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BIO201 Quiz File

Chapter-wise Solved MCQs

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Chapter 2: Life and Chemistry: Small Molecules

Q1. What subatomic particles are contained within the dense, positively charged nucleus of an atom? A) Electrons and protons B) Protons and neutrons C) Electrons and neutrons D) Protons only

Q2. Which six chemical elements compose approximately 98 percent of the mass of every living organism? A) Carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur B) Carbon, sodium, potassium, calcium, magnesium, and iron C) Carbon, hydrogen, oxygen, silicon, aluminum, and nitrogen D) Hydrogen, helium, carbon, nitrogen, oxygen, and iodine

Q3. What is the molecular weight of glucose as specified in the handout's molecular weight table? A) 18 B) 89 C) 180 D) 342

Q4. Under what chemical condition do optical isomers occur in a molecule? A) When two atoms share a double covalent bond B) When a single carbon atom is attached to four different atoms or groups C) When two molecules possess identical physical properties D) When hydrogen bonds form between water molecules

Answer Key

Q1: B — An atom's dense nucleus contains positively charged protons and uncharged neutrons, surrounded by negatively charged electrons

Q2: A — Carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur make up about 98 percent of the mass of living tissue

Q3: C — Based on atomic weight totals, the molecular weight of glucose (C6H12O6) is 180

Q4: B — Optical isomers result when four different atoms or chemical groups are bonded to a single asymmetrical carbon atom

Chapter 3: Life and Chemistry: Large Molecules

Q1. What type of reaction links monomers together into polymers by releasing a molecule of water for each bond formed? A) Hydrolysis reaction B) Oxidation reaction C) Condensation reaction D) Reduction reaction

Q2. What defines the primary structure of a protein? A) The local folding into α helices and β pleated sheets B) The precise linear sequence of amino acids in a polypeptide chain C) The overall three-dimensional shape stabilized by disulfide bridges D) The assembly of four distinct polypeptide subunits

Q3. Fats and oils (triglycerides) are composed of three fatty acids covalently bonded to a glycerol molecule by which linkages? A) Peptide linkages B) Glycosidic linkages C) Ester linkages D) Phosphodiester linkages

Q4. Which nitrogenous base is present in RNA as a substitute for thymine in DNA? A) Cytosine B) Uracil C) Guanine D) Adenine

Answer Key

Q1: C — Condensation reactions join monomers into polymers by removing a molecule of water, whereas hydrolysis breaks them apart by adding water

Q2: B — The primary structure of a protein is defined specifically by the exact sequence of amino acids linked in its polypeptide chain

Q3: C — Triglycerides consist of three fatty acid hydrocarbon chains joined to a glycerol backbone through covalent ester linkages

Q4: B — Both DNA and RNA share adenine, guanine, and cytosine, but RNA contains uracil in place of thymine

Chapter 4: Cells: The Basic Units of Life

Q1. Which statement is one of the three core tenets of the cell theory? A) All cells contain membrane-enclosed internal organelles B) All organisms are composed of one or more cells C) Living cells generate spontaneously from nutrient broth D) Cell walls are present in all living organisms

Q2. What is the resolving power of a standard light microscope compared to the human eye? A) About 0.2 mm B) About 0.2 μm (1,000 times that of the human eye) C) About 0.5 nm D) About 100 μm

Q3. What cell wall material is characteristic of most bacteria but absent in archaea? A) Chitin B) Cellulose C) Peptidoglycan D) Phospholipid

Q4. What photosynthetic structures inside chloroplasts consist of flat, circular compartments stacked into grana? A) Stroma B) Thylakoids C) Matrix D) Cristae

Answer Key

Q1: B — Cell theory dictates that cells are the fundamental units of life, all organisms are composed of cells, and all cells come from preexisting cells

Q2: B — Light microscopes use glass lenses and visible light to achieve a resolution limit of about 0.2 μm

Q3: C — Most bacterial cell walls contain peptidoglycan, a polymer of amino sugars cross-linked by short peptides, which is not found in archaea

Q4: B — The internal membrane system of chloroplasts consists of thylakoid disks stacked together into grana suspended in fluid stroma

Chapter 5: Membrane Composition and Structure

Q1. According to the fluid mosaic model, what forms the continuous matrix of biological membranes? A) A single layer of peripheral proteins B) A phospholipid bilayer C) A fibrous mesh of proteoglycans D) A continuous sheet of cholesterol

Q2. Which portion of a phospholipid molecule is hydrophilic and associates with water? A) The nonpolar fatty acid tail B) The phosphorus-containing head C) The central hydrophobic core D) The hydrocarbon chain

