

1. All are circular DNA EXCEPT:

a) Nuclear

b) Plasmid

c) Mitochondrial

d) Yeast

Correct Answer - A

Nuclear REF: Jawetz's 24th edition chapter 7

The Eukaryotic Genome

- The genome is the totality of genetic information in an organism. Almost all of the eukaryotic genome is carried on *two or more linear chromosomes* separated from the cytoplasm within the membrane of the nucleus.
- Eukaryotic cells *contain mitochondria* and, in some cases, chloroplasts. Within each of these organelles is a *circular molecule* of DNA that contains a few genes whose function relates to that particular organelle. Most genes associated with organelle function, however, are carried on eukaryotic chromosomes.
- *Many types of yeast* contain an additional genetic element, an independently replicating *2-m circle* containing about 6.3 kbp of DNA. *Such small circles of DNA, termed plasmids*, are frequently encountered in the genetics of prokaryotes. The small size of plasmids renders them amenable to genetic manipulation and, after their alteration, may allow their introduction into cells. Therefore, plasmids are frequently called upon in genetic engineering.

2. Thiamine deficiency in a chronic alcoholic can reduce energy production as a result of which of the following reasons?

a) It is required for the process of transamination

b) It is a co-factor for oxidative reduction

c) It is a co-enzyme for transketolase in pentose phosphate pathway

d) It is a co-enzyme for pyruvate dehydrogenase and α -ketoglutarate dehydrogenase in TCA pathway

Correct Answer - D

Thiamine is a co-enzyme for **pyruvate dehydrogenase** and **α -ketoglutarate dehydrogenase** in the TCA pathway. Both the steps of the TCA cycle have thiamine requiring enzymes are required for the aerobic generation of ATP through krebs cycle. So thiamine deficiency can result in decreased energy production.

Ref: Textbook of biochemistry by DM Vasudevan, 3rd Edition, Page 268

3. Acetylcholine is the neurotransmitter in the cholinergic neurons. What is the precursor that acetylcholine is derived from?

a) Dicholine

b) Tyrosine

c) Cholic acid

d) Choline

Correct Answer - D

The conversion of choline by CAT (choline acetyltransferase) is responsible for converting choline to acetylcholine.

Likewise, the conversion of acetylcholine back to choline is by ACh-ase (acetylcholine esterase).

CAT **ACh-ase**
Choline ----> Acetylcholine -----> Choline

4. Which of the following glucose transporter mediates insulin stimulated glucose uptake?

a) SGLT-1

b) GLUT-1

c) GLUT-2

d) GLUT 4

Correct Answer - D

Insulin stimulated glucose uptake into fat and muscle cells is mediated by GLUT 4.

Insulin stimulates translocation of a pool of GLUT 4 to the plasma membrane through targeted exocytosis and depress the rate of GLUT4 endocytosis.

5. Substrate level phosphorylation occur in step catalysed by which of the following enzyme in TCA cycle?

a) Isocitrate dehydrogenase

b) Malate dehydrogenase

c) Aconitase

d) Succinate thiokinase

Correct Answer - D

Succinate thiokinase is the enzyme that generates ATP directly by substrate-level phosphorylation. In Krebs cycle succinate thiokinase catalyze the conversion of Succinyl CoA into succinate. In this step GDP is phosphorylated to GTP. GTP can then be converted to ATP by reacting with an ADP molecule.

Substrate-level phosphorylation is a type of metabolism that results in the formation and creation of adenosine triphosphate (ATP) or guanosine triphosphate (GTP) by the direct transfer and donation of a phosphoryl (P₀₃) group to adenosine diphosphate (ADP) or guanosine diphosphate (GDP) from a phosphorylated reactive intermediate.

In glycolysis substrate level phosphorylation occur in two steps:

Conversion of 1,3 BPG to 3 Phosphoglycerate catalyzed by Phosphoglycerate kinase

Conversion of Phosphoenolpyruvate to pyruvate catalyzed by Pyruvate kinase

Ref: Textbook of Biochemistry By D M Vasudevan, 3rd Edition, Page 195

6. Xanthurenic acid in the urine is suggestive of deficiency of which vitamin?

a) Vitamin B6

b) Vitamin B12

c) Folic acid

d) Thiamine

Correct Answer - A

Xanthurenic acid is formed in the side reaction of kynurenine.

Kynurenine which is an intermediate of tryptophan metabolism requires vitamin B6 dependent enzyme kynureinase for its normal metabolism.

In pyridoxine (Vit B6) deficiency kynurenine is metabolized to xanthurenic acid which is excreted unchanged in urine.

Ref: Textbook of Biochemistry DM Vasudevan, 5th Ed, page 208

7 Glycogen phosphorylase catalyzes the first step in glycogen degradation.
▪ Glycogen phosphorylase requires:

a) Pyridoxine

b) Vit. B

c) Nickel

d) Cobalt

Correct Answer - A
Pyridoxine (Vitamin B6):

The active form of pyridoxine is pyridoxal phosphate.

Functions:

- Transamination reactions
- Alanine synthetase (heme synthesis)
- Decarboxylation of histidine to histamine
- Deamination of serine to pyruvate
- Glycogen phosphorylase action
- Conversion of tryptophan to niacin
- Synthesis of several neurotransmitters

One half of the total pyridoxine is bound to muscle glycogen phosphorylase.

Ref: Elsevier's Integrated Review Biochemistry By John W. Pelley, 2011, Page 175.

8. Which of the following vitamin acts as a cofactor for metabolism of sulphur containing amino acids?

a) Folic acid

b) Biotin

c) Vit K

d) Pyridoxine

Correct Answer - A

Methyl group in N5-methyl tetrahydrofolic acid (N5- methyl THFA) is used for synthesis of active methionine, which takes part in transmethylation reactions.

- Such transmethylation reactions are required for synthesis of choline, epinephrine, creatine etc.
- Sulphur containing amino acids include **cysteine** and **methionine**.

Ref: Textbook of Biochemistry by DM Vasudevan, 5th edition, Page 303.

9. The vitamin B6 contained in plants is less bioavailable than that in animal tissues. Pyridoxine is required for:

a) Urea formation

b) Heme synthesis

c) Amylase

d) Lipoprotein lipase

Correct Answer - B

Pyridoxine (Vitamin B6):

- Vitamin B6 refers to a family of compounds that include pyridoxine, pyridoxal, pyridoxamine, and their 5'-phosphate derivatives.
- 5'-Pyridoxal phosphate (PLP) is a cofactor for enzymes that involved in amino acid metabolism.
- Vitamin B6 also is involved in *heme and neurotransmitter synthesis and in the metabolism of glycogen, lipids, steroids, sphingoid bases, and several vitamins, including the conversion of tryptophan to niacin.*

Severe vitamin B6 deficiency can lead to,

- Peripheral neuropathy
- Abnormal electroencephalograms
- Personality changes that include depression and confusion.

Ref: Russell R.M., Suter P.M. (2012). Chapter 74. Vitamin and Trace Mineral Deficiency and Excess. In D.L. Longo, A.S. Fauci, D.L. Kasper, S.L. Hauser, J.L. Jameson, J. Loscalzo (Eds), Harrison's Principles of Internal Medicine, 18e.

10. Which of the following enzymes is stimulated by glucagon?

a) Acetyl-CoA carboxylase

b) Glycogen phosphorylase

c) Glycogen synthase

d) HMG-CoA reductase

Correct Answer - B

Before you started analyzing all of the answer choices you should have reminded yourself that glucagon increases serum glucose. So an enzyme stimulated by glucagon might be involved in either the breakdown of glycogen to glucose (glycogenolysis) or in the creation of glucose from noncarbohydrate precursors (gluconeogenesis). ***Glycogen phosphorylase catalyzes the first step in glycogenolysis; it makes sense that it would be stimulated by glucagon.***

Acetyl-CoA carboxylase catalyzes the first step in fatty acid synthesis, an anabolic process that would be stimulated by insulin, not glucagon.

As its name implies, **glycogen synthase** is involved in the synthesis of glycogen. Glucagon (and epinephrine) stimulate the phosphorylation and inactivation of glycogen synthase.

HMG-CoA reductase is the key enzyme involved in the synthesis of cholesterol. Since this is an anabolic process that occurs in the well-fed state, you would expect it to be stimulated by insulin and inhibited by glucagon (which it is).

Ref: Bender D.A., Mayes P.A. (2011). Chapter 14. Carbohydrates of Physiologic Significance. 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.

11. In Ochronosis there is deficiency of which of the following enzymes?

a) Phenylalanine decarboxylase

b) Homogentisic acid oxidase

c) Alpha ketoglutarate decarboxylase

d) Glucocerebrosidase

Correct Answer - B

The defective enzyme in Ochronosis (Alkaptonuria) is homogentisic acid oxidase in tyrosine metabolism. Homogentisate gets oxidised by polyphenol oxidase to benzoquinone acetate which undergoes polymerization to form a pigment ALKAPTON. Alkapton gets deposited in connective tissues, bones and various organs resulting in condition called OCHRONOSIS.

12. Albinism is due to deficiency of the following enzyme?

a) Phenylalanine hydroxylase

b) Homogentisic acid oxidase

c) Tyrosinase

d) Decarboxylase

Correct Answer - C

The most common cause of albinism is a defect in tyrosinase, the enzyme most responsible for the synthesis of melanin. Albinism is an inborn error due to lack of synthesis of melanin. It is an autosomal recessive disorder with a frequency of 1 in 20,000.

Ref: Textbook of Biochemistry and Human Biology by G. P. Talwar, 3rd Ed, Page 452

13. Trace element present in carbonic anhydrase is?

a) Zinc

b) Molybdenum

c) Copper

d) Magnesium

Correct Answer - A

Zn is an essential component of several enzymes like carbonic anhydrase, alcohol dehydrogenase, alkaline phosphatase, carboxypeptidase and superoxaide dismutase.

The **carbonic anhydrases** (or carbonate dehydratases) form a family of enzymes that catalyze the rapid interconversion of carbon dioxide and water to bicarbonate and protons (or vice versa), a reversible reaction that occurs rather slowly in the absence of a catalyst. The active site of most carbonic anhydrases contains a zinc ion; they are therefore classified as **metalloenzymes**.

Ref: Barrett K.E., Barman S.M., Boitano S., Brooks H.L. (2012). Chapter 39. Acidification of the Urine & Bicarbonate Excretion. In K.E. Barrett, S.M. Barman, S. Boitano, H.L. Brooks (Eds), Ganong's Review of Medical Physiology, 24e.

14. Clinically enzymes are classified as functional plasma enzymes and non functional plasma enzymes. Which among the following is an example for functional enzyme?

a) ALT

b) Lipoprotein lipase

c) Prothrombin

d) Amylase

Correct Answer - B

Functional enzymes and non-functional enzymes:

- Functional plasma enzymes or specific enzymes have their substrates in the plasma itself.
- These enzymes are synthesized in the liver and actively secreted into plasma.
- Examples: Enzymes of blood coagulation, **lipoprotein lipase, pseudocholesterase.**
- **Nonfunctional enzymes or nonspecific enzymes** are coming out from cells of various tissues due to normal wear and tear.
- Their normal levels in blood are very low; but are drastically increased during cell death or disease.
- Therefore assays of these enzymes are very useful in diagnosis of diseases.
- Examples: **Alkaline phosphatase, acid phosphatase, lipase, amylase.**

Ref: Textbook of Biochemistry by DM Vasudevan, 5th edition, Page 53.

15. Replacing alanine by which amino acid will increase UV absorbance of protein at 280nm wavelength?

a) Leucine

b) Proline

c) Arginine

d) Tryptophan

Correct Answer - D

Aromatic amino acids (phenylalanine, tryptophan, and tyrosine) absorb UV light at a maximum of 280 nm because the pi electrons in their aromatic rings can absorb photons.

That is because benzene, the core of a phenyl group, absorbs UV light as well. Amino acids do not absorb visible light and thus are colorless.

However, tyrosine, phenylalanine, and especially tryptophan absorb high-wavelength (250–290 nm) ultraviolet light.

Because it absorbs ultraviolet light about ten times more efficiently than phenylalanine or tyrosine, tryptophan makes the major contribution to the ability of most proteins to absorb light in the region of 280 nm.

Ref: Kennelly P.J., Rodwell V.W. (2011). Chapter 3. Amino Acids & Peptides. 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.

16. Serine while metabolism is converted to which amino acid?

a) Proline

b) Alanine

c) Glycine

d) None of the above

Correct Answer - C

Following conversion to glycine, catalyzed by serine hydroxymethyltransferase, **serine catabolism merges with that of glycine.**

- It requires folic acid (as THF) and vitamin B6 (as PLP)

Ref: Harper 28th edition, chapter 29.

17. Which of the following is an inhibitory neurotransmitter found exclusively in the central nervous system?

a) Acetylcholine

b) Glutamate

c) Norepinephrine

d) Serotonin

Correct Answer - D

Serotonin (5-hydroxytryptamine) is an important regulatory amine in the CNS. **Serotonin**-containing neurons are present in the raphe nuclei in the pons and medulla.

Serotonin is a generally inhibitory monoamine type neurotransmitter found in the CNS.

Acetylcholine can be excitatory or inhibitory and is found in the CNS, neuromuscular junction, and many autonomic nervous system (ANS) synapses. Glutamate is found in the brain and spinal cord and is excitatory.

Norepinephrine, such as serotonin, is a monoamine neurotransmitter but can be excitatory or inhibitory found in the CNS, sympathetic ANS synapses, and nearly all tissues.

Ref: Katzung B.G. (2012). Chapter 16. Histamine, Serotonin, & the Ergot Alkaloids. In B.G. Katzung, S.B. Masters, A.J. Trevor (Eds), *Basic & Clinical Pharmacology*, 12e.

18. To which of the following family of chemical mediators of inflammation, the Lipoxins belong:

a) Kinin system

b) Cytokines

c) Chemokines

d) Arachidonic acid metabolites

Correct Answer - D

They are derived from arachidonic acid and manufactured in leukocytes by the 15-lipoxygenase pathway.

They are characterized by the presence of three or four conjugated double bonds.

Leukocytes produce two types of lipoxins, lipoxin A 4 (LXA4) and lipoxin B 4 (LXB4).

Eicosanoids: are named so reflecting their origin from the 20-carbon (eicosa-) polyunsaturated fatty acid arachidonic acid (arachidonate) and the 20-carbon derivatives of linoleic and linolenic acids.

There are then three main enzymatic pathways for eicosanoid formation, involving cyclooxygenases (COXs), lipoxygenases (LOs) and enzymes of the cytochrome P-450 family.

- **Cyclooxygenase (COX) Pathway:** The COX pathway (two isoforms denoted COX-1 and COX-2) produces the prostaglandins PGG₂ and PGH₂, which are subsequently converted into further prostaglandins, prostacyclin and thromboxanes (TXs).
- **Lipoxygenase pathway:** The leukotrienes and lipoxins are a group of eicosanoid derivatives formed through the lipoxygenase pathway. They are characterized by the presence of three or four conjugated double bonds, respectively.
- **Cytochrome P450 (CYP) Pathway:** Third eicosanoid pathway cytochrome P450 (CYP) system consists of two main branches: ω -hydroxylases convert arachidonic acid to hydroxyeicosatetraenoic acids (HETEs) and epoxygenases convert it to epoxyeicosatrienoic acids (EETs).

Enzymatic Pathways	Eicosanoid
Cyclooxygenases	Prostaglandins

	Prostacyclin, Thromboxanes
Lipoxygenases	5-HETE, 12-HETE, 15-HETE, Lipoxins, Leukotrienes
CYP monooxygenases	12-HETE, EETs, DHTs

Ref: The Eicosanoids, edited by Peter Curtis-Prior, page 341.

19. Single base pair substitution is related to which of the following?

a) RFLP

b) PCR

c) FISH

d) Southern blot

Correct Answer - A

The term RFLP (Restriction Fragment Length Polymorphisms) refers to single base pair substitutions in germ line DNA of different individuals that either destroys or creates new recognition site for a given restriction enzyme.

PCR is used to amplify a specific region of a DNA strand (the DNA target).

FISH is a technique used to identify the presence of specific chromosomes or chromosomal regions through hybridization (attachment) of fluorescently-labeled DNA probes to denatured chromosomal DNA.

Southern blotting combines transfer of electrophoresis-separated DNA fragments to a filter membrane and subsequent fragment detection by probe hybridization.

20. Circular DNA, found in eukaryote cells are found in all, EXCEPT:

a) Nuclear

b) Plasmid

c) Mitochondrial

d) Yeast

Correct Answer - A

Circular DNA are occasionally found in eukaryotic cells, including plasmids such as the 2 μ circle of yeast. Mitochondria and chloroplasts also contain their own genomes, or replicons, which are circular molecules of self-replicating DNA.

21. If more than one codon codes for same amino acid, this phenomenon is known as?

a) Degeneracy

b) Frameshift mutation

c) Transcription

d) Mutation

Correct Answer - A

3 out of 64 codons do not code for any amino acid. These have been termed nonsense codons.

These nonsense codons are utilized in the cell as termination signals; they specify where the polymerization of amino acids into a protein molecule is to stop.

The remaining 61 codons code for 20 amino acids.

Thus, there must be *degeneracy in the genetic code, ie; multiple codons must decode the same amino acid.*

Some amino acids are encoded by several codons; for example six different codons, UCU, UCC, UCA, UCG, AGU, and AGC all specify serine. Other amino acids, such as methionine and tryptophan, have a single codon. In general, the third nucleotide in a codon is less important than the first two in determining the specific amino acid to be incorporated, and this accounts for most of the degeneracy of the code.

However, for any specific codon, only a single amino acid is indicated; with rare exceptions, the genetic code is **unambiguous**—that is, given a specific codon, only a single amino acid is indicated. **The distinction between ambiguity and degeneracy is an important concept.**

Ref: Weil P. (2011). Chapter 37. Protein Synthesis & the Genetic Code. 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.

22. Nucleoside is made up of:

1. Pyrimidine
2. Histone
3. Sugar
4. Purine
5. Phosphate

a) 1,2 & 3

b) 1,3 & 4

c) 1,3 & 5

d) 2,3 & 4

Correct Answer - B

“The nucleoside is composed of purine or pyrimidine base linked to either D-ribose (in RNA) or D-2- deoxyribose (in DNA)”

“The nuclear DNA is found bounded to basic proteins called histones”.

Nucleotides

- Nucleotides are nucleoside +P
- The Phosphodiester bond between the nucleotides is formed mainly between 3’OH group of sugar of one nucleotide to 3’OH group of sugar of another nucleotide.

Ref: Harper 27/e, Page 297; Chatterjee & shinde 7/e, Page 206-07.

23. Which of the following are Pyrimidine bases?

a) Adenine and Guanine

b) Guanine and Cytosine

c) Cytosine and Adenine

d) Thymine and Cytosine

Correct Answer - D

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

24. Which of the following elements is not required for hydroxylation of proline in collagen synthesis?

a) Vit C

b) O₂

c) Dioxygenases

d) Pyridoxal phosphate

Correct Answer - D

Fe²⁺ and α-ketoglutarate are also needed in hydroxylation of proline for collagen synthesis.

25. All of the following are consequences of Protein denaturation, EXCEPT:

a) Loss of solubility

b) Loss of function

c) Loss of primary structure

d) Change in viscosity

Correct Answer - C

Protein denaturation is defined as the partial or complete disorganization of a proteins characteristic three dimensional shape as a result of disruption of its secondary, tertiary, and quarternary structural interactions.

Protein denaturation doesn not affect the primary structure of proteins.

Consequences of Denaturation:

- Loss of enzymatic activity/Function (death)
- Destruction of toxins
- Improved digestibility
- Loss of solubility
- Changes in texture

26. Dinitrophenol causes:

a) Inhibition of ATP synthase

b) Inhibition of electron transport

c) Uncoupling of oxidation and phosphorylation

d) Accumulation of ATP

Correct Answer - C

C i.e. Uncoupling of oxidation & phosphorylation

- Dinitrophenol is an uncoupler.
- Uncouplers cause uncoupling of oxidation and phosphorylation, i.e. they allow electrons transport to proceed without ATP synthesis.
- Picric acid (2, 4, 6- trinitrophenol) when reduced with sodium sulphide forms picraamic acid (2-amino-4, 6- dinitrophenol).
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27. Regarding HMP shunt all of the following are true except:

a) Occurs in the cytosol

b) No ATP is produced in the cycle

c) It is active in Adipose tissue, Liver and Gonads.

d) The oxidative phase generates NADPH and the Non oxidative phase generates pyruvate.

Correct Answer - D

D i.e. The oxidative phase generates NADPH and non oxidative phase generates pyruvate

The oxidative (irreversible) phase of HMP shunt *produce NADPH and ribulose 5 phosphate*, whereas reversible non-oxidative phase catalyze the *interconversion of 3, 4, 5, 6, and 7 carbon sugars*, and permit ribulose 5 phosphate to be converted either to *ribose 5 phosphate (needed for nucleotide synthesis) or to intermediates of glycolysis - fructose 6 - PO₄ & glyceraldehyde 3phosphate*

28. Epimer combination (s) is/are :

a) D-glucose & D-fructose

b) D-mannose & D-talose

c) D-glucose & D-mannose

d) None of these

Correct Answer - C

Ans. C, i.e. D-glucose & D-mannose

- Carbohydrate isomers that differ in configuration around only one carbon atom are called epimers. D-glucose and D-mannose are C2 epimers whereas D-glucose and D-galactose differ only at C4.

However, D-mannose & D-galactose are not epimers as they differ at 2 carbons (2 & 4).

Enantiomers (optical isomers or stereoisomers) are pairs of structures that are mirror images of each other but not identical, similar to left and right hand which are the same but opposite. These are non super imposable and are designated as D and L-sugar.

Each enantiomer often *shows different chemical reactions* with other enantiomers. Because of presence of many enantiomers in living beings, there is usually a marked difference in effects of two stereoisomers. For example only one of drug stereoisomer produces desired effect while the other does not.

29. Gaucher's disease is due to deficiency of enzyme :

a) Sphingomyelinase

b) 13-Clucosidase

c) Hexosaminidase-A

d) P-Galactosidase

Correct Answer - B
B i.e. 13-glucosidase

30. The most important carrier of cholesterol in plasma is:

a) Chylomicrons

b) HDL

c) VLDL

d) LDL

Correct Answer - D
D i.e. LDL

31. Which receptors are present in liver for uptake of LDL:

a) Apo E

b) Apo A and Apo E

c) Apo E and Apo B100

d) Apo B100

Correct Answer - C

C i.e. Apo E and Apo B100

Liver and many extra hepatic tissues express *LDL (apo- B-100 and E) receptors*. LDL receptors are present on *cell membrane pits coated with clathrin (protein) on the cytosolic side*; and taken into the *cell by endocytosis* (after binding LDL). And cholesterol present in LDL, on accumulation in the cell *inhibits replenishment (recruitment i.e. transcription) of LDL receptors via SREBP pathway*.

Increased cellular cholesterol coordinately suppress cholesterol synthesis (by inhibiting HMG Co A synthase, HMG CoA reductase etc enzymes) *as well as uptake (by down regulating synthesis of LDL receptors)*; whereas cholesterol esterification is promoted (by stimulating ACAT activity). Thus the LDL receptor activity on cell surface is *regulated by cholesterol requirement for membranes, steroid hormones or bile acid synthesis*

32. Bile acids synthesized in liver (Primary bile acids):

a) Taurocholic acid

b) Cholic acid

c) Chenodeoxycholic acid

d) All Correct

Correct Answer - D

Ai.e. Taurocholic acid, B i.e Cholic acid; C i.e. Chemodeoxycholic acid.

Bile salts = Sodium or potassium + Amino acid (glycine or taurine) + Bile acids (Cholic acid or chenodeoxycholic acid.

- Sodium + glycine + cholic acid = Sodium-glyco-cholic acid (sodium-glyco-cholate)
- Sodium + taurine + cholic acid = Sodium-tauro-cholic acid (sodium-tauro-cholate)
- Sodium + glycine + chenodeoxycholic acid = Sodium-glyco-chenodeoxycholate
- Sodium + taurine + chenodeoxycholic acid = Sodium-tauro-chenodeoxycholate
- Similarly potassium bile salts are *potassium-glycocholate*, *potassium-taurocholate*, *potassium-glyco chenodexoxycholate*, and *potassium-tauro-chenodexoxycholate*.

33. The protein rich in basic amino acids, which functions in the packaging of DNA in chromosomes, is:

a) Histone

b) Collagen

c) Hyaluronic acid binding protein

d) Fibrinogen

Correct Answer - A
A i.e. Histone

34. Normal role of Micro RNA is:

a) Gene Regulation

b) RNA splicing

c) Initiation of Translation

d) DNA conformational change

Correct Answer - A

A i.e. Gene Regulation

- *Micro-RNA (mi-RNA) is transcribed by RNA polymerase HQ as primary mi-RNA (pri-mi-RNA). It is processed by 2 endoribonucleases of RNase III family:*
 - .. Drosha (with DGCR8, in nucleus to precursor mi-RNA or pre-mi-RNA) and
 2. Dicer (with *TRBP* in cytoplasm to nearly mature mi-RNA or small interfering RNAs = si -RNAs or small temporal RNAs = st RNAs paired with a short RNA complement)
- RNA helicase removes the complement and mature mi- RNA is incorporated into protein complexes to form RNA induce silencing complex (RISC).

By this process of gene silencing by RNA interference (Nobel prize 2006 given to Andrew Fire & Craig mello) mi- RNA, st?

RNA and si - RNA play a important role in gene regulation by inhibition of gene expression (& so translational process)Q

35. Which of the following is not a post transcriptional modification of RNA?

a) Splicing

b) 5'capping

c) 3' polyadenylation

d) Glycosylation

Correct Answer - D

D i.e. Glycosylation

- Prokaryotic mRNA is functional immediately upon synthesis, i.e. prokaryotic primary transcript of mRNA is functional. Thus it does not require post-transcriptional modification. In Eukaryotes the primary transcript of mRNA is the hn RNA (heterogeneous nuclear RNA). After transcription hnRNA is extensively modified to form functional mRNA.
- Post-transcriptional modification of mRNA involves : (i) 5'-capping (ii) Addition of a poly-A tail (polyadenylation), and (iii) Removal of introns (splicing).

36. APO B48 & APO B100 is synthesized from the same rnRNA; the difference between them is due to:

a) RNA splicing

b) Allelic exclusion

c) Deamination of cytidine to uridine

d) Upstream repression

Correct Answer - C

C i.e. Deamination of cytidine to uridine IRef: Vasudevan

- **Least post translational modification** occurs in **prokaryotic mRNA**, which is generally identical to its primary transcript. Post translational modification of t-RNA includes removal of introns from anticodon loop, trimming of 5' & 3' **ends**, **methylation** / reduction / deamination / alkylation / rearranging glycosidic bond to produced modified bases like methylated bases, dihydrouracil (D) & pseudo uracil (W) bases in nucleus, whereas cleavage and attachment of CCA tailing occur in cytoplasmQ.
- In RNA, gene during processing undergoes nucleoside modifications, nucleoside cleavage and terminal addition but not chemical hydrolysisQ.
- Post translational modification of mRNA involves 5' capping , 3' polyadenylation (addition of poly 'A' tail at 3' end), splicing (removal of non coding intervening or intron sequences and ligation / joining of coding exons) by Sn RNA/ Sn RNPs / Snurps or self splicing d/t ribozyme activity of self splicing introns with formation of lariat intermediates, RNA editing and secondary methylationQ.
- Apo B-48 and Apo B-100 are synthesized from same Apo B gene

and same ApoB- m-RNA. Apo B 100 is a 100 kDa protein synthesized in liver by full length translation of corresponding mRNA of Apo B gene. Apo - B-100 forms part of LDL, IDL and VLDL. Apo B-48 is a 48 KDa protein (48% shorter form of Apo B-100) synthesized in intestine by partial translation of same mRNA of Apo B gene. Apo B 48 forms part of chylomicron & chylomicron remnant. This difference between the sizes of Apo B100 and Apo B48 occurs because post transcriptional processing (editing) of Apo B mRNA , deaminates the cytidine (C) to uracil (U) in intestine at 2153 position. After cyti dine deamination the CAA codon (which codes glutamine in liver) becomes UAA (nonsense or stop codon) in intestine. This results in shorter apo B-48 protein being made in intestine (and incorporated into chylomicron) than is made in the liver full length Apo B-100, incorporated in to VLDL.

37. Which of the following blocks DNA replication with getting incorporated in DNA strand:

a) Cytarabine

b) Nalidixic acid

c) Ciprofloxacin

d) Paclitaxel

Correct Answer - A
A i.e. Cytarabine

38. Reperfusion injury is caused by:

a) Vitamin E

b) Superoxide ion

c) Calcium ion

d) Magnesium ion

Correct Answer - B

B i.e. Superoxide ion

- *Xanthine oxidase increases oxidative stress by generating superoxide free radicals*

- Ischemic reperfusion injury is caused by reactive oxygen species (ROS)/free radical or pro oxidant like superoxide ion

Antioxidants blocking free radical formation include vitamin A (Beta carotene), C and E; superoxide dismutase, catalase and selenium containing glutathione peroxidase enzymes; ceruloplasmin, transferrin, ferritin, and lactoferrin transport proteins etc.

39. Albumin and globulin are classified as:

a) Conjugated proteins

b) Simple globular proteins

c) Unconjugated proteins

d) Derived proteins

Correct Answer - B

B i.e. Simple globular protein

Plasma proteins like *albumin and globulin* are simple globular proteinQ

40. The serine proteases do not include

a) Pepsin

b) Trypsin

c) Elastase

d) Chymotrypsin

Correct Answer - A

41. Thiamine deficiency leads to ?

a) Confabulation

b) Low output cardiac failure

c) Anaemia

d) Night blindness

Correct Answer - B

Ans. is 'a' i.e., Confabulation [Ref Harper 27thVe ch. 44, Harrison 18thVe ch. 74; Kaplan & Saddock 9thie_ p. 396-413]

Alcohol induced thiamine deficiency	
Wernicke's Encephalopathy	Korsakoffs Psychosis
Triad of : Global confusion • Horizontal nystagmus & Ophthalmoplegia (B/L • lateral rectus palsy) Cerebellar ataxia •	Amnesia (recent > long-term) Confabulation (filling memory gaps with imaginary events)

42. Xanthine Oxidase is associated with which co-factor:

a) Zinc

b) Copper

c) Selenium

d) Molybdenum

Correct Answer - D

Glutathione peroxidase contains selenium.

Xanthine oxidase is large protein, having a molecular weight of 270,000, and has 2 flavin molecules (bound as FAD), 2 molybdenum atoms and 8 iron atoms bound per enzymatic unit.

The molybdenum atoms are contained as molybdopterin cofactors and are the active sites of the enzyme.

The iron atoms are part of (2Fe-2S) ferredoxin iron-sulfur clusters and participate in electron transfer reactions

43. True regarding ubiquitin is:

a) Product of purine metabolism

b) Protein destructions

c) Present in prokaryotes

d) Protein synthesis

Correct Answer - B

There are two major pathways of protein degradation in eukaryotes. One involves lysosomal proteases and does not require ATP. The other way involves ubiquitin and is ATP-dependent. Ubiquitin is a small, highly-conserved regulatory protein that is ubiquitously expressed in eukaryotes.

