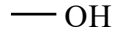
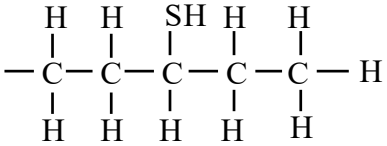
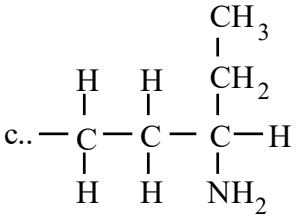
Package Title: Test Bank
Course Title: Karp8e
Chapter Number: 2

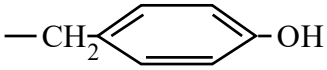
Question Type: Multiple Choice

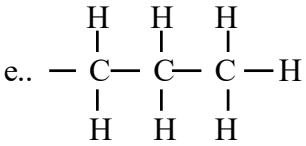
1) Which of the groups below is capable of only hydrophobic interactions?

a.. 

b. 

c.. 

d. 

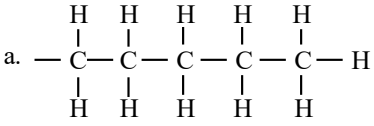
e.. 

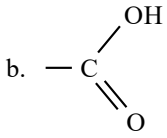
a) A
b) B
c) C
d) D
e) E

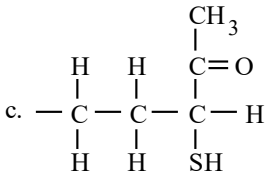
Answer: e

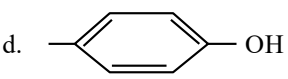
Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

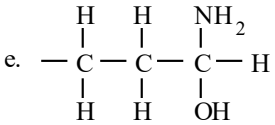
2) Which of the following groups is capable of only hydrophilic interactions?

a. 

b. 

c. 

d. 

e. 

a) A
b) B
c) C
d) D
e) E

Answer: b

Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

3) Which of the following tripeptides would be most likely to be soluble in an organic (hydrophobic) solvent like benzene?

a) N - phenylalanine - alanine - glycine – C
b) N - leucine - alanine - lysine - C
c) N - proline - phenylalanine - leucine - C
d) N - arginine - lysine - proline - C
e) N - glutamate - aspartate - glycine – C

Answer: c

Difficulty: Hard
Learning Objective: LO 2.5 Describe the general structure and functions of biological molecules. Section Reference: Section 2.5 The Nature of Biological Molecules

4) What kind of bond results from an unequal sharing of electrons?

a) ionic bond
b) polar covalent bond
c) H bond
d) nonpolar covalent bond

Answer: b

Difficulty: Easy
Learning Objective: LO 2.1 Describe the role of electrons in the formation of covalent bonds. Section Reference: Section 2.1 Covalent Bonds

5) Under which circumstances would electrons be most likely to be shared equally?

a) when they are equidistant from nuclei
b) when they are equidistant from each other

c) when atoms of the same element are sharing them
d) when the atoms sharing them are different

Answer: c

Difficulty: Easy
Learning Objective: LO 2.1 Describe the role of electrons in the formation of covalent bonds. Section Reference: Section 2.1 Covalent Bonds

6) The most electronegative atoms typically present in biological molecules are ____ and ____.

a) O, C
b) O, P
c) O, N
d) C, N
e) C, Na

Answer: c

Difficulty: Easy
Learning Objective: LO 2.1 Describe the role of electrons in the formation of covalent bonds. Section Reference: Section 2.1 Covalent Bonds

7) The most stable atoms and thus those that are typically nonreactive are the atoms that have _____.

a) equal numbers of electrons and protons
b) equal numbers of electrons and neutrons
c) full inner shells
d) full outer shells
e) all covalent bonds

Answer: d

Difficulty: Easy
Learning Objective: LO 2.1 Describe the role of electrons in the formation of covalent bonds. Section Reference: Section 2.1 Covalent Bonds

8) Why are free ionic bonds of little importance and relatively unlikely to form in living organisms?
1)Cells are composed mostly of water, which interferes with ionic bonds between free ions.
2)Cells are largely hydrophobic.
3)They are crystals.

a) 1
b) 2

c) 3
d) 1 and 2
e) 2 and 3

Answer: a

Difficulty: Easy
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

9) In a living organism, where are ionic bonds most likely to be found?

a) in the cytoplasm
b) between DNA strands
c) deep in a protein's core where water is excluded
d) on the surface of a protein
e) on the surface of a lipid

Answer: c

Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

10) Which interaction is most important in enhancing the solubility of macromolecules in water?

a) hydrophobic interactions
b) nonpolar covalent bonds
c) H bonds
d) van der Waals forces
e) Both hydrophobic interactions and nonpolar covalent bonds

Answer: c

Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

11) Where are hydrophobic interactions most likely to occur?

a) on the surface of a water-soluble protein
b) the core of a water-soluble protein
c) in contact with water molecules
d) between two charged molecules

e) between two ions

Answer: b

Difficulty: Easy
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

12) What kind of noncovalent interaction is typified by interactions between two molecules that are so close together that they can experience weak attractive forces bonding them together?

a) H bonds
b) ionic bonds
c) hydrophobic interactions
d) polar covalent bonds
e) van der Waals forces

Answer: e

Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

13) A molecule that is capable of releasing or donating a hydrogen ion is termed a(n) _____.

a) base
b) hydrion
c) acid
d) anachronism
e) pain

Answer: c

Difficulty: Easy
Learning Objective: LO 2.4 Explain the characteristics of acids, bases, and buffers. Section Reference: Section 2.4 Acids, Bases, and Buffers

14) A release of hydrogen ions to a solution would most likely _____.

a) raise pH
b) lower pH
c) buffer pH
d) change salinity
e) keep pH steady

Answer: b

Difficulty: Easy
Learning Objective: LO 2.4 Explain the characteristics of acids, bases, and buffers. Section Reference: Section 2.4 Acids, Bases, and Buffers

15) Why is silicon not suitable for making covalent bonds stable and strong enough to form the basis of living organisms, even though it is just below carbon on the periodic table?

a) Silicon is too large for its nucleus to attract the valence electrons of neighboring atoms enough to hold molecules together sufficiently.
b) Silicon is too small for its nucleus to attract the valence electrons of neighboring atoms enough to hold molecules together sufficiently.
c) Silicon is too large for its nucleus to attract the protons of neighboring atoms enough to hold molecules together.
d) Silicon is too small for its nucleus to attract the protons of neighboring atoms enough to hold molecules together.

Answer: a

Difficulty: Hard
Learning Objective: LO 2.1 Describe the role of electrons in the formation of covalent bonds. Section Reference: Section 2.1 Covalent Bonds

16) The low-molecular-weight building blocks of polymers are called _____.

a) minipolymers
b) monoblocks
c) monomers
d) portions
e) octamers

Answer: c

Difficulty: Easy
Learning Objective: LO 2.5 Describe the general structure and functions of biological molecules. Section Reference: Section 2.5 The Nature of Biological Molecules

17) What bond is responsible for the branch points in glycogen and amylopectin?

a) α (1—>4) glycosidic linkages
b) β (1—>4) glycosidic linkages

c) α (1—>6) glycosidic linkages
d) β (1—>6) glycosidic linkages
e) 3'-5' phosphodiester linkages

Answer: c

Difficulty: Medium
Learning Objective: LO 2.6 Describe the structures and functions of carbohydrates. Section Reference: Section 2.6 Carbohydrates

18) Which polysaccharide bond cannot be broken by mammalian enzymes that normally digest polysaccharides?

a) α (1—>4) glycosidic linkages
b) β (1—>4) glycosidic linkages
c) α (1—>6) glycosidic linkages
d) β (1—>6) glycosidic linkages
e) phosphate ester linkages

Answer: b

Difficulty: Hard
Learning Objective: LO 2.6 Describe the structures and functions of carbohydrates. Section Reference: Section 2.6 Carbohydrates

19) Why do sugars tend to be highly water soluble?

a) because they have only a few hydroxyl groups
b) because of their large numbers of hydroxyl groups
c) because of their large numbers of sulfhydryl groups
d) because of their large numbers of methyl groups
e) because of their small molecular weights

Answer: b

Difficulty: Medium
Learning Objective: LO 2.6 Describe the structures and functions of carbohydrates. Section Reference: Section 2.6 Carbohydrates

20) Which of the following is not a macromolecule formed by polymerization?

a) proteins
b) lipids

c) polynucleotides
d) polysaccharides
e) DNA

Answer: b

Difficulty: Hard
Learning Objective: LO 2.5 Describe the general structure and functions of biological molecules. Section Reference: Section 2.5 The Nature of Biological Molecules

21) What is the maximum number of 100 amino acid long polypeptides that could be made?

a) 10020
b) 2,000
c) 20100
d) 20101
e) 20

Answer: c

Difficulty: Hard
Learning Objective: LO 2.9 Explain the basis of the primary and secondary structure of a protein. Section Reference: Section 2.9 Primary and Secondary Structures of Proteins

22) How do amino acids like hydroxylysine and thyroxine, which are not among the 20 amino acids that are inserted into proteins, get into proteins?

a) They are inserted directly.
b) They are the result of the alteration of R groups of the 20 amino acids after their incorporation into the polypeptide.
c) They are the result of the alteration of R groups of the 20 amino acids before their incorporation into the polypeptide.
d) There are more than the 20 amino acids that are said to be inserted into proteins.
e) Their atoms are altered by insertion into the polypeptide.

Answer: b

Difficulty: Medium
Learning Objective: LO 2.8 Explain why the R group largely determines the properties of an amino acid. Section Reference: Section 2.8 Building Blocks of Proteins

23) Which amino acid is most likely to be found in the core of a protein?

a) methionine

b) asparagine
c) serine
d) threonine
e) glutamic acid

Answer: a

Difficulty: Medium
Learning Objective: LO 2.8 Explain why the R group largely determines the properties of an amino acid. Section Reference: Section 2.8 Building Blocks of Proteins

24) What type of protein secondary structure is characterized as being highly extensible because of its coiled structure?

a) β-pleated sheet
b) double helix
c) α-helix
d) supercoiling

Answer: c

Difficulty: Medium
Learning Objective: LO 2.9 Explain the basis of the primary and secondary structure of a protein. Section Reference: Section 2.9 Primary and Secondary Structures of Proteins

25) The β -pleated sheet is characterized by orientation of _____ the molecular axis.

a) H bonds parallel to
b) H bonds perpendicular to
c) ionic bonds parallel to
d) ionic bonds perpendicular to
e) peptide bonds perpendicular to

Answer: b

Difficulty: Easy
Learning Objective: LO 2.9 Explain the basis of the primary and secondary structure of a protein. Section Reference: Section 2.9 Primary and Secondary Structures of Proteins

26) Proteins are often composed of two or more distinct modules that fold up independently of one another. They often represent parts of a protein that function in a semi-independent manner. These modules are called _____.

a) protein motifs

b) functionals
c) domains
d) dominoes

Answer: c

Difficulty: Easy
Learning Objective: LO 2.10 Discuss the basis and significance of the tertiary structure of proteins. Section Reference: Section 2.10 Tertiary Structure of Proteins

27) What level of structure in proteins is held together by intermolecular R group interactions?

a) primary structure
b) secondary structure
c) tertiary structure
d) quaternary structure

Answer: d

Difficulty: Medium
Learning Objective: LO 2.11 Describe how the structure of hemoglobin exemplifies quaternary protein structure. Section Reference: Section 2.11 Quaternary Structure of Proteins

28) Which of the following is a nucleotide?

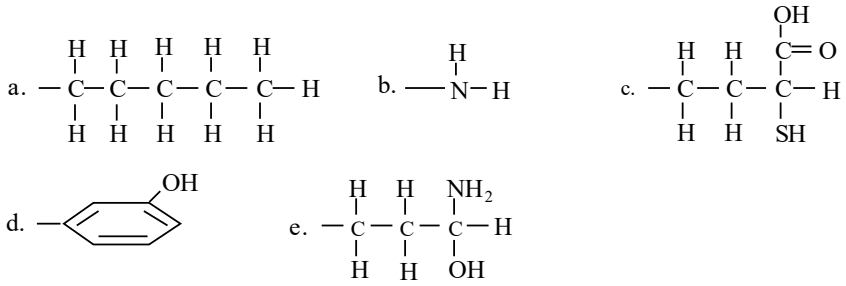
a) phosphate + ribose
b) adenine + deoxyribose
c) sugar + nitrogenous base
d) adenine + ribose + phosphate

Answer: d

Difficulty: Medium
Learning Objective: LO 2.18 Describe the structures and functions of nucleic acids. Section Reference: Section 2.18 Nucleic Acids

Question Type: Essay

31) Which of the groups below is capable of only hydrophobic interactions? Explain your answer. Which is capable of only hydrophilic interactions? Explain your answer.



Answer:

Difficulty: Medium
Learning Objective: LO 2.3 Describe the role of noncovalent bonds in the structure of molecules such as water. Section Reference: Section 2.3 Noncovalent Bonds

Solution: A is capable of only hydrophobic interactions. It contains no ionizable or hydrophilic groups. B is capable of only hydrophilic interactions, since it has no component with a long carbon chain or a carbon-containing ring and no nonpolar covalent linkages. It is also capable of ionization.

32) You treat a partially purified preparation of protein with a reagent that breaks bonds between sulfur atoms. Which level(s) of protein structure are likely to be affected the most?

Answer:

Difficulty: Medium
Learning Objective: LO 2.12 Discuss the study of protein folding, including the role of molecular chaperones. Section Reference: Section 2.12 Protein Folding

Solution: Both the tertiary and quaternary levels of structure would be affected since those levels are the only ones in which disulfide bonds are prominent.

33) Not all proteins are able to renature. Some proteins when exposed to heat or some other denaturing treatment are irreversibly denatured. What is an example of such a protein?

Answer:

Difficulty: Easy
Learning Objective: LO 2.12 Discuss the study of protein folding, including the role of molecular chaperones. Section Reference: Section 2.12 Protein Folding

Solution: Egg white protein and yolk are examples of proteins that are irreversibly denatured by heat.

34) You are working with an enzyme altase that you denature in the presence of urea. If altase were denatured no further by the addition of mercaptoethanol, what would that suggest to you about the enzyme?

Answer:

Difficulty: Medium
Learning Objective: LO 2.12 Discuss the study of protein folding, including the role of molecular chaperones. Section Reference: Section 2.12 Protein Folding

Solution: The enzyme probably contained no disulfide linkages since mercaptoethanol breaks such linkages.

35) Would all proteins be likely to require exposure to mercaptoethanol in order to accomplish full denaturation? If not, what trait would a protein that did not require mercaptoethanol possess?

Answer:

Difficulty: Medium
Learning Objective: LO 2.12 Discuss the study of protein folding, including the role of molecular chaperones. Section Reference: Section 2.12 Protein Folding

Solution: Not all proteins would require mercaptoethanol to accomplish full denaturation. If a protein has no disulfide linkages, it probably would not require mercaptoethanol for full denaturation.

36) An enzyme is placed in a solution containing urea. Assuming that this protein contains no disulfide linkages, is it reasonable to suspect that it will be totally denatured by the treatment? How could you know that the enzyme has, in fact, been denatured? Why does the urea denature the tertiary structure of the enzyme?

Answer:

Difficulty: Hard
Learning Objective: LO 2.12 Discuss the study of protein folding, including the role of molecular chaperones. Section Reference: Section 2.12 Protein Folding

Solution: Placement in a urea solution should totally denature the enzyme, especially since there are no disulfide linkages. If there are extensive hydrophobic interactions between enzyme R groups, total denaturation may be difficult to accomplish. If the enzyme activity disappears, there is a good chance the enzyme has been denatured. Urea breaks up the tertiary structure by interfering with hydrophilic interactions, like H bonds.

37) Which of the following tripeptides would be most likely to be soluble in an organic (hydrophobic) solvent like benzene: N - phenylalanine - alanine - glutamine - C, N - leucine - alanine - lysine - C, N - proline - phenylalanine - leucine - C, N - arginine - lysine - proline - C, N - glutamate - aspartate - glycine - C? Explain your answer.

Answer:

Difficulty: Medium

Learning Objective: LO 2.8 Explain why the R group largely determines the properties of an amino acid. Section Reference: Section 2.8 Building Blocks of Proteins

Solution: N - proline - phenylalanine - leucine - C would be most soluble in a hydrophobic solvent. All three amino acids are classed as nonpolar amino acids and could be soluble in benzene. In the other tripeptides, at least one of the amino acids does not belong to the nonpolar class.

40) Mammals lack the enzyme that hydrolyzes cellulose. Yet many mammals are herbivores and they eat grass and other plant material for nutrition. How can this be, given that they cannot digest the food they are eating?

Answer:

Difficulty: Easy
Learning Objective: LO 2.6 Describe the structures and functions of carbohydrates. Section Reference: Section 2.6 Carbohydrates

Solution: While these animals lack the enzyme that digests cellulose, bacteria that reside within their digestive tracts possess it. There is a symbiotic relationship between the two organisms. The herbivores seek out and eat the grass; the bacteria in their digestive tract digest it. What the bacteria don't use, the herbivore does.

42) What are some possible explanations for the branched structure of glycogen?

Answer:

Difficulty: Medium
Learning Objective: LO 2.6 Describe the structures and functions of carbohydrates. Section Reference: Section 2.6 Carbohydrates

Solution: First, branching allows more efficient storage of energy. More glucose monomers can be stored in a smaller space. Second, branching creates more free ends on the structure. This would allow glycogen to be disassembled more rapidly when free glucose is needed and would also allow quicker assembly when glycogen is being constructed.

43) Scientists have sequenced proteins by using specific proteases to "clip" a purified protein preparation between two specific amino acids, thus forming a number of moderately sized fragments; they have used acid hydrolysis to produce smaller fragments. Each fragment can then be sequenced by breaking the moderate fragments into dipeptides that are easily sequenced. The fragments below are obtained after the initial enzymatic cleavages. Can you deduce the sequence of the original polypeptide? (HINT: the original cleavages at specific locations differ depending on which proteolytic enzyme was used to create each fragment; this causes an overlap in the fragments' sequences.) The final polypeptide should have 18 amino acid residues.

N - ala - ala - gluN - aspN - met - C
N - iso - pro - aspA - try - thr - C
N - met - cys - leu - lys - phe - arg - aspA - C
N - aspN - met - cys - leu - lys - C
N - aspA - try - thr - phe - tyr - ala - ala - C

Answer:

Difficulty: Hard
Learning Objective: LO 2.9 Explain the basis of the primary and secondary structure of a protein. Section Reference: Section 2.9 Primary and Secondary Structures of Proteins

Solution: N- iso - pro - aspA - try - thr - phe - tyr - ala - ala - gluN - aspN - met - cys - leu - lys - phe - arg - aspA - C

44) Many so-called temperature-sensitive mutations have been discovered in a wide variety of organisms. These are proteins that are non-functional at higher temperatures, while, at lower temperatures (often just a few degrees lower), they function normally. For example, the coloration patterns in Siamese Cats arise from a temperature-sensitive mutation. An enzyme required for the synthesis of dark pigment is unable to function in areas close to the body where normal physiological temperatures prevail. However, at the tips of the ears, paws, the tip of the tail and other extremities where the temperature is slightly lower, the enzyme works correctly and dark pigment is produced. What is happening at the molecular level that explains this?

Answer:

Difficulty: Easy
Learning Objective: LO 2.14 Trace the history of our understanding of the role of molecular chaperones in protein folding. Section Reference: Section 2.14 Experimental Pathways: Chaperones - Helping Proteins Reach Their Proper Folded State

Solution: In warmer areas of the organism, the temperature is just high enough to denature the enzyme in question. Since it is denatured, it will not work properly and dark pigment will not be produced in those areas.

45) You are studying a protein. It binds to elongating polypeptide chains as they emerge from an exit channel within the ribosome's large subunit. It appears to prevent partially formed or nascent polypeptides from binding to other proteins in the cytosol, which might cause them either to aggregate or misfold. What kind of proteins is this likely to be? Another protein you are studying picks up larger proteins from Hsp70 family proteins. It is a cylindrical protein complex that contains chambers in which newly synthesized polypeptides can fold without interference from other cellular macromolecules. What is this protein called?

Answer:

Difficulty: Hard

Learning Objective: LO 2.14 Trace the history of our understanding of the role of molecular chaperones in protein folding. Section Reference: Section 2.14 Experimental Pathways: Chaperones - Helping Proteins Reach Their Proper Folded State

Solution: A chaperone of the Hsp70 family. It is called a chaperonin. One chaperonin, TRiC, is thought to assist in the folding of up to 15% of the polypeptides synthesized in mammalian cells.

46) It is thought that most human diseases leave telltale patterns among the thousands of proteins present in the blood or other bodily fluids. It was hoped that analysis of the proteins present in the blood would help in the diagnosis of human disease; however, thus far, searches for these proteins in blood or bodily fluids have been largely unsuccessful and their use in diagnostics largely unreliable. What are these telltale patterns of proteins called?

Answer:

Difficulty: Easy
Learning Objective: LO 2.15 Differentiate between study of the proteome and study of the interactome. Section Reference: Section 2.15 Proteomics and Interactomics

Solution: Biomarkers

47) Some proteins have multiple binding partners. In some cases, they have several different binding interfaces and they are thus capable of binding a number of different binding partners at the same time. On the other hand, other such proteins have a single binding interface, which is capable of binding several different partners, but only one at a time. They can play central roles in such processes as cell division and gene expression. What are such proteins called?

Answer:

Difficulty: Easy
Learning Objective: LO 2.15 Differentiate between study of the proteome and study of the interactome. Section Reference: Section 2.15 Proteomics and Interactomics

Solution: Hub proteins

48) What does the compound, 2-phenylaminopyrimidine, inhibit? It was determined that 2-phenylaminopyrimidine would not have made a very effective drug. Why? What is the basis of Gleevec's effectiveness as a drug in the treatment of chronic myelogenous leukemia (CML)? Why do some patients taking Gleevec experience a recurrence of their cancer even though they initially went into remission?

Answer:

Difficulty: Medium
Learning Objective: LO 2.16 Describe the strategies used to produce novel proteins. Section Reference: Section 2.16 Protein Engineering

Solution: It inhibits tyrosine kinases. It was a weak enzyme inhibitor, which meant that it would have had to be used in very large quantities. Tyrosine kinases are often involved in the transformation of normal cells into cancer cells. The development of CML is driven almost single-handedly by the presence of an overactive tyrosine kinase called ABL. Gleevec binds tightly to the inactive form of the ABL tyrosine kinase and prevents the enzyme from being activated, which is a necessary step if the cell is to become cancerous. Thus, the drug can put CML patients into remission. The ABL kinase becomes resistant to the drug, thus abrogating its effectiveness as a treatment for CML.

49) What kinds of conditions can cause free radicals?

Answer:

Difficulty: Medium
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Free radicals may form when a covalent bond is broken such that each atom that had participated in the bond retained one of the two shared electrons that comprised the bond. They may also form when an atom or molecule accepts a single electron transferred during an oxidation - reduction reaction. Water, for example, can be converted into free radicals when exposed to solar radiation.

50) Why are free radicals capable of altering molecules, such as proteins, nucleic acids and lipids?

Answer:

Difficulty: Easy
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: They are extremely reactive, which makes them well suited for chemically altering these molecules. The formation of hydroxyl radicals is probably a major reason that sunlight is so damaging to the skin.

51) What enzyme is responsible for the destruction of a type of free radical formed when molecular oxygen picks up an extra electron?

Answer:

Difficulty: Easy
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Superoxide dismutase

52) Why is hydrogen peroxide often used as a disinfectant and bleaching agent? How do cells generally rid themselves of hydrogen peroxide?

Answer:

Difficulty: Medium
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Hydrogen peroxide is a potentially reactive oxidizing agent. If it is not rapidly destroyed, hydrogen peroxide can break down to form hydroxyl radicals that attack the cell's macromolecules. Hydrogen peroxide is normally destroyed in the cell by the enzymes catalase or glutathione peroxidase.

53) What is some specific evidence that demonstrates the importance of superoxide dismutase in getting rid of superoxide free radicals?

Answer:

Difficulty: Hard
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Mutant bacteria and yeast cells that lack SOD activity are unable to grow in the presence of oxygen. Furthermore, mice that lack the mitochondrial version of the enzyme (SOD2) are not able to survive more than a week or so after birth. Conversely, mice that have been genetically engineered so that their mitochondria contain elevated levels of the H2O2–destroying enzyme catalase live 20% longer than untreated controls.

54) Why might an organism that had functional SOD but mutant catalase and/or glutathione peroxidase be at a disadvantage?

Answer:

Difficulty: Hard
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: SOD converts two superoxide free radicals and two hydrogen ions into hydrogen peroxide and oxygen. Hydrogen peroxide is also a highly destructive substance and without catalase and glutathione peroxidase, the organism would be less able to get rid of it.

55) You isolate superoxide dismutase from two cell culture lines. One of the lines (SOD1) has a level of SOD activity similar to that found in liver, the tissue from which the cell line was originally obtained. The other cell line (SOD10) has elevated SOD activity. The enzyme in SOD10 is extremely efficient at converting the superoxide free radical to hydrogen peroxide. In a routine check of other critical enzyme activities, catalase was found to have activity levels that were severely depressed in SOD10, while they appeared normal in SOD1. Observations of SOD10 reveal that this cell line cannot be maintained as easily as SOD1. SOD10 cells appear to die at an accelerated rate. What, if anything, can you conclude from these data?

Answer:

Difficulty: Medium
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: While SOD10 is very efficient at neutralizing superoxide free radicals by producing hydrogen peroxide, the peroxide is toxic in its own right. SOD10 also has a relatively ineffective catalase, which detoxifies hydrogen peroxide. Thus, SOD10 builds up hydrogen peroxide rapidly, but lacks the ability to neutralize it just as rapidly. The result is that these cells die at an accelerated rate.

56) What is a randomized, double-blind, placebo-controlled study?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: Patients are randomly divided into two groups that are treated similarly except that one group is given the curative factor being investigated and the other group is given a placebo (an inactive substance that has no therapeutic value). In a double-blind study, neither the researchers nor the patients know who is receiving treatment and who is receiving the placebo.

57) Given what you have learned about SOD, what do you hypothesize would happen to fruit flies that have been genetically engineered to produce large amounts of SOD? Why might houseflies that are kept caged and unable to fly live longer than those allowed to fly?

Answer:

Difficulty: Hard
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Fruit flies genetically engineered to produce large amounts of SOD should live longer than untreated controls. Flying requires a lot of energy and thus high metabolic rates. A fly's mitochondria works very hard and produces many free radicals. As a result, flies that are unable to fly have much lower metabolic rates and therefore require less oxygen. Consequently, they would be expected to produce fewer free radicals, which according to some would slow up aging.

58) What are some common antioxidants found in the body?

Answer:

Difficulty: Easy

Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Glutathione, vitamins E and C, beta-carotene (the orange pigment in carrots and other vegetables), and the parent compound for vitamin A.

59) Red wine supposedly has health-related benefits. What antioxidant chemical is reputed to be responsible for these benefits? Where is this chemical normally found that explains its ending up in red wine? How is this chemical thought to exert its antioxidant effects?

Answer:

Difficulty: Medium
Learning Objective: LO 2.2 Explain the role of free radicals in aging. Section Reference: Section 2.2 Human Perspective: Do Free Radicals Cause Aging?

Solution: Resveratrol. Resveratrol is a polyphenolic compound that is found at high concentration in the skin of red grapes. Rather than scavenging for free radicals, resveratrol appears to act by stimulating an enzyme (Sir2) that serves as a key player in promoting longevity in animal studies.

64) What human disease was found to be similar to kuru in the brain abnormalities it caused? What disease in sheep contributes its name to the abnormal prion molecule, PrPSC? What have been the causes of outbreaks of acquired CJD?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: Creutzfeld-Jakob disease (CJD) is similar to kuru. The disease in sheep that contributes its name to the prion molecule is scrapie. Acquired CJD has been seen in recipients of organs and organ products that were donated by a person with undiagnosed CJD. Apparently, contaminated beef that the infected individuals had eaten years before has also been implicated as a cause of acquired CJD.

65) What is spongiform encephalopathy?

Answer:

Difficulty: Easy
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: This is a pathology in which certain brain regions are riddled with microscopic holes called

vacuolations. It causes the tissue to resemble a sponge.

66) When it was discovered that CJD could be acquired in addition to being inherited, why was it at first assumed that the infectious agent was a virus?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: The infectious agent was found to pass through filters that retard the passage of bacteria. This is usually a characteristic of viral infections.

67) How was it proved that CJD could be passed to another organism?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: Extracts from the tissues of diseased individuals can be proved to be infectious if they transmit the disease to another individual. In the case of CJD, this was demonstrated across species with extracts from the brain biopsy of a human CJD victim causing disease in laboratory animals.

68) An infectious agent is discovered that causes a particular disease. It has a relatively low molecular weight. Treatment with phenol or proteolytic enzymes, treatments that destroy proteins, render the infectious agent harmless, while treatment with nucleases and ultraviolet radiation, treatments that damage polynucleotides, has no effect. What is your interpretation of the above data and why?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: The sensitivity to protein-destroying treatments means that the agent contains protein and that the protein is important to the infectious process. The lack of effect of nucleic acid-destroying treatments suggests that nucleic acids are not important for infection and that the infectious agent is not a virus since nucleic acids are essential when viruses are responsible for an infection. The active part of the infectious agent above is clearly protein.

69) How was it proved that the brains of patients suffering from CJD, an inherited disease, contain an infectious agent?

Answer:

Difficulty: Medium
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: Carlton Gajdusek prepared extracts from a biopsy of the brain of a CJD victim. The extract was injected into a suitable laboratory animal. The animal developed a spongiform encephalopathy similar to that of kuru or CJD.

70) Since replication is a property characteristic of nucleic acids, how might a prion, which lacks nucleic acids, "replicate" itself?

Answer:

Difficulty: Hard
Learning Objective: LO 2.13 Explain the role of misfolded proteins in Creutzfeld-Jakob Disease (CJD) and in Alzheimer's Disease (AD). Section Reference: Section 2.13 Human Perspective: Protein Misfolding Can Have Deadly Consequences

Solution: The mutant form of the protein in patients suffering from inherited CJD may act as a template that causes the conformation of the normal protein to convert to the abnormal form. The resultant two abnormal proteins could then convert two others, etc. The conversion of PrPC to PrPSc has been accomplished in a test tube. Presumably, the appearance of the abnormal protein in the body, by whatever means, starts a chain reaction in which normal protein molecules in the cells are gradually converted to the abnormal prion form. How can the inherited form of CJD be transmitted to another person? A person who has the inherited form of CJD could transmit the disease to another person, if they donate tissue or blood to a person who does not have the disease. The proteins in the donated tissue could then cause normal proteins in the recipient to shift conformation to the abnormal form. This could eventually lead to clinical CJD.