SDH) catalyses the oxidation of succinate to fumarate in the Krebs cycle (citric acid cycle).
- Succinate dehydrogenase complex is made up of four subunits - (i) SDH-A; (ii) SDH-B; (iii) SDH-C; and (iv) SDH-D.

Functions of succinate dehydrogenase are :?

1. Catalyses oxidation of succinate or fumarate in TCA cycle / citric acid cycle.
2. Transfers electrons from succinate to coenzyme Q (at complex II) → Succinate dehydrogenase acts as complex II in ETC.

- Defect in SDH causes defect in mitochondrial ETC. Which leads to mitochondria! encephalopathy and myopathy (encephalomyopathy) → This is due to mutation in SDHA subunit gene.
- Mutation in SDH-B,-C and -D subunits causes tumor formation,

especially paraganglioma / pheochromocytoma / carotid body tumor
Thus, these subunits are regarded as a tumor suppressor gene.

58. All are true about glycosaminoglycans except?

a) Protein associated with glycosaminoglycans is called core proteins

b) May be associated with connective tissues

c) Highly positively charged

d) Negatively charged

e) Component of ECM

Correct Answer - C

Ans. is 'c' i.e., Highly positively charged ***[Ref Harper 30"/e p. 786]***

- Proteoglycans are carbohydrates to which small amount of protein is attached. Proteoglycans consists of 95% of carbohydrates and 5% of protein. To know the structure of proteoglycans, one should know the structure of glycosaminoglycans.
- Glycosaminoglycans are heteropolysaccharide (heteropolysaccharides are polysaccharides which contain two or more different monosaccharide unit or their derivatives). Glycosaminoglycans are linear (unbranched) polysaccharides, with repeating diasaccharide units. Each disaccharide unit consists of an amino sugar and an acid sugar (sugar acid).
- Glycosaminoglyclans were first isolated from mucin, therefore they are also called mucopolysaccharides.
- They are negatively charged.

59. Mechanisms for regulating enzyme activity are ALL EXCEPT

a) Covalent modification

b) Allosteric activation

c) Competitive inhibition

d) Induction of genes for enzyme synthesis

e) Repression of gene for inhibition of enzyme synthesis

Correct Answer - C

Ans. is (c) Competitive inhibition [Ref: *Harper 319`Ve* p. 89-94; *Lippincott 6"/e* p. *62-64; Vasudevan 5th ie* p. *42-50; Shinde*

- As the name suggests, there is competition between inhibitor and normal substrate for the catalytic binding site of the enzyme. This is because both the inhibitor and the normal substrate have similar structural configuration. Therefore, enzyme cannot differentiate these two and both can bind to the enzyme. Both ES and EI complexes are formed. But only ES can form product.

60. True statement are -

a) All lipid are fat

b) Linoleic acid is essential fatty acid

c) Hydrogenation converts unsaturated fatty acid to saturated fatty acid

d) Rancidity of food is due to lipid peroxidation

e) Hydrolysis of fat by acid is saponification.

Correct Answer - B:C:D

Ans. is "B" i.e., Linoleic acid is essential fatty acid; "C" Hydrogenation converts unsaturated fatty acid to saturated fatty acid; 'd' i.e., Rancidity of food is due to lipid peroxidation *[Ref Lippincott 6"Ie p. 181-1821.*

- The three polyunsaturated fatty acids (PUFAs), namely, linoleic acid linolenic acid and arachidonic acid are called essential fatty acids. they are called essential fatty acids because human beings require these fatty acids but cannot synthesize them.
- Addition of hydrogen atoms to unsaturated fatty acid refers to hydrogenation. It reduces the number of double bonds in unsaturated fats, As hydrogenation reduces number of double bonds, unsaturated fatty acids may get converted to saturated fatty acid, if all double bonds are reduced.
- The unpleasant odor and taste, developed by natural fats upon aging, is referred to as "rancidity". Rancidity may be due to hydrolysis (by lipase) or oxidation of fat.

61. True statement(s) about lipid digestion and absorption-

a) Micelles play an important role in lipids absorption

b) Absorption of long-chain fatty acids is greatest in the upper parts of the small intestine

c) Bile acid has no role in fat absorption

d) Fatty acids after absorption are reesterified to triglycerides in the enterocytes

e) Gastric lipase is the major enzyme

Correct Answer - A:B:D

Ans. is 'a' i.e., Micelles play an important role in lipids absorption; 'b' i.e., Absorption of long-chain fatty acids is greatest in the upper parts of the small intestine; & 'd' Le., Fatty acids after absorption are reesterified to triglycerides in the enterocytes *[Ref Ganong 25^{1h}/e p. 481-83; Harper ..30th Ie p. 253-54; Guyton 12thIe p. 421-23; Lippincott 6th/e p. 1761.*

- Micelles formation is the process in which digested fats (FFAs and monoglycerides) are incorporated into much smaller droplets (micelles) so that they can be absorbed more efficiently. Thus, micelles formation helps in absorption of digested fats.
- Fat digestion essentially begins in the duodenum with entry of pancreatic and biliary secretions. Pancreatic juice contains lipase (pancreatic lipase), the most important enzyme for fat digestion. The pancreatic lipase digests triglycerides (triacylglycerols) into free fatty acids and 2-monoglycerides (2-monoacylglycerols).
- After fat digestion, fatty acids and monoglycerides are absorbed in

the small intestine, especially in the jejunum and some amount also in ileum. In side the enterocyte, fatty acids and monoglycerides again form triglycerides.

62. Gluconeogenesis is favoured in fasting state by -

a) Activation of pyruvate carboxylase by acetyl CoA

b) Increased conversion of phosphoenolpyruvate to pyruvate by activation of pyruvate kinase

c) Increased fatty acid oxidation in liver

d) Hydrolysis of fructose l, 6-bisphosphate by fructose l, 6-bisphosphatase

e) None

Correct Answer - A:C:D

Ans. is 'a' i.e., Activation of pyruvate carboxylase by acetyl CoA; 'c' i.e., Increased fatty acid oxidation in liver; 'd' i.e., Hydrolysis of fructose 1,6-bisphosphate by fructose 1,6-bisphosphatase,

[Ref: Satyanarayan 4thie p. 258-63; Harper 30thie p. 188; Lippincott 6^{f}Ve p. 117-123; Shinde 7^{m}/e p. 347]

- The activation of pyruvate carboxylase and reciprocal inhibition of PDH complex by acetyl-CoA derived from the oxidation of fatty acids explain the action of fatty acid oxidation in sparing the oxidation of pyruvate and in stimulating gluconeogenesis.
- The reciprocal relationship between these two enzymes alters the metabolic fate of pyruvate as the tissue changes from carbohydrate oxidation (glycolysis) to gluconeogenesis during the transition from the fed to fasting state.
- Fructose-2-6-bisphosphate is formed by phosphorylation of fructose-6-phosphate by phosphofructokinase-2. This enzyme is a

bifunctional enzyme that also has fructose-2, 6-bisphosphatase activity which is responsible for breakdown of fructose-2, 6-bisphosphatase back to fructose-6-phosphate.

- This bifunctional enzyme is under allosteric control of fructose-6-phosphate which stimulates phosphofructokinase-2 activity and inhibits fructose-2, 6-bisphosphatase activity.

63. All are true about Hexose monophosphate pathway (HMP) except -

a) Produce NADPH in oxidative phase of pathway

b) Does not produce ATP

c) Occurs in testes, ovaries, placenta and adrenal cortex

d) Produces ribose 5-phosphate in oxidative phase of pathway

e) Glucose 6-phosphate dehydrogenase enzyme is involved

Correct Answer - D

Ans is. 'd' i.e., Produces ribose 5-phosphate in oxidative phase of pathway *[Ref Harper 30thie p. 196-200; Lippincott ele* p. *145; Satyanarayan 4thIe* p. *270-71]*

- HMP shunt is a multicyclic process in which 3 molecules of glucose-6-phosphate give rise to 3 molecules of CO, and 3 molecules of 5-carbon sugars (ribulose-5-phosphate).
- The latter are rearranged to generate 2 molecules of glucose-6-phosphate (through fructose-6-phosphate) and 1 molecule glyceraldehyde-3-phosphate. HMP shunt does not generate ATP.
- HMP shunt occurs in the cytosol. It is highly active in liver, adipose tissue, adrenal cortex, lens, cornea, lactating (but not the nonlactating) mammary gland, Gonads (testis, ovary) and erythrocytes. Activity of this pathway is minimal in muscle and brain, where almost all of the glucose is degraded by glycolysis.

64. Post-translation modification of protein includes all except :

a) Removal of peptide

b) 5' capping

c) Intron splicing

d) Protein folding

e) Covalent modification

Correct Answer - B:C

Ans. is B., 5' capping & 'c i.e., intron splicing ***[Ref; Satyanarayan 4thie p. 561-62; Harper 30` le p 426; Lippincott*** **0-4** ***p.*** **443-441**

- 5' capping and intron splicing are post-transcriptional modification (not post-translational modification.
- This is the first processing reaction. 5'-end of mRNA is capped with 7-methylguansosine.
- This cap helps in initiation of translation (protein synthesis) and stabilizes the structure of mRNA by protecting from 5' -exonuclease
- Removal of introns (splicing) :? Eukaryotic genes contain some coding sequences which code for protein and some intervening non-coding sequences which do not code for protein.

65. Which of the following is not true about transcription

a) Synthesis of precursors for the large and small ribosomal RNAs

b) Formation of tRNA transcript

c) RNA polymerase II is responsible for the synthesis of precursors for the large ribosomal RNAs

d) RNA polymerase I is responsible for the synthesis small ribosomal RNAs

e) Binding of RNA polymerase on DNA

Correct Answer - C:D

Ans. is 'c' i.e., RNA polymerase II is responsible for the synthesis of precursors for the large ribosomal RNAs; & 'd' i.e., RNA polymerase I is responsible for the synthesis small ribosomal RNAs.

[Ref: Harrion 19th/e p. 427-28; Satyanarayan 4thie* p. *546, 566-68]

- RNA, eukaryotes have three different RNA polymerases : I,II,II
- RNA polymerase I : It catalyzes the synthesis of large ribosomal RNA (rRNA), i.e. 28S rRNA, 18S rRNA and 5.8S rRNA.
- These rRNAs are coded on class-I gene, i.e. class I gene is transcribed by rRNA. rRNAs are not translated into protein.
- RNA polymerase II :?It catalyzes the synthesis of mRNA, small nuclear RNA (sn-RNA) and miRNA. These products are coded by class II gene, i.e. class II gene is transcribed by mRNA. Class II gene differ from class I and III in that one of its transcribed products (mRNA) is translated into protein
- RNA polymerase III :? It catalyzes the synthesis of tRNA and 5S

rRNA. These products are coded by class III gene.

- Besides these three nuclear RNA polymerases, in a eukaryotic cell, a fourth type of RNA polymerase is found in mitochondrial matrix known as mitochondrial RNA polymerase (mtRNAP). Similar to prokaryotic RNA polymerase, mtRNAP catalyzes the synthesis of all the three types of RNA, i.e. mRNA, tRNA and rRNA

66. Ultraviolet radiation exposure can causes DNA damage by -

a) Pyrimidine dimers formation

b) DNA breakage

c) Thymine dimer formation

d) Acetylation of DNA

e) Methylation of DNA

Correct Answer - A:C

Ans. is 'a' Pyrimidine dimers formation; & 'c' i.e., Thymine dimer formation *[Ref Harper 30/e p. 761; Lippincott 0/e p. 412]*

- UV rays exposure results in covalent joining of two adjacent pyrimidines (usually thymine) to form pyrimidine dimers (thymine - thymine dimers or cyclobutane pyrimidine dimers). Cytosine - thymine and cytosine - cytosine dimers are also formed but at slower rates.
- Ultravialet (UV)radiations :- Induce dimerization of adjacent pyrimidines to produce pyrimidine dimers.