Ubiquitination (or ubiquitylation) refers to the post-translational modification of a protein by the covalent attachment (via an isopeptide bond) of one or more ubiquitin monomers. The most prominent function of ubiquitin is labeling proteins for proteasomal degradation.

44. True regarding familial hypercholesterolemia is:

- a) Deficient VLDL receptors
- b) Deficient HDL receptors
- c) HMG CoA reductase deficiency
- d) Deficient LDL receptors

Correct Answer - D

Familial hypercholesterolemia have defective LDL receptors
Many patients with familial hypercholesterolemia have mutations in the LDLR gene that encodes the LDL receptor protein, which normally removes LDL from the circulation, or apolipoprotein B (ApoB), which is the part of LDL that binds with the receptor.

Patients who have one abnormal copy (are heterozygous) of the LDLR gene may have premature cardiovascular disease at the age of 30 to 40.

Having two abnormal copies (being homozygous) may cause severe cardiovascular disease in childhood.

Patients may have xanthelasma palpebrarum, yellowish patches consisting of cholesterol deposits above the eyelids.

45. Watson's DNA model is :

a) Right handed, parallel

b) Left handed, anti parallel

c) Left handed, parallel

d) Right handed, anti parallel

Correct Answer - D

Chemically, DNA consists of two long polymers of simple units called nucleotides, with backbones made of sugars and phosphate groups joined by ester bonds.

This common form of DNA is said to be right handed because as one looks down the double helix, the base residues form a spiral in a clockwise direction.

These two strands run in opposite directions to each other and are therefore anti-parallel.

46. Which is not a common enzyme for glycolysis and gluconeogenesis?

a) Aldolase

b) Glucose-6-phosphatase

c) Phosphoglycerate mutase

d) Phosphoglycerate kinase

Correct Answer - B

Seven of the reactions of glycolysis are reversible and are used in the synthesis of glucose by gluconeogenesis.

Thus, seven enzymes are common to both glycolysis and gluconeogenesis :

- (i) Phosphohexose isomerase;
- (ii) Aldolase;
- (iii) Phosphotriose isomerase,
- (iv) Glyceraldehyde 3-phosphate dehydrogenase;
- (v) Phosphoglycerate kinase;
- (vi) Phosphoglycerate mutase;
- (vii) Enolase.

Three reactions of glycolysis are irreversible which are circumvented in gluconeogenesis by four reactions. So, enzymes at these steps are different in glycolysis and gluconeogenesis.

47. In humans, ascorbic acid cannot be synthesized because of ?

- a) Deficiency of G6PD
- b) Deficiency of xylulose kinase
- c) Deficiency of L-gulonolactone oxidase
- d) Deficiency of phosphoglucomutase

Correct Answer - C

In man, other primates and guinea pigs, ascorbic acid can be synthesized due to absence of L-gulonolactone oxidase, an enzyme used in lower animals to synthesise ascorbic acid as a byproduct of uronic acid pathway (glucuronic acid cycle).

48. Lactose intolerance is due to ?

a) Deficiency of Galactokinase

b) Deficiency of Uridyl transferase

c) Deficiency of Lactase

d) Deficiency of Enteropeptidase

Correct Answer - C

Ans. is 'c' i.e., Deficiency of Lactase

Lactose intolerance

- It occurs due to deficiency of lactase, the most important member of β -galactosidase enzymatic class.
- Lactase hydrolyses lactose into glucose and galactose in the small intestine.
- Lactose is present in milk.
- Therefore, deficiency of lactase, (β -galactosidase) results in intolerance to milk and other dairy products.
- Clinical features are bloating, diarrhea, failure to thrive, abdominal distension and abdominal cramp.

49. Von Geirke's occurs due to deficiency of ?

a) Glucose-6-phosphatase

b) Liver Phosphorylase

c) Muscle phosphorylase

d) Debranching enzyme

Correct Answer - A

Ans. is 'a' i.e., Glucose-6-phosphatase

Glucose - 6- phosphatase is deficient in Von Gierke's disease.

50. Normal serum value of magnesium ?

a) 1.5 mEq/L

b) 5 mEq/L

c) 25 mEq/L

d) 50 mEq/L

Correct Answer - A
Ans. is 'a' i.e., 1.5 mEq/L

51. Citrate to cis-aconitate conversion is inhibited by?

a) Malonate

b) Fluoride

c) Arsenite

d) Fluoroacetate

Correct Answer - D

Ans. is 'd' i.e., Fluoroacetate

Conversion of citrate to cis-aconitate is a step of Krebs cycle, catalyzed by Aconitase.

Aconitase is inhibited by fluoroacetate.

52. Which of the following is a non-reducing sugar ?

a) Glucose

b) Lactose

c) Maltose

d) Sucrose

Correct Answer - D
Ans. is 'd i.e., Sucrose

53. Role of selenocystein is important in ?

a) Hydroxylation of dopamine

b) Oxidation of drugs

c) Antioxidant mechanism

d) None of the above

Correct Answer - C

Ans. is 'c' i.e., Antioxidant mechanism

54. Active form of Vitamin -D ?

a) 25-hydroxycholecalciferol

b) 24,25-dihydroxycholecalciferol

c) 1,25-dihydroxycholecalciferol

d) Cholecalciferol

Correct Answer - C

Ans. is 'c' i.e., 1,25-dihydroxycholecalciferol

Vitamin D

- Vitamin D is the major vitamin involved in the absorption of calcium.
- Beside dietary intake, cutaneous synthesis is the other and more important source of vitamin D (cholecalciferol) in the body. The keratinocytes of stratum corneum of the epidermis of skin contain 7-*dehydrocholesterol* which is converted to Vitamin **D₃** (cholecalciferol) by the action of sunlight (UV light).
- This vitamin **D₃** (Cholecalciferol) is converted to calcidiol (calcifediol or 25 hydroxy cholecalciferol or 25hydroxy vitamin D₃) by 25 hydroxylase in the liver.
- Calcidiol is the major circulating form of vitamin **D₃**.
- Calcidiol is then converted to Calcitriol (1-25 dihydroxy-cholecalciferol or 1-25 dihydroxy vitamin D₃) by 1- α hydroxylation in kidneys.
- The final hydroxylation in kidney is rate limiting steps.
- Calcitriol is the active form of vitamin *D*.
- Dietary vitamin D is absorbed in ileum ^Q and requires bile salts.
- When Ca⁺² level is high, little calcitriol is produced, and the kidney produce the relatively inactive metabolite 24, 25 dihydroxycholecalciferol instead.

55. Poly 'A' tail attached at 3' end of mRNA helps in?

- a) Unwinding of mRNA
- b) Stabilization of mRNA
- c) Polymerization of mRNA
- d) Transcription of mRNA

Correct Answer - B

Ans. is 'b' i.e., Stabilization of mRNA

At the 5¹-end, mRNA possesses a 7-methylguanosine triphosphate cap which helps in the recognition of mRNA in protein biosynthesis and it helps to stabilize the mRNA by preventing attack of 5¹-exonuclease.

At its 3¹-end, there is a poly-A tail made up of several adenylate residues which stabilize mRNA by preventing attack of 3¹-exonuclease.

56. Smallest unit of genetic expression

a) Gene

b) Cistrone

c) Codon

d) Genetic code

Correct Answer - B

Ans. is 'b' i.e., Cistrone

- Gene :- *It is the smallest functional unit of genome.* Gene is the unit of DNA that carries the information for synthesis of specific protein.
- Cistrone:- It is smallest unit of genetic expression. It is the basic genetic unit coding for one polypeptide chain, i.e., a subunit of a complete protein molecule. It is regarded as one cistrone-one subunit concept. Prokaryotic mRNA is polycistronic, i.e. each mRNA has several coding region. Eukaryotic mRNA is monocistronic, i.e. each mRNA has single coding region.
- Smallest functional unit of genome → gene, codes for a specific protein.
- Smallest unit of genetic expression → cistrone, (codes for the subunit of protein, i.e. one polypeptide chain).

**57. A codon codes for a single amino acid.
This characteristic is called ?**

a) Non-overlapping

b) Unambiguous

c) Non-punctate

d) Degeneracy

Correct Answer - B

Ans. is 'b' i.e., Unambiguous

Characteristics of genetic codes

Genetic codes have following characteristics ?

1) Universal :- Each codon specifically codes for same amino acid in *all species*, e.g. UCA codes for serine and CCA codes for proline in all organisms. That means specificity of codon has been conserved from very early stages of evolution. Exception to the universality of genetic code are found in human mitochondria, where the code :-
α UGA codes for tryptophan instead of serving as a stop codon.
AUA codes for methionine instead of isoleucine.
CUA codes for threonine instead of leucine.
LI AGA and AGG serve as stop codon instead of coding for arginine.

2) Unambiguous/Specific :- A particular codon always codes for the same amino acid. For example CCU always codes for proline and UGG always codes for tryptophan.

3) Degeneracy/Redundancy :- A given amino acid may have more than one codon. For example, CCU, CCC, CCA and CCG all four codons code for proline. Therefore, there are 61 codons for 20 amino acids.

4) Stop or termination or nonsense codons:- Three of the 64 possible nucleotide triplets UAA (amber), UAG (Ochre) and UGA

(opal) do not code for any amino acid. They are called nonsense codons that normally signal termination of polypeptide chains. Thus, though there are 64 possible triplet codons, only 61 codes for 20 amino acids (as remaining three are non-sense codons).

5) Non overlapping and nonpunctate (Comma less) :- During translation, the code is read sequentially, without spacer bases, from a fixed starting point, as a continuous sequence of bases, taken 3 at a time, e.g. AUGCUA GACUUU is read as AUG/CUA/GAC/UUU without "punctuation" (comma) between codons.

58. Sickle cell anemia is due to which type of mutation?

a) Frame-shift mutation

b) Base substitution mutation

c) Trinucleotide repeat

d) Splice site mutation

Correct Answer - B

Ans. is 'b' i.e., Base substitution mutation

- Sickle cell anemia is a hereditary hemoglobinopathy, i.e., the type of disease characterized by production of defective hemoglobin.
- Sickle cell anemia results from mutation in β -globin gene.
- It is caused by a point mutation (Base substitution mutation) at the sixth position of the β -globin chain leading to substitution of a valine residue for a glutamic acid residue resulting in sickle hemoglobin (HbS).
- Sickle cell anemia is an autosomal recessive disorder.
- If an individual is homozygous for the sickle cell mutation, almost all the hemoglobin in the red cell is HbS.
- In heterozygotes, only about 40% of the hemoglobin is HbS, the remainder being normal hemoglobins.

59. Which Branched chain amino acid is ketogenic?

a) Lysine

b) Leucine

c) Isoleucine

d) b and c both

Correct Answer - D

Ans. is 'b > c' i.e., Leucine > Isoleucine

Branched chain amino acids are leucine, Isoleucine and valine.

1) Leucine is purely ketogenic.

2) Isoleucine is both ketogenic and glucogenic.

3) Valine is glucogenic.

60. Succinyl CoA is formed from which glucogenic acid ?

a) Tyrosine

b) Phenylalanine

c) Valine

d) Proline

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

61. Pyruvate dehydrogenase is inhibited allosterically by ?

a) AMP

b) Pyruvate

c) NADH

d) `Insulin

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

62. Expected change in Vitamin B₁₂ deficiency

- a) Increased homocysteine in urine
- b) Increased methylmalonic acid in urine
- c) FIGLU in urine
- d) Phenylalanine in urine

Correct Answer - B

Ans. is 'b' i.e., Increased methylmalonic acid in urine

Isomerization of methylmalonyl CoA to succinyl CoA

In this reaction, active form of vitamin B₁₂ is deoxyadenosyl cobalamine.

Propionyl-CoA is produced as catabolic end product of some aliphatic amino acids and β -oxidation of odd chain fatty acids.

Propionyl CoA is then converted to succinyl CoA through methylmalonyl-CoA.

Thus methylmalonyl-CoA is accumulated and excreted in urine as methylmalonic acid (methylmalonate) in vitamin B₁₂ deficiency, i.e. methylmalonic aciduria.

63. Action of physiological uncoupler ?

a) Inhibition of both ATP synthesis and ETC

b) Inhibition of ATP synthesis only not ETC

c) Inhibition of only ETC not ATP synthesis

d) None of the above

Correct Answer - B

Ans. is 'b' i.e., Inhibition of ATP synthesis only not ETC

As the name suggests, these compounds 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.

Thus the energy instead of being trapped by phosphorylation is dissipated as heat. Uncouplers may be :?

i) *Natural* :- Thermogenin, thyroxine

ii) *Synthetic* :- 2, 4-dinitrophenol (2, 4-DNP), 2, 4-dinitroresol (2, 4-DNC), and CCCP (chlorocarbonylcyanidephenyl hydrazone).

64. In starvation, there is ketosis due to ?

a) Decreased acetyl CoA

b) Increased β -oxidation

c) Decreased lipolysis

d) Decreased fatty acid

Correct Answer - B

Ans. is 'b' i.e., Increased β -oxidation

Starvation is characterized by decreased insulin : glucagon ratio.

This causes :?

- i) *Increased lipolysis* → More FFAs for ketogenesis.
- ii) *Increased β -oxidation* → Increased ketogenesis.
- iii) *Decreased oxaloacetate* → Acetyl CoA is utilized in ketogenesis.

Regulation of ketogenesis

Ketogenesis is regulated at three levels:?

1) Factors regulating mobilization of fatty acids from adipose tissues (i.e. lipolysis):- Free fatty acids, the precursors of ketone bodies, arise from lipolysis of triglycerides in adipose tissue. Hence, factors which enhance lipolysis (e.g. *glucagon*) stimulate ketogenesis by providing more free fatty acids. Conversely, factors that inhibit lipolysis (e.g. *insulin*) inhibit ketogenesis.

2) Factors regulating β -oxidation of fatty acids:- After uptake by liver, FFAs are either (i) β -oxidized to CO, or ketone bodies, or (ii) esterified to triacylglycerol. Carnitine acetyl transferase-I (CAT-I) regulates the β -oxidation of fatty acid and therefore the production of starting materials of ketogenesis i.e. acetylCoA and acetoacetyl-CoA (The remainder of fatty acids which do not enter β -oxidation, are esterified). Activity of CAT-1 is high in starvation and diabetes

leading to increased β -oxidation of fatty acids and increased ketogenesis. CAT-1 activity is low in well fed state, resulting in decreased β -oxidation and ketogenesis. This regulation is governed by Malonyl CoA, which is an allosteric *inhibitor of carnitine acetyl transferase-1: CAT-1 (or carnitine palmitoyl transferase-1: (CPT-1)*. Malonyl CoA is synthesized by acetyl CoA carboxylase. Activity of acetyl CoA carboxylase is high in well fed state due to increase in insulin/ glucagon ratio, which in turn results in increased formation of malonyl-CoA. Malonyl-CoA inhibits CAT-I (CPT-I) leading to decreased β -oxidation and ketogenesis. Hence, esterification of fatty acids is increased. Conversely, during starvation (and diabetes) insulin/glucagon ratio is decreased which results in decreased activity of acetyl CoA carboxylase and decreased production of malonyl-CoA, releasing the inhibition of CAT-I (CPT-I). This results in increase β -oxidation of fatty acids and ketogenesis.

3) Factors regulating the oxidation of acetyl CoA:- The acetyl-CoA formed in β -oxidation is oxidized in the citric acid cycle, or it enters the ketogenesis to form ketone bodies. *When oxaloacetate concentration is low*, little acetyl-CoA enters the TCA cycle and ketogenesis is favoured (first reaction of TCA cycle involves oxaloacetate, where it combines with acetyl-CoA to form citrate). Concentration of oxaloacetate is lowered if carbohydrate is unavailable or improperly utilized, e.g. in *fasting and in diabetes*.

65. RNA primer is synthesized by ?

a) Topoisomerase

b) Helicase

c) DNA primase

d) DNA ligase

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

66. Glutathione consists of cysteine plus glutamate plus ?

a) Leucine

b) Lysine

c) Glycine

d) Valine

Correct Answer - C

Ans. is 'c' i.e., Glycine

Glutathione

Glutathione is a tripeptide made up of glutamate, cysteine and glycine (T-glutamyl-cysteinyl-glycine).

Glutathione is present in all mammalian cells *except neurons*.

The sulphhydryl (-SH) group of cysteine residue is the reactive portion of glutathione which can undergo oxidation and reduction.

Thus, glutathione may exist as the reduced (G-SH) or oxidized form (G-S-S-G) and can play a role in some *oxidation-reduction reactions*. In oxidized form two molecules of glutathione are linked by disulfide bond.

Glutathione has following function : -

i) It helps in keeping some enzyme in active state by preventing the oxidation of sulphhydryl (-SH) group of enzyme.

ii) It helps in detoxification of H_2O_2 by reducing it. Superoxide anion (O_2^-) first converted to H_2O_2 by superoxide dismutase. H_2O_2 is then reduced to H_2O by glutathione peroxidase, a reaction requires reduced glutathione. Thus, glutathione scavenges free radicals and superoxide anion.

iii) It helps in detoxification of xenobiotics by their conjugation (conjugation reaction)

(conjugation reaction).

iv) Reduced form of glutathione (GSH) with a free sulphhydryl (-SH) group serves as a redox buffer, regulating redox state of the cell.

v) Reduced glutathione is essential for maintaining the normal structure of RBCs and for keeping hemoglobin iron in ferrous state (prevents formation of methemoglobin).

vi) It is involved in the transport of amino acids across the cell membrane of kidney and intestine.

67. Branched chain amino acid which is both ketogenic and glucogenic ?

a) Leucine

b) Isoleucine

c) Valine

d) Tryptophan

Correct Answer - B
Ans. is 'b' i.e., Isoleucine

68. True about charge in amino acid ?

a) Carboxyl group can form positive charge

b) Amino group can form negative charge

c) Neutral at isoelectric pH

d) All of the above

Correct Answer - C

Ans. is 'c' i.e., Neutral at isoelectric pH

The pH value at which the number of positive charges equals the number of negative charges is isoelectric pH of amino acids.

At its isoelectric pH, an amino acid is in zwitterion form (dipolar molecule), i.e. has both positive and negative charge on same acid, but overall molecule is electrically neutral.

- The carboxy (-COON) group of an amino acid can donate proton (H^+) and behave as an acid forming a negatively charged anion (COO^-).
- Amino group ($-NH_2$) can accept proton (H^+) and behave as a base, forming positively charged cation (NH_3^+).

Amphoteric property of amino acid

- Substances having a two-way property are called amphoteric or ampholyte. Amino acids have both acidic and basic groups, i.e., they can donate a proton or accept a proton, hence amino acids are referred to as amphoteric. Amphoteric property is related to : ?
- Zwitterion or dipolar molecule**
- Monoamine-Monocarboxylic amino acids exist as dipolar ion or zwitterions, i.e., they have both positive and negative charges on the same amino acids.
 - The α -COOH group donate its proton to amino group ($-NH_2$) and becomes negatively charged anion (COO^-).

- The α -NH₂ group accepts proton from carboxyl group (α -COOH) to form positively charged cation (NH₃⁺).
- The overall molecule (zwitterion) is electrically neutral, i.e., the molecular species which contain an equal number of ionizable group of opposite charge and as a result bear no charge (are neutral) are called zwitterions.

69. LCAT is induced by ?

a) Apo A-I

b) Apo B-48

c) Apo B-100

d) Apo C-II

Correct Answer - A
Ans. is 'a' i.e., Apo A-I

70. Cytochrome P450 is name derived from ?

- a) Molecular weight 450D
- b) Produced by 450 genes
- c) Absorbs light at 450 nanometres
- d) Have 450 isoforms

Correct Answer - C

Ans. is 'c' i.e., Absorbs light at 450 nanometres

- Cytochrome P450 got its name because it strongly absorbs light at 450 nanometres, which is blue is visible spectrum.

71. Rate limiting enzyme in fatty acid synthesis ?

a) PDH dehydrogenase

b) Malonyl reductase

c) Acetyl CoA carboxylase

d) Transacetylase

Correct Answer - C

Ans. is 'c' i.e., Acetyl CoA carboxylase

72. Number of prosthetic groups in a hemoglobin molecule ?

a) 1

b) 2

c) 3

d) 4

Correct Answer - D

Ans. is 'd' i.e., 4

- Hemoglobin is a *conjugated protein* which has a *tetrameric* structure.
- It is an assembly of four globular proteins.
- Each subunit is composed of a protein part, i.e. globin and a nonprotein prosthetic group, i.e. heme.
- Each hemoglobin molecule is made up of 4 heme molecules and 4 polypeptide chains (2 pairs of similar polypeptide chains).
Hemoglobin=Globin (containing 4 polypeptide chains)+ 4 heme molecules

73. Regulation of enzyme activity by covalent modification is seen in all except ?

a) Glycogen synthase

b) Glycogen phosphorylase

c) Aspartate transcarboxylase

d) HMG CoA reductase

Correct Answer - C

Ans. is 'c' i.e., Aspartate transcarboxylase

Covalent modification

- The enzymes regulated by covalent modification can exist in two forms.
- The two forms of enzyme can be converted into each other by a covalent modification of the enzyme molecule.
- *The most common covalent modification is the addition or removal of a phosphate group.*
- The covalent attachment of phosphate group converts the enzyme into phosphorylated form whereas removal of phosphate group converts the same enzyme into dephosphorylated form.
- One of the forms of the enzyme, either phosphorylated or dephosphorylated, is active and the other is inactive.
- Phosphorylation of the enzyme is catalyzed by a *protein kinase* that transfers a phosphate group from ATP to the enzymes.
- Dephosphorylation of the enzyme is catalyzed by a protein phosphatase that removes the phosphate group from the enzyme.
- Whether the enzyme will be active or inactive at a given time depends upon the relative activities of protein kinase and protein phosphatase which are usually controlled by hormones through second messengers.

- An example is *glycogen synthase*, which is active in dephosphorylated state and inactive in phosphorylated state.
- Glucagon stimulates formation of cAMP (a second messenger) which in turn stimulates protein kinase.
- Protein kinase catalyze the phosphorylation of glycogen synthase.
- Therefore, glucagon inactivate glycogen synthase.

74. Per TCA with 3 NADH and 1 FADH₂, generates how many ATP?

a) 6

b) 9

c) 12

d) 15

Correct Answer - B

Ans. is 'b' i.e., 9

One NADH produces 2.5 ATP and one FADH₂ produces 1.5 ATP.

Thus 3 NADH and 1 FADH₂ will produce 9 ATP.

There is production of ATP at substrate level also, Thus total 10 ATP molecules are produced per cycle.

75. Monitoring of DNA denaturation in vitro is done by ?

a) Centrifugation

b) UV absorption

c) Chromatography

d) HPLC

Correct Answer - B

Ans. is 'b' i.e., UV absorption

Denaturation (melting) of DNA

Denaturation (melting) refers to separation of the two strands of the DNA into two component strands. When temperature of medium is raised, the hydrogen bonds linking of complementary base pair tends to break. As a result, separation of two strands occur. Melting temperature (T_m) indicates the temperature at which half of the double stranded structure is lost. Normally, T_m is between 85°C and 95°C .

Since G and C are linked more strongly by three hydrogen bonds, in contrast to two hydrogen bonds linking A and T, G and C linking provides thermostability to DNA. Therefore, DNA molecules having higher GC content have relatively higher T_m . For every 10% increase in GC content, melting temperature increases by 5°C .

Simple formula is -

$T_m (^\circ\text{C}) = 2 (\text{number of AT base pairs}) + 4 (\text{number of GC base pairs})$

In addition to *heat*, *alkali treatment* and decrease of salt concentration also cause denaturation. Decrease in salt concentration decreases T_m . Therefore, *increase in salt concentration increases DNA duplex stability. Denaturation affects properties of DNA and these can be*

used to monitor strand separation -

i) Hyperchromicity (hyperchromic effect) : DNA bases (purines and pyrimidines) absorb UV light of 260 nm. Upon denaturation, this optical absorbance is increased and is called hyperchromicity of denaturation or hyperchromic effect.

ii) Viscosity : Viscosity of the DNA solution decreases on melting (denaturation) because single strands are more flexible than the stiff, resilient double helix.

The separated strands of denatured DNA can rejoin on gradual cooling. This is called renaturation or reannealing.

76. What can be prevented by inhibiting aldose reductase in diabetes mellitus ?

a) Deafness

b) Diabetic nephropathy

c) Diabetic neuropathy

d) Diabetic cataract

Correct Answer - D

Ans. is 'd' i.e., Diabetic cataract

When there is excessive glucose, e.g., in diabetes, it is converted to sorbitol by aldose reductase. Sorbitol is responsible for accumulates in the lens and causes diabetic cataract.

77. Side chain of which amino acid contains sulfhydryl group ?

a) Asparagine

b) Cysteine

c) Isoleucine

d) Threonine

Correct Answer - B

Ans. is 'b' i.e., Cysteine

There are two sulfur containing amino acids :-

i) Cysteine

ii) Methionine

The side chain of cysteine contains sulfhydryl group that has a pKa of approximately 8.4 for dissociation of its hydrogen sulfhydryl groups of two cysteine molecules can form covalent disulfide bond to form cystine.

Methionine although it contains sulfur group, does not contain sulfhydryl group and cannot form disulfide bond.

78. Polymerase chain reaction is used for ?

a) Cloning of DNA in vitro

b) Amplification of DNA in vitro

c) DNQA sequencing

d) Visualization of nucleic acid

Correct Answer - B

Ans. is 'b' i.e., Amplification of DNA in vitro

- PCR is a method of enzymatic amplification of a target sequence of DNA.
- It is *sensitive, selective (specific) and extremely rapid* means of amplifying any desired sequence of double stranded DNA, which can be as short as 50-100 base pairs (bp) and as long as 10 kbp.
- In PCR, the DNA to be amplified is replicated by DNA polymerase of *Thermus aquaticus* (Taq).
- Taq polymerase is used because it is thermostable, not denatured at a temperature upto 95°C (in PCR DNA is to be heated to 94°-95° C for separation of strands).
- For amplifying a desired DNA sequence in DNA, we have to know short flanking sequences on either side of the target sequence so that complementary primers can be prepared.
- Primers are the synthetic oligonucleotides of 20-35 sequence, which have sequence complementary to flanking sequence, i.e. sequence of flanking region of target DNA sequence.
- *Primers* are amplified to produce desired sequence of DNA.

79. Acetyl CoA carboxylase enzyme is present in ?

a) Cytosol

b) Mitochondria

c) Nucleus

d) Lysosome

Correct Answer - A

Ans. is 'a' i.e., Cytosol

This question is slightly different from previous one.

The major acetyl CoA carboxylase which is involved in lipogenesis is acetyl CoA Carboxylase-1 (ACC-1). It is a cytosolic enzyme. In general acetyl CoA carboxylase refers to ACC-1.

There is one more isoform of acetyl CoA carboxylase, i.e. ACC-2.

Which is present in muscle, allowing muscle to regulate β -oxidation.

ACC-2 is present in mitochondria.

80. Enzyme which is not regulated by phosphorylation dephosphorylation ?

a) Glycogen synthase

b) Glycogen phosphorylase

c) Aspartate transcarboxylase

d) HMG CoA reductase

Correct Answer - C

Ans. is 'c' i.e., Aspartate transcarboxylase

81. Not a substrate for gluconeogenesis -

a) Glycerol

b) Leucine

c) Lactate

d) Propionate

Correct Answer - B

Ans. is 'b' i.e., Leucine

Substrates for gluconeogenesis ?

- i. *Lactate*
 - i. *All amino acids except leucine and lysine*
 - i. *Pyruvate*
 - i. *Propionate*
 - i. *Glycerol*
 - i. *Intermediates of citric acid cycle*
- Alanine is the most important gluconeogenic amino acid.*

82. For conversion of aspartate to asparagine, nitrogen comes from ?

a) Alanine

b) Glutamate

c) Glutamine

d) Histidine

Correct Answer - C

Ans. is 'c' i.e., Glutamine

Synthesis of asparagine from aspartate is catalyzed by asparagine synthetase.

Donor of amide group (containing nitrogen) in this reaction is glutamine.

83. Which of the following glycolytic enzyme does not catalyze irreversible step ?

a) Hexokinase

b) Phosphoglycerate kinase

c) Phosphofructokinase

d) Pyruvate kinase

Correct Answer - B

Ans. is 'b' i.e., Phosphoglycerate kinase

Irreversible steps are catalyzed by :- Glucokinase / Hexokinase, phosphofructokinase-I, and pyruvate kinase.

Reversible steps are catalyzed by :- Phosphohexose isomerase, aldolase, phosphotriose isomerase, glyceraldehyde 3-phosphate dehydrogenase, phosphoglycerate kinase, phosphoglycerate mutase, Enolase.

84. Key enzyme in glycogenolysis ?

a) Branching enzyme

b) Glycogen synthase

c) Debranching enzyme

d) Glycogen phosphorylase

Correct Answer - D

Ans. is 'd' i.e., Glycogen phosphorylase

85. Most popular acceptable theory for oxidative phosphorylation is ?

a) Semiconservative

b) Chemical coupling

c) Chemiosmotic theory

d) Physical coupling

Correct Answer - C

Ans. is 'c' i.e., Chemiosmotic theory

The *chemiosmotic coupling hypothesis* is the most accepted theory which explains the mechanism of oxidative phosphorylation.

It states that "free energy of electron transport" is conserved by pumping protons from mitochondrial matrix to the intermembrane space, so as to create an electrochemical proton gradient across the inner mitochondrial membrane, with outer side of membrane is positively charged as compared to inside. Electrochemical potential of this gradient is used to synthesize ATP by ATP synthase.

86. Which amino acid binds NH_4^+ covalently and makes it non-toxic for transportation ?

a) Histidine

b) Serine

c) Glutamate

d) Aspartate

Correct Answer - C

Ans. is 'c' i.e., Glutamate

DISPOSAL/DETOXIFICATION OF AMMONIA

1. First line of Defense (Trapping of ammonia)

- Being highly toxic, ammonia should be eliminated or detoxified, as and when it is formed. Even very minute quantity of ammonia may produce toxicity in central nervous system.
- But, ammonia is always produced by almost all cells, including neurons.
- The intracellular ammonia is immediately trapped by glutamic acid to form glutamine, especially in brain cells .
- The glutamine is then transported to liver, where the reaction is reversed by the enzyme glutaminase .
- The ammonia thus generated is immediately detoxified into urea.
- Aspartic acid may also undergo similar reaction to form asparagine .

2. Transportation of Ammonia

- Inside the cells of almost all tissues, the transamination of amino acids produce glutamic acid.
- However, glutamate dehydrogenase is available only in the liver.
- Therefore, the final deamination and production of ammonia is

taking place in the liver .

- Thus, glutamic acid acts as the link between amino groups of amino acids and ammonia.
- The concentration of glutamic acid in blood is 10 times more than other amino acids.
- Glutamine is the transport form of ammonia from brain and intestine to liver; while alanine is the transport form from muscle.

3. Final disposal

- The ammonia from all over the body thus reaches liver. It is then detoxified to urea by liver cells, and then excreted through kidneys.
- Urea is the end product of protein metabolism.

87. An infant presents with hepatosplenomegaly, hypoglycemia, hyperuricemia and lactic acidosis. Liver biopsy shows normal structured glycogen deposition. Enzyme deficient in this infant is ?

a) Debranching enzyme

b) Branching enzyme

c) Glucose-6-phosphatase

d) Muscle phosphorylase

Correct Answer - C

Ans. is 'c' i.e., Glucose-6-phosphatase

The infant is presenting with features of liver glycogenosis, i.e. glycogen storage disease which primarily affects liver.