Q3. How are peripheral membrane proteins bound to the surface of biological membranes? A) By penetrating completely through the phospholipid bilayer B) By covalent peptide bonds to fatty acids C) By ionic bonds to exposed membrane surfaces D) By embedding hydrophobic R groups into the membrane interior

Q4. What is the primary function of carbohydrates attached to proteins or lipids on the outer plasma membrane surface? A) Pumping ions against concentration gradients B) Catalyzing

energy transformation in mitochondria C) Serving as cell recognition signals for cell-cell interactions D) Anchoring sister chromatids during metaphase

Answer Key

Q1: B — The fluid mosaic model describes membranes as a flexible phospholipid bilayer wherein proteins move laterally

Q2: B — Phospholipids possess an electrically charged, polar phosphate head that interacts with water and nonpolar fatty acid tails that avoid water

Q3: C — Unlike integral proteins that penetrate the lipid core, peripheral proteins lack hydrophobic regions and attach to membrane surfaces via ionic bonds

Q4: C — Plasma membrane carbohydrates function as external recognition sites that allow specific cells to adhere to and recognize one another

Chapter 6: Life and Chemistry: Energy, Enzymes, and Regulation

Q1. The second law of thermodynamics states that: A) Energy can neither be created nor destroyed B) Entropy of the universe increases with every energy transformation C) Energy transformations are always 100% efficient D) Entropy decreases during chemical reactions

Q2. Enzymes accelerate chemical reactions primarily by: A) Increasing the temperature of the reaction environment B) Lowering the activation energy required for the reaction C) Increasing the concentration of reactants D) Changing the equilibrium constant of the reaction

Q3. What distinguishes a coenzyme from a prosthetic group? A) Coenzymes are proteins; prosthetic groups are nonprotein molecules B) Coenzymes bind transiently to enzymes; prosthetic groups are tightly or covalently bound C) Coenzymes are only found in plants; prosthetic groups are only in animals D) Coenzymes increase activation energy; prosthetic groups decrease it

Q4. In feedback (end-product) inhibition: A) The end product of a metabolic pathway inhibits an enzyme early in the pathway B) The initial substrate activates all enzymes in the pathway C) Enzymes are permanently destroyed by the end product D) The end product speeds up the first enzyme in the pathway

Answer Key

Q1: B — The second law dictates that every energy transfer increases the entropy (disorder) of the universe

Q2: B — Enzymes provide an alternative reaction pathway with a lower activation energy barrier, speeding up the reaction without being consumed

Q3: B — Coenzymes are organic cofactors that associate transiently with enzymes, while prosthetic groups are bound tightly or covalently to the enzyme

Q4: A — The accumulation of the pathway's end product inhibits an earlier enzyme, preventing overproduction of the product

Chapter 9: Chromosomes, the Cell Cycle, and Cell Division

Q1. During which specific subphase of interphase does DNA replication take place? A) G1 phase B) S phase C) G2 phase D) M phase

Q2. What key regulatory transition in G1 serves as the restriction point (R) beyond which cell cycle completion is inevitable? A) Activation of Cyclin B-Cdk1 B) Activation of Cyclin D-Cdk4 C) Disassembly of spindle kinetochores D) Phosphorylation of histone H1

Q3. What basic structural unit of chromatin consists of DNA wound 1.65 turns around a core of eight histone proteins? A) Centromere B) Nucleosome C) Kinetochore D) Aster

Q4. How does programmed cell death (apoptosis) differ fundamentally from cell death by necrosis? A) Apoptosis causes tissue inflammation and requires no ATP B) Apoptosis is genetically programmed, requires ATP, and produces no tissue inflammation C) Necrosis requires ATP and involves chromatin condensation D) Necrosis involves single-cell fragmentation without cellular swelling

Answer Key

Q1: B — Interphase consists of G1, S (synthesis), and G2 subphases, with DNA replication taking place strictly during the S phase

Q2: B — Cyclin D-Cdk4 operates during G1 at the restriction point (R), committing the cell to DNA replication and division

Q3: B — A nucleosome is composed of 146 base pairs of DNA wrapped around an octamer core of histones (two each of H2A, H2B, H3, and H4)

Q4: B — Apoptosis relies on ATP to execute an orderly, genetically controlled cell death without inducing tissue inflammation, whereas necrosis involves bursting and inflammation

Chapter 10: Genetics: Mendel and Beyond

Q1. At what exact stage of meiosis are two alleles of a gene segregated into separate daughter cells? A) End of Meiosis I B) End of Meiosis II C) S phase of Interphase D) Mitotic Anaphase

