Unit 8.2. MCQs Set 1

Results

#1. Q1. Which of the following best describes how atoms bond to form biological molecules?

☐
(A). Strictly ionic bonds are used
☐
(B). Covalent bonds, plus hydrogen bonds, Van der Waals, and hydrophobic interactions
☐
(C). Only metallic bonds exist in cells
☐
(D). Molecules in biology rarely form bonds

Biomolecules rely on strong covalent bonds for their backbone, while non-covalent interactions (hydrogen bonds, Van der Waals forces, and hydrophobic interactions) determine structure and function.

#2. Q2. Stereochemistry is crucial in biological systems because:

☐
(A). Most biomolecules are achiral
☐
(B). Mirror-image isomers usually have identical biological activity
☐
(C). The 3D arrangement can significantly alter biological activity
☐
(D). It matters only for inorganic compounds

The three-dimensional arrangement (chirality) of biomolecules often determines their interactions with enzymes and receptors, dramatically affecting biological activity.

#3. Q3. In carbohydrate metabolism, which pathway breaks down glucose into pyruvate and yields ATP and NADH?

☐
(A). Gluconeogenesis
☐
(B). Glycolysis
☐
(C). Pentose phosphate pathway
☐

(D). Urea cycle

Glycolysis converts glucose into pyruvate while generating a net gain of 2 ATP and 2 NADH molecules.

#4. Q4. A defect in the enzyme glucose-6-phosphatase leads to which glycogen storage disease?

☐
(A). Von Gierke’s disease (Type I)
☐
(B). Pompe disease (Type II)
☐
(C). McArdle’s disease (Type V)
☐
(D). Hers disease (Type VI)

Glucose-6-phosphatase deficiency results in Von Gierke’s disease, causing severe fasting hypoglycemia.

#5. Q5. Which of the following is NOT a main function of lipids?

☐
(A). Energy storage in the form of triacylglycerols
☐
(B). Serving as enzymes for catalytic reactions
☐
(C). Forming membranes (phospholipids), and acting as signals
☐
(D). Providing precursors for steroid hormones

Enzymatic activity is typically performed by proteins; lipids serve as energy reserves, structural components of membranes, and hormone precursors.

#6. Q6. Fatty acids with zero double bonds are called:

☐
(A). Saturated fatty acids
☐
(B). Unsaturated fatty acids
☐
(C). Trans fatty acids
☐
(D). Polyunsaturated fatty acids

Saturated fatty acids are those that have no double bonds, meaning they contain only single bonds between carbon atoms.

#7. Q7. The breakdown of fatty acids to acetyl-CoA is known as:

☐
(A). Lipogenesis
☐
(B). β-oxidation
☐
(C). Glycogenolysis
☐
(D). None

β-oxidation is the process by which fatty acids are broken down in the mitochondria to produce acetyl-CoA.

#8. Q8. Elevated LDL levels in blood often correlate with:

☐
(A). Decreased risk of cardiovascular disease
☐
(B). Increased atherogenic risk and heart disease
☐
(C). Complete immunity to pathogens
☐
(D). Zero relationship to any pathology

High levels of LDL cholesterol are associated with an increased risk of atherosclerosis and cardiovascular disease.

#9. Q9. Proteins are polymers composed of:

☐
(A). Simple sugars
☐
(B). Nucleotides
☐
(C). Amino acids linked by peptide bonds
☐
(D). Fatty acids

Proteins are long chains of amino acids linked by peptide bonds.

#10. Q10. The Ramachandran plot shows allowable:

☐
(A). Carbohydrate isomerization
☐
(B). φ (phi) and ψ (psi) backbone dihedral angles for amino acid residues
☐
(C). RBC doping patterns
☐
(D). All illusions

The Ramachandran plot is used to visualize the sterically allowed regions for backbone dihedral angles in proteins.

#11. Q11. Which secondary structure is stabilized by hydrogen bonds between the carbonyl oxygen and the amide hydrogen four residues apart?

☐
(A). β-sheet
☐
(B). α-helix
☐
(C). Random coil
☐
(D). None

The α-helix structure is stabilized by intra-chain hydrogen bonds between the backbone atoms spaced four residues apart.

