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BIO302 Quiz File

Chapter-wise Solved MCQs

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Chapter 1. Introduction

1. Who first used the term "molecular biology" in 1945 to describe the study of the physical and chemical structure of biological macromolecules?

A) Oswald Avery
B) William Astbury
C) Francis Crick
D) Frederick Griffith

2. Which biological phenomenon was discovered by Frederick Griffith in bacteria in 1928?

A) Translation
B) Bacterial transformation
C) Transduction
D) Transcription

3. In 1934, M. Schlesinger demonstrated that bacteriophages are chemically composed of which two components?

A) RNA and lipids
B) DNA and protein
C) RNA and carbohydrates
D) DNA and lipids

4. Which hypothesis was proposed by F.H.C. Crick in 1965 to explain how several codons for the same amino acid are recognized by a single tRNA?

A) Operon concept
B) Inchworm model
C) Wobble hypothesis
D) Tetranucleotide hypothesis

Answer Key

1. B) William Astbury — William Astbury coined the term "molecular biology" in 1945 when referencing the structure of biological macromolecules.

2. B) Bacterial transformation — Frederick Griffith discovered bacterial transformation in 1928 while working with Streptococcus pneumoniae strains.

3. B) DNA and protein — Schlesinger demonstrated that bacteriophages consist of nucleic acid (DNA) and a protein shell.

4. C) Wobble hypothesis — Crick formulated the wobble hypothesis in 1965 to account for tRNA anticodon pairing flexibility.

Chapter 2. DNA Structure

1. Who discovered nucleic acids in 1869?

A) Phoebus Levene
B) Friedrich Miescher
C) Erwin Chargaff
D) Maurice Wilkins

2. What three fundamental chemical components assemble to form a single nucleotide?

A) Amino acid, fatty acid, and glycerol

B) Nitrogenous base, 5-carbon sugar, and phosphate group
C) Glucose, nitrogenous base, and peptide bond
D) Ribose, lipid, and purine

3. Which biochemist proposed the "tetranucleotide structure" hypothesis in 1919?

A) Phoebus Levene
B) Oswald Avery
C) Erwin Chargaff
D) Linus Pauling

4. According to Chargaff's rules established in 1950, which nitrogenous base equivalency exists in double-stranded DNA?

A) A = C and T = G
B) A = G and T = C
C) A = T and C = G
D) A = U and C = G

Answer Key

1. B) Friedrich Miescher — Friedrich Miescher first isolated and discovered nucleic acids in 1869.

2. B) Nitrogenous base, 5-carbon sugar, and phosphate group — A nucleotide is made of a nitrogenous base, a pentose sugar, and one to three phosphate groups.

3. A) Phoebus Levene — Phoebus Levene proposed the tetranucleotide theory suggesting nucleotides occurred in a fixed repeating order.

4. C) A = T and C = G — Erwin Chargaff proved that in DNA, adenine equals thymine and cytosine equals guanine.

Chapter 3. RNA Structure

1. Which nitrogenous base is present in RNA to replace thymine found in DNA?

A) Adenine
B) Guanine
C) Cytosine
D) Uracil

2. What structural feature distinguishes ribose sugar in RNA from 2'-deoxyribose sugar in DNA?

A) A methyl group (-CH3) at position 2'
B) A hydroxyl group (-OH) at position 2'
C) An amino group (-NH2) at position 3'
D) A phosphate group (-PO4) at position 5'

3. Ribosomal RNA (rRNA) constitutes approximately what proportion of a ribosome's total weight?

A) About 15%
B) About 30%
C) About 60%
D) About 85%

4. Which class of RNA functions as an adapter molecule covalently linked to an amino acid at one end during protein synthesis?

A) Messenger RNA (mRNA)
B) Transfer RNA (tRNA)
C) Ribosomal RNA (rRNA)
D) Small nuclear RNA (snRNA)

Answer Key

1. D) Uracil — Uracil replaces thymine in RNA and pairs with adenine during transcription.

2. B) A hydroxyl group (-OH) at position 2' — Ribose contains an -OH group at carbon 2', whereas deoxyribose possesses only a hydrogen atom.