Q2. Why are individuals with type O blood considered universal donors in blood transfusions? A) Type O red blood cells contain both A and B surface antigens B) Type O red blood cells do not react with anti-A or anti-B antibodies C) Type O serum contains neither anti-A nor anti-B antibodies D) Type O blood lacks red blood cells

Q3. How is chromosomal sex determined in grasshoppers? A) Females are XX and males are XY B) Females are XX and males are XO C) Females are ZW and males are ZZ D) Females are haploid and males are diploid

Q4. What meiotic event in prophase I permits linked genes on the same chromosome to separate and recombine? A) Nondisjunction B) Independent assortment C) Crossing over D) Cytokinesis

Answer Key

Q1: A — Homologous chromosome pairs separate during Meiosis I, segregating their corresponding alleles into distinct daughter cells

Q2: B — Type O blood cells lack A and B glycoproteins, preventing clumping when transfused into serum containing anti-A or anti-B antibodies

Q3: B — Sex determination in grasshoppers operates on an XX/XO system, where females carry two X chromosomes and males carry only one X chromosome

Q4: C — Homologous chromatids exchange reciprocal genetic segments during prophase I via crossing over, generating recombinant gametes

Chapter 11: DNA: The Genetic Material

Q1. Which radioactive isotope was used by Hershey and Chase to specifically trace viral DNA in bacteriophages? A) Radioactive sulfur (35S) B) Radioactive phosphorus (32P) C) Radioactive carbon (14C) D) Radioactive nitrogen (15N)

Q2. What term describes the structural orientation of DNA where the 5' end of one strand pairs with the 3' end of the opposite strand? A) Semiconservative B) Antiparallel C) Complementary D) Redundant

Q3. What short discontinuous segments of newly synthesized DNA are produced on the lagging strand during replication? A) Leading strands B) Okazaki fragments C) RNA primers D) Promoters

Q4. What initial thermal step in a PCR cycle separates double-stranded DNA templates into single strands? A) Primer annealing B) Mild heating (denaturation) C) Extension by DNA polymerase D) Ligation

Answer Key

Q1: B — Hershey and Chase labeled bacteriophage DNA with radioactive phosphorus (32P) and viral protein coats with radioactive sulfur (35S)

Q2: B — The two strands of a DNA double helix run in opposite 5'-to-3' directions, making them antiparallel

Q3: B — Because DNA polymerase synthesizes only in the 5'-to-3' direction, the lagging strand is built discontinuously as Okazaki fragments

Q4: B — Each Polymerase Chain Reaction cycle begins by heating double-stranded DNA to break hydrogen bonds and denature it into template strands

Chapter 12: From DNA to Protein: Genotype to Phenotype

Q1. What hypothesis was established by Beadle and Tatum based on their experiments with Neurospora arginine mutants? A) One gene, one chromosome hypothesis B) One gene, one enzyme (polypeptide) hypothesis C) Central dogma hypothesis D) Operon hypothesis

Q2. What three-letter nucleotide unit in mRNA specifies a particular amino acid during translation? A) Anticodon B) Promoter C) Codon D) Cistron

Q3. In early cell-free translation experiments, an artificial mRNA composed entirely of repeating uracil (poly U) produced a polypeptide containing only which amino acid? A) Proline B) Lysine C) Phenylalanine D) Methionine

Q4. What type of mutation changes a single nucleotide in a codon but results in no alteration of the encoded amino acid sequence? A) Missense mutation B) Silent mutation C) Nonsense mutation D) Frame-shift mutation

Answer Key

Q1: B — Beadle and Tatum's work with nutritional mutants in bread mold proved that each gene directs the production of a specific enzyme

Q2: C — A codon is a sequential triplet of nucleotide bases along mRNA that encodes a specific amino acid

Q3: C — Nirenberg and collaborators demonstrated that the artificial mRNA codon UUU specifically codes for the amino acid phenylalanine

Q4: B — Due to degeneracy in the genetic code, silent mutations alter a base without changing the resulting amino acid or protein function

Chapter 13: The Genetics of Viruses and Prokaryotes

Q1. What term defines an individual, non-replicating viral particle composed of a nucleic acid genome enclosed in a protein capsid? A) Viroid B) Virion C) Prion D) Provirus

Q2. What event characterizes the lytic cycle of a bacteriophage? A) Integration of viral DNA into the host genome B) Rupture (lysis) of the host bacterial cell to release progeny viruses C) Long-term maintenance of the viral genome as a prophage D) Synthesis of cDNA from mRNA templates