Among the given options a, b and c are liver glycogenoses. but normal glycogen structure rules out a and b options.

- i. Debranching enzyme deficiency (Type III glycogenosis) and branching enzyme deficiency (type IV glycogenosis) have deposition of abnormal glycogen.
- i. Glucose-6-phosphatase deficiency (type I glycogenosis) has deposition of normal glycogen.

88. 1st response to hypoglycemia ?

a) Decreased insulin

b) Increased glucagon

c) Increased cortisol

d) Increased norepinephrine

Correct Answer - A

Ans. is 'a' i.e., Decreased insulin

Decreased insulin is the first response followed successively by increase in glucagon, epinephrine, cortisol and GH.

89. Allosteric inhibition of an enzyme is ?

a) Binding of inhibitor to catalytic site and inhibition of enzyme

b) Binding of inhibitor to other site and inhibition of enzyme

c) Inhibition of enzyme by inhibitors without binding to enzyme

d) Inactivation by phosphorylation or dephosphorylation

Correct Answer - B

Ans. is 'b' i.e., Binding of inhibitor to other site and inhibition of enzyme

- Some enzymes, called allosteric enzymes, possess a site, in addition to substrate binding (catalytic) site, known as the allosteric site.
- Binding of *allosteric modulator* at the allosteric site affects the conformation of catalytic site.
- Such enzymes are called *allosteric enzymes*.
- The allosteric modulator (regulator) may facilitate the conformational change of catalytic site, required for substrate binding.
- Such regulators are called *allosteric activators (positive allosteric modifier)*; for example, fructose-2, 6-bisphosphate is an allosteric activator of Phosphofructokinase-I.
- Some allosteric regulators prevent the conformational change required for binding of the substrate.
- Such regulators are called *allosteric inhibitors (negative allosteric modifier)*; for example, citrate is an allosteric inhibitor of phosphofructokinase-I.

90. Alcohol causes hypoglycemia due to ?

a) Decreased gluconeogenesis

b) Decreased NADH

c) Decreased lipogenesis

d) Decreased glycogenesis

Correct Answer - A

Ans. is 'a' i.e., Decreased gluconeogenesis

Excess intake of alcohol leads to excessive production of NADH with a concomitant decrease in NAD⁺.

This causes following metabolic alterations :-

i) The increase availability of NADH favours the reduction of pyruvate to lactate and oxaloacetate to malate and decreasing its availability for gluconeogenesis and decrease synthesis of glucose.

This results in Hypoglycemia.

ii) Increased ratio of NADH/NAD⁺ inhibits β -oxidation of fatty acids and citric acid cycle and promotes lipogenesis, triacylglycerol synthesis and cholesterol synthesis from acetyl CoA.

iii) Increased lactic acid production causes lactic acidosis and hyperuricemia.

iv) Accumulation of lipid in various tissues causes fatty liver, fatty myocardium etc.

91. Histidine to histamine is ?

a) Carboxylation

b) Decarboxylation

c) Oxidation

d) Reduction

Correct Answer - B

Ans. is 'b' i.e., Decarboxylation

Histamine is synthesized from histidine by decarboxylation catalyzed by histidine decarboxylase.

Reaction requires pyridoxal phosphate (PLP) as coenzyme.

92. Glutathione is maintained in reduced state by the help of ?

a) HMP shunt

b) Glycogenesis

c) Uronic acid pathway

d) Transamination

Correct Answer - A

Ans. is 'a' i.e., HMP shunt

Oxidized glutathione is reduced by the help of NADPH, which is generated by NADPH.

93. Rate limiting enzyme in bile acid synthesis ?

a) Desmolase

b) 21 α -hydroxylase

c) 7 α -hydroxylase

d) 12 α -hydroxylase

Correct Answer - C

Ans. is 'c' i.e., 7 α -hydroxylase

About half of the cholesterol in the body is ultimately metabolized to bile acids.

The primary bile acids are synthesized from cholesterol in liver.

These are cholic acid and chenodeoxycholic acid.

Rate limiting enzyme in primary bile acids synthesis is 7 α - hydroxylase (cholesterol 7 α - hydroxylase).

This enzyme is inhibited by bile acids and induced by cholesterol.

Thyroid hormones induce transcription of 7 α -hydroxylase, thus in patients with hypothyroidism plasma cholesterol tends to rise (because of inhibition of 7 α -hydroxylase which in turn inhibits conversion of cholesterol to bile acids).

94. Rate limiting enzyme in catecholamine synthesis?

a) Dopa decarboxylase

b) N-methyltransferase

c) Dopamine hydroxylase

d) Tyrosine hydroxylase

Correct Answer - D

Ans. is 'd' i.e., Tyrosine hydroxylase

95. β -oxidation of fatty acids with odd number of carbon atoms yield ?

a) Acetyl CoA

b) Propionyl CoA

c) Both

d) None

Correct Answer - C

Ans. is 'c' i.e., Both

Even chain fatty acids are β -oxidized to acetyl CoA.

Odd chain fatty acids are also β -oxidized normally but the last step produces a 3-carbon propionyl CoA along with an acetyl CoA (instead of 2 molecules acetyl CoA that occurs in even chain fatty acids).

For example, a C-17 fatty acid produces 7 acetyl CoA molecules and one propionyl CoA molecule by β -oxidation.

Propionyl CoA is catabolized to succinyl CoA, a krebs cycle intermediate via methylmalonyl CoA. so, propionyl CoA enters the gluconeogenic process.

This three carbon units (propionyl CoA) from odd chain fatty acids is the only part of a fatty acid that is glucogenic.

96. Two carbon atoms leave in the form of CO₂ in TCA cycle are derived from ?

a) Oxaloacetate

b) Acetyl CoA

c) Succinyl CoA

d) fumerate

Correct Answer - B

Ans. is 'b' i.e., Acetyl CoA

TCA cycle consists of sequential reactions. It begins with condensation of four carbon oxaloacetate molecule with 2 carbon acetyl CoA molecule to form six carbon citrate molecule. In subsequent reaction two carbon atoms are lost in the form of CO₂ at two different reactions. A series of modifications occur in the remaining four carbon atoms to ultimately form oxaloacetate. Thus the last substrate (oxaloacetate) of one cycle is ready for use as a substrate in the next cycle. In this way, *there is no net generation of OAA, or of any of the cycle intermediates.*

So, two carbon atoms enter the cycle as acetyl CoA (and condense with oxaloacetate) and two carbons leave in the form of two molecules of CO₂. Thus, TCA cycle basically involves oxidation of acetyl CoA to CO₂ and as such *there is no net consumption or regeneration of oxaloacetate or any of the other cycle intermediates.*

97. Uronic acid pathway does not have role in formation of which glycosaminoglycan proteoglycan?

a) Keratan sulfate

b) Chondroitin sulphate

c) Hyaluronic acid

d) Heparan sulphate

Correct Answer - A

Glycosaminoglycans are *heteropolysaccharide*

(heteropolysaccharides are polysaccharides which contain two or more different monosaccharide unit or their derivatives).

Glycosaminoglycans are linear (unbranched) polysaccharides, with *repeating disaccharide units*.

Each disaccharide unit consists of an *amino sugar* and an *acid sugar (sugar acid)*.

98. Uronic acid pathway is important for the formation of?

a) GAG (glycosamine glycans)

b) Glycoproteins

c) Conjugation of bilirubin

d) All of the above

Correct Answer - D

UDP-glucuronate (a product of uronic acid pathway) is a donar of glucuronate residue for various conjugation and synthetic processes.

99. Glucogenic amino acid is transported to the liver most commonly by

a) Alanine

b) Glycine

c) Lysine

d) Leucine

Correct Answer - A

Ans. A. Alanine

100. Rate limiting step in HMP shunt ?

a) Glucose-6-phosphate → 6-phosphogluconolactone

b) 6-phosphogluconolactone → 6-phosphogluconate

c) 6-phosphogluconate → Ribulose-5-phosphate

d) Ribulose-5-phosphate → Xylulose-5-phosphate

Correct Answer - A

Ans. A. Glucose-6-phosphate → 6-phosphogluconolactone

101. NAD^+ Acts as a coenzyme for ?

a) Xanthine oxidase

b) L-amino acid oxidase

c) Succinate dehydrogenase

d) Malate dehydrogenase

Correct Answer - D

- .. Malate dehydrogenase [Ref Harper 29th/e p. 198, 199 & 26thie p. 163]
- NAD⁺-linked dehydrogenases Pyruvate dehydrogenase, isocitrate dehydrogenase, malate dehydrogenase, α -ketoglutarate dehydrogenase, glutamate dehydrogenase, glyceraldehyde-3-P dehydrogenase, lactate dehydrogenase, 13-hydroxy acyl CoA dehydrogenase, glycerol 3-P dehydrogenase (cytoplasmic).
- NADP⁺-linked dehydrogenases Glucose-6-P dehydrogenase, 6-Phosphogluconate dehydrogenase, 3-ketoacyl reductase, Enoyl reductase, gulonate dehydrogenase.
- FAD-linked dehydrogenases Succinate dehydrogenase, fatty acyl CoA dehydrogenase, glycerol-3P dehydrogenase (mitochondrial).

102. Coenzyme A is formed from which vitamin?

a) C

b) B4

c) Nicotinic acid

d) Pantothenic acid

Correct Answer - D

- CoA biosynthesis requires cysteine, pantothenate (vitamin B₅), and adenosine triphosphate (ATP).
- it is naturally synthesized from pantothenate (vitamin B₅), which is found in food such as meat, vegetables, cereal grains, legumes, eggs, and milk.
- Pantothenate (vitamin B₅) is phosphorylated to 4'-phosphopantothenate by the enzyme pantothenate kinase (PanK; CoaA; CoaX). This is the committed step in CoA biosynthesis and requires ATP.
- 1. A cysteine is added to 4'-phosphopantothenate by the enzyme phosphopantothenoylcysteine synthetase (PPCS; CoaB) to form 4'-phospho-N-pantothenoylcysteine (PPC). This step is coupled with ATP hydrolysis.^[10]
- 2. PPC is decarboxylated to 4'-phosphopantetheine by phosphopantothenoylcysteine decarboxylase (PPC-DC; CoaC)
- 3. 4'-phosphopantetheine is adenylylated (or more properly, AMPylated) to form dephospho-CoA by the enzyme phosphopantetheine adenylyl transferase (PPAT; CoaD)
- 4. Finally, dephospho-CoA is phosphorylated to coenzyme A by the

enzyme dephosphocoenzyme A kinase (DPCK; CoaE). This final step requires ATP.

5.

**103. Tyrosine utilized in synthesis of all
except ?**

a) Melanin

b) Melatonin

c) Dopamine

d) Thyroxine

Correct Answer - B
Melatonin [*Ref Harper 29th/e p. 288-290*]

104. Hartnup disease is related to ?

a) Rickets symptoms

b) Pellagra symptoms

c) Burning foot syndrome

d) Angular stomatitis

Correct Answer - B

Ans. B. Pellagra symptoms

Hartnup disease

- It is an inherited disorder in the metabolism of tryptophan.
- It is due to defective transport of tryptophan and other neutral amino acids in the intestine and kidney.
- This results in deficiency of tryptophan leading to decreased synthesis of niacin and serotonin.
- Thus there are *pellagra (niacin deficiency)*, *neurological symptoms (serotonin deficiency)* and *amino aciduria* due to defective transport of amino acids in kidney.

105. Enzyme Transketolase requires ?

a) FAD

b) TPP

c) PLP

d) FMN

Correct Answer - B

- Transketolase reactions require thiamine pyrophosphate (TPP).
- Coenzyme can be classified according to the group whose transfer they facilitate.
 - a) *For transfer groups other than hydrogen* :- Sugar phosphate, CoA-SH, thiamine pyrophosphate (TPP), Pyridoxal phosphate, Folate, Biotin.
 - b) *For transfer of hydrogen* : - NAD⁺, NADP⁺, FMN, FAD, Lipoic acid, Coenzyme Q.

106. Enzyme inhibited by insulin ?

a) Glucokinase

b) PFK-1

c) Glycogen phosphorylase

d) Glycogen synthase

Correct Answer - C

Ans. is 'c' i.e., Glycogen phosphorylase

Enzymes /Pathways inhibited by insulin :

i) *Gluconeogenesis* : Pyruvate carboxylase, PEP carboxykinase, fructose-1, 6-bisphosphatase, glucose-6 phosphatase

ii) *Glycogenolysis* : Glycogen phosphorylase

iii) *Lipolysis* : *Hormone sensitive lipase*

107. RNA primer in eukaryote is formed by ?

a) Ligase

b) RNA polymerase

c) Topoisomerase

d) Helicase

Correct Answer - B

DNA synthesis cannot commence with deoxyribonucleotides because DNA polymerase cannot add a mononucleotide to another mononucleotide.

Thus, DNA polymerase cannot initiate synthesis of complementary DNA synthesis strand of DNA on a totally single stranded template. For this, they require RNA primer, which is a short piece of RNA formed by enzyme primase (RNA polymerase) using DNA as a template.

RNA primer is then extended by addition of deoxyribonucleotides. Later on, the ribonucleotides of the primer are replaced by deoxyribonucleotides.

Primase is actually a DNA primase which has RNA polymerase activity. This DNA primase is also called DNA polymerase.

108. In mass spectrometer, peptide are studied by projection of ?

a) Helium

b) Hydrogen ion

c) Oxygen

d) None

Correct Answer - B

A mass spectrometer generates multiple ions from the sample under investigation, it then separates them according to their specific mass-to-charge ratio (m/z), and then records the relative abundance of each ion type.

In positive ionisation mode, a trace of formic acid is often added to aid protonation (addition of proton or hydrogen ion) of sample molecules. Proteins and peptides are usually analysed under positive ionisation conditions.

In negative ionisation mode, a trace of ammonia solution or volatile amine is added to aid deprotonation (removal of proton or hydrogen ion) of the sample molecules. Saccharides and oligonucleotides are usually analysed under negative ionisation conditions.

109. PRPP glutamyl amidotransferase is increased to increase purine synthesis in ?

a) Liver

b) RBC

c) Brain

d) Polymorphs

Correct Answer - A

PRPP glutamyl amidotransferase is one of the rate limiting enzyme in de novo synthesis of purines. *The de novo synthesis of purines is most active in liver.*

Brain, RBCs (erythrocytes) and polymorphonuclear leukocytes (polymorphs) cannot synthesize purine nucleotides by de novo pathway.

Biosynthesis of purine nucleotides

Two important purine nucleotides are synthesized : (i) *adenosine monophosphate (AMP)* and (ii) *guanosine monophosphate (GMP)*. Then AMP and GMP are converted to other purine nucleotides like ADP, ATP, GDP, GTP etc. Purine nucleotides can be synthesized by two pathways - (1) *De novo synthesis* and (2) *Salvage pathway*. De novo pathway (De novo synthesis)

In de novo pathway, the purine nucleotides are synthesized from amphibolic intermediates. Amphibolic intermediates are the intermediary metabolites of amphibolic pathways (eg. citric acid cycle) which have dual purposes, i.e. they serve in catabolism as well as in anabolism.

In de novo synthesis, purine ring is formed from variety of precursors is assembled on ribose-5-phosphate. Precursors for de novo synthesis are ?

- i) Glycine provides C4 C5 and N7*
- ii) Aspartate provides N1*
- iii) Glutamine provides N3 and N9*
- iv) Tetrahydrofolate derivatives furnish C2 and Cs*
- v) Carbon dioxide provides C6*

110. 3' end of t-RNA possesses ?

a) Poly 'A' tail

b) CCA sequence

c) Anticodon

d) D arm

Correct Answer - B

t-RNA molecule get folded into a structure that appears like a clover leaf.

There are four arms.

1. Acceptor arm : It consists of a base paired stem that terminates in the sequence CCA at the 3' end. This is the *attachment site for amino acids*.
2. D arm - It contains the base dihydrouridine (D).
3. Anticodon arm - 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.
4. Tyr C arm : It contains both ribothymidine (T) and pseudouridine

111. Succinyl CoA is formed by all except ?

a) Proline

b) Isoleucine

c) Methionine

d) Valine

Correct Answer - A

Histidine, proline, glutamine, arginine	Glutamate à α -ketoglutarate
<i>Isoleucine, methionine, valine</i>	Succinyl CoA
Tyrosine, phenylalanine	Fumarate
Tryptophan	Alanine à Pyruvate
Hydroxyproline, serine, cysteine, threonine, glycine	Pyruvate

112. ApoE, ApoC is synthesized by ?

a) Liver

b) Kidney

c) Intestine

d) RBCs

Correct Answer - A

- Liver [*Ref Harper 29thie p. 239*]

Site of synthesis

Liver & intestine A-I ,

Liver A-V , B-00, C (C-I, C-11, C-III), E

Intestine A-IV, B-48

Spleen, brain, testes adrenal --> A- D

113. Phenylalanemia I is due to deficiency of ?

a) Phenylalanine hydroxylase

b) Homogentisate oxidase

c) Tyrosinase

d) None

Correct Answer - A

Phenylalanine hydroxylase [Ref Harper 29th/e p. 288 & 28⁵/e p. 254]

i) *Classical phenylketonuria (hyperphenylalanemia type I)*

Deficiency of phenylalanine hydroxylase.

ii) *Atypical phenylketonuria (hyperphenylalanemia type II and*

III) • Defect in dihydrobiopterin reductase.

iii) *Hyperphenylalanemia type IV and V*

• Defect in

dihydrobiopterin synthesis.

114. Genetic code does not contain ?

a) Adenine

b) Guanine

c) Thymine

d) Cytosine

Correct Answer - C

The information needed to direct the synthesis of protein is contained in the mRNA in the form of a genetic code, which in turn is transcribed from template strand of DNA and is therefore complementary to it. *The genetic code is the system of nucleotide sequences of mRNA that determines the sequence of amino acids in protein.*

Codon is a sequence of three adjacent bases that corresponds to one amino acid. *There are 64 possible codon sequences.* Because four nucleotide bases A, G, C and U are used to produce the three base codons, there are therefore 4^3 possible codon sequences. Thymine is not involved in codons as mRNA does not contain thymine (codon is contained in mRNA).

115. Enzyme replacement therapy is not available for?

a) Gaucher's disease

b) Tay sach disease

c) Pompe's disease

d) Hurler syndrome

Correct Answer - B

Important diseases for which enzyme replacement therapy is available are :-

- i. *Gaucher's disease*
- i. Maroteaux Lamy syndrome (mucopolysaccharidosis VI)
- i. Hurler syndrome (mucopolysaccharidosis I)
- /i. Fabry's disease
- /i. Hunter syndrome (mucopolysaccharidosis II)
- i. Pompe's disease (Type II glycogenosis)

116. True about tRNA ?

a) 80% of total RNA

b) Contains 50-60 nucleotides

c) CCA sequence is transcribed

d) Longest RNA

Correct Answer - C

"The CCA tail is a CCA sequence at 3' end of the tRNA molecule. In prokaryotes, CCA sequence is transcribed. In eukaryotes, the CCA sequence is added during processing".

"tRNA is the smallest of three major species of RNAs" — Dinesh puri

tRNA comprises 15% of total RNA in the cell. It contains 73-93 nucleotide residue.

117. Enzyme alglucerase is used in the treatment of ?

a) Gaucher's disease

b) Galactosemia

c) Niemann Pick disease

d) Pompe's disease

Correct Answer - A

Ans. is 'a' i.e., Gaucher's disease

Alglucerase (ceredase) is used in the treatment of Gaucher's disease.

118. In how much time does Hepatic glycogen storage depletes during starvation?

a) 18 hrs

b) 36 hrs

c) 72 hrs

d) 48 hrs

Correct Answer - A

The primary role of altered metabolism during fasting is to maintain blood glucose through the synthesis (gluconeogenesis) and utilization of alternate substrates. Fasting-starvation is divided in three broad categories:?

- i. *Initial stage* :- Lasts upto 2-3 days
- i. *Intermediate stage* :- Lasts upto 24 days
- i. *Advanced stage*:- begins after 24 days.
 - a) *Initial stage (first stage)*:- *Liver glycogen is the first main provider of energy.* But due to limited storage it can not last longe (16-18 hrs.). Further glucose is provided by gluconeogenesis by non-carbohydrate sources (*muscle protein breakdown is increased which provides amino acids alanine and glutamine for gluconeogenesis*). Utilization of alternate substrates (other than glucose) starts increasing in terminal period of this stage. Free fatty acids and ketone bodies start rising in this stage. Glycogen is completely depleted by the end of this stage. Blood glucose is slightly decreased.
- The first priority of metabolism in starvation is to provide sufficient glucose to brain and other tissues that are absolutely dependent on glucose.

- Liver glycogen provides glucose only for a short period. Whereas, gluconeogenesis plays an essential role in maintaining blood glucose during both short-term and prolonged starvation.
- The substrate for gluconeogenesis are pyruvate, lactate (from RBCs and exercising muscles), glucogenic amino acids released from muscle protein breakdown, and glycerol released from lipolysis.
 - b) Intermediate stage (Second stage):- *Free fatty acids are the major substrates for energy production.* They are derived from hydrolysis of fat (triglycerides) in adipose tissue. *Ketone bodies* serve as additional source of energy. As glycogen source is already depleted, the only source of glucose is increased *gluconeogenesis*. After sometimes muscle breakdown decreases due to decreased need of glucose as a fuel for brain which has began using ketone bodies as a source of energy.
 - c) Advanced stage (Third stage):- When fat stores are almost exhausted, *energy requirement is obtained from breakdown of tissue proteins* and protein stores once again enter in stage of rapid depletion.
- Thus the second priority of metabolism in starvation is to preserve protein. This is accomplished by using fatty acids and ketone bodies in place of glucose as a fuel.

119. In hemoglobin, affinity for carbon monoxide is diminished by presence of ?

a) Histidine F8

b) Histidine F7

c) Histidine E7

d) Histidine E8

Correct Answer - C

Heme is a derivative of porphyrin (protoporphyrin) porphyrin is composed by fusion of four pyrrole ring linked by methenyl (=CH) bridges, i.e. tetrapyrrole ring. Since an atom of iron is present, heme is a ferroprotoporphyrin. Four methyl, two vinyl and two propionate side chain groups are attached to the porphyrin ring. The iron is held in the center of porphyrin ring in ferrous form (Fe^{+2}). Iron has six coordinated bonds: (i) four bonds are formed between the iron and nitrogen atoms of the porphyrin ring system; (ii) fifth bond is formed between nitrogen atoms of histidine residue of globin chain, known as proximal histidine (His F8); (iii) sixth bond is formed with oxygen. The oxygenated form of hemoglobin is stabilized by the hydrogen bond between oxygen and side chain of another histidine residue of globin chain, known as distal histidine (His E7).

120. Which of the following is not used as vector in genetics ?

a) Adenovirus

b) Proteasome

c) Liposome

d) Retrovirus

Correct Answer - B

The traditional viral vectors are adenoviral vectors followed by papilloma viruses and retroviruses. *Retroviruses are the main and most commonly used viral vectors.*

Other cloning vectors for gene delivery are :-

- i. *Plasmid*
- i. *Bacteriophage*
- i. *Cosmid*
- i. *BAC (Bacterial artificial chromosome)*
- i. *YAC (Yeast artificial chromosome).*

Liposomes or lipoplexes are also used as vector for gene delivery.

121. Telomerase is ?

a) DNA dependant RNA polymerase

b) RNA dependant DNA polymerase

c) RNA dependant RNA polymerase

d) DNA dependant DNA polymerase

Correct Answer - B

Telomers and Telomerase

Telomers are short repeated sequences of DNA present at the end of eukaryotic chromosomes.

In normal cells, telomeres get shortened in each replicated cycle.

After the telomers get shortened by a critical length, cell stops dividing and enters into Go phase (senescence).

However, germ cells, cancer cells and stem cells have an enzyme telomerase (telomerase activity) which prevents telomer shortening. Thus telomers are not shortened in these cells, and therefore these cells have ability to self replicate extensively.

Telomerase is a reverse transcriptase (RNA dependent DNA polymerase) and is responsible for telomer synthesis and maintaining the length of telomers (replication of end of chromosome).

Thus, telomerase provide longetivity to the cells which contain this enzyme.

Telomerase is absent from most of the somatic cells and hence they suffer progressive loss of telomers and they exit the cell cycle.

122. Nucleosome core protein is made up of

a) DNA

b) RNA

c) Histones

d) None

Correct Answer - C

Nucleosomes

Nucleosomes are primary structural units of chromatin. It consists of DNA bound to protein histones, i.e. core of protein histones wrapped with DNA. Histones are basic proteins rich in lysine and arginine. These positively charged amino acids interact with negatively charged phosphate group of DNA. There are five types of histones, H1, H2A, H2B, H3 and H4. Two molecules of each H2A, H2B, H3 and H4 associate one another to form histone octamer. Around histone octamer a segment of the DNA helix is wound nearly twice forming nucleosome core. A nucleosome associated with histone H1 is called chromatosome.

A series of nucleosome (*"beads on a string"*) form a polynucleosome or chromatin. The DNA connecting two nucleosomes is called linker (or spacer) DNA. To linker DNA, *H1 histone* is attached to stabilize the complex. Non-histone proteins are also attached to linker DNA. These repeating units of nucleosomes, connected with linker DNA, form chromatin fiber.

123. Glycoproteins are ?

- a) Proteins to which glucose is attached
- b) Carbohydrate to which protein is attached
- c) Protein to which lipid and glucose is attached
- d) None of the above

Correct Answer - A

Glycoprotein are conjugated proteins. They consists of *protein to which short branched, oligosaccharides are covalently attached*. Proteoglycans *are carbohydrates to which small amount of protein is attached*. Proteoglycans consists of 95% of carbohydrate and 5. 5% of protein. To know the structure of proteoglycans, one should know the structure of glycosaminoglycans.

124. Selenocysteine is associated with ?

a) Carbonic anhydrase

b) Catalase

c) Deiodinase

d) Transferase

Correct Answer - C

- *Selenocysteine is considered as 21 standard amino acid.*
- *It is present at the active site of some enzymes that catalyze redox reactions, e.g. thioredoxin reductase, glutathione peroxidase, and the deiodinase (converts thyroxin to triiothyronine).*
- *Biosynthesis of selenocysteine requires cysteine, serine, ATP and a specific t-RNA*
- *Serine provides the carbon skeleton of selenocysteine.*
- *Selenocysteine has a structure similar to cysteine, but containing the trace element selenium in place of sulfur atom of cysteine*

125. Which vitamin is required for transfer of 1-carbon unit?

a) Vitamin A

b) Folic acid

c) Vitamin B₁₂

d) Niacin

Correct Answer - B

Folic acid [Ref Harper 29^{m/e} p. 537-539, Vasudevan et al p. 400-402]

- Groups, containing a single carbon atom are called one carbon groups. One carbon groups are formed from following amino acids during their metabolism:- *Serine, glycine, histidine and tryptophan*. One carbon groups formed during metabolism are: **methyl (C₁₁), methylene (CH₂), methenyl (CH), formyl (CHO) and formimino (CH=NH)**

These one carbon groups are transferred by way of tetrahydrofolate (THF), which is derivative of folic acid^o. One carbon groups carried by THF are attached either to nitrogen N⁵ or M^{C'} or to both N⁵ and N^{''}). Different one carbon derivatives of THF are- N⁵- methyl THF, N⁵, N^{''}-methylene THF, N⁵, N^{''}-methenyl THF, N⁵-formyl THF and N⁵-formimino THE These derivatives are interconvertable.

126. Fluoroacetate inhibits ?

a) Citrate synthetase

b) Aconitase

c) Succinate dehydrogenase

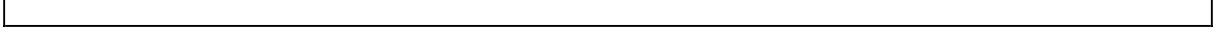
d) Alphaketoglutarate dehydrogenase

Correct Answer - B

Aconitase [Ref Harper 29th /e p. 164 & 28thVe p. 145]

In glycolysis

- Fluoride inhibits --> Enolase
 - Iodoacetate inhibits > Glyceroldehyde 3-phosphate dehydrogenase.
 - Arsenite inhibits —> Phosphoglycerate kinase
- In TCA cycle
- Fluoroacetate inhibits aconitase non-competitively.
 - Arsenite inhibits a-ketoglutarate dehydrogenase non-competitively.
 - Malonate inhibits succinate dehydrogenase competitively.
- During glycolysis 2 ATP are utilized and 4 ATP are produced at substrate level. 2 reducing equivalents NADH* are produced and reoxidized by electron transport chain, to generate 5 ATP molecules (2.5 ATP per NADH* molecule). Thus total 9 ATP molecules are produced and 2 are utilized, i.e., There is net gain of 7 ATP molecules in aerobic glycolysis.
 - In anaerobic conditions, the reoxidation of NADH by electron transport chain is prevented and NADH gets reoxidized by conversion of pyruvate to lactate by lactate dehydrogenase. Thus, in anaerobic glycolysis only 4 ATP are produced at substrate level. Therefore, there is net gain of 2 ATP molecules in anaerobic glycolysis.



127. Malonyl acetyl transferase has activity of how many enzymes?

a) 1

b) 2

c) 3

d) 4

Correct Answer - B

- Malonyl acetyl transferase (MAT) is a part of multienzyme complex : Fatty acid synthase.

It has two activities:?

- .. *Acetyl transferase or acetyl transacylase (E1)*
- .. *Malonyl transferase or malonyl transacylase (E2)*

128. Allosteric inhibitors of TCA cycle are all except?

a) ADP

b) ATP

c) NADH

d) Succinly CoA

Correct Answer - A

Regulation of TCA cycle

As the primary function of TCA cycle is to provide energy, respiratory control via the respiratory chain (ETC) and oxidative phosphorylation regulates citric acid cycle activity. Excess of ATP, NADH and succinyl-CoA which signals high energy status of the cell, inhibit TCA cycle. *ADP and NAD⁺ stimulate the cycle* as these signal low energy status. Regulation occurs at three allosteric enzymes by *allosteric modulation* :-

i) *Citrate synthase* :- It is inhibited by ATP, long-chain acyl-CoA, and succinyl CoA.

ii) *Isocitrate dehydrogenase* :- It is activated by ADP and is inhibited by ATP and NADH.

iii) *α -ketoglutarate dehydrogenase complex* :- It is inhibited by succinyl-CoA and NADH.

129. Frame shift mutation causes ?

a) Transversion

b) Transition

c) Termination of protein synthesis

d) Alteration of whole reading sequence

Correct Answer - D

Mutations

- A mutation is a *permanant change in the DNA*.
- Mutations that affect germ cells (sperm or ovum) are transmitted to progeny and may give rise to inherited disease.
- Mutations that affect somatic cells are not transmitted to progeny but are important in the genesis of cancers and congenital malformations.
- Mutations may be classified into three categories -
 1. Gene mutations
The vast majority of mutations associated with hereditary disease are gene mutations.
These may of different types depending whether it involves complete gene or single base -(a) *Point mutation*
- A single nucleotide base is substituted by a different base.
- When a pyrimidine base is substituted by other pyrimidine base or a purine base is substituted by other purine *Transition*.
- When a purine is substituted by a pyrimidine or vice-versa *Transversion*.
- This may alter the code in a triplet of bases, i.e. in codon and leads to replacement of one aminoacid by another in the gene product.
- Because these mutations alter the meaning of the genetic code, they

are often termed *missense mutation*.

