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Unit-1.1: Structure of Atoms, Molecules & Chemical Bonds

[MH-2011-AUG]

- Which of the following properties of water makes it a universal solvent?
(A) Hydrophobic bonds formed between water and fatty acids
(B) Strong covalent bonds formed between water and salts
(C) High dielectric constant of water
(D) Hydrogen bonds formed between water and biochemical molecules

[MH-2011-AUG]

- Osmotolerant yeasts are able to grow at high salt concentrations because their cytoplasm contains high concentration of:
(A) Divalent cations (B) Lipids
(C) Amino acids (D) Polyalcohols

[RJ-2012]

- Which molecular orbital has the highest energy out of the following?
(A) σ^* (1s) (B) σ ($2p_x$)
(C) σ (2s) (D) π^* ($2p_y$)

[JK-2013]

- In polysaccharides, monosaccharides are linked together by:
(A) Peptide bonds
(B) Hydrogen bonds
(C) Glycosidic linkages
(D) Phosphodiester linkages

[AP-2014]

- Among the following compounds which two components cannot form hydrogen bonds with water.
i. Methanol
ii. Toluene
iii. Methyl acetate
iv. Hexane
(A) (i) and (iii) are correct
(B) (ii) and (iv) are correct
(C) (ii) and (iii) are correct
(D) (i) and (iv) are correct

[MH-2015]

- Water is effective in screening the electrostatic interactions between dissolved ions because it has

- (A) a high dielectric constant
(B) a high fluidity property
(C) a high electrical conductivity
(D) a neutral pH value

[MH-2015]

- When two uncharged atoms are brought very close together, the two nuclei are said to be in van der Waals contact, when the net:
(A) attraction is maximum
(B) repulsion is maximum
(C) attraction is equal to repulsion
(D) attraction is minimum

[WB-2015]

- The energy is most favourable at the van der Waals contact distance. Owing to electron-electron repulsion, the energy rises rapidly as the distance between the atoms becomes shorter than the
(A) Contact distance (B) Polar distance
(C) Bond length (D) Electric dipole

[CG-2017]

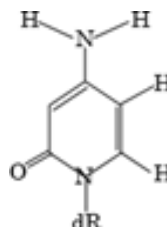
- Which of the following covalent bond types are found in the structure of 'ATP'
(A) N-glycosidic, thioester phosphodiester
(B) Phosphoanhydride, phosphomonoester, N-glycosidic
(C) Ester, ether, phospho anhydride
(D) Ether, thioester, phosphomonoester

[MP-2017]

- The magnitude of ionization potential depends upon:
(A) Radius of the atom
(B) Magnitude of positive charge on the nucleus
(C) Number of electron orbits
(D) All are correct

[TN-2017]

- Name the following structure



- (A) Deoxy cystidine
- (B) 5-methyl – Deoxycytidine
- (C) heterochromatin
- (D) Deoxy uridine

[CG-2018]

12. The strong tendency of the water to exclude _____ is frequently referred to as hydrophobic bond.

- (A) Non-polar groups
- (B) Polar groups
- (C) Hydroxyl group
- (D) Both (B) and (C)

[MH-2018]

13. Carbon-14 undergoes beta decay upon which it is converted into a new element having:

- (A) Increased atomic number
- (B) Decreased atomic number
- (C) Increased mass number
- (D) Decreased mass number

[MH-2019]

14. By what process does Thorium-230 decay to radium-226?

- (A) Gamma emission
- (B) Alpha emission
- (C) Beta emission
- (D) Electron capture

[GJ-2022]

15. Water is an excellent solvent for polar molecules. The reason is that water

- (A) Greatly strengthens electrostatic forces
- (B) Greatly weakens electrostatic forces
- (C) Greatly strengthens hydrogen bond formation
- (D) Greatly weakens hydrophobic interaction

[JK-2018]

16. Which of the following shows the types of bonding in decreasing order of strength?

- (A) Covalent, hydrogen, Van der Waals
- (B) Covalent, Van der Waals, Hydrogen
- (C) Hydrogen, Van der Waals, Covalent
- (D) Van der Waals, Hydrogen, Covalent

[WB-2020]

17. Configuration of a protein can only be altered by breaking

- (A) Hydrogen bond
- (B) Disulfide bond
- (C) Hydrophobic interaction
- (D) Ionic interaction

[GJ-2021-DEC]

18. Po (atomic mass 216 and atomic number 84) undergoes decay to form Po (atomic mass 212 and atomic number 84). $\text{Po} \rightarrow \rightarrow \rightarrow \text{Po}$. What radioactive particles are emitted in this decay?

- (A) $2\alpha + 2^-$
- (B) $\alpha + \beta^-$
- (C) $2\alpha + 2\beta^+$
- (D) $\alpha + 2\beta^-$

EXPLANATIONS

1. **Correct Answer is (D):-** Hydrogen bonds formed between water and biochemical molecules.

Water is often referred to as the universal solvent because it has the ability to dissolve a wide variety of solutes. This is primarily due to the hydrogen bonding that occurs between water molecules and other substances.

2. **Correct Answer is (D):-** Osmotolerant yeasts are able to grow in high salt concentrations because their cytoplasm contains high concentrations of polyalcohols, which help them balance osmotic pressure and maintain their cellular integrity in such environments. Divalent cations, amino acids, and lipids also play roles in various cellular processes, but they are not the primary contributors to osmotolerance in yeasts.

3. **Correct Answer is (D):-** π^* ($2p_y$). In molecular orbital theory, molecular orbitals are formed by the combination of atomic orbitals. The π^* (π star) orbital is an antibonding orbital, meaning it has higher energy compared to the corresponding bonding orbital. In this case, the π^* ($2p_y$) orbital refers to the antibonding molecular orbital formed by the combination of the $2p_y$ atomic orbitals

4. **Correct Answer is (D):-** Glycosidic linkages. Polysaccharides are composed of monosaccharide units that are linked together by glycosidic linkages. A glycosidic linkage is a type of covalent bond formed between the hydroxyl group of one monosaccharide and the anomeric carbon of another monosaccharide, resulting in the formation of a disaccharide or a larger polysaccharide chain.

5. **Correct Answer is (B):-** Among the given compounds: ii. Toluene: Toluene does not have hydrogen-bonding-capable functional groups. It lacks electronegative atoms like oxygen or nitrogen directly bonded to hydrogen atoms. Therefore, it cannot form hydrogen bonds with water.

iv. Hexane: Hexane does not have hydrogen-bonding-capable functional groups. It consists only of carbon and hydrogen atoms and lacks the necessary electronegative atoms to form hydrogen bonds with water.

6. **Correct Answer is (A):-** Water has a high dielectric constant, which means it has the ability to reduce

the strength of electrostatic interactions between dissolved ions. It does this by surrounding the ions with its polar molecules, effectively shielding the electrostatic charges and weakening the interactions. This property of water is crucial for various biological and chemical processes.

7. Correct Answer is (C):- When two uncharged atoms are brought very close together, they reach a point called van der Waals contact. At this distance, the attractive London dispersion forces (van der Waals forces) and the repulsive electron-electron repulsion are approximately equal. This balance results in a stable equilibrium, where the net effect of attraction and repulsion is minimized. This point is not where the attraction is maximum, but rather where the two opposing forces are in equilibrium.

8. Correct Answer is (A):- The energy is most favorable at the van der Waals contact distance, and as the atoms get closer than this distance, the energy rises rapidly due to electron-electron repulsion.

9. Correct Answer is (B):- Phosphoanhydride, phosphomonoester, N-glycosidic. ATP (adenosine triphosphate) is an important molecule involved in energy storage and transfer in cells. It contains several covalent bond types in its structure. The phosphoanhydride bond is present between the phosphate groups, connecting them in the ATP molecule.

10. Correct Answer is (D):-

(A) Radius of the atom: The ionization potential tends to decrease as the radius of the atom increases. This is because electrons are farther from the nucleus in larger atoms, experiencing weaker attractive forces, making them easier to remove.

(B) Magnitude of positive charge on the nucleus: The ionization potential increases as the positive charge on the nucleus (proton number) increases. A stronger positive charge implies stronger attraction between the nucleus and the electrons, making it more difficult to remove an electron.

(C) Number of electron orbits: The ionization potential generally increases as the number of electron orbits (energy levels) increases. Electrons in inner orbits are closer to the nucleus and experience stronger attractive forces. As electrons are removed from

higher energy levels, the ionization potential tends to increase.

All these factors influence the ionization potential, and their combined effects determine the energy required to remove an electron from an atom.

11. Correct Answer is (A):- Deoxycytidine is a nucleoside composed of the pyrimidine base cytosine linked to the sugar deoxyribose. It is one of the building blocks of DNA, where it pairs with deoxyguanosine through hydrogen bonding to form a complementary base pair.

12. Correct Answer is (A):- The strong tendency of water to exclude non-polar groups is frequently referred to as the hydrophobic effect or hydrophobic interaction. Non-polar groups are hydrophobic, which means they are not attracted to water molecules due to differences in their polarities. In aqueous environments, non-polar molecules or groups tend to cluster together to minimize their contact with water.

13. Correct Answer is (A):- In beta decay, a nucleus emits a beta particle (an electron or a positron) to achieve a more stable configuration. The decay can be represented as:

Carbon-14 (6 protons, 8 neutrons) → Nitrogen-14 (7 protons, 7 neutrons) + beta particle

The beta particle is emitted from the carbon-14 nucleus, and a neutron is converted into a proton, increasing the atomic number by 1. As a result, the new element formed after the beta decay of carbon-14 is nitrogen-14, which has an increased atomic number.

14. Correct Answer is (B):- Alpha emission. Thorium-230 decays to radium-226 through alpha decay. In alpha decay, the nucleus emits an alpha particle, which consists of two protons and two neutrons.

15. Correct Answer is (C):- Hydrogen bonding is an electrostatic interaction between the positively charged hydrogen atom of one water molecule and the negatively charged oxygen atom of another molecule. This interaction is stronger than typical van der Waals forces and contributes to the dissolution and solvation of polar compounds in water.

16. Correct Answer is (A):- Covalent bonds: These are the strongest type of chemical bonds, where atoms share electrons to achieve a stable electron configuration.

Hydrogen bonds: Hydrogen bonds are electrostatic interactions between a hydrogen atom bonded to an electronegative atom (such as oxygen or nitrogen) and another electronegative atom in another molecule.

Van der Waals forces: This is a collective term for weak intermolecular forces, including London dispersion forces (induced dipole-dipole interactions) and dipole-induced dipole interactions. These forces arise from temporary fluctuations in electron distribution within molecules.

17. Correct Answer is (A):- Hydrogen bonds, hydrophobic interactions, and ionic interactions are all weaker interactions that can be disrupted without changing the overall configuration of the protein. Disulfide bonds, on the other hand, are stronger interactions that hold the protein in its folded shape. When disulfide bonds are broken, the protein unfolds and loses its function.

18. Correct Answer is (D):- The given decay of Po (atomic mass 216 and atomic number 84) to form Po (atomic mass 212 and atomic number 84) is represented as:

^{216}Po (84 protons, 132 neutrons) $\rightarrow$ ^{212}Po (84 protons, 128 neutrons) + radioactive particles

In this decay, an alpha (α) particle is emitted from the ^{216}Po nucleus, and the resulting element is ^{212}Po .

Therefore, the Correct Answer is indeed:

(D) $\alpha + 2\beta^-$

Unit - 1.2: Composition, Structure and Function of Biomolecules
(Carbohydrates, Lipids, Proteins, Nucleic Acids and Vitamins).

[MH-2011-AUG]

1. Which of the following statements regarding lipids is false?
 (A) Lipids can serve as energy source for cells
 (B) All cell membranes contain lipids
 (C) All lipids can form bilayer membranes
 (D) Lipids can function as hormones

[AP-2012]

2. Non-polar amino acid residues are found mostly
 (A) In the core of proteins
 (B) On the surface of proteins
 (C) On alpha helix
 (D) In no specific region

[AP-2012]

3. **Assertion (A):** (A) Monellin is a sweetener and it is a protein. When it is heated its sweetness is lost
Reason (R): The reason for its sweetness lies in its confirmation
 (A) A and R are correct
 (B) A and R are wrong
 (C) A is correct and R is wrong
 (D) A is wrong and R is correct

[AP-2012]

4. Branched hydrophobic amino acids are
 (I) Valine
 (II) Leucine
 (III) Isoleucine
 (IV) Threonine
 (A) I & IV are correct
 (B) I, II & III are correct
 (C) I & II are correct
 (D) Only I is correct

[JK-2013]

5. Fruit juices bought from the market are clearer than those made at home. These juices are clarified by the use of:
 (A) Amylase and lipase
 (B) Lipase and cellulase
 (C) Cellulase and pectinase
 (D) Pectinase and protease

[MH-2013-JAN]

6. Cellulose is formed by repeated units of
 (A) glucose and galactose
 (B) galactose
 (C) glucose
 (D) fructose

[MH-2013-JAN]

7. The disaccharide that does not react with Benedict's reagent is:
 (A) Sucrose
 (B) Lactose
 (C) Maltose
 (D) Isomaltose

[MH-2013-JAN]

8. Two molecules of double stranded DNA have same length (1000 base pairs) but differ in base composition. Molecule 1 contains 20% A + T, molecule 2 contains 60% A + T. Which molecule has a higher T_m and how many C residues are there in molecule 2?
 (A) 1; 400
 (B) 1; 200
 (C) 2; 400
 (D) 2; 40

[MH-2013-DEC]

9. If one arginine has a molecular weight of 174 Daltons, then what would be the molecular weight (in Daltons) of a circular polymer of 38 arginines?
 (A) 6612
 (B) 5928
 (C) 5946
 (D) 6594

[MH-2013-DEC]

10. Sucrose does not occur in its anomeric form while its hydrolyzed products glucose and fructose have anomer. The reason is:
 (A) C1 of glucose and C1 of fructose are bonded in glycosidic bond
 (B) C1 of glucose and C2 of fructose are bonded in glycosidic bond
 (C) Sucrose is not soluble in water
 (D) Sucrose is polysaccharide

[AP-2013]

11. A phosphoglyceride is constituted with
 I. Fatty acids
 II. Glycerol
 III. Phosphate
 IV. Head alcohol
 (A) I and II are correct
 (B) II and III are correct
 (C) I and III are correct
 (D) I, II, III and IV are correct

[AP-2013]

12. Glycogen and cellulose consist of 100% D-glucose but they differ in
 (A) Glycosidic bonds
 (B) Covalent bonds
 (C) Ionic bonds
 (D) Peptide bonds

[GJ-2013]

13. Which of the following statements is correct?
 (A) Cellulose is glucose polymer of α 1 - 4 linkage
 (B) Starch is glucose polymer of β 1 - 4 linkage
 (C) Amylopectin has large number of β 1 - 6 linkage
 (D) Cellulose is glucose polymer of β 1 - 4 linkage

[JK-2013]

14. Example of a typical homopolysaccharide is :

- (A) Sucrose (B) Suberin
(C) Lignin (D) Starch

[JK-2013]

15. 2-amino 6-oxypurine is also known as:

- (A) Adenine (B) Xanthine
(C) Guanine (D) Hypoxanthine

[JK-2013]

16. The epimerization of galactose to glucose and viceversa takes place by:

- (A) UTP (B) GTP
(C) CTP (D) ATP

[AP-2014]

17. Arrange the following carbohydrate in the increasing order of the number of carbon atoms

1. sucrose
2. Glucose
3. Glycerol
4. Ribose
(A) 1, 2, 4, 3 (B) 3, 4, 2, 1
(C) 2, 3, 4, 1 (D) 4, 2, 3, 1

[GJ-2014]

18. The lipid lacking fatty acids is

- (A) Sphingolipid (B) Cholesterol
(C) Phosphatidylserine (D) Phospholipid

[GJ-2014]

19. Which of the following pairs of polysaccharides has identical linkage bonds?

- (A) Cellulose and starch
(B) Cellulose and glycogen
(C) Glycogen and starch
(D) Chitin and cellulose

[KA-2014]

20. Which of the following statements does not relate to hydrogen bonds?

- (A) A hydrogen bond takes place between an electron deficient hydrogen and an electron rich heteroatom.
(B) Weaker than electrostatic interactions but stronger than van der Waals interactions
(C) The electron deficient hydrogen is called a hydrogen bond donor
(D) Water molecules interact with each other and form an ordered layer next to hydrophobic pending regions.

