Biochemistry problems and solutions assignment

Because the rise per residue in an a helix is 1. K the length is 477 A (318*1. 5). (b) Eighteen residues in each strand (40 minus 4 divided by 2) are in a ; sheet conformation. Because the rise per residue is the length is 63 A. 2. Contrasting isomers . Poly-L-Lucien in an organic solvent such as dioxide is a-helical, whereas poly-l_-silencing is not, Why do these amino acids with the same number and kinds to atoms have different helix-forming tendencies? Mans: The methyl group attached to the carbon of silencing statically interferes with a helix formation.

In Lucien, this methyl group is attached to the y carbon atom, which is farther from the main chain and once does not interfere. 3. Active again A mutation that changes an Elaine residue in the interior of a protein to a valise is found to lead to a loss of activity. However, activity is regained when a second mutation at a different position changes an silencing residue to a glycogen. How might this second mutation lead to a restoration Of activity? Mans: The first mutation destroys activity because valise occupies more space than Elaine, and so the protein must take a different shape.

The second mutation restores activity because of a compensatory reduction of volume; glycogen is smaller than silencing. 4 Shuffle test (! ы) . An enzyme that catalysts disulfide-slothfully exchange reactions, called protein disulfide isomerism (POI, has been isolated. Inactive scrambled ribonucleic is rapidly converted into enigmatically active ribonucleic by POI. In contrast, insulin is rapidly inactivated by POI. What does this important observation imply about the relation between the amino acid sequence of insulin and its three-dimensional structure?

Mans: The native conformation of insulin is not the thermodynamically most stable form. Indeed, insulin is frowned from pro- insulin, a single-chain precursor containing 33 additional residues. In pro-insulin, sides 30 of the future B-chain of insulin is linked to the residue I of the future A-chain. S. Stretching a target (?? Evil*-K-) A protease is an enzyme that catalysts the hydrolysis of peptide bonds of target proteins. How might a protease bind a target protein so that its main chain becomes fully extended in the vicinity of the vulnerable peptide bond?

Mans: A segment of the main chain of the protease could hydrogen-bonded to the main chain Of the substrate to form an extended parallel or anti-parallel pair of strands. 6. Often irreplaceable Glycogen is a highly conserved amino acid residue in the evolution Of proteins. Why? Mans: Glycogen has the smallest side chain Of any amino acid. Its smallness often is critical in allowing polypeptide chains to make tight turns or to approach one another closely. 7. Potential partners . Identify the groups in a protein that can form hydrogen bonds or electrostatic bonds with an argentine side chain at pH 7. Mans: Glutamate, separate.

The terminal carbonyl group can form salt bridges with the guanidine group of argentine. In addition, this group can be a hydrogen bond donor to the side chains of glutamine, aspirating, serine, throne, separate, and glutamate, and the main chain carbonyl. 8. Permanent waves . The shape Of hair is determined in part by the patterns of disulfide bonds in keratin, its major protein. How can curls be induced? Mans Disulfide bonds in hair are broken by adding a Athol and applying gentle heat. The hair is curled, and an oxidize agent is added to re-form disulfide bonds to stabilize the desired shape.

Chapter 02 Exploring Proteins I _ Valuable reagents (E ?? it*J) . The following reagents are often used in protein chemistry: CNR Trying Dabs chloride urea Phenyl stationmaster AN HCI Performer acid ;-merchantable In hydride Chemotherapy Which one is the best suited for accomplishing each of the following tasks? A) Determination of the amino acid sequence of a small peptide. (b) Identification of the main&terminal residue of a peptide (of which you have less than O. 1 peg). (c) Reversible denomination of a protein devoid of disulfide bonds. Which additional reagent would you need if disulfide bonds were present? D) Hydrolysis Of peptide bonds on the carbonyl side Of lysine and aromatic residues. (e) Cleavage of peptide bonds on the carbonyl side of Mennonite. (f) Hydrolysis Of peptide bonds on the carbonyl side Of lysine and argentine residues. Mans: (a) Phenyl stationmaster. (b) Dandy’s chloride or dabs chloride. (c) Urea; p- recreational to reduce disulfide. (d) Chemotherapy. (e) CNR. (n Trying 2. Acid-base relations What is the ratio of base to acid at pH 4, 5, 6, 7, and 8 for an acid with a peak of 6? Mans: 0. 01, 0. 1, 1. 10, and 100. 3. Finding an end . Anhydrous hydrazine (4) has been used to cleave peptide bonds in proteins.