- Example is *sickle mutation* in which CTC codon in 3-chain of hemoglobin that codes for glutamic acid is changed to CAC codon that codes for valine.
- Another type of point mutation is *nonsense mutation* in which a point mutation may change an amino acid codon to a stop codon.
- Example is 3-thalassemia in which CAG codon in 3-chain of hemoglobin that code for glutamin is changed to stop codon UAG after point mutation.

Deletion and insertions

- Deletion or insertion of one or two base lead to alterations in the reading frame of the DNA strand —> *frame shift mutation*.
- If the number of base pairs invoved is three or a multiple of three framshift does not occur (because codon is triplet), instead an abnormal protein missing one or more amino acids is synthesized.

(c) Trinucleotide repeat mutation

- Normally a codon is triplet ie trinucleotide.
- In this type of mutation a codon, ie trinucleotide sequence undergoes amplification and the same codon is repeated continuously so many times in the chain.
- For example in fragile X-syndrome, CGG codon is repeated 250-4000 times, ie. there are 250-4000 tandem repeater of CGG.

2.Chromosome mutation

- Result from rearrangement of genetic material that give rise to visible structural changes in the chromosome. 3.Genome mutation
- Involves loss or gain of whole chromosome, e.g. *monosomy* - Turner syndrome, *trisomy* - Down syndrome.

130. Carbamoyl phosphate synthase - 1 acts on ?

a) Ornithine

b) Carbamoyl phosphate

c) CO₂ & ammonia

d) Arginine

Correct Answer - C

CO₂ & Ammonia [*Ref Harper 29th ed p. 276-278*]

- CPS-I causes condensation of CO₂ and ammonia.
- Biosynthesis of urea occurs in five steps :
 - 1) Carbamoyl phosphate synthase-I (CPS-I), a mitochondrial enzyme, catalyzes the formation of carbamoyl phosphate by condensation of CO₂ and ammonia. Two molecules of ATP are required for the reaction. CPS-I is the rate limiting enzyme of urea cycle. It is an allosteric enzyme and allosterically activated by N-acetyl glutamate.
 - 2) Ornithine transcarbamoylase catalyzes the formation of citrulline from carbamoyl phosphate and ornithine.
 - 3) Argininosuccinate synthase catalyzes the formation of argininosuccinate from citrulline and aspartate. This reaction requires 1ATP, but 2 high energy phosphate bonds are consumed as ATP is converted to AMP + P_i. The amino group of aspartate provides one of the two nitrogen atoms that appear in urea (The other one is provided by ammonia NH₄).
 - 4) Argininosuccinate lyase (argininosuccinase) catalyses the cleavage of argininosuccinate into arginine and fumarate. Fumarate enters in TCA cycle.

5) 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.

131. Reaction occurring in conversion of norepinephrine to epinephrine?

a) Hydroxylation

b) Oxidation

c) Glucuronidation

d) Methylation

Correct Answer - D
Ans. D. Methylation

132. Salvage pathway of purine nucleotide synthesis are used by all except ?

a) Brain

b) Liver

c) RBC

d) Leukocytes

Correct Answer - B

Purine nucleotide synthesis occurs by two pathways :-

1. De novo synthesis

2. Salvage pathway

Liver is the major site of purine nucleotide biosynthesis (de novo).

Certain tissues cannot synthesize purine nucleotides by de novo pathway, e.g. *brain, erythrocytes and polymorphonuclear leukocytes*.

These are dependent on salvage pathway for synthesis of purine nucleotides by using exogenous purines, which are formed by degradation of purine nucleotides synthesized in liver.

133. Glutathion synthetase requires ?

a) Copper

b) Selenium

c) Magnesium

d) Iron

Correct Answer - C

Magnesium [*Ref Clinical biochemistry 9th le p. 786*]

Remember

Glutathione synthetase requires -- Magnesium*

Glutathione peroxidase contains -> Selenium

134. Defect in Snurps causes ?

- a) Defect in 5' - capping
- b) Defect in addition of poly-A tail
- c) Defect in Splicing
- d) Defect in terminal addition of nucleotide

Correct Answer - C

m-RNA processing

Prokaryotic mRNA is functional immediately upon synthesis, i.e. prokaryotic primary transcript of mRNA is functional. Thus it does not require post-transcriptional modification. In Eukaryotes the primary transcript of mRNA is the hn RNA (heterogeneous nuclear RNA). After transcription hnRNA is extensively modified to form functional mRNA. These modifications are as follows.

1) The 5'-capping :- This is the first *processing reaction*. 5¹-end of mRNA is capped with 7-methylguanosine. This cap helps in initiation of translation (protein synthesis) and stabilizes the structure of mRNA by protecting from 5'-exonuclease.

2) Addition of poly 'A' tail :- As the name suggests, multiple 'A' (adenylate) residues are added at 3'*end*. This poly-A tail is not transcribed from DNA, but rather added after transcription. These tails help to stabilize the mRNA (by protecting from 3'-exonuclease), facilitate exit from the nucleus, and aid in translation. After mRNA enters the cytosol, the poly-A tail is gradually shortened. *Some mRNAs do not have poly-A tail, e.g. mRNAs of histones and some interferons.*

3) 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. The coding sequences are called 'exons' and intervening non-coding sequences are called 'introns'. The process by which introns are excised and exons are linked to form functional mRNA is called *splicing*. Thus mature mRNA does not contain introns.

- Spliceosome Spliceosome is an assembly made up of small nuclear RNA (snRNA), some proteins and hnRNA. snRNA combines with proteins to form small nuclear ribonucleoprotein particles (snRNPs or snurps) that mediate splicing. It is snRNA component of snurps that catalyzes splicing. Snurps are U4, U5 and U6.
- Only about 1-5% of human DNA has coding sequence (exons). Remaining is non-coding (introns).

4) Alternate splicing :- The hn-RNA molecules from some genes can be spliced in alternative way in different tissues. Thus two or more different mRNA (and therefore 2 or more proteins) can be synthesized from same hnRNA. For example, difference isoforms of tropomyosin in different tissues in due to alternate splicing.

135. Defect in Snurps causes?

a) Sickle cell anemia

b) Thalassemia

c) Marfan syndrome

d) EDS

Correct Answer - B

Defective splicing (defect in snurps) is the most common mutation causing thalassemia.

- Molecular defect in pathogenesis of thalassemia:?
A) β -Thalassemia
- Most common type of genetic abnormality in β -thalassemia is *point mutation i.e., nonsense*.
- Some may also occur due to deletion or insertion i.e., frame shift mutations.
- Defect may occur at different steps of β -chain synthesis:
 - i) *Splicing mutations*
- Mutations leading to aberrant splicing are the most common cause of P-thalassemia.
 - ii) *Chain terminator mutations*
- This cause premature termination of mRNA *translation*.
- iii) *Promoter region mutations*
- This results in *transcription defect*.
- B) α -Thalassemia
- The most common cause of reduced a-chain synthesis is deletion of a-globin genes.
- Rarely nonsense mutation may also cause a-thalassemia.

136. ATP synthetase is a marker of ?

a) Golgi apparatus

b) Mitochondria

c) Cytosol

d) Endoplasmic reticular

Correct Answer - B
Ans. is 'b' i.e., Mitochondria

137. Carnitine is synthesised from ?

a) Methionine

b) Arginine

c) Histidine

d) Choline

Correct Answer - A

Carnitine is synthesized from amino acids *lysine and methionine*.

138. Number of ATP molecules formed in anaerobic glycolysis ?

a) 1

b) 2

c) 4

d) 8

Correct Answer - C

Two different questions can be framed :?

- *Number of ATP molecules produced in anaerobic glycolysis → 4*
- *Number of ATP molecules gained in aerobic glycolysis → 2*

139. Enzyme deficient in maple syrup urine disease?

a) α -ketoacid decarboxylase

b) Transaminase

c) Isomerase

d) Mutase

Correct Answer - A

Maple syrup urine disease (MSUD) or branched chain ketoaciduria

- It is an inborn error of metabolism of branched chain amino acids *valine*, *leucine* and *isoleucine*.
- It is due to deficiency of enzyme that catalyzes the second reaction in these amino acids metabolism i.e. **branched chain- α keto acid dehydrogenase** which catalyses decarboxylation of branched chain amino acids.
- As a result, the branched chain amino acids, leucine, isoleucine and valine, and their α -keto acids accumulate in blood, urine and CSF.
- There is characteristic maple syrup odor to the urine.
In maple syrup urine disease there is excretion of branched chain amino acids (*isoleucine*, *leucine*, *valine*) and their keto acids (α -keto β -methylvalerate, α -ketoisocaproate, α -ketoisovalerate) in urine.

140. According to IUB classification of enzyme, 4th digit in enzyme refers to ?

a) Main class

b) Subclass

c) Sub-subclass

d) Individual enzyme

Correct Answer - D

The classification of enzyme was described in 1961 by enzyme commission of the international Union of Biochemistry (IUB). According to this classification, each enzyme code number or 'EC' number, consisting of four digits:-

- The first digit indicates the main class; that characterizes the type of reaction they catalyzed.
- Second digit indicates the subclass. This indicates the type of group involved in the reaction.
- Third digit indicates the sub-subclass, which denotes the substrate on which enzyme acts.
- The fourth digit specifies the individual enzyme. It indicates the systematic serial number and name. For example, lactate dehydrogenase (LDH) : EC (1.1.1.27)
- The first number indicates that the enzyme is an oxidoreductase.
- Second number indicates that the enzyme acts on the **CH-OH** group which is the donor of hydrogen.
- The third number indicates that the acceptor is NAD.

141. Cholesteryl ester transfer protein transport cholesterol from HDL to ?

a) VLDL

b) IDL

c) LDL

d) Chylomicrons

Correct Answer - A

Cholesteryl ester is transferred from HDL to VLDL and chylomicrons in exchange with triglyceride by the *cholesteryl ester transfer protein (CETP)*.

142. Enzyme deficient in tyrosinemia type 1 ?

a) Phenylalanine hydroxylase

b) Tyrosinase

c) Fumarylacetoacetate hydroxylase

d) Tyrosine transaminase

Correct Answer - C

Tyrosinemia

It is a defect in metabolism of tyrosine. It may be of following types :-

1. *Tyrosinemia type-I (tyrosinosis/hepatorenal syndrome) :-* It is due to defect in *fumarylacetoacetate hydroxylase deficiency*. Patients with chronic tyrosinosis are prone to develop cirrhosis and hepatic carcinoma. There is cabbage like odor in acute tyrosinosis.
2. *Tyrosinemia type - II (Richer-Hanhart syndrome) :-* It is due to *deficiency of tyrosine transaminase (tyrosine aminotrans-ferase)*.
3. *Neonatal tyrosinemia :-* It is due to *deficiency of hydroxyphenyl pyruvate hydroxylase*.

143. Unaltered final product of TCA cycle ?

a) Oxaloacetate

b) Acetyl CoA

c) CO₂

d) Pyrovate

Correct Answer - A

TCA cycle consists of sequential reactions. It begins with condensation of four carbon oxaloacetate molecule with 2 carbon acetyl CoA molecule to form six carbon citrate molecule.

In subsequent reaction two carbon atoms are lost in the form of CO₂ at two different reactions.

A series of modifications occur in the remaining four carbon atoms to ultimately form oxaloacetate.

Thus the last substrate (oxaloacetate) of one cycle is ready for use as a substrate in the next cycle.

In this way, *there is no net generation of OAA, or of any of the cycle intermediates.*

144. In E. coli, Arthur Kornberg found which enzyme?

a) Fatty acid synthase

b) DNA polymerase

c) Topoisomerase

d) Glucose-6-phosphate dehydrogenase

Correct Answer - B

The identification and partial purification by Arthur Kornberg and his colleagues in 1956 of an enzyme - DNA polymerase I of Escherichia coli - that catalyzed the stable incorporation of deoxyribonucleotides into DNA in vitro came as a surprise.

145. Brain damage in phenylketonuria is due to accumulation of ?

a) Tyrosine

b) Phenylalanine

c) Tryptophan

d) None

Correct Answer - B

"The primary symptom of untreated phenylketonuria (i.e. mental retardation) is the result of consuming foods that contain phenylalanine, which is toxic to brain tissue"

Phenylketonuria

- It is an autosomal recessive disorder due to deficiency of phenylalanine hydroxylase.
- As a result phenylalanine is not metabolized by hydroxylase, and metabolism is shifted to alternative pathway and there is increased concentration of *phenylalanine, phenylpyruvate, phenylacetate and phenyl-lactate*.
- Because phenylalanine is not converted into tyrosine, *tyrosine becomes an essential amino acid*.
- *Classical phenylketonuria is due to deficiency of phenylalanine hydroxylase*. Milder form may be caused by deficiency of dihydrobiopterin reductase that produces tetrahydrobiopterin, a cofactor for phenylalanine hydroxylase.

Clinical presentation

- The babies are *normal at birth* but may present with vomiting. Gradually mental retardation and growth retardation develop. Baby has *light complexion with blue iris*. Other features are *microcephaly*,

rash, hypertonia, seizures, *exaggerated tendon reflex*, wide spaced teeth, *enamel hypoplasia* and hyperactivity.

- There is *musty or mousy odour of urine* and other body secretions due to presence of phenylketones.
- Pregnant females with increased phenylalanine (maternal phenylketonuria) may cause *mental retardation, microcephaly, growth retardation and CHDs in babies.*

146. Splicing is a process of ?

a) Activation of protein

b) Removal of introns

c) Synthesis of protein

d) Replication of DNA

Correct Answer - B

In molecular biology and genetics, splicing is a modification of an RNA after transcription, in which introns are removed and exons are joined.

This is needed for the typical eukaryotic messenger RNA before it can be used to produce a correct protein through translation.

For many eukaryotic introns, splicing is done in a series of reactions which are catalyzed by the *spliceosome* a complex of small nuclear ribonucleoproteins (*snRNAs*), but there are also self-splicing introns.

147. Which type of enzyme is Transaminase?

a) Xidoreductase

b) Isomerase

c) Ligases

d) Transferase

Correct Answer - D

Transferase- Amino transferase or transaminase, e.g., SGOT (AST) and SGPT (ALT), kinases (Hexokinase glucokinase, pyruvate kinase etc), Transketolases, transaldolases, transcarboxylases

148. Fructose 2-6 biphosphate (F26BP) regulates glycolysis at the level of ?

a) Glucose -6- phosphate

b) Fructose -6- phosphate

c) Glyceraldehyde -3- phosphate

d) Phosphoenol pyruvate

Correct Answer - B

Regulation of glycolysis

- 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 and glucokinase

- These enzymes catalyze the first step of glycolysis, i.e., Glucose → Glucose-6-phosphate. Glucokinase is found in liver, Whereas hexokinase is found in all tissues. Kinetic properties of these two are different.
- Hexokinase has low K_m , i.e., high affinity for glucose, low V_{max} , and is subjected to feedback inhibition by the reaction product, glucose-6-phosphate. *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. Hexokinase is not specific for glucose metabolism, it is also involved in metabolism of fructose and galactose.
- Glucokinase, on the other hand, is specific for glucose. It has high K_m (i.e., low affinity for glucose), high V_{max} and unlike hexokinase, it is not inhibited by glucose-6-phosphate. As it has low affinity for

glucose (high K_m), it comes into play only when intracellular glucose concentration is high. It is induced by feeding and insulin. Glucagon inhibits glucokinase.

- Function of hexokinase is to provide glucose-6-phosphate at a constant rate, according to the needs of cells, i.e., function of hexokinase is to provide constant glucose utilization by all tissues of the body even when blood sugar is low. Function of glucokinase in the liver is to remove glucose from blood after a meal, providing glucose-6-phosphate in excess of requirement for glycolysis so that it can be used for glycogen synthesis and lipogenesis.

Phosphofructokinase I

- Phosphofructokinase I is the major regulatory enzyme of glycolysis. It catalyzes the 3rd reaction of glycolysis, i.e., fructose-6-P → Fructose 1,6 bis-P. This reaction is irreversible and is the "rate-limiting step" for glycolysis. It is also the "committed step", meaning that once fructose 1,6 bisphosphate is formed it must go for the glycolytic pathway only. So, *most important control point for glycolysis is through regulation of phosphofructokinase I.*
- Phosphofructokinase - I is *allosterically activated by* : Fructose-6-phosphate, fructose 2,6-bisphosphate, 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.*
- *Fructose 2,6-bisphosphate (F-2,6-BP) is the most important allosteric modulator (activator) of phosphofructokinase-I.* Fructose 2,6-bisphosphate is synthesized as a side product of glycolysis. A *bifunctional enzyme named PFK-2/Fructose 2,6 bisphosphatase* is responsible for regulating the level of fructose 2,6 bisphosphate in the liver. Phosphofructokinase-2 (PFK-2) activity of this bifunctional enzyme is responsible for synthesis of F-2,6-BP from fructose-6-phosphate and fructose 2,6 bisphosphatase activity is responsible for hydrolysis of F-2,6-BP back to fructose-6-phosphate.

149. Inhibitor of FOF1 ATPase in Electron transport chain ?

a) Antimycin

b) Oligomycin

c) 2, 4 dinitrophenol

d) Barbiturate

Correct Answer - B

Oligomycin [*Ref Harper 29^m le p. 127*]

Inhibitors of oxidative phosphorylation

- These compounds directly inhibit phosphorylation of ADP to ATP.
- Oligomycin inhibits F_a component of F_oF_i ATPase.
- Atractiloside inhibits translocase, a transport protein that transports ADP into mitochondria for phosphorylation into ATP.

150. 1st Carbon to urea comes from ?

a) Succinyl CoA

b) Malonyl CoA

c) Acetyl CoA

d) CO₂

Correct Answer - D

Ans:D.)CO₂

UREA CYCLE

- Location: Cytosol and mitochondria of hepatocytes.
- Substrates: NH₃ (as derived from oxidative deamination of glutamate); **CO₂**; aspartate; three ATP.
- Products: Urea; fumarate; H₂O.
- Purpose: The urea cycle allows for the excretion of NH₄⁺ by transforming ammonia into urea, which is then excreted by the kidneys.
- Important enzymes:
 - Carbamoyl phosphate synthetase I: Converts ammonium and bicarbonate into carbamoyl phosphate. This is the rate-limiting step in the urea cycle. This reaction requires two ATP and occurs in the mitochondria.
 - Ornithine transcarbamoylase: Combines ornithine and carbamoyl phosphate to form citrulline. Located in mitochondria.
 - Argininosuccinate synthetase: Condenses citrulline with aspartate to form argininosuccinate. This reaction occurs in the cytosol and requires one ATP.
 - Argininosuccinate lyase: Splits argininosuccinate into arginine and fumarate. Occurs in the cytosol.

- Arginase: Cleaves arginine into one molecule of urea and ornithine in the cytosol. The ornithine is then transported back into the mitochondria for entry back into the cycle.
 - Regulation: Carbamoyl phosphate synthetase I catalyzes the rate-limiting step of the cycle and is stimulated by N -acetylglutamate.
 - Diseases: Hyperammonemia occurs when there is a deficiency in one of more of the urea cycle enzymes, causing insufficient removal of NH_4^+ .
- Ammonia intoxication leads to CNS deterioration in the form of mental retardation, seizure, coma, and death.

151. Energy storage form in liver ?

a) Triglyceride

b) Cholesterol

c) FFA

d) Glycogen

Correct Answer - D

Provider of energy	Grams	Kilocalories
Plasma glucose	12	48
Hepatic glycogen	70	280
Muscle glycogen	280	1120
Fat (Triglyceride) in adipose tissue	13,000	117,000
Muscle protein	10,000	40,000

152. Total ATP generated by oxidation of stearic acid is

a) 114

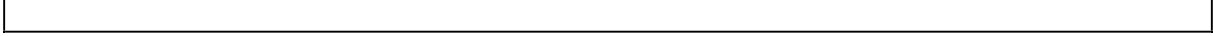
b) 131

c) 148

d) None

Correct Answer - C

<i>Fatty acid</i>	Cycles in 0-oxidation	Source of ATP	Total ATPs (recent calculations)	Total ATPs (older calculations)
Myristic acid (14-C)	6 Cycles	7 acetyl CoA 6 FADH NA	$(7 \times 10) + (6 \times 1.5) + (6 \times 2.5) = 94$ ATPs	$(7 \times 12) + (6 \times 2) - 1 - (6 \times 3) = 114$ ATPs
Palmitic acid (16-C)	7 Cycles	8 acetyl CoA, 7 FADH, 6 NADH	<u>108 ATPs</u> (Net gain = $108 - 2 = 106$ ATPs)	$(6, 12) + (7 \times 2) - 131$ ATPs (Net gain = $131 - 2 = 129$ ATPs)
Stearic acid (18-C)	8 Cycles	9 acetyl 8 FADH ₂ , 8 NADH	$(9 \times 10) + (8 \times 1.5) + (8 \times 2.5) = 122$ ATPs (Net gain = $122 - 2 = 120$ ATPs)	$(9 \times 12) + (8 \times 3) = 148$ ATPs (Net gain = $148 - 2 = 146$ ATPs)



153. Transamination reaction requires which vitamin?

a) Thiamine

b) Pyridoxin

c) Riboflavin

d) Pantothenic acid

Correct Answer - B

Pyridoxal phosphate (active form of vitamin B₆) is the coenzyme for transamination reactions.

154. Action of topoisomerase III ?

a) Remove positive supercoil

b) Remove negative supercoil

c) Form negative supercoil

d) Single strand break

Correct Answer - D

Ans. is 'd' i.e., Single strand break

- *Topoisomerase I* 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 by adjacent chromosome.
- *Topoisomerase IV* Acts to disentangle the replicated intertwined DNA strands by making double-strand breaks that allow one duplex to pass through the other.

155. Function of mitochondrial DNA ?

- a) Encodes proteins of cell membrane
- b) Encodes proteins of respiratory chain
- c) Helps in cell replication
- d) Formation of rRNA

Correct Answer - B

Human mitochondria contain two to ten copies of a small circular double-stranded DNA molecule that makes up approximately 1% of total cellular DNA.

The majority of the peptides in mitochondria (about 54 out of 67) are coded by nuclear genes.

The rest are coded by genes found in mitochondrial (mt) DNA

This mtDNA codes for mt ribosomal and transfer RNAs and for 13 proteins that play key roles in the respiratory chain.

156. Creatinine is formed from -

a) Glycine

b) Lysine

c) Leucine

d) Histamine

Correct Answer - A

Creatinine and creatine are synthesized from glycine, arginine and methionine.

Synthesis of creatine and creatinine

Creatine and creatinine are not amino acids, but specialized products of amino acids. Creatine is synthesized from glycine, arginine and methionine. Synthesis start with formation of guanidoacetate from glycine and arginine in kidney. Further reactions takes place in liver and muscle.

157. Rapid method of chromosome identification in interphase is -

a) FISH

b) PCR

c) SSCP

d) Karyotyping

Correct Answer - A

FISH is a cytogenetic technique that can be used to detect the presence or absence of specific DNA sequences (specific gene locus) on chromosomes.

It uses fluorescent probes that bind to only those parts of the chromosome with which they show a high degree of sequence similarity.

Fluorescence microscopy can then be used to find out where the fluorescent probe bound to the chromosome.

FISH can be used for rapid identification of chromosome during interphase.

FISH can be used in metaphase cells to detect specific *microdeletions* beyond the resolution of routine cytogenetics or identify extra material of unknown origin.

It can also help in cases where it is difficult to determine from routine cytogenetics if a chromosome has a simple deletion or is involved in a subtle or complex rearrangement.

In addition, metaphase FISH can detect some of the specific chromosome rearrangements seen in certain cancers.

158. Sequence of amino acid in collagen ?

a) Ala-X-Y

b) Lys-X-Y

c) Gly-X-Y

d) His-X-Y

Correct Answer - C

- In order to form a triple-helix, a polypeptide chain (α-chain) must contain *glycine as every third residue* in the sequence.
- This is because only the glycine is small enough to be accommodated in the limited space available down the central core of the triple helix.
- *Each turn of polypeptide chain (α-chain) contains three amino acid residues, and glycine (Gly) is present at every third position.*
- Thus glycine constitutes 33% of the total amino acid residues.
- The repeating amino acid residues, represented as (Gly-X-Y)_n, is an absolute requirement for formation of triple helix.
- X and Y can be any amino acids, but most of the time X is *proline (10% of the total amino acid residues)* and most of the time Y is *hydroxyproline*.
- Other important amino acids found in collagen are *lysine* and *hydroxylysine*.

159. Reduction potential of potassium ?

a) -2.93

b) -0.44

c) -0.34

d) +0.54

Correct Answer - A

160. McArdle's disease is due to deficiency of ?

a) Branching enzyme

b) Glucose 6 phosphatase

c) Acid maltase deficiency

d) Muscle phosphorylase

Correct Answer - D

Muscle phosphorylase [*Ref Harper 25⁰/e p. 181*]

Type		Enzyme deficiency	Organ (s) affected
	von Gierke's disease	Glucose 6-phosphatase	Liver, kidney
II	Pompe's disease	a (1 4) Glucosidase	All organs
	Cori's disease/Forbe's disease		
III	Andersen's disease	Debranching enzyme	Muscle, liver
IV	McArdle's disease	Branching enzyme	Liver, myocardium
V	Hers' disease	Phosphorylase	Muscle
VI	Tarui's disease	Phosphorylase	Liver
VII		Phosphofructokinase	Muscle, RBCs
VIII		Phosphorylase kinase	Liver

- There is also on X-linked form of phosphorylase kinase deficiency.

This is sole exception as all other glycogen storage diseases are inherited as autosomal recessive trait.

161. Which complex in mitochondrial ETC does not pump out H ions ?

a) Complex I

b) Complex II

c) Complex III

d) Complex IV

Correct Answer - B

Complex II [Ref Harper 29th/e p. 126, 128]

- Complex II does not act as proton (H⁺) pump.

Complex I: NADH CoQ-reductase Permit ATP formation (Site I) Act as proton pump

Complex II: Succinate Co() reductase No ATP form

Complex III: CoQ - cytochrome - C reductase Permit ATP formation (Site II) Act as proton pump

Complex IV: Cytochrome C oxidase Permit ATP formation (Site III) Act as proton pump

162. Molecular size of protein is determined by?

a) Sedimentation

b) SDS-PAGE

c) Salting out

d) Liophilization

Correct Answer - B

The molecular size of protein is estimated usually by SDS-PAGE. Other common methods are mass spectroscopy and MALDI.

163. Protein separation based on molecular size ?

a) HPLC

b) Gel filtration chromatography

c) Salting out

d) Affinity chromatography

Correct Answer - B

Protein solubility

Salting out' or salt extraction

(precipitation of protein by ammonium sulfate)

Molecular size

• **Gel filtration**

chromatography (molecular-sieve chromatography or size exclusion chromatography)

- Ultracentrifugation
- SDS-PAGE (Sodium dodecyl sulphate-polyacrylamide gel electrophoresis)
- Dialysis
- Molecular charge (Ionic charge) • Ion exchange chromatography
- High performance liquid chromatography (HPLC)
- Electrophoresis (simple on cellulose acetate starch gel)
- Isoelectric focusing (a variant of electrophoresis)
- Molecular charge and molecular weight PAGE : polyacrylamide gel electrophoresis

Affinity binding

Affinity chromatography

Hydrophobicity

Hydrophobic interaction chromatography

164. Chargaff's rule state that, in DNA ?

a) Purines to pyrimidines ratio is 2

b) $A+T=G+C$

c) Purines = Pyrimidines

d) All of the above

Correct Answer - C

[Ref : Harper 29th/e p. 344 & 28th/e p. 302; Essentials of biochemistry p. 915]

- Chargaff's rule states that in DNA of all species quantities of purines is the same as that of pyrimidines, i.e. $A+G = T+C$. In other words, *ratio of purines to pyrimidines is one, i.e. $\frac{A+G}{T+C} = 1$*
- This is because one member of a base pair in a DNA must always be a purine and the other a pyrimidine.
- This base pairing restriction explains that in a double stranded DNA molecule, *the content of adenine equals that of thymine ($A=T$) and the content of guanine equals that of cytosine ($G=C$).* Therefore $A=C$ or $A=C$ = $T=G$

165. Carbamoyl phosphate synthase - 1 is stimulated by ?

a) ATP

b) Arginosuccinate

c) Carbamoyl phosphate

d) N-acetyl glutamate

Correct Answer - D

Carbamoyl phosphate synthase-I (CPS-I), a *mitochondrial* enzyme, catalyzes the formation of carbamoyl phosphate by condensation of CO₂ and ammonia.

Two molecules of ATP are required for the reaction. *CPS-I is the rate limiting enzyme of urea cycle.*

It is an allosteric enzyme and allosterically activated by N-acetyl glutamate.

166. Fructose uptake in small intestine is via ?

a) GLUT - 1

b) GLUT - 2

c) GLUT - 4

d) GLUT - 5

Correct Answer - D

- Fructose is absorbed by facilitated diffusion by GLUT-5.

167. Which vitamin is associated with glycogen phosphorylase?

a) Pyridoxin

b) Niacin

c) Riboflavin

d) Thiamine

Correct Answer - A

Pyridoxin [*Ref Dinesh puri p. 187; Harper 29thle p. 180 & 27th/e p. 159-160*]

Pyridoxal phosphate is an essential cofactor for glycogen phosphorylase

168. Which of the following is/are the application/s of FISH?

a) Gene mapping

b) Study of 3D chromosome organization in interphase nuclei

c) Monitoring the success of bone marrow transplantation

d) All the above

Correct Answer - D

Diagnostic

- The identification of specific chromosome abnormalities
- The characterization of marker chromosomes
- Interphase FISH for specific abnormalities in cases of failed cytogenetics
- Monitoring disease progression
- Monitoring the success of bone marrow transplantation

Research

- The identification of new non-random abnormalities (by M-FISH or SKY)
- Gene mapping
- Identification of regions of amplification or deletion by CGH
- The identification of translocation breakpoints
- The study of 3D chromosome organization in interphase nuclei

169. Most commonly used vector for DNA cloning ?

a) Plasmid

b) Virus

c) Cosmid

d) Phage

Correct Answer - A

A cloning vector is a carrier DNA molecule to which human DNA fragment is attached. Normally, foreign DNA fragments cannot self-replicate within host cell. Therefore, they are joined to a vector DNA, that can replicate within host cell.

The five major types of cloning vectors used are -

- i) Plasmids
- ii) Viral vectors/Bacteriophages
- iii) Cosmids
- iv) Bacterial Artificial Chromosomes (BACs)
- v) Yeast artificial chromosomes (YACs)

170. Most powerful cloning vector ?

a) Plasmid

b) Virus

c) Cosmid

d) Phage

Correct Answer - C

Most powerful cloning vector is cosmid as largest DNA can be incorporated in cosmid.

Overall, most powerful cloning vector is YAC (Yeast artificial chromosome).

171. Action of metalloproteinase ?

a) Degradation of collagen

b) Polymerization of collagen

c) Oxidation of collagen

d) Stimulation of collagen

Correct Answer - A

Ans. is 'a' i.e., Degradation of collagen

- Degradation of collagen and other ECM (extracellular matrix) proteins is achieved by matrix metalloproteinases (MMPs).
- MMPs is a family of enzymes that have in common a 180-residue zinc protease domain.