3. C) About 60% — Ribosomal RNA makes up approximately 60% of the total mass of ribosomes.

4. B) Transfer RNA (tRNA) — tRNA molecules serve as specific adapter molecules carrying amino acids to the mRNA-ribosome complex.

Chapter 4. DNA a Genetic Material

1. Which radioactive isotope was utilized by Hershey and Chase in 1952 to label bacteriophage DNA?

A) 35S
B) 32P
C) 14C
D) 15N

2. Why was radioactive sulfur (35S) used in the Hershey-Chase experiment?

A) To label viral carbohydrates
B) To label viral DNA
C) To label viral protein coats
D) To label bacterial membranes

3. In Frederick Griffith's 1928 experiment, which bacterial strain possessed a protective polysaccharide capsule that rendered it virulent?

A) Type II-R
B) Type III-S
C) E. coli K12
D) Bacteriophage T2

4. What term did Frederick Griffith assign to the factor from heat-killed virulent bacteria that transformed live non-virulent cells?

A) Replicons
B) Transforming principle
C) Transposons
D) Okazaki fragments

Answer Key

1. B) 32P — Hershey and Chase used 32P to label DNA because phosphorus is present in DNA but absent in proteins.

2. C) To label viral protein coats — 35S incorporates into sulfur-containing amino acids in phage proteins.

3. B) Type III-S — The III-S strain forms a smooth polysaccharide capsule that protects it from host immunity.

4. B) Transforming principle — Griffith designated the unidentified hereditary agent as the "transforming principle".

Chapter 5. Protein Structure

1. How many standard amino acids serve as the building blocks for all natural proteins?

A) 12
B) 20
C) 30
D) 64

2. What type of covalent bond links adjacent amino acid residues in a polypeptide chain?

A) Phosphodiester bond
B) Glycosidic bond
C) Peptide bond
D) Hydrogen bond

3. In protein backbone stereochemistry, which symbol denotes the torsional angle of rotation around the N–alpha-C bond?

A) psi (ψ)
B) phi (ϕ)
C) omega (ω)
D) chi (χ)

4. Who predicted the beta-pleated sheet conformation as a prominent regular secondary structure in proteins?

A) Watson and Crick
B) Pauling and Corey
C) Jacob and Monod
D) Sanger and Holley

Answer Key

1. B) 20 — Proteins are synthesized from twenty standard amino acids.

2. C) Peptide bond — Amino acids are joined covalently via peptide bonds between the carboxyl and amino groups.

3. B) phi (ϕ) — The rotation around the N–alpha-C bond is defined as the phi dihedral angle.

4. B) Pauling and Corey — Linus Pauling and Robert Corey predicted the extended beta-pleated sheet structure.

Chapter 6. Organisation of Genetic Material

1. Approximately how many supercoiled domain loops are present in an E. coli bacterial chromosome?

A) 40
B) 100
C) 400
D) 1000

2. Which histone protein acts as a clamp to seal the two turns of DNA wrapped around the histone octamer core in a nucleosome?

A) Histone H2A
B) Histone H2B
C) Histone H3
D) Histone H1

3. According to the solenoid model of chromatin packaging, how many nucleosomes are contained per turn of the 30 nm fiber?

A) 2
B) 6
C) 10
D) 12

4. Which factor does NOT contribute to DNA compaction in prokaryotic bacterial cells?

A) Supercoiling of domain loops
B) Histone octamer spooling
C) Macromolecular crowding
D) DNA-binding proteins

Answer Key

1. C) 400 — An E. coli chromosome is packaged into roughly 400 supercoiled loops.

2. D) Histone H1 — Histone H1 binds linker DNA and clamps the DNA turns around the core histone octamer.

3. B) 6 — The solenoid model predicts a helical arrangement containing approximately 6 nucleosomes per turn.

4. B) Histone octamer spooling — Bacteria lack membrane-bound organelles and histone octamers; compaction relies on supercoiling, crowding, and architectural proteins.