[KA-2015]

21. The relationship between D-Glucose and d-Glucose is

(A) Both are the same

(B) D-refers to optical rotation and d-refers to configuration

(C) D-refers to configuration and d-refers to optical activity

(D) D configuration always gives rise to dextro rotation

[MH-2015]

22. What is the role of peptidoglycan?

- (A) extracellular adhesive
(B) gives rigidity and strength to exoskeletons
(C) gives rigidity and strength to cell envelope
(D) energy storage

[MH-2015]

23. Which of the following enzyme reactions is termed as acyl group transfer reaction?

- (A) Chymotrypsin (B) Lysozyme
(C) Hexokinase (D) Isomerase

[MH-2016]

24. Water readily dissolves charged biomolecules by replacing

- (A) water molecules by solute molecules
(B) solute-solute hydrogen bonds by solute-water hydrogen bonds
(C) big molecules by small molecules
(D) positive charges by negative charges

[GJ-2016]

25. Which one of the following sugar is present in all cells of aquatic monocotyledons?

- (A) Sorbose (B) Rhamnose
(C) Galactose (D) Apiose

[GJ-2016]

26. The most common storage polysaccharide in yeast is

- (A) Glycogen (B) Starch
(C) Dextran (D) Cellulose

[GJ-2016]

27. Which of the following is a keto triose?

- (A) Glyceraldehyde (B) Dihydroxyacetone
(C) Erythrose (D) Arabinose

[GJ-2016]

28. Milk protein casein is a:

- (A) Nucleoprotein (B) Phosphoprotein
(C) Lipoprotein (D) Glycoprotein

[GJ-2016]

29. Which of the following is not a conjugated protein?

- (A) Peptone
(B) Phosphoprotein
(C) Lipoprotein
(D) Glycoprotein

30. Match Column I with Column II.

Column I	Column II
(a) Thiamine Pyrophosphate	(i) L-amino acid oxidase
(b) Biotin	(ii) Transaminases
(c) Pyridoxal phosphate	(iii) Pyruvate carboxylase
(d) Flavin mononucleotide	(iv) Pyruvate Decarboxylase

Codes:

- (A) a-ii, b-i, c-iv, d-iii (B) a-i, b-iii, c-iv, d-ii
(C) a-iii, b-l, c-ii, d-iv (D) a-iv, b-iii, c-ii, d-i

[AP-2017]

31. The three amino acids present in glutathione are:

- (A) Glutamic acid, cysteine, Glycine
(B) Cysteine, alanine, proline
(C) Alanine, Serine, Aspartic acid
(D) Leucine, Glycine, Glutamic acid

[CG-2017]

32. Glycogen is a branched polymer of glucose, it has:

- (A) No reducing ends.
(B) No non-reducing ends.
(C) One reducing end and several non-reducing ends.
(D) One non-reducing end and several reducing ends.

[CH-2017]

33. Some inorganic elements that serve as co-factor for enzymes. Match Table-I and Table - II.

Table - I	Table - II
(A) Cytochrome oxidase	(i) K^+
(B) Pyruvate kinase	(ii) Cu^{2+}
(C) Dinitrogenase	(iii) Ni^{2+}
(D) Urease	(iv) Mo

Choose the correct answer:

- (A) (i) (B) (ii) (C) (iii) (D) (iv)
(A) (i) (B) (ii) (C) (iii) (D) (iv)
(B) (iii) (C) (iv) (D) (i) (ii)
(C) (ii) (D) (i) (iii) (iv)
(D) (iv) (i) (ii) (iii)

[GJ-2017]

34. Which one of the following is a structural homopolysaccharide?

- (A) Hyaluronic acid (B) Inulin
(C) Chitin (D) Starch

[KA-2017]

35. Why do fats give more energy than carbohydrates?

- (A) Fats have carboxyl group
(B) Fats are more reduced than carbohydrates
(C) Fats are larger than carbohydrates
(D) Fats have more number of bonds than carbohydrates

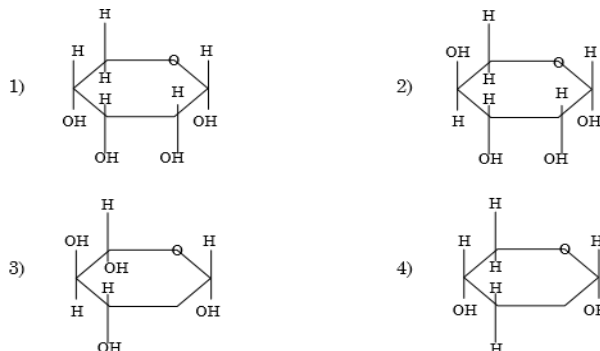
[MP-2017]

36. Chitin, is a linear polymer with:

- (A) α D-galactouronic units with $(1 \rightarrow 4)$ linkage
(B) N - acetyl-D-glucosamine units with $\beta (1 \rightarrow 4)$
(C) 4-O-methylglucuronic acid with $\beta (1 \rightarrow 4)$ linkage
(D) β -D-glucose units with $\beta (1 \rightarrow 4)$ linkage -D

[TN-2017]

37. Which is the furanose form of D-ribose?



[TN-2017]

38. What products are obtained when 1-palmityl-2-oleyl-3-phosphatidyl serine is hydrolyzed by a phospholipase A1

- (A) palmitic acid and 2-oleoyl-3-phosphatidyl serine
(B) oleic acid and 1-palmitoyl - 3- phosphatidyl serine
(C) phosphoserine and 1-palmitoyl - 2 - oleoyl - glycerol
(D) serine and 1-palmitoyl - 2 - oleoyl - phosphatic acid

[MH-2017]

39. Raffinose is a carbohydrate and aminor constituent of sugar beets. Which class of arbohydrates from below does it belong to?

- (A) Monosaccharide (B) Disaccharide
(C) Trisaccharide (D) Polysaccharide

[MH-2017]

40. Phytochelatins are low-molecular- weight thiols consisting of the:

- (A) Organic acids (B) Amino acids
(C) Fatty acids (D) Nucleic acids

[MH-2017]

41. The genome of which of the following virus obeys Chargaff's rule ?

- (A) TMV (B) Mu phage
(C) ox 174 (D) Adenovirus

[TN-2017]

42. The empirical formula of thiamine is

- (A) $C_{12} H_4 N_{17} OS$ (B) $C_{12} H_{17} N_4 OS$
(C) $C_{17} H_{12} N_4 OS$ (D) $C_4 H_{17} N_{12} OS$

[WB-2017]

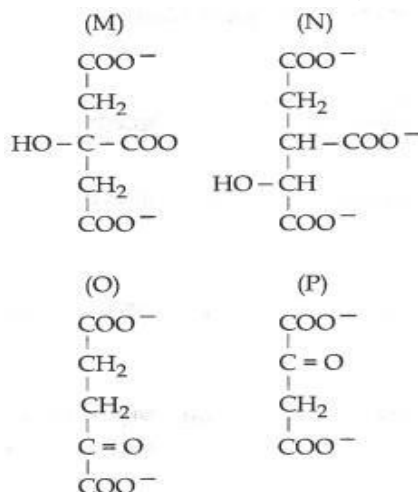
43. Teichoic acid is composed of repetitive units of
 (A) N-acetyl glucosamine (B) Ribitol phosphate
 (C) Glucose-6-phosphate (D) Glucosamine

[WB-2017]

44. The gla domain is found in
 (A) Fibrinogen (B) Fibrin polymer
 (C) Prothrombin (D) Kininogen

[CG-2018]

45. Indicate names of the following molecules:



- (A) (M) - Citrate (N) - Oxaloacetate (O) - Isocitrate (P) - α -ketoglutarate
 (B) (M) Oxaloacetate (N) - Isocitrate (O) - α -ketoglutarate (P) - Citrate
 (C) (M) -Isocitrate (N) - Citrate (O) - Oxaloacetate (P) - α -ketoglutarate
 (D) (M) Isocitrate (N) - α -ketoglutarate (O) - Oxaloacetate (P) - Citrate

[AP-2018]

46. Which one of the following acts as the precursor for the biosynthesis of lysine?
 (A) Cysteine
 (B) Pyrroline-5-carboxylate
 (C) 2-oxoglutarate
 (D) Ornithine

[AP-2018]

47. Assertion (A): Storage polysaccharides show more branches than structural polysaccharides in their structure.
 Reason (R): Branched polysaccharides have more free ends and can form more glycoside bonds.
 (A) Both (A) and (R) are true and (R) is the correct explanation of (A)
 (B) Both (A) and (R) are true, but (R) is not the correct explanation of (A)
 (C) (A) is true but (R) is false
 (D) (A) is false but (R) is true

[AP-2018]

48. If the average molecular weight of an amino acid is 120 daltons, then what is the weight in grams of a single molecule of protein containing 300 amino acids?
 (A) 6.02×10^{-23} g (B) 270×10^{-18} g
 (C) 53.85×10^{-22} g (D) 5.98×10^{-20} g

[GJ-2018]

49. Which one of the following aldose sugar is most abundant in biological systems?
 (A) D-Mannose (B) D-Gulose
 (C) D-Xylose (D) D-Arabinose

[JK-2018]

50. Which of the following statements is NOT true?
 (A) Oxidation and reduction reactions occur simultaneously.
 (B) When a sugar molecule is oxidized to CO, and H₂O, molecules are reduced.
 (C) Hydrogenation reactions are oxidation and dehydrogenation reactions are reduction
 (D) Hydrogenation reactions are reduction and dehydrogenation reactions are oxidation

[JK-2018]

51. Which of the following is an example of structural polysaccharide?
 (A) Starch (B) Cellulose
 (C) Glycogen (D) Sucrose

[JK-2018]

52. Fatty acids are termed as unsaturated if
 (A) they have one or more double bonds
 (B) they are insoluble in water
 (C) they are insoluble in alcohol
 (D) they have no double bonds

[MH-2018]

53. Maleic acid and Fumaric acid are:
 (A) Geometric isomers (B) Chiral isomers
 (C) Enantiomers (D) Diastereomers

[MH-2018]

54. Artificial sweetener aspartame is:
 (A) L-Aspartyl-L-Phenylalanine methyl ester.
 (B) L-Aspartyl-D-Phenylalanine methyl ester
 (C) D-Aspartyl-D-Phenylalanine methyl ester
 (D) D-Aspartyl-L-Phenylalanine methyl ester

[WB-2018]

55. Name the vitamins that are found in the liver of marine fishes.
 (A) Vit C & D (B) Vit B & D
 (C) Vit A & B (D) Vit A & D

[WB-2018]

56. Cobalt is an essential component of

- (A) Vitamin B (B) Vitamin B,
(C) Vitamin B (D) Vitamin B2

[WB-2018]

57. Besides its anti-oxidant activity, vitamin E causes

- (A) Increased release of prostacyclin
(B) Increased adherence of blood cell components to inner lining of blood vessels
(C) Stimulation of protein kinase C
(D) Vasoconstriction

[WB-2018]

58. $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ represents

- (A) An unsaturated fatty acid
(B) A saturated fatty acid
(C) A triglyceride
(D) A lipid

[MH-2019]

59. Glycogen, starch and cellulose are polymers of glucose. Which of the following statements are true about these polymers?

- (i) β Glycogen and starch are having α 1-4 and α 1-6 glycosidic bonds.
(ii) Cellulose is having 1-4 glycosidic linkage.
(iii) All these polymers are giving energy for the cells.
(iv) Glycogen is present in animals and starch in plants.
(v) Amylase enzyme is useful in digestion of these polymers.
- (A) (i), (ii) and (v) (B) (i), (ii) and (iv)
(C) (ii), (iii) and (iv) (D) (ii), (iii) and (v)

[MH-2019]

60. Maple syrup urine disease, one of the inherited metabolic disorders is caused because of blockage of oxidative decarboxylation of α -keto acids derived from valine, leucine and isoleucine. Which of the following enzyme is missing or defective in the patient?

- (A) Homogentisate reductase
(B) Branched chain dehydrogenase
(C) Oxaloacetate decarboxylase
(D) Acetoacetate carboxylase

[MH-2019]

61. Isoenzymes are.....

- (A) Oligomeric proteins which have different physico-chemical properties and catalyse the same reaction.

(B) Monomeric proteins which have different physico-chemical properties and catalyse the same reaction.