Matrix metalloproteinases include :-

- Interstitial collagenase (MMP-1, 2, and 3) : Cleave the fibrillar collagen types I, II and III.
- Gelatinases (MMP-2 and 9) : Degrade amorphous collagen and fibronectin.
- Stromelysins (MMP-3, 10 and 11) : Act on proteoglycans, laminin, fibronectin and amorphous collagen.
- Membrane-bound MMPs (ADAMs) : Cleave membrane-bound precursor forms of TNF and TGF- α , releasing the active molecule.

172. Endogenous triglycerides in plasma are maximally carried in -

a) VLDL

b) Chylomicrons

c) LDL

d) HDL

Correct Answer - A

Ans. is 'a' i.e., VLDL

vLDL [Ref Harper 29Th/e p. 238 & 28th /e p. 213; Dinesh puri 3^{'e} p. 237]

- Maximum triglyceride content - Chylomicrons
- Maximum exogenous triglyceride - Chylomicrons
- Maximum endogenous triglyceride - VLDL
- Maximum cholesterol content - LDL

173. Oxidative deamination is catalyzed by ?

a) Glutaminase

b) Glutamine synthase

c) Glutamate dehydrogenase

d) None of the above

Correct Answer - C

Ans. is 'c' i.e., Glutamate dehydrogenase

174. Copper containing enzyme is ?

a) Cytochrome oxidase

b) Catalase

c) LDH

d) None

Correct Answer - A

Ans. is 'a' i.e., Cytochrome oxidase

- Copper containing enzymes are *cytochrome oxidase*, tyrosinase, lysyl oxidase, ferroxidase (ceruloplasmin), Ascorbic acid oxidase, and superoxide dismutase.

175. True about gluconeogenesis ?

a) Occurs mainly in muscle

b) It is reverse of glycolysis

c) Alanine & lactate both can serve as substrate

d) Glycerol is not a substrate

Correct Answer - C

Ans. is 'c' i.e., Alanine & lactate both can serve as substrate

- Synthesis of glucose from noncarbohydrate precursors is called gluconeogenesis i.e., synthesis of new glucose.
- The major noncarbohydrate precursors (substrate) for gluconeogenesis are lactate, pyruvate, glycerol, glucogenic amino acids, propionate and intermediates of the citric acid cycle.
- All amino acids, except for leucine and lysine, are substrate for gluconeogenesis.
- Alanine is the most important gluconeogenic amino acid.
- Gluconeogenesis occurs mainly in the liver and to a lesser extent in renal cortex.
- Some gluconeogenesis can also occur in small intestine, but it is not significant.
- Some of the reactions of gluconeogenesis occurs in the mitochondria but most occur in cytosol.
- Gluconeogenesis involves glycolysis, the citric acid cycle plus some special reactions.
- Glycolysis and gluconeogenesis share the same pathway but in opposite direction.
- Seven reactions of glycolysis are reversible and therefore are used with same enzyme in the synthesis of glucose by gluconeogenesis.
- However, three of the reactions of glycolysis are irreversible and

must be circumvented by four special reactions which are unique to gluconeogenesis and catalyzed by : (1) Pyruvate carboxylase, (ii) Phosphoenolpyruvate carboxykinase, (iii) Fructose-1,6-bisphosphatase, (iv) Glucose-6-phosphatase.

- These four enzymes are the key enzymes of gluconeogenesis (or gluconeogenesis enzymes).
- Among these four, pyruvate carboxylase is a mitochondrial enzyme and other three are cytoplasmic enzymes.

176. Which of the following is high energy compound?

a) ADP

b) Glucose-6-phosphate

c) Creatine phosphate

d) Fructose-6-phosphate

Correct Answer - C

Ans. is 'c' i.e., Creatine phosphate

High energy compounds

- The energy released during oxidation of monosaccharides, fatty acids and amino acids may not be required immediately. Therefore, there must be some way of storing energy. The energy released during catabolism is captured in the form of a group of compounds known as "high-energy phosphates". The most important member of this group is ATP.
- A compound that liberates 7 Kcal/mol or more on hydrolysis is called high energy compound, or a compound that on hydrolysis undergoes a large (7 kcal/mol) decrease in free energy (ΔG) under standard condition is called high energy compound, i.e., $\Delta G < -7$ Kcal/mol. For example, ATP liberates 7.3 Kcal/mol on hydrolysis. High energy compounds are : ?
- Phosphate compounds : Nucleotides (ATP, GTP, UTP, UDP-glucose), Creatinine phosphate, arginine phosphate, 1,3-bisphosphoglycerate, Phosphoenol pyruvate, inorganic pyrophosphate, Carbamoyl phosphate^e, amino acyl adenylate (amino acyl AMP).
- Sulfur compounds : - CoA derivatives (acetyl CoA^e, Succinyl CoA,

fatty acyl CoA, HMG CoA), S-adenosyl methionine (SAM), adenosine phosphosulfate.

- A compound which liberates < 7 Kcal/mol on hydrolysis is called low energy compound, i.e., a decrease in free energy is < 7 Kcal/mol, i.e., $\Delta G < -7$ Kcal/mol. Low energy compounds are glucose- 1-phosphate, fructose-6phosphate, glucose-6-phosphate, glycerol-3-phosphate, AMP, ADPQ.

177. Serotonin is derived from -

a) Tyrosine

b) Tryptophan

c) Phenylalanine

d) Methionine

Correct Answer - B

Ans. is 'b' i.e., Tryptophan

[Ref Harper 29th e p. 300]

- Tryptophan is a precursor for synthesis of niacin (nicotinic acid), serotonin and melatonin.

178. Substrate level phosphorylation is seen in reaction catalyzed by which enzyme of citric acid cycle?

a) Pyruvate kinase

b) Succinate thiokinase

c) Phosphoglycerate kinase

d) All of the above

Correct Answer - B
Ans. is 'b' i.e., Succinate thiokinase

179. Which of the following is the major proteoglycan of synovial fluid ?

a) Chondroitin sulfate

b) Dermatan sulfate

c) Heparan sulfate

d) Hyaluronic acid

Correct Answer - D

Ans. is 'd' i.e., Hyaluronic acid

	Distribution
Hyaluronic acid	Synovial fluid (provides viscosity), vitreous humor, loose connective tissue)
Chondroitin sulfate	Cartilage, bone, tendon, ligament, cornea
Dermatan sulfate	Pliability of skin, and heart valves, wide distribution
Keratan sulfate	Horny structures like hair, nails, claws, horn, hoofs Also present in cornea
Heparin	Mast cells
Heparan sulfate	Skin fibroblast, aortic wall

180. True regarding collagen synthesis is all except ?

a) Synthesized in ribosomes as procollagen

b) Hydroxylation of proline occurs in Golgi apparatus

c) Hydroxylation of lysine occurs in ER

d) Triple helix assembly occurs in ER

Correct Answer - B

Ans. is 'b' i.e., Hydroxylation of proline occurs in Golgi apparatus

181. Physiological uncoupler is ?

a) Thyroxine

b) Free fatty acids

c) Thermogenin

d) All of the above

Correct Answer - D

Ans. is 'd' i.e., All of the above

182. Magnesium is not involved in ?

a) Cellular oxidation

b) Membrane transport

c) Increased neuromuscular excitability

d) Glucose tolerance

Correct Answer - C

Ans. is 'c' i.e., Increased neuromuscular excitability

Biochemical functions of magnesium

- o Important function of magnesium are :?

1. Enzyme activation

- Magnesium activates a number of enzymes, particularly in which ATP-Mg²⁺ is a substrate, i.e. phosphate transferring enzymes.
- The enzymes needing magnesium are involved in intermediary metabolism, transcellular ion transport, muscle contraction and oxidative phosphorylation.
- Important examples of such enzymes are hexokinase, phosphofructokinase, pyruvate kinase, Glucose-6- phosphatase, enolase, creatine kinase, other phosphatases and kinases, adenylate cyclase, glutamine synthase, thiokinase, squalene synthase etc.

2. Neuromuscular excitability

- Neuromuscular excitability is *decreased by magnesium*, therefore, a decrease in magnesium level results in increased nerve excitability.

3. Other

- Magnesium *improves glucose tolerance, probably by enhancing insulin dependent glucose uptake.*
- Magnesium is a constituent of bone & teeth.
- Magnesium binds to other nucleoside phosphates and nucleic acids

and is required for DNA replication, transcription and translation.

- The DNA helix is stabilized by binding of histones and magnesium to the exposed phosphate groups.

183. Hereditary orotic aciduria Type-I is due to deficiency of ?

a) Orotate phosphoribosyl transferase

b) Orotic acid decarboxylase

c) UMP synthase

d) All of the above

Correct Answer - D

Ans. is 'd' i.e., All of the above

- Orotic aciduria is a hereditary disorder which can result from a defective enzyme in pyrimidine synthesis.
- There is a defect in the multifunctional enzyme UMP synthase which has two activities :?
 1. Orotate phosphoribosyl transferase
 2. Orotic acid decarboxylase (orotidylate decarboxylase)
- UMP synthase converts orotic acid to UMP. Thus, in defect of UMP synthase orotic acid can not be converted to UMP and is excreted in urine → orotic aciduria.
- There are two types of orotic aciduria.
 1. Type I :- There is deficiency of both the components of UMP synthase, i.e. orotate phosphoribosyl transferase and orotidylate decarboxylase.
 2. Type II :- There is deficiency of only orotidylate decarboxylase.

184. Carbamoyl phosphate synthase I is used in ?

a) Purine synthesis

b) Pyrimidine synthesis

c) Urea cycle

d) Uronic acid pathway

Correct Answer - C

Ans. is 'c' i.e., Urea cycle

- Carbamoyl phosphate synthase I Urea cycle
- Carbamoyl phosphate synthase II → Pyrimidine synthesis

185. Amino acid with aliphatic side chain ?

a) Serine

b) Leucine

c) Threonine

d) Aspartate

Correct Answer - B

Ans. is 'b' i.e., Leucine

- Based on chemical structure of side chain, amino acids are classified into ?
 1. Aliphatic amino acids : - Alanine, glycine, isoleucine, leucine, valine.
 2. Hydroxy amino acids : - Serine, threonine, tyrosine.
 3. Sulfur containing amino acids : - Cysteine, methionine.
 4. Dicarboxylic amino acids : - Aspartic acid (aspartate), glutamic acid (glutamate).
 5. Amide containing amino acids : - Glutamine, asparagine (these are amides of dicarboxylic amino acids. Glutamine is amide of glutamic acid and asparagine is amide of aspartic acid).
 6. Aromatic amino acids : - Phenylalanine, tyrosine, tryptophan.
 7. Imino acids or heterocyclic amino acids : - One of the 20 amino acids, proline is an imino (-NH) acid not an amino (-NH₂) acid, as are other 19.

186. Which of the following is an ionophore -

a) Carboxin

b) 2, 4 dinitrophenol

c) Atractiloside

d) Valinomycin

Correct Answer - D

Ans. is 'd' i.e., Valinomycin

Ionophores

- Ionophores are *ion carrier molecules*. These are lipid soluble (lipophilic) compounds that increase the permeability of lipid bilayers to certain ions. These are two types of ionophores.
- .. Mobile ion carriers : - These molecules are capable by binding and carrying specific cations (other than *Fr*) through mitochondrial membrane. Oxidative phosphorylation can be prevented by certain ionophores, e.g., Valinomycin. They differ from uncouplers in that they promote the transport of *cations* other than H^+ through the membrane and abolish the membrane potential and proton gradient (pH gradient) across the membrane and phosphorylation is therefore completely inhibited, i.e., ATP synthesis is inhibited.
- 2. Acetaldehyde dehydrogenase dehydrogenase "
v:shapes="_x0000_s1028">*Channel formers* : - These ionophores form the channels allowing ions to pass through, e.g., *gramicidine*, *nigricine*.

187. Glucose transporter present in the RBC-

a) a) GLUT 1

b) b) GLUT 2

c) c) GLUT 3

d) d) GLUT 4

Correct Answer - A
Highest level of GLUT 1 is present in RBC.

188. True about transamination reaction are all except-

a) Transfer of alpha amino group from alpha amino acid to keto acid

b) Alpha ketoglutarate is the most common receptor

c) Threonine does not undergo transamination

d) Biotin is required as a coenzyme.

Correct Answer - D

Pyridoxial phosphate is a coenzyme in transamination reaction.

189. Orotic aciduria like picture can be produced by deficiency of -

a) Vitamin B12

b) Essential fatty acids

c) Riboflavin

d) None of the above

Correct Answer - A

Deficiency of folate or vitamin B12 can cause hematological changes similar to hereditary orotic aciduria"

190. Which of the following is not the source of cytosolic NADPH ?

a) Isocitrate dehydrogenase

b) ATP citrate lyase

c) Malic enzyme

d) G6PD

Correct Answer - B

Answer. B. ATP citrate lyase

- NADPH is a cofactor used in anabolic reactions, such as lipid and nucleic acid synthesis, which require NADPH as a reducing agent.
- The major source of NADPH in animals and other non-photosynthetic organisms is the pentose phosphate pathway.
- The key enzymes in these processes are: NADP-linked malic enzyme, NADP-linked isocitrate dehydrogenase, NADP-linked glutamate dehydrogenase and nicotinamide nucleotide transhydrogenase.

191. Which enzyme joins two substrates?

a) Lyase

b) Ligase

c) Isomerase

d) Synthase

Correct Answer - B

Ans. is 'b' i.e., Ligase

[Ref Chatterjea 8thie p. 123-124]

- An enzyme which joins two substrates in an energy dependent process is called ligase.
- Ligases ligate or bind two compounds together by creating a new chemical bond. A source of energy is required, usually ATP, Example are synthatases, carboxylases.

192. Trypsin, Chymotrypsin & Elastases - What type of enzymes are they?

a) Hydrolases

b) Lyases

c) Synthases

d) Synthetases

Correct Answer - A

Ans. is 'a' i.e., Hydrolases

- All digestive enzymes (trypsin, pepsin, elastase, chymotrypsin) are hydrolases.

193. True about allosteric enzyme?

a) Single unit enzyme

b) Follows saturation kinetics

c) Allosteric activity is more prominent in the active site of the enzyme

d) Hill's equation is used to study the kinetics of allosteric enzyme

Correct Answer - D

Ans. is 'd' i.e., Hill's equation is used to study the kinetics of allosteric enzyme

- Allosteric enzyme is an enzyme in which activity in one subunit affects activity in another subunit. Hence allosteric enzymes are mostly multi subunit enzymes.
- Most commonly, in an allosteric enzyme, binding of an allosteric regulator to an allosteric site, affects activity in the active site of an enzyme.

194. Which of the following aminoacids is a component of Thioredoxin reductase?

a) Selenocysteine

b) Cysteine

c) Methionine

d) Homocysteine

Correct Answer - A

Ans. is 'a' i.e., Selenocysteine [*Ref Dinesh purl 22nd/e p. 72*]

- Selenocysteine is present at the active site of some enzymes that catalyze redox reactions, e.g. thioredoxin reductase, glutathione peroxidase, and the deiodinase (converts thyroxin to triiothyronine).

195. Co enzyme for dopa decarboxylase?

a) Biotin

b) Vitamin B6

c) Vitamin C

d) B12

Correct Answer - B

Ans. is 'b' i.e., Vitamin B6

All decarboxylases require pyridoxin (vitamin B6)

196. Example of metallo enzyme is ?

a) Lysyl oxidase

b) Lysyl hydroxylase

c) Prolyl hydroxylase

d) Glucosyl transferase

Correct Answer - A

Ans. is 'a' i.e., Lysyl oxidase

[Ref Harper 30th p. 675]

Lysyl oxidase is a metalloenzyme (copper containing

197. True about transfer of electrons in electron transport chain is ?

- a) All the complexes are arranged in an increasing order of redox potential
- b) The direction of transport of electrons in C - Complex III Q - Complex I -> Complex IV
- c) All the complexes are arranged in an increasing order of energy
- d) 10 hydrogen ions get translocated when FADH₂ electrons get into electron transport chain

Correct Answer - A

Ans. is 'a' i.e., All the complexes are arranged in an increasing order of redox potential.

- The complexes of electron transport chain are arranged in an increasing order of redox potential or decreasing order of energy level.
- The direction of transport of electrons from NADH is Complex I -> Q -> Complex III -> Complex C -> Complex IV -> Oxygen.
- The direction of transport of electrons from FADH₂ is Complex II -> Q -> Complex III -> Complex C -> Complex IV -> Oxygen.

198. GLUT 4 is present in ?

a) Endothelium

b) Liver

c) Cardiac muscle

d) Lens

Correct Answer - C

Ans. is 'c' i.e., Cardiac muscle

- GLUT4 transporters mediate insulin dependent glucose uptake in skeletal muscle, cardiac muscle and adipose tissue.

199. Inulin is a homopolymer of ?

a) Fructose

b) Glucose

c) Mannose

d) Galactose

Correct Answer - A

Ans. is 'a' i.e., Fructose

- Inulin is a homopolymer made up of fructose.

200. True about carbohydrate absorption?

a) Glucose absorption occurs independent of sodium

b) Fructose absorption occurs dependent on Na

c) Fructose absorption occurs via SGLT 1

d) Fructose absorption is not by secondary active transport

Correct Answer - D

Ans. is 'd' i.e., Fructose absorption is not by secondary active transport

Glucose absorption

- Fructose absorption along the apical side is by GLUT 5 transporter.
- GLUT 5 transporter is an example of facilitated passive diffusion
- Fructose absorption along the basolateral side is by GLUT 5 transporter or through GLUT 2 transporter
- Thus Fructose absorption along both apical side and basolateral side is by facilitated passive diffusion.

201. In Citric acid cycle, which enzyme is inhibited by arsenite?

a) Isocitrate Dehydrogenase

b) a ketoglutarate Dehydrogenase

c) Succinate Dehydrogenase

d) Aconitase

Correct Answer - B

Ans. is 'b' i.e., a ketoglutarate Dehydrogenase

- Arsenite binds to the sulfhydryl group and hence inhibits the activity of enzymes which have lipoamide in the active site, Hence Arsenite inhibits Pyruvate Dehydrogenase and a ketoglutarate dehydrogenase of citric acid cycle, It is an example for non competitive inhibition, Succinate dehydrogenase is inhibited by malonate.

202. Maximum number of enzymes of krebs cycle are found in ?

a) Mitochondrial matrix

b) Intermembrane space

c) Cytosol

d) Ribosome

Correct Answer - A

Ans. is 'a' i.e., Mitochondrial matrix

- Kreb's cycle or citric acid cycle happens in mitochondria. All enzymes of citric acid cycle are present in mitochondrial matrix.

203. Overingestion of fructose leads to ?

a) Hypertriglycreidemia

b) Hypouricemia

c) Hyperphosphatemia

d) Hypoglycemia

Correct Answer - A

Ans. is 'a' i.e.,Hypertriglycreidemia

- As Fructokinase is very active, following fructose ingestion, there is increased utilization of ATP forming more ADP and AMP. AMP on catabolism gives rise to uric acid. Hence it results in hyperuricemia.
- A person who is on fructose based diet ends up getting hypertriglyceridemia and hypercholesterolemia.

204. What are the enzymes required for the formation of Phosphoenolpyruvate from Pyruvate?

a) Pyruvate dehydrogenase and Pyruvate carboxylase

b) Lactate Dehydrogenase and Pyruvate Dehydrogenase

c) Pyruvate carboxylase and Phosphoenolpyruvate Carboxykinase

d) Phosphoenolpyruvate carboxykinase and Pyruvate Dehydrogenase

Correct Answer - C

Ans. is 'c' i.e., Pyruvate carboxylase and Phosphoenolpyruvate Carboxykinase

- Pyruvate conversion to Phosphoenol pyruvate is a part of gluconeogenesis, Pyruvate is converted to Oxaloacetate by Pyruvate Carboxylase, Pyruvate Carboxylase requires Biotin as coenzyme. It uses Carbondioxide in the form of Bicarbonate. It uses ATP as a source of energy.

205. Maximum number of energy rich phosphate is formed from which of the following pathways?

a) Glycolysis

b) Gluconeogenesis

c) HMP shunt

d) Citric acid cycle

Correct Answer - D

Ans. is 'd' i.e., Citric acid cycle

- Citric acid cycle or Krebs's cycle generates 10 ATPs for every acetyl CoA that enters into citric acid cycle, Aerobic glycolysis generates 7 ATPs for every molecule of glucose, Anaerobic glycolysis generates 2 ATPs for every molecule of glucose utilised, HMP shunt is a pathway which neither generates ATP nor utilises ATP.

206. Source of ATP in RBCs is ?

a) Glucose

b) Fatty acid

c) Aminoacid

d) Ketone body

Correct Answer - A

Ans. is 'a' i.e., Glucose

- RBCs don't have mitochondria., The only pathway that provides ATP even in anaerobic conditions is glycolysis.
- Oxidation of reducing equivalents in the respiratory chain is coupled with phosphorylation of ADP to ATP.
- *This is the most important mechanism for capturing the energy present in various nutrients.*

207. What is the inhibitor of Carnitine Palmitoyl Transferase-1 [CPT-1]?

a) ATP

b) Acetoacetate

c) Succinyl CoA

d) Acyl CoA

Correct Answer - A

Ans. is 'a' i.e., ATP

[Ref Harper 30th le p. 186]

- As CPT-1 is an enzyme catalyzing a catabolic process (produces ATP), it is stimulated by anything which signals low energy like : ADP, NAD, FAD, Glucagon (catabolic hormone), Acyl CoA (the substrate)

208. Omega three fatty acid is?

a) Linoleic acid

b) Arachidonic acid

c) Cervonic acid

d) Oleic acid

Correct Answer - C

Ans. is 'c' i.e., Cervonic acid [*Ref Harper 30th le p. 214*]

209. Which 2 additional enzymes required in Beta Oxidation of PUFA?

a) Dienoyl CoA isomerase and Enoyl CoA reductase

b) Dienoyl CoA isomerase and Dienoyl CoA reductase

c) Enoyl CoA racemase and Enoyl CoA reductase

d) Enoyl CoA isomerase and 2,4 Dienoyl CoA reductase

Correct Answer - D

Ans. is 'd' i.e., Enoyl CoA isomerase and 2,4 Dienoyl CoA reductase

- Saturated Fatty acid oxidation begins with acyl CoA dehydrogenase acting on a fatty acid.
- Unsaturated fatty acid that is undergoing oxidation has a cis 43 bond, then Enoyl CoA isomerase converts into trans - 42 bond.
- For oxidation of saturated fatty acids, the enzymes required are Carnitine Acyl Palmitoyl Transferase I, Carnitine Acyl Palmitoyl Transferase II, Acyl CoA dehydrogenase, Hydrap hydroacyl coA dehydrogenase.

210. Carnitine shuttle is involved in ?

a) Fatty acid synthesis

b) Fatty acid oxidation

c) Cholesterol synthesis

d) Bile acid synthesis

Correct Answer - B

Ans. is 'b' i.e., Fatty acid oxidation

- Very short chain, short chain, medium chain and long chain fatty acids get oxidized in mitochondria,
- Very short chain, short chain and medium chain fatty acids can cross inner mitochondrial membrane by passive diffusion,
- Long chain fatty acids cannot cross the inner mitochondrial membrane. Hence they need a carrier. The carrier is carnitine.
- Carnitine is p hydroxy y N trimethylaminobutyric acid. It is synthesized from lysine.

211. The effect of Lipotropic agents on fat metabolism is ?

a) Increases the rate of fatty acid synthesis in liver

b) Increases the rate of lipid output from liver

c) Increases the rate of cholesterol synthesis in liver

d) Decreases the rate of cholesterol synthesis in liver

Correct Answer - B

Ans. is 'b' i.e., Increases the rate of lipid output from liver

- Lipotropic agents are substances which increase the rate of lipid output from liver and they also stimulate the rate of lipid utilization in extrahepatic tissues. This way, lipotropic agents protect liver from fatty liver changes and liver cirrhosis.

212. Example for a conjugated protein is ?

a) Heme

b) Chylomicron

c) Albumin

d) Histone

Correct Answer - B
Ans. is 'b' i.e., Chylomicron

213. Intake of high protein diet causes?

a) Increased gluconeogenesis

b) Increased beta oxidation

c) Decreased glycogenolysis

d) Metabolic alkalosis

Correct Answer - A

Ans. is 'a' i.e., Increased gluconeogenesis

- High protein diet is generally recommended for weight loss.
- High protein diet is found to increase the rate of gluconeogenesis. Glucogenic aminoacids in circulation is found to stimulate glucagon release.
- Glucagon stimulates Phosphoenol pyruvate carboxykinase and glucose 6 phosphatase. This way blood glucose is increased and this high blood glucose also has a satiation effect. High protein diet also stimulates glycogenolysis because of its effect on glucagon release.

214. Tyrosine deficiency causes ?

a) Depression

b) Hyperthyroidism

c) Hyperpigmentation

d) Phenylketonuria

Correct Answer - A

Ans. is 'a' i.e., Depression [Ref Essential of biochemistry p. 912]

- Tyrosine deficiency causes *hypothyroidism* (lethargy, weight gain) as tyrosine is required for T3 & T4; *depression* (due to dopamine deficiency); albinism & hair hypopigmentation (due to deficiency of melanin); and stunted growth (as tyrosine is a component of proteins).

215. Oxaloacetate synthesized from which amino acid -

a) Aspartate

b) Glycine

c) Serine

d) Valine

Correct Answer - A

Ans. is 'a' i.e., Aspartate [*Ref Harper 30th/e p. 298 & 29th/e p. 274*]

- Two most important transamination reactions are catalyzed by alanine transaminase (ALT) and aspartate transaminase (AST).

216. Which of the following amino acids is involved in one carbon pool?

a) Glycine

b) Proline

c) Threonine

d) Hydroxyproline

Correct Answer - A

Ans. is 'a' i.e., Glycine

- Groups, containing a single carbon atom are called one carbon groups. One carbon groups are formed from following amino acids during their metabolism:- *Serine, glycine, histidine and tryptophan*. One carbon groups formed during metabolism are: methyl (CH₃), methylene (CH₂), methenyl (CH), formyl (CHO) and formimino (CH=NH).

217. Disulfide bonds are formed by pairs of which amino acid?

a) Methionine

b) Homocysteine

c) Serine

d) Cysteine

Correct Answer - D

Ans. is 'd' i.e., Cysteine

There are two sulfur containing amino acids :-

i) Cystein

ii) Methionine

- The side chain of cysteine contains sulfhydryl group that has a pKa of approximately 8.4 for dissociation of its hydrogen sulfhydryl groups of two cystein molecules can form covalent disulfide bond to form cystine.
- Methionine although it contains sulfur group, does not contain sulfhydryl group and cannot form disulfide bond.
- Disulfide bridges are R-S-S-R', These bridges are formed by oxidation of Sulfhydryl groups of cysteine residues of proteins.
- This is the basis or reducing type of SDS - PAGE. SDS PAGE is used to find the molecular weight of an unknown protein.
- Disulfide bridges are not formed by methionine, as methionine does not have sulfhydryl group - they have a thioether linkage

218. Which of the following is true about HPLC and gas chromatography?

a) In Gas Chromatography, the stationary phase is always solid

b) In HPLC, the stationary phase is solid

c) In HPLC, the mobile phase is a liquid or solid

d) In Gas chromatography, the mobile phase is always gas

Correct Answer - D

Ans. is 'd' i.e., In gas chromatography, the mobile phase is always gas

- if a solute has an affinity for the mobile phase, it moves faster. If a solute has an affinity for stationary phase, it gets retarded.
- That way, the solutes get separated based on differential distribution of them between a mobile phase and a stationary phase.

219. Which vitamin deficiency is seen in vegetarians especially ?

a) Vitamin B12

b) Vitamin B6

c) Vitamin B3

d) Vitamin B2

Correct Answer - A

Ans. is 'a' i.e., Vitamin B12

- Dietary sources of vitamin B12 are of animal origin only and include meat, eggs, milk, dairy products, fish, poultry etc. Vitamin B12 is absent in plant foods. Small amount of vitamin B 12 is synthesized in the intestine by the action of intestinal flora.

220. Which amino acid required in infants and not in adults?

a) Histidine

b) Glycine

c) Isoleucine

d) Valine

Correct Answer - A

Ans. is 'a' i.e., Histidine

- Histidine and Arginine are partially or semiessential aminoacids. They are synthesized by metabolic pathways but the rate of synthesis is low, that the endogenous synthesis is not sufficient to meet the requirements during periods of increased demand like during growth

221. Which micronutrient deficiency causes anemia?

a) Copper

b) Molybdenum

c) Selenium

d) Fluorine

Correct Answer - A

Ans. is 'a' i.e., Copper

- Copper containing protein ceruloplasmin is necessary for transport of iron in the Ferric form across membranes
- Copper is an integral component of ALA synthase, which is necessary for heme synthesis
- Copper helps in the uptake of iron across normoblasts

222. Which of the following is a component of Coenzyme A?

a) 3 Alanine

b) Glycine

c) Pyrrolysine

d) Selenocysteine

Correct Answer - A

Ans. is 'a' i.e., 3 Alanine

- Coenzyme A is a carrier of acyl group. Hence it takes part of fatty acid synthesis and fatty acid oxidation
- It is formed from pantothenic acid and mercaptoethanolamine, Pantothenic acid is formed from pantoic acid and p alanine

223. B12 deficiency causes ?

a) Demyelination

b) Dermatitis

c) Burning foot syndrome

d) Beriberi

Correct Answer - A

Ans. is 'a' i.e., Demyelination

- B12 in the form of Adenosyl B12 acts as a coenzyme for Methyl malonyl CoA mutase. Methyl Malonyl CoA mutase helps in the conversion of methyl malonyl CoA to Succinyl CoA.
- in B12 deficiency, methyl malonyl CoA accumulates. Methyl Malonyl CoA gets incorporated into fatty acids (instead of malonyl CoA).
- This results in abnormal fatty acids getting synthesized. When these fatty acids get incorporated in myelin, it results in rapid demyelination

224. Deficiency of zinc causes all except ?

a) Diarrhea

b) Acrodermatitis

c) Vitamin A deficiency

d) Neuropathy

Correct Answer - D

Ans. is '**d**' i.e., Neuropathy

- Zinc is found in skeletal muscle and in bones, Sources of Zinc are grains, beans, cheese, Shell fish
- Zinc is absorbed from duodenum, stored in liver in conjugation with metallothionein.
- Zinc is necessary for synthesis of Retinol Binding Protein.
- Hence Zinc deficiency is found to present with Vitamin A deficiency

225. Hemopexin binds ?

a) Heme

b) Hemoglobin

c) Iron

d) Bilirubin

Correct Answer - A

Ans. is 'a' i.e., Heme.

- Hemopexin is a glycoprotein which exhibits the highest affinity for free heme
- Hemopexin's function is to protect the cell and tissues from oxidative damage caused by heme. Because hemopexin does not only bind to free heme but also facilitates the uptake of heme into liver by binding to specific receptors on hepatocytes.
- Hence hemopexin helps in recycling iron and the iron stores are maintained. Hemopexin is also found to cause an upregulation of heme oxygenase 1 enzyme, thereby they facilitate the conversion of heme into bilirubin and biliverdin.

226. Common substrate for purine and pyrimidine synthesis are all except ?

a) Glutamine

b) Glycine

c) Aspartate

d) Carbon dioxide

Correct Answer - B

Ans. is b i.e., Glycine [*Ref Harper 30thle p. 348*]

- Glutamine, aspartate (aspartic acid) and CO, are precursors for both purines & pyrimidines.
- In de novo synthesis, purine ring is formed from variety of precursors is assembled on ribose-5-phosphate.

