

Test Bank for Biochemistry Concepts and Connections 2nd Appling

Biochemistry: Concepts and Connections, 2e (Appling et al.)**Chapter 2 The Chemical Foundation of Life: Weak Interactions in an Aqueous Environment**

1) Each of the following is a noncovalent interaction EXCEPT _____.

- A) Hydrogen bond
- B) Carbon-hydrogen bond
- C) Dipole-dipole
- D) Van der Waals interaction

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.1

2) Which of the following is an important noncovalent interaction in biochemistry?

- A) Sulfhydryl bonds
- B) Phosphate bonds
- C) Hydrogen bonds
- D) Electron bonds

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.1

3) Which of the following is FALSE when considering van der Waals interactions?

- A) The van der Waals radius represents the most stable distance between two interacting centers.
- B) Van der Waals radii can determine molecular surfaces.
- C) Molecules that interact by van der Waals forces do not interpenetrate.
- D) They are not important in determining the stability of three-dimensional structures of proteins.

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

4) Which of the following in biological compounds are sufficiently electronegative to serve as strong donors in a hydrogen bond?

- A) Hydrogen and oxygen
- B) Oxygen and nitrogen
- C) Nitrogen and hydrogen
- D) Hydrogen and carbon

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

5) Hydrogen bond donors must be covalently attached to atoms that are _____.

- A) Electronic
- B) Electronegative
- C) Electrostatic
- D) Elastic

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

6) Which of the following is TRUE of hydrophobic molecules?

- A) They have limited solubility in water.
- B) Water forms a cage-like structure around them.
- C) Dissolving in water decreases the entropy of the mixture.
- D) All of the above

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

7) Which of the following can serve as both a hydrogen bond donor and acceptor?

- A) CH₄
- B) Water
- C) A carbonyl group
- D) An internal methionine

Answer: B

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Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

8) Amphipathic molecules are _____; not able to interact via van der Waals forces.

- A) Polar only
- B) Nonpolar only
- C) Neither polar nor nonpolar
- D) Both polar and nonpolar

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

9) Ionic compounds can be readily dissolved in water because the high dielectric constant of water screens and decreases the _____ force between the oppositely charged ions.

- A) Entropic
- B) Enthalpic
- C) Electrostatic
- D) Enantiomeric

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

10) The _____ describes the tendency for hydrophobic molecules to aggregate because of the exclusion of water with the consequent increase of entropy of the solvent.

- A) Hydrophobic effect
- B) Hydrophilic effect
- C) Hypertonic effect
- D) Hypotonic effect

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

11) Which of the following can serve as a buffer because it has two ionizable groups?

- A) Benzene
- B) Sulphur
- C) CH₄
- D) Glycine

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

12) The average charge on an amino acid below its pI will be _____.

- A) Positive
- B) Negative
- C) Neutral
- D) There will be no charges on an amino acid below its pI.

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

13) Calculate the acid dissociation constant K_a of a 0.2 M solution of weak acid that is 0.1% ionized is _____.

- A) 2×10^1
- B) 2×10^{-1}
- C) 2×10^7
- D) 2×10^{-7}

Answer: D

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

14) What is the pH of a 0.1 M phosphate buffer ($pK_a = 6.86$) that contains equal amounts of acid and conjugate base?

- A) 5.86
- B) 6.86
- C) 5.61
- D) 8.11

Answer: B

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

15) What is the pH of a 0.2 M acetate buffer ($pK_a = 4.77$) that contains twice as much acid as conjugate base?

- A) 4.07
- B) 4.47
- C) 5.46
- D) 5.07

Answer: B

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

16) Which of the following amino acid functional groups will influence the pK_a of an amino acid residue the least if it is on an adjacent residue?

- A) $—OH$
- B) $—COOH$
- C) $—CH_3$
- D) $—NH_3$

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

17) What would the pH be at the end of an enzyme-catalyzed reaction if it were carried out in a 0.1 M phosphate buffer of pK_a 6.86 and 0.005 M of acid was produced during the reaction?

- A) 6.86
- B) 6.77
- C) 6.15
- D) 6.00

Answer: B

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.5

18) If hydroxide is added to an amino acid, how will this affect the charge on the amino acid?

- A) It will become more positively charged.
- B) It will become more negatively charged.
- C) It will become more neutrally charged.
- D) It will have a higher charge than before the $—OH$ group was added.

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.6

19) What is the pH of a weak acid that is 0.2% ionized in a 0.2 M solution?

- A) 2.76
- B) 3.05
- C) 3.21
- D) 3.39

Answer: D

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.6

20) The net charge on an amino acid at its isoelectric point (pI) is _____.

- A) 0
- B) +1
- C) -1
- D) +2

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.7

21) Many proteins interact with DNA at physiological pH because _____.

- A) Proteins are naturally attracted to DNA regardless of the pH
- B) The negatively charged DNA is electrostatically attracted to positively charged regions on proteins
- C) The positively charged DNA is electrostatically attracted to negatively charged regions on proteins
- D) Proteins and DNA interact using mainly hydrophobic interactions

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Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.8

22) Small ions in biological fluids _____.

- A) Encourage strong electrostatic interactions between oppositely charged macro-ions at low ionic strengths
- B) Encourage strong electrostatic interactions between oppositely charged macro-ions at high ionic strengths
- C) Have no effect on the interactions between oppositely charged macro-ions
- D) Tend to cluster around macro-ions of the same charge

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.8

23) Which statement does NOT explain the polarity of water?

- A) Oxygen is more electronegative than hydrogen.
- B) Water molecules have a bent geometry (V-shaped).
- C) The oxygen in water has sp² hybrid orbitals.
- D) In water the hydrogen carries a partial positive charge (δ^+).

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.1

24) Which substance do you expect to be most soluble in water?

- A) Ammonia, NH₃
- B) Methane, CH₄
- C) Carbon dioxide, CO₂
- D) Nitrogen, N₂

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

25) What is the maximum number of hydrogen bonds that one water molecule can have with neighboring water molecules?

- A) 1
- B) 2
- C) 3
- D) 4

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Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

26) Which statement is TRUE about hydrogen bonds between water molecules?

- A) They are about as strong as the covalent bonds in a water molecule.
- B) They arise because of the linear geometry of water.
- C) They cause water to have an unusually low freezing point for its molecular weight.
- D) They involve the unequal sharing of a proton between water molecules.

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

27) Compounds that ionize when dissolved in water are called _____.

- A) Electrolytes
- B) Polar compounds
- C) Hydrophobic compounds
- D) Amphipathic compounds

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

28) Poorly soluble molecules such as lipids and nucleoside bases can be made more soluble in cells by attaching _____ to them.

- A) Water
- B) Oxygen
- C) Carbohydrates
- D) Salt ions

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

29) Electrolytes dissolve readily in water because _____.

- A) They are held together by electrostatic forces
- B) They are hydrophobic
- C) Water molecules can cluster around cations
- D) Water molecules can cluster around cations and anions

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

30) What is the difference between a particle, being hydrated versus being solvated?

- A) A hydrated particle is surrounded by a shell of water. A solvated molecule is surrounded by a shell of solvent molecules, not necessarily water.
- B) The terms hydrated and solvated mean exactly the same thing.
- C) A hydrated particle has reacted with hydrogen. A solvated particle is dissolved in a solvent.
- D) The word hydrated is used only when the solute is an electrolyte.

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

31) Micelles, formed by detergents in water, have _____.

- A) Hydrophilic interiors and hydrophobic exteriors
- B) Hydrophobic interiors and hydrophilic exteriors
- C) Hydrophilic interiors and exteriors
- D) Hydrophobic interiors and exteriors

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

32) Molecules that are both hydrophobic and hydrophilic are _____.

- A) Amphipathic
- B) Amphoteric
- C) Bipolar
- D) Cannot exist

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

33) Which molecule or ion below is amphipathic?

- A) $\text{H}_2\text{NCH}_2\text{COOH}$ (glycine)
- B) H_2O
- C) $\text{CH}_3(\text{CH}_2)_{14}\text{COO}^-$
- D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

34) Which statement explains the cleaning action of soap on greasy dishes?

- A) The soap changes the water-solubility of the grease so that it is easily dissolved by the water.
- B) The grease is trapped inside the hydrophobic interior of micelles made of soap molecules.
- C) The soap chemically breaks down the grease into smaller, more water-soluble molecules.
- D) The soap hydrates the grease with its polar head groups and holds it in suspension.

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

35) Which of the following is NOT a "weak" interaction?

- A) Hydrogen bonds
- B) Van der Waals forces
- C) Disulfide bonds
- D) Ionic interactions

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Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

36) Which of the following weak interactions is NOT an electrostatic interaction?

- A) Hydrogen bonds
- B) Charge-charge interactions
- C) Hydrophobic interactions
- D) Van der Waals forces

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

37) Which of these noncovalent forces in biological systems is usually the strongest?

- A) Hydrogen bonds
- B) London dispersion forces
- C) Hydrophobic interactions
- D) Van der Waals forces

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

Learning Outcome: 2.1

Learning Outcome: 2.1

Learning Outcome: 2.1

Learning Outcome: 2.1

42) London dispersion forces are attractive forces that arise due to _____.

- A) Infinitesimal dipoles generated by the constant random motion of electrons
- B) Permanent dipoles of molecules containing covalent bonds between atoms of very different electronegativities
- C) The hydrophobic effect
- D) Ion pairing between oppositely charged functional groups

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

43) The aggregation of nonpolar molecules or groups in water is thermodynamically due to the _____.

- A) Increased entropy of the nonpolar molecules when they associate
- B) Decreased enthalpy of the system
- C) Increased entropy of the water molecules
- D) Very strong van der Waals forces among the nonpolar molecules or groups

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.2

44) Water molecules clustered around nonpolar molecules contribute to hydrophobic interactions because _____.

- A) Their number is minimized to increase the total entropy of water
- B) Nonpolar molecules are more highly organized than polar molecules
- C) Water molecules in the cell are more organized in the regions away from the nonpolar molecule
- D) Water molecules will aggregate around nonpolar molecules

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

45) The three dimensional structure of most proteins is largely determined by _____.

- A) Other proteins which fold them
- B) Weak noncovalent interactions
- C) Denaturation
- D) Hydrogen bonds

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

46) Enzymes that condense subunits of macromolecules during their synthesis usually _____.

- A) Transfer an acyl or carbonyl group to an electrophile
- B) Exclude water from the active site
- C) Contain inhibitors of hydrolases
- D) Are catalyzing thermodynamically favored reactions

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

47) The ion-product constant for water, K_w , is _____.

- A) $1 \times 10^{-7} \text{ M}^2$
- B) $1 \times 10^{-7} \text{ M}$
- C) $1 \times 10^{-14} \text{ M}^2$
- D) $1 \times 10^{-14} \text{ M}$

Answer: C

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

48) What is the concentration of hydroxide ion in an aqueous solution with an H^+ concentration of $2 \times 10^{-5} \text{ M}$?

- A) $2 \times 10^9 \text{ M}$
- B) $2 \times 10^{19} \text{ M}$
- C) $2 \times 10^{-19} \text{ M}$
- D) $5 \times 10^{-10} \text{ M}$

Answer: D

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

49) Pure water has a concentration of _____.

- A) 18 g/ml
- B) 1 g/ml
- C) 1000 g/ml
- D) 55 M

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

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50) How does the ion-product of water, K_W , relate to the equilibrium constant, K_{eq} , for the dissociation reaction of water?

- A) K_W is calculated by multiplying K_{eq} by the concentration of water.
- B) K_W is just another symbol for K_{eq} , so they are equal.
- C) K_W is calculated by dividing K_{eq} by the ideal gas constant.
- D) K_W is calculated by multiplying K_{eq} by the concentrations of hydronium ion and hydroxide ion.

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

51) In pure water, the concentration of H^+ equals _____.

- A) $1 \times 10^{-7} M$
- B) $1 \times 10^{-14} M$
- C) 1 M
- D) .07 M

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

52) The pH of a $10^{-4} M$ solution of HCl is _____.

- A) 3.0
- B) 3.5
- C) 4.0
- D) 4.5

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Answer: C

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

53) Compare solution A with pH 4 to solution B with pH 6.

- A) The concentration of hydronium ion in solution A is twice that in solution B.
- B) Solution A has greater buffering capacity than solution B.
- C) The concentration of hydronium ion in solution A is 100 times that in solution B.
- D) The hydroxide concentrations are equal in the two solutions since pH only measures the concentration of H^+ .

Answer: C

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

54) The Henderson-Hasselbalch equation cannot be used to calculate _____.

- A) The pH of a solution of an organic acid
- B) The amount of salt and acid to add to form a specific buffer
- C) The pK_a of a weak acid
- D) The amount of a divalent cation being used in a buffer

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

55) Two weak acids, A and B, have pK_a values of 4 and 6, respectively. Which statement is TRUE?

- A) Acid A dissociates to a greater extent in water than acid B.
- B) For solutions of equal concentration, acid B will have a lower pH.
- C) Acid B is the conjugate base of Acid A.
- D) Acid A is more likely to be a polyprotic acid than acid B.

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

56) Calculate the value of pK_a for an acid when $K_a = 2.6 \times 10^{-4}$.

- A) -3.59
- B) +3.59
- C) -8.25
- D) +8.25

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Answer: B

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

57) What is the approximate pH of a 0.10 M solution of a weak acid that has a K_a of 5×10^{-5} M?

- A) 2.7
- B) 5.3
- C) 4.8
- D) 11.3

Answer: A

Bloom's Level: 3-4: Applying/Analyzing

Learning Outcome: 2.4

58) The ratio of the concentration of a(n) _____ over _____ describes the proportions of a weak acid necessary to satisfy the Henderson-Hasselbalch equation.

- A) Conjugate acid; conjugate base
- B) Conjugate base; conjugate acid
- C) Proton donor; proton acceptor
- D) Electron acceptor; electron donor

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

59) At the midpoint of a titration curve _____.

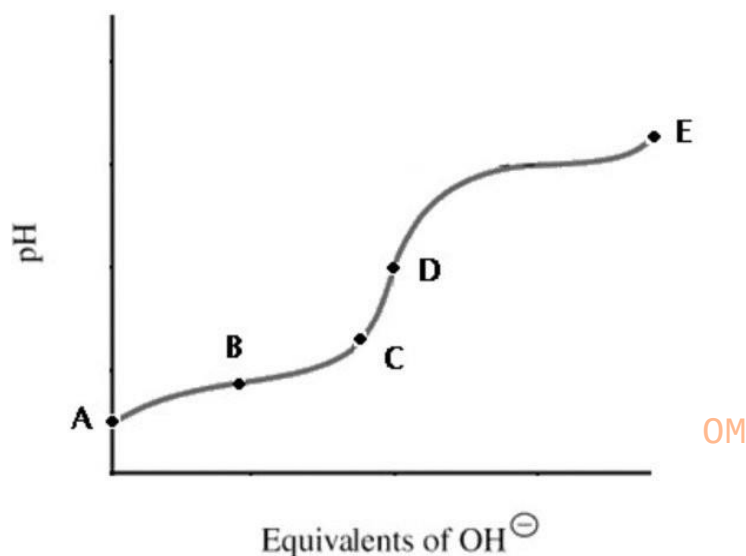
- A) The concentration of a conjugate base is twice that of the concentration of a conjugate acid
- B) The pH equals the pK_a
- C) The ability of the solution to buffer is at its least effective
- D) The concentration of a conjugate base is 1/2 that of the concentration of a conjugate acid

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

60) A titration curve for a weak acid is shown. Which point shows the most buffering?



- A) A
- B) B
- C) C
- D) D

Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

61) The imidazolium ion has a $pK_a = 7.0$. Imidazolium buffers can be prepared for pH values of _____.

- A) 6.5 to 7.5
- B) 6.1 to 7.1
- C) 5.5 to 8.5
- D) 6.0 to 8.0

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

62) Since HCl is a strong acid its value of K_a is _____.

- A) Effectively equal to infinity
- B) Equal to K_w
- C) Zero
- D) Dependent on the concentration of HCl

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

63) For a weak acid with a $pK_a = 6.5$, the effective buffering range is usually considered to be _____.

- A) pH 6 to pH 7
- B) pH 6.4 to pH 6.6
- C) pH 5.5 to pH 7.5
- D) Dependent on the molarity of the acid

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

64) The pK_a of lactic acid is 3.9. A lactate buffer will be useful from pH values _____.

- A) 3.5 through 4.4
- B) 3.0 through 4.5
- C) 2.9 through 4.9
- D) 3.8 through 4.0

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Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

65) pK_a values of phosphoric acid are 2.2, 7.2 and 12.7. A phosphate buffer of pH = 7.4 can be prepared using _____.

- A) $H_2PO_4^-$ and HPO_4^{2-}
- B) HPO_4^{2-} and PO_4^{3-}
- C) H_3PO_4 and HCl
- D) H_3PO_4 and PO_4^{3-}

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.4

66) Which of the following interaction(s) below is/are NOT considered non-covalent?

- A) Hydrogen bonding
- B) Disulfide bonding
- C) Carbon-carbon bonding
- D) The bonding of an amino group to the α -carbon in an amino acid

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.1

67) In the detergent sodium dodecyl sulfate, which of the following is (are) TRUE about them being hydrophobic?

- A) Sulfate is very hydrophobic.
- B) Sodium is very hydrophobic.
- C) Dodecyl is very hydrophobic.
- D) Dodecyl is slightly hydrophilic.

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.3

68) Van der Waals forces are _____.

- A) Very strongly repulsive to each other at short nuclear distances
- B) Very strongly repulsive to each other at long nuclear distances
- C) Very strongly attractive to each other at short nuclear distances
- D) Very strongly attractive to each other at long nuclear distances

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

69) The combined effect of many weak _____ interactions can be very significant in determining factors such as three-dimensional structure for large biological molecules.

- A) Covalent
- B) Noncovalent
- C) Disulfide bridges
- D) Modular

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Answer: B

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

70) Water molecules that surround a less polar molecule in solution are _____.

- A) Immobile and ordered
- B) Immobile and disordered
- C) Mobile and ordered
- D) Mobile and disordered

Answer: A

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

71) The strength of van der Waals forces between two molecules would be strongest if _____.

- A) The distance between them was zero angstroms away
- B) The distance between them was 10 angstroms away
- C) The distance between them was 20 angstroms away
- D) The distance between them was 4 angstroms away

Answer: D

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

72) Micelles are stabilized in water by _____.

- A) Interactions of hydrogen-bonding molecules with each other
- B) Interactions of electrostatic molecules with each other
- C) Interactions of nonpolar molecules with each other
- D) Interactions of salt-bridge containing molecules with each other

Answer: C

Bloom's Level: 1-2: Remembering/Understanding

Learning Outcome: 2.5

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