(C) Oligomeric proteins which have same physico-chemical properties and catalyse different reactions

(D) Monomeric proteins which have same physico-chemical properties and catalyse different reactions

[KA-2020]

62. The constituent monosaccharide in chitin is

- (A) D-Glucose
(B) D-Xylose
(C) N-acetyl D-glucosamine
(D) D-Galactose

[MH-2020]

63. Which of the following statements about monosaccharides is correct?

P- Epimers of monosaccharides differ in chemical properties.

Q- In aldoses, C_1 is the anomeric carbon R- Anomers differ in configuration at the glycosidic carbon.

S- Epimers differ in configuration at any carbon other than glycosidic carbon.

- (A) R and s (B) P and Q
(C) Q, R and S (D) P, Q, R and S

[MH-2020]

64. Fungi can synthesize one of the following structural polysaccharide from the beta-glucose:

- (A) amylopectin (B) chitin
(C) cellulose (D) lignin

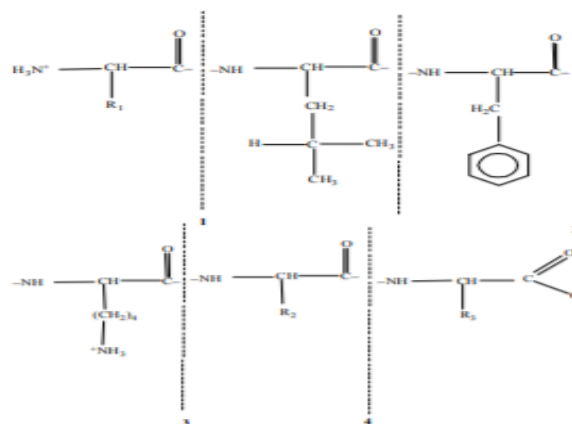
[WB-2020]

65. Collagen instability and connective tissue abnormalities are caused due to the absence of

- (A) Vitamin A (B) Vitamin C
(C) Vitamin D (D) Vitamin H

[WB-2020]

66.



Aminopeptidase catalyzes the hydrolysis of amino acids from the N-terminal end of a protein, while carboxypeptidase catalyzes the hydrolysis of amino acids from the C-terminal end of a protein. Chymotrypsin catalyzes the hydrolysis of peptide bonds following aromatic amino acids, while trypsin catalyzes the hydrolysis of peptide bonds following lysine and arginine. Select the correct order from the following:

- (A) 1-Aminopeptidase, 2-Chymotrypsin, 3-Trypsin, 4-Carboxypeptidase
- (B) 1-Chymotrypsin, 2-Trypsin, 3-Aminopeptidase, 4-Carboxypeptidase
- (C) 1-Chymotrypsin, 2-Trypsin, 3-Carboxypeptidase, 4-Aminopeptidase
- (D) 1-Aminopeptidase, 2-Trypsin, 3-Chymotrypsin, 4-Carboxypeptidase

[WB-2020]

67. Protamines, small arginine rich proteins, are characteristically

- (A) large sized DNA fragments
- (B) sequences of DNA that are unique in nature
- (C) histone like proteins found in fish sperm
- (D) moderately repeated DNA sequence

68. Proteomics technique used to analyse the characteristics of molecular protein network involved in living cell is termed as [WB-2020]

- (A) Functional proteomics
- (B) Expression proteomics
- (C) Structural proteomics
- (D) Protein mining

[GJ-2022]

69. Amino acid threonine has how many optical isomers?

- (A) 1
- (B) 2
- (C) 3
- (D) 4

[GJ-2022]

70. What happens to the osmotic potential of the pure water, if we add NaCl and sugars?

- (A) Osmotic potential of the pure water becomes negative
- (B) Osmotic potential of the pure water becomes positive
- (C) Solutes do not show any effect on the osmotic potential
- (D) Osmotic potential of the pure water becomes zero

[GJ-2022]

71. A drop of water on glass slide takes a bead shape and why not alcohol?

- (A) Water has high surface tension
- (B) Alcohol has high surface tension
- (C) Water has low surface tension
- (D) Both (A) and (C)

[WB-2023]

72. Which of the following statements is not correct for teichoic acids?

- (A) Teichoic acids are anionic polymers found in the cell walls of Gram-positive bacteria.
- (B) They are composed of glycerol phosphate or ribitol phosphate residues joined through phosphodiester linkage.
- (C) They are covalently linked to N-acetyl-muramic acid of the peptidoglycan layer.
- (D) They are composed of N-acetylglucosamine residues linked by $\beta(1-4)$ linkages.

[JK-2022]

73. Name the two amino acids that are components of artificial sweetener, 'aspartame'.

- (A) Aspartic acid and phenylalanine
- (B) Arginine and tyrosine
- (C) Aspartic acid and tryptophan
- (D) Aspartic acid and glutamic acid

[RJ-2023]

74. Consider the following steps of beta oxidation:

1. Activation of fatty acid
2. Elongation cycle of fatty acid via ACP intermediates
3. Conversion of acetyl-CoA into Malonyl CoA
4. Transport of fatty acid in mitochondria
5. Breakdown of fatty acid in mitochondria matrix

Which of the following are not involved in beta oxidation?

- (A) 1, 2 and 3.
- (B) 2 and 3
- (C) 3, 4 and 5
- (D) 3 and 5

EXPLANATIONS

1. **Correct Answer is (D):-** Lipids cannot act as hormones it can be precursor for the hormones but it cannot act as an hormone.
2. **Correct Answer is (A):-** Non-polar amino acid residues are found mostly: (A) In the core of proteins. Non-polar amino acid residues, which are hydrophobic, tend to be found in the interior, or core, of proteins away from the surrounding water.

3. Correct Answer is (A):- The assertion (A) states that Monellin is a sweetener and a protein, and its sweetness is lost when heated, which is correct. The reason (R) provides the explanation that the reason for its sweetness lies in its conformation (referring to its three-dimensional structure). This is also correct, as the specific conformation of monellin's protein structure is responsible for its sweet taste. So, both assertion (A) and reason (R) are correct, and the correct option is (A) "A and R are correct."

4. Correct Answer is (B):- I, II & III are correct. Valine, leucine, and isoleucine are examples of branched hydrophobic amino acids.

5. Correct Answer is (D):- The bottled fruit juices bought from the market are clearer as compared to those made at home because the bottle juices are clarified by the use of pectinases and proteases. Home made juices are turbid due to the presence of fibers and pectin.

6. Correct Answer is (C):- Cellulose is formed by repeated units of: (C) Glucose. Cellulose is a polysaccharide composed of repeated units of glucose linked together.

7. Correct Answer is (A):- The disaccharide that does not react with Benedict's reagent is: (A) Sucrose. Sucrose does not contain a reducing sugar group and, therefore, does not react with Benedict's reagent, which is used to detect reducing sugars.

8. Correct Answer is (C):- 2; 400. Molecule 2 has a higher T_m because it has a higher percentage of A + T base pairs. The number of C residues in molecule 2 would be 40% of 1000 base pairs, which is 400.

9. Correct Answer is (B):- Arginine has a molecular weight of 174 Daltons. If you have a circular polymer of 38 arginines, you can calculate the total molecular weight by multiplying the molecular weight of one arginine by the number of arginines in the polymer.
Total molecular weight = Molecular weight of one arginine $\times$ Number of arginines
Total molecular weight = 174 Daltons $\times$ 38
Total molecular weight = 6612 Daltons

When two amino acids join, a condensation reaction takes place, hydrolysis of water takes place.

Molecular weight of one hydrogen atom = 18 dalton
Here circular polymer of 38 arginines, means
 $= 18 \times 38 = 684$

Therefore, the molecular weight (in Daltons) of a circular polymer of 38 arginines = $6612 - 684 = 5928$

10. Correct Answer is (B): -C1 of glucose and C2 of fructose are bonded in a glycosidic bond. The glycosidic bond between glucose and fructose involves the anomeric carbon of both monosaccharides (C1 of glucose and C2 of fructose), resulting in the formation of a non-reducing disaccharide sucrose.

11. Correct Answer is (D):- I, II, III, and IV are correct. A phosphoglyceride consists of fatty acids, glycerol, phosphate, and a head alcohol group.

12. Correct Answer is (A):- Glycosidic bonds. Glycogen and cellulose are both composed of glucose units, but they differ in the type of glycosidic bonds present in their structures.

13. Correct Answer is (D):- Cellulose is a glucose polymer of β 1-4 linkage. Cellulose is composed of glucose units linked together by β 1-4 glycosidic bonds. Starch, on the other hand, is a glucose polymer of α 1-4 linkage.

14. Correct Answer is (D):- Starch is a typical homopolysaccharide because it is composed of repeating units of glucose molecules. It is a polysaccharide found in plants and serves as a storage form of energy.

15. Correct Answer is (C):- Guanine: 2-amino 6-oxypurine is the chemical name for GUANINE. A GUANINE is one of the four nucleotide bases found in DNA and RNA, and it pairs with CYTOSINE in DNA and RNA.

16. Correct Answer is (A):- UTP: The epimerization of galactose to glucose and vice versa takes place by the enzyme uridine diphosphate (UDP)-galactose-4-epimerase. UTP is not involved in this process.

17. Correct Answer is (B):- 3, 4, 2, 1: The increasing order of the number of carbon atoms in the given carbohydrates is as follows:

Ribose (5 carbon atoms)
 Glucose (6 carbon atoms)
 Sucrose (12 carbon atoms)
 Glycerol (3 carbon atoms)

18. Correct Answer is (C):- Phosphatidylserine is a type of phospholipid that lacks fatty acids in its structure. It contains a glycerol backbone, a phosphate group, and a serine molecule, but it does not have fatty acid chains.

19. Correct Answer is (D):- Chitin and cellulose are both polysaccharides that have identical linkage bonds. They both consist of glucose monomers linked together through beta-1,4-glycosidic bonds. In contrast, the other options have different linkage bonds.

20. Correct Answer is (D):- Option (D) is not related to hydrogen bonds. It describes the interaction of water molecules with hydrophobic regions, which is not specifically related to hydrogen bonding. The tendency of water molecules to form ordered layers around hydrophobic molecules is due to hydrophobic interactions, not hydrogen bonds. Hydrophobic interactions are driven by the tendency of water molecules to minimize contact with nonpolar substances.

21. Correct Answer is (B):- D-refers to optical rotation and d-refers to configuration: D-Glucose and d-Glucose are not the same compound. The designation D or d refers to the configuration of the molecule, specifically the stereochemistry at the chiral carbon farthest from the carbonyl group.

22. Correct Answer is (C):- Gives rigidity and strength to cell envelope: Peptidoglycan is a major component of the cell envelope in bacteria. It forms a rigid mesh-like structure that surrounds the bacterial cell membrane, providing strength and rigidity to the cell. It helps protect the cell from osmotic pressure and provides structural integrity.

23. Correct Answer is (A):- Chymotrypsin: Acyl group transfer reactions involve the transfer of an acyl group ($-\text{COCH}_3$) from one molecule to another. Chymotrypsin is a protease enzyme that catalyzes the hydrolysis of peptide bonds and does not perform acyl group transfer. The other options,

Lysozyme, Hexokinase, and Isomerase, are not primarily involved in acyl group transfer reactions.

24. Correct Answer is (B):- Solute-solute hydrogen bonds by solute-water hydrogen bonds: Water readily dissolves charged biomolecules by forming new hydrogen bonds. In a solution, water molecules form hydrogen bonds with charged solute molecules, breaking the solute-solute hydrogen bonds. The polar nature of water allows it to surround and interact with charged molecules, effectively dissolving them.

25. Correct Answer is (D):- Apiose is a sugar that is present in all cells of aquatic monocotyledons.

26. Correct Answer is (C):- Dextran: The most common storage polysaccharide in yeast is dextran. Dextran is a polysaccharide composed of glucose units, and they serve as a reserve of energy in yeast cells.

27. Correct Answer is (B):- Dihydroxyacetone: Dihydroxyacetone is a keto triose. It is a three-carbon sugar with a ketone group ($-\text{C}=\text{O}$) on the second carbon. Glyceraldehyde and Erythrose are aldose trioses, while Arabinose is a pentose sugar.

28. Correct Answer is (B):- Phosphoprotein: Milk protein casein is a phosphoprotein. Phosphoproteins are proteins that contain phosphate groups attached to specific amino acid residues. Casein contains phosphate groups that are covalently linked to serine residues.

29. Correct Answer is (A):- Peptone: Peptone is not a conjugated protein. It is a mixture of peptides obtained from the partial hydrolysis of proteins. Conjugated proteins are proteins that contain non-protein components such as lipids (lipoproteins), carbohydrates (glycoproteins), or nucleic acids (nucleoproteins).