227. Guanine ring - True are all except ?

a) It has 9 atoms

b) Aspartate acts as the amino group donor for forming guanine

c) Carbonyl group at C6 acts as a hydrogen bond acceptor

d) It forms three hydrogen bonds with cytosine

Correct Answer - B

Ans. is 'b' i.e., Aspartate acts as the amino group donor for forming guanine

- Guanine ring is a purine ring. Hence it has nine atoms included in the ring.
- It is formed from IMP (Inosine Mono Phosphate). IMP undergoes dehydrogenation, in the presence of IMP dehydrogenase (NADP is the coenzyme) to form Xanthosine Mono Phosphate (XMP). XMP undergoes amination with glutamine to form GMP.
- On the other hand, IMP undergoes amination with Aspartate to form Adenylosuccinate. Adenylosuccinate in the presence of Adenylosuccinate lyase to form AMP and fumarate.

228. Which of the following can carry larger genome ?

a) Plasmids

b) BAC

c) YAC

d) Cosmids

Correct Answer - C

Ans. is 'c' i.e., YAC [*Ref Harper's 30th/e p. 454 & 29th/e p. 437*]

Vector	DNA insert size
Plasmid	0.01-10 kb
Phage	10-20 kb
Cosmid	35-50 kb
BAC, PAC	50-250 kb
YAC	500-3000 kb

229. Pulsed gel electrophoresis is used for?

a) DNA

b) RNA

c) Ribosome

d) Protein

Correct Answer - A

Ans. is 'a' i.e., DNA [*Ref Essential of biochemistry p. 912*]

- Large DNA of size larger than 15 to 20 KB can be separated with higher resolution by periodically changing the voltage direction. This is called as pulsed gel Electrophoresis

230. Disease caused by trinucleotide repeats are all except?

a) Huntington's chorea

b) Myotonic dystrophy [dystrophia myotonica]

c) Friedrich's ataxia

d) Hereditary Nonpolyposis Colon Cancer

Correct Answer - D

Ans. is 'd' i.e., Hereditary Nonpolyposis Colon Cancer [Ref *Essentials of biochemistry p. 676*]

Examples of trinucleotide repeat mutation :?

1) Huntington's disease

2)

Spinocerebellar ataxia

3) Friedreich ataxia

4) Fragile - X-

syndrome

5) Dystrophia myotonica

6) Dentorubral

pallidolusian atrophy 7) X-chromosome spinobulbar muscular

atrophy

231. Which of the following is an example of post translational modification ?

a) Gamma carboxylation of glutamate residues

b) N glycosylation of proteins

c) 7 methyl Guanosine capping

d) Poly A tail addition

Correct Answer - B

Ans. is 'a > b' i.e, **Gamma carboxylation of glutamate residues**, N glycosylation of proteins

[Ref Lippin cott's 3/e p. 429]

Important post-transcriptional modifications are?

- 7 methyl guanosine capping along 5' end of mRNA
- Poly A tail addition along 3' end of mRNA
- Removal of introns and linkage of exons - RNA splicing

232. Which radioisotope labeled molecule is used to find out rate of DNA synthesis?

a) [H3] Thymidine

b) [H2] Thymidine

c) [H3] Adenine

d) [H2] Adenine

Correct Answer - A

Ans. is 'a' i.e., [H3] Thymidine [*Ref Essentials of molecular biochemistry p. 321*]

- One application of isotope labeling would be in measuring DNA synthesis, that is cell proliferation in vitro. uses [H3]- thymidine labeling to compare pattern of synthesis (or sequence) in cells.

233. Epigenetics is ?

a) Alteration in nucleotide sequence

b) Alteration in chromosome number

c) Alteration in gene expression

d) Alteration in chromosome size

Correct Answer - C

Ans. is 'c' i.e., Alteration in gene expression [*Ref Essentials of molecular biochemistry p. 321*]

- Epigenetics is a heritable change in the level of gene expression, not caused by changes in DNA sequence. It includes changes like Histone modification or DNA methylation

234. Taq DNA polymerase true is ?

a) Thermolabile

b) High fidelity

c) Optimum temperature for chain elongation is 75°

d) Has 3'S' exonuclease activity

Correct Answer - C

Ans. is 'c' i.e., Optimum temperature for chain elongation is 75° [Ref *Clinical biochemistry p. 888*]

- As the DNA polymerase that is used in this process should be capable of withstanding repeated cycles of 94 or 95°C, the enzyme should be thermostable. Hence the DNA polymerase used in Polymerase Chain Reaction is extracted from an organism which lives in hot springs. That organism being *Thermus aquaticus* and hence the DNA polymerase is Taq DNA polymerase.
- Optimum temperature required for this enzyme for elongation is 75°C. Hence elongation is carried out at 72°C.

235. Best sample for DNA karyotyping ?

a) Blood

b) Bone marrow

c) Amniotic fluid

d) Chorionic villi

Correct Answer - A

Ans. is 'a' i.e., Blood

- Karyotyping is the study of number and appearance of chromosomes,
- Most commonly used sample is blood. Blood is centrifuged. WBCs are separated. White Blood cells are rapidly dividing cells with DNA.

236. True about chaperone?

a) Also known as HS proteins

b) Have ATPase activity

c) Always bind to specific areas on unfolded proteins

d) They always acts as foldases

Correct Answer - A

Ans. is 'a' i.e., Also known as HS proteins

- Chaperones are proteins which help in folding or unfolding of proteins
- Molecular chaperones prevent aggregation and promote refolding after stress and hence promote cell survival. This so-called stress response is ubiquitous and conserved across all organisms. Hence Chaperones are otherwise known as heat shock proteins (HSP)
- Chaperones are synthesized in response to heat and other stress conditions like exposure to heavy metals, UV radiation, oxidative stress, nutrient deficiencies, dehydration, osmotic pressures and viral infections. Hence, they are otherwise called as stress proteins

237. Concentration of which of the following is maximum in a cell next to water ?

a) Protein

b) Fat

c) Sodium

d) Carbohydrates

Correct Answer - A

Ans. is 'a' i.e., Protein

- Most of the cytosol is water, which makes up about 70% of the total volume of a typical cell.
- Next higher concentration is of proteins. Protein molecules that do not bind to cell membranes or the cytoskeleton are dissolved in the cytosol. The amount of protein in cells is extremely high, and approaches 200 mg/ml, occupying about 20-30% of the volume of the cytosol

238. Primary bile acid secreted by liver is ?

a) Chenodeoxycholic acid

b) Lithocholic acid

c) Deoxycholic acid

d) Lithodeoxycholate

Correct Answer - A

Ans. is 'a' i.e., Chenodeoxycholic acid [Ref: Ganong 22nd/e p. 26]

- The primary bile acids are produced from cholesterol in liver. These are cholic acid and chenodeoxycholic acid. These are conjugated with glycine or taurine. So primary bile acids are glycocholic acid, glycochenodeoxycholic acid, taurocholic acid, and taurochenodeoxycholic acid. The primary bile acids are secreted in bile and in the lower parts of small intestine, primary bile acids are converted to secondary bile acids by bacterial enzymes. Secondary bile acids are deoxycholic acid and lithocholic acid.

239. Collagen protein axial periodicity is -

a) 67nm

b) 107nm

c) 207nm

d) 307nm

Correct Answer - A

Ans. is 'a' i.e., 67 nm.

- The fibrillogenesis involves the lateral association of collagen triple helices, the structural unit of collagen, to form long, smooth fibrils with a *characteristic 67-nm axial structural* feature known as the D-periodicity or axial periodicity.

240. Nephelometry measures the light?

a) Absorbed

b) transmitted

c) Scattered

d) Refracted

Correct Answer - C

Ans. is 'c' i.e., Scattered

- When particles are suspended in a solution in a cuvette, they make the solution unclear (turbid).
- Nephelometry is concerned with measurement of scattered light from a cuvette containing suspended particles in a dilute solution.
- The components of a nephelometer are the same as a light spectrophotometer except that the detector is placed at a specific angle from the incident light

241. Unit of turbidity is calculated by ?

a) Measuring the scattered light at 90°

b) Measuring the scattered light at 180°

c) Measuring the scattered light at 270°

d) Measuring scattered light at 135°

Correct Answer - A

Ans: A. Measuring the scattered light at 90°

- IT is involved with measuring the amount of transmitted light (and calculating the absorbed light) by particles in suspension to determine the concentration of the substance in question.
- Amount of absorbed light, and therefore, concentration is dependent on, Number of particles, Size of particles, Measurements are made using light spectrophotometers
- Turbidity Unit is the International Standard Unit. Both measure the light scattered at 90° . NTU uses white light with peak spectral output at 400 to 680nm as light source. FTU uses Infrared monochromatic light with peak output at 780 to 900nm as light source.

242. Hardening of sodalime done by?

a) CaCO

b) CaSO₄

c) BaSO₄

d) Sodium silicate

Correct Answer - D

Ans. is 'd' i.e., Sodium silicate

- Soda lime is a mixture of chemicals, used in granular form in closed breathing environments, such as general anaesthesia to remove carbon dioxide from breathing gases to avoid hypercarbia

243. Synthetic Oxygen carrier is made up of_

a) Iron

b) Bronze

c) Molybdenum

d) Flurine

Correct Answer - D

Ans. is '**d**' i.e., Flurine

- Blood doping is a form of fraudulent increase in the oxygen carrying capacity of a person, widely used to improve the aerobic capacity of athletes.

244. Hepcidin associated with which molecule?

a) Iron

b) Copper

c) Selenium

d) Fluorine

Correct Answer - A

Ans. is 'a' i.e., Iron

- Hepcidin is a positive acute phase reactant. Hence during inflammation, liver releases more hepcidin. This inhibits basolateral side transport of iron along intestine. This results in a hematological picture which mimics iron deficiency anemia. This is the basis of Anemia of Chronic Disease

245. Products of Phospholipase C are ?

a) Inositol and diacylglycerol

b) Inositol triphosphate and Diacylglycerol

c) Lysophospholipid and fattyacid

d) Phosphatidate and IP2

Correct Answer - B

Ans. is 'B' i.e., Inositol triphosphate and Diacylglycerol

- IP3 or Inositol triphosphate and DAG or Diacyl glycerol are second messengers formed from Phosphatidyl inositol diphosphate (PIP₂) by the action of Phospholipase C.
- Activation of phospholipase (by stimulatory G protein) hydrolyses the membrane phospholipid phosphatidyl inositol 4, 5 bisphosphate (PIP₂) to generate the second messenger inositol 1, 4, 5 - triphosphate (IP) and diacylglycerol (DAG).

246. Hepatic encephalopathy is caused by an increase of ?

a) Urea

b) Glutamate

c) Ammonia

d) Fattyacid

Correct Answer - C

Ans. is 'c' i.e., Ammonia

- Hepatic encephalopathy is characterized by altered level of consciousness, caused by liver disorder.
- Liver disorder is characterized by elevation of ammonia. As liver is considered with detoxification of ammonia to form urea, in liver failure ammonia level is elevated.
- Hepatic encephalopathy basically presents with manifestations of CNS depression

247. Which of the following is action of insulin ?

a) Gluconeogenesis

b) Increased glucose uptake in muscle

c) Glycogenolysis

d) Increased glucose uptake in endothelium

Correct Answer - B

Ans. is '**b**' i.e., Increased glucose uptake in muscle

- Insulin is a hypoglycemic and anabolic hormone Immediate effects of insulin:
- Immediate effects of insulin include the effect of insulin on causing glucose and potassium uptake into cells, Insulin stimulates glucose uptake into cells by Stimulating GLUT4 transporter up regulation across the membranes of skeletal muscle, cardiac muscle and adipose tissue
- Stimulating glucokinase in liver. As glucokinase is stimulated in liver, glucose in liver is converted to glucose 6 phosphate. This reduces glucose level within hepatocytes. This stimulates further glucose uptake into hepatocytes

248. When glucose concentration in blood increases, there is linear increase in?

a) Insulin

b) Glucagon

c) Growth Hormone

d) Cortisol

Correct Answer - A

Ans. is 'a' i.e., Insulin

- When blood glucose concentration increases, glucose enters into pancreatic β cells. Glucose goes through glycolysis and citric acid cycle in β cells. ATP is generated. ATP closes K^+ channels. This causes depolarization of pancreatic β cells. Depolarisation and the resultant action potential opens up voltage gated calcium channels. Entry of calcium ions causes exocytosis of insulin release.

249. G protein of G protein coupled receptors are attached to?

a) Aminoterminal end

b) Carboxyterminal end

c) Third transmembrane domain

d) Seventh transmembrane domain

Correct Answer - B

Ans. is 'b' i.e., Carboxyterminal end

- G protein coupled receptors are receptors which are coupled to G protein, G proteins are proteins which get activated on binding to GTP
- There are two types of G proteins, Small G proteins, Heterotrimeric G proteins

250. Largest protein in body is ?

a) Titin

b) Myosin

c) Actin

d) Troponin

Correct Answer - A

Ans. is 'a' i.e., Titin

- Titin is a muscle protein
- It connects Z lines with M line in a sarcomere
- It is responsible for passive elasticity of a muscle
- Titin is the third most abundant protein of human body (after myosin and actin)
- Titin is the largest protein in human body. It has 34350 aminoacids.

251. True about hybridoma is all except?

a) In-situ hybridization

b) DNA sequencing

c) Formation of monoclonal antibodies

d) Formation of continuous cell line

Correct Answer - A

Ans. is 'a' i.e., In-situ hybridization

[Ref Pankaj Naik 3/e p. 109; Textbook of molecular biology 7th/e p. 1131]

- Hybridomas are cells that have been engineered to produce a specific antibody in huge numbers.
- two types of cells have to be combined together i.e. cells which can produce large amount of pure antibody. And Cells which have the ability to grow continually, These two types of cells are then fused together to form hybridoma.

252. Amino-acid expressed maximally in collagen?

a) Tyrosine & phenylalanine

b) Alanine & aspartic acid

c) Glycine & cysteine

d) Proline & hydroxyproline

Correct Answer - D

Ans. is `d' i.e., Proline & hydroxyproline

[Ref Harper's 30th/e p. 629 & 28th/e p. 527, 530]

- Glycine (33%), proline (10%), hydroxyproline, lysine and hydroxylysine are the predominant amino acids in collagen. Collagen.

253. The hormonal factor responsible for circadian rhythm is formed from which amino acid?

a) Tyrosine

b) Tryptophan

c) Phenylalanine

d) Histidine

Correct Answer - B

Ans. is 'b' i.e., Tryptophan [Ref Harper 30th/e p. 319]

- In circadian rhythm maintenance melatonin is involved which is derived from tryptophan.
- Tryptophan is a precursor for synthesis of niacin (nicotinic acid), serotonin and melatonin.

254. Glycine is present in all except?

a) Creatine

b) Purine

c) Glutamine

d) Glutathione

Correct Answer - C

Ans. is 'c' i.e., Glutamine

[Ref Harper 30th/e p. 316; Dinesh puri Vie p. 353] Glycine

- It is a nonessential amino acid which is synthesized from serine
- Glycine is necessary for the formation Heme, purine ring, bile acids conjugation (formation of glycocholic acid, and glycochenodeoxycholic acid), creatine, glutathione, glucose (by gluconeogenesis).

255. HMG-CoA can be directly converted to all except?

a) Acetoacetate

b) Acetyl-CoA

c) Mevalonate

d) Aceto-acetyl CoA

Correct Answer - D

Ans. is 'd' i.e., Aceto-acetyl CoA

[Ref Vasudevan ele p. 143; Harper 30th/e p. 226-228]

- Acetoacetate & Acetyl - CoA are derived from HMG-CoA during ketogenesis by HMG-CoA lyase which breaks the HMG-CoA into acetoacetate and acetyl-CoA during ketogenesis.
- Mevalonate is formed directly from HMG-CoA in cholesterol synthesis.
- HMG-CoA is converted to mevalonate by HMG-CoA reductase, the key regulatory enzyme of cholesterol synthesis.

256. Attachment site of miRNA to inhibit gene expression?

a) 3' end of mRNA

b) 5' end of mRNA

c) Binding to sigma factor

d) Cap binding protein

Correct Answer - A

Ans. is 'a' i.e., 3' end of mRNA

[Ref Lippincott's 5th/e p. 422-424; Harper's 30thVe p. 409 e^{tr} 29thYe p. 81; Molecular biology by Lodish W^hie p. 348]

- Dicer (cytoplasmic enzyme) produce mi-RNA duplex, i.e. double stranded miRNA.
- It unwinds and one strand of this duplex is incorporated into RNA induced silencing complex (RISC), which help in gene regulation.
- miRNA (RISC) then recognize target sequences in the 3' untranslated region of mRNA for complementary base pairing.
- Base-pairing directs RISC to either cause mRNA cleavage or repress its translation.

257. What is the basis of sorting X-chromosome bearing and Y-chromosome bearing sperm?

a) X-chromosome has 2.8% more DNA

b) Y-chromosome has 2.8% more DNA

c) X-chromosome has 0.28% more DNA

d) Y-chromosome has 0.28% more DNA

Correct Answer - A

Ans. is 'a' i.e., X-chromosome has 2.8% more DNA

[Ref www.sciencedirect.com; Textbook of Human reproductive biology 4th/e p. 169]

- A sperm-sorting technology (the microsort method) is the most effective procedure yet devised at separating X-bearing and Y-bearing sperm.
- X sperm have only 2.8% more DNA than those carrying a Y chromosome,
- fluorescent dye that attaches to DNA and glows under laser light in sperm sorter then separates the sperm, sending X sperm down one tube and Y sperm into another.
- The sorted sperm can then be placed in the woman's uterus (artificial insemination) or used for in vitro fertilization.

258. Mucopolysaccharide/proteoglycans present in eye are?

a) Keratan sulfate & dermatan sulfate

b) Dermaton sulfate & heparan sulfate

c) Dermaton sulfate & chondroitin sulfate

d) Keratan sulfate and chondroitin sulfate

Correct Answer - D

Ans. is 'd' i.e., Keratan sulfate and chondroitin sulfate

[Ref Dineshpuri Vie p. 31-32; Pankaj Naik 5^{1} p. 29]*

- Keratan sulfate and chondroitin sulfate are present in cornea. Hyaluronic acid is present in vitreous humor.
- Keratan Sulphate is the only proteoglycan that does not contain acid sugar in disaccharide repeat unit. Instead it contains D-galactose (simple sugar) in place of acid sugar.

259. Reverse transcription causes synthesis of?

a) RNA from DNA template

b) DNA from RNA template

c) RNA from RNA template

d) DNA from DNA template

Correct Answer - B

Ans. is 'b' i.e., DNA from RNA template

[Ref Harper 30/e p. 364]

- According to the central dogma, information flows from DNA to RNA to protein, Exception to central dogma of molecular biology is reverse transcription.
- reverse transcription refers to reverse of transcription, i.e. synthesis of double stranded DNA from RNA.
- catalyzed by enzyme reverse transcriptase which uses RNA template to synthesize DNA, thus called RNA dependent DNA polymerase.
- For eg- Retroviruses (e.g. HIV) carry RNA as their genetic material which is used to synthesize DNA by reverse transcriptase.

260. Reverse transcription involves ?

a) RNA dependent DNA synthesis

b) DNA dependent RNA synthesis

c) DNA dependent DNA synthesis

d) RNA dependent RNA synthesis

Correct Answer - A

Ans. is 'a' i.e., RNA dependent DNA synthesis

[Ref Harper's 30th/e p. 364 & 29th/e p. 348]

261. Alcohol/ethanol induced fatty liver is caused by increased in ratio of?

a) **NAD*** to NADH

b) NADH to NAD'

c) NADPH to NADP*

d) NADP' to NADPH

Correct Answer - B

Ans. is 'b' i.e., NADH to NAD'

[Ref: Pankaj Naik 3rd/e p. 351]

- Ethyl alcohol (ethanol) is readily absorbed from GIT and degraded by oxidation (oxidative process).
- Liver is the major site for ethanol oxidation.
- Excess alcohol intake leads to excessive production of NADH with a concomitant decrease in NAD⁺ which causes Hypoglycemia, Inhibition of β -oxidation of fatty acids and citric acid cycle, Increased lipogenesis, Accumulation of lipids, Lactic acidosis and hyperuricemia.

262. True about ribozyme is ?

a) A protein

b) Catalytic RNA

c) Helps in esterification

d) Peptide bond formation

Correct Answer - B:D

Ans. is `b > d' i.e., Catalytic RNA and Peptide bond formation

[Ref Harper 30th ed p. 367, 348, 305]

- Two important RNA enzymes or ribozymes are the peptidyl transferase that catalyzes peptide bond formation on the ribosome and ribozymes involved in the RNA splicing.

263. True about sigma factor?

a) Subunit of 50s ribosome

b) Subunit of DNA polymerase

c) Subunit of RNA polymerase

d) Initiates DNA replication

Correct Answer - C

Ans. is 'c' i.e., Subunit of RNA polymerase

[Ref Lippincott]

- Sigma factor (sigma subunit) is a subunit of RNA polymerase.
- It is involved in initiation of transcription (RNA synthesis) in prokaryote (not DNA replication).

264. Which of the following enzyme is not a protein ?

a) Carboxypeptidase

b) Amylase

c) Ribozyme

d) DNAase

Correct Answer - C

Ans. is 'c' i.e., Ribozyme [Ref RC Gupta 2ndie p. 65]

- Enzymes are natural thermolabile, biological catalysts. They are protein or polypeptide in nature, except for a few, i.e., ribozyme is not a protein but a RNA molecule with catalytic activity. enzymes are secreted by living cells.

265. Alcohol dehydrogenase is a/an -

a) Transferase

b) Hydrolase

c) Ligase

d) Oxidoreductase

Correct Answer - D

Ans. is 'd' i.e., Oxidoreductase [Ref Essentials of biochemistry p. 786]

- Alcohol dehydrogenase is a NAD-linked *dehydrogenase* (*oxidoreductase*), It catalyzes the oxidation of ethanol to acetaldehyde.

266. Regan enzyme is an isoenzyme of ?

a) LDH

b) Creatinine kinase

c) Acid phosphatase

d) Alkaline phosphatase

Correct Answer - D

Ans. is 'd' i.e., Alkaline phosphatase

- Regan enzyme (isoenzyme) is the isoenzyme of alkaline phosphatase.
- It arises from placenta known as carcinoplacental enzyme.
- It is elevated in about 15% of cases of carcinoma of lung, liver and gut.

267. Carbonic anhydrase is which type of enzyme ?

a) Coenzyme

b) Metalloenzyme

c) Serine protease

d) Endopeptidase

Correct Answer - B

Ans. is 'b' i.e., Metalloenzyme [Ref: *Essentials of biochemistry* p. 785]

- The active site of carbonic anhydrase contains a zinc ion, they are therefore classified as metalloenzymes.

268. Maximum protein to lipid ratio is seen in ?

a) Inner mitochondrial membrane

b) Outer mitochondrial membrane

c) Sarcoplasmic reticulum

d) Myelin sheath membrane

Correct Answer - A

Ans. is 'a' i.e., Inner mitochondrial membrane [Ref Principles of medical physiology p. 15]

- Mitochondrial inner membrane has maximum protein contents with highest protein to lipid ratio and cell membrane in myelin has lowest protein to lipid ratio.
Protein to lipid ratio in decreasing order of frequency is as follows:
- Inner mitochondrial membrane (3.2) : Maximum > Sarcoplasmic reticulum (2.0) > outer mitochondrial membrane (1.1) = Human erythrocyte cell membrane (1.1) > Myelin sheath cell (plasma) membrane (0.23) : Minimum.
- In all the membranes, proteins content is higher than lipid, with only one major exception of myelin which has higher lipid content than protein to provide good insulation.

269. Both lipid and protein contents are equal in membrane of which organelle -

a) Sarcoplasmic reticulum

b) Mitochondria

c) Myeline Sheath

d) Golgi apparatus

Correct Answer - B

Ans. is 'b' i.e., Mitochondria [Ref Harper 28th/e p. 407]

Outer mitochondrial membrane has protein to lipid ratio of 1.1.

270. In ETC, cyanide inhibits ?

a) Complex I

b) Cytochrome C oxidase

c) Complex IV

d) Complex III

Correct Answer - B:C

Ans. is 'b' i.e., Cytochrome C oxidase & 'c' i.e., Complex IV

[Ref Harper 29th/e p. 127, 28th/e p. 108, 109; Vasudevan 6th le p. 234]

- Complex I :- Barbiturates (amobarbital), piercidin A, rotenone, chlorpromazine, guanithidine.
- Complex II :- Carboxin, TTFA, malonate.
- Complex III:- Dimercaprol, BAL, actinomycin A, Naphthylquinone.
- Complex IV (cytochrome c oxidase) :- Carbon monoxide (CO), cyanide (CN⁻), H₂S, azide (N⁻)

271. FADH₂ enters at which complex in ETC ?

a) I

b) II

c) III

d) IV

Correct Answer - B

Ans. is 'b' i.e., II [Ref Harper 29^m/e p. 125-126; Vasudevan 5th/e p. 231]

FADH, enters at complex II, therefore, generates only 1-5 molecules of ATP (1 ATP production is bypassed at complex I).

272. Pyruvate kinase is inhibited by ?

a) Insulin

b) Fructose -1,6 bisphosphate

c) ATP

d) All of the above

Correct Answer - C

Ans. is 'c' i.e., ATP

- Pyruvate Kinase enzyme 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.

273. Irreversible step in citric acid cycle is catalyzed by ?

a) Aconitase

b) Succinate thiokinase

c) a-ketoglutarate dehydrogenase

d) Isocitrate dehydrogenase

Correct Answer - C

Ans. is 'c' i.e., a-ketoglutarate dehydrogenase [*Ref Harper 29th/e p. 165*]

There are two irreversible steps :

- .. oxaloacetate to citrate catalysed by citrate (synthase), and
- ?. a-ketoglutarate to succinyl CoA, catalyzed by a-ketoglutarate dehydrogenase.

274. Structure of triglyceride is ?

a) 2 molecules of FA + Glycerol

b) 3 molecules of FA + Glycerol

c) 2 molecules of FA + 2, 3 DPG

d) 3 molecules of FA + 2, 3 DPG

Correct Answer - B

Ans. is 'b' i.e., 3 molecules of FA + Glycerol

- Triglycerides (or Triacylglycerols) are esters of the alcohol glycerol and fatty acid. Triglyceride contains one molecule of glycerol and 3 molecules of fatty acids.
- Triglycerides are synthesized in many tissues, e.g. liver, kidneys, lactating mammary glands, intestinal mucosa, adipose tissue, muscles etc.

275. Hydrogenation of fatty acid is ?

a) Hydrolysis by Alkali

b) Auto-oxidation of PUFA

c) Addition of hydrogen to unsaturated fatty acid

d) Addition of hydrogen to saturated fatty acid

Correct Answer - C

Ans. is 'c' i.e., Addition of hydrogen to unsaturated fatty acid

[Ref Harper 29th le p. 143; Lippincott's 4th/e p. 363-364]

- Addition of hydrogen atoms to unsaturated fatty acid refers to hydrogenation. It reduces the number of double bonds in the unsaturated fats.
- Hydrogenation of unsaturated fats in the presence of a catalyst (nickel) is known as "hardening", because it converts liquid vegetable oils into solid fats e.g. margarine, vegetable ghee, etc.

276. Which of the following reaction is due to lipid peroxidation ?

a) Saponification

b) Rancidity

c) Hydrogenation

d) Soap formation

Correct Answer - B

Ans. is 'b' i.e., Rancidity [Ref Chatterjee 8th le p. 54]

- Peroxidation (auto-oxidation) of lipids exposed to oxygen is responsible not only for deterioration of foods (rancidity) but also for damage to tissues *in vivo*.
- Lipid peroxidation is a chain of reaction generating free radicals that initiate further peroxidation.

277. End point of fatty acid synthesis is formation of -

a) Palmitic acid

b) Stearic acid

c) Oleic acid

d) Linoleic acid

Correct Answer - A

Ans. is 'a' i.e., Palmitic acid

- Palmitate (Palmitic acid) is formed after a total of seven cycles in fatty acid synthesis.
- Fatty acid synthesis takes place in cytosol.
- Acetyl-CoA is the immediate substrate for lipogenesis and synthesis always ends in formation of palmitic acid.

278. Limiting amino acid in legumes ?

a) Lysine

b) Methionine

c) Alanine

d) Tryptophan

Correct Answer - B

Ans. is b, i.e., Methionine

Food item limiting amino acid

Legumes Methionine (also leucine & threonine)

Cereals Threonine (also lysine)

Pulses Methionine (also cysteine)

Maize Tryptophan (also lysine)

279. Methionine is synthesized from ?

a) Cysteine

b) Glycine

c) Histidine

d) Arginine

Correct Answer - A

Ans. is 'a' i.e., Cysteine [Ref Essentials of biochemistry p. 332; Plant Biochemistry p. 74]

- Methionine is a sulphur containing amino acid and is synthesized from cysteine.
- The precursor is homoserine, a product of reduction of aspartic acid.
- Homoserine is phosphorylated (by ATP) and the phosphate is then displaced by sulfhydryl group of cysteine to form cystathionine.
- Cleavage of alanine group from cystathionine yields homocysteine, which is methylated to yield methionine.

280. In human body, methionine is synthesized from ?

a) Cysteine

b) Proline

c) Threonine

d) None

Correct Answer - D

Ans. is 'd' i.e., None *[Ref Read above explanation]*

- Methionine is an essential amino acid, cannot be synthesized in body.

281. Most important amino acid which acts as methyl group donor -

a) Cysteine

b) Methionine

c) Tyrosine

d) Tryptophan

Correct Answer - B

Ans. is 'b' i.e., Methionine

- Methionine is activated into S-adenosylmethionine, which then transfers its methyl group to an acceptor.
- **Thus methionine acts as methyl donor in transmethylation reactions.**
- Some of the important transmethylation reactions are?
- Norepinephrine - Epinephrine
- Phosphatidylethanolamine - Phosphatidylcholine
- Guanidoacetate → Creatine
- Ethanolamine → Choline
- Acetyl serotonin - Serotonin
- Nucleotides methylated nucleotides

282. Amino-acid substitute for tryptophan without altering proteins characteristics ?

a) Tyrosine

b) Phenylalanine

c) Methionine

d) Alanine

Correct Answer - B

Ans. is `b' i.e., Phenylalanine [Ref Rawn biochemistry p. 47]

- Tryptophan is an aromatic amino acid, thus it can only be replaced with other aromatic amino acid.
- **Other two aromatic amino acids are :?**
- Phenylalanine
- Tyrosine
- Among these two, phenylalanine can substitute tryptophan but not tyrosine because
- Phenylalanine and tryptophan both are hydrophobic (non-polar).
- Whereas, tyrosine is hydrophilic (Polar).
- "The only other aromatic residue that can substitute for tryptophan is phenylalanine.
- Tyrosine cannot substitute since it has hydrophilic property"

283. Semiessential amino acid is -

a) Histidine

b) Alanine

c) Leucine

d) Lysine

Correct Answer - A

Ans. is 'a' i.e., Histidine [Ref Rawl biochemistry p. 47]

- Arginine and histidine are semi - essential amino acids.

284. Serine is produced in human from -

a) Glycine

b) Methionine

c) Homocysteine

d) Homoserine

Correct Answer - A

Ans. is 'a' i.e., Glycine

- Serine is converted to glycine and after that its metabolism is similar to glycine. Conversion of serine to glycine is reversible reaction; therefore, serine is synthesized also from glycine.