67. True about DNA photolyase -

a) Repair damage caused by UV light

b) Found only in human

c) Use visible light

d) Breaks pyrimidine dimers

e) None

Correct Answer - A:C:D

Ans. is 'a' i.e., Repair damage caused by UV light; 'c' i.e., Use visible light; & 'd' Breaks pyrimidine dimer *[Ref: Pankaj Naik* p. 496]

- Nearly all cells contain a photoreactivating enzyme called DNA photolyase. It is a DNA repair enzyme which bind to the damaged region of DNA and get excited by light energy absorbed by N^5, N'°-methenyltetrahydrofolate, which is bound to the photolyase. The process is called photoreactivation.
- The activation requires visible light, preferentially from the violet/blue end of the spectrum.
- The excited photolyase then cleaves the dimer into original bases.
- These enzymes occur in almost all living organisms exposed to sunlight, the only exception being placental mammals like humans and mice. Their catalytic mechanism employs the light-driven injection of an electron into the DNA lesion to trigger the cleavage of cyclobutane- pyrimidine dimers.
- Photolyase is particularly important in repairing UV induced damage in plants. The photolyase mechanism is no longer working in humans and other placental mammals who instead rely on the less efficient nucleotide excision repair mechanism.

68. True about DNA Gyrase -

a) A type of topoisomerase I

b) A type of topoisomerase II

c) Act on circular DNA

d) Overcome the problem of supercoils

e) None

Correct Answer - B:C:D

Ans. is 'b' i.e., A type of topoisomerase IL; "c' i.e., Act on circular DNA; 'd' , Overcome the problem of supercoils

[Ref *Lippincott etc 401; Stayanarayan [x]I[a]Ve p. 528J*

- Topoisomerase I → 4 Removes negative supercoiling.
- Topoisomerase II → Relaxes positive supercoils and forms negative supercoiling by condensation. of chromosome.
- Topoisomerase III → Can introduce single strand breaks during recombination that are required for DNA to be exchanged .

69. Which of the following enzymes of urea cycle is/are not present in mitochondria?

a) Carbamoyl phosphate synthetase-1 [CPS-1]

b) Arginase

c) Arginosuccinase

d) Arginosuccinate synthase

e) Ornithine transcarbamylase

Correct Answer - B:C:D

Ans. is 'b' i.e., Arginase, 'c' i.e., Arginosuccinase & 'd' i.e. Arginosuccinate synthase *[Ref Harper's 30th/e* p. *291]*

- Ammonia is ultimately disposed of by formation of urea by "Kreb's Henseleit urea cycle" in the liver.
- Urea cycle takes place both in mitochondria and cytosol.
- First two reactions of urea cycle occur in the mitochondria, and remaining reactions occurs in cytosol
- Argininosuccinate synthase catalyzes the formation of argininosuccinate from citrulline and aspartate. This reaction requires IATP, but 2 high energy phosphate bonds are consumed as ATP is converted to AMP + PPi. The amino group of aspartate provides one of the two nitrogen atoms that appear in urea (The other one is provided by ammonia NH4).
- Argininosuccinate lyase (argininosuccinase) catalyses the cleavage of argininosuccinate into arginine and fumarate. Fumarate enters in TCA cycle.
- Arginase catalyses the formation of urea from arginine by hydrolytic cleavage of arginine to yield urea and ornithine. Ornithine is thus

regenerated and can enter mitochondria to initiate another round of the urea cycle.

70. Regulatory enzymes of glycolysis are -

a) Phosphofructokinase

b) Pyruvate kinase

c) BPG kinase

d) Hexokinase

e) Glucose -6- phosphatase

Correct Answer - A:B:D

Ans. 'a' i.e., Phosphofructokinase, 'b' i.e., Pyruvate kinase & 'd' i.e., Hexokinase *[Ref Harper's 30th Ie p. 170-177]*

- Glycolysis is regulated at 3 steps which are irreversible. These reactions are catalyzed by following key enzymes : (1) Hexokinase and glucokinase, (2) Phosphofructokinase I, and (3) Pyruvate kinase.
- Hexokinase is found in most of the tissue except liver and comes into play when blood glucose is low. It is not affected by feeding or insulin or starvation. Hexokinase is not specific for glucose metabolism, it is also involved in metabolism of fructose and galactose.
- Phosphofructokinase I is the major regulatory enzyme of glycolysis. It catalyzes the 3rd reaction of glycolysis, i.e., fructose-6-P -a Fructose 1,6 bis-P. This reaction is irreversible and is the "rate - limiting step" for glycolysis.
- It is allosterically activated by : Fructose-6-phosphate, fructose 2,6-bisphophate, AMP, ADP, K· and phosphate. It is allosterically inhibited by : ATP, citrate, Ca+2, Mg+2, and low pH. Phosphofructokinase is an inducible enzyme that increases its

synthesis in response to insulin and decreases in response to glucagon.

- Pyruvate kinase is enzyme that catalyzes conversion of PEP to pyruvate. Pyruvate kinase is an inducible enzyme that increases in concentration with high insulin level and decreases with glucagon. It is activated by fructose-1,6 bisphosphate and inactivated by ATP and alanine.

71. Which of the following is/are to-6 fatty acid(s)

a) Linoleic acid

b) Arachidinic acid

c) Gamma linolenic acid

d) Alpha linolenic acid

e) Oleic acid

Correct Answer - A:B:C

Ans. is 'a' i.e., Linoleic acid, 'b' i.e., Arachidinic acid & 'c' i.e., Gamma linolenic acid *[Ref: Harper's 30th Ie* p. *2141*

- Linoleic acid (18 carbon: Chemical formula '^{a}CH, - (CH,), - CH = CH - CH_2 - CH = CH - $(CH_2)_7$- COOH
- C-System C:18:2:6,^{9,12} or C:18:2:9,12, i.e. 18 carbon fatty acid with 2 double bonds at 9^{15} (between C-9 and C-10) and 12' (between C-12 and C-13) positions when numbering is started from carboxyl carbon.
- co-system C:18:2:w-6,9, i.e. 18 carbon fatty acid with 2 double bonds at 6th (between C-6 and C-7) and 9' (between C-9 and C-10) positions when numbering is started from terminal methyl carbon. So linoleic acid is co-6 fatty acid, as the first double bond is at 6th position in co-system classification.
- Arachidonic acid (20 carbon) Chemical formula $C_{20}H_{32}O_2$

72. Nonreducing sugars are all except -

a) Glucose

b) Maltose

c) Sucrose

d) Fructose

e) Galactose

Correct Answer - A:B:D:E

Ans. is 'a' i.e., Glucose; b' i.e., Maltose; 'd' i.e., Fructose & `e' i.e., Galactose *[Rep Dinesh Puri 3"'/e le p. 24]*

- Reducing sugars are sugars which have free aldehyde or ketone group their in their structure. Because of the presence of free aldehyde or ketone group, they can reduce certain heavy metallic cations in an alkali medium and in the process they themselves get oxidized to a mixture of sugar acids.
- Glucose and galactose have free aldehyde group at carbon-1, and fructose has free ketone group at carbon-2. Thus, reducing end of glucose and galactose is carbon-1 and of fructose is carbon-2.
- Sucrose (disaccharide of glucose and fructose) is formed due to formation of a-glycosidic bond between carbon-1 of glucose and carbon-2 of fructose (Glucose - al → 2 - Fructose). Thus, reducing end of both glucose (carbon-1) and fructose (carbon-2) are involved in glycosidic bond formation and therefore lost their reducing property. Hence, sucrose is a non-reducing disaccharide.

73. Apo integrated in HDL is -

a) Apo Al

b) Apo E

c) Apo D

d) Apo B48

e) Apo B100

Correct Answer - A:B:C

Ans. is 'a' i.e., Apo Al; 'b' i.e., Apo E; & 'c' i.e., ApoD *[Ref Harper's 30th/e p. 257, 255; Chatterjee 6th/e p. 382]*

- Apo-A1 is found in HDL,Chylomicrons, site of synthesi is Liver, intestine,and function in Major structural protein of HDL, major activator of LCAT.
- Apo-E (arginine rich), found in -Chylomicrons, chylomicron,site of synthesis- liver, function as Mediates uptake of chylomicron remnants and IDL by LDL receptors in liver.
- Apo-D--found in HDL-Spleen, brain, testes, adrenal

74. Poor wound healing in vitamin 'C' deficiency is due to all except -

a) Inhibition of collagen synthesis

b) Defective collagen synthesis

c) Defective post-translational modification of collagen

d) Defective hydroxylation

e) Defect in antioxidant system

Correct Answer - A

Ans. is "a" Inhibition of collagen synthesis

- Ascorbic acid (Vitamin C) is also called antiscorbutic factor. It is very heat labile, especially in basic medium. Ascorbic acid itself is an active form. Maximum amount of vitamin C is found in adrenal cortex.
- Ascorbic acid functions as a reducing agent and scavanger of free radicals (antioxidant). Its major functions are

.. vitamin C is essential for the conversion of procollagen to collagen, which is rich in hydroxyproline and hydroxylysine. Through collagen synthesis, it plays a role in the formation of matrix of bone, cartilage, dentine and connective tissue.

2. Vitamin C is required for post-translational modification by hydroxylation of proline and lysine residues converting them into hydroxyproline and hydroxylysine.

75. Micro Satellite instability is seen in ?

a) Huntington's disease

b) Lynch syndrome

c) Spinocerebellar ataxia

d) HNPCC

e) Colorectal cancer

Correct Answer - A:B:C:D:E

Ans. is 'a' i.e., Huntington's disease; 'b' i.e., Lynch syndrome; 'c' i.e., Spinocerebellar ataxia; 'd' i.e., HNPCC; & 'e' i.e., Colorectal cancer *[Ref Textbook of genetic counselling p. 712]*

- Microsatellite instability is genetic instability in short nucleotide repeats (microsatellites) due to high mutation rate as a result of defects in mismatch repair of DNA.
- Sometimes replication errors escape the proofreading function during DNA synthesis causing a mismatch of one of several bases. These errors are repaired later.
- An important point is that the repair system must be able to discriminate between the parent (template) strand and the new daughter strand because it is the base on the daughter strand parent that is incorrect so needs to be excised.
- Methyl group on parent strand attached to adenine (methylated adenine) near the mismatch serves as a tag by which the repair system identifies .
- Several Neurological disease are characterized by microsatellite sequence instability including Huntington's disease, myotonic dystrophy, Fragile-X syndrome, Friedreich's ataxia and spinocerebellar ataxia.

76. UDP-glucose is used for -

a) Glycogen synthesis

b) Galactose metabolism

c) Bilirubin metabolism

d) Ganglioside synthesis

e) Heparin synthesis

Correct Answer - A:B:C:E

Ans. is 'a' i.e., Glycogen synthesis; 'b' i.e., Galactose metabolism; 'c' i.e., Bilirubin metabolism; & `e' i.e., Heparin synthesis *[Ref Basic medical biochemistry p. 475]*

- UDP-glucose is derived from glucose-6-phosphate via glucose-l-phosphate.
- The major fate of UDP-glucose is the synthesis of glycogen.