Q3. In the lac operon of E. coli, what happens when allolactose binds to the lac repressor protein? A) The repressor binds more tightly to the operator B) The repressor changes shape and detaches from the operator, allowing transcription C) The repressor destroys RNA polymerase D) The repressor directly converts lactose into glucose

Q4. How does the CRP–cAMP complex stimulate positive transcriptional control of the lac operon when glucose levels are low? A) By binding directly to the operator to block repressor binding B) By binding to the promoter and enhancing RNA polymerase binding efficiency C) By inactivating β-galactosidase D) By degrading mRNA transcripts

Answer Key

Q1: B — A virion is the physical viral particle consisting of nucleic acid inside a protective protein coat called a capsid

Q2: B — During a lytic infection, the viral genome takes over host machinery to assemble viruses, ultimately causing the host cell to burst

Q3: B — Binding of lactose/allolactose alters the repressor's conformation so it can no longer bind the operator, removing transcriptional inhibition

Q4: B — When glucose drops, elevated cAMP forms a CRP–cAMP complex that binds the lac promoter, facilitating efficient RNA polymerase binding

Chapter 14: The Eukaryotic Genome and Its Expression

Q1. What complex of snRNPs and proteins catalyzes intron removal and exon splicing in eukaryotic pre-mRNA? A) Ribosome B) Spliceosome C) Proteasome D) Nucleosome

Q2. How do noncoding sequences (introns) within coding genes compare between prokaryotes and eukaryotes? A) Introns are common in eukaryotic coding sequences but rare in prokaryotes B) Introns are completely absent in eukaryotic genes C) Prokaryotes possess far more introns per gene than eukaryotes D) Both domains share identical intron frequencies

Q3. What multi-enzyme complex in eukaryotic cells recognizes ubiquitin-tagged proteins and hydrolyzes them into short peptides? A) Spliceosome B) Proteasome C) Nucleosome D) Kinetochore

Q4. Why is simultaneous transcription and translation impossible in eukaryotic cells? A) Eukaryotic mRNA lacks ribosome binding sites B) Transcription occurs inside the nucleus

while translation occurs in the cytoplasm C) Eukaryotic DNA is single-stranded D) Translation factors inhibit RNA polymerase

Answer Key

Q1: B — Spliceosomes are specialized RNA-protein complexes that splice out noncoding introns and join exons into mature mRNA

Q2: A — Noncoding introns are common throughout eukaryotic protein-coding genes but occur only rarely in prokaryotes

Q3: B — Target proteins are marked for destruction by covalent ubiquitin attachment and subsequently digested inside proteasomes

Q4: B — The eukaryotic nuclear envelope physically isolates nuclear transcription from cytoplasmic translation, enabling extensive pre-mRNA processing

Chapter 15: Cell Signaling and Communication

Q1. What are the three sequential steps comprising any cell signal transduction pathway? A) Signal binding by receptor, signal transduction, and cellular response B) Transcription, translation, and posttranslational modification C) Ingestion, digestion, and exocytosis D) Phosphorylation, dephosphorylation, and degradation

Q2. How do steroid hormone signals interact with target cells? A) By opening ligand-gated membrane ion channels B) By binding to cytoplasmic receptors that enter the nucleus to alter gene transcription C) By directly activating G proteins on the cell surface D) By degrading second messengers like cAMP

Q3. In a protein kinase cascade (such as Ras/MAPk), how is the G protein Ras activated? A) By exchanging bound GDP for GTP upon receptor activation B) By direct cleavage by executioner caspases C) By binding cAMP in the cytosol D) By entering nuclear pores

Q4. What determines whether a specific cell will respond to a given chemical signal? A) The overall size and surface area of the cell B) The presence of a specific functional receptor protein for that signal C) The amount of glycogen stored in its cytoplasm D) The thickness of its outer phospholipid bilayer

Answer Key

Q1: A — A complete signal transduction pathway requires ligand binding to a receptor, signal processing/amplification, and an ultimate cellular response

Q2: B — Nonpolar steroid signals diffuse across membranes and bind intracellular receptors, which then move to the nucleus to regulate gene expression

Q3: A — Activated growth factor receptors recruit adaptor proteins that trigger Ras to exchange bound GDP for active GTP

Q4: B — Cells exhibit signal specificity based solely on whether they synthesize the specific receptor protein required to bind that ligand