285. Which amino acid spares the use of methionine -

a) Cysteine

b) Glycine

c) Histidine

d) Arginine

Correct Answer - A

Ans. is 'a' i.e., Cysteine [*Ref Essentials of biochemistry p. 332; Plant Biochemistry p. 74*]

"Adequate dietary source of cysteine 'saves' methionine".

- Methionine is an essential amino acid.
- Methionine is required for synthesis of cysteine (thus cysteine is non-essential amino acid)
- Thus, cysteine can spare the requirement of methionine in diet.

286. Which of the following amino acid contains free sulphhydryl group

a) Cysteine

b) Methionine

c) Serine

d) Glycine

Correct Answer - A

Ans. is 'a' i.e., Cysteine [Ref Mark's Basic Medical Biochemistry p. 76]

There are two sulfur containing amino acids :?

- Cysteine
- Methionine
- The side chain of cysteine contains sulfhydryl group that has a pKa of approximately 8.4 for dissociation of its hydrogen sulfhydryl groups of two cystein molecules can form covalent disulfide bond to form cystine.
- Methionine although it contains sulfur group, does not contain sulfhydryl group and cannot form disulfide bond.

287. True about carbamoyl phosphate synthase ?

a) Mitochondria] enzyme

b) Cytosolic enzyme

c) Catalyzes condensation reaction

d) All are true

Correct Answer - D

Ans. is 'd' i.e., All are true [Ref: Harper 29th/e p. 277-278]

- There are two types of carbamoyl phosphate synthase (CPS) :?
- CPS - I:- catalyzes the condensation of CO₂ and ammonia to form carbomoyl phosphate in urea cycle. It is a mitochondrial enzyme.
- CPS - II:- It is a cytosolic enzyme and participates in pyrimidine synthesis.

288. Carbamoyl group of carbamoyl phosphate is derived from ?

a) Ammonia

b) Citrulline

c) Ornithine

d) Arginosuccinate

Correct Answer - A

Ans. is 'a' i.e., Ammonia [Ref A guide to Biochemistry p. 203]

- **1st** reaction of urea cycle is synthesis of carbamoyl phosphate by condensation of ammonia (NH_4^+) and CO_2 .
- The carbamoyl group of carbomoyl phosphate is derived from NH_4^+ and a bicarbonate ion.
- The reaction is energetically demanding (two ATP) and is catalyzed by carbomoyl phosphate synthase L
- CPS-I is allosterically activated by N-acetyl glutamate.

289. Urea cycle is linked to TCA cycle by ?

a) Arginine

b) Ornithine

c) Oxaloacetate

d) Fumarate

Correct Answer - D

Ans. is 'd' i.e., Fumarate [Ref Harper 29thie p. 276-277]

- Fumarate is released during urea cycle, which is an intermediate of Krebs's cycle, thus linking the two.

290. Conversion of phenylalanine to tyrosine is hampered in ?

a) Phenylketonuria

b) Alkaptonuria

c) Maple syrup disease

d) Tyrosinemia

Correct Answer - A

Ans. is 'a' i.e., Phenylketonuria

- Phenylketonuria is characterized by inability of oxidation of phenylalanine into tyrosine.
- It is an inborn metabolism of phenylalanine, in which there is inability of oxidation of phenylalanine into tyrosine.
- There is defective function of phenylalanine hydroxylase, which may be due to : ?
- Classical phenylketonuria (hyperphenylalanemia type I) - Deficiency of phenylalanine hydroxylase.
- Atypical phenylketonuria (Hyperphenylalanemia type II and III) → Defect in dihydrobiopterin reductase.
- Hyperphenylalanemia type - IV and V - Defect in dihydrobiopterin synthesis.

291. Hartrup disease causes deficiency of ?

a) Nicotinamide

b) Thiamine

c) Riboflavin

d) Biotin

Correct Answer - A

Ans. is 'a' i.e., Nicotinamide [Ref Harper 29th /e p. 292] Hartnup disease

- It is an inherited disorder in the metabolism of tryptophan.
- It is due to defective transport of tryptophan and other neutral amino acids in the intestine and kidney.
- This results in deficiency of tryptophan leading to decreased synthesis of niacin and serotonin.
- Thus there are pellagra (niacin deficiency), neurological symptoms (serotonin deficiency) and amino aciduria due to defective transport of amino acids in kidney.
- Note : Niacin is a general name for the nicotinic acid and nicotinamide, either of which may act as a source of vitamin in the diet

292. HHH syndrome is due to defect in ?

a) Tryptophan metabolism

b) Histidine transporter

c) Branched chain AA metabolism

d) Ornithine transporter

Correct Answer - D

Ans. is 'd' i.e., Ornithine transporter [Ref Textbook of clinical paediatrics p. 496]

- Hyperornithinaemia, hyperammonaemia, homocitrullinuria (HHH) syndrome is an autosomal recessive disorder of ornithine transport caused by mutations in gene SLC 25A15 encoding the ornithine transporter protein (ORNT1).
- There is defective activity of the ornithine transporter across the mitochondrial membrane, which causes a functional deficiency of two mitochondrial enzymes:
- Ornithine transcarbamoylase : Which catalyses the condensation of ornithine and carbamoylphosphate to citrulline.
- Ornithine-8-aminotransferase (OAT) : Which metabolizes the ornithine to Δ^1 -pyrroline-5-carboxylate and ultimately glutamate and proline.
- Ornithine accumulates in the cytoplasm and its deficiency in mitochondria causes a secondary urea cycle disorder and hyperammonemia.

Carbamoylphosphate accumulates and undergoes alternate metabolism to form :

1. Homocitrulline - Excreted in urine
2. Orotic acid
3. Plasma

293. HHH syndrome is due to deficiency of which enzyme?

a) Arginase

b) Arginosuccinase

c) Ornithine transcarbomylase

d) None

Correct Answer - C

Ans. is. c' i.e., Ornithine transcarbomylase [Ref: Textbook of clinical pediatrics p. 496]

- Actually there is no molecular deficiency of any enzyme but functional deficiency.
- In HHH syndrome there is deficiency/defect in Ornithine transporter across the mitochondrial membrane which causes functional deficiency of :?
 - .. Ornithine transcarbomylase
 - ?. Ornithine -8- aminotrans ferase (OAT)

294. First protein to be broken down for energy in prolonged starvation is from?

a) Skeletal muscle

b) Smooth musclesc

c) Kidney

d) Liver

Correct Answer - A

Ans. is 'a' i.e., Skeletal muscle [Ref Satyanarayan le p. 386]

- Proteins are degraded in Skeletal muscles to liberate amino acids which are utilized for gluconeogenesis.

295. Positive nitrogen balance is seen in ?

a) Trauma

b) Burns

c) Pregnancy

d) Stress

Correct Answer - C

Ans. is 'c' i.e., Pregnancy [Ref Essentials of biochemistry p. 224]

- The normal healthy adult is in "nitrogen balance or equilibrium".
- That is the amount of nitrogen ingested in the diet over a given period of time is equals that excreted in the urine and feces as excretory products.
- Positive nitrogen balance means amount of nitrogen taken in and retained exceeds that excreted.

Positive nitrogen balance is seen in ?

1. Pregnancy
2. Recovery phase of trauma/surgery
3. Infancy and childhood

Negative nitrogen balance is seen in :

1. Starvation
 2. Infection
 3. Burns
 4. Acute stress
 5. Immediately after trauma/surgery
- Hormones causing positive nitrogen balance → GH, insulin, testosterone
 - Hormone causing negative nitrogen balance → Glucocorticoids

296. Insulin causes decrease in activity of which enzyme?

a) PFK-1

b) Glucokinase

c) Pyruvate Carboxylase

d) Acetyl CoA Carboxylase

Correct Answer - C

Ans. is 'c' i.e., Pyruvate carboxylase [Ref Dinesh purl 3^{ra} le p. 414]

→ **Enzymes / Pathways activated by insulin**

1. Glycolysis : PFK-1, Pyruvate kinase, glucokinase, PDH.
2. Glycogenesis : Glycogen synthase.
3. Lipogenesis : Acetyl-Co-carboxylase, Fatty acid synthase.
4. Cholesterol synthesis : HMG - CoA reductase.
5. Triglyceride synthesis : Acyl - CoA glycerol-3-P transferase, glycerol kinase.
6. Lipoprotein degradation : Lipoprotein lipase.

→ **Enzymes / Pathways inhibited by insulin :**

1. Gluconeogenesis : Pyruvate carboxylase, PEP carboxykinase, fructose-1, 6-bisphosphatase, glucose-6 phosphatase
2. Glycogenolysis : Glycogen phosphorylase
3. Lipolysis : Hormone sensitive lipase.

297. Most important vitamin which prevent autooxidation of PUFA in membrane ?

a) Tocopherol

b) Ascorbate

c) Retinol

d) Calcitriol

Correct Answer - A

Ans. is 'a' i.e., Tocopherol [Ref : Harper 25⁰/e p. 532, 541, 543]

- Amongst given options, vitamin A, E and C are anti-oxidants.
- However, Vitamin E (tocopherol) is the most important antioxidant in the body, acting in the lipid phase of membranes protecting against the effects of free radicals.
- The main function of vitamin E is as a chain-breaking, free radical-trapping antioxidant in cell membranes and plasma lipoproteins by reacting with lipid peroxide radicals formed by peroxidation of polyunsaturated fatty acid.

298. Lipid soluble plasma membrane associated antioxidant?

a) Ubiquitin

b) Vitamin E

c) Vitamin C

d) Glutathione

Correct Answer - B

Ans. is 'b' i.e., Vitamin E

"Alpha-tocopherol is the only lipid soluble, chainbreaking antioxidant present in biological membranes".

299. Test to diagnose thiamine deficiency ?

a) RBC transketolase

b) FIGLU excretion

c) Methyl-malonic acid in urine

d) Histidine load test

Correct Answer - A

Ans. is 'a' i.e., RBC transketolase [Ref Harper 29th/e p. 534]

- Thiamine diphosphate is also the coenzyme for transketolase, in the pentose phosphate pathway.
- Therefore, thiamine nutritional status is best assessed by erythrocyte (preferred) or whole blood transketolase activity..

300. During destruction in proteosomes, proteins are bound to ubiquitin by ?

a) Covalent bond

b) Hydrogen bond

c) Hydrophobic interactions

d) Van-der Wall's forces

Correct Answer - A

Ans. is 'a' i.e., Covalent bond [Ref Essentials in Biochemistry p. 717]

- Defective protein is first covalently attached to ubiquitin.
- Covalent bond is formed between glycine (α-carboxyl group) of ubiquitin and lysine (amino group) of target protein.
- Ubiquitinated protein is then degraded in proteosomes by ATP dependent (energy dependent) mechanism.
- Proteins are degraded by proteolytic enzymes which is energy independent (non-energy dependent).

301. In lac operon, transcription is inhibited by binding into ?

a) Promotor site

b) Operator site

c) CAP site

d) None of the above

Correct Answer - B

Ans. is 'b' i.e., Operator site

- **Repressor binds to this site and blocks transcription.**

302. Enzyme needed in leucocytes for production of hypochlorite ?

a) NADPH oxidase

b) Myeloperoxidase

c) Catalase

d) Superoxide dismutase

Correct Answer - B

Ans. is 'b' i.e., Myeloperoxidase [Ref Robbins 4th/e p. 47-48]

- Enzyme required to generate superoxide anion (O_2^-) NADPH oxidase
- Enzyme required to generate Hypochlorite ($HOCl$) → Myeloperoxidase
- NADPH oxidase is also called respiratory burst (oxygen burst) oxidase.

303. Glycopeptide bond is cleaved by ?

a) Endopeptidase

b) Exopeptidase

c) Glycosidase

d) Trypsin

Correct Answer - C

Ans. is 'c' i.e., Glycosidase [Ref Essentials of biochemistry p. 132]

- glycopeptide bonds can be hydrolysed by glycosidases.
- "A number of endoglycosidases and glycosidases have been effectively employed to split N- and O- glycosidic bonds in structural investigations"

304. 17-a hydroxylase is not involved in the pathway for synthesis of ?

a) Cortisol

b) Aldosterone

c) Androsteredione

d) Testosterone

Correct Answer - B

Ans. is 'b' i.e., Aldosterone [Ref: Dinesh Puri .3rd le p. 626]

305. Which of the following is a weak bond -

a) Covalent bond

b) Peptide bond

c) Disulphide bond

d) Hydrophobic interactions

Correct Answer - D

Ans. is 'd' i.e., Hydrophobic interactions [Ref Harper 28th/e p. 9; Basics of molecular biology p. 786]

- Covalent (strongest)^o > Electrostatic^s (ionic or salt linkage) > hydrogen > hydrophobic > Van de waal's (weakest)Q

306. Earliest symptom of Tay sach disease

a) Exaggerated startle response

b) Bone deformation

c) Hepatomegaly

d) Excessive bleeding

Correct Answer - A

Ans. is 'a' i.e., Exaggerated startle response [Ref Illustrated medical biochemistry p. 330]

Tay-Sach disease

- Clinical symptoms are usually evident in the first year of life
- Initial signs are not dramatic and present as enfeeblement, spasticity and slow development.
- An exaggerated startle response to sound may be the most significant early sign of which a parent is aware.
- Other features are mental retardation, deterioration of vision and early death.

307. Enzyme catalase is found in -

a) Lysosome

b) Mitochondria

c) Peroxisomes

d) Cytosol

Correct Answer - C

Ans. is 'c' i.e., Peroxisomes [Ref Ganong 24th/e p. 40; Harper 28th/e p. 597]

Mitochondria	Inner membrane :- ATP synthase, Succinate dehydrogenase Intermembrane space :- Creatine kinase, Adenyl kinase. Matrix :- Glutamate dehydrogenase, Pyruvate dehydrogenase, enzymes of TCA cycle & (3-oxidation of fatty acids)
Plasma membrane	5'-Nudeotidase, Adenyl cydase, Na+K+ ATPase
Lysosome	Acid phosphatase
Golgi Apparatus	Galactosyl transferase, Golgi mannosidase II, Sialyl transferase, GlcNAc transferase I
Endoplasmic reticulum	Glucose-6-phosphatase
Peroxisome	Catalase, Urate (uric acid) oxidase
Cytosol	Lactate dehydrogenase
Nucleus	DNA

308. Free radical scavenger is

a) Peroxidase

b) Catalase

c) Dehydrogenase

d) All of the above

Correct Answer - B

Ans. is 'b' i.e., Catalase [Ref Robbin's 9th /e p. 48-49]

- Antioxidant enzymes are catalase, superoxide desmutase and glutathione peroxidase.
- These enzyme together act as free radical scavenging system.

309. Phosphorylation of which amino acid does not occur by protein kinase -

a) Asparagine

b) Threonine

c) Serine

d) Tyrosine

Correct Answer - A

Ans. is 'a' i.e., Asparagine [Ref Lehninger 4th/e p. 229]

- Protein kinase mostly add phosphoryl group to a serine, threonine, or tyrosine residues. Some protein kinase target the side chains of histidine, lysine, arginine, aspartic acid and glutamic acid.

310. DNA labelling is done by using

a) Tc-99

b) P-32

c) I-131

d) Co-60

Correct Answer - B

Ans. is 'b' i.e., P-32 [Ref Principles & Techniques of practical Biochemistry p. 115]

- The simplest form of labelling DNA is by 5'- or 3'- end labelling.
- 5`-end - labelling involves a phosphate transfer or exchange reaction where the 5' - phosphate of the DNA to be used as the probe is removed and in its place a labelled phosphate, usually P³² is added.
- In 3'-end-labelling, labelled dNTP (ATP or biotin-labelled dNTP) is added to 3' end of DNA by enzyme terminal transferase.

311. P : O ratio for FAD is -

a) 3

b) 2.5

c) 1.5

d) 4

Correct Answer - C

Ans. is 'c' i.e., 1.5

- The P : O ratio is a measure of the number of high energy phosphates (i.e., number of ATP molecules) synthesized per atom of oxygen consumed or per molecule of water is produced.
- The P : O ratio for oxidation of metabolites that yield NADH is 2.5 and the ratio for those that yield FADH₂ is 1.5.

312. Most important tool used in genetic engineering

a) Genes

b) Enzymes

c) Ribozymes

d) Peptidyl-transferase

Correct Answer - B

Ans. is 'b' i.e., Enzymes [Ref Satyanarayan p. 579]

- Genetic engineering simply means manipulation of genetic material to achieve the desired goal in a predetermined way.
- Most important molecular tools in genetic engineering are enzymes used in recombinant DNA technology. (also called genetic engineering).
- Most important of these enzymes is restriction endonuclease.

313. Chromosomal instability syndrome is

a) Fanconi syndrome

b) Ataxia Telangectasia

c) Bloom syndrome

d) All of the above

Correct Answer - D

Ans. is 'd' i.e., All of the above [Ref Talwar G P p. 855]

- Chromosomal instability syndromes are a group of disorders characterized by chromosomal instability and breakage.

There are :

1. Xeroderma pigmentosa

3. Fanconi syndrome

2. Bloom syndrome

4. Ataxia telangectasia

314. In ETC at which complex ATP is not formed -

a) NADH CoQ reductase

b) Succinate CoQ reductase

c) CoQ-cytochrome-C reductase

d) Cytochrome C oxidase

Correct Answer - B

Ans. is 'b' i.e., Succinate CoQ reductase [Ref Harper 29th p. 123-125 & p. 107; Chatterjea er Shinde 7th p. 134; Vasudevan 4th p. 216]

Complex I: NADH CoQ-reductase	Permit ATP formation (Site I) Act as proton pump
Complex II: Succinate CoQ reductase	No ATP form Permit ATP formation (Site II)
Complex III: CoQ - cytochrome - C reductase	Act as proton pump Permit ATP formation (Site III)
Complex IV: Cytochrome C oxidase	Act as proton pump

315. RNA dependent DNA polymerase is

a) DNA polymerase

b) RNA polymerase

c) Reverse transcriptase

d) Phosphokinase

Correct Answer - C

Ans. is 'c' i.e., Reverse transcriptase

- Reverse transcriptase is an RNA dependent DNA polymerase that produces ds DNA from RNA template. It moves along the template in 3' 5' direction, synthesizing DNA is 5' -> 3' direction.
- It is seen in retro viruses (e.g. HIV).

316. RNA polymerase is

a) DNA dependent RNA polymerase

b) RNA dependent DNA polymerase

c) DNA dependent DNA polymerase

d) RNA dependent RNA polymerase

Correct Answer - A

Ans. is 'a' i.e., DNA dependent RNA polymerase [Ref Harper 29th ed p. 386]

- The major enzyme involved in transcription (i.e. synthesis of DNA to RNA) is RNA polymerase.
- It is DNA dependent RNA polymerase.
- DNA dependent DNA polymerase DNA polymerase (In DNA replication)
- DNA dependent RNA polymerase - RNA polymerase (In transcription)
- RNA dependent DNA polymerase -> Reverse transcriptase (In reverse transcription)

317. If only one terminal aldehyde group of glucose is oxidized, the product is -

a) Glucuronic acid

b) Gluconic acid

c) Glucosaccharic acid

d) Gluconalactone

Correct Answer - B

Ans. is 'b' i.e., Gluconic acid [Ref Chatterjee 8th le p. 29]

Oxidation of sugar

- When aldose sugars are oxidized they may form three different sugar acid, depending upon oxidation of aldehyde group (at C-1) or terminal alcohol group (at C-6).
- .. Aldonic acid :- Oxidation of an aldose with hypobromous acid (HOBr) oxidises only aldehyde group and convert it to carboxyl group to form aldonic acid. For example, glucose is oxidized to gluconic acid.
- 2. Saccharic acid :- Oxidation of aldoses with nitric acid convert both aldehyde and terminal primary alcohol groups to carboxyl group, formic saccharic acid. For example, glucose is oxidize to glucosaccharic acid.
- 3. Uronic acid :- When an aldose is oxidized in such a way that the terminal primary alcohol is converted is to carboxyl without oxidation of aldehyde group, a uronic acid is produce. For example, glucose is oxidized to glucuronic acid.

318. Example of postranslational modification is

a) Methylation

b) Oxidation

c) Phosphorylation

d) Splicing

Correct Answer - C

Ans. is 'c' i.e., Phosphorylation [Ref Harper 29th/e p. 380-391]

Important post-translational modifications are :

- Trimming
- Covalent modification : Phosphorylation, glycosylation hydroxylation, γ -Carboxylation of clotting factor by vitamin K.
- Protein folding and Protein degradation

319. Which of the following are Enantiomers -

a) D-glucose and L-glucose

b) Glucose and galactose

c) Glucose and Mannose

d) d-glucose and 1-glucose

Correct Answer - A

Ans. is 'a' i.e., D-glucose and L-glucose [Ref Harper 29th/e p. 133-134] D and L isomers

- This type of isomerism depends on the orientation of H and OH group around the asymmetric carbon atom just adjacent to terminal primary alcohol (penultimate carbon atom), e.g., carbon atom number 5 in glucose determines whether the sugar belongs to D or L isomer.
- When OH group on this carbon atom is on the right, it belongs to D-series, when it is on left, it is the member of L-series.
- D and L isomers are mirror images of each other.
- These two forms are called enantiomers of each other. Thus, D-glucose and L-glucose are enantiomers of each other.
- Similarly D-mannose and L-mannose, and D-galactose and L-galactose are enantiomers.

All properties of the two members of an enantiomeric pairs (D-or L-series) are identical, they have same boiling point and melting point and the same solubility but they exhibit different optical activity

320. Common function of Golgi apparatus and endoplasmic reticulum

a) Protein synthesis

b) Protein degradation

c) Post-translational modification

d) Glycosylation

Correct Answer - C:D

Ans. is 'd > c' i.e., Glycosylation > Post-translational modification [Ref Harper 29th p. 984]

- Golgi apparatus and ER are involved in glycosylation process.
- Glycosylation is a type of post-translational modification

321. Oxidation without oxygen leads to formation of which product -

a) Pyruvate

b) Fructose

c) Lactate

d) None

Correct Answer - C

Ans. is 'c' i.e., Lactate

- Final product of glycolysis in the absence of O₂ (anaerobic glycolysis) is lactate. Anaerobic glycolysis
- It occurs in the absence of oxygen. The pyruvate is fermented (reduced) to lactate in single stage.
- The reoxidation of NADH (formed in the glyceraldehyde-3-phosphate dehydrogenase step) by respiratory chain is prevented as same NADH is utilized at lactate dehydrogenase step.
- So, there is no net production of NADH. Thus, there is net gain of 2 ATP only.
- Unlike pyruvate which is converted to acetyl CoA to enter into krebs cycle, lactate cannot be further utilized by further metabolic pathways. Thus, lactate can be regarded as dead end in glycolysis.
- Anaerobic glycolysis occurs in exercising skeletal muscle, RBCs, lens, some region of retina, renal medulla, testis and leucocytes.

322. Most important enzyme in DNA replication for chain elongation

a) Helicase

b) DNA polymerase I

c) DNA polymerase III

d) Topoisomerase III

Correct Answer - C

Ans. is 'c' i.e., DNA polymerase III Important DNA Polymerases In Prokaryotes

- **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
- **DNA polymerase II**:- Helps in (i) proof reading (3' 5' exonuclease activity), and (ii) DNA repair.
- **DNA polymerase III** :- It is the main enzyme that synthesizes prokaryote DNA, i.e., synthesis of leading and lagging strand. It has (i) 5' -> 3' polymerase (or simply polymerase) activity for DNA synthesis, and (ii) 3'->5' exonuclease activity for proof reading.

In Eukaryotes

- **DNA polymerase a** :- It has primase activity (i.e. synthesizes RNA primer), and initiates DNA synthesis.
- **DNA polymerase p** :- It is a DNA repair enzyme
- **DNA polymerase y** :- Replicates mitochondrial DNA
- **DNA polymerase ?**:- Helps DNA synthesis on lagging strand, i.e. elongation of okazaki fragments on lagging strand. It also has 5'->3' exonuclease activity for proof reading.

- **DNA polymerase c** :- Helps in DNA synthesis on leading strand. It also has 5'43 'exonuclease activity for proof reading.

323. Allosteric stimulator of glycogen synthase -

a) AMP

b) Insulin

c) Glucose-6-phosphate

d) Glucose

Correct Answer - C

Ans. is 'c' i.e., Glucose-6-phosphate [Ref Harper 29th/e p. 182 & 28th/e p.

324. Which of the following is not required for healing

a) Vitamin C

b) Copper

c) Methionine

d) Sodium

Correct Answer - D

Ans. is 'd' i.e., Sodium [Ref Textbook of Pathology by Krishna p. 410]

Nutrient required for proper wound healing are :

- Minerals: Iron (divalent iron), Manganese, Magnesium, copper, calcium, zinc.
- Vitamins: Ascorbic acid (vitamin C), Retinol (vitamin A), and less importantly riboflavin, pyridoxin, thiamine, tocopherol (vitamin E).
- Protein and amino acids : Methionine and cysteine are most important.

325. Vitamin B₁ is required for which reaction

a) Transamination

b) Oxidative decarboxylation

c) Carboxylation

d) All of the above

Correct Answer - B

Ans. is 'b' i.e., Oxidative decarboxylation [Ref Harper 29th/e p. 534]

- Active form (coenzyme form) of thiamine is thiamine pyrophosphate (TPP), also called thiamine diphosphate (TDP).
- TPP acts as coenzyme for
 - .. Oxidative decarboxylation:- Pyruvate dehydrogenase, α -ketoglutarate dehydrogenase, branched-chain keto acid dehydrogenase.
 - ?. Transketolase in PPP.

326. Least energy producing cycle

a) Glycolysis

b) Krebs's cycle

c) HMP shunt

d) Fatty acid oxidation

Correct Answer - C

**Ans. is 'c' i.e., HMP shunt [Ref Harper 29 /e p. 200-202;
Vasudevan 6th /e p. 116]**

- HMP shunt does not produce energy.
- HMP shunt is particularly important for two purposes :-
 1. Synthesis of ribose for nucleotide and nucleic acid formation.
 2. Formation of NADPH which plays important role in several other biological processes, e.g. synthesis of fatty acids, cholesterol, steroid hormones and neurotransmitters.

327. Ammonia in brain is trapped by

a) Alanine

b) Glutamine

c) Ornithine

d) Aspartate

Correct Answer - B

Ans. is 'b' i.e., Glutamine [Ref Harper 29th ed p. 275]

- The brain is a rich source of glutamine synthase and predominantly detoxifies ammonia by synthesis of glutamine.
- Glutamate + NH₄ → Glutamine synthetase → Glutamine

328. OTC deficiency causes

a) Citrullinemia

b) Argininemia

c) Hyperammonemia type-1

d) Hyperammonemia type-2

Correct Answer - D

Ans. is 'd' i.e., Hyperammonemia type-2

- Orinithine transcarbomylase (OTC) deficiency causes hyperammonemia type-2.

329. Hyperammonemia type-1 is due to deficiency of

a) Arginase

b) Argininosuccinate lyase

c) Argininosuccinate synthase

d) CPS-1

Correct Answer - D

Ans. is 'd' i.e., CPS-1 [Ref Dinesh Puri 3rd ed p. 275]

Disorders caused by genetic defects of urea cycle enzymes

- Hyperammonemia type-I Hyperammonemia type-II Citrullinemia
Argininosuccinic aciduria Arginemia
- **Defective enzyme**
Carbamoyl phosphate synthase-I Ornithine transcarbamoylase
Argininosuccinate synthase Argininosuccinate lyase Arginase
- **Products accumulated**
Ammonia Ammonia Citrulline Argininosuccinate Arginine.

330. Argininosuccinate is synthesized from

a) Citrulline and arginine

b) Arginine and aspartate

c) Citrulline and aspartate

d) Citrulline and fumarate

Correct Answer - C

Ans. is 'c' i.e., Citrulline and aspartate [Ref Harper's 25⁰/e p. 273]

- **Argininosuccinate** is synthesized from citrulline and aspartate in **Urea cycle**.

331. Edman's reagent is

a) 2-4 dinitrophenol

b) 1-fluoro-2, 4-dinitrobenzene

c) Phenyl-isocyanate

d) Cyanogen bromide

Correct Answer - C

Ans. is 'c' i.e., Phenyl-isocyanate

- Determination of amino acid sequence (sequence analysis) is performed by **Edman degradation method** on automatic machines, called cyclic sequencers. **Edman's reagent is phenyl-isothiocyanate**, and forms a covalent bond to N-terminal of amino-acid. This can be identified.
- Sanger's reagent (1-fluoro-2,4-dinitrobenzene) can be used in place of Edman's reagent.

332. Imidazole ring is present in

a) Tryptophan

b) Arginine

c) Histidine

d) Tyrosine

Correct Answer - C

Ans. is 'c' i.e., Histidine [Ref Lehinger 2nd ed p.80]

Some amino acids contain a special functional group in their side chain which provide some specific functions to that amino acids. These are :

- Hydroxyl group in serine and threonine → **Indole ring in tryptophan**
- Amide group in asparagine and glutamine → (3-Carboxyl in glutamic acid)
- Thioether in methionine → Imidazole in histidine
- Sulphydryl in cysteine → Phenol in tyrosine
- γ -carboxyl in glutamic acid → Pyrrolidine in proline
- **Guanidinium in arginine** → ϵ -amino in lysine

333.

Fatty acid elongation occurs in which part of cell -

a) Cytosol

b) Mitochondria

c) Lysosome

d) Nucleus

Correct Answer - B

Ans. is 'b' i.e., Mitochondria

- There is one step (occurring in cytosol) in synthesis of fatty acid called elongation which involves elongation of synthesizing fatty acid chain by adding carbon atoms.
- But this is not elongation of fatty acid, it is elongation of incompletely synthesized fatty acid chain which leads to formation of a fatty acid (not elongation of fatty acid) The final product is a fatty acid and only after completion of this the product becomes fatty acid.
- Elongation of fatty acid refers to elongation of chain of already existing (or full synthesized) fatty acid. This occurs in microsomes (smooth ER) and mitochondria.

334. Histidine is the most important amino acid for buffering in normal conditions because

a) It regulates kidney acid-base balance

b) PKa value is higher than pH

c) PKa value is closer to pH

d) PKa value is very low

Correct Answer - C

Ans. is 'c' i.e., PKa value is closer to pH [Ref Harper 29th/e p. 20, 21 & 28th/e p. 17, 18; Vasudevan 6' p. 22, 23]

- Maximal buffering capacity occurs at pH equal to pka of buffer.
- Therefore, to work as a best buffer at physiological pH amino acid should have pka value close to physiological pH (7.4).
- Amino acids can have buffering action due to three ionizable groups :
 1. **a-carboxyl group** :- Different amino acids have pka value of a-carboxyl group between 3.5-4. So, carboxyl group of amino acids has maximum buffering capacity between pH 3.5-4.
 2. **a-amino group** :- Different amino acids have pka value of a-amino group between 8.0-9.0. Thus, a-amino group has maximum buffering capacity between pH 8.0-9.0.
 3. **Special ionizable group (in some amino acids)**:- Among special ionizable group of amino acids, imidazole group of histidine has pka value 6.5-7.4, which is closest to physiological pH. Hence, histidine (due to imidazole group) has maximum buffering capacity at physiological pH.