Other uses of UDP-glucose are -

1. In uronic acid (glucoronic acid) cycle to generate UDP glucuronate.
2. Galactose metabolism
- Glycosylation of proteins, lipids and proteoglycans.
- UDP glucuronate (which is derived from UDP glucose) is used for :-

1. Conjugation of bilirubin, benzoic acid, sterols, estrogen and drugs.
2. Biosynthesis

77. Complementary DNA differs from genomic DNA in -

a) Has coded segments

b) Has introns

c) Has only exons

d) Uses reverse transcriptase

e) Larger

Correct Answer - A:C:D

Ans. is 'a' i.e., Has coded segments; 'c' i.e., Has only exons; & 'd' i.e., Uses reverse transcriptase. [Ref: Lehninger 5"Ye p. 940-9601

- Collection of cloned (recombinant) DNA fragments is called DNA library or shotgun collection. DNA libraries may be of two types ?

1) Genomic library :-

- The entire genomic DNA (both exons and introns) of an organism is cut into small pieces by restriction endonucleases.
- Each and every fragment is then cloned with suitable vector. These recombinant clones are then collected.

2) Complementary DNA (cDNA) library :-

- In cDNA library only exons are represented. It is constructed so as to include only those genes that are expressed.
- cDNA library is more specialized and exclusive DNA library.
- The mRNAs from an organism is extracted and complementary double stranded DNAs (cDNAs) are produced from these mRNAs by reverse transcriptase. The resulting DNA fragments are then inserted into a suitable vector and cloned

78. Which of the following enzymes have proof reading function in PCR [Polymerase Chain Reaction]

a) Taq polymerase

b) PFU Polymerase

c) Thermos thermophilus

d) Thermal flavus (Replinase)

e) T-7 polymerase

Correct Answer - B:E

Ans. is 'b' i.e., PFU Polymerase; & 'e' i.e., T-7 polymerase *[Ref Textbook of PCR by Mike McPherson]*

- The use of high fidelity DNA polymerases in PCR is essential for reducing the introduction of amplification errors in PCR products.
- Several thermostable DNA polymerases with 3' → 5' exonuclease - dependent proofreading activity have been introduced for high.
- Pfu DNA polymerase → Derived from Pyrococcus fusarious.
- Pwo DNA polymerase → Isolated from Pyrococcus woesei.
- KOD HiFi DNA polymerase → Isolated from Thermococcus Kodakaraensis.
- T7 DNA polymerase.

79. Enzymes required for mRNA synthesis is/are ?

a) RNA polymerase I

b) RNA polymerase II

c) Primase

d) Topoisomerase

e) Ligase

Correct Answer - B

Ans. is 'b' i.e., RNA polymerase II *[Ref Herper's 30"'/e p. 390-400]*

- It catalyzes the synthesis of *mRNA, small nuclear RNA (sn-RNA) and miRNA.*
- These products are coded by class II gene, i.e. class II gene is transcribed by mRNA.
- Class II gene differ from class I and III in that one of its transcribed products (mRNA) is translated into protein.

80. Which DNA polymerase has/have proofreading activity -

a) DNA polymerase I

b) DNA polymerase II

c) DNA polymerase a

d) DNA polymerase δ

e) DNA polymerase y

Correct Answer - A:B:D

Ans. is 'a' i.e., DNA polymerase I; 'b' i.e., DNA polymerase II; & 'd' i.e., DNA polymerase δ

DNA polymerase I - possesses three different catalytic activities :?

.. 5'→ 3' exonuclease activity, Polymerase activity (5'→3' polymerase activity), 3'→ 5' exonuclease activity,

2. DNA polymerase I :- Helps in gap filling and synthesis between okazaki fragments of lagging strand, and replaces ribonucleotides of RNA primer by deoxyribonucleotides. It has (i) 3' → 5' exonuclease activity, (ii) 5' → 3' exonuclease activity and (iii) polymerase (5' → 3' polymerase) activity.

3. DNA polymerase I :- Helps in gap filling and synthesis between okazaki fragments of lagging strand, and replaces ribonucleotides of RNA primer by deoxyribonucleotides. It has (i) 3' → 5' exonuclease activity, (ii) 5' → 3' exonuclease activity and (iii) polymerase (5' → 3' polymerase) activity.

4. DNA polymerase II:- Helps in (i) proofreading (3' à 5' exonuclease activity), and (ii) DNA repair.

5. DNA polymerase III :- It is the main enzyme that synthesizes prokaryote DNA, i.e., synthesis of leading and lagging strand. It has (i) $5^1 \rightarrow$ 3' polymerase (or simply polymerase) activity for DNA synthesis, and (ii) 3'--> 5^1 exonuclease activity for proofreading.

81. 30S ribosome INTERACTS with all except?

a) mRNA

b) ATP

c) GTP

d) Initiating factor

e) Elongating factor

Correct Answer - B:E

ANS- 'b' i.e., ATP; & 'e' i.e., Elongating factor *[Ref Dinesh Purl Y^{a}le* p. *482, 483]*

- INIATIATION process begins by formation of 30S initiation complex between 30S ribosomal subunit, mRNA and formyl mettRNA. GTP serves as source of energy. Three initiation factors (IF1, IF2, IF3) are also required for formation of this complex.
- Then there is formation of 70S initiation complex by joining of 50S and 30S subunits. In this complex, initiator tRNA occopies P-site on the ribosome. `A'-site is still empty.
- Elongation factors : EF-Tu, EF-Ts, EF-G.

82. Components / genes involved in RISC complex -

a) Pasha

b) Mi RNA

c) rRNA

d) Drosha

e) Dicer nuclease

Correct Answer - A:B:D:E

Ans. is 'a' i.e., Pasha; 'b' i.e., Mi RNA; 'd' i.e., Drosha; & 'e' i.e., Dicer nuclease *[Ref Textbook of molecular biology p.7121]*

- RNA- induced silencing complex (RISC) is a multiprotein complex that incorporates one strand of a double stranded small interfering RNA (siRNA) or single stranded micro RNA (miRNA).
- RISC uses the siRNA or miRNA as a template for recognizing complementary mRNA.
- Once RISC finds complementary strand of mRNA (with help of miRNA or siRNA), it activates RNAase to cleave (degrade) mRNA.
- The RISC-loading complex (RLC) is the essential structure required to load dsRNA fragments into RISC in order to target mRNA. The RLC consists of dicer, the human immunodeficiency virus transactivating response RNA-binding protein (TRBP) and Argonuate 2.
- A nuclear RNAase specific for dsRNA called Drosha acts with a nuclear ds-RNA binding protien called DGCR in human **(Pasha** in Dorsophila) and cleaves the hairpin region out of long precursor RNA generating a pre-miRNA.

83. 30S ribosome CONSIST of all except -

a) mRNA

b) ATP

c) GTP

d) Initiating factor and Elongating factor

e) None

Correct Answer - E

Ans. is None *[Ref Lippincates 5th/e p. 436]*

- Ribosomes are large complexes of r-RNA and proteins with one large and one small subunits.
- The **small subunit** binds m-RNA, thus guiding interaction between m-RNA codon and anticodon of t-RNA to read the genetic information with exiquisite **fidelity.** Hence small subunit is responsible for accuracy, whereas the **large subunit** catalyzes the **formation of peptide bond.**
- **Ribosomes are composed of two unequal subunits.**
- Eukaryotic(80 S) ribosome is made up of 60 S and 40 S subunits.
- Prokaryotic (70S) ribosome is made of 50S and 30S subunits.
- 60S subunit of eukaryotes contains 5 S rRNA, 5.8 S rRNA, 28S rRNA and more than 50 polypeptides. 40 S subunit contains 18 S rRNA and about 30 polypeptide chains.

84. Which of the following is required for unwinding of DNA -

a) Helicase

b) Primase

c) SSBP

d) Ligase

e) Topoisomerase

Correct Answer - A

Ans. is 'a' i.e., Helicase *[Ref: Harper's 30th Ie p. 383 & 29th p. 367]*

protein	function
DNA polymerases	Deoxynucleotide polymerization
Helicases	Processive unwinding of DNA
Topoisomerases	Relieve torsional strain that results from helicase induced unwinding
DNA primase	Initiates synthesis of RNA primers
Single-strand binding proteins	Prevent premature reannealling of dsDNA
DNA ligase	Seals the single strand nick between the nascent chain and Okazaki fragments on lagging strand

85. True about collagen :

a) Double helix structure

b) Single helix structure

c) Triple helix structure

d) β-pleated structure

e) Component of connective tissue of body

Correct Answer - C:E

Ans: c. Triple helix..., e. Component....*[Ref Harper 30th/46-47,627-32; Lippincott 6th/43-48; Vasudevan 5th/254-55]*

- In collagen, the collagen helix, or type-2 helix, is a major shape in secondary structure
- All collagen have a triple helical structure.
- A striking characteristic of collagen is occurrence of glycine residue at every third position of triple helical portion of **a** chain.
- This repeating structure, represented as $(Gly\text{-}x\text{-}y)_n$, is an absolute requirement for the formation of the triple helix.
- 300 nm long and 1.5 nm in diameter, it is made up of three polypeptide strands (called alpha chains), each possessing the conformation of a left-handed helix (its name is not to be confused with the commonly occurring alpha helix, a right-handed structure).
- These three left-handed helices are twisted together into a right-handed coiled coil, a triple helix or "super helix"
- Collagen, the major component of most connective tissues, constitutes approximately 25% of the protein of mammals.
- It provides an extracellular framework for all metazoan animals and exists in virtually every animal tissue. At least 28 distinct types of

collagen made up of over 30 distinct polypeptide chains (each encoded by a separate gene) have been identified in human tissues.

86. At isoelectric point (p1) net charge of amino acis is:

a) -1

b) +1

c) -2

d) +1

e) 0

Correct Answer - E

Ans: e. 0...[*Ref Harper 30th/201]*

- Isoelectric point (pI) is a pH in which net charge of amino acid is zero" (Harper 30th/20)
- "Isoelectric point (pI) is a pH in which net charge of amino acid is zero. In case of proteins isoelectric point mostly depends on seven charged amino acids: glutamate (6-carboxylgroup), aspartate (13-carboxyl group), cysteine (thiol group), tyrosine (phenol group), histidine (imidazole side chains), lysine (c-ammonium group) and arginine (guanidinium group).

87. Hexosaminidase A deficiency causes:

a) Niemann-pick

b) Tay-Sachs disease

c) Hurler syndrome

d) Gaucher's disease

e) Krabbe's disease

Correct Answer - B

Ans: b. Tay-Sachs disease *[Refs Harper 30th/251; Lippincott 6th/212; Harrison 19th/432e,433e*

- Hexosaminidase A deficiency is an enzyme deficiency that causes brain and other nerve cells to die, which can lead to severe neurological and mental problems.
- Hexosaminidase A (HEX A) deficiency is caused by a deficiency in an enzyme called beta-hexosaminidase A. This enzyme helps break down a particular fatty acid called GM2 ganglioside.
- Without adequate amounts of functional enzymes, GM2 ganglioside will build up in nerve cells and cause them to die.
- There are several forms of HEX A deficiency, including acute infantile (Tay-Sachs disease), juvenile, chronic, or adult-onset forms.