Chapter 7. DNA Replication

1. Which initiator protein binds to the origin of replication (oriC) in Escherichia coli to initiate DNA unwinding?

A) DnaA
B) DnaB
C) DnaC
D) DnaG

2. The catalytic palm domain of DNA polymerase coordinates which two divalent metal ions for active site function?

A) Fe2+ or Cu2+
B) Mg2+ or Zn2+
C) Ca2+ or Na+
D) Mn2+ or K+

3. What enzyme decouples topologically entangled circular daughter DNA molecules (catenanes) following bacterial replication?

A) Topoisomerase IV
B) DNA Ligase I
C) DNA Primase

D) Telomerase

4. What hexanucleotide sequence repeat is added to the 3' end of eukaryotic chromosome termini by telomerase?

A) "TATAAA"
B) "TTAGGG"
C) "GGCCCC"
D) "AGGAAG"

Answer Key

1. A) DnaA — DnaA is the initiator protein in E. coli that recognizes origin sequences.

2. B) Mg2+ or Zn2+ — Two divalent ions (Mg2+ or Zn2+) in the palm domain facilitate phosphoryl transfer.

3. A) Topoisomerase IV — Topoisomerase IV (a Type IIA topoisomerase) decatenates interlinked daughter circles in prokaryotes.

4. B) "TTAGGG" — Telomerase adds tandem "TTAGGG" repeats to counteract the end-replication problem in eukaryotes.

Chapter 8. DNA Mutation

1. Which type of point mutation involves substituting a purine base on one strand with another purine base?

A) Transversion
B) Transition
C) Frameshift
D) Inversion

2. What is the wavelength spectrum of ultraviolet (UV) light responsible for inducing pyrimidine dimers in DNA?

A) 0.01–100 nm
B) 100–400 nm
C) 400–700 nm
D) 700–1000 nm

3. Which chemical carcinogen produced by Aspergillus flavus requires metabolic activation to form DNA adducts that induce liver cancer?

A) Psoralen
B) Aflatoxin B1
C) Nitrogen mustard
D) 5-Bromouracil

4. Nitrogen mustard gas forms inter-strand DNA cross-links by covalently attacking which atomic site on guanine residues?

A) N-1 position
B) N-3 position
C) N-7 position
D) C-8 position

Answer Key

1. B) Transition — Transition mutations swap a purine for a purine (A ↔ G) or a pyrimidine for a pyrimidine (C ↔ T).

2. B) 100–400 nm — Ultraviolet radiation occupies the 100 to 400 nm electromagnetic spectrum.

3. B) Aflatoxin B1 — Aflatoxin B1 is activated to an epoxide derivative that causes bulky guanine adducts.

4. C) N-7 position — Nitrogen mustard gas alkylates N-7 atoms of guanines on opposite DNA strands.

Chapter 9. DNA Repair

1. Which photo-reactivating enzyme directly splits UV-induced cyclobutane pyrimidine dimers using energy absorbed from visible light?

A) AP endonuclease
B) CPD Photolyase
C) AlkB
D) UvrC excinuclease

2. Which enzyme provides the primary AP endonuclease activity in E. coli during Base Excision Repair (BER)?

A) Endonuclease VIII
B) Exonuclease III (Xth)
C) DNA Polymerase III
D) RecJ exonuclease

3. In E. coli Nucleotide Excision Repair (NER), which helicase strips away the damaged 12-mer oligonucleotide after dual incisions by UvrBC?

A) UvrA
B) UvrB
C) UvrC
D) UvrD

4. In E. coli mismatch repair, which protein recognizes hemimethylated GATC sequences and nicks the unmethylated daughter strand?

A) MutS
B) MutL
C) MutH
D) Dam methylase

Answer Key

1. B) CPD Photolyase — CPD photolyase uses light energy to directly reverse pyrimidine dimers.

2. B) Exonuclease III (Xth) — Exonuclease III accounts for the majority of AP endonuclease nicking activity in E. coli.

3. D) UvrD — UvrD (Helicase II) releases the damaged oligomer prior to repair synthesis by DNA Polymerase I.

4. C) MutH — MutH endonuclease selectively cleaves the newly synthesized, unmethylated strand at GATC sites.

End of Quiz

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