335. Acidic property to α -carbon of amino acid is due to

a) Carboxyl group

b) Amino group

c) Hydrogen atom

d) None

Correct Answer - A

Ans. is 'a' i.e., Carboxyl group

- The acid base properties of amino acids depend on the amino and carboxyl groups attached to the α -carbon.
- The carboxyl ($-\text{COOH}$) group of an amino acid can donate proton (H^+) and behave as an acid forming a negatively charged anion (COO^-).
- Amino group ($-\text{NH}_2$) can accept proton (H^+) and behave as a base, forming positively charged cation (NH_3^+).

336. Barth syndrome is due to defect in -

a) Thermogenic

b) Cardiolipin

c) Ubiquinone

d) Cytochrome

Correct Answer - B

Ans. is 'b' i.e., Cardiolipin [Ref Biochemistry by Roger Mc Loed p. 27]

- Barth syndrome is an X-linked recessive disorder due to mutation in *tafazzin gene (TAZ)*.
- The mutation leads to abnormal structure or deficiency of cardiolipin, a mitochondrial structural phospholipid.
- This results in mitochondrial dysfunction

337. What will happens to structure of alpha-helix if L-alanine is replaced by d-alanine alternatively

a) Change in optical activity

b) Interruption of structure

c) Increased stereoisomerism

d) Increased stability

Correct Answer - B

Ans. is 'b' i.e., Interruption of structure

- D-amino acid would interrupts an α -helix made of L-amino acid.
- D-amino acid substitution in α -helix causes a local change in structure and flexibility at the substituted site, which leads to destabilization

338. Glycolipids are formed in -

a) Mitochondria

b) Cytosol

c) Peroxisomes

d) Endoplasmic reticulum

Correct Answer - D

Ans. is 'd' i.e., Endoplasmic reticulum [Ref David E Metzler p. 1168]

- Like the glycoproteins, glycolipids (glycosphingolipids) are synthesized in the endoplasmic reticulum, then transported into the golgi apparatus and eventually outward to join the outer surface of plasma membrane.

339. Beta oxidation of very long chain fatty acids occurs

a) Cytoplasm

b) Endoplasmic reticulum

c) Lysosome

d) Peroxisomes

Correct Answer - D

Ans. is 'd' i.e., Peroxisomes [Ref Harper 28th /e p. 185, 195]

340. Which apoprotein is the most important to activate lipoprotein lipase -

a) Apo-A I

b) Apo B48

c) Apo-C II

d) Apo-E

Correct Answer - C

Ans. is 'c' i.e., Apo-C II

- Major activator of lipoprotein lipase is apo-CII

341. In ETC complex-4 is inhibited by all except ?

a) CO

b) CN

c) H₂S

d) BAL

Correct Answer - D

Ans. is 'd' i.e., BAL [Ref Harper 29th le p. 127 & 28th le p. 108, 109; Vasudevan 6th le p. 234]

Complex I :- Barbiturates (amobarbital), piercidin A, rotenone, chlorpromazine, guanithidine.

342. Isomer differences of position of -H and -OH at 2'', 3', and 4' carbon atom of glucose are called?

a) Optical isomers

b) Epimers

c) Anomers

d) D,L isomers

Correct Answer - B

Ans. is 'b' i.e., Epimers [Ref Harper 29thie p. 133-135]

- Isomers differing as a result of variations in configuration of the -OH and -H on carbon atoms 2, 3, and 4 of glucose are known as epimers.
- Biologically, the most important epimers of glucose are mannose and galactose, formed by epimerization at carbons 2 and 4, respectively

343. Homocystein is not associated with ?

a) Coronary artery disease

b) Fracture

c) Hearing loss

d) Neuropsychiatric manifestations

Correct Answer - C

Ans. is 'c' i.e., Hearing loss

Elevated level of homocysteine (hyperhomocysteinemia) is associated with -

- Thrombosis, coronary artery disease & stroke.
- Osteoporosis & fracture.
- Neuropsychiatric manifestations.
- Developmental delay.
- Visual disturbances.

344. Final common pathway of metabolism of carbohydrates, lipids and protein metabolism is ?

a) TCA cycle

b) Glycogenesis

c) Gluconeogenesis

d) None of the above

Correct Answer - A

Ans. is 'a' i.e., TCA cycle [Ref Harper 29th/e p. 190, 175]

- Tricarboxylic acid (TCA) cycle is a series of reactions through which final oxidation of acetyl CoA to CO₂ and H₂O occurs along with generation of ATP.
- TCA cycle is the final common pathway of the oxidation of the acetyl CoA, formed from carbohydrates, fatty acids and amino acids.
- It provides electrons which are transferred to ETC where they help in the formation of ATP.

345. Amphibolic cycle is ?

a) Citric acid cycle

b) Glycolysis

c) Protein synthesis

d) Lipolysis

Correct Answer - A

Ans. is 'a' i.e., Citric acid cycle

Metabolic pathways fall into three categories :?

- **Anabolic pathways:-** Involved in synthesis of larger and more complex compounds from smaller precursors, e.g. synthesis of protein from amino acids, triglyceride synthesis, cholesterol synthesis, etc.
- **Catabolic pathway:-** Involved in the breakdown of larger molecules, commonly involving oxidative reaction.
- They are exothermic reactions producing reducing equivalents and mainly via the ETC, ATP. Example are glycolysis, 13-oxidation of fatty acid etc.
- **Amphibolic pathway:-** occur at the "crossroads" of metabolism, acting as links between the anabolic and catabolic pathways, eg. the *citric acid cycle*.

346. In TCA cycle, NADH is produce at all sites except -

a) Isocitrate dehydrogenase

b) Succinate dehydrogenase

c) Malate dehydrogenase

d) a Ketoglutarate dehydrogenase

Correct Answer - B

Ans. is 'b' i.e., Succinate dehydrogenase [Ref: Harper 28th/e p. 155, 145]

NADH is produced and CO₂ is liberated at 3 steps :

1. Conversion of isocitrate to a-ketoglutarate by isocitrate dehydrogenase
2. Conversion of a-ketoglutarate to succinyl CoA by a-ketoglutarate dehydrogenase
3. Conversion of L-malate to oxaloacetate by malate dehydrogenase.

347. Thermogenin is present in ?

a) Cytoplasm

b) Mitochondria

c) Ribosome

d) Nucleus

Correct Answer - B

Ans. is 'b' i.e., Mitochondria [Ref Vasudevan p. 234, 235; Essentials Biochemistry p. 333]

- Thermogenin is found in mitochondria of brown adipose tissue.
- Thermogenin is an uncoupler protein present in 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.
- Oxidation occurring in brown adipose tissue without generation of ATP results in production of heat.

348. TCA is not controlled by ?

a) NADH

b) ATP

c) NADPH

d) ADP

Correct Answer - C

Ans. is 'c' i.e., NADPH [Ref Chatterjee & Shinde 7th/e p. 171,166-180; Harper 28th/e p. 145-147]

Enzyme

Allosteric inhibitors

Citrate synthase

ATP, long chain acyl-CoA, succinyl-CoA

Isocitrate dehydrogenase
ADP

ATP, NADH

α -ketoglutarate
dehydrogenase

NADH, succinyl CoA

349. Source of ribose is ?

a) HMP shunt

b) Glycolytic pathway

c) Uronic acid pathway

d) Beta oxidation

Correct Answer - A

Ans. is 'a' i.e., HMP shunt [Ref Harper 28th/e p. 174-176]

HMP shunt is particularly important for two purposes :-

1. Synthesis of ribose for nucleotide and nucleic acid formation.
2. Formation of NADPH which plays important role in several other biological processes, e.g. synthesis of fatty acids, cholesterol, steroid hormones and neurotransmitters.

350. Major site of protein glycosylation is ?

a) ER and golgi body

b) Ribosome and golgi body

c) ER and ribosome

d) Ribosome and cytoplasm

Correct Answer - A

Ans. is 'a' i.e., ER and golgi body [Ref Harper 28thVe p. 514, 515; Lippincotts 5thle p. 167,168]

- N- Glycosylation occurs in ER and O-glycosylation occurs in golgi apparatus.

351. Which is an omega-9 fatty acid ?

a) Arachidonic acid

b) Oleic acid

c) Linolenic acid

d) Cervonic acid

Correct Answer - B

Ans. is 'B i.e., Oleic acid [Ref Harper 28"/e p. 123]

352. Complex-I in electron transport chain is ?

a) NADH - CoQ reductase

b) CoQ - cytochrome C reductase

c) Cytochrome-C oxidase

d) None of the above

Correct Answer - A

Ans. is 'a' i.e., NADH - CoQ reductase [Ref Chatterjee er Shinde 7th /e p. 134]

Components of ETC are :?

- 1. Complex I (NADH - CoQ reductase) catalyzes the transfer of electron from NADH to coenzyme Q (CoQ).**
- 2. Complex II (Succinate - CoQ reductase or succinate dehydrogenase) transfers electrons from succinate to coenzyme Q.**
- 3. Complex III (CoQ - cytochrome C reductase), transfers electron from CoQ to cytochrome C.**
- 4. Complex IV (cytochrome C oxidase) transfers electrons from cytochrome C to O₂.**

353. If FADH₂ provides reducing equivalents to electron transport chain then ATP formed will be ?

a) 1.5

b) 2.5

c) 3.5

d) 4.5

Correct Answer - A

Ans. is 'a' i.e., 1.5 [Ref Harper 28th/e p. 106, Vasudevan 5th/e p. 231]

ATP generation by oxidation of	Presently accepted	Old values
NADH	2.5	3
FADH ₂	1.5	2
Glucose	32	38
Acetyl CoA	10	12
Palmitate	106	129

354. Methylation Vitamin H is also known as ?

a) Cobalamin

b) Biotin

c) Pyridoxine

d) Folate

Correct Answer - B

Ans. is 'b' i.e., Biotin [Ref Clinical biochemistryrpm P. 123]

- **Biotin is also known as vitamin B7 or vitamin H.**

355. Lineweaver-Burk plot represents which of the following?

a) Oxygen dissociation

b) CO diffusion

c) Enzyme kinetics

d) Logarithmic index of DNA replication

Correct Answer - C

Ans. is 'c' i.e., Enzyme kinetics [Ref Clinical biochemistry 3rd /e p. 112]

- **Lineweaver Burk plot, also called double reciprocal plot represents lineweaver - burk equation of enzyme kinetics.**
- **It is used to determine the values of Vmax and Km.**

356. Uric acid is formed in humans in -

a) Liver

b) GIT mucosa

c) Kidney

d) Joints

Correct Answer - B

Ans. is 'b' i.e., GIT mucosa [Ref Dinesh puri 3rd/e p. 429]

- **Uric acid is produced in intestinal mucosal cells from dietary purines.**
- **The sources of purine nucleotides in the body are :?**
 - 1. Synthesis of purine rings by body itself.**
 - 2. Presence of purines in diet (dietary purines).**
- **this the usual source of purines also pyrimidines for the use of body.**
- **Human body is capable of synthesizing the purine and the pyrimidine rings de novo (anew) and also by salvaging (recycling) the nitrogenous bases arising from degradation of nucleic acid.**
- **Brain, RBCs and polymorphonuclear leucocytes cannot produce purines by de novo synthesis. Almost all other cells can produce purines by de novo synthesis**

357. Enzyme marker for pancreas ?

a) CPK

b) Amylase

c) SGOT

d) ALt

Correct Answer - B

Ans. is 'b' i.e.,Amylase [Ref Chatterjee Shinde 7¹Ve p. 600-605]

358. Octant rule is related to ?

a) Spectroscopy

b) Chromatography

c) Electroscopy

d) None

Correct Answer - A

Ans. is 'a' i.e., Spectroscopy [Ref en.wikipedia.org.]

- **Ultraviolet visible spectroscopy (UV-vis) can distinguish between enantiomers by showing a distinct Cotton effect for each isomer.**
- **UV-vis spectroscopy sees only chromophores, so other molecules must be prepared for analysis by chemical addition of a chromophore such as anthracene.**
- **Two methods are reported : the octant rule and the excitation chirality method.**

359. strand Hydrophobic amino acid is ?

a) Alanine

b) Tyrosine

c) Glycine

d) Histidine

Correct Answer - A

Ans. is 'a' i.e., Alanine [Ref Vasudevan 6th le p. 20-24; Harper 28th le p. 15-20]

Polar (hydrophilic) amino acids

- **Negatively charged (acidic) :- Aspartic acid (aspartate), glutamic acid (glutamate)**
- **Positively charged (basic) :- Histidine, lysine, arginine**
- **Uncharged (neutral) :- Asparagie, Cysteine, glycine, glutamine, serine, threonine, tyrosine**

Non-polar (hydrophobic) amino acids

- **With aliphatic chain :- Alanine, isoleucine, leucine, methionine, proline, valine**
- **With aromatic side chain :- Phenylalanine, tryptophan**
- **Tyrosine and cysteine may show hydrophobic (non-polar) character when present in the interior of protein**

360. True about membranes is all except -

a) Dynamic & asymmetric

b) Lipid soluble moiety on outer & inner surface

c) Lipid soluble moiety within the membrane

d) Lipid rafts are characteristic features

Correct Answer - B

Ans. is 'b' i.e., Lipid soluble moiety on outer & inner surface

- **The membrane that surrounds the cell is called cell membrane. It is approximately 7.5-10 nanometer thick.**
- **It is composed almost entirely of proteins and lipids . Carbohydrates are minimal and occurs almost invariably in combination with proteins or lipids in the form of glycoproteins or glycolipids.**
- **Phospholipid of cell membrane has two ends. One end is soluble in water, i.e., hydrophilic (polar); and the other end is soluble in lipid, i.e., hydrophobic (non-polar).**
- **The phosphate end of phospholipid is hydrophilic and the fatty acid portion is hydrophobic.**
- **The phospholipid molecules arrange themselves as a bilayer, with polar (hydrophilic) end lies at the internal or external side of membrane and nonpolar (hydrophobic) end lies in the central portion of membrane, facing each other. Therefore, hydrophilic end faces ECF and ICF both.**
- **The cell membranes contain combinations of glycosphingolipids and protein receptors organized in glycolipoprotein microdomains termed lipid raft.**

- **Membranes are asymmetrical structures and their components are dynamic**

361. Transketolation mRNA is complementary to ?

a) Coding strand

b) Non-template strand

c) Non-coding strand

d) Sense

Correct Answer - C

Ans. is 'c' i.e., Non-coding strand [Ref Essentials Biochemistry p. 812]

- **DNA is a double-stranded molecule. Each strand is a polymer of nucleotides (deoxyribonucleotides). Each strand possesses a**
- **polarity. It has a 3' end and a 5' end. The two strands are antiparallel, i.e. they are parallel but run in opposite directions.**
- **The DNA 'sense (coding) strand' itself is not used to make protein. It is the DNA antisense (non-coding) or template strand which serves as the source for protein code, because, it is used as a template for the mRNA. Since transcription result in formation of mRNA which has base sequence complementary to template strand, its base sequence is same as for coding (non-template) strand.**
- **mRNA is used for translation (protein synthesis). So, mRNA is a complementary copy of template strand (non coding) and is exactly similar to non-template (coding) strand, except. Uracil is there instead of thymine.**



362. Endoplasmic reticulum is not involved in ?

a) Protein synthesis

b) Steroid synthesis

c) DNA synthesis

d) Triglyceride synthesis

Correct Answer - C

Ans. is 'c' i.e., DNA synthesis [Ref Pankaj Naik p. 2]

Endoplasmic reticulum are involved in :-

- 1. Rough ER : Protein synthesis (hormones, enzymes etc.)**
- 2. Smooth ER: Triglyceride synthesis, steroid synthesis, cholesterol synthesis, Phospholipid synthesis, fatty acid chain elongation.**

363. proteins Pyridoxine is involved in ?

a) Carboxylation

b) Trans-sulfuration

c) Oxidation-reduction

d) Transketolation

Correct Answer - B

Ans. is 'b' i.e., Trans-sulfuration [Ref Harper 29th le p. 533]

- **Pyridoxine is involved in transamination, deamination, decarboxylation, condensation and trans-sulfuration.**

364. Which of the following is not an oxidoreductase -

a) Catalase

b) Glucokinase

c) Alcohol dehydrogenase

d) Peroxidase

Correct Answer - B

Ans. is 'b' i.e., Glucokinase [Ref: Chatterjee 8th le p. 123; Harper 28th le p. 52]

- **Oxidoreductases are oxidases, dehydrogenases, hydroperoxidases (Catalase, peroxidase), oxygenases.**
- **Glucokinase is a transferase.**

365. Enzyme does not act by ?

a) Increasing the rate of reaction

b) Catalyzing the reaction

c) Increasing activation energy

d) Forming non-covalent interactions

Correct Answer - C

Ans. is 'c' i.e., Increasing activation energy

- **Enzymes increase the rate of a biochemical reaction, therefore they are called catalysts of reaction.**
- **Now the question arises that how does they do that?**
- **In a chemical reaction, the substrate has to be converted to a higher energy form (called transition form) before it can form the reaction products.**
- **The transition state is structurally an intermediate between the substrate and the product, and represents the highest energy arrangement of atoms.**
- **Therefore, it is unstable; once formed, it decomposes almost immediately to form the reaction product.**
- **So, this high energy intermediate acts as energy barrier, separating the substrates and the products.**
- **This barrier, called the free energy of action, is the energy difference between the energy of the substrates and high energy intermediates.**
- **In other words, initially some energy must be put into the substrate for conversion into transition state (high-energy intermediate); this is the free energy of activation.**
- **The enzymes speed up the chemical reaction by lowering**

the magnitude of the activation energy barrier, i.e., free energy of activation.

- **Most enzyme-substrate combinations are mostly due to weak non-covalent interactions like hydrogen bond, hydrophobic interactions, ionic (electrostatic) interaction and Vander waals forces.**
- **However, covalent catalysis involves the formation of a covalent bond between the amino acyl residues of active site of enzyme and substrate.**
- **Covalent catalysis is used by serine proteases (trypsin, chymotrypsin) which bind their substrate covalently at serine side chain.**

366. None Not seen in alpha helix ?

a) Alanine

b) Leucine

c) Proline

d) Isoleucine

Correct Answer - C

Ans. is 'c' i.e., Proline [Ref: Harper 28th le p. 33]

- **Proline is never found in a-helix as it has imino group (-NH) not amino (-NH₂).**
- **Thus it cannot provide hydrogen for hydrogen bonding, the major stabilizing force of a-helix.**
- **Glycine also tends to disrupt a-helix; because of its high flexibility and small size it often induces bends in a-helix.**

367. Electron transport from cytochrome 'b' to cytochrome 'c' is inhibited by ?

a) Oligomycin

b) Antimycin

c) Piericidin

d) Carbon monoxide

Correct Answer - B

Ans. is 'b' i.e., Antimycin [Ref Harper 28th/e p. 109]

- **Cytochrome b to cytochrome c₁ (complex III) is inhibited by dithionite, antimycin A, BAL and naphthoquinone.**

368. Phospholipids are ?

a) Simple lipids

b) Derived lipids

c) Complex lipids

d) None

Correct Answer - C

Ans. is 'c' i.e., Complex lipids

The most commonly used classification of lipids is Bloor's classification which is based on the chemical composition. According to this classification lipids are classified as follows :?

A) Simple lipids:- These are esters of fatty acids with glycerol or other higher alcohol. These include:?

- Neutral fats (Triacylglycerol or triglycerides)
- Waxes

B) Compound or complex lipids:- These are fatty acids esterified with alcohol, but in addition they contain other group (prosthetic group). These include phospholipids, glycolipids (glycosphingolipids), lipoprotein.

c) Derived lipids:- Derived lipids include compounds (products) obtained after the hydrolysis of simple or compound lipids which possess the characteristics of lipids, eg. fatty acid, steroids, cholesterol, Lipid soluble vitamins and hormones, prostaglandins, leukotrienes, terpens.

369. Ribonuclease-P is a ?

a) Ligase

b) Ribonuclease

c) Ribozyme

d) Ribosome

Correct Answer - C

Ans. is 'c' i.e., Ribozyme [Ref Lippincott's 4th/e ch. 30]

There are five classes of ribozymes :

- 1. Ribonuclease P**
- 2. Hammerhead**
- 3. Tetrahymena group I intron**
- 4. HDV ribozyme**
- 5. Hairpin ribozyme**

370. Which has least density ?

a) LDL

b) Chylomicrons

c) HDL

d) VLDL

Correct Answer - B

Ans. is 'b' i.e., Chylomicrons [Ref: Chatterjea Shinde 8thie p. 445,446]

- **HDL :- Has maximum electrophoretic mobility, has maximum density, has minimum lipid content, has maximum protein (apoprotein) content, are smallest in size, has maximum phospholipid, has minimum triglycerides.**
- **Chylomicrons :- Have no electrophoretic mobility, have minimum density, have maximum lipid content, have minimum protein content, are largest in size, have minimum phospholipids, have maximum triglycerides.**

371. Which is not a step of PCR ?

a) Annealing

b) Extension

c) Transformation

d) Denaturation

Correct Answer - C

Ans. is 'c' i.e., Transformation [Ref Lippincott's 5th ed p. 479-83; Harper 28th/e p. 395] Steps in PCR

- **Isolation of target DNA sequence → Primer construction → Denaturation of DNA → Annealing of primers to single stranded DNA → Chain extension.**

372. Severe hypoglycemia, increased uric acid and renal failure are seen in ?

a) Carbohydrate metabolic disorder

b) Glycogen storage disorder

c) Lipoprotein deficiency disorder

d) Protein folding disorder

Correct Answer - B

Ans. is 'b' i.e., Glycogen storage disorder [Ref Nelson 18th le table. 81.1, Harper 27th/e ch. 33]

These symptoms are seen in Von-Gierhe disease (a glycogen storage disease), which is characterized by

- 1. Severe fasting hypoglycemia**
- 2. Fatty liver with hepato and renomegaly**
- 3. Progressive renal disease**
- 4. Growth retardation and delayed puberty**
- 5. Hyperlacticacidemia, hyperlipidemia, hyperuricemia**

373. Which of the following is not a test for amino acids?

a) Biuret test

b) Xanthoproteic reaction

c) Ninhydrin test

d) Molisch's test

Correct Answer - D

Ans. is 'd' i.e., Molisch's test [Ref Chatterjea 5th/e p. 87]

Tests for amino acids are :?

- **Ninhydrin test : - All α -amino acids.**
- **Xanthoproteic reaction : - Aromatic amino acids (Tyrosine, tryptophan, phenylalanine).**
- **Milan's test (Millon-Nasse reaction): - Tyrosine (phenol group of tyrosine). Therefore millon's test is positive in tyrosinosis.**
- **Aldehyde test : - Tryptophan (indole ring)**
- **Hopkins-cole reaction : - Tryptophan (indole ring)**
- **Sakaguch's reaction : - Arginine (guanidinium group of arginine).**
- **Sulphur test : - Cysteine (sulphydryl group)**
- **Nitroprusside test : - Cysteine (sulphydryl group)**
- **Pauly's test : - Histidine (imidazole group)**
- **Biuret reaction : - Peptide bond.**

374. Amino acid used in the synthesis of purines ?

a) Glycine

b) Ornithine

c) Alanine

d) Threonine

Correct Answer - A

Ans. is 'a' i.e., Glycine [Ref Harper 29th le p. 332]

- **Amino acids involved in purine synthesis - *Glycine, aspartate, glutamine.***
- **Amino acids involved in pyrimidine synthesis → Glutamine, aspartic acid (aspartate).**

375. Covalent bond is seen in ?

a) Hydrogen bond

b) Disulphide bond

c) Electrostatic bond

d) Ionic bond

Correct Answer - B

Ans. is 'b' i.e., Disulphide bond [Ref Harper 28th/e p. 9; Basics of molecular biology p. 786]

There are two types of interactions between molecules that stabilize molecular structure ?

1) Covalent bonds: These are the strongest bonds.

Examples are :?

- Peptide bonds
- Disulphide bonds

2) Non-Covalent bonds: These are relatively weak bonds.

Examples are :?

- Electrostatic interactions (ionic bonds or salt bridges)
- Hydrogen bonds
- Hydrophobic interactions
- Van Der Waal's forces (weakest bonds)

376. Glycine provides all in purine synthesis, except ?

a) Carbon - 4

b) Carbon - 5

c) Nitrogen - 4

d) Nitrogen - 7

Correct Answer - C

Ans. is 'c' i.e., Nitrogen - 4 [Ref: Harper 29th/e p. 232]

- In de novo synthesis, purine ring is formed from variety of precursors is assembled on ribose-5-phosphate. Precursors for de novo synthesis are ?
 1. Glycine provides C4, Cs and N7
 2. Aspartate provides N1
 3. Glutamine provides N3 and N9
 4. Tetrahydrofolate derivatives furnish C2 and Cs
 5. Carbon dioxide provides C6

377. Not a nucleic acid test?

a) Western blot

b) Southern blot

c) Northern blot

d) Microarray

Correct Answer - A

**Ans. is 'a' i.e., Western blot [Ref Lehninger 5th/e p. 325-28;
Lippincott's 5thle p. 483-85]**

378. Which does not play a role in protein synthesis?

a) Exon

b) Intron

c) m-RNA

d) ATP

Correct Answer - B

Ans. is 'b' i.e., Intron [Ref Lippincott's ^{5th} p. 426]

- **Primary transcript contains introns & exons. Splicing removes introns (segment of gene that is not represented in mature m-RNA) from primary transcript.**
- **Synthesis of protein from mRNA is called translation. Translation is the process by which ribosomes convert the information (genetic code) carried by mRNA to the synthesis of new protein.**
- **Translation occurs in ribosomes. Basic requirements for translation include mRNA, tRNAs, ribosomes, energy (ATP and GTP), enzymes, and specific protein factors like initiation factors, elongation factors etc.**

379. What supplies ammonia to liver ?

a) Arginine

b) Alanine

c) Lactate

d) Pyruvate

Correct Answer - B

Ans. is 'b' i.e., Alanine [Ref Harper 28th/e p. 170]

Transport of alanine from muscle to liver (glucose-alanine cycle) has two functions :?

- 1. Providing substrate for gluconeogenesis**
- 2. Transport of ammonia (NH_4^+) to liver for urea synthesis.**

380. Isoelectric point of a protein is located by which method?

a) Isoelectric pointing

b) Isoelectric cardiac failure

c) Ion exchange

d) pH

Correct Answer - B

Ans. is 'b' i.e., Isoelectric cardiac failure [Ref Lehninger 4thie p. 93-94]

- **Isoelectric focusing is a procedure used to determine the isoelectric point (pI) of a protein.**
- **A pH gradient is established by allowing a mixture of low molecular weight organic acids and bases to distribute themselves in an electric field generated across the gel.**
- **When a protein mixture is applied, each protein migrates until it reaches the pH that matches its pI.**
- **Proteins with different isoelectric points are thus distributed differently throughout the gel.**

381. In liver ammonia is formed from which amino acid ?

a) Glycine

b) Glutamine

c) Isoleucine

d) Proline

Correct Answer - B

Ans. is 'b' i.e., Glutamine [Ref Read below] Transport of ammonia

- **Ammonia is produced in most of the tissues. However, it should be transported to liver as urea cycle (formation of urea) occurs only in liver. Since free ammonia is highly toxic, it is never transported in free form in blood. Two mechanisms are available for transport of ammonia from the peripheral tissues to the liver :**
 - 1) In the form of glutamine**
- **In many tissues like liver, kidney and brain, ammonia combines with glutamate to yield glutamine, by the action of glutamine synthase. The brain is a rich source of glutamine synthase and it predominantly detoxifies ammonia by this route**
- **Glutamine is a nontoxic major transport form of ammonia. The glutamine is transported by blood to liver where deamination (removal of amino group) of glutamine takes place. Glutaminase cleaves glutamine to yield glutamate and free ammonia ammonium ion). "[he ammonia is**

converted by liver to urea.

- **Formation and secretion ammonia by renal tubular cells maintain acid base balance. Ammonia is formed from glutamine by glutaminase. Excretion of ammonia increases in metabolic acidosis and decreases in metabolic alkalosis.**
- 2) **In the form of alanine**
- **Alanine transports ammonia from muscles to liver through glucose-alanine cycle'.**
- **In muscle, glutamate is formed from ammonia and α -ketoglutarate by reversal of the glutamate dehydrogenase reaction. L-glutamate then transfers its α -amino group to pyruvate by transamination reaction to form alanine.**
- **Alanine is transported to liver. In liver alanine is converted to pyruvate and glutamate by transamination reaction. Glutamate undergoes oxidative deamination to release free ammonia, which is converted to urea.**

382. All are actions of HDL EXCEPT ?

a) Reverse transport of cholesterol to liver

b) Apolipoproteins storage

c) Transfer of malate into mitochondria

d) Esterification of cholesterol

Correct Answer - C

Ans. is 'c' i.e., Transfer of malate into mitochondria [Ref Lippincott's 4th/e p. 234-236]

HDL has following important function -

- **Reservoir of apolipoproteins (apo C-II and apo E)**
- **Esterification of cholesterol**
- **Reverse cholesterol transport from tissue to liver**
- **Uptake of unesterified cholesterol**

383. Pyridoxine deficiency leads to altered metabolism of?

a) Phenylalanine

b) Tryptophan

c) Methionine

d) Tyrosine

Correct Answer - B

Ans. is 'b' i.e., Tryptophan [Ref Dineshpuri 3rd le p. 378]

- **Tryptophan load test is used for pyridoxin.**
- **In pyridoxin (vitamin B₆) deficiency, xanturenic acid excretion is increased after giving tryptophan load dose.**

384. In which form are bile acids present in body ?

a) Weak acids

b) In ionized form

c) In salt form

d) In esterified form

Correct Answer - C

Ans. is 'c' i.e., In salt form [Ref Clinical biochemistry 3rd e,p 815]

- **Bile acids are mainly presents as sodium or potassium salts which are conjugated with glycine or taurine to form bile salts.**
- **Primary bile acids are *cholic acid* and *chenodeoxycholic acid*, which are synthesized from cholesterol in liver.**
- **In the intestine some of the primary bile acids are converted into secondary bile acids, i.e., *deoxycholic acid* (formed from cholic acid) and *lithocholic acid* (derived from chenodexoxycholic acid).**
- **Glycine and taurine conjugates of these bile acids are called as bile salts. For example, cholic acid is a bile acid, and its glycine conjugate (glycocholic acid) is a bile salt.**
- **Bile salts = Sodium or potassium + Amino acid (glycine or taurine) + Bile acids (Cholic acid or chenodeoxycholic.**

385. Protein structure not lost in denaturation is ?

a) Primary structure

b) Secondary structure

c) Tertiary structure

d) Quaternary structure

Correct Answer - A

Ans. is 'a' i.e., Primary structure

- **The term denaturation refers to disruption of higher order (secondary, tertiary and quaternary) structure of protein.**
- **All non-covalent bonds that maintain higher order structure are disrupted, but peptide bond (covalent bond) remains intact. Thus, the primary structure is not altered during denaturation, i.e., amino acid sequence is not altered, but denaturation may completely disrupt secondary, tertiary and quaternary structure, e.g., denaturated oligomeric proteins dissociated into subunits, each with a random coil formation.**
- **Denaturation is always accompanied by a loss of biological function, e.g., enzymes are inactivated and antibodies fail to act with antigens.**
- **Denaturation is generally irreversible, e.g., boiled egg does not regain its original form when kept in cold.**
- **Denatured proteins are *less soluble* and in many cases they precipitate.**