88. Mitchondrial matrix contains enzymes of :

a) Pyruvate dehydrogenase

b) TCA cycle enzyme

c) Acyl CoA synthetase

d) ATP synthase

e) β-oxidation enzymes

Correct Answer - A:B:D

Ans: a. Pyruvate dehydrogenase, b. TCA cycle enzyme, d. ATP synthase

- Matrix of the Mitochondrion is gel-like solution in the interior of mitochondria is 50% protein. These molecules include the enzymes responsible for the oxidation of pyruvate, amino acids, fatty acids (by n-oxidation), and those of the tricarboxylic acid (TCA) cycle.
- The synthesis of glucose, urea, and heme occur partially in the matrix of mitochondria. In addition, the matrix contains NAD+ and FAD (the oxidized forms of the two coenzymes that are required as hydrogen acceptors) and ADP and Pi, which are used to produce ATP.

89. Which of the following group(s) are present in natural amino acids:

a) Imidazole group

b) Tetrapyrrole group

c) Indole group

d) Guanidinium group

e) Keto group

Correct Answer - A:B:C:D
Ans: a. Imidazole..., b. Tetrapyrrole..., c. Indole..., d. Guanidinium *(Ref Harper 30th/20-23; Lippincott 6th/I-11; Vasudevan 5th/19]*

- Imidazole group: Histidine, Beta carboxyl group: Aspartic acid (Vasudevan 5th/19) Gamma carboxyl group: Glutamic acid (Vasudevan 5th/19) ?-amino group: Lysine (Vasudevan 5th/19).
- Special groups in Amino acids Vasudevan 5th/17:→ Benzene group- Phenylalanine Indole group in- Tryptophan Pyrrolidine group - Proline Guanidinium group- Arginine Phenol group- Tyrosine

90. Which of the following vitamin deficiency cause triad of mental confusion, ophthalmoplegia & ataxia:

a) Vit B2

b) Vit B1

c) Vit B6

d) Vit C

e) Vit. B12

Correct Answer - B

Ans: b. Vit Bl ***[Ref Lippincott 6th/378-79; Harrison 19th/96e, 18th/594-96; Harper 30th/555-56, 28th/ 468]***

- Classically, Wernicke's encephalopathy is characterized by the triad of ophthalmoplegia, ataxia, and mental confusion, but confusion & a staggering gait are perhaps most common"-Synopsis of Psychaitry by (Kaplan 11th/796-799)
- Thiamine deficiency in its early stage induces anorexia and nonspecific symptoms (e.g., irritability, decrease in short-term memory).
- Alcoholic patients with chronic thiamine deficiency also may have central nervous system (CNS) manifestations known as Wernicke's encephalopathy, which consists of horizontal nystagmus, ophthalmoplegia (due to weakness of one or more extraocular muscles), cerebellar ataxia, and mental impairment

91. Which of the following enzyme(s) is/are involved in gluconeogenesis:

a) Pyruvate carboxylase

b) Phosphoenolpyruvate carboxykinase

c) Phosphofructokinase-1

d) Glucose 6-phosphatase

e) Pyruvate dehydrogenase

Correct Answer - A:B:D

Ans: a. Pyruvate carboxylase, b. Phosphoenolpyruvate carboxykinase, d. Glucose 6-phosphatase ,*[Ref Harper 30th/188; Lippincott 6th/117-122; Harper 28th/ 165-68; Lippincott 4th/329J]*

- glucose-6-phosphatase, fructose-1,6-bisphosphatase, and PEP carboxykinase/pyruvate carboxylase.

92. Gel used in electrophoresis is/are:

a) Agarose gel

b) Polyacrylamide plain gel

c) Polyacrylamide SDS (Sodium dodecyl sulphate) impregnated Polyacrylamide gel

d) all of the above

e) None

Correct Answer - D

Ans. d- all of the above [www.lonza.com/go/literature/2043; Shinde 7th/7741]

- Separation of RNA in agarose gels is used for a number of different purposes, including Northern blots to monitor RNA expression levels, checking RNA integrity and size selection of RNA for cloning experiments. Separation of RNA based on fragment length requires conditions that are different from DNA analysis.
- These include sample preparation, the use of sample and gel denaturants, electrophoresis buffers, and visualization. The purpose of the experiment and the size of the RNA being separated are the primary drivers in determining which denaturing system to use.
- The most frequently used denaturants for RNA agarose gel electrophoresis are formaldehyde, formaldehyde/formamide, and glyoxal plus DMSO.

93. Which of the following method(s) is/are used for detection of nucleic acid:

a) Northern blotting

b) Southern blotting

c) Western blotting

d) Microarray

e) ELISA

Correct Answer - A:B:D

Ans: a. Northern..., b. Southern"', d' Microarray'

Technique	Sample Analysed	Gel Used	Purpose
Southern blot	DNA°	Yes	Detect DNA changes
Northern blot	RNA°	Yes	Measures mRNA amounts & size
Western blot	Protein°	Yes	Measures protein amount
ASO	DNA°	No	Detects DNA mutations°
Microarray	RNA or cDNA	No	Measures many mRNA levels at one time
ELISA	Proteins° or antibodies	No	Detects proteins (antigens)or antibodies°
Proteomics	Proteins°	Yes	Measures abundance, distribution, posttranslai.iuri modifications, functions &

interactions of cellular proteins

94. Mucopolysacchidosis, which is a lysosomal storage disease, occurs due to abnormality in:

a) Hydrolase enzyme

b) Dehydorgenase enzyme

c) Lipase enzyme

d) Phosphatase

e) Acetyl-CoA carboxylase

Correct Answer - A

Ans: a. Hydrolase enzyme ***[Ref Harper 30th/638-39, 29th/589, 599, 600; Lippincott 6th/163-64]***

- The mucopolysaccharidoses are hereditary diseases caused by a deficiency of any one of the lysosomal hydrolases normally involved in the degradation of heparan sulfate and/or dermatan sulfate
- They are progressive disorders characterized by accumulation of glycosaminoglycans in various tissues, causing a range of symptoms, such as skeletal and extracellular matrix deformities, and mental retardation.
- Children who are homozygous for any one of these diseases are apparently normal at birth, then gradually deteriorate. In severe cases, death occurs in childhood.
- Diagnosis is confirmed by measuring the patient's cellular level of the lysosomal hydrolases. Bone marrow and cord blood transplants have been used to treat Hurler and Hunter syndrome

95. Sulphur of cystein are not used/ utilized in body for the following process/product:

a) Help in conversion of cyanide to thiocyanate

b) Thiosulphate formation

c) Introduction of sulphur atom in methionine

d) Disulfide bond formation b/w two adjacent peptide

e) None

Correct Answer - C

Ans: c. Introduction of sulphur atom in methionine, *[Ref Harper 30th/301-02, 313-14, 29th/285-86; Lippincott 6th/263-68; Shinde 7th/471-73, 578; Vasudevan 5th/191; Satyanarayan 3rd/361]*

- The H_2S derived from the cysteine may be oxidized to sulfites & thiosulfates er further oxidized to sulfate.
- Cysteine transaminates to form beta mercapto pyruvic acid & finally pyruvate. The beta mercapto pyruvate can transfer S to CN to form thiocynate (SCN).
- The sulphur may be removed either as H_2S or elemental sulphur or as sulfite, Cysteine on decarboxylation gives beta mercapto ethanolamine. This is used for synthesis of coenzyme A.
- Formation of cysteine is by using the carbon skeleton contributed by serine & sulphur originating from methionine.

96. Which one of the following statements about protein structure is correct:

a) Proteins consisting of one polypeptide can have quaternary structure

b) The formation of a disulfide bond in a protein requires that the two participating cysteine residues be adjacent to each other in the primary sequence of the protein

c) The stability of quaternary structure in proteins is mainly a result of covalent bonds among the subunits

d) The denaturation of proteins always leads to irreversible loss of secondary and tertiary structure

e) The information required for the correct folding of a protein is contained in the specific sequence of amino acids along the polypeptide chain

Correct Answer - E

Ans: e. The information required for the correct...*[Ref Harper 3001/36-41, 29th/36-40; Lippincott 6th/24, 13-20]*

- The correct folding of a protein is guided by specific interactions between the side chains of the amino acid residues of the polypeptide chain
- The two cysteine residues that react to form the disulfide bond may be a great distance apart in the primary structure (or on separate polypeptides), but are brought into close proximity by the three-dimensional folding of the polypeptide chain. Denaturation may either be reversible or irreversible.
- Quaternary structure requires more than one polypeptide chain.

These chains associate through noncovalent interactions"

- Primary structures are stabilized by covalent peptide bonds. Higher orders of structure are stabilized by weak forces—multiple hydrogen bonds, salt (electrostatic) bonds, and association of hydrophobic R groups.
- Protein denaturation results in the unfolding and disorganization of the protein's structure, which are not accompanied by hydrolysis of peptide bonds. Denaturation may be reversible or, more commonly, irreversible.

97. True about retinol:

a) Form part of rhodopsin

b) Transported from intestine to liver by via chylomicrons

c) Actively take part in visual cycle

d) Implicated in growth & differentiation of tissue

e) Not formed by retinoic acid

Correct Answer - B:D:E

Ans: b. Transported from intestine to liver by via chylomicrons, d. Implicated in growth & differentiation of tissue, & e. Not formed by retinoic acid,

[Ref Harper 30th/547-51, 29th/526-28; Lippincott 6th/381-83; Shinde 7th/152-56; Vasudevan 5th/284-86]

- Retinoic acid is produced by oxidation of retinal. However, retinoic acid cannot give rise to the formation of retinal or retinol"
- Retinoic acid is implicated in growth & differentiation of tissue, it is necessary for the reproductive system. Retinol
- acts like a steroid hormone in controlling the expression of certain genes. This may account for the requirement of Vit A for normal reproduction
- Retinyl esters present in the diet are hydrolyzed in the intestinal mucosa, releasing retinol and free fatty acids. Retinol derived from esters and from the cleavage and reduction of carotenes is re-esterified to long-chain fatty acids in the intestinal mucosa and secreted as a component of chylomicrons into the lymphatic system.
- Retinyl esters contained in chylomicron remnants are taken up by, and stored in, the liver.
- retinol is released from the liver and transported to extrahepatic

tissues by the plasma retinol binding protein (RBP).

98. In prolong fasting glycerol is formed from triglyceride. Which of the following statement (s) is/are true regarding glycerol:

a) Used in synthesis of chylomicron

b) It is directly used by tissues for energy needs

c) It is formed due to increased activity of lipoprotein lipase

d) It is formed due to increased activity of hormone sensitive lipase

e) Glycerol acts as a substrate for gluconeogenesis in the liver

Correct Answer - D:E

Ans: d. It is formed due to increased activity of hormone sensitive lipase, & e. Glycerol acts as a substrate for gluconeogenesis in the liver,*[Ref Harper 30th/262, 149, 29th/160-61; Lippincott 6th/331, 178, 190].*

- Fasting: In adipose tissue the decrease in insulin and increase in glucagon results in inhibition of lipogenesis, inactivation of lipoprotein lipase, and activation of intracellular hormone-sensitive lipase.
- This leads to release from adipose tissue of increased amounts of glycerol (which is a substrate for gluconeogenesis in the liver) and free fatty acids, which are used by liver, heart, and skeletal muscle as their preferred metabolic fuel, therefore sparing glucose.
- The glycerol produced from TAG degradation is used as a gluconeogenic precursor by the liver.
- Lipolysis Is Controlled by Hormone-Sensitive Lipase, which is

·activated by ACTH, TSH, glucagon, epinephrine, norepinephrine, and vasopressin and inhibited by insulin, prostaglandin E_1 and nicotinic acid

- Activity of the hormone-sensitive lipase is increased by fasting and stress and decreased by feeding and insulin. Conversely, feeding increases and fasting and stress decrease the activity of lipoprotein lipase

99. Pyruvate dehydrogenase complex uses following coenzymes/ cofactors:

a) Biotin

b) Lipoic acid

c) NAD

d) FMN

e) TPP

Correct Answer - B:C:E

Ans: b. Lipotic. acid. , c. NAD & e. TPP *(Ref Harper 30th/172-74, 29th/174-75; Lippincott 6th/109-11; Satyanarayan 3rd/253-54]*

Pyruvate Dehydrogenase Complex (PDH) Satyanarayan 3rd/253-54

- It is found only in mitochondria, High activity of PDH are found in cardiac muscle & kidney
- The enzyme PDH requires five cofactors (coenzymes) namely- TPP, lipoamide (it contains lipoic acid linked to c-amino group of lysine), FAD, coenzyme A & NAD+, PDH is inhibited by arsenite
- Pyruvate dehydrogenase irreversibly converts pyruvate, the end product of glycolysis, into acetyl CoA, a major fuel for the TCA cycle and the building block for fatty acid synthesis.
- The PDH complex contains five coenzymes that act as carriers or oxidants for the intermediates of the reactions. El requires thiamine pyrophosphate (TPP), E2 requires lipoic acid and CoA, and E3 requires FAD and NAD+.