30. Correct Answer is (D):-

Column I	Column II
(a) Thiamine Pyrophosphate	(iv) Pyruvate Decarboxylase
(b) Biotin	(iii) Pyruvate Carboxylase
(c) Pyridoxal phosphate	(ii) Transaminases
(d) Flavin mononucleotide	(i) L-amino acid oxidase

- 31. Correct Answer is (A):-** Glutamic acid, cysteine, Glycine: The three amino acids present in glutathione are glutamic acid, cysteine, and glycine. Glutathione is a tripeptide composed of these amino acids and plays a crucial role in cellular defense against oxidative stress.
- 32. Correct Answer is (C):-** One reducing end and several non-reducing ends: Glycogen is a branched polymer of glucose. It has one reducing end and several non-reducing ends. The reducing end of glycogen contains a free anomeric carbon that can undergo a reducing reaction, while the non-reducing ends are the terminations of the glycogen chains.
- 33. Correct Answer is (C):-**
- | | |
|------------------------|------------------------|
| (A) Cytochrome oxidase | (i) K ⁺ |
| (B) Pyruvate kinase | (iii) Ni ²⁺ |
| (C) Dinitrogenase | (ii) Cu ²⁺ |
| (D) Urease | (iv) Mo |
- 34. Correct Answer is (C):-** Chitin: Chitin is a structural homopolysaccharide. It is composed of repeating units of N-acetylglucosamine and forms the main component of the exoskeleton of arthropods, such as insects and crustaceans, and the cell walls of fungi.
- 35. Correct Answer is (B):-** Fats are more reduced than carbohydrates: Fats give more energy than carbohydrates because they are more reduced. Fats contain more carbon-hydrogen bonds compared to carbohydrates, which are primarily composed of carbon, hydrogen, and oxygen.
- 36. Correct Answer is (B):-** N-acetyl-D-glucosamine units with β (1 $\rightarrow$ 4) linkage: Chitin is a linear polymer composed of N-acetyl-D-glucosamine units linked together through β (1 $\rightarrow$ 4) glycosidic bonds. It forms the structural component of the exoskeleton of arthropods and the cell walls of fungi.
- 37. Correct Answer is (D):-** The furanose form of D-ribose is a five-membered ring structure. It is also known as β -D-ribofuranose.
- 38. Correct Answer (A):-** Palmitic acid and 2-oleoyl-3-phosphatidyl serine: When 1-palmityl-2-oleyl-3-phosphatidyl serine is hydrolyzed by a phospholipase A1, it cleaves the acyl chain at the sn-
- 1 position, resulting in the release of palmitic acid and the formation of 2-oleoyl-3-phosphatidyl serine.
- 39. Correct Answer is (C):-** Trisaccharide: Raffinose is a trisaccharide composed of galactose, glucose, and fructose. It is commonly found in plants, such as sugar beets and legumes.
- 40. Correct Answer is (B):-** Amino acids: Phytochelatin are low-molecular-weight thiols that are composed of amino acids. They are synthesized by plants and play a role in heavy metal detoxification and tolerance
- 41. Correct Answer is (D):-** Adenoviruses are DNA viruses that have double-stranded DNA genomes. These genomes adhere to Chargaff's rule. The adenovirus genome follows base-pairing rules where adenine (A) pairs with thymine (T) and guanine (G) pairs with cytosine (C), thus maintaining equal proportions of A-T and G-C pairs.
- 42. Correct Answer is (B):-** C₁₂ H₁₇ N₄ O₅: The empirical formula of thiamine (vitamin B1) is C₁₂ H₁₇ N₄ O₅.
- 43. Correct Answer is (B):-** Teichoic acids are an important component of the cell walls of many Gram-positive bacteria. They are composed of repetitive units of ribitol phosphate, which is a sugar alcohol (ribitol) linked to phosphate groups.
- 44. Correct Answer is (C):-** The Gla domain, also known as gamma-carboxyglutamic acid domain, is a characteristic structural feature found in various proteins involved in blood coagulation. Prothrombin, which is a precursor of the enzyme thrombin, contains a Gla domain.
- 45. Correct Answer is (A):-** (M) - Citrate (N) - Oxaloacetate (O) - Isocitrate (P) - α -ketoglutarate: The names of the given molecules are as follows: (M) - Citrate (N) - Oxaloacetate (O) - Isocitrate (P) - α -ketoglutarate
- 46. Correct Answer is (C):-** 2-oxoglutarate: 2-oxoglutarate acts as a precursor for the biosynthesis of lysine. It is an intermediate in the tricarboxylic acid cycle (TCA cycle) and participates in various metabolic pathways.

47. Correct Answer is (B):- Both (A) and (R) are true, but (R) is not the correct explanation of (A): Storage polysaccharides do show more branches than structural polysaccharides. However, the reason given that branched polysaccharides have more free ends and can form more glycosidic bonds is not accurate. The branching in storage polysaccharides allows for efficient storage and rapid release of glucose units, but it does not necessarily result in more glycosidic bonds.

48. Correct Answer is (D):- $5.98 \times 10^{-20} \text{ g}$

The molecular weight of the protein containing 300 amino acids is calculated as follows:

Molecular weight of the protein = (Average molecular weight of an amino acid) $\times$ (Number of amino acids)

Molecular weight of the protein = 120 daltons $\times$ 300 amino acids = 36,000 daltons

Since 1 dalton is equal to 1 g/mol, the weight of the protein in grams will be:

Weight of the protein in grams = 36,000 g/mol

To express this in scientific notation:

Weight of the protein in grams = $3.6 \times 10^4 \text{ g}$

Now, since we are looking for the weight of a single molecule of protein, we need to divide the total weight by Avogadro's number (6.022×10^{23} molecules/mol):

Weight of a single protein molecule in grams = $(3.6 \times 10^4 \text{ g}) / (6.022 \times 10^{23}) = 5.98 \times 10^{-20} \text{ g}$

So, the correct answer is (D) $5.98 \times 10^{-20} \text{ g}$.

49. Correct Answer is (A):- D-Mannose is the most abundant aldose sugar in biological systems. It is a hexose sugar and is commonly found in glycoproteins, glycolipids, and polysaccharides.

50. Correct Answer is (C):- This statement is not true. In chemistry, hydrogenation reactions involve the addition of hydrogen atoms to a compound. During hydrogenation, the compound gains hydrogen atoms, which leads to a decrease in the degree of oxidation of the compound. As a result, hydrogenation reactions are considered reduction reactions.

51. Correct Answer is (B):- Cellulose: Cellulose is an example of a structural polysaccharide. It is a linear polymer of glucose units linked together by β (1 $\rightarrow$ 4) glycosidic bonds. Cellulose forms the major

component of plant cell walls and provides structural support.

52. Correct Answer is (A):- Unsaturated fatty acids have one or more double bonds in their carbon chain, which creates "kinks" in the chain and prevents them from packing closely together. This leads to their characteristic liquid state at room temperature. In contrast, saturated fatty acids have no double bonds and have a straight chain, making them solid at room temperature.

53. Correct Answer is (A):- Geometric isomers, also known as cis-trans isomers or E/Z isomers, are molecules that have the same molecular formula and connectivity but differ in the arrangement of atoms or groups around a double bond or a ring. In the case of maleic acid and fumaric acid, they are geometric isomers because they have the same chemical formula but differ in the arrangement of atoms around a double bond.

54. Correct Answer is (A):- L-Aspartyl-L-Phenylalanine methyl ester.

Explanation: Aspartame is a low-calorie artificial sweetener used as a sugar substitute in many food and beverage products. Its chemical structure is L-Aspartyl-L-Phenylalanine methyl ester.

55. Correct Answer is (D):- Vitamin A (Retinol): Marine fish liver, especially in species that live in cold and deep waters, can accumulate high levels of vitamin A. Vitamin D (Calciferol): Vitamin D is often called the "sunshine vitamin" because our skin can produce it when exposed to sunlight. However, marine fish liver is another significant source of vitamin D. Vitamin D is crucial for maintaining healthy bones and teeth by aiding in the absorption of calcium and phosphorus.

56. Correct Answer is (D):- Cobalt is an essential component of Vitamin B12, also known as cobalamin. Vitamin B12 is a complex molecule that contains a cobalt atom at its center. It plays a crucial role in various physiological processes, including DNA synthesis, red blood cell formation, and nervous system function.

57. Correct Answer is (A):- Prostacyclin is a hormone that is produced by the cells lining the blood

vessels. It has a number of effects, including vasodilation (widening of the blood vessels) and inhibition of platelet aggregation (clumping together of platelets). Vitamin E is thought to increase the production of prostacyclin, which in turn helps to protect against heart disease and stroke.

58. Correct Answer is (B):- $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ represents palmitic acid, which is a 16-carbon saturated fatty acid. Saturated fatty acids have no double bonds in their carbon chain, meaning that all carbon atoms are saturated with hydrogen atoms.

59. Correct Answer is (B):- (i) Glycogen and starch are having α 1-4 and α 1-6 glycosidic bonds. - True. Both glycogen and starch are composed of glucose units linked together by α 1-4 glycosidic bonds in the main chain, with occasional α 1-6 glycosidic bonds forming branches. (ii) Cellulose is having 1-4 glycosidic linkage. - True. Cellulose is composed of glucose units linked together by β 1-4 glycosidic bonds, forming long straight chains. (iv) Glycogen is present in animals and starch in plants. - True. Glycogen is the primary energy storage molecule in animals, while starch serves the same purpose in plants. (v) Amylase enzyme is useful in the digestion of these polymers. - True. Amylase is an enzyme that breaks down the α 1-4 glycosidic bonds in starch and glycogen, facilitating their digestion.
The correct answer is (B) (i), (ii), and (iv).

60. Correct Answer is (B):- Maple Syrup Urine Disease is caused by a blockage in the oxidative decarboxylation of keto acids derived from valine, leucine, and isoleucine. This metabolic disorder is due to the deficiency or defect in the enzyme Branched Chain α -Keto Acid Dehydrogenase Complex, which is responsible for the oxidative decarboxylation of these branched-chain amino acids' keto acids.

61. Correct Answer is (A):- Oligomeric proteins which have different physico-chemical properties and catalyze the same reaction.
So, isoenzymes are different forms of an enzyme that perform the same reaction but might have variations in their properties or distribution within an organism.

62. Correct Answer is (C):- N-acetyl D-glucosamine.

Explanation: Chitin is a polysaccharide found in the exoskeletons of arthropods (e.g., insects and crustaceans) and in the cell walls of fungi. Its constituent monosaccharide is N-acetyl D-glucosamine.

63. Correct Answer is (D):- Epimers are stereoisomers that differ in the configuration at only one chiral center (carbon atom). They have similar chemical properties. Q- In aldoses, C1 is the anomeric carbon. - True. In aldoses (a type of monosaccharide), the carbon atom with the carbonyl group (aldehyde functional group) is called the anomeric carbon, and it is designated as C1. R- Anomers differ in configuration at the glycosidic carbon. - True. Anomers are a special type of stereoisomers that differ in the configuration of the anomeric carbon, which is the carbon involved in the glycosidic bond formation. S- Epimers differ in configuration at any carbon other than the glycosidic carbon. - True. Epimers differ in configuration at any carbon other than the one involved in the glycosidic bond formation.

64. Correct Answer is (D):- Chitin is a complex carbohydrate that forms the structural component of fungal cell walls, as well as the exoskeletons of arthropods (such as insects and crustaceans). It is composed of repeating units of N-acetylglucosamine, a derivative of glucose. Chitin provides strength and rigidity to the cell walls, making them resistant to mechanical stress.

65. Correct Answer is (B):- Collagen instability and connective tissue abnormalities are caused due to the absence of Vitamin C, also known as ascorbic acid. Vitamin C is essential for the synthesis of collagen, a major structural protein found in connective tissues such as skin, tendons, ligaments, and blood vessels. Without sufficient Vitamin C, collagen synthesis is disrupted, leading to weakened connective tissues and various health issues, including scurvy.

66. Correct Answer is (D):- 1-Aminopeptidase, 2-Trypsin, 3-Chymotrypsin, 4-Carboxypeptidase

67. Correct Answer is (C):- Protamines are small arginine-rich proteins that are found in the sperm cells of fish and other animals. They replace histones in the sperm nucleus, and help to condense the DNA.

68. Correct Answer is (A):- Functional proteomics is a technique used to analyze the characteristics of the molecular protein network involved in living cells. It focuses on understanding the functions, interactions, and activities of proteins within a cell or organism. This technique aims to provide insights into how proteins work together to perform various biological processes and pathways.

69. Correct Answer is (B):- Amino acids are chiral molecules, which means they have a non-superimposable mirror image called an optical isomer or enantiomer. Threonine is one of the chiral amino acids and has two chiral centers, which leads to the presence of two optical isomers or enantiomers: L-threonine and D-threonine. These isomers are mirror images of each other and cannot be superimposed.

70. Correct Answer is (A):- When solutes such as NaCl and sugars are added to pure water, the osmotic potential of the solution decreases. Osmotic potential is a measure of the tendency of water to move across a semipermeable membrane from an area of lower solute concentration to an area of higher solute concentration. Adding solutes to the water increases its solute concentration and reduces its osmotic potential. Since osmotic potential is typically expressed as a negative value, adding solutes will make the osmotic potential even more negative. This reflects the fact that the solution has a greater tendency to draw water in due to the presence of solutes.

71. Correct Answer is (A):- Water has a higher surface tension than alcohol. This means that the water molecules are more attracted to each other than they are to the glass slide. As a result, the water molecules tend to form a bead shape on the glass slide. Alcohol, on the other hand, has a lower surface tension than water. This means that the alcohol molecules are less attracted to each other than they are to the glass slide. As a result, the alcohol molecules tend to spread out on the glass slide and not form a bead shape.

72. Correct Answer is (D):- Teichoic acids are not composed of N-acetylglucosamine residues linked by (1-4) linkages. Instead, they are composed of glycerol phosphate or ribitol phosphate residues linked through phosphodiester linkage.

73. Correct Answer is (A):- Aspartic acid and phenylalanine.

Explanation: Aspartame is composed of two amino acids: aspartic acid and phenylalanine. These amino acids are linked together by a peptide bond, forming the dipeptide L-Aspartyl-L-Phenylalanine methyl ester, which is the chemical structure of aspartame.

74. Correct Answer is (D):- Steps 3 and 5 are not involved in beta oxidation. Step 3 is the conversion of acetyl-CoA into malonyl-CoA, which is an intermediate in fatty acid synthesis. Step 5 is the breakdown of fatty acid in the mitochondrial matrix, which is not part of beta oxidation.

Unit-1.3: Stabilizing Interactions

(Van der Waals, Electrostatic, Hydrogen Bonding, Hydrophobic Interaction, etc.)

- [AP-2012]
1. The protein structure is stabilized by
 I. Hydrogen bonds
 II. Disulphide bonds
 III. Glycolidic bonds
 IV. Hydrophobic interactions
 (A) I and II are correct
 (B) II, III and IV are correct
 (C) I and IV are correct
 (D) I, II and IV are correct
- [RJ-2012]
2. The greatest amount of energy per unit weight would be supplied to the body by which of the following
 (A) Potatoes (B) Butter
 (C) Eggs (D) Milk
- [AP-2014]
3. Which of the following is an example of a noncovalant interaction in proteins?
 (A) Salt bridge
 (B) Disulfide bridge
 (C) Peptide bond
 (D) Phosphodiester bond
- [GJ-2014]
4. Which of the following decreases most rapidly with small increase in distance?
 (A) van der Waals interactions
 (B) Electrostatic Interactions
 (C) Hydrogen bonding
 (D) Hydrophobic interactions
- [GJ-2014]
5. Coiled coil structure of d-keratin m animal hair is due to
 (A) Disulfide bonds
 (B) Hydrophobic interactions of side chains of amino acid residues
 (C) Hydrogen bonds
 (D) Salt bridges
- [KA-2014]
6. The bond formed by sharing of electrons between two atoms is called
 (A) Electrovalent bond (B) Coordinate bond
 (C) Covalent bond (D) Ionic bond
- [KA-2014]
7. Hydrogen bond can be formed with the following except
- (A) $O - H \cdots O$ (B) $O - H \cdots N$
 (C) $O - H \cdots S$ (D) $N - H \cdots N$
- [KA-2015]
8. Association of a nucleotide base with a complementary one by the formation of specific hydrogen bonding is
 (A) Peptide bond (B) Base pairing
 (C) Recombination (D) Mismatching
- [KA-2016]
9. Which one of the following compounds have both covalent and coordinate bonds?
 (A) NH_4Cl (B) Fe_3O_4
 (C) $MgCl_2$ (D) H_2SO_4
- [GJ-2016]
10. Which one of the following coenzymes acts as a donor of one carbon unit?
 (A) Tetrahydrofolate
 (B) Riboflavin
 (C) Lipoic acid
 (D) Pyridoxal phosphate
- [KA-2016]
11. Which of the following is strongest among weak forces of interactions?
 (A) Ionic (B) Hydrogen bond
 (C) Van der waal's (D) Dipole-dipole
- [MH-2016]
12. The forces that hold the non-polar regions of the molecules together are called:
 (A) hydrophilic interaction
 (B) hydrophobic interaction
 (C) ionic interaction
 (D) amphipathic interaction
- [MH-2016]
13. Codon-anticodon pairing occurs by:
 (A) Covalent bonds
 (B) Electrostatic interactions
 (C) Hydrogen bonds
 (D) Hydrophobic interactions
- [CG-2018]
14. The solubility of gases in water depends on their interaction with water molecules. Four gases i.e., Carbon dioxide, Oxygen, Sulphur dioxide and Ammonia are dissolved in water. In terms of their solubility, which of the following statements is correct?