#12. Q12. Quaternary structure means:

☐
(A). The linear amino acid sequence
☐
(B). Local folding such as α-helix or β-sheet
☐
(C). The overall 3D folding of one polypeptide

☐
(D). The complex formed by multiple polypeptide subunits

Quaternary structure refers to the assembly of multiple polypeptide subunits into one functional protein complex.

#13. Q13. Enzymes primarily function by:

☐
(A). Increasing the activation energy
☐
(B). Lowering the activation energy to speed up reactions
☐
(C). Being consumed permanently
☐
(D). Serving only as structural components

Enzymes accelerate chemical reactions by lowering the activation energy required for the reaction to proceed.

#14. Q14. In enzyme kinetics, a competitive inhibitor:

☐
(A). Binds allosterically far from the active site
☐
(B). Binds the active site, competing with the substrate, and increases the apparent Km
☐
(C). Does not affect Km but lowers Vmax
☐
(D). Permanently inactivates the enzyme

Competitive inhibitors resemble the substrate and compete for binding at the active site, which increases the apparent Km without affecting Vmax.

#15. Q15. Many coenzymes (NAD^+, FAD) are derived from:

☐
(A). Polysaccharides
☐
(B). Vitamins such as niacin (B3) or riboflavin (B2)
☐
(C). Cholesterol
☐
(D). N_2 gas

NAD^+ is derived from niacin, and FAD is derived from riboflavin.

#16. Q16. A defect in phenylalanine hydroxylase causes:

☐
(A). Maple syrup urine disease
☐
(B). Phenylketonuria (PKU)
☐
(C). Alkaptonuria
☐
(D). None

Phenylalanine hydroxylase deficiency leads to phenylketonuria, characterized by elevated phenylalanine levels and potential neurological damage.

#17. Q17. Proteomics is:

☐
(A). Study of RBC doping
☐
(B). A large-scale study of the entire protein complement (proteome) in a cell or organism
☐
(C). None
☐
(D). Study of illusions

Proteomics involves the comprehensive analysis of the proteins expressed by a cell or organism at a given time.

#18. Q18. Heme synthesis occurs partly in the cytosol and partly in mitochondria. A disorder in the porphyrin pathway can cause:

☐
(A). Scurvy
☐
(B). Porphyria, leading to photosensitivity or neurological symptoms
☐
(C). Gouty arthritis
☐
(D). RBC doping

Porphyrias are a group of disorders resulting from defects in the enzymes of the heme synthesis pathway, leading to the accumulation of porphyrin compounds.

#19. Q19. In nucleic acids, the monomeric units are:

☐
(A). Amino acids
☐
(B). Fatty acids
☐
(C). Nucleotides (each consisting of a base, a sugar, and a phosphate)
☐
(D). None

Nucleic acids are polymers made up of nucleotides, each containing a nitrogenous base, a sugar (ribose or deoxyribose), and a phosphate group.

#20. Q20. The main difference between DNA and RNA is that RNA typically:

☐
(A). Uses thymine (T) as a base
☐
(B). Has deoxyribose sugar
☐
(C). Is single-stranded and contains uracil (U) instead of thymine (T)
☐
(D). Cannot form hydrogen bonds

RNA usually is single-stranded and contains uracil instead of thymine, and it has ribose as its sugar, unlike DNA.

#21. Q21. The A-T base pair is stabilized by:

☐
(A). Three hydrogen bonds
☐
(B). Two hydrogen bonds

☐
(C). Covalent disulfide linkages
☐
(D). None

Adenine pairs with thymine using two hydrogen bonds, whereas guanine pairs with cytosine via three hydrogen bonds.

#22. Q22. Chargaff’s rule for double-stranded DNA states that:

☐
(A). A + G = T + C
☐
(B). A + T = G + C
☐
(C). %A = %T and %G = %C
☐
(D). None

In double-stranded DNA, the percentage of adenine equals that of thymine and guanine equals cytosine.

#23. Q23. The form of DNA most common in cells under physiological conditions is:

☐
(A). A-DNA
☐
(B). B-DNA (Watson-Crick)
☐
(C). Z-DNA (left-handed)
☐
(D). None

B-DNA is the classic right-handed helical form found in vivo.