100. In conversion of pyruvate to acetyl CoA & CO2, which of the following coenzyme is used:

a) Biotin

b) Lipoic acid

c) TPP

d) Pyridoxal phosphate

e) Tetrahydrofolate

Correct Answer - B:C

Ans: b. Lip... & c. TPP ***[Ref above* Q; *Harper 30th/172-74, 29th/174-75; Lippincott 6th/109-11; Satyanarayan 3rd/253-54]***

- Pyruvate dehydrogenase irreversibly converts pyruvate, the end product of glycolysis, into acetyl CoA, a major fuel for, the TCA cycle and the building block for fatty acid synthesis". (Lippincott 6th/109-10)

101. True about urea cycle:

a) Nitrogen of the urea comes from alanine & ammonia

b) Uses ATP during conversion of arginosuccinate to arginine

c) On consumption of high amount of protein, excess of urea formed

d) Occur mainly in cytoplasm

e) Synthesis of argininosuccinate consumes energy

Correct Answer - C:D:E

Ans: c. On consumption of high..., d. Occur mainly in cytoplasm & e. Synthesis of arginosuccinate.... ***[Ref Harper 30th/290-96, 29th/274-88; Lippincott 6th/253-55; Shinde 7th/450-51; Vasudevan 5th/180-811]***

- In healthy people, the normal blood urea concentration is 1040 mg/dl. Higher protein intake marginally increases blood urea level.
- Citrulline Plus aspartate forms argininosuccinate, catalysed by enzyme Argininosuccinate synthase. The reaction requires ATP.
- Cleavage of argininosuccinate, catalyzed by argininosuccinase, proceeds with retention of nitrogen in arginine and release of the aspartate skeleton as fumarate (require no ATP)" .
- Urea has two amino groups, one derived from ammonia & other from aspartate. Carbon atom is supplied from carbon dioxide.

102. Gangliosides contains:

a) Phosphate

b) Galactose

c) Sulphate

d) Serine

e) Sailic acid

Correct Answer - B:E

Ans: b. Galactose & e. Sailic acid ***[Ref Harper 30th/218, 250-51, 29th/146, 136, 234; Lippincott 6th/209; Vasudevan 5th/78; Chatterjea Shinde 7th/45, 58-61].***

- A ganglioside is a molecule composed of a glycosphingolipid with one or more sialic acids linked on the sugar chain.
- NeuNAc, an acetylated derivative of the carbohydrate sialic acid, makes the head groups of gangliosides anionic at pH 7, which distinguishes them from globosides.
- Gangliosides are present and concentrated on cell surfaces, with the two hydrocarbon chains of the ceramide moiety embedded in the plasma membrane and the oligosaccharides located on the extracellular surface, where they present points of recognition for extracellular molecules or surfaces of neighboring cells. They are found predominantly in the nervous system where they constitute 6% of all phospholipids.

103. Which of the following RNA contains unusal bases:

a) mRNA

b) rRNA

c) tRNA

d) 30 S RNA

e) 50s RNA

Correct Answer - B:C

Ans: c.tRNA [Ref Harper 30th/pg394.

- tRNA molecule contain a high percentage of unusal bases, for example, dihydrouracil er have extensive intra-chain base pairing that leads to characteristic secondary 6'' tertiary structure"- Lippincott 6th/418.
- The tRNA molecules contain a high percentage of unusual bases (for example, dihydro uracil) and have extensive intrachain base-pairing that leads to characteristic secondary and tertiary structure.
- Each tRNA serves as an "adaptor" molecule that carries its specific amino acid—covalently attached to its 3'-end—to the site of protein synthesis. There it recognizes the genetic code sequence on an mRNA, which specifies the addition of its amino acid to the growing peptide chain

104. All are true about structure of DNA except:

a) Right -handed helix

b) Left-handed helix

c) Phosphate form backbone

d) Deoxyribose forms backbone

e) Nitrogen bases form backbone

Correct Answer - E

Ans: e. Nitroge...*[Ref Harper 30th/359-61, 29th/354-60; Lippincott 6th/395-400; Ananthanarayan 9th/54)*

- Each chain of double helix has a backbone of deoxyribose & phosphate residues arranged alternately. Attached to each deoxyribose is one of the 4 nitrogenous bases: A, G, C for T"-Ananthanarayan 9th/54
- The common form of DNA is said to be right-handed. In the test tube, double-stranded DNA can exist in at least six forms (A-E & Z)"
- With the exception of a few viruses that contain single-stranded (ss) DNA, DNA exists as a double stranded (ds) molecule, in which the two strands wind around each other, forming a double helix
- The A form is produced by moderately dehydrating the B form. It is also a right-handed helix, but there are 11 base pairs per turn, and the planes of the base pairs are tilted 20"
- away from the perpendicular to the helical axis. . Z-DNA is a left-handed helix that contains about 12 base pairs per turn (Note: deoxyribose -phosphate backbone "zigzags, " hence, the name'S"-DNA)

105. Which of the following is false:

a) Ratio of A:T & G:C is approximately equal to 1:1

b) Ratio of A:G & T:C is approximately equal to 1:1

c) A+T=G+C

d) A+C=G+T

e) A+G= C+T

Correct Answer - B:C

Ans: b. Ratio of A: G... & *c.* A+T=G+C*(Ref Harper 30th/360-61; Satyanarayan 3rd/73; Lippincott 4th/291; Ananthanarayan 9th/54-55]*

- Chargaff rule stated that in DNA molecules the concentration of deoxyadenosine (A) nucleotides equals that of thymidine (T) nucleotides (A = T), while the concentration of deoxyguanosine (G) nucleotides equals that of deoxycytidine (C) nucleotides (G = C)
- The two strands of this double-stranded helix are held by both, hydrogen bonds between the purine and pyrimidine bases of the respective linear molecules and by vander Waals and hydrophobic interactions between the stacked adjacent base pairs.
- The pairings between the purine and pyrimidine nucleotides on the opposite strands are very specific and are dependent upon hydrogen bonding of A with T and G with C
- "The ratio of each pair of bases (A÷T)/(G+C) though constant for each species, varies widely from one bacterial species to another"- Ananthanarayan 9th/54

106. True about restriction enzyme:

a) Also k/a restriction endonuclease

b) Produce sticky ends

c) Can detect mutations

d) Obtained from virus

e) Breaks at sugar-phosphate bond

Correct Answer - A:B:E

Ans: a. Also k/a. restriction..., b. Produce sticky ends & e. Breaks at sugar-phosphate bond.*[Ref Harper 30th/452-54, 28th/388-90; Lippincott 4th/465-66; Satyanarayana 3rd/580]*

- RE can specifically recognize DNA with particular sequence of 4-6 mucleotides and cleave. The recognition sequences are palindromic^{Q} (i.e., twofold rotational symmetry" (Lippincott 4th/466)
- It is an enzyme that cleave double-stranded DNA^{Q} at specific recognition nucleotide known as restriction sitesQ. To cut the DNA, a restriction enzyme makes two incisions, one through each sugar-phosphate backbone^{Q} (i.e. each strand) of the DNA double helix. This enzyme can restrict viral replication so called restriction enzymes.
- The cut DNA fragments by RE may have sticky ends (cohesive ends)^{Q} or blunts ends^{Q} depending on the mechanism used by enzyme. DNA fragments with sticky ends are particularly useful for recombinant DNA experiments (hybrid or chimeric DNA molecules).
- To cut the DNA, a restriction enzyme makes two incisions, once through each sugar-phosphate backbone (i.e. each strand) of the DNA double helix.

107. Genes in CpP island is inactivated by:

a) Methylation

b) Metrylation

c) Ubiquitisation

d) Acetylation

e) None

Correct Answer - A

Ans: a. Methylation*[Ref Lippincott 6th/709; Harrison 19th/101e-4, 18th/668, 679; Robbins 9th/893; Satyanarayan 3rd/359, 572; Lippincott 4th/460-62; Chatterjea Shinde 7th/346, 426; en. wikipedia. org/wiki/DNA_methylationj*

- CpG islands: Methylation of cytosine by a methyltransferase is associated with silencing of the activities of certain gene"-Lippincott 6th/709
- Cytosine in the sequence CG of DNA gets methylated to form 5'-methylcytosine. A major portion of CG (about 20%) in human DNA exists in methylated form. In general, methylation leads to loss of transcriptional activity & thus inactivation of genes.
- The role of epigenetic control mechanisms in the development of human cancer is unclear. However, a general decrease in the level of DNA methylation has been noted as a common change in cancer. In addition, numerous genes, including some tumor-suppressor genes, appear to become hypermethylated and silenced during tumorigenesis.

108. Which of the following is/are true about PCR except:

a) Uses heat labile DNA polymerase

b) Uses heat stable DNA polymerase

c) Is technique for DNA amplification

d) Used to yield multiple copies of DNA

e) Reverse transcriptase- PCR is used for quantification of RNA

Correct Answer - A

Ans: a. Uses heat labile DNA polymerase,*[Ref Harper 30th/458-59; Lippincott 6th/479-83, 5th/497-83; Chatterjea er Shinde7th/267-272]*

- Specificity[Q] is based on the use of two oligonucleotide primers that hybridize to complementary sequence on opposite strands of DNA & flank the target sequence Double stranded DNA can be disrupted by heat or high pH, giving rise to single stranded DNA. The single stranded DNA serves as a template for synthesis of a complementary strand by replicating enzymes, DNA polymerase.
- Early PCR reaction used an E. coli DNA polymerase that was destroyed by each heat denaturation cycle. Substitution of a heat-stable DNA polymerase (Taq polymeraseY from Thermus aquaticus, obviates this problem & has made possible automation of the reaction, since the polymerase reactions can be run at 70°C

109. Which of the following techniques are used for detection of mutation:

a) RT-PCR

b) Microarray

c) Allele-specific oligonucleotide (ASO)

d) Westren blot

e) DNA sequencing

Correct Answer - A:B:C:E

Ans: a. RT-PCR , b. Microarray , c. Allele-specific oligonucleotide (ASO) & e. DNA sequencing,

[Ref Lippincott 6th/473; Harper 30th/470, 29th/483-85; Harrison 19th/83e, 443-44, 18th/508, 17th/406; Vasudevan 5th/454-56]

- Mutational analysis: More discrete sequence alterations rely heavily on the use of PCR, which allows rapid gene
- amplification and analysis. Moreover, PCR makes it possible to perform genetic testing and mutational analysis with small amounts of DNA extracted from leukocytes or even from single cells, buccal cells, or hair roots. DNA sequencing can be performed directly on PCR products or on fragments cloned into plasmid vectors amplified in bacterial host cells" (Harrison 19th/444).
- Southern blotting can detect DNA mutations such as the insertion or deletion of nucleotides.
- It can also detect point mutations that cause the loss or gain of restriction enzyme cleavage sites. Such mutations cause the pattern of bands to differ from those seen with a normal gene.
- A comprehensive approach to genome-scale studies consists of

microarrays, or DNA chips. Used to determine the gene expression pattern of thousands of genes simultaneously. Microarrays allow the detection of variations in DNA sequence and are used for mutational analysis and genotyping.