Chapter 16: Recombinant DNA Technology

Q1. What defensive enzymes are produced naturally by bacteria to cleave foreign bacteriophage DNA at specific recognition sites? A) Reverse transcriptases B) Restriction enzymes C) DNA polymerases D) RNA ligases

Q2. Which technique separates restriction enzyme-cleaved DNA fragments strictly on the basis of their molecular size? A) Differential centrifugation B) Gel electrophoresis C) Freeze-fracture electron microscopy D) Phase-contrast microscopy

Q3. What term describes the use of transgenic animals to produce human therapeutic proteins or drugs in their milk? A) Transduction B) "Pharming" C) Electroporation D) Hybridization

Q4. Which specialized vector is utilized to introduce engineered foreign genes into plant hosts via Agrobacterium tumefaciens? A) Plasmid pBR322 B) Ti plasmid C) Yeast artificial chromosome (YAC) D) Bacteriophage lambda vector

Answer Key

Q1: B — Bacteria protect themselves against viral infection using restriction enzymes that cut foreign double-stranded DNA at specific recognition sequences

Q2: B — Gel electrophoresis drives negatively charged DNA fragments through a gel matrix toward a positive pole, separating small fragments faster than larger ones

Q3: B — "Pharming" refers to inserting recombinant human genes into agricultural animals so they express pharmaceutical proteins in accessible fluids like milk

Q4: B — The tumor-inducing (Ti) plasmid from Agrobacterium tumefaciens acts as a natural gene transfer vector for plant genetic engineering

Chapter 17: Molecular Biology and Medicine

Q1. What metabolic genetic disorder is caused by a nonfunctional enzyme that fails to convert phenylalanine into tyrosine? A) Sickle cell anemia B) Phenylketonuria (PKU) C) Cystic fibrosis D) Hemophilia

Q2. What defines a prion? A) An infectious single-stranded RNA virus B) An infectious protein with an altered conformation that converts normal proteins into the altered shape C) A mutated tumor suppressor gene D) A transposable DNA element

Q3. In the multi-step progression of colon cancer, what initial genetic loss typically leads to polyp formation on the colon wall? A) Activation of the ras oncogene B) Loss of the APC tumor suppressor gene C) Loss of the p53 gene D) Inactivation of human papillomavirus

Q4. What percentage of all human diseases are estimated to be multifactorial (caused by interactions among multiple genes and the environment)? A) Less than 1 percent B) Up to 60 percent C) Exactly 90 percent D) 100 percent

Answer Key

Q1: B — Phenylketonuria (PKU) is an autosomal recessive disease resulting from a defect in phenylalanine hydroxylase, leading to toxic accumulation of phenylpyruvic acid

Q2: B — Prions are misfolded proteins that act as infectious agents by inducing normal host proteins of the same sequence to adopt the disease-causing conformation

Q3: B — Colon cancer progression typically starts when loss of the APC tumor suppressor gene triggers precancerous polyp growth on the intestinal epithelium

Q4: B — While single-gene defects account for under 1% of human diseases, up to 60% of people are affected by multifactorial conditions influenced by gene-environment interactions

Chapter 18: Natural Defenses against Disease

Q1. What two major types of lymphocytes mediate specific adaptive immune responses in vertebrate animals? A) Neutrophils and macrophages B) B cells and T cells C) Erythrocytes and platelets D) Natural killer cells and basophils

Q2. Which surface proteins display processed intracellular peptide antigens on infected body cells to Cytotoxic T (TC) cells? A) Class I MHC proteins B) Class II MHC proteins C) Immunoglobulin M (IgM) receptors D) CD14 receptors

Q3. How do innate immune defenses recognize bacterial cell wall fragments to initiate defensive gene transcription? A) Through binding to Toll-like receptors via CD14 signaling B) Through alternative pre-mRNA splicing C) Through somatic recombination of V, D, and J gene segments D) Through direct injection of granzyme B

Q4. Which specialized white blood cells non-specifically recognize, attack, and lyse virus-infected or cancerous body cells? A) Plasma cells B) Natural killer cells C) Helper T cells D) Memory B cells

Answer Key

Q1: B — Specific adaptive immunity relies on B lymphocytes (which produce antibodies) and T lymphocytes (which carry out cellular responses)

Q2: A — Class I MHC molecules present internal protein fragments on almost all nucleated cells for recognition by TC cells

Q3: A — Bacterial cell wall components bind CD14 and activate Toll receptors, initiating a kinase cascade that translocates NF-κB into the nucleus to transcribe defense genes

Q4: B — Natural killer cells provide innate defense by recognizing surface changes on virus-infected or tumor cells and lysing them

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End of Quiz

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