- (A) Ammonia > Oxygen > Sulphur dioxide > Carbon dioxide
 (B) Oxygen > Carbon dioxide > Sulphur dioxide > Ammonia
 (C) Sulphur dioxide > Oxygen > Ammonia > Carbon dioxide
 (D) Ammonia > Sulphur dioxide > Carbon dioxide > Oxygen

[JK-2018]

15. Which type of bond is broken when ice melts?

- (A) Ionic (B) Polar covalent
 (C) Hydrogen (D) Non-polar covalent

[JK-2018]

16. Which of the following has the highest chemical bond energy?

- (A) Hydrogen bond (B) Triple bond
 (C) Ionic bond (D) Double bond

[MH-2018]

17. Hydrogen bond can be formed between the pair of atoms such as:

- (A) Hydrogen and Carbon
 (B) Hydrogen and Nitrogen
 (C) Oxygen and Nitrogen
 (D) Oxygen and Carbon

[KA-2020]

18. Match the following with reference to protein structure and modifying reagents.

	Column A		Column B
i	Mercapto ethanol	a	Peptide bond
ii	Guanidine hydrochloride	b	Disulphide bridge
iii	Urea	c	Hydrogen bond
iv	Dithiothreitol	d	Ionic bond

- (A) i-a ii-d iii-b iv-c
 (B) i-b ii-c iii-c iv-b
 (C) i-c ii-b iii-a iv-d
 (D) i-d ii-a iii-c iv-a

[RJ-2023]

19. Glycophorin A is the major sialoglycoprotein of the human erythrocyte membrane, which has 3 domains composed of 2 hydrophilic segments which are separated by a region of amino acids. How many amino acids are present in this region?

- (A) 10 amino acids (B) 20 amino acids
 (C) 37 amino acids (D) 5 amino acids

[MH-2023]

20. In which of the following the hydrogen bond is NOT formed?

- (A) between water and amino group of an amino acid
 (B) between carbonyl group of protein and amino group of protein
 (C) between hydroxy group of alcohol and water
 (D) between methyl group of alanine and water

(MP SET-2023)

21. What is the correct order of the following Hydrides according to decrease in their bond angles?

- (A) $H_2O > H_2S > H_2Se > H_2Te$
 (B) $H_2S > H_2Se > H_2Te > H_2O$
 (C) $H_2Se > H_2Te > H_2O > H_2S$
 (D) $H_2Te > H_2O > H_2S > H_2Se$

(MP SET-2023)

22. Intramolecular hydrogen bonding is-

- (A) Hydrogen fluoride (B) m-Chlorophenol
 (C) Water (D) o-Chlorophenol

EXPLANATIONS

1. **Correct Answer is (D):-** I, II, and IV are correct.

Protein structure is stabilized by various interactions. I. Hydrogen bonds: Hydrogen bonds form between the hydrogen atom attached to a polar atom (e.g., nitrogen or oxygen) and another electronegative atom in the protein structure, stabilizing its folding. II. Disulfide bonds: Disulfide bonds are covalent bonds formed between two cysteine residues through oxidation, contributing to the stability of protein structure. IV. Hydrophobic interactions: Hydrophobic interactions occur between nonpolar amino acids in the protein core, minimizing contact with the surrounding aqueous environment and contributing to protein folding and stability.

2. **Correct Answer is (B):-** Butter is a dense source of energy due to its high fat content. Fat provides more calories per unit weight compared to carbohydrates or proteins. It's important to note that while butter does provide a high amount of energy, it's also high in saturated fats, which should be consumed in moderation as part of a balanced diet.

3. **Correct Answer is (A):-** Salt bridge.

Noncovalent interactions in proteins are crucial for their structure and function. Among the given

options, a salt bridge, which is an electrostatic interaction between charged amino acid residues (e.g., a negatively charged amino acid and a positively charged amino acid), is a noncovalent interaction.

4. Correct Answer is (A):- van der Waals interactions

Explanation: van der Waals interactions, also known as ionic interactions, decrease most rapidly with an increase in distance. The strength of van der Waals interactions between charged particles (e.g., amino acid side chains) decreases as the distance between them increases.

5. Correct Answer is (A):- The coiled-coil structure of d-keratin in animal hair is primarily due to the formation of disulfide bonds between cysteine residues. Disulfide bonds are covalent bonds that form between the sulfur atoms of two cysteine residues in the protein chain. These bonds stabilize the coiled-coil structure and contribute to the strength and rigidity of keratin, which is essential for the structural integrity of hair and other biological materials like nails, feathers, and horns. The coiled-coil structure is a characteristic feature of fibrous proteins like keratin.

6. Correct Answer is (C):- A covalent bond is formed when two atoms share electrons, resulting in the formation of a stable molecular bond.

7. Correct Answer is (C):- O – H.... S is not a typical hydrogen bond. Hydrogen bonds typically involve hydrogen atoms bonded to electronegative elements like oxygen or nitrogen, forming weak electrostatic interactions with other electronegative atoms.

8. Correct Answer is (B):- Base pairing is a fundamental concept in molecular biology where specific nucleotide bases (adenine with thymine or uracil, and guanine with cytosine) form hydrogen bonds to create the rungs of the DNA double helix structure. This base pairing specificity is critical for DNA replication, transcription, and other cellular processes.

9. Correct Answer is (D):- H₂SO₄ (sulfuric acid) has both covalent and coordinate bonds. Covalent bonds are formed between the hydrogen and

oxygen atoms, while coordinate bonds are formed between the sulfur atom and the oxygen atoms.

10. Correct Answer is (A):- Tetrahydrofolate (THF) acts as a coenzyme and is involved in one-carbon transfer reactions in various metabolic pathways.

11. Correct Answer is (A):- Among the given options, ionic interactions (ionic bonds) are the strongest among weak forces of interactions. Ionic interactions involve the attraction between oppositely charged ions.

12. Correct Answer is (B):- Hydrophobic interactions refer to the forces that hold nonpolar regions of molecules together, driven by the tendency of nonpolar molecules to minimize contact with water.

13. Correct Answer is (C):- Codon-anticodon pairing refers to the complementary base pairing between the codon (triplet of mRNA) and the anticodon (triplet of tRNA) during protein synthesis. This pairing is primarily mediated by hydrogen bonds between specific nucleotide bases, ensuring accurate translation of the genetic code.

14. Correct Answer is (A):- Ammonia > Oxygen > Sulphur dioxide > Carbon dioxide
Ammonia can form hydrogen bonds with water and is more soluble due to its ability to donate a lone pair of electrons and interact with water molecules. Oxygen is less soluble than ammonia but still more soluble than other gases listed. Sulphur dioxide and carbon dioxide have weaker interactions with water compared to ammonia and oxygen, leading to lower solubility.

15. Correct Answer is (C):- Ice is a solid form of water in which water molecules are held together by hydrogen bonds. When ice melts and turns into liquid water, these hydrogen bonds are broken, allowing the water molecules to move more freely.

16. Correct Answer is (B):- The bond energy refers to the energy required to break a chemical bond. Among the given options, the triple bond has the highest bond energy. Triple bonds consist of three covalent bonds between two atoms, making them stronger than double bonds (option D), hydrogen bonds (option A), and ionic bonds (option C).

17. Correct Answer is (B):- Hydrogen and Nitrogen.

Explanation: Hydrogen bonds can form between a hydrogen atom covalently bonded to a highly electronegative atom (e.g., oxygen, nitrogen, or fluorine) and another electronegative atom in a different molecule. Option (B) represents the correct pairing for hydrogen bond formation.

18. Correct Answer is (A):- The correct matching is as follows:

- | | |
|-------------------------------|---------------------|
| i. Mercapto ethanol - | b. Disulfide bridge |
| ii. Guanidine hydrochloride - | d. Ionic bond |
| iii. Urea - | c. Hydrogen bond |
| iv. Dithiothreitol - | a. Peptide bond |

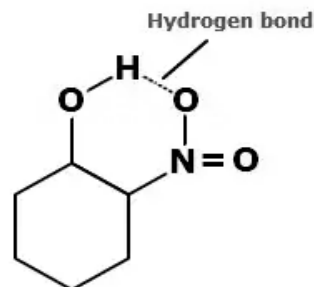
19. Correct Answer is (C):- Glycophorin A is a sialoglycoprotein found in the membrane of human erythrocytes (red blood cells). It plays a role in maintaining the stability and flexibility of the cell membrane. This protein consists of three domains, each composed of two hydrophilic segments separated by a region of hydrophobic amino acids that anchors the protein in the lipid bilayer of the cell membrane.

The specific region you're asking about, which separates the hydrophilic segments of each domain, contains 37 amino acids. This region helps anchor the protein within the lipid bilayer and is responsible for the protein's integration and stability in the cell membrane.

20. Correct Answer is (4):- Hydrogen bonds form between a hydrogen atom and an electronegative atom (e.g., oxygen, nitrogen) in a different molecule.

21. Correct Answer is (A):- The correct order of the hydrides according to decrease in their bond angles is: $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$. As you move down the group in the periodic table from oxygen (O) to sulfur (S) to selenium (Se) to tellurium (Te), the bond angles generally increase.

22. Correct Answer is (D):- Intramolecular H-bonding is present in ortho-nitrophenol.



Ortho-Nitro phenol

Unit-1.4:- Principles of Biophysical Chemistry

(pH, Buffer, Reaction Kinetics, Thermodynamics, Colligative Properties).

- [RJ-2012]
- Energy released during ATP→ADP is
(A) 3000 cal approx. (B) 12000 cal approx.
(C) 9000 cal approx. (D) 1000 cal approx.
- [RJ-2012]
- The size of particles in a colloidal solution is
(A) Smaller than 10^{-8} cm
(B) Bigger than 10^{-5} cm
(C) Between 10^{-8} and 10^{-5} cm
(D) Smaller than 10^{-10} cm
- [AP-2013]
- Arrange the compounds in ascending order based on their energy content
I. Glucose 6-phosphate
II. ATP
III. Phosphoenol pyruvate
IV. Creatine phosphate
(A) I II III IV (B) II IV I III
(C) IV III II I (D) III IV II I
- [GJ-2013]
- An example for a basic buffer is:
(A) phosphate (B) histidine
(C) citrate (D) tris
- [MH-2013-JAN]
- For a spontaneous reaction ΔG should be:
(A) positive
(B) negative
(C) equal to zero
(D) may be negative or zero
- [MH-2013-DEC]
- What will be the pH of acetate- acetic acid buffer, when the ratio of [acetate]/[acetic acid] is 10? (Given $pK_a = 4.76$)
(A) 3.76 (B) 4.76
(C) 5.76 (D) 2.76
- [GJ-2014]
- A carbonated drink of pH 3.0, is how many times more acidic than distilled water?
(A) 10 (B) 100
(C) 1000 (D) 10,000
- [GJ-2014]
- An enzyme facilitates chemical reaction by
(A) Increasing free energy difference between reactants and products
(B) Decreasing free energy difference between reactants and products
(C) Lowering the activation energy of the reaction
(D) Raising the activation energy of the reaction
- [AP-2014]
- Which of the following give a buffer solution?
(A) $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$ (B) $\text{H}_2\text{SO}_4 + \text{Na}_2\text{SO}_4$
(C) $\text{HCl} + \text{NaCl}$ (D) $\text{HCl} + \text{NaOH}$
- [AP-2014]
- Match the following buffers with their PH range
- | List-I | | List-II |
|-----------------------|---|----------|
| I. Acetate buffer | 1 | 7.8 -8.8 |
| II. Tris HCL buffer | 2 | 2.8- 4 |
| III. Phosphate buffer | 3 | 4.0- 5.0 |
| IV. Citrate Buffer | 4 | 6-7.2 |
- (A) I-2, II-4, III-1, IV-3 (B) I-4, II-1, III-2, IV-3.
(C) I-4, II-3, III-2, IV-1. (D) I-3, II-1, III-4, IV-2.
- [KA-2014]
- The rate constant of a reaction at 293°K was found to be 3.2×10^{-3} /sec. At 303°K it is likely to be
(A) 3.2×10^{-3} /sec (B) 6.4×10^{-3} /sec
(C) 1.6×10^{-3} /sec (D) 6.4×10^{-6} /sec
- [KA-2015]
- The entropy of a thermodynamic system refers to
(A) Heat given off by the reaction
(B) Tendency of a system to randomness
(C) Maximum energy of the transition states
(D) Effect of temperature on the reaction velocities
- [MH-2015]
- In a highly acidic solution ($\text{pH} = 1.3$) the amino acid glycine exists in:
(A) $^+\text{NH} - \text{CH}_2 - \text{COO}^-$
(B) $^+\text{NH} - \text{CH}_2 - \text{COOH}$
(C) $\text{NH}_2 - \text{CH}_2 - \text{COOH}$
(D) $\text{NH}_2 - \text{CH}_2 - \text{COO}^-$
- [MH-2015]
- A beaker marked 'X' has 100 ml of water at 80°C while another beaker marked 'Y' has 200 ml water at 20°C. If we mix the two completely in 500 ml beaker and record the temperature immediately, the temperature will be closest to:
(A) 20°C (B) 40°C
(C) 80°C (D) 50°C
- [KA-2016]
- Which among the following is not a thermodynamic system?
(A) Open system (B) Isolated system
(C) Closed system (D) Surrounding