110. Which of the following technique is/are used in quantitification of viral nucleic acid:

a) MALDI-TOF MS

b) Branched-chain DNA (bDNA)

c) PCR

d) Gas-Liquid Chromatography

e) Biochemical phenotyping

Correct Answer - B:C

Ans: (B) Branched-chain DNA (bDNA) & (C) PCR *[Ref Harper 29th/26; Lippincott 6th/482, 485; Harrison 19th/150e-3-6, 183e-1, 194e-3; http://www. researchgate. net/profile/Ivo_Gut/ publication/8597456_DNA_ analysis_by_MALDI- TOP]*

- Quantitative NAATs are available for HIV (PCR), cytomegalovirus (PCR), hepatitis B virus (PCR), and hepatitis C virus (PCR and TMA).
- Branched-chain DNA (bDNA) testing is an alternative to NAAT (Nucleic acid amplification techniques) for quantitative nucleic acid testing. In such testing, bDNA attaches to a site different from the target-binding sequence of the original probe.
- Chemiluminescence-labeled oligonucleotides can then bind to multiple repeating sequences on the bDNA. The amplified bDNA signal is detected by chemiluminescence. bDNA assays for viral load of HIV, hepatitis B virus, and hepatitis C virus have been approved by the FDA.
- The advantage of bDNA.assays over PCR is that only a single

heating/annealing step is required to hybridize the target-binding probe to the target sequence for amplification.

111. Which of the following is/are most severe/ dangerous change in gene:

a) Deletion

b) Insertion

c) Mutation

d) Translocation

e) Duplication

Correct Answer - A:B

Ans: a. Deletion & b. Insertion -Most probably *[Ref Harper 30th/416-19; Lippincott 6th/434; Harrison 19th/432-34; Robbins 9th/160-61; Harshmohan 7th/2551.*

- Deletion & Insertion could be possible answer (Please go through explanation given & other references for deciding appropriate answer
- Frameshift Mutations Result from Deletion or Insertion of Nucleotides in DNA That Generates Altered mRNAs
- The deletion of a single nucleotide from the coding strand of a gene results in an altered reading frame in the mRNA.
- if three nucleotides or a multiple of three are deleted from a coding region, the corresponding mRNA when translated will provide a protein from which is missing the corresponding number of amino acids. Because the reading frame is a triplet, the reading phase will not be disturbed for those codons distal to the deletion.
- If, however, deletion of one or two nucleotides occurs just prior to or within the normal termination codon (nonsense codon), the reading of the normal termination signal is disturbed. Such a deletion might

result in reading through a termination signal until another nonsense codon is encountered.

- Insertions of one or two or nonmultiples of three nucleotides into a gene result in an mRNA in which the reading frame is distorted upon translation, and the same effects that occur with deletions are reflected in the mRNA translation. This may result in garbled amino acid sequences distal to the insertion and the generation of a nonsense codon at or distal to the insertion, or perhaps reading through the normal termination codon

112. True statement regarding Lactate dehydrogenase deficiency:

a) Fumarate level increases

b) Exercise intolerance

c) Muscle cramps may occur

d) **It** operates in anaerobic condition

e) It is the key enzyme of Kreb cycle

Correct Answer - B:C:D

Ans: b. Exercise ..., c. Muscle ..., d. It operate...*[Ref Harper 30th/171, 69, 28th/149-151; Harrison 19th/433e2; Lippincott 4th/103, 111; Chatterjea & Shinde 7th/313]1*

- Fumarate is converted to malate by fumarase enzyme in Kreb cycle (so fumarate level increases in defective enzyme functioning in Krebs cycle, not in abnormality of glycolysis i.e., lactate dehydrogenase deficiency, Lactate dehydrogenase catalyse conversion of pyruvic acid to lactic acid .
- Lactate dehydrogenase deficiency is a condition that affects how the body breaks down sugar to use as energy in cells, primarily muscle cells.
- There are two types of this condition: lactate dehydrogenase-A deficiency (sometimes called glycogen storage disease XI) and lactate dehydrogenase-B deficiency.
- People with lactate dehydrogenase-A deficiency experience fatigue, muscle pain, and cramps during exercise (exercise intolerance).

113. Hyaloronic acid is composed of:

a) N-acetyl glucosamine

b) N-acetyl galactosamine

c) Glucuronic acid

d) N-acetylneuramic acid

e) Iduronic acid

Correct Answer - A:C

Ans: a. N-acetyl and c. Glucuronic*[Ref Harper 30th/156, 159, 637, 640, 28th/119, 534-39; Lippincott 4th/159, 163; Chatterjea er Shinde 7th/38]*

- Composition of Hyaluronic Acid: It is composed of repeating units of N-acetyl glucosamine & D-Glucuronic acid. On hydrolysis, it yields equimolecular quantities of D-Glucosamine, D-Glucuronic acid & acetic acid.
- Hyaluronic acid is present in bacteria and is widely distributed among various animals and tissues, including synovial fluid, the vitreous body of the eye, cartilage, and loose connective tissues.
- Hyaluronic acid is especially high in concentration in embryonic tissues and is thought to play an important role in permitting cell migration during morphogenesis and wound repair. Its ability to attract water into the extracellular matrix and thereby "loosen it up" may be important in this regard.

114. The size of Microsatellite repeat sequence is:

a) <1 kb

b) 2-6 bp

c) 1-3 kb

d) >3 kb

e) 5-20 bp

Correct Answer - B

Ans: b. 2-6 bp

- sequences of 2-5 bp repeated up to 50 times. May occur at 50000-100000 locations in the genome"-Harper 30th/377-78, 28th/404
- Short (2-6 bp), inherited, tandem repeat units of DNA occur about 50,000-100,000 times in the human genome.
- Because they occur more frequently—and in the view of the routine application of sensitive PCR methods—they are replacing RFLPs as the marker loci for various genome searches.

115. All are feature of Refsum disease except:

a) Deficiency of a-hydroxylase

b) Defect in p oxidation

c) Accumulation of phytanic acid

d) Peripheral neuropathy

e) Treated by removing phytanic acid precursors from diet

Correct Answer - B

Ans: b. Defect in p oxidation ***[Ref Harper 30th/231, 614, 28th/l91, 493; Lippincott 4th/195; Harrison 19th/2681, 18th/3456, 236]***

- Refsum disease is a rare autosomal recessive disorder caused by a deficiency of a-hydroxylase" (Lippincott 4th/195)
- "Refsum's disease: Alpha oxidation does not occur. Alpha oxidation is mainly used for fatty acids that have a methyl group at beta-carbon, which block beta-oxidation. This process occur mainly in endoplasmic reticulum & some also in peroxisomes.
- **Refsum's disease** is a rare neurologic disorder due to a metabolic defect that results in the accumulation of phytanic acid, which is found in dairy products and ruminant fat and meat. Phytanic acid is thought to have pathological effects on membrane function, protein prenylation, and gene expression" (Harper 30th/231, 28th/191)
- Refsum disease can manifest in infancy to early adulthood with the classic **tetrad of** (1) peripheral neuropathy, (2) retinitis pigmentosa, (3) cerebellar ataxia, and (4) elevated CSF protein concentration .
- Refsum disease is genetically heterogeneous but autosomal recessive in nature. Classical Refsum disease with childhood or early adult onset is caused by mutations in the gene that encodes for phytanoyl-CoA a-hydroxylase (PAHX).

- Refsum disease is treated by **removing phytanic precursors** (phytols: fish oils, dairy products, and ruminant fats) from the diet.

116. Group of alleles that are closely linked together at a genomic locus & inherited together as a cluster is/are:

a) Idiotype

b) Haplotype

c) Genotype

d) Phenotype

e) None

Correct Answer - B

Ans. (B) Haplotype([Refs Harrison 19th/435, 18th /497, 505; Robbins 9th/195, 8th/177])

- The entire human genome now can be divided into blocks known as haplotypes, which contain varying numbers of contiguous single nucleotide polymorphisms on the same chromosome that are in linkage disequilibrium & hence inherited together as a cluster
- A haplotype refers to a group of alleles that are closely linked together at a genomic locus.
- Haplotypes are useful for tracking the transmission of genomic segments within families and for detecting evidence of genetic recombination, if the crossover event occurs between the alleles.

117. Which of the following is true regarding DNA double-strand breaks repair pathway

a) Homologous recombination require a long homologous sequence to guide repair

b) Non-homologous end-joining does not require a long homologous sequence to guide repair

c) Homologous recombination repairs DNA before the cell

d) Non-homologous end-joining repairs DNA before the cell enters mitosis

e) Non-homologous end joining is prominent DSB repair mechanism in mammals

Correct Answer - A:B:C:E

Ans: a. Homologus..., b. Non-homologous..., *c.* Homologous ..., e. Non-homologous... ***[Ref Harper 30th/389-91, Satyanarayan3rd/532; Robbins 9th/430-31, 8th /302; http: www.ncbi.nlm. nih.gov/pubmed/20192759]***

- Non-homologous end joining (NHEJ) is the predominant type of DSB repair in mammalian cells, as opposed to lower eukaryotes.
- DSB in DNA are dangerous; They result in genetic recombination which may lead to chromosomal translocation, broken chromosome & finally cell death; DSBs can be repaired by homologous recombination or non-homologous end joining; Homologous recombination occurs in yeasts while in mammals, non-homologous end joining dominates

Double-Strand Breaks Repair Mechanism

1. Double-strand breaks can be repaired through homologous recombination or through non-homologous end joining (NHEJ).
2. NHEJ is a DNA repair mechanism which, unlike homologous recombination, does not require a long homologous sequence to guide repair.
3. Whether homologous recombination or NHEJ is used to repair double-strand breaks is largely determined by the phase of cell cycle. Homologous recombination repairs DNA before the cell enters mitosis (M phase).
4. DNA double-strand breaks (DSB) are presumed to be the most deleterious DNA lesions as they disrupt both DNA strands.
5. Homologous recombination (HR), single-strand annealing, and non-homologous end joining are considered to be the pathways for repairing DSB.

118. Which of the following enzyme (s) participate in protein synthesis:

a) DNA ligase

b) DNA Helicase

c) Peptidase

d) Peptidyl transferase

e) DNA polymerase

Correct Answer - D

Ans: d. Peptidyl transferase

[Ref Harper 30th/422-24, 28th/359-66, 323; Lippincott 4th/438-42; Chatterjea & Shinde 7th/248-501

Enzyme Required for Translation

- **Amino-acyl-t-RNA synthetase:** Enzyme **required for** activation of amino acids, Peptide synthetase (peptidyl transferase)
- The NH_2 of new aminoacyl t - RNA (A_l) in 'A' site combine with the - **COOH** group of Met - **t** -RNA occupying the **'P'** site. The reaction is catalyzed by peptidyl transferase". "Peptidases degrades proteins to amino acids
- The NH_2 of new aminoacyl t - RNA (A_l) in 'A' site combine with the - **COOH** group of Met - **t** -RNA occupying the **'P'** site. The reaction is catalyzed by peptidyl transferase . `` peptidases degrades proteins to amino acids.

