

Biochemistry Quiz I Review Questions Fall 2019

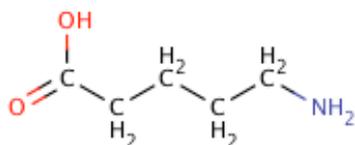
These questions are representative of material that may appear on the Quiz, but are not exhaustive. You are responsible for all material covered in class and in the textbook.

A general note: Short answer questions are just that, short. Writing a paragraph filled with every term you can remember from class won't improve your answer— just answer clearly, succinctly, and in your own words.

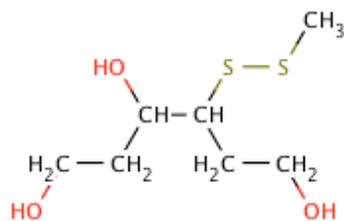
Useful information: $R = 8.315 \text{ J/mol}\cdot\text{K}$ $T = 298 \text{ K}$

Circle and identify the functional groups in the following molecules:

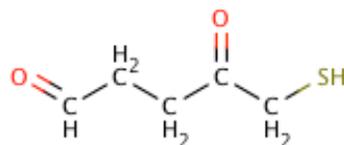
1.



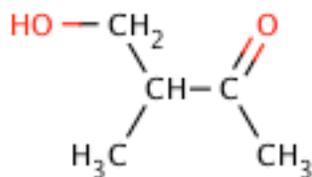
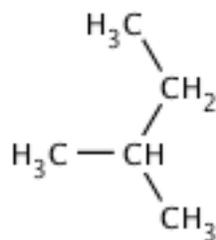
2.



3.



4. Which of the following molecules would you expect to be more soluble in water? Explain why.



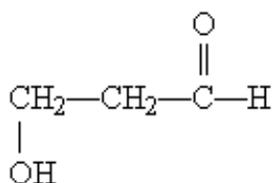
5. What is the pH of a $1.0 \times 10^{-4} \text{ M}$ solution of HBr?

6. What is the $[\text{OH}^-]$ concentration in a solution with a pH of 4.51?
7. Calculate the pH of a solution that contains a molar ratio of sodium acetate to acetic acid (pK_a 4.76) of 3:1.
8. Buffer preparation: Calculate the concentrations of potassium acetate and acetic acid (pK_a 4.76) necessary to prepare a 0.5 M buffer solution at a pH of 5.2.
9. Buffer Adjustment: Given 200 mL of a 0.5 M solution of acetic acid at pH 5.50, how much 1 M HCl must be added to change the pH to 5.0?
10. Draw an example structure that is a good electrophile, and put a star beside the electrophilic atom. Draw an example structure that is a good nucleophile, and put a # beside the nucleophilic atom.
11. What is a buffer? Why are buffers important for life?

12. Explain, in terms of bonding, why water has a higher boiling point than methane.

13. What is hydrophobic exclusion? What force(s) drive this process?

14. What functional groups are present on this molecule?



- A. ether and aldehyde
- B. hydroxyl and aldehyde
- C. hydroxyl and carboxylic acid
- D. hydroxyl and ester
- E. hydroxyl and ketone

15. Which of these statements about hydrogen bonds is *not* true?

- A. Hydrogen bonds account for the anomalously high boiling point of water
- B. In liquid water, the average water molecule forms hydrogen bonds with three to four other water molecules
- C. Individual hydrogen bonds are much weaker than covalent bonds
- D. Individual hydrogen bonds in liquid water exist for many seconds and sometimes for minutes
- E. The strength of a hydrogen bond depends on the linearity of the three atoms involved in the bond

16. The pH of a solution of 1 M HCl is:

- A. 0
- B. 0.1
- C. 1
- D. 10
- E. -1

17. The pH of a solution of 0.1 M NaOH is:

- A. 0.1
- B. 1.0
- C. 12.8
- D. 13
- E. 14

18. Which of the following is true about the properties of aqueous solutions?

- A. A pH change from 5.0 to 6.0 reflects an increase in the hydroxide ion concentration ($[\text{OH}^-]$) of 20%
- B. A pH change from 8.0 to 6.0 reflects a decrease in the proton concentration ($[\text{H}^+]$) by a factor of 100
- C. Charged molecules are generally insoluble in water
- D. Hydrogen bonds form readily in aqueous solutions
- E. The pH can be calculated by adding 7 to the value of the pOH

19. Which of the following statements about buffers is true?

- A. A buffer composed of a weak acid of $\text{p}K_a = 5$ is stronger at pH 4 than at pH 6
- B. At pH values lower than the $\text{p}K_a$, the salt concentration is higher than that of the acid
- C. The pH of a buffered solution remains constant no matter how much acid or base is added to the solution
- D. The strongest buffers are those composed of strong acids and strong bases
- E. When $\text{pH} = \text{p}K_a$, the weak acid and salt concentrations in a buffer are equal

20. How many bases are in the double-stranded DNA sequence with one-strand code ATTGTCA?

21. What nucleobase pairs with Guanine? Draw it.

22. If you heat a solution of DNA to their T_m , what fraction of it will be denatured?

23. "RNA is more flexible than proteins." Explain what might be meant by this statement.