#24. Q24. In carbohydrate metabolism, “gluconeogenesis” is:

☐
(A). The breakdown of glycogen into glucose
☐
(B). The synthesis of glucose from non-carbohydrate precursors
☐
(C). None
☐
(D). RBC doping

Gluconeogenesis is the process by which the liver produces glucose from non-carbohydrate precursors.

#25. Q25. The pentose phosphate pathway’s main functions are to

☐
(A). Generate lactate and store fat
☐
(B). Produce NADPH and ribose-5-phosphate for biosynthesis
☐
(C). None
☐
(D). RBC doping

The pentose phosphate pathway generates NADPH for reductive biosynthesis and ribose-5-phosphate for nucleotide synthesis.

#26. Q26. A major regulatory enzyme for cholesterol biosynthesis is:

☐
(A). HMG-CoA reductase
☐
(B). G6PD
☐
(C). None
☐
(D). RBC doping

HMG-CoA reductase is a key enzyme in the cholesterol biosynthetic pathway and the target of statin drugs.

#27. Q27. Lipid transport from the intestines to tissues initially occurs via:

☐
(A). VLDL
☐
(B). LDL
☐
(C). Chylomicrons
☐
(D). None

Chylomicrons transport dietary lipids from the intestines through the lymphatic system to the bloodstream.

#28. Q28. The amino acids leucine, isoleucine, and valine are known as branched-chain amino acids, and a defect in their metabolism can cause:

☐
(A). Maple syrup urine disease
☐
(B). Phenylketonuria (PKU)
☐
(C). Alkaptonuria
☐
(D). None

A deficiency in branched-chain α-keto acid dehydrogenase leads to Maple Syrup Urine Disease.

#29. Q29. In protein structure, an α-helix or β-sheet is an example of which level of structure?

☐
(A). Primary structure
☐
(B). Secondary structure
☐
(C). Tertiary structure
☐
(D). None

Secondary structure refers to local folding patterns such as α-helices and β-sheets stabilized by hydrogen bonds.

#30. Q30. Enzyme specificity is largely due to

☐
(A). None
☐
(B). The precise arrangement of active site residues that interact with the substrate
☐

(C). RBC doping
☐
(D). Infectious illusions

The active site of an enzyme is tailored to bind its substrate specifically through shape complementarity and chemical interactions.

#31. Q31. Coenzyme NAD^+ is derived from which vitamin?

☐
(A). Riboflavin (B2)
☐
(B). Niacin (B3)
☐
(C). Pantothenic acid (B5)
☐
(D). None

NAD^+ is derived from niacin (vitamin B3); its deficiency can lead to pellagra.

#32. Q32. In red blood cell metabolism, 2,3-BPG is important because it

☐
(A). None
☐
(B). Decreases hemoglobin’s oxygen affinity, facilitating oxygen release to tissues
☐
(C). RBC doping
☐
(D). Infectious illusions

2,3-BPG binds deoxyhemoglobin, reducing its oxygen affinity and promoting oxygen release to tissues.

#33. Q33. Porphyrias are disorders of

☐
(A). None
☐
(B). The heme synthesis pathway
☐
(C). RBC doping
☐
(D). Infectious illusions

Porphyrias are caused by defects in enzymes of the heme synthesis pathway, leading to porphyrin accumulation.

#34. Q34. The urea cycle removes

☐
(A). None
☐
(B). Nitrogenous waste by converting ammonia into urea
☐
(C). RBC doping
☐
(D). Infectious illusions

The urea cycle in the liver converts toxic ammonia to urea, which is excreted by the kidneys.

#35. Q35. DNA is the genetic material, as proven by experiments such as

☐
(A). None
☐
(B). Griffith’s transformation, Avery-MacLeod-McCarty, and Hershey-Chase experiments
☐
(C). RBC doping
☐
(D). Infectious illusions

These landmark experiments established DNA, rather than protein, as the molecule of heredity.

#36. Q36. tRNA’s primary function is to

☐
(A). None
☐
(B). Deliver specific amino acids to the ribosome by matching its anticodon with the mRNA codon
☐
(C). RBC doping
☐
(D). Infectious illusions

tRNA molecules are responsible for bringing the correct amino acids during protein synthesis.

#37. Q37. Amino acids at physiological pH typically exist as

☐
(A). None
☐
(B). Zwitterions, with both a positively charged amino group and a negatively charged carboxyl group
☐
(C). RBC doping
☐
(D). Infectious illusions

At physiological pH, the amino group is protonated and the carboxyl group is deprotonated, forming a zwitterion.