Protein	**function**
DNA polymerases	Deoxynucleotide polymerization
Helicases	Processive unwinding of

Helicases	DNA
Topoisomerases	Relieve torsional strain that results from helicase-induced unwinding
DNA primase	Initiates synthesis of RNA primers
Single-strand binding proteins	Prevent premature reannealing of dsDNA
DNA ligase	Seals the single strand nick between the nascent Okazaki chain and fragments on tagging strand

119. All are true regarding epigenetics mechanism except:

a) Non-heritable

b) Acetylation of Histone

c) Hereditary

d) Methylation of DNA

e) X chromosome inactivation

Correct Answer - A

Ans. (A) Non-heritable

- Epigenetics *is defined as the study of heritable chemical modification of DNA or chromatin that does not alter the DNA sequence itself. Example of such modification include methylation of DNA & the methylation er acetylation of histones.*
- *Epigenetic modification is critical for normal development including-regulation of tissue specific gene expression, X-chromosome inactivation & genomic imprinting.*
- An *epigenetic modification* refers to a change in the genome, *heritable by cell progeny,* that does not involve a change in the DNA sequence. The *inactivation of the second* X *chromosome* in female cells is an example of an epigenetic silencing that prevents gene expression from the inactivated chromosome.

120. True about peptide bond formation:

a) The NH2 group of new aminoacyl t -RNA at A site combine with the - COOH group of Met-t -RNA occupying the 'P' site

b) The NH2 group of new aminoacyl t - RNA at 'P' site combine with the - COOH group of Met-t-RNA occupying the 'A site

c) Reaction is catalyzed by peptidyl transferase

d) Peptide bond formation require energy

e) None

Correct Answer - A:C

Ans: a. **The NH2 and *c*. Reaction...***[Ref Harper 30th/422-25, 28th/359-66; Lippincott 4th/438-42; Chatterjea te• Shinde 7th/248-501]*

- The a-amino group of the new aminoacyl-tRNA in the A site **carries out** a nucleophilic attack on the esterified carboxyl group of the peptidyl-tRNA occupying the P site (peptidyl or polypeptide site). At initiation, this site is occupied by aminoacyl-tRNA met'.
- This reaction **is** catalyzed by a **peptidyltransferase, a** component of the 28S RNA of the 60S ribosomal subunit. This is another example of ribozyme activity and indicates an important—and previously unsuspected—direct role for RNA in protein synthesis.
- Because the amino acid on the aminoacyl-tRNA is **already "activator** no further energy source is required for this reaction. The reaction results in attachment of the growing peptide chain to the tRNA in the A site.

121. All are true about DNA methylation except:

a) It usually occurs in the cytosine

b) Can alters the gene expression pattern in cells

c) Role in genomic imprinting

d) No role in carcinogenesis

e) Essential for normal development

Correct Answer - D

Ans: (D) No role in carcinogenesis*[Ref Harper 30th/438; Harrison 19th/101e-4, 18th/668, 679; Robbins 9th/319-20, 893, 8th /306; Satyanarayan 3rd/359, 572; Lippincott 4th/460-62; Chatterjea Shinde 7th/346, 426;en. wikipedia. org/wiki/ DNA_methylation]*

- Cytosine in the sequence CG of DNA gets methylated to form 5'-methylcytosine. A major portion of CG (about 20%) in human DNA exists in methylated form.
- In DNA, methylation usually occurs in the CpG islands, a CG rich region, upstream of the promoter region. In humans, DNA methylation is carried out by a group of enzymes called DNA methyltransferases.
- DNA methylation stably alters the gene expression pattern in cells such that cells can "remember where they have been" or decrease gene expression
- DNA methylation is essential for normal development and is associated with a number of key processes including genomic imprinting, X-chromosome inactivation, suppression of repetitive

elements, and carcinogenesis.

- Adenine or cytosine methylation is part of the restriction modification system of many bacteria, in which specific DNA sequences are methylated periodically throughout the genome.
- Within the bacterium, methylation protects the host DNA from cleavage by its own restriction enzyme. Unmethylated foreign DNA is not protected from cleavage.

122. All are true regarding Urea cycle except:

a) Urea formed from ammonia

b) Rate limiting enzyme is ornithine transcarbamoylase

c) Require Energy expenditure

d) Malate is byproduct of urea cycle

e) One nitrogen of urea comes from for aspartate

Correct Answer - B:D

Ans: b. Rate limiting ..., d. Malate… ***[Ref Harrison 19th/434e3-5, 18th/3216, 3219;17th/2472-74; Harper 30th/290-96, 28th/243;Shinde 7th/450-51; Vasudevan 5th/180-81]***

- Urea has two amino groups, one derived from ammonia & other from aspartate. Carbon atom is supplied from carbon dioxide.
- Rate-limiting enzyme (pacemaker enzyme) of Urea cycle: Carbamoyl phosphate synthetase I (CPS II is involved in pyrimidine synthesis)"(Harper 28th/245).
- Rate-limiting enzyme of Glycogen Synthesis: Glycogen synthase (not too hard there)
- Rate-limiting enzyme of Glycogenlysis: Glycogen phophorylase (phophorylase breaks phosphate bond, which means activated glycogen releases a lot of energy)
- Rate-limiting enzyme of HMP Shunt: Glucose-6Phosphate dehydrogenase (bad to lose this in RBCs)
- Rate-limiting enzyme of de novo pyrimidine synthesis: Carbamoyl phosphate synthase II (CPS I is involved in urea cycle)

123. Which of the following is true regarding phenylketonuria:

a) Dietary phenylalanine restriction is used in treatment

b) Occur due to deficiency of Phenyalanine hydroxylase enzyme

c) Occur due to increase activity of phenyalanine hydroxylase enzyme

d) Tyrosine must be supplied in diet

e) Diet should contain high phenylalanine containing food items

Correct Answer - A:B:D

Ans: a. Dietary ..., b. Occur ..., d. Tyrosine… ***[Ref Harrison 19th/434e1-3, 18th/3217-18; Harper 30h/304-306, 28th/254; Lippincott 4th/270-72]***

- In patients with PKU, tyrosine cannot be synthesized from phenylalanine & therefore, it becomes an essential amino acid that must be supplied in the diet
- Dietary phenylalanine restriction is usually instituted if blood phenylalanine levels are >300 umol/L (5 mg/dL).
- Treatment consists of a special diet low in phenylalanine and supplemented with tyrosine, since tyrosine becomes an essential amino acid in phenylalanine hydroxylase deficiency.
- About one-third of all patients with phenylketonuria and the majority of those with milder forms (phenylalanine <1200 umol/L at presentation) show increased tolerance to dietary proteins and improved metabolic control when treated with tetrahydrobiopterin (5-20 mg/kg per day), an essential cofactor of phenylalanine hydroxylase. This drug should be used in addition to dietary therapy.

- Pregnancy risks can be minimized by continuing lifelong phenylalanine-restricted diets and assuring strict phenylalanine restriction 2 months prior to conception and throughout gestation.

124. True about DNA hyperchromatism:

a) It is increase of absorbance

b) Measured by absorbance at 260 nm (in a spectrophotometer)

c) It occurs when the DNA duplex is denatured

d) Double stranded DNA is more hyperchromic than ssDNA

e) None

Correct Answer - A:B:C

Ans: (A) It is increase of absorbance (B) Measured by absorbance at 260 nm (in a spectrophotometer) (C) It occurs when the DNA duplex is denatured*[Ref Harper 30th/361, 28th/303; Satyanarayan 3rd/78; Lippincott 4th/397-98]*

- Hyperchromicity is the increase of absorbance (optical density) of a material. The most famous example is the hyperchromicity of DNAthat occurs when the DNA duplex is denatured
- It is the increase of absorbance (optical density) of a material. The most famous example is the hyperchromicity of DNA that occurs when the DNA duplex is denatured.
- 'At a wavelength of 260 nm, ssDNA has a higher relative absorbance than does double stranded DNA" (Lippincott
- 4th/397-98)
- The UV absorption is increased when the two single DNA strands are being separated, either by heat or by addition of denaturant or by increasing the pH level.
- Loss of helical structure can be measured by increase in absorbance at 260 nm (in a spectrophotometer), The opposite, a decrease of absorbance is called hypochromicity
- Renatuartion (reannealing) is the process in which the separated

complementary DNA strands can form a double helix

125. In Benedict test, red colour is/are produced by:

a) Sucrose

b) Inositol

c) Fructose

d) Lactose

e) Maltose

Correct Answer - C:D:E

Ans: c. Fructose, d. Lactose, e. Maltose *[Ref Lippincott 4th/84-85; Chatterjea Fr Shinde 7th/31; Satyanarayan 3rd/16]*

- Inositol is also called as muscle sugar. Chemically it is hexa hydroxyl cyclohexane" (Chatterjea d Shinde 7th/190)
- Reducing sugars can react with chromogenic agents (for e.g, Benedict's reagent or Fehling's solution or Barfoed's test) causing the reagent to be reduced & coloured, with anomeric carbon of the sugar becoming oxidized" (Lippincott 4th/84; Satyanarayan 3rd/16).
- In Benedict's test, reaction of reducing sugar with Benedict's reagent produce red colour of cuprous oxide.

126. True statements are:

a) Vitamin A in dose 20, 000 unit may be used during lactation to prevent Vit A deficiency to infants

b) High dose of Vitamin C may cause renal stone

c) Vitamin E reduces risk of atherosclerosis

d) Folic acid deficiency cause microcytic anaemia

e) Banana is a rich source of Vit. B6

Correct Answer - A:B:C:E

Ans: a. Vitamin a...., b. High..., *c.* Vitamin e..., e. Banana… ***[Ref Harrison 19th/96e1-7, 18th/599; Harper 30th/547-62, 28th/47178; Lippincott 4th/374]***

- Vit. C toxicity: Oxalate kidney stones are of theoretic concern because ascorbic acid is metabolized to oxalate, but stone formation has not been frequently reported"(CMDT06/1 275) "Prophylaxis against xerophthalmia: Lactating mothers should be given 20, 000 IU orally once at delivery or during the next 2 months. This will raise the concentration of vitamin A in the breast milk & therefore, help to protect the breastfed infant" (Khurana 5th/466)
- "Folic acid deficiency cause megaloblastic anaemia (macrocytic)" (Lippincott 4th/374)
- "Vit. E reduces the risk of atherosclerosis" (Vasudevan 5th/291) "Banana: It is a very good source of vitamin-B6 (pyridoxine), provides about 28% of daily-recommended allowance.

127. Thiamine deficiency cause (s):

a) Glossitis

b) Polyneuropathy

c) Pellagra

d) Angular stomatitis

e) Cardiomegaly

Correct Answer - B:E

Ans: b. Polyneuropathy, e. Cardiomegaly ***[Re(Harrison 19th/96e-3, 18th/594-96; Harper 30th/555-56, 28th/468]***

- Wet beriberi presents primarily with cardiovascular symptoms, due to impaired myocardial energy metabolism and dysautonomia, and can occur after 3 months of a thiamine-deficient diet. Patients present with an enlarged heart, tachycardia, high-output congestive heart failure, peripheral edema, and peripheral neuritis.
- Patients with dry beriberi present with a symmetric peripheral neuropathy of the motor and sensory systems with diminished reflexes. The neuropathy affects the legs most markedly, and these patients have difficulty rising from a squatting position.