24. In the Central Dogma of Molecular Biology, what are the three main molecular components?

25. Explain why DNA can form "hairpins".

26. What is a restriction enzyme? What function does it catalyze?

27. How is recombinant DNA inserted into bacterial cells?

28. If you started with one copy of DNA and began the polymerase chain reaction, how many copies would you have after 5 rounds of amplification?

29. Explain why Adenine and Cytosine cannot efficiently hybridize.

30. Only a small portion of our genomic DNA is translated into protein. What is the rest of the DNA for?

31. Why does a plasmid include an origin of replication (ori)?

32. How does cDNA differ from a gene in the genome?

33. Which would you expect to be larger, the % of the human genome that is translated into protein, or the % of a bacterial genome that is translated into protein. Why?

34. A major component of RNA but not of DNA is:

- A. adenine.
- B. cytosine.
- C. guanine.
- D. thymine.
- E. uracil.

35. The phosphodiester bonds that link adjacent nucleotides in both RNA and DNA:

- A. always link A with T and G with C.
- B. are susceptible to alkaline hydrolysis.
- C. are uncharged at neutral pH.
- D. form between the planar rings of adjacent bases.
- E. join the 3' hydroxyl of one nucleotide to the 5' hydroxyl of the next.

36. For the oligoribonucleotide ACGUAC:

- A. the nucleotide at the 3' end has a phosphate at its 3' hydroxyl.
- B. the nucleotide at the 3' end is a purine.
- C. the nucleotide at the 5' end has a 5' hydroxyl.
- D. the nucleotide at the 5' end has a phosphate on its 5' hydroxyl.
- E. the nucleotide at the 5' end is a pyrimidine.

37. In a double-stranded nucleic acid, cytosine typically base-pairs with:

- A. adenosine.
- B. guanine.
- C. inosine.
- D. thymine.
- E. uracil.

38. Double-stranded regions of RNA:

- A. are less stable than double-stranded regions of DNA.
- B. can be observed in the laboratory, but probably have no biological relevance.
- C. can form between two self-complementary regions of the same single strand of RNA.
- D. do not occur.
- E. have the two strands arranged in parallel (unlike those of DNA, which are antiparallel).

39. Restriction enzymes:

- A. act at the membrane to restrict the passage of certain molecules into the cell.
- B. are highly specialized ribonucleases that degrade mRNA soon after its synthesis.
- C. are sequence-specific DNA endonucleases.
- D. are very specific proteases that cleave peptides at only certain sequences.
- E. catalyze the addition of a certain amino acid to a specific tRNA.

40. A convenient cloning vector with which to introduce foreign DNA into *E. coli* is a(n):

- A. *E. coli* chromosome.
- B. messenger RNA.
- C. plasmid.
- D. yeast "ARS" sequence.
- E. yeast transposable element.

41. The PCR reaction mixture does *not* include:

- A. all four deoxynucleoside triphosphates.
- B. DNA containing the sequence to be amplified.
- C. DNA ligase.
- D. heat-stable DNA polymerase.
- E. oligonucleotide primer(s).

42. Of the 20 standard amino acids, only _____ is not optically active. The reason is that its side chain _____.

- A. alanine; is a simple methyl group
- B. glycine; is a hydrogen atom
- C. glycine; is unbranched
- D. lysine; contains only nitrogen
- E. proline; forms a covalent bond with the amino group

43. Two amino acids of the standard 20 contain sulfur atoms. They are:

- A. cysteine and serine
- B. cysteine and threonine
- C. methionine and cysteine
- D. methionine and serine
- E. threonine and serine

44. In a highly basic solution, pH = 13, the dominant form of glycine is:

- A. $\text{NH}_2\text{—CH}_2\text{—COOH}$
- B. $\text{NH}_2\text{—CH}_2\text{—COO}^-$
- C. $\text{NH}_2\text{—CH}_3^+\text{—COO}^-$
- D. $\text{NH}_3^+\text{—CH}_2\text{—COOH}$
- E. $\text{NH}_3^+\text{—CH}_2\text{—COO}^-$

45. An octapeptide composed of four repeating glycyalanyl units has:

- A. one free amino group on an alanyl residue
- B. one free amino group on an alanyl residue and one free carboxyl group on a glycy residue
- C. one free amino group on a glycy residue and one free carboxyl group on an alanyl residue
- D. two free amino and two free carboxyl groups
- E. two free carboxyl groups, both on glycy residues

46. Draw the amino acid Glutamic Acid:

47.	1	2	3	4	5
	Asp-Glu	Gly-Arg	Trp-Tyr	His-Glu	Leu-Val

Which one of the above dipeptides (1 through 5):

- (a) Is most negatively charged at pH 7?
- (b) Contains the largest number of nonpolar R groups?

48. Glycine has two dissociable protons: one with a pKa of 2.3, the other with a pKa of 9.6. Draw the structure of Glycine and indicate where these protons are attached.

49. Name the following amino acids with full name and 1 letter code:

