

# BMB 401 EXAM 1

## February 5, 2001

Please write the letter that indicates your choice to the left of the number of the question.

1. Which of the following statements best characterizes living systems.
  - a. They have a remarkable capacity for self-replication.
  - b. They contain a high abundance of iron
  - c. They are complicated and highly organized
  - d. a and c only
  - e. all of the above
2. Which of the following best describes macromolecules.
  - a. They are held together primarily by hydrogen bonds
  - b. They are bigger than organelles
  - c. They typically have an associated "sense" and directionality.
  - d. answers a and b only
  - e. answers a and c only
3. Rank the following forces in increasing order of strength.
  - a. hydrogen bonds, ionic interactions, van der Waals forces, covalent bonds
  - b. van der Waals forces, hydrogen bonds, ionic interactions, covalent bonds
  - c. ionic interactions, hydrogen bonds, van der Waals forces, covalent bonds
  - d. covalent bonds, ionic interactions, hydrogen bonds, van der Waals forces
  - e. van der Waals forces, covalent bonds, hydrogen bonds, ionic interactions

4. Which of the following is a legitimate reason for carbon being the backbone biological macromolecules?

- a. There are three isotopes of carbon: C-14, C-13, and C-12.
- b. It can form resonance structures
- c. It can form four covalent bonds.
- d. a and c only
- e. Without it, radiocarbon dating cannot be carried out.

5. When two atoms approach they attract each other until their electron clouds interpenetrate, causing strong repulsion. The most energetically favorable distance between the two atoms is best described by which of the below?

- a. Pauling radii optima
- b. The Marcus inverted region
- c. The covalent radius
- d. The dipole-dipole distance
- e. van der Waals contact distance

6. Which of the following compounds would you expect to not act as a hydrogen bond acceptor?

- a. methylamine ( $\text{CH}_3\text{NH}_2$ )
- b. ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ )
- c. acetic acid ( $\text{CH}_3\text{COOH}$ )
- d. formaldehyde ( $\text{CH}_2\text{O}$ )
- e. acetylene ( $\text{C}_2\text{H}_2$ )

7. What is the pH of a 10 mM solution of acetic acid? The pKa of acetic acid is 4.76.

- a. 4.76
- b. 2.88
- c. 3.76
- d. 3.4
- e. 5.76

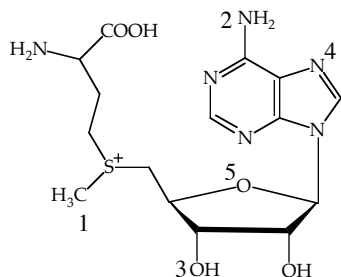
8. Which of the following peptides would absorb light centered at 280 nm?
- A-K-H
  - S-G-N
  - A-A-W
  - V-P-L
  - both a and c
9. Which of the following amino acids listed below has more than one chiral carbon?
- D
  - T
  - P
  - W
  - C
10. Which of the following L-amino acids does not have an S (R, S system of nomenclature) configuration at its alpha carbon.
- P
  - S
  - Q
  - R
  - none of the above
11. Which of the following amino acids would make the best buffer at pH 4.5?
- F
  - R
  - E
  - S
  - H
12. For the amino acids **H**, **A**, and **D**, list them in order of increasing isoelectric points.
- A, H, D
  - D, A, H
  - H, A, D
  - A, D, H
  - H, D, A

13. Calculate the pH upon diluting 2 mL of 2 M HCl to a final volume of 100 mL

- a. 1.0
- b. 1.4
- c. 1.7
- d. 2.0

14. If equal amounts of  $\text{Na}_2\text{HPO}_4$  and  $\text{Na}_3\text{PO}_4$  are mixed in water, calculate the resulting pH. The pKas of phosphoric acid are 2.1, 7.2, and 12.4

- a. ~7.0
- b. ~12
- c. ~4.5
- d. ~9.5
- e. ~2



15. For the above molecule, determine the number of chiral carbons present. In cases where only 3 atoms are bonded, assume that the remaining is a hydrogen.

- a. 0
- b. 3
- c. 4
- d. 5
- e. 6

16. In the molecule above, which of the positions cannot participate in hydrogen bonding?

- a. 1
- b. 2
- c. 3
- d. 4
- e. 5

17. Which of the following statements about atom 4 of the above molecule are true?

- a. It is a hydrogen bond donor
- b. It is an imine nitrogen
- c. It is a hydrogen bond acceptor
- d. both b and c are true
- e. none of the above are true

18. Which of the following concerning the nature of ice is false?

- a. The hydrogen bonding between  $\text{H}_2\text{O}$  molecules is strong and ordered
- b. The hydrogen bonds between  $\text{H}_2\text{O}$  molecules are highly directional
- c. Each molecule of  $\text{H}_2\text{O}$  participates in 2 hydrogen bonds
- d. The density of ice is slightly less than the density of water.
- e. All of the above are true.

19. The fluidity of  $\text{H}_2\text{O}$  at room temperature is due primarily to which of the following?

- a. The rapid interruption and formation of different hydrogen bonding patterns
- b. Its high dielectric constant
- c. It's ability to form hydration shells
- d. all of the above
- e. none of the above

20. What is the pI of arginine?
- 7.4
  - 5.6
  - 10.8
  - 7
  - none of the above
21. What is the pH of a  $2 \times 10^{-9}$  M solution of KOH?
- 8.7
  - 7.01
  - 5.3
  - 9
  - 7.5
22. An electrostatic interaction in the solvent acetone (dielectric constant 20.7) would change in what way if placed in chloroform (dielectric constant 5.0)
- It would not change at all
  - It would be 4 times greater
  - It would be infinitely less
  - It would be 2 times less
  - It would be 4 times less
23. The dissolution of NaCl in water to give a 1 M solute concentration would result in which of the following?
- Lowering of water's boiling point
  - Lowering of water's freezing point
  - Increasing of water's osmotic pressure
  - all of the above
  - b and c only
24. What is the net charge on histidine at pH 7.6
- +1
  - 1
  - 2
  - 0
  - +2

25. Predict the order of elution of amino acids **D, H, M, C, K** from an anion exchange column at pH 7.0
- K, M, C, H, D,
  - D, H, M, K, C
  - K, C, M, H, D,
  - H, M, C, K, D
  - K, H, M, C, D
26. What is the pH when 50 mL of 0.2 M NaOH is added to 200 mL of 0.2 M Acetic acid? Remember, the pKa of acetic acid is 4.76.
- 4.46
  - 4.28
  - 4.18
  - 4.76
  - 13.3
27. What is the net charge on arginine at pH 6
- 0
  - 1
  - +2
  - +1
  - none of the above
28. What is the net charge on amino acid Y at pH13
- 0
  - 1
  - 2
  - 1
  - 2
29. Which of the following is not a real one-letter code for an amino acid.
- Q
  - K
  - P
  - U
  - W

30. Which statements are correct concerning the ninhydrin reaction?
- a. Ninhydrin interacts with the carboxylate group of amino acids
  - b. 1 mole of Ninhydrin is needed per mole of amino acid to detect the color change
  - c. 1 mole of  $\text{CO}_2$  is release per mole of amino acid
  - d. leucine gives a yellow color with ninhydrin
  - e. both b and c are correct