#38. Q38. G6PD deficiency leads to

☐
(A). None
☐
(B). Hemolytic anemia under oxidative stress due to insufficient NADPH production
☐
(C). RBC doping
☐
(D). Infectious illusions

G6PD is crucial for generating NADPH via the pentose phosphate pathway; deficiency impairs cellular protection against oxidative damage.

#39. Q39. Transamination reactions require a coenzyme derived from vitamin B6, known as

☐
(A). None
☐
(B). Pyridoxal phosphate (PLP)
☐
(C). RBC doping
☐

(D). Infectious illusions

Pyridoxal phosphate (PLP) is the active form of vitamin B6 required for amino group transfer in transamination reactions.

#40. Q40. “Essential amino acids” are

☐
(A). None
☐
(B). Amino acids that must be obtained through the diet because the body cannot synthesize them
☐
(C). RBC doping
☐
(D). Infectious illusions

Essential amino acids cannot be synthesized endogenously and must come from dietary sources.

#41. Q41. β-oxidation of fatty acids occurs primarily in

☐
(A). None
☐
(B). The mitochondrial matrix
☐
(C). RBC doping
☐
(D). Infectious illusions

Long-chain fatty acids are broken down in the mitochondrial matrix via β-oxidation to generate acetyl-CoA.

#42. Q42. Cholesterol can be converted into all EXCEPT

☐
(A). None
☐
(B). Bile acids
☐
(C). Steroid hormones
☐
(D). Essential amino acids

Cholesterol is a precursor for bile acids and steroid hormones but not for amino acids.

#43. Q43. Glucose can be converted into glycogen via which process?

☐
(A). None
☐
(B). Glycogenesis
☐
(C). Glycolysis
☐
(D). Lipolysis

Glycogenesis is the process by which glucose molecules are linked together to form glycogen, a storage form of glucose.

#44. Q44. The “Malate-Aspartate shuttle” helps transport

☐
(A). None

☐
(B). NADH equivalents from the cytosol into the mitochondria
☐
(C). RBC doping
☐
(D). Infectious illusions

The Malate-Aspartate shuttle carries reducing equivalents (NADH) from the cytosol into mitochondria, where they drive ATP production.

#45. Q45. A point mutation causing a single amino acid substitution is called

☐
(A). None
☐
(B). A missense mutation
☐
(C). A nonsense mutation
☐
(D). A frameshift mutation

A missense mutation results in the replacement of one amino acid with another in a protein sequence.

#46. Q46. A frameshift mutation arises from

☐
(A). None
☐
(B). Insertion or deletion of nucleotides not in multiples of three, shifting the reading frame
☐
(C). RBC doping
☐
(D). Infectious illusions

Frameshift mutations change the reading frame, leading to a completely altered protein sequence downstream of the mutation.

#47. Q47. The key regulatory enzyme in glycolysis is

☐
(A). None
☐
(B). Phosphofructokinase-1 (PFK-1)
☐
(C). Lactate dehydrogenase
☐
(D). Hexokinase

Phosphofructokinase-1 (PFK-1) is a major control point in glycolysis, regulating the conversion of fructose-6-phosphate to fructose-1,6-bisphosphate.

#48. Q48. The “glyoxylate cycle” in plants and some microbes allows

☐
(A). None
☐
(B). Conversion of acetyl-CoA to succinate for carbohydrate synthesis
☐
(C). RBC doping
☐
(D). Infectious illusions

The glyoxylate cycle bypasses the decarboxylation steps of the TCA cycle, allowing organisms to convert fat into carbohydrates.

#49. Q49. The main route of ammonia detoxification in vertebrates is the

☐
(A). None
☐
(B). Urea cycle
☐
(C). RBC doping
☐
(D). Infectious illusions

The urea cycle converts toxic ammonia into urea, which is then excreted by the kidneys.

#50. Q50. DNA is stabilized by

☐
(A). None
☐
(B). Hydrogen bonds between base pairs and hydrophobic base stacking interactions
☐
(C). RBC doping
☐
(D). Infectious illusions

The double helix structure of DNA is maintained by hydrogen bonding between complementary bases and hydrophobic interactions among the stacked bases.

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