What are the reaction products? How might this technique be used to identify’ the carbonyl-terminal amino acid? Mans: Each amino acid residue, except the carbonyl-terminal one, gives rise to a hydrazine on reacting with hydrazine. The carbonyl-terminal residue can be identified because it yields a free amino acid. . Crafting a new breakthrough Ethylene’s reacts with cytosine side chains in proteins to for S-inanimately derivatives. The peptide bonds on the carbonyl side of these modified cytosine residues are

susceptible to hydrolysis by trying. Why? Mans: The S-indiscriminately side chain resembles that of lysine.

The only difference is a sulfur atom in place of a methyl group. 5. Spectrometry . The absorbency A Of a solution is defined as A = log 10 (10/1) In Which 10 is the incident light intensity and I is the transmitted light intensity. The absorbency is related to the molar absorption coefficient (extinction efficient E (in CM. L WI), concentration c (in M), and path length (in CM) by The absorption coefficient of mycologist at Mann is 15000 CM. L WI . What is the absorbency of a elm/ml solution across a I-CM path? What percentage of the incident light is transmitted by this solution? Mans: A elm/ml solution of mycologist (1 7. kid) corresponds to 5. Xx-S M. The absorbency to a I-CM path length is 0. 84, which corresponds to an 10/1 ratio of 6. 96, Hence 144% of the incident light is transmitted. 6. A slow mover . Transmission, a 93-kid muscle protein, sediments more slowly than does hemoglobin (asked). Their sedimentation efficient are ASS and 4. AS respectively. Which structural features of transmission accounts for its slow sedimentation? Mans Transmission is rod shaped, whereas hemoglobin is approximately spherical. 7. Sediment spheres _ What is the dependence of the sedimentation coefficient S of a spherical protein on its mass?

How much more rapidly does an 80-kid protein sediment than does a 40-kid protein? Mans: The frictional coefficient f as well as the mass m determines S. Specifically, f is proportional to r. Hence, ifs proportional to ml and so S is proportional to mm/3. An 80-kid spherical protein sediments 1. 9 times as rapidly as a 40- kid spherical protein. 8 Size estimate . The relative electrophoresis nobilities off 30-kid protein and a 32-kid protein used as

standards on an SO- polysaccharide gel are 0. 80 and 0. 41 , respectively. What is the apparent mass Of a protein having a mobility of 0. 2 on this gel? Mans: kid. (plotting the mobility against the value Of log MM Of the two known proteins, and then find the apparent amass of the unknown protein) 9. A new partnership?) The gene encoding a protein with a single disulfide bond difference undergoes a mutation that changes a serine residue into a cytosine residue. You want to find out whether the disulfide pairing in this mutant is the same as in the original protein. Propose an experiment to directly answer this question, Mans: The positions of disulfide bonds can be determined by diagonal electrophoresis.

The disulfide pairing is unaltered by the mutation if the off-diagonal peptides forded from the native and mutant proteins are the same. 10, Helix-coil transitions (a) Circular diachronic measurements have shown that poly-L-lysine is a random coil at pH but becomes a-helical as the pH is raised above I C. Account for this pH-dependent conformational transition. B) Predict the pH dependence of the helix-coil transition of poly-L-estimate. Mans: (a) Electrostatic repulsion between positively charged E-amino groups prevents a-helix formation at pH 7.

At pH 10, the side chains become depredation, allowing a-helix formation. (b)Poly-L-glutamate is a random coil at pH 7 and becomes a-helical below pH 4. 5 because the V-carboxylic groups become propionate. 11. Sorting cells . Fluorescence-activated cell sorting (FACES, is a powerful technique for separating cells according to their content of particular molecules. For example, a fluorescent-labeled antibody specific for a cell-surface protein an he used to detect cells containing such molecules. Suppose that you want to

isolate cells that possess a receptor enabling them to detect bacterial degradation products.

However, you do not yet have an antibody directed against this receptor. Which fluorescent-labeled molecule would you prepare to identify such cells? Mans: A fluorescent-labeled derivative of a bacterial degradation product (e. G. A fermentation peptide) would bind to cells containing the receptor of interest. 12. Mirror images (ski#) . Suppose that a protease is synthesized by the solid-phase method from D rather than L amino acids. How would the sedimentation, electrophoresis and circular diachronic properties of this enzyme compare with those of the native form?

What prediction can you make about the relation of peptide substrates of the D and L enzymes? Mans: The sedimentation and electrophoresis properties of the L enzyme and the mirror-image D form would be the same. The circular dichotomies spectra would have the same magnitude but Of opposite sign because the two Structures have opposite stew- sense. Peptide substrates that are mirror images of one another would be cleaved at the same rate by the L and D enzymes. 13. Peptides on a chip Large numbers of different peptides can be synthesized in a small area on a solid support.

This high-density array can then be probed With a fluorescent-labeled protein to find out which peptides are recognized. The binding of an antibody to an array of 1024 different peptides occupying a total area of a thumbnail. How would you synthesize such a peptide array? (Hint: use light instead of acid to depreciate the terminal amino group in each round of synthesis). Mans: Light was used to direct the synthesis theses peptides. Each amino

acid added to the solid support contained a photovoltaic protecting group instead of t-Boca protecting group at its a-amino group.

Illumination of selected regions of the solid support led to the release of the protecting group, which exposed the amino groups in these sites to make them reactive. The pattern of masks used in these illuminations and the sequence of reagents define the ultimate products and their locations. Chapter 03 DNA and RNA: Molecules of Heredity Complements . Write the complementary sequence (in the standard 5′ -?? 3′ notation) (a) CATCH Mans: (a) TACT (b) TACT (b) GTAG (c) ACTING (d) TACT and (d) TAIGA 2. Compositional constraint – The composition (in mole fraction units) f one of the strands of a double-helical DNA is [A] = 0. 0 and [G] = 024 (a) What can you say about [T] and [C] for the same strand? (b) What can you say about [A], [T], and [C) of the complementary strand? Mans: (a) -0. 46 (b) [C] and -0. 46 3. Lost DNA DNA) . The DNA Of a deletion mutant Of A bacteriologic has a length of PRNG instead of 17 GM. How many bas pairs are missing from this mutant? Mans: 5882 base pairs 4. An unseen pattern What result would Mesons and Stash have obtained if the replication of DNA were conservative (i. E. , the parental double helix stayed together)? Give the expected distribution of DNA molecules after 1. And 2. Generations for conservative replication. Mans: In conservative replication, after 1. 0 generation, one half of the molecules would be NON-NON, the other half NON-NON. After 2. 0 generations, one quarter of the molecules would be NON-NON, the other three quarters IAN-NON. Hybrid 14 N-SIN molecules would not be observed in conservative replication. 5. A fortunate circumstance Griffith used heat-killed S pneumatic to transform R. Mutants. Studies years later showed that the

double-stranded DNA is needed for efficient transformation and that high temperatures melt the DNA double helix.

Why were Griffith experiments breathless successful? Mans: The DNA reentered when the heat-killed pneumatic were cooled before they were injected into mice. 6. A matter Of competence Strains of Bacillus subsists that can be transformed by foreign DNA are termed competent. Others, termed incompetent, are insusceptible to transformation. How might theses strains differ from each other? Mans: Incompetent strains may not be able to take up DNA Alternatively, they may have potent deoxyribonucleic, or they may not be able to integrate fragments of DNA into their genome. 5 7.

A propitious choice . Bacteriologic MUM infects E. Coli differently room the way bacteriologic T 2 does, The MI 3 protein coat is removed in the inner membrane of the bacterial cell, where it is sequestered and subsequently used for the development of progeny DNA_ Why would MI 3 have been much less suitable than TO was for the experiments carried out by Hershey and Chase? Mans: In the Hershey-Chase experiment, ASS-Babied T 2 viral proteins did not become incorporated into infected cells. The labeled viral proteins were found in the supernatant when infected cells were centrifuged.

In contrast, MI 3 proteins become embedded in the inner membrane of infected cells; they would appear in he pellet rather than the supernatant after centrifugation. Hershey and Chase would not have been able to separate MI? Into genetic and nonmagnetic parts, as they did for TO_ 8. Tagging DNA DNA) . (a) Suppose that you want to radioactively label DNA but not RNA in dividing and growing bacterial cells. Which radioactive

molecule would you add to the culture medium? (b)Suppose that you want to prepare DNA in Which the backbone phosphorus atoms are uniformly labeled with APP. Which precursors should be added to a solution containing DNA polymerase and primed template DNA? Specify the position of the radioactive atoms in these precursors. Mans: (a) titrated thymine or titrated thymine. (b) adapt, get, duct, and http labeled with APP in the innermost (a) phosphorus atom, 9. Finding a template A solution contains polymerase and the MGM+ salts of ADAPT, get, duct and http. The DNA molecules listed below are added in aliquots of this solution. Which of them would lead to DNA synthesis? (a) A single-stranded closed circle containing COCO nucleotide units. B) A double stranded closed circle containing 1000 nucleotide pairs. (c) A single-stranded closed circle of 1000 nucleotide base paired to a linear strand of SO nucleotide with a free 3′-OH terminus. D) A double-stranded linear molecule of 1000 nucleotide pairs with a free 3′ OH at each end. Mans: Molecules (a) and (b) would not lead to DNA synthesis because they lack a 3′-OH group (a primer Molecule (d) has a free 3′-OH at one end of each strand but no template strand beyond. Only (c) would lead to DNA synthesis. 10. The right start . Suppose that you want to assay reverse transcript activity.

If plenipotentiary is the template in the assay, What should you use as the primer? Which radioactive nucleotide should you use to follow chain elongation? Mans: A declaratively electioneered should be used s the primer. The poly (A) template specifies the incorporation of dot; hence, radioactive http should be used in the assay. 11. Essential degradation . Reverse transcript has ribonucleic activity as well as polymerase activity. What is the

role of its ribonucleic activity? Mans: The ribonucleic serves to degrade the RNA strand, a necessary step in forming duplex DNA 6 from the RNA-DNA hybrid. 2. Virus hunting . You have purified a virus that infects turnip leaves, Treatment of a sample with phenol removes viral proteins. Application to the residual material to scraped leaves results in the formation to progeny iris particles. You infer that the infectious substance is a nucleic acid, propose a simple and highly sensitive means of determining whether the infectious nucleic acid is DNA or RNA_ Mans: treat one aliquot of the sample with ribonucleic and another with deoxyribonucleic Test these nuclease-treated samples for ineffectively 13.

Mutagen consequences Spontaneous denomination of cytosine bases in DNA occurs at low but measurable frequency. Cytosine is converted to oracular by loss of its amino group. After this conversion, which base pair occupies this position in each of the daughter strands resulting from one mound of replication? Two rounds of replication? Mans: Denomination changes the original GO base pair into a GIG pair. After one round Of replication, one daughter duplex will contain a GO pair, and the other duplex an A-U pair. After NON rounds Of replication, there would be two GO pairs, one AU pair, and one A- T pair. 4. Eons ago . The atmosphere of the primitive earth before the emergence of life contained NZ NH, H2O, HCI, CO. And H2O. Which of these compounds is the most likely precursor of most of the atoms in adenine? Why? Mans: Hydrogen cyanide. Adenine can be viewed as a pentameter of HCI. 15. Information content a) How many different 8. Mere sequences of DNA are there? B) How many bits of information are stored in an 8-Mere DNA sequence? In the E. Coli genome? In the human genome? C)

Compare each of these values with the amount of information that can be stored on a personal computer diskette.

A byte is equal to 8 bits. Mans: (a) 48= 65536, In computer terminology, there are ASK 8-mere of DNA. (b) A bit specifies two bases (say, A and C) and a second bit specifies the other two (G and T), Hence, two bits are needed to specify a single nucleotide (or base pair) in DNA For example, 00, 01, 10, and 11, could encode A, C, G, and T. An 8-Mere stores 16-bits (216= 65536), the E. Coli genome I Cob) stores ICC bits, and the human genome (2. Xx bases) stores 5. 8* 109 bits of genetic information. (c) A high-density diskette stores about I . 5 megabytes, Vichy is equal to I . ICC bits.

A large number of 8-Mere sequences could be stored on such a diskette. The DNA sequence Of E. Coli, once known, could be written on a single diskette. Nearly 500 diskettes would be needed to record the human DNA sequence. Chapter 04 Plow Of Genetic Information 1. Key polymerases . Compare DNA polymerase I and RNA polymerase from E. Olio in regard to each Of the following features: (a) Activated precursors. (b) Direction of chain elongation. (c) Conservation of the template. (d) Need for a primer. Mans: (a) Deoxyribonucleic troposphere versus ribonucleic troposphere. (b) 5′ , 3′ tort both. C) Semiconscious tort DNA polymerase l, conserved for RNA polymerase. (d) DNA polymerase needs a primer, whereas RNA polymerase does not. 2. Encoded sequences (a) Write the sequence of the Mrs. molecule synthesized from a DNA template strand having the sequence 5′-ATTACHING-3 (b) What amino acid sequence is encoded by the following base sequence of an RNA molecule? Assume that the reading frame starts at the 5′ end. 5′ UlJGCCUAGUGAUUGGAUG-3′ (c) What is the sequence of the

polypeptide formed on addition of poly (ILIAC) to a cell free protein synthesizing system? Mans: (a) 5′-SAGACIOUS-3′; (b) Eel-Pro-seer-Asp-Trip-Met. C) Poly (Eel-Eel- Thro-Try) 3. A tougher chain RNA is readily hydrolysis by alkali, whereas DNA is not. Why? Mans: The 2′-OH group in RNA acts as an intermolecular catalyst. In the alkaline hydrolysis of RNA, it forms a 2′, 3′-cyclic intermediate. 4. A potent How does correction (X) (3′ dissensions, 3 -EN, BE) block the synthesis of RNA? Mans: Correction terminates RNA synthesis. An RNA chain containing correction lacks a 3′-OH group. 5. Silent RNA (In RNA) . The code word EGG could not be deciphered in the same way as was LOLLS, ICC, and AAA because poly (G) does not act as a template.

Poly (G) forms a triple-stranded helical structure. Why is it an ineffective template? Mans: Only single-stranded RNA can serve as a template for protein synthesis. 6. Two from one(-?? Z). Shoran synthesized by organic-chemical methods two complementary deconstructionists, each with nine residues: d (TACT)3 and d (GTAG)3. Partially overlapping duplexes that formed on axing these elocutionists then served as templates for the synthesis by DNA polymerase of long, repeating double helical DNA chains. The next step was to obtain long plenipotentiaries chains with a sequence complementary to only one of the two DNA strands.

How did he obtain only poly (LAG) Only poly (GUY)? Mans: Incubation with RNA polymerase and only LIT, TAP, and ACT led to the synthesis Of only poly (LILAC). Only poly (GILA) was formed when GET was used in place of ACT. 7. Back to the bench . A protein chemist told a molecular geneticist that he had found a new mutant hemoglobin in Which separate replaced lysine. The molecular geneticist expressed surprise and sent his friend scurrying back to

the laboratory. (a) Why was the the molecular geneticist dubious about the reported amino acid substitutions? B) Which amino acid substitution would have been more palatable to the molecular geneticist? Mans: (a) A code for lysine cannot be changed to one for separate by the mutation of a single nucleotide. (b) Rag. Assn, Glen, Lie, Met, or Thro. B. Triple entendre . The RNA transcript of a region offs phage DNA contains the sequence 5′-?? MANAGUA-3′. This sequence encodes three different polypeptides, What are they? Mans: A peptide terminating with Lays (CIA is a stop code), -Assn-Glue-, and -Met- Raga_ Valuable synonyms . Proteins generally have low contents of Met and Trip, intermediate ones of His and Sys, and high ones of Eel and Seer.

What is the relationship between the number of godsons of an amino acid and its frequency of occurrence in proteins? What might be the selective advantage of the relation? Mans: Highly abundant amino acid residues have the most godsons (e. G. Eel and Seer each have six), whereas the least abundant ones have the fewest (Met and Trip each have only one). Degeneracy allows (a) variation in base composition and b) decreases the likelihood that a substitution of a base will change the encoded amino acid. Fifth degeneracy were equally distributed, each of the 20 amino acids would have three godsons.

Benefits (a) and (b) are maximized by assigning more godsons to prevalent amino acids than to less frequently used ones. 10. A new translation A transfer RNA With a GU indication is enigmatically conjugated to ICC-labeled cytosine. The cytosine unit is then chemically modified to Elaine. The altered Nicolay-tarn is added to a protein- synthesizing system containing normal

components except for this tarn. The Mrs. added to this mixture contains the following sequence: 5′-UUUUGCCAUGUUUGUGCU-3′ What is the sequence of the corresponding irredeemable peptide?

Mans: Phew. Sys. His-Vale-Ala-Ala 11. Fire and ice (*SAA”) . Valise is specified by four godsons. How might the relative frequencies of their usage in an alga isolated from a volcanic hot spring differ trot those of an alga isolated trot an Antarctic bay? Mans: GU and GUY are likely to be used more by the algae from the hot springs to increase the melting temperature of its DNA 12. Eons apart – The amino acid sequences off yeast protein and human protein carrying out the same function are found to be 60% identical.