128. Thiamine act as co-enzyme for:

a) Transketolase

b) Pyruvate dehydrogenase

c) Alcohol dehydrogenase

d) Transaminase

e) None

Correct Answer - A:B

Ans: a. Transketolase, b. Pyruvate… ***[Ref Harper 30th/555, 28th/52; Chatterjea & Shinde 7th/166-67]***

- "NAD+ (by vitamin B 3) acts as a coenzyme for alcohol dehydrogenase"(Chatterjea Shinde 7th/171)
- Pyridoxal phosphate (by vitamin pyridoxine, B6) acts as coenzyme for transaminases like aminotransferase.
- thiamine pyrophosphate acts as coenzyme in: Pyruvate dehydrogenasemn (oxidative decarboxylation), a-oxoglutararte dehydrogenase complex (oxidative decarboxylation), transketolase (transketolation reaction), tryptophan pyrrolase, pyruvate carboxylase (non-oxidative decarboxylation) .

129. Terminal product(s) of phenylalanine is :

a) Fumarate

b) Acetyl CoA

c) Oxaloacetate

d) Acetoacetate

e) None

Correct Answer - A:B:D

Ans: a. Fumarate, b. Acetyl CoA & d. Acetoacetate

[Ref Harper 30th/285, 304, 29th/269, 290; Lippincott 6th/263, 262; Satyanarayan 3rd/345-47; Vasudevan 5th/202-03]

- "The predominant metabolism of phenylalanine occurs through tyrosine. During the course of degradation, phenylalanine & tyrosine are converted to metabolite, fumarate & acetoacetate, which can serve as precursors for the synthesis of glucose (fumarate- It is an intermediate of the citric acid cycle & can also serve as precursor for gluconeogenesis) & fat (acetoacetate- It is a ketone body from which fat can be synthesized)" .
- Phenylalanine hydroxylase is an enzyme that catalyzes the hydroxylation of the aromatic side-chain of phenylalanine to generate tyrosine.
- Phenylalanine is first converted to tyrosine . Subsequent reactions are those of tyrosine" (Harper 30th/304, 29th/288) "Hydroxylation of phenylalanine produce tyrosine. Metabolism of phenylalanine & tyrosine merge, leading ultimately to the formation of fumarate er acetoacetate. phenylalanine & tyrosine are, therefore, both glucogenic or ketogenic.

130. NADPH is produced by:

a) Pyruvate dehydrogense

b) Isocitrate dehydrogense

c) a-ketoglutaryl Dehydrogense

d) Succinate Dehydrogense

e) Malate dehydrogense

Correct Answer - A:B:C:E

Ans: a. Pyruvate..., b. Isocitrate.... c. a-ketoglutaryl..., & e. Malate...,

[Ref Harper 30th/169, 29th/177; Lippincott 6th/109-13, 155; Shinde 7th/321]

Pathway	Reaction catalyzed by	Method of ATP formation	ATP
Citric acid cycle	1.Pyruvate dehydrogenase	1. Respiratory chain oxidation of 2 NADH	5
	2. Isocitrate dehydrogenase	2. Respiratory chain oxidation of 2 NADH	5
	3. a-Ketoglutarate dehydrogenase	3. Respiratory chain oxidation of 2 NADH	5
	4. Succinate thiokinase	4. Substrate level phosphorylation	2
	5. Succinate dehydrogenase	5.Respiratory chain oxidation of 2 ADH2	3
	6. Malate dehydrogenase	6. Respiratory chain oxidation of 2 NADH	5

131. Function of miRNA is/are:

a) Gene silencing

b) Gene activation

c) Transcription inhibition

d) Translation repression

e) Breaking of messenger RNA

Correct Answer - A:D:E

Ans: a. Gene..., d. Translation... & e. Breaking… ***[Ref Harper 30th/368, 29th/351-52; Lippincott 6th/459; Vasudevan 5th/436]***

- RNA interference is a mechanism of gene silencing through decreased expression of mRNA, either by repression of translation or by increased degradation.
- miRNA bind to matching pieces of messenger RNA, turn it into a double strand & keep it from doing its job. The process effectively blocks the production of corresponding protein.
- miRNAs are typically 21-25 nucleotides in length and are generated by nucleolytic processing of the products of distinct genes/transcription units . miRNA precursors are single stranded but have extensive intramolecular secondary structure.

132. Optically inactive amino acid is/are:

a) Threonine

b) Thyronine

c) Valine

d) Glycine

e) Serine

Correct Answer - D

Ans: d. Glycine *[Ref Vasudevan 5th/20; Shinde 7th/78]*

- Amino acids having an asymmetric carbon atom exhibit optical activity. Asymmetry arises when 4 different groups are attached to the same carbon atom
- Glycine is the simplest amino acids & has no asymmetric carbon atom & therefore shows no optical activity. All others are optically active
- The mirror image forms produced with reference to the alpha carbon atom, are called D & L isomers
- Isoleucine er threonine have 2 optically active centres & therefore each has 4 diastereo isomers

133. cDNA is used in gene amplification in bacteria instead of genomic DNA because:

a) Easy to replicate because of small size

b) cDNA lacks intron whereas this is present in genomic DNA

c) Promotor are not found in bacteria

d) Complete genome can not easily replicated in bacteria

e) None

Correct Answer - A:B:D

Ans: a. Easy..., b. cDNA... & d. Complete [Ref Harper 30th/455-56, 29th/438-39; Lippincott 6th/469-70; Vasudevan 5th/449]

- Because cDNA has no intervening, it can be cloned into an expression vector for the synthesis of eukaryotic proteins by bacteria" ; "cDNA lacks introns & the control regions of the gene, whereas these are present in genomic DNA" (Lippincott 6th/469) "Bacterial promoters are relatively simple.
- cDNA libraries contain those DNA sequences that only appear as processed messenger RNA molecules & these differ from one cell type to another. A cDNA library comprises complementary DNA copies of the population of mRNAs in a tissue.
- cDNA probes are used to detect DNA fragments on Southern blot transfers and to detect and quantitate RNA on Northern blot transfers

134. In forming 3D structure of protein following components help:

a) Hydrogen bonds

b) Amino acid sequence

c) Interaction between amino acid side chains

d) Chaperon

e) all of these

Correct Answer - E

Ans: (E) all of these ***[Ref Harper 30th/39-41, 29th/36-40; Vasudevan 5th/27; Lippincott 6th/18-19, 22; Shinde 7th/86-88]***

- The 3-dimensional arrangement of protein structure is referred to as tertiary structure. This type of arrangement ensures stability o f the molecule. Besides the hydrogen bonds, disulfide bonds, ionic interactions (electrostatic bonds) & hydrophobic interactions also contribute to the tertiary structure of protein.
- The unique 3 dimensional structure of the native conformation is determined by its primary structure, that is, its amino acid sequence, Interactions b/w the amino acid side chains guide the folding of the polypeptide chain to form secondary, tertiary & (sometimes) quaternary structures, which cooperate in stabilizing the native conformation of the protein.
- In addition, a specialized group of protein named chaperones is required for the proper folding of many species of proteins.

135. Test used for protein is/are:

a) Western blot

b) Southern blot

c) ELISA

d) CHIP essay

e) Dot blotting

Correct Answer - A:C:D

Ans: a. Western blot, c. ELISA d. CHIP essay

[Ref Harper 30th/457, 29th/439; Lippincott 6th/484, 473, 485; Satyanarayan 3rd/589]

- Western blot- Measures protein amount
- ELISA- detects proteins(antigen or antibodies)

136. Which of the following disease occurs due to DNA molecule repair defect:

a) Krabe's disease

b) Angelmann syndrome

c) Xeroderma pigmentosum

d) Marfan syndrome

e) Ataxia telangiectasia

Correct Answer - C:E

Ans: c. Xeroderma..., e. Ataxia… [Ref Harper 30th/390, 29th/374, 28th/330-333; Lippincott 6th/410-13; Harrison 18th/496, 17th/395]

- Angelmann syndrome results from genetic disorder that results from defect in gene that encodes ubiquitin"; "Marfan syndrome: It is caused by mutation in gene for fibrillin" ; "Krabbe disease: due to 13 – galactosidase enzyme deficiency.
- Xeroderma Pigmentosum (XP): An autosomal recessive genetic disease; more than 10 genes are involved; The clinical syndrome includes marked sensitivity to sunlight (ultraviolet) with subsequent formation of multiple skin cancers and premature death, The risk of developing skin cancer is increased 1000- to 2000-fold.

137. Full form of LCAT is:

a) Lecithin cholesterol acyltransferase

b) Lecithin choline acyl transferase

c) Lecithin cholesterol alkyl transferase

d) Lecithin choline alcohol transferase

e) Lecithin CoA transferase

Correct Answer - A

Ans: a. Lecithin cholesterol… ***[Ref Harper 30th/272, 29th/242, 256; Lippincott 6th/234-36]***

- Plasma LCAT Is Responsible for Virtually All Plasma Cholesteryl Ester in Humans (Harper 29th/256). LCAT activity is associated with HDL containing apo A-I. As cholesterol in HDL becomes esterified, it creates a concentration gradient and draws in cholesterol from tissues and from other lipoproteins, thus enabling HDL to function in reverse cholesterol transport.
- This protein, associated with HDL, is found in plasma of humans and many other species. It facilitates transfer of cholesteryl ester from HDL to VLDL, IDL, and LDL in exchange for triacylglycerol, relieving product inhibition of LCAT activity in HDL.

138. Which vitamin deficiency cause dementia:

a) Vitamin A

b) Vitamin C

c) Vitamin B12

d) Vitamin B1

e) Nicotinic acid

Correct Answer - C:D:E

Ans: c. Vitamin..., d. Vitamin... & e. Nicotinic...*[Ref Lippincott 6th/379-80; Harrison 19th/463]*

- Niacin or nicotinic acid deficiency causes pellagra. The symptom of pellagra progress through the three Ds: dermatitis, diarrhea *& dementia"*
- Niacin → pellagra: pigmented rash of sun-exposed areas, bright red tongue, diarrhea, apathy, memory loss, disorientation
- Folate → Megaloblastic anemia, atrophic glossitis, depression, T homocysteine
- Vitamin → Megaloblastic anemia, loss of vibratory and position
- B12 → sense, abnormal gait, dementia, impotence, loss of bladder and bowel control, Thomocysteine, Methylmalonic acid
- Vitamin C → Scurvy: petechiae, ecchymosis, coiled hairs, inflamed and bleeding gums, joint effusion, poor wound healing, fatigue
- Vitamin A → Xerophthalmia, night blindness, Bitot's spots, follicular hyperkeratosis, impaired embryonic development, immune dysfunction

139. Which of the following organ can not use ketone body:

a) Brain

b) RBC

c) Muscle

d) Heart

e) Liver

Correct Answer - A:E

Ans: a. Brain, e. Liver ***[Ref Harper 30th/150, 211-12, 29th/161, 211-12; Lippincott 6th/196; Vasudevan 5th/1451.***

- Ketone bodies can be used by extrahepatic tissue such as skeletal & cardiac muscle, intestinal mucosa & renal cortex. Even the brain can use ketone bodies to help meet its energy needs if the blood levels rise sufficiently.
- The ketone bodies are formed in the liver; but they are utilized by extrahepatic tissues. The heart muscle & renal cortex prefer the ketone bodies to glucose as fuel. Tissue like skeletal muscle & brain can also utilize the ketone bodies as alternate sources of energy, if glucose is not available·