[KA-2016]

16. Which among the following is a buffer?
 (A) Mixture of acid and base
 (B) Mixture of weak acid and strong base
 (C) Mixture of strong acid and weak base
 (D) A weak acid and its conjugate base

[MH-2016]

17. A solution of acidic buffer with a pH of 4.0 is times more acidic than same buffer with a pH of 6
 (A) 2 (B) 100
 (C) 1000 (D) 10

[MH-2016]

18. Which of the following reactions will not proceed in the direction written, assuming that the reactants are initially present in a 1 : 1 molar ratio ?
 (A) ATP + Creatine → Creatine Phosphate + ADP
 (B) ATP + Glycerol → Glycerol 3-phosphate + ADP
 (C) ATP + Fructose → Fructose 6-phosphate + ADP
 (D) ATP + Glucose → Glucose 6-phosphate + ADP

[AP-2017]

19. Which of the following statements is true?
 (A) Free energy is kinetic energy
 (B) If a reaction is endergonic the products are of lower free energy than reactants
 (C) Entropy is the amount of order in energy
 (D) In exergonic reactions, free energy of the products is lower than the reactants

[GJ-2017]

20. The solution of acetic buffer with pH 4.00 is how many times stronger than the same buffer with pH 6.
 (A) 2 (B) 100
 (C) 1000 (D) 10

[CH-2017]

21. The following small peptide substrate are used for determining elastase activity and the following data have been recorded

	K _m (mM)	K _{cat} (S ⁻¹)
PAPA ↓ G	4.02	26
PAPA ↓ A	1.51	37
PAPA ↓ F	0.64	18

The arrow indicates the cleavage site. From the above observations, it appears that:

- (A) PAPA F is digested more rapidly.
 (B) PAPA G is digested most rapidly.
 (C) A hydrophobic residue at the C-terminus seems to be favored
 (D) A smaller residue at the C-terminus seems to be favored

[KA-2017]

22. Choose the right arrangement in the increasing order of energy.
 (A) erg < calorie < joule (B) joule < calorie < erg
 (C) erg < joule < calorie (D) calorie < erg < joule

[KA-2017]

23. The pK_a of acetic acid is 4.76. If a buffer is prepared using acetic acid sodium acetate, and the pH of the solution is 5.76, what will be the ratio of acetic acid concentration to sodium acetate concentration?
 (A) 1:1 (B) 1:10
 (C) 10:1 (D) 1: 100

[MH-2017]

24. In the antigen antibody reaction, the association constant (K_a at equilibrium is represented by:
 (A) [Ag -Ab complex]
 (B) [Free Ag] / [Free Ab]
 (C) [Free Ag] [Free Ab] / [Ag - Ab complex]
 (D) [Ag -Ab complex] / [Free Ag] [Free Ab]

[MH-2017]

25. When a weak acid is mixed with its salt, pH of the solution becomes:
 (A) More acidic (B) Remains same
 (C) Neutral (D) Less acidic

[MH-2017]

26. The amount of energy that must be added to break a bond is exactly equal to the amount that is released upon formation of the bond. Which law of thermodynamics among the following is applicable to this situation?
 (A) First (B) Second
 (C) Third (D) Fourth

[TN-2017]

27. Indicate the ionic species that predominates at pH 4, 8 and 11 for ammonia
 (A) pH 4, NH₄⁺; pH 8, NH₄⁺; pH 11, NH₃
 (B) pH 4, NH₄⁺; pH 8, NH₃⁺; pH 11, NH₂⁻
 (C) pH 4, NH₄⁺; pH 8, NH₃⁺; pH 11, NH₃
 (D) pH 4, NH₃⁺; pH 8, NH₃⁺; pH 11, NH₂⁻

[TN-2017]

28. Estimate the volume of a solution of 5 M NaOH that must be added to adjust the pH from 4 to 9 in 100 mL of a 100 mM solution of phosphoric acid
 (A) 4 mL (B) 2 mL
 (C) 1 mL (D) 0.5 mL

[AP-2018]

29. If the pH of a solution is 8, its hydroxyl ion concentration is
 (A) 10⁻⁸
 (B) ten times more than that of pH 7 solution

- (C) 10^{-2}
(D) 10^8 [AP-2018]
30. An increase in entropy
I. is an increase in order
II. occurs when a NaCl solution is diluted
III. occurs when a hydrocarbon molecule is removed from an aqueous environment
IV. occurs in the system when amino acids are linked to form a protein
(A) I, II are correct (B) I, IV are correct
(C) II, III are correct (D) II, IV are correct [JK-2018]
31. In thermodynamics "free energy" refers to
(A) energy that can be harnessed to do work or drive chemical reaction.
(B) excess energy from a reaction that a cell does not use.
(C) energy required to initiate a chemical reaction
(D) energy which is left after a reaction has completed [MH-2018]
32. If an aqueous solution has a hydrogen ion concentration of 10^{-3} M, what is the concentration of hydroxyl ion?
(A) 10^{-14} M (B) 10^{-10} M
(C) 10^{-11} M (D) 10^{-12} M [MH-2018]
33. The feasibility of a biochemical reaction is decided by the equation $G = H - TS$. If both H and S have negative values, the reaction:
(A) is not favoured at any temperature
(B) happens spontaneously
(C) is exergonic, favoured below $T = H/S$
(D) is endergonic, favoured above $T = H/S$ [AP-2019]
34. Calculate the pH of a bicarbonate buffer that is composed of 0.5 M sodium carbonate and 0.05 M carbonic acid solution. The pK is 6.1
(a) 7.1 (b) 8.0
(c) 7.4 (d) 9.0 [CG-2019]
35. Following are few chemical reactions:
Adenosine diphosphate (ADP) = AMP + P
(b) Adenosine Triphosphate (ATP) = ADP + P
(c) Phosphoenolpyruvate (PEP) = pyruvate + P
Arrange these reactions as per increasing order of AG
(A) (a), (b), (c) (B) (c), (b), (a)
(C) (b), (a), (c) (D) (b), (c), (a)
- [MH-2019]
36. Such a set of opposing reaction shown as (A) and (B) in above figure is an example of:
(A) Reversible reaction (B) Substrate cycle
(C) Product cycle (D) Enzyme cycle
37. For the reaction $A \rightarrow B$ at 298 K, the change in enthalpy is -7 kJ.mol^{-1} and the change in entropy is $-25 \text{ J.K}^{-1}.\text{mol}^{-1}$. How much is the free energy change and whether the reaction is spontaneous or nonspontaneous? [MH-2019]
(A) $\Delta G = 450 \text{ J.mol}^{-1}$ and reaction is not spontaneous
(B) $\Delta G = 450 \text{ J.mol}^{-1}$ and reaction is spontaneous
(C) $\Delta G = 900 \text{ J.mol}^{-1}$ and reaction is spontaneous
(D) $\Delta G = 900 \text{ J.mol}^{-1}$ and reaction is not spontaneous [MH-2019]
38. A solution is made by mixing 50 ml of 2 M K_2HPO_4 and 25 ml of 2.0 M KH_2PO_4 . The solution is diluted to a final volume of 250 ml. What is the pH of the final solution? ($\text{p}^K = 6.82$)
(A) 6.82 (B) 7.12
(C) 6.52 (D) 7.51 [MH-2020]
39. State, whether the following two statements (I and II), are true or false:
(I) A reaction is said to be spontaneous when it can proceed in either the forward or reverse direction.
(II) A spontaneous process can occur with a large decrease in entropy.
(A) I = False and II = False
(B) I = True and II = False
(C) I = False and II = True
(D) I = True and II = True [KA-2020]
40. $\text{pH} = \text{pK}$, when
(A) $[\text{Proton acceptor}] = \frac{1}{2} [\text{Proton donor}]$
(B) $[\text{Proton acceptor}] = [\text{Proton donor}]$
(C) $[\text{Proton acceptor}] = 2 [\text{Proton donor}]$
(D) $2[\text{Proton acceptor}] = [\text{Proton donor}]$ [MH-2020]
41. Calculate the pl value of aspartic acid from the given pK values. (Given : $\text{pK}_1 = 1.99$, $\text{pK}_2 = 9.90$ and $\text{pK}_R = 3.90$)
(A) 2.945 (B) 5.945
(C) 6.9 (D) 7.895

[WB-2020]

42. Succinate dehydrogenase converts succinate to fumarate. Which one of the following is true when the competitive inhibitor malonate is added to the reaction mixture?
- (A) Both K_m and V_{max} increase
 (B) Both K_m and V_{max} decrease
 (C) K_m increases and V_{max} remains unchanged
 (D) K_m increases and V_{max} decreases

[MH-2021]

43. A population of cells grown in adherent culture contains 0.4 mg protein per 10 cells. Actin comprises 4.5% of the total protein. Given the Mr of actin is 42000 daltons and Avogadro 23 number is 6.02×10^{23} , which of the following equals the mean number of actin molecules per cell?

- 14
 (1) 2.58×10^{11} actin molecules
 11
 (2) 2.58×10^8 actin molecules
 8
 (3) 2.58×10^{10} actin molecules
 10
 (4) 2.58×10^{10} actin molecules

[GJ-2022]

44. In an equilibrium reaction the value of ΔG
- (A) $\Delta G = 0$ (B) $\Delta G = -1$
 (C) $\Delta G = 1$ (D) $\Delta G = \Delta G^\circ$

[GJ-2022]

45. What is the pI value of a nonstandard amino acid X whose pK_1 , pK_2 and pK_3 values are 2.1, 7.8 and 11.3 ?
- (A) 6.7 (B) 4.95
 (C) 9.55 (D) 7.06

[JK-2022]

46. Net charge on an amino acid at a pH less than pI will be
- (A) Positive
 (B) Negative
 (C) Neutral
 (D) Charge is not affected by pH

[MH-2023]

47. What is the pI value of a non-standard amino acid X, whose pK_1 , pK_2 , and pK_3 values are 2.5, 7.5 and 9.0?
- (A) 8.25 (B) 50
 (C) 5.75 (D) 6.33

[WB-2023]

48. Probability of dissociation of a solution of DNA double helix into its component single strands by removing certain susceptible protons is the highest in which one of the following pH values?

- (A) pH 3.0 (B) pH 5.0
 (C) pH 7.0 (D) pH 9.0

(MP SET-2023)

49. For which the half-life period is directly proportional to initial concentration of a solution?
- (A) First Order Reaction
 (B) Second Order Reaction
 (C) Third Order Reaction
 (D) Zero Order Reaction

(MP SET-2023)

50. If the Hydrogen ion concentration in a solution is one gram mole per litre, then the pH of the solution is:
- (A) 07 (B) 14
 (C) 08 (D) 00

(MP SET-2023)

51. The substrate concentration at which an enzyme exhibits half the maximum velocity is known as:
- (A) V_{max} (B) $[S]$
 (C) K_m (D) K_{eq}

(MP SET-2023)

52. Isoenzyme is characterized as:
- (A) Non-protein part of enzyme
 (B) Enzymes with same quaternary structure
 (C) Similar enzymes that catalyse different types of reactions
 (D) Multiple forms of given enzyme that catalyze same type of reaction

EXPLANATIONS

- Correct Answer is (A):-** The hydrolysis of ATP to ADP involves the release of energy. This energy release is approximately 3000 calories per mole of ATP hydrolyzed.
- Correct Answer is (C):-** Between 10^{-8} and 10^{-5} cm: This is the correct option. Colloidal particles generally have sizes in this range, which allows them to remain dispersed in the solution without settling.
- Correct Answer is (A):-** Phosphoenol pyruvate is an intermediate molecule in glycolysis, the process by which glucose is broken down to produce energy. It has a high energy content, which is released when it is converted to pyruvate. (14.8 Kcal/mole)
 Creatine phosphate is a high-energy compound that can be used to quickly regenerate ATP. It is found in muscle cells and is used to provide energy for muscle contraction. (10 Kcal/mole)

ATP is the main energy currency of the cell. It is used to power many cellular processes, such as muscle contraction, active transport, and protein synthesis. (7.3Kcal/mole)

Glucose 6-phosphate is a molecule that is formed when glucose is phosphorylated. It is an intermediate molecule in glycolysis and the pentose phosphate pathway. It has a relatively low energy content.

4. **Correct Answer is (D):-** Tris (tris(hydroxymethyl) aminomethane) is a commonly used basic buffer in biological and biochemical experiments.

5. **Correct Answer is (B):-** A spontaneous reaction is one that proceeds without the need for external input of energy. It is a reaction that releases free energy, which is the energy available to do work. The free energy change for a reaction, ΔG , is calculated using the following equation : $\Delta G = \Delta H - T\Delta S$ where ΔH is the change in enthalpy, T is the temperature in Kelvin, and ΔS is the change in entropy. A negative ΔG means that the reaction releases free energy, and so it is spontaneous. A positive ΔG means that the reaction absorbs free energy, and so it is non-spontaneous. A ΔG of zero means that the reaction is at equilibrium, and there is no net change in free energy.

6. **Correct Answer is (C):-** The pH of a buffer solution is determined by the pKa value and the ratio of the concentrations of the conjugate base (acetate) to the weak acid (acetic acid). In this case, when the ratio is 10, the pH can be calculated as $pK_a + \log([acetate]/[acetic acid]) = 4.76 + \log(10) = 5.76$.

7. **Correct Answer is (D):-** The pH scale is a logarithmic scale, which means that each whole number change in pH represents a tenfold change in acidity or basicity.

Given that the carbonated drink has a pH of 3.0 and distilled water has a pH of 7.0 (neutral pH), we can calculate the difference in acidity as follows:

Difference in acidity = $10^{(pH \text{ of distilled water} - pH \text{ of carbonated drink})}$ Difference in acidity = 10^{7-3}
Difference in acidity = 10^4

So, the carbonated drink is 10,000 times more acidic than distilled water.

The correct answer is (D) 10,000.

8. **Correct Answer is (C):-** Enzymes are biological catalysts that increase the rate of chemical reactions. They achieve this by lowering the activation energy required for the reaction to occur, thereby facilitating the conversion of reactants to products.

9. **Correct Answer is (A):-** A buffer solution consists of a weak acid and its conjugate base (or a weak base and its conjugate acid) in approximately equal concentrations. In this case, CH_3COOH is a weak acid, and CH_3COONa is its conjugate base, so their combination can form a buffer solution.

