

log 7	= 0.84
log 8	= 0.90
log 9	= 0.95
log 10	= 1.0
log 100	= 2.0

anti log 1	= 10
anti log 2	= 100
anti log 3	= 1000
anti log -1	= 1/10
anti log -2	= 1/100
anti log -3	= 1/ 1000

Amino Acid 1- and 3-letter Codes

A	Ala	Alanine	M	Met	Methionine
C	Cys	Cysteine	N	Asn	Asparagine
D	Asp	Aspartate	P	Pro	Proline
E	Glu	Glutamate	Q	Gln	Glutamine
F	Phe	Phenylalanine	R	Arg	Arginine
G	Gly	Glycine	S	Ser	Serine
H	His	Histidine	T	Thr	Threonine
I	Ile	Isoleucine	V	Val	Valine
K	Lys	Lysine	W	Trp	Tryptophan
L	Leu	Leucine	Y	Tyr	Tyrosine

pKas of Amino Acid Functional Groups

Ionizable Group	pKa
α -COOH of any aa	3
β -COOH of Asp	4
γ -COOH of Glu	4
imidazole of His	6
SH of Cys	8
α -NH ₂ of any aa	8
phenolic OH of Tyr	10
ϵ -NH ₂ of Lys	10
guanidino of Arg	12

Unit Conversion

nM = 10⁻⁹ molar, μ M=10⁻⁶ molar, mM= 10⁻³ molar

TABLE 4.4 The genetic code

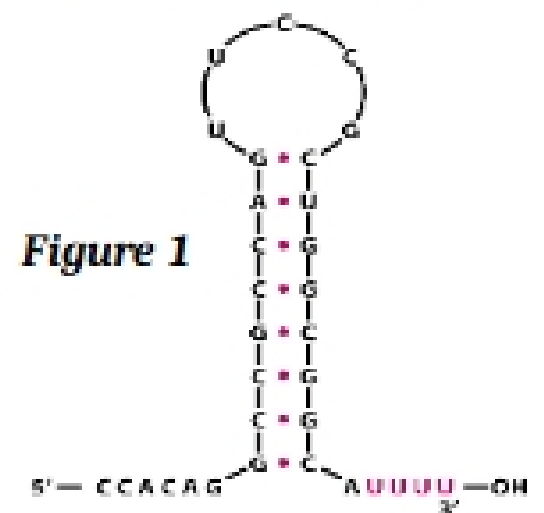
First position (5' end)	Second Position				Third position (3' end)
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

1. Please select the **true** statement:
 - a. Our bodies represent closed systems.
 - b. The energy described by: $E_{\text{system}} + E_{\text{surroundings}}$ is always a number greater than zero.
 - c. The pI of a protein is the pH at which each amino acid in the protein has no charge.
 - d. Some proteins need the assistance of chaperones to fold correctly.
 - e. Only c and d are true.
2. Please select the **true** statement:
 - a. Ionic bonds are directional.
 - b. The fatty acid tails of membrane lipids primarily associate through van der Waals interactions.
 - c. In solving for the energy present in an ionic bond, positive values of E are attractive, whereas negative values for E are repulsive.
 - d. All the statements above are true.
3. Which buffer is optimal for an enzymatic reaction if the enzyme optimal pH=5.8; Note: this reaction releases CO_2 .
 - a. Acid A, with the following pKas: $\text{pK}_{a1} = 3.2$, $\text{pK}_{a2} = 4.8$, $\text{pK}_{a3} = 9.2$
 - b. Acid B with the following pKas: $\text{pK}_{a1} = 4.1$, $\text{pK}_{a2} = 9.8$.
 - c. Acid C with the following pKas: $\text{pK}_{a1} = 6.1$, $\text{pK}_{a2} = 7.8$.
 - d. Acid D with the following pKas: $\text{pK}_{a1} = 2.0$, $\text{pK}_{a2} = 4.7$, $\text{pK}_{a3} = 8.1$.
4. The Second Law of Thermodynamics says that the entropy of the universe is constant. **True False**
5. Please select the **true** statement:
 - a. RNA is used as the template during replication.
 - b. DNA is used as a template during the transcription of proteins.
 - c. The polymerization of RNA requires ATP for energy to power the synthetic reaction.
 - d. In bacteria, like *E. coli*, splicing of mRNA does not occur.
6. Which of the following is **true**?
 - a. Carbon dioxide produced in metabolically active cells is used to make carbonic acid in red blood cells.
 - b. The heme ring is an asymmetrical prosthetic group, as the portion that is buried in the globin chain and the portion that contacts the aqueous solution are not the same.
 - c. Hemoglobin in the tense state has a lower affinity for oxygen than hemoglobin in the relaxed state.
 - d. All the above are true.
 - e. Only a and c are true.
7. The chloride shift promotes the movement of bicarbonate into red blood cells in the capillaries surrounding metabolically active tissues, by pumping Cl^- ions out of red blood cells here. **True False**
8. What is the pH of a liter of 10 mM NaOH?
 - a. 13.8
 - b. 12
 - c. Approximately 7
 - d. 2
 - e. 1.8
 - f. The correct pH is not shown here.
9. Please select the **true** statement:
 - a. Fetal hemoglobin is a tetramer of two alpha-globin chains and two beta-globin chains.
 - b. Myoglobin is primarily alpha-helix in secondary structure, and shares the tertiary and quaternary structure of hemoglobin.
 - c. Myoglobin and the globin chains of hemoglobin are homologs.
 - d. Myoglobin functions as a tetramer and shows allosteric binding kinetics.
 - e. All but a are true.

10. Please select the **true** statement:
- The proximal histidine of hemoglobin acts to limit access to the central iron ion, and prevent superoxide release.
 - When oxygen leaves the hemoglobin oxygen-binding site as superoxide, the resultant oxidation state of that iron ion in the heme molecule is 3⁺.
 - The primary function of myoglobin is to carry oxygen in the blood.
 - All of the above are true.
11. In adding amino acids to form a peptide, a peptide bond forms between the alpha amino group of the amino acid already in the chain, and the alpha carboxy group of the incoming amino acid being added. **True False**
12. In the lipid bilayer, lipids are held together by covalent bonds to form the lipid membrane. **True False**
13. In aqueous solution, polar amino acids are most commonly on the outside of a protein, while non-polar amino acids are generally buried inside the protein, away from the aqueous solution. **True False**
14. Please select the ***FALSE*** answer:
- The four elements at the highest mole percent in humans are H, C, N, O
 - Amino acids in living organisms are in the L-configuration
 - A covalent bond between two carbon atoms has a higher bond energy than the van der Waals interactions between two carbon atoms.
 - Hydrogen bonds are non-directional interactions.
15. Please select the **true** statement:
- Prolines tend to kink the peptide backbone, and are commonly found in areas where the peptide backbone changes direction, such as the beginning of an alpha helix.
 - Free alanine has a positive charge of one in aqueous solution at physiologic pH.
 - Glycine is one of the most commonly substituted amino acids in proteins because it is so small.
 - Disulfide bonds form between two cysteine residues under reducing conditions.
 - All the above are true except b.
 - Only a and d are true.
16. Select the ***FALSE*** statement:
- Alpha helices are held in position by hydrogen bonds parallel to the axis of the helