Biochemistry 10th edition Berg Test Bank

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Name:_____ Class:_____ Date:_____

Chapter 1

1. Which statement about biological diversity is FALSE?
   a. The plant kingdom includes species as relatively simple as algae and as complex as sequoias.
   b. No species can live in seemingly hostile environments such as hot springs and glaciers.
   c. Animal kingdom species range from nearly microscopic to very large.
   d. Organisms such as protozoa, yeast, and bacteria are present with great diversity in water and soil.
   e. Microscopic organisms can live on or within larger organisms.

ANSWER: b

2. What are molecules A and B called, if molecule A is large and transforms into a low-molecular-weight molecule B?
   a. A and B are both biological macromolecules.
   b. A and B are both metabolites.
   c. A is a biological macromolecule and B is a metabolite.
   d. A is a metabolite and B is a biological macromolecule.
   e. A is a protein and B is deoxyribonucleic acid.

ANSWER: c

3. Which animal metabolic process is highly similar to the plant process of capturing and converting light energy?
   a. capturing energy released from acid dissociation
   b. capturing energy released from DNA double helix formation
   c. capturing energy released from resisting the change in pH
   d. capturing energy released from glucose breakdown
   e. capturing energy released from the breakage of noncovalent bonds

ANSWER: d

4. When did life on Earth begin and when did human beings emerge, respectively?
   a. 3 billion years ago and 1 billion years ago
   b. 3.5 billion years ago and 0.5 billion years ago
   c. 3.5 billion years ago and 0.2 billion years ago
   d. 3.5 billion years ago and less than 0.1 billion years ago
   e. 3.5 billion years ago and 0.1 billion years ago

ANSWER: d

5. What are the main paths of the tree of life?
   a. eukarya and prokarya
   b. eukarya and archea
   c. bacteria, prokarya, eukarya, and archea
   d. bacteria and eukarya
   e. bacteria, eukarya, and archea

ANSWER: e

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6. Which statement about DNA structure is INCORRECT?
   a. It is a branched polymer with a flexible backbone.
   b. The DNA backbone is built of repeating sugar–phosphate units.
   c. Each DNA strand has directionality due to identical orientation of the sugar–phosphate units.
   d. Each sugar is connected to two phosphate groups through different linkages.
   e. Its structure is a double helix composed of two intertwined strands.

ANSWER: a

7. What makes water a versatile solvent?
   a. stabilization of large molecular complexes
   b. ease of breaking different bonds
   c. irreversible breakage of different bonds
   d. simultaneous formation of a large number of hydrogen bonds
   e. stabilization by large molecular complexes

ANSWER: d

8. Which statement about covalent bonds is INCORRECT?
   a. A covalent bond is formed by the sharing of a pair of electrons between adjacent atoms.
   b. If more than one electron pair is shared, then a covalent bond becomes stronger.
   c. Existence of several resonance structures of nearly equal energies decreases stability of a compound.
   d. Some molecules possess several patterns of covalent bonding.
   e. The key properties of a bond are length and energy.

ANSWER: c

9. What is the energy of an ionic interaction?
   a. the product of a proportionality constant and charges of two atoms divided by the product of the dielectric constant and the distance between atoms
   b. the product of the dielectric constant and a sum of two charges divided by the product of the proportionality constant and the distance between charges
   c. the product of the dielectric constant and the distance between atoms divided by the product of the proportionality constant and charges of two atoms
   d. the product of the dielectric constant and two charges subtracted from the product of the proportionality constant and the distance between charges
   e. the difference between the proportionality constant and charges of two atoms multiplied by the dielectric constant

ANSWER: a

10. What is the reason for the existence of the hydrophobic effect?
   a. the tendency of water molecules to make a bond with hydrophobic proteins
   b. the tendency of polar molecules to self-associate in the presence of an aqueous solution
   c. the tendency of nonpolar molecules to self-associate in the presence of an aqueous solution

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d. the inability of charged molecules to dissolve in water
e. the property of nucleic acids to dissolve in water

ANSWER: c

11. Which statement about noncovalent bonds is CORRECT?
a. Five fundamental noncovalent bonds differ in their geometry, strength, and specificity.
b. In the strongest hydrogen bonds, all their components lie along a straight line.
c. The transient asymmetry in the electronic charge distribution of one atom can induce a complementary asymmetry in the neighboring atoms due to hydrophobic interactions.
d. The release of water from more ordered structures is unfavorable.
e. Very strong repulsive forces become dominant at distances greater than the van der Waals contact distance.

ANSWER: b

12. Which statement about ionic interactions in the formation of the DNA double helix is CORRECT?
a. Separation of negatively charged phosphate groups with distances greater than 10 Å prevents unfavorable interactions.
b. Only favorable ionic interactions take place when two strands of DNA come together.
c. Ionic interactions cause the formation of the double helix.
d. Disposition of negatively charged phosphate groups with distances greater than 10 Å provides only favorable interactions.
e. Some unfavorable ionic interactions take place when two strands of DNA come together.

ANSWER: e

13. Which statement about the role of hydrogen bonds in DNA double helix formation is INCORRECT?
a. The hydrophobic effect contributes to the favorability of base stacking.
b. Hydrogen bonds contribute greatly to the overall process of double helix formation.
c. There are more hydrogen bonds with water than bonds between the bases in single-stranded DNA.
d. When two single strands come together, hydrogen bonds with water are broken and new hydrogen bonds between the bases of two DNA strands are formed.
e. Hydrogen bonds contribute greatly to the specificity of bases binding.

ANSWER: b

14. Which statement about nonpolar interactions in the formation of the DNA double helix is INCORRECT?
a. Van der Waals interactions are nearly optimal in a double-helical structure.
b. Nonpolar surfaces of the bases are moved into contact with each other due to a more complete base stacking.
c. Nucleotide bases tend to stack even in single-stranded DNA molecules.
d. The separation distance of the planes of adjacent bases needs to be adjusted for the favorable van der Waals contacts.
e. Surface complementarity maximizes the formation of hydrogen bonds and van der Waals interactions while minimizing the nonpolar surface area exposed to the aqueous environment.

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ANSWER: d

15. What is FALSE regarding the laws of thermodynamics?
    a. Energy can be neither created nor destroyed.
    b. The local decrease in enthalpy will increase the entropy of the surroundings.
    c. Heat is a manifestation of the kinetic energy associated with the random motion of molecules.
    d. Within chemical systems, potential energy is related to the likelihood that atoms will store energy in some form.
    e. Ordered structures can be formed within a system only if the entropy of the surroundings will proportionally increase.

ANSWER: d

16. The heat content of a system is called:
    a. entropy.
    b. enthalpy.
    c. kinetic energy.
    d. potential enthalpy.
    e. kinetic entropy.

ANSWER: b

17. Why does a spontaneous chemical process always increase the entropy of the universe?
    a. The system entropy will increase if and only if the entropy of surroundings is greater than the ratio of the heat transferred to the surroundings and their temperature.
    b. The total entropy will increase if and only if the product of temperature and the change in system entropy is lower than zero.
    c. The total entropy will increase if and only if the change in enthalpy is lower than zero.
    d. The system enthalpy will increase only when the change in temperature is greater than zero.
    e. The total entropy will increase if and only if the entropy of a system is greater than the ratio of the heat transferred to surroundings and their temperature.

ANSWER: e

18. How was the fact that formation of the double helix does not violate the second law of thermodynamics experimentally confirmed?
    a. in a water bath monitoring the change in entropy to check whether it remains constant
    b. in a water bath monitoring the change in heat to sustain a constant temperature in the bath
    c. in a water bath monitoring the change in entropy to sustain a constant temperature in the bath
    d. in a water bath monitoring the free energy to sustain constant heat content in the bath
    e. in a water bath monitoring the change in heat to sustain constant Gibbs energy in the bath

ANSWER: b

19. A proton exists in a solution as:
    a. H^+.

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b. a water molecule.
c. a deprotonated water molecule.
d. a hydronium ion.
e. H_2O^+.

ANSWER: d

20. What is the direct consequence of the bent shape of a water molecule?
a. Water is highly cohesive.
b. Distribution of charge is asymmetric.
c. Hydrogen atoms possess a net negative charge.
d. The oxygen atom possesses a net positive charge.
e. The water molecule is able to form hydrogen bonds.

ANSWER: b

21. Why are free interactions of water molecules in bulk water more favorable than more ordered interactions with nonpolar compounds?
a. The total entropy in such interactions increases because the Gibbs free energy is positive.
b. The total entropy in such interactions decreases because the Gibbs free energy is negative.
c. The enthalpy of the ordered state is lower than the enthalpy of the bulk state.
d. The total entropy in such interactions increases because the Gibbs free energy is negative.
e. The total entropy in such interactions decreases because the Gibbs free energy is positive.

ANSWER: d

22. What is the concentration of hydroxide ions $[OH^-]$ in an aqueous solution with pH 9?
a. 10^{-9} M
b. 10^{-14} M
c. 10^{5} M
d. 9 M
e. 10^{-5} M

ANSWER: e

23. Which statement about acid–base relations is CORRECT?
a. If $[H^+]$ is higher than 10^{-3}, pH is above 3.
b. If $[OH^-]$ is 10^{-9}, pH is 7.
c. If $[H^+]$ is lower than 10^{-9}, pH is below 9.
d. If $[OH^-]$ is higher than 10^{-3}, pH is below 3.
e. If $[OH^-]$ is 10^{-7}, pH is 7.

ANSWER: e

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24. Which component of DNA bases is the most susceptible to hydroxide ions?
    a. proton of N-1 atom of guanine base
    b. proton of O atom of guanine base
    c. proton of N-3 atom of thymine base
    d. proton of O atom of adenine base
    e. proton of N-1 atom of adenine base

ANSWER: a

25. What is a pK_a value in an acid–base reaction?
    a. the equilibrium constant for proton dissociation
    b. concentration of hydrogen ions in the solution
    c. a quantitative measure of the strength of an acid in the solution
    d. the equilibrium constant for the dissociation of water
    e. concentration of hydroxide ions in the solution

ANSWER: c

26. What is pK_a of a buffer solution (pH = 5.05) containing 0.2 M sodium acetate and 0.1 M acetic acid?
    a. 4.75
    b. 0.2
    c. 0.3
    d. 4.45
    e. 1.58

ANSWER: a

27. Which statement is INCORRECT if the buffer capacity is not consumed upon addition of a strong acid to the solution?
    a. There are more protonated forms of the buffer compound than deprotonated ones.
    b. When hydrogen ions are added to this buffer solution they remain free.
    c. The pH differs from the pK_a value of the buffer's base component.
    d. There are more deprotonated forms of the buffer compound than protonated ones.
    e. Such a buffer is not actually a buffer and cannot mitigate the pH changes.

ANSWER: d

28. By which factor will the 1 M buffer sodium acetate (pK_a = 4.75) increase the amount of acid required to produce a drop of pH from 7.4 to 7.3 in comparison with pure water where a respective change in $[H^+]$ is equal to 1×10^{-8} M?
    a. 5,600
    b. 60
    c. 60,000
    d. 1

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e. 600

ANSWER: c

29. What is the average difference in the genome sequence between each pair of individuals?
    a. 1 different base per 200 bases
    b. 1 different base per 20 bases
    c. 1 different base per 100 bases
    d. 1 different base per 1000 bases
    e. 1 different base per 2000 bases

ANSWER: a

30. Which statement about genetic variations is CORRECT?
    a. Predisposition inevitably results in the onset of a disease.
    b. Only a few genetic variations are connected to some ailments.
    c. Several genetic variations are required to cause a disease.
    d. The average difference between two people within one ethnic group is lower than the difference between the averages of two different ethnic groups.
    e. A particular variation can lead to a predisposition to the development of a particular disease rather than to its inevitable development.

ANSWER: e

31. Which statement about the microbiome is CORRECT?
    a. There are about 10 times more human cells than microbial cells in the body.
    b. The human microbiome does not play a role in obesity.
    c. The microbiome present on a body remains constant throughout a human life.
    d. The microbiome present on different body surfaces is largely distinct.
    e. Many species of the human microbiome have been grown in cultures.

ANSWER: d

32. What principle is comparative genomics based on?
    a. Biological polymers are evolutionary and functionally related in all living organisms.
    b. There is a link between evolution and biochemistry.
    c. DNA can be isolated from previously known organisms.
    d. Biological polymers are greatly variable between single-celled and multicellular organisms.
    e. The sequence variation between remotely related individuals is quite substantial compared to differences in populations.

ANSWER: a

33. Which statement about DNA is INCORRECT?
    a. The most fundamental role of DNA is to encode the sequences of proteins.
    b. The genetic code is the set of rules that links the DNA sequence to the encoded protein sequence.

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c. Gene is the fundamental unit of hereditary information.
d. The control regions account for only a small portion of the human genome.
e. There are about 100,000 protein-coding genes in the human genome.

ANSWER: e

34. What is the number of hydrogen bonds formed between A and T nucleotides?
a. 1
b. 2
c. 3
d. 4
e. 5

ANSWER: b

35. What is the number of hydrogen bonds formed between G and C nucleotides?
a. 1
b. 2
c. 3
d. 4
e. 5

ANSWER: c

36. The structure of DNA described by Watson and Crick includes:
a. a triple helix.
b. a triple helix composed of three intertwined strands.
c. base pairs that are stacked on the inside of the double helix.
d. a sugar-phosphate backbone that lies on the inside of the helix.
e. base pairs that are stacked on the outside of the triple helix.

ANSWER: c

37. What did Watson and Crick suggest to be significant about the base-pairing found in the DNA helix?
a. It allowed the DNA to twist in a helix.
b. The DNA could be circular.
c. It was a good base for the mechanism of copying genetic information.
d. Only one of the strands could act as a template.
e. The DNA sequence was determined by the sequence of RNA.

ANSWER: c

38. What gives proteins such a dominant role in biochemistry?
a. rigidity of the peptide backbone
b. ability to act as a blueprint
c. ability to self-replicate

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d. ability to spontaneously fold into complex three-dimensional structures
e. usage of 40 different building blocks

ANSWER: d

39. What is the concentration of hydrogen ions in a urine sample that has a pH of 6?
a. 10^{-6} M
b. 10^{-8} M
c. 10^{6} M
d. 10^{-14} M
e. 6 M

ANSWER: a

40. Order the type of interactions by the bond strength in descending value.
a. hydrogen bonds, covalent bonds, van der Waals interactions
b. covalent bonds, van der Waals interactions, hydrogen bonds
c. van der Waals interactions, covalent bonds, hydrogen bonds
d. covalent bonds, hydrogen bonds, van der Waals interactions
e. hydrophobic interactions, hydrogen bonds, electrostatic interactions

ANSWER: d

41. Which of the following is a hydrogen bond donor?
a. the N in H- - -N—HD
b. the S in S—H- - -O
c. the O and P in P—O- - -H
d. the H in O—H- - -O
e. the O in O—H- - -NN

ANSWER: d

42. If a particular reaction has a negative ΔG, is it likely to occur?
a. Not unless energy is added to the system.
b. Yes, if it is coupled with another reaction.
c. Yes, it is spontaneous.
d. No, it is not spontaneous.
e. Yes, as long as the temperature increases.

ANSWER: c

43. What is the $[A^-]$:[HA] ratio when a weak acid is in a solution one pH unit below its pK_a?
a. 1:1
b. 1:10
c. 10:1

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d. 2:1
e. 1:2

ANSWER: b

44. Using the Henderson–Hasselbalch equation, calculate the pH of a buffer solution made from 0.20 M CH_3COOH and 0.05 M CH_3COO^- that has pK_a = 4.7.

a. 5.3
b. 4.1
c. 2.5
d. 0.4
e. 5.0

ANSWER: b

45. What are the primary chemical components present in a phosphate buffer at pH = 7.4?

a. H_3PO_4 and PO_4^{3-}
b. $H_2PO_4^-$ and PO_4^{3-}
c. HPO_4^{2-} and PO_4^{3-}
d. $H_2PO_4^-$ and HPO_4^{2-}
e. H_3PO_4 and HPO_4^{2-}

ANSWER: d

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