10. **Correct Answer is (D):-**

List-I	List-II
I. Acetate buffer	3. 4.0- 5.0
II. Tris HCL buffer	1. 7.8 -8.8
III. Phosphate buffer	4. 6-7.2
IV. Citrate Buffer	2. 2.8- 4

11. **Correct Answer is (B):-** The rate constant of a reaction generally increases with an increase in temperature. In this case, the rate constant at 303°K is expected to be approximately double the value at 293°K, resulting in a rate constant of $6.4 \times 10^{-3}/\text{sec}$.

12. **Correct Answer is (B):-** Entropy is a measure of the degree of randomness or disorder in a system. It represents the number of ways in which the energy of a system can be distributed among its microstates.

13. **Correct Answer is (B):-** At low pH values, glycine, an amino acid, exists in its protonated form ($+3NH - CH_2 - COOH$) where the amino group is positively charged.

14. **Correct Answer (A):-**

The formula for heat transfer is:

$$Q = m * c * \Delta T$$

where: Q = Heat gained or lost m = Mass of the substance c = Specific heat capacity of water (approximately 4.18 J/g°C or 4.18 J/mL°C) ΔT = Change in temperature (final temperature - initial temperature)

Let's calculate the heat gained and lost for both beakers:

For beaker X: $m_X = 100 \text{ mL}$ $\Delta T_X = (\text{final temperature}) - 80^\circ\text{C}$

For beaker Y: $m_Y = 200 \text{ mL}$ $\Delta T_Y = (\text{final temperature}) - 20^\circ\text{C}$

Since the total heat gained by the cold water (beaker Y) is equal to the total heat lost by the hot water (beaker X), we can set up the equation:

$$m_Y \cdot c \cdot \Delta T_Y = m_X \cdot c \cdot \Delta T_X$$

Now, let's substitute the values:

$$200 \text{ mL} \cdot 4.18 \text{ J/mL}^\circ\text{C} \cdot (\text{final temperature} - 20^\circ\text{C}) = 100 \text{ mL} \cdot 4.18 \text{ J/mL}^\circ\text{C} \cdot (\text{final temperature} - 80^\circ\text{C})$$

Solve for the final temperature:

$$8360 \text{ J} \cdot (\text{final temperature} - 20^\circ\text{C}) = 418 \text{ J} \cdot (\text{final temperature} - 80^\circ\text{C})$$

$$8360 \text{ J} \cdot \text{final temperature} - 8360 \text{ J} \cdot 20^\circ\text{C} = 418 \text{ J} \cdot \text{final temperature} - 33440 \text{ J}$$

$$8360 \text{ J} \cdot \text{final temperature} - 418 \text{ J} \cdot \text{final temperature} = 33440 \text{ J} - 8360 \text{ J} \cdot 20^\circ\text{C}$$

$$7942 \text{ J} \cdot \text{final temperature} = 1680 \text{ J}$$

$$\text{final temperature} \approx 1680 \text{ J} / 7942 \text{ J} \approx 0.211^\circ\text{C}$$

Since the final temperature must be within the initial temperature range of the two beakers (20°C to 80°C), the closest option to 0.211°C is 20°C .

So, the correct answer is (A) 20°C .

15. Correct Answer is (D):- In thermodynamics, a system refers to the part of the universe that is under consideration, while the surrounding refers to everything outside the system. The surrounding is not considered a thermodynamic system itself.

16. Correct Answer is (D):- A buffer is a solution that resists changes in pH when small amounts of acid or base are added. It is composed of a weak acid and its conjugate base (or a weak base and its conjugate acid) in roughly equal concentrations.

17. Correct Answer is (B):- The pH scale is logarithmic, and each unit represents a tenfold difference in acidity or alkalinity. Therefore, a solution with a pH of 4.0 is 10^2 or 100 times more acidic than a solution with a pH of 6.0.

18. Correct Answer is (A):- $\text{ATP} + \text{Creatine} \rightarrow \text{Creatine Phosphate} + \text{ADP}$

This reaction represents the phosphorylation of creatine using ATP to form creatine phosphate and ADP. Since ATP is used to transfer a phosphate group to creatine, this reaction can proceed in the direction written.

19. Correct Answer is (D):- Exergonic reactions are characterized by the release of free energy, and the

free energy of the products is lower than that of the reactants. This energy difference is available for performing work or driving other chemical reactions.

20. Correct Answer is (B):- The pH scale is logarithmic, and each unit represents a tenfold difference in acidity or alkalinity. Therefore, a solution with a pH of 4.00 is 10^2 or 100 times stronger (more acidic) than a solution with a pH of 6.00.

21. Correct Answer is (C):- Looking at the given data, the peptide substrate PAPAF is digested most rapidly compared to PAPAG and PAPAA. This suggests that a hydrophobic residue at the C-terminus (F in this case) seems to be favored by the elastase enzyme, resulting in faster digestion.

22. Correct Answer is (C):- An erg is a unit of energy in the CGS (centimeter-gram-second) system. It is a very small unit of energy.

A joule is the standard unit of energy in the International System of Units (SI). It is a larger unit compared to an erg but is still relatively small in everyday contexts.

A calorie is another unit of energy. It is defined as the amount of energy required to raise the temperature of 1 gram of water by 1 degree Celsius. One calorie is approximately equal to 4.184 joules.

23. Correct Answer is (C):- pK_a of acetic acid (CH_3COOH) = 4.76 pH of the buffer solution = 5.76 We want to find the ratio of $[\text{A}^-]$ (concentration of sodium acetate) to $[\text{HA}]$ (concentration of acetic acid) in the buffer.

Let's rearrange the Henderson-Hasselbalch equation to solve for the ratio $[\text{A}^-]/[\text{HA}]$:

$$[\text{A}^-]/[\text{HA}] = 10^{(\text{pH} - \text{pK}_a)}$$

Now, plug in the given values:

$$[\text{A}^-]/[\text{HA}] = 10^{(5.76 - 4.76)} = 10^1 = 10$$

The ratio of $[\text{A}^-]$ (sodium acetate) to $[\text{HA}]$ (acetic acid) in the buffer solution is indeed 10:1.

Therefore, option (C) is correct, and the ratio of acetic acid concentration to sodium acetate concentration is 10:1.

24. Correct Answer is (C):- The association constant (K_a) represents the equilibrium constant for the formation of the antigen-antibody complex. It is given by the ratio of the concentrations of free

antigen ([Free Ag]) and free antibody ([Free Ab]) to the concentration of the antigen-antibody complex ([Ag-Ab complex]).

- 25. Correct Answer is (B):-** When a weak acid is mixed with its salt, it forms a buffer solution. Buffers resist changes in pH when small amounts of acid or base are added. The pH of a buffer solution depends on the pKa of the weak acid and its conjugate base, but the addition of the salt does not significantly change the pH.
- 26. Correct Answer is (A):-** The First Law of Thermodynamics, also known as the law of conservation of energy, states that energy cannot be created or destroyed, only transferred or converted from one form to another. This law is applicable in situations where the energy required to break a bond is equal to the energy released upon the formation of the bond, as the total energy remains constant.
- 27. Correct Answer is (C):-** Ammonia (NH₃) can act as a weak base and donate a proton to form the ammonium ion (NH₄⁺). At lower pH (acidic conditions, pH 4), the ammonium ion predominates. At higher pH (alkaline conditions, pH 8 and 11), ammonia (NH₃) predominates as the pH increases and can accept a proton to form the ammonium ion (NH₄⁺).
- 28. Correct Answer is (B):-** To adjust the pH from 4 to 9 in 100 mL of a 100 mM solution of phosphoric acid, an estimate of 2 mL of a 5 M NaOH solution needs to be added.
- 29. Correct Answer is (B):-** When the pH of a solution changes by one unit, the hydrogen ion concentration ([H⁺]) changes by a factor of 10. A solution with a pH of 8 is one unit higher than a solution with a pH of 7. Therefore, the hydroxyl ion concentration ([OH⁻]) of a pH 8 solution is ten times higher than that of a pH 7 solution.
- 30. Correct Answer is (C):-** Entropy is a measure of the disorder or randomness in a system. Dilution of a solution increases the randomness of the solvent and solute particles, leading to an increase in entropy. Removing a hydrocarbon molecule from an aqueous environment also increases the disorder and randomness, resulting in an increase in entropy.
- 31. Correct Answer is (A):-** In thermodynamics, free energy (often denoted as G) is a measure of the energy in a system that is available to do useful work, such as driving chemical reactions or performing mechanical work. It takes into account both the internal energy of the system and the energy required to perform work against its surroundings.
- 32. Correct Answer is (C):-** In water, the concentration of hydrogen ions (H⁺) multiplied by the concentration of hydroxyl ions (OH⁻) is equal to 10⁻¹⁴ M² at 25°C. Therefore, if the hydrogen ion concentration is 10⁻³ M, the concentration
- 33. Correct Answer is (C):-** The reaction is exergonic, favored below T = H/S.
Explanation: The equation $G = H - TS$ represents the Gibbs free energy change, where G is the free energy, H is the enthalpy change, T is the temperature in Kelvin, and S is the entropy change. When both H and S have negative values, the reaction is exergonic (releases energy) and favored below a certain temperature determined by $T = H/S$.
- 34. Correct Answer is (A):-** The Henderson-Hasselbalch equation is $\text{pH} = \text{pKa} + \log([A^-]/[HA])$. In this case, the pKa is given as 6.1. The ratio of [A⁻]/[HA] can be calculated as (0.5 M sodium carbonate) / (0.05 M carbonic acid) = 10. Taking the logarithm (log₁₀) of 10 gives 1. Therefore, $\text{pH} = 6.1 + 1 = 7.1$.
- 35. Correct Answer is (B):-** The Gibbs free energy change (ΔG) determines the spontaneity and energy released or required in a chemical reaction. A reaction with a lower ΔG value is more favorable and spontaneous. Based on the given reactions, the reaction with the lowest ΔG is (c) PEP = pyruvate + P, followed by (b) ATP = ADP + P, and (a) ADP = AMP + P has the highest ΔG value.
- 36. Correct Answer is (A):-** A reversible reaction is a chemical reaction that can proceed in both the forward and reverse directions. In the given figure, the reactions (A) and (B) represent a reversible reaction where the reactants can form products and the products can also react to form the original reactants.

37. Correct Answer is (A):- The free energy change (ΔG) can be calculated using the equation $\Delta G = \Delta H - T\Delta S$, where ΔH is the change in enthalpy, ΔS is the change in entropy, and T is the temperature in Kelvin. Plugging in the values, we have $\Delta G = -7 \text{ kJ/mol} - (298 \text{ K})(-25 \text{ J/K/mol}) = -7 \text{ kJ/mol} + 7.45 \text{ kJ/mol} = 0.45 \text{ kJ/mol} = 450 \text{ J/mol}$.

Since ΔG is positive (450 J/mol), the reaction is nonspontaneous.

38. Correct Answer is (B):- Given:

Volume of K_2HPO_4 solution = 50 ml

Concentration of K_2HPO_4 solution = 2 M

Volume of KH_2PO_4 solution = 25 ml

Concentration of KH_2PO_4 solution = 2.0 M

Final volume of the solution = 250 ml

To calculate the concentrations of H_2PO_4^- and HPO_4^{2-} ions, we can use the following equations:

$[\text{H}_2\text{PO}_4^-] = (\text{moles of } \text{KH}_2\text{PO}_4) / (\text{final volume of the solution})$

$[\text{HPO}_4^{2-}] = (\text{moles of } \text{K}_2\text{HPO}_4) / (\text{final volume of the solution})$

The moles of KH_2PO_4 can be calculated as follows:

$\text{moles of } \text{KH}_2\text{PO}_4 = (\text{volume of } \text{KH}_2\text{PO}_4 \text{ solution}) \times (\text{concentration of } \text{KH}_2\text{PO}_4 \text{ solution})$

Similarly, the moles of K_2HPO_4 can be calculated as follows:

$\text{moles of } \text{K}_2\text{HPO}_4 = (\text{volume of } \text{K}_2\text{HPO}_4 \text{ solution}) \times (\text{concentration of } \text{K}_2\text{HPO}_4 \text{ solution})$

Using the given values, we can calculate the moles of KH_2PO_4 and K_2HPO_4 :

$\text{moles of } \text{KH}_2\text{PO}_4 = (25 \text{ ml}) \times (2.0 \text{ M}) = 50 \text{ mmol}$

$\text{moles of } \text{K}_2\text{HPO}_4 = (50 \text{ ml}) \times (2.0 \text{ M}) = 100 \text{ mmol}$

Now, we can calculate the concentrations of H_2PO_4^- and HPO_4^{2-} ions:

$[\text{H}_2\text{PO}_4^-] = (50 \text{ mmol}) / (250 \text{ ml}) = 0.2 \text{ M}$

$[\text{HPO}_4^{2-}] = (100 \text{ mmol}) / (250 \text{ ml}) = 0.4 \text{ M}$

Since H_2PO_4^- is a weak acid and HPO_4^{2-} is its conjugate base, we can use the Henderson-Hasselbalch equation to calculate the pH of the solution:

$\text{pH} = \text{pK}_a + \log([\text{HPO}_4^{2-}] / [\text{H}_2\text{PO}_4^-])$

The pK_a value for the $\text{H}_2\text{PO}_4^- / \text{HPO}_4^{2-}$ buffer system is given as 6.82.

Substituting the values into the Henderson-Hasselbalch equation:

$\text{pH} = 6.82 + \log(0.4/0.2)$

$\text{pH} = 6.82 + \log(2)$

$\text{pH} = 6.82 + 0.301$

$\text{pH} = 7.121$

39. Correct Answer is (A):- (I) A reaction is said to be spontaneous when it can proceed in either the forward or reverse direction. This is not an accurate definition of spontaneity. A spontaneous reaction is one that can occur in a particular direction under certain conditions, and it's not necessarily reversible.

(II) A spontaneous process typically occurs with an increase in entropy. Spontaneous processes tend to move towards greater disorder, resulting in an increase in entropy. A large decrease in entropy is generally associated with non-spontaneous processes.

40. Correct Answer is (B):- The pH is equal to pK_a when the proton acceptor is equal to the proton donor.

41. Correct Answer is (B):- The pI (isoelectric point) value of aspartic acid can be calculated by taking the average of the two pK_a values that are closest to each other. In this case, $\text{pK}_1 = 1.99$ and $\text{pK}_2 = 9.90$. The two pK_a values closest to each other are $\text{pK}_1 = 1.99$ and $\text{pK}_R = 3.90$. Taking the average of these values, we have $(1.99 + 3.90) / 2 = 5.89$.

42. Correct Answer is (D):- When the competitive inhibitor malonate is added to the reaction mixture of succinate dehydrogenase, both the K_m (Michaelis constant) and V_{max} (maximum reaction rate) decrease.

43. Correct Answer is (A):- Given: 0.4 mg protein per 10 cells, and actin comprises 4.5% of the total protein. The total mass of actin in 10 cells can be calculated as $(0.4 \text{ mg}) \times (0.045) = 0.018 \text{ mg}$.

Converting the mass of actin to the number of molecules using Avogadro's number, we have $(0.018 \text{ mg}) \times (1 \text{ g} / 1000 \text{ mg}) \times (1 \text{ mol} / 42000 \text{ g}) \times (6.02 \times 10^{23} \text{ molecules/mol}) = 2.58 \times 10^{11}$ actin molecules.

44. Correct Answer is (A):- In an equilibrium reaction, the value of ΔG is equal to zero.

45. Correct Answer is (A):- At low pH (acidic conditions), all the groups are protonated, and the amino acid has a net positive charge.

At high pH (alkaline conditions), all the groups are deprotonated, and the amino acid has a net negative charge.

To find the pI, we need to consider the two relevant pKa values that are closest together. In this case, it's pKa2 and pKa3.

The pI is the average of pKa2 and pKa3:

$$pI = (pKa2 + pKa3) / 2 \quad pI = (2.3 + 11.3) / 2 \quad pI = 13.6 / 2 \quad pI = 6.8$$

Therefore, the pI of amino acid X is approximately 6.8.

The closest option to this value is (A) 6.7.

properties, regulatory characteristics, or tissue distributions. They often arise due to genetic variation or alternative splicing.

46. Correct Answer is (A):- At a pH less than the pI (isoelectric point) of an amino acid, the net charge on the amino acid will be positive.

47. Correct Answer is (A):- In this case, the closest pK values are pK2 = 7.5 and pK3 = 9.0.

Taking the average of these values, we have $(7.5 + 9.0) / 2 = 8.25$.

48. Correct Answer is (A):- This is because acidity can facilitate the removal of susceptible protons, leading to the disruption of hydrogen bonds that hold the DNA strands together. Among the given pH values, pH 3.0 is the most acidic option.

49. Correct Answer is (A):- In a first-order reaction, the half-life period is directly proportional to the initial concentration of a solution. The rate of a first-order reaction is proportional to the concentration of a single reactant raised to the power of 1, which leads to this relationship between half-life and initial concentration.

50. Correct Answer is (D):- The pH of a solution is given by the formula:

$$pH = -\log[H^+]$$

If the hydrogen ion concentration ($[H^+]$) in the solution is one gram mole per liter, then:

$$pH = -\log(1) = 0$$

51. Correct Answer is (C):- The substrate concentration at which an enzyme exhibits half the maximum velocity is known as the Michaelis-Menten constant (Km). It's a measure of the affinity of the enzyme for its substrate.

52. Correct Answer is (D):- Isoenzymes are multiple forms of a given enzyme that catalyze the same type of reaction but might have different kinetic

Unit-1.5: Bioenergetics, Glycolysis, Oxidative Phosphorylation, Coupled Reaction, Group Transfer, Biological Energy Transducers.

[AP-2012]

1. Electron Transport chain contains the following components:

- I. Cytochrome C-oxidase
- II. Succinate/COQ oxidoreductase
- III. NADH: COQ oxidoreductase
- IV. Coenzyme Q: cytochrome oxidoreductase

Choose correct one of following sequences

- (A) III, II, IV, I
- (B) II, III, IV, I
- (C) I, IV, III, II
- (D) IV, III, II, I

[RJ-2012]

2. Oxidation of α -carbon of phytanic acid takes place prior to β -oxidation because

- (A) coenzyme A cannot activate phytanic acid
- (B) β -carbon is blocked by methyl group
- (C) the chain of phytanic acid is too long
- (D) enzymes cannot transport phytanic acid into mitochondrial matrix

[RJ-2012]

3. The enzyme involved in 'foxfire' is

- (A) Aldolase
- (B) Luciferase
- (C) Glucose-6-phosphate dehydrogenase
- (D) Hexokinase

[RJ-2012]

4. Which of the following acts as connecting link between EMP pathway and Krebs' cycle?

- (A) Pyruvic acid
- (B) Acetyl CoA
- (C) Phosphoenol Pyruvate
- (D) Ribulose bis phosphate

[RJ-2012]

5. The conversion of phosphoenol pyruvic acid in a kind of reaction called

- (A) Oxidative decarboxylation
- (B) Trans phosphorylation reaction
- (C) Dehydrogenation reaction
- (D) Isomerization

[RJ-2012]

6. In 1861 it was observed that in the absence of O_2 yeast consumes more glucose than in the presence of O_2 . The phenomenon is known as

- (A) Warburg effect
- (B) Pasteur effect
- (C) Calvin effect
- (D) Emerson effect

[AP-2012]

7. Which of the following has more redox potential (E^0) value?

- (A) Flavo proteins
- (B) Cytochrome B
- (C) Nicotinamide adenine dinucleotide
- (D) Ubiquinone

[MH-2013-DEC]

8. If more is the negative standard, reduction potential of a redox pair, greater is the tendency to:

- (A) Loose electron
- (B) Gain electron
- (C) Gain a proton
- (D) Loose a proton

[MH-2013-JAN]

9. The sequence in which the following electron carriers are organised in electron transport chain is:

- (A) Ubiquinone, cytochrome $a + a_3$, NADH dehydrogenase
- (B) Cytochrome $a + a_3$ ubiquinone, NADH dehydrogenase
- (C) NADH dehydrogenase, ubiquinone, cytochrome $a + a_3$
- (D) NADH dehydrogenase, cytochrome $a + a_3$, ubiquinone

[MH-2013-JAN]

10. There are many compounds that are known to be inhibitors of mitochondrial electron transport chain (ETC). Which of the following is not an inhibitor of ETC?

- (A) Rotenone
- (B) Antimycin A
- (C) Sodium azide.
- (D) Dinitrophenol

[MH-2013-JAN]

11. Which one of the following is not a proton pump?

- (A) NADH-Q reductase
- (B) Succinate-Q reductase
- (C) Cytochrome C reductase
- (D) Cytochrome oxidase

[MH-2013-DEC]

12. Which of the following cases is not involved in group transfer?

- (A) Lipoic acid
- (B) TPP
- (C) Coenzyme A
- (D) NAD^+

[MH-2013-DEC]

13. A laboratory technician was rushed to hospital, where she was found dead. The most dramatic symptom found was that her body was very hot indicating extremely high fever. You can learn that her laboratory has been working on metabolic inhibitors and she might have ingested one. Which one of the following is the most likely culprit?

- (A) Barbiturate
- (B) Dimercaprol
- (C) Dinitrophenol
- (D) Cyanide

[MH-2013-DEC]

14. In order to fully oxidize a saturated fatty acid containing 13 carbon atoms, besides the enzymes of β oxidation, one additional enzyme required is.....

(A) Methyl malonyl-CoA mutase
 (B) Acyl-CoA dehydrogenase
 (C) Enoyl-CoA hydratase
 (D) Carnitine acyl transferase

[MH-2013-DEC]

15. Which one of the following is a fundamental mode of energy exchange in biological system?

(A) ATP-AMP cycle
 (B) ADP-creatine phosphate cycle
 (C) ATP-ADP cycle
 (D) ADP-Arginine phosphate cycle

[GJ-2013]

16. Which of the following statements is false?

(A) All biological processes have negative ΔG°
 (B) Biological processes with positive ΔG° can only occur upon coupling with another process with higher negative ΔG°
 (C) ΔG° varies with the concentrations of biological constituents of the process
 (D) ΔG° does not describe the energetics of biological process

[JK-2013]

17. A fatty acid with 14 C-atoms will undergo how many cycles of β -oxidation?

(A) 7 (B) 4
 (C) 6 (D) 5

[JK-2013]

18. An enzyme used in both glycolysis and gluconeogenesis is:

(A) 3-phosphoglycerate kinase
 (B) Glucose 6-phosphate
 (C) Hexokinase
 (D) Phosphofructokinase

[JK-2013]

19. Co-enzyme Q is involved in electron transport as:

(A) A water soluble electron donor
 (B) Covalently attached cytochrome co-factor
 (C) Lipid soluble electron carrier
 (D) Oxygen carrier

20. The standard free energy change for Oxidative Phosphorylation using NADH as a substrate is about -53 Kcal/mole and the free energy in the 2.5 moles of ATP generated is -17.5 Kcal/mole. You can conclude all of the following except [AP-2014]

(A) Only about 33% of free energy in NADH was used to generate ATP
 (B) About 66% of the free energy in NADH was converted to heat
 (C) Overall change in free energy of the reaction was -35.5 Kcal/mole
 (D) Oxidative Phosphorylation is a reversible reaction

[GJ-2014]

21. Which of the following is involved at substrate level phosphorylation?

(A) Hexokinase
 (B) Pyruvate kinase
 (C) Phosphofructokinase
 (D) Phosphofructo kinase

[GJ-2014]

22. Cofactor for oxidoreductase responsible for transmitting electron photosystem-I during photosynthesis is

(A) Plastoquinone (B) Plastocyanin
 (C) Ferredoxin (D) Cytochrome a3

[KA-2014]

23. During oxidative Phosphorylation in mitochondria synthesis of ATP Occurs due to.

(A) Oxidation of glucose by glycolysis
 (B) Electrochemical proton gradient
 (C) Oxidation NADH to NAD^+
 (D) Oxidation of pyruvate to acetyl Co(A)

[KA-2014]

24. The co-factor involved in the conversion of succinic acid to fumaric acid is

(A) NAD^+ (B) FAD
 (C) GTP (D) NADP

[KA-2015]

25. In the glycolytic pathway, 1,3 bis phospho glycerate is converted into 3 phospho glycerate and the phosphate group is transferred to ADP to produce ATP. This type of reaction is called

(A) Futile cycle
 (B) Substrate level phosphorylation
 (C) Energy conservation reaction
 (D) Oxidative phosphorylation

[KA-2015]

26. Which of the following is not an intermediate in the citric acid cycle?

(A) Pyruvate (B) Oxaloacetate
 (C) Succinate (D) Malate

[KA-2015]

27. Methyl carbon of pyruvate was labeled with ^{14}C . If this pyruvate underwent gluconeogenesis, which carbon of glucose will be labelled?
- (A) 1 (B) 1 and 3
(C) 3 (D) All

[MH-2015]

28. Which of the following high energy compound releases maximum amount of energy on hydrolysis?
- (A) ATP
(B) 1, 3 bis-phosphoglycerate
(C) Creatine phosphate
(D) Phosphoenol pyruvate

[MH-2015]

29. Which of the following pentose is not formed during pentose phosphate pathway?
- (A) Ribulose 5-phosphate
(B) Ribose 5-phosphate
(C) Xylulose 5-phosphate
(D) Xylose 5-phosphate

[MH-2015]

30. Which shuttle is operated to get 32 ATP molecule after complete oxidation of glucose?
- (A) Glycerol-3-phosphate (B) Malate-aspartate
(C) Pyruvate-malate (D) Citrate-pyruvate

[MH-2015]

31. No net conversion of fatty acids to glucose occurs in mammals because
- (A) pyruvate dehydrogenase reaction is irreversible
(B) of the presence of citrate synthase
(C) lack of glycerol kinase
(D) lack of acetyl CoA carboxylase

[MH-2015]

32. Which of the following biochemical reaction shows highest standard free energy change?
- (A) $\text{UDP-glucose} + \text{H}_2\text{O} \rightarrow \text{UMP} + \text{glucose 1-phosphate}$
(B) $\text{Glucose 1-phosphate} \rightarrow \text{glucose 6-phosphate}$
(C) $\text{Malate} \rightarrow \text{fumarate} + \text{H}_2\text{O}$
(D) $\text{Palmitate} + 23\text{O}_2 \rightarrow 16\text{CO}_2 + 16\text{H}_2\text{O}$

[WB-2015]

33. The entry of ADP into mitochondria is coupled to the exit of ATP by
- (A) Malate - aspartate shuttle
(B) Glycerol 3-phosphate shuttle
(C) Dicarboxylate carrier
(D) ATP-ADP translocase

[JK-2016]

34. A product or products of glycolysis is/are:
- (A) ATP (B) H^+
(C) CO_2 (D) Both (A) and (B)

[JK-2016]

35. Identify the type of reactions during the conversion of pyruvate to acetyl CoA:
- (A) Oxidation and reduction
(B) Dehydrogenation and decarboxylation
(C) Oxidation and dehydrogenation
(D) Reduction and decarboxylation alone.

[MH-2016]

36. Which of the following compounds is not an inhibitor of electron transport chain?
- (A) Rotenone (B) Antimycin A
(C) Cyanide (D) Dinitrophenol

[MH-2016]

37. Which of the following enzyme is carrying a reversible reaction in glycolysis?
- (A) Hexokinase
(B) Phosphofructokinase
(C) Phospho glycerate kinase
(D) Pyruvate kinase

[MH-2016]

38. Coupling of oxidation and phosphorylation can be demonstrated by using oligomycin. This antibiotic inhibits which of the following process?
- (A) Inhibition of electron transfer
(B) Inhibition of ATP synthase
(C) Uncoupling of phosphorylation from electron transfer
(D) Inhibition of ATP-ADP exchange

[AP-2017]

39. Match Column - I with Column - II with respect to oxidative phosphorylation.

Column I	Column II
(a) Oxidative phosphorylation	(i) Blocked by rotenone
(b) NADH reductase	(ii) Blocked by Antimycin A
(c) QH_2 , to cytochrome C_1	(iii) Blocked by Cyanide
(d) Cytochrome oxidase to oxygen	(iv) Yields ATP in mitochondr

- (A) a-iv, b-i, c-ii, d-iii (B) a-iii, b-ii, c-i, d-iv
(C) a-ii, b-i, c-iii, d-iv (D) a-i, b-iv, c-iii, d-ii

[AP-2017]

40. Arrange the steps in glycolysis in correct order:
- (a) Fructose . 6 . phosphate
(b) Glyceraldehyde - 3 - phosphate
(c) Glucose - 6 . phosphate
(d) Phosphoenol pyruvic acid
(e) Pyruvic acid