# Tansey Test Bank, Chapter 1: The Chemical Foundations of Biochemistry

**MULTIPLE CHOICE**

1.If a reaction at 37°C has a Δ*H* of 23 kJ/mol and a Δ*S* of 337 J/K•mol, what is the Δ*G* for the reaction?

A) 65 kJ/mol

B) –42 kJ/mol

C) 18 kJ/mol

D) –19 kJ/mol

E) none of the above

Answer: D

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

2.The second law of thermodynamics states \_\_\_\_\_\_.

A) that spontaneous processes are characterized by the overall conversion of order to disorder

B) that spontaneous processes are characterized by the conversion of work to force

C) that nonspontaneous processes are characterized by the conversion of order to disorder

D) that spontaneous processes are characterized by the conversion of heat to pressure

E) none of the above

Answer: A

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

3. Change in enthalpy (Δ*H*) is best defined as \_\_\_\_\_\_.

A) the sum of heat absorbed and work done

B) the heat transferred at constant pressure

C) the pressure change at constant temperature

D) the measure of disorder in a system

E) none of the above

Answer: B

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

4.A reaction with a \_\_\_\_\_\_ Δ*H* and a \_\_\_\_\_\_ Δ*S* will never be spontaneous.

A) positive, positive

B) positive, negative

C) negative, positive

D) negative, negative

E) none of the above

Answer: B

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

5.Calculate the Δ*G* for a reaction with Δ*H* = 20. kJ/mol and Δ*S =* 20. J/K•mol that is carried out at 27°C.

A) 14 J/mol

B) 140 J/mol

C) 1,400 J/mol

D) 14,000 J/mol

E) none of the above

Answer: D

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

6.A spontaneous process \_\_\_\_\_\_.

A) occurs without the addition of free energy

B) has a Δ*G* < 0

C) is exergonic

D) is all of the above

E) is none of the above

Answer: D

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MATCHING:**

|  |  |
| --- | --- |
| A) | phylogenetic |
| B) | negative |
| C) | H2O |
| D) | Δ*H*° |
| E) | *H – TS* |
| F) | halobacteria |
| G) | open |
| H) | entropy |
| I) | flux |
| J) | polymers |
| K) | Δ*G*°ꞌ |
| L) | thermophiles |
| M) | nitrogen |
| N) | positive |

7. The term used to indicate the degree of randomness within a system is \_\_\_\_\_\_.

Answer: H

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

8. Spontaneous processes are characterized by a change in Gibbs free energy that is \_\_\_\_\_\_.

Answer: B

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

9. Gibbs free energy is defined as *G* = \_\_\_\_\_\_.

Answer: E

Difficulty: Easy

Section: 1.1

Learning objective: Basic principles of thermodynamics describe all systems

10. The symbol for free energy under standard biochemical conditions is \_\_\_\_\_\_.

Answer: K

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

11. Living creatures can be described thermodynamically as \_\_\_\_\_\_ systems.

Answer: G

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

12.An endergonic reaction with a \_\_\_\_\_\_ Δ*H* and a \_\_\_\_\_\_ Δ*S* can be changed into an exergonic reaction by decreasing the temperature.

A) positive, positive

B) positive, negative

C) negative, positive

D) negative, negative

Answer: D

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

13.For a reaction with Δ*H* = 23 kJ/mol and Δ*S =* 22 J/K•mol, at 2°C, the reaction is \_\_\_\_\_\_.

A) spontaneous

B) nonspontaneous

C) at equilibrium

D) impossible to determine reactivity

E) none of the above

Answer: B

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

14.An increase in disorder in the system \_\_\_\_\_\_.

A) is required for a process to be spontaneous

B) results in a decrease in entropy

C) is characteristic of a system increasing in enthalpy

D) results in the factor *T*Δ*S* being positive

E) is found in every exergonic process

Answer: D

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**SHORT ANSWER**

15.Consider a reaction in which Δ*H* = -20. kJ/mol and Δ*S* = 10. J/mol · K.

a. Calculate the Δ*G* for this reaction at 25°C.

b. Is the reaction spontaneous (explain your answer)?

Answer: a. Δ*G* = Δ*H* − *T*Δ*S* ⇒ Δ*G* = –20,000 J/mol – (298 × 10 J/mol) = −23,000 J/mol

b. The reaction is spontaneous because the Δ*G* is negative.

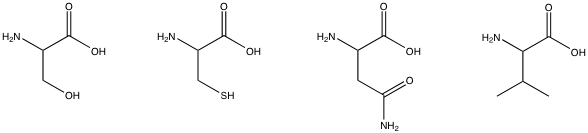
Difficulty: Moderate

Section 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

16.Of the following amino acids, which contains an alcohol?



A B C D

A) A

B) B

C) C

D) D

E) all of the above

Answer: A

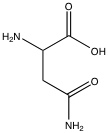
Difficulty: Easy

Section: 1.1

Learning Objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

17.What functional groups are present in the following molecule?

**

A) amine and carboxylic acid

B) amine, ketone, and carboxylic acid

C) amine, amide, and carboxylic acid

D) alcohol, amine, amide, and carboxylic acid

E) none of the above are correct

Answer: C

Difficulty: Medium

Section: 1.1

Learning Objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

18.*K*eq can be determined from the change in standard free energy using the equation \_\_\_\_\_\_.

A) *K*eq = e−Δ*G*°/*RT*

B) *K*eq = ln e−Δ*G*°/*T*Δ*S*

C) *K*eq = e−Δ*H*/*RT*

D) *K*eq = e−Δ*G*°/*T*Δ*S*

E) *K*eq = log e−Δ*G*°/*RT*

Answer: A

Difficulty: Easy

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

19.Consider the reaction A + B  C + D. After reaching equilibrium at 25°C, the following concentrations of reactants and products were measured: [A] = 10 µM, [B] = 15 µM, [C] = 10 µM, [D] = 10 µM. Calculate ∆*G*°ꞌfor this reaction.

A) 1,000 J/mol

B) 10 kJ/mol

C) 1 J/mol

D) insufficient data to determine answer

E) none of the above

Answer: A

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**SHORT ANSWER**

20.Consider the isomerization reaction R ⮀ P, in which R is converted to P. The Δ*G*°ꞌ for this reaction is −10. kJ/mol. Calculate the [P]/[R] at equilibrium at 25°C.

Answer: At equilibrium [P]/[R] = *K*eq = e−Δ*G*°/*RT* ⇒ [P]/[R] = e− -(−-10000 J/mol)/8.3145 × 298 J/mol =

e10000/8.3145 × 298 = 57

Difficulty: Moderate

Section 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**SHORT ANSWER**

21.Phosphoglucomutase catalyzes the reaction in which a phosphate group is transferred from the C-1 of glucose to the C-6 of glucose (G1P ⮀ G6P). A student incubates a 0.2 M solution of glucose-1-phosphate overnight with a small amount of the enzyme. At equilibrium the concentration of glucose-1-phosphate is 9.0 × 10−3 M and the concentration of glucose-6-phosphate is 19.1 × 10−2 M.

Calculate the equilibrium constant (Keq) and the standard state free energy (∆*G*°ꞌ) for this reaction at 25°C.

Answer: The equilibrium constant *K*eq = [G6P]eq/[G1P]eq = 19.1 × 10−2 M/ 9.0 × 10−3 M = 21.

Δ*G*°ꞌ = −*RT*ln*K*eq = −8.3145 × 298 J/mol × ln 21.2 = −7,600 J/mol.

Difficulty: Difficult

Section 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

**MULTIPLE CHOICE**

22.Enzymes accelerate biochemical reactions by \_\_\_\_\_\_.

A) decreasing the ∆*G* for the reactions

B) increasing the ∆*G* for the reactions

C) establishing a “closed system” for each reaction

D) promoting reaction pathways associated with a positive ∆*G*

E) providing a more favorable pathway for the reactions

Answer: E

Difficulty: Moderate

Section: 1.1

Learning objective: Apply the basic principles of thermodynamics, equilibrium, and kinetics to biological systems.

For questions 23–26, consider the structure of the coenzyme NADP.

nad

**MULTIPLE CHOICE**

23.Which arrow points at a phosphoester bond?

A) A

B) B

C) C

D) D

E) E

Answer: E

Difficulty: Easy

Section: 1.2

Learning objective: Describe biological molecules and processes using the tools of organic chemistry.

**MULTIPLE CHOICE**

24.Which arrow points at an amide bond?

A) A

B) B

C) C

D) D

E) E

Answer: B

Difficulty: Easy

Section: 1.2

Learning objective: Describe biological molecules and processes using the tools of organic chemistry.

**MULTIPLE CHOICE**

25.Which arrow points at a phosphoanhydride bond?

A) A

B) B

C) C

D) D

E) E

Answer: A

Difficulty: Moderate

Section: 1.2

Learning objective: Describe biological molecules and processes using the tools of organic chemistry.

**MULTIPLE CHOICE**

26. In a water molecule, hydrogens are partially \_\_\_\_\_; oxygens are partially \_\_\_\_\_.

A) negative; negative

B) negative; positive

C) positive; positive

D) positive; negative

E) none of the above

Answer: D

Difficulty: Easy

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

27. Due to the formation of hydrogen bonds, \_\_\_\_\_ is highly soluble in water.

A) carbon dioxide

B) sodium chloride

C) methanol

D) octane

E) cholesterol

Answer: C

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

28. Which of the following explains the interactions that occur between the atoms of water molecules and the ions that form when sodium chloride dissolves in water?

A) Hydrogens interact with the sodium ion; oxygens interact with the chloride ion.

B) Hydrogens interact with the chloride ion; oxygens interact with the sodium ion.

C) Hydrogens interact with the sodium ion and the chloride ion.

D) Oxygens interact with the sodium ion and the chloride ion.

E) none of the above

Answer: B

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**TEXT ENTRY**

29. The 104.5° bond angle in the water molecule is the result of the \_\_\_\_\_\_ of electron orbitals around oxygen.

Answer: tetrahedral arrangement

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**TEXT ENTRY**

30. The polarity of the O–H bond is caused by the \_\_\_\_\_\_ of oxygen relative to that of hydrogen.

Answer: higher electronegativity

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

31. Which of the following statements about water is *not true*?

A) It has a high dielectric constant.

B) It dissolves salts and polar substances.

C) It can form two hydrogen bonds per water molecule.

D) It packs in a hexagonal- (honeycomb-) shaped lattice when the temperature falls below 0°C.

E) In the liquid state it is only 15% less hydrogen bonded than in the solid state at 0°C.

Answer: C

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

32. In a hydrogen bond between a water molecule and another biomolecule, \_\_\_\_\_.

A) a hydrogen ion on the water molecule forms an ionic bond with a hydride ion on the other molecule

B) the hydrogen bond will typically form between a hydrogen atom and either a nitrogen, sulfur, or oxygen atom

C) the partial charge on a hydrogen of the water interacts with the partial charge on a hydrogen of the other molecule

D) a hydrogen on the water molecule forms a covalent bond to an oxygen or nitrogen atom on the other molecule

E) the hydrogen atom is located between an oxygen atom of the water and a carbon atom of the other molecule

Answer: B

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

33. Which of the following is a physical property of water that results from hydrogen bonding?

A) a high boiling point relative to molecular weight

B) a solid state that is less dense than the liquid state

C) high surface tension

D) the ability to solubilize polar molecules

E) all of the above

Answer: E

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

34. Which of the following functional groups has two hydrogen bond donors and one hydrogen bond acceptor?

A) alcohol

B) ester

C) thiol

D) amine

E) amide

Answer: D

Difficulty: Difficult

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

35. Molecules such as methanol and ethanol are very soluble in water because \_\_\_\_\_\_.

A) they tend to avoid contact with each other

B) they contain C─H groups that donate H-bonds to water

C) they contain C─H groups that accept H-bonds from water

D) they contain O─H groups that can form multiple H-bonds with water

E) they do not form intermolecular H-bonds

Answer: D

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

36. The boiling point of water is 264°C higher than the boiling point of methane because \_\_\_\_\_\_.

A) the molecular mass of methane is much lower than that of water

B) methane molecules tend to avoid contact with each other

C) water molecules are connected to each other by H-bonds

D) methane molecules do not undergo London dispersion forces

E) all of the above

Answer: C

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

37. Hydrophobic interactions between nonpolar molecules \_\_\_\_\_\_.

A) result from the tendency of water to maximize contact with nonpolar molecules

B) are the result of strong attractions between nonpolar molecules

C) are the result of strong repulsion between water and nonpolar molecules

D) depend on strong permanent dipoles in the nonpolar molecules

E) require the presence of surrounding water molecules

Answer: E

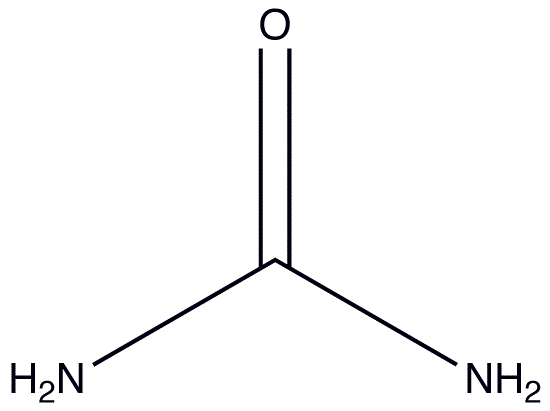
Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

38. Urea is a water-soluble product of nitrogen metabolism. How many hydrogen bonds can one urea molecule *donate* to surrounding water molecules?



A) 2

B) 3

C) 4

D) 5

E) 6

Answer: C

Difficulty: Moderate

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

39. In a hydrogen bond between a water molecule and another biomolecule, \_\_\_\_\_\_.

A) a hydrogen ion on the water molecule forms an ionic bond with a hydride ion on the other molecule

B) the partial charge on a hydrogen of the water molecule interacts with the partial charge on a hydrogen of the other molecule

C) the hydrogen bond will typically form between a hydrogen atom of the water molecule and either a nitrogen, sulfur, or oxygen atom of the other molecule

D) a hydrogen on the water molecule forms a covalent bond with a hydrogen atom on the other molecule.

E) the hydrogen atom is located between an oxygen atom of the water and a carbon atom of the other molecule

Answer: C

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

40. In an aqueous solution, if the [OH-] is 3.0 × 10-5 M, what is the [H+]?

A) 7.0 × 10-9

B) 7.0 × 10-2

C) 3.3 × 10-3

D) 3.3 × 10-10

E) none of the above

Answer: D

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

41. What is the [H+] of an aqueous solution with a pH of 6.2?

A) 6.2 × 10-6

B) 1.6 × 10-8

C) 6.3 × 10-7

D) 3. 3 × 10-5

E) none of the above

Answer: C

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

42. What would be the resulting pH if one drop (0.05 ml) of 1.0 M HCl was added to one liter of pure water (assume pH 7.0)?

A) 2.7

B) 4.3

C) 5.0

D) 7.0 (there would be no significant change)

E) 9.7

Answer: B

Difficulty: Difficult

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

43. What would be the resulting pH if one ml of 1.0 M NaOH was added to one liter of pure water (assume pH 7.0)?

A) 1

B) 3

C) 7.3

D) 11

E) 13

Answer: D

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

44. Which of the following would be the strongest acid?

A) formic acid, p*K* = 3.75

B) succinic acid, a diprotic acid with p*K* = 4.21 and 5.64

C) acetic acid, p*K* = 4.76

D) ammonium ion, p*K* = 9.25

E) cannot be determined from the given information

Answer: A

Difficulty: Easy

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

45. What is the pH of a solution that contains three parts acetic acid and one part sodium acetate? The p*K* for acetic acid is 4.76.

A) 5.24

B) 5.06

C) 4.46

D) 4.28

E) cannot be determined from the given information

Answer: D

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

46. If the p*K* values for phosphoric acid are 2.15, 6.82, and 12.38, at what pH would one observe equal amounts of H2PO4- and HPO42-?

A) 2.15

B) 4.49

C) 6.82

D) 9.60

E) 12.38

Answer: C

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

47. If the p*K* values for phosphoric acid are 2.15, 6.82 and 12.38, \_\_\_\_\_ would predominate at pH 5, and \_\_\_\_\_ would predominate at pH 10.

A) H3PO4; H2PO4-

B) H3PO4; HPO42-

C) H3PO4; PO43-

D) H2PO4-; PO43-

E) H2PO4-; HPO42-

Answer: E

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

48. What is the conjugate acid of H2PO4-?

A) HPO42-

B) H2PO4

C) H3PO4

D) PO43-

E) none of the above

Answer: C

Difficulty: Easy

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

49. Which of the following shows the buffer that is found in the bloodstream?

A) H3PO4  H2PO42- + H+

B) H2PO4-  HPO42- + H+

C) HPO42-  PO43- + H+

D) H2CO3  HCO3- + H+

E) HCO3-  CO32- + H+

Answer: D

Difficulty: Medium

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

50. If a phosphate buffer (p*K* = 6.82) was formulated such that its pH was 7.3, it would be best suited to buffer against \_\_\_\_\_. If instead, it was formulated such that its pH was 6.3, it would be best suited to buffer against \_\_\_\_\_.

A) acid; base

B) acid; acid

C) base; acid

D) base; base

E) a buffer with a pH that far from the p*K* would not be an effective buffer

Answer: A

Difficulty: Difficult

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

51. Metabolic acidosis often causes increased respiratory rates. What portion of the bloodstream buffer is lost through increased respiration?

A) H+

B) HCO3-

C) H2CO3

D) CO2

E) H2O

Answer: D

Difficulty: Easy

Section: 1.3

Learning Objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

52. Weak acids \_\_\_\_\_\_.

A) are only partially ionized in an aqueous solution

B) give solutions with a high pH

C) do not provide hydronium ions

D) are almost insoluble in water

E) are of no value in a buffering system

Answer: A

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

53. The pH of coffee is 5.6. The pH of grapefruit juice is 2.6. This means that the proton concentration in coffee is \_\_\_\_\_\_.

A) 1,000 times higher than in grapefruit juice

B) 1,000 times lower than in grapefruit juice

C) 3,000 times lower than in grapefruit juice

D) 3 times the proton concentration of grapefruit juice

E) 3,000 times higher than in grapefruit juice

Answer: B

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

54. Phosphoric acid is a polyprotic acid, with p*K* values of 2.14, 6.86, and 12.38. Which ionic form predominates at pH 9.3?

A) H3PO4

B) H2PO41−

C) HPO42−

D) PO43−

E) none of the above

Answer: C

Difficulty: Moderate

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

55. To make a phosphate buffer at pH 6.82 starting with one liter of 10 mM phosphoric acid (p*K*s are 2.15, 6.82, and 12.38), you could add \_\_\_\_\_\_.

A) 5 millimoles of HCl

B) 20 millimoles of K+

C) 25 millimoles of HCl

D) 15 millimoles of KOH

E) You can’t make a buffer by adding HCl or KOH.

Answer: E

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

56. You mix equal volumes of 0.05 M NaH2PO4 and 0.05 M Na2HPO4 (p*K*s for phosphoric acid are 2.15, 6.82, and 12.38). Which of the following best describes the resulting solution?

A) pH 2.15 and poorly buffered

B) pH 2.15 and well buffered

C) pH 6.82 and well buffered

D) pH 12.38 and well buffered

E) pH 6.82 and poorly buffered

Answer: C

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

57. What is the approximate p*K*a of a weak acid HA if a solution of 0.1 M HA and 0.3 M A– has a pH of 6.5?

A) 5.8

B) 6.0

C) 6.2

D) 6.4

E) 6.6

Answer: B

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

58. The pH at the midpoint in the titration of an acid with a base is \_\_\_\_\_\_.

A) equal to the p*K* of the corresponding acid

B) equal to the p*K* of the corresponding base

C) equal to 14 minus the p*K* of the corresponding acid

D) equal to 14 plus the p*K* of the corresponding base

E) none of the above

Answer: A

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**MULTIPLE CHOICE**

59. The capacity of a buffer to resist changes in pH upon addition of protons or hydroxide ions depends on \_\_\_\_\_\_.

A) the p*K*a of the weak acid in the buffer

B) the pH of the buffer

C) the total concentration of the weak acid and its conjugate base in the buffer

D) all of the above

E) none of the above

Answer: D

Difficulty: Easy

Section: 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.

**SHORT ANSWER**

60. Biological processes can be best understood in the context of water.

a. What effect does water have on the noncovalent interactions between either charged or polar groups/molecules?

b. Why is this effect important with respect to biochemical processes?

Answer: a. Water reduces the strength of those interactions.

b. Water reduces the strength of polar and ionic interactions. This makes those interactions reversible and life is based on reversible interaction between biomolecules.

Difficulty: Difficult

Section 1.3

Learning objective: Perform basic calculations pertaining to the chemistry of water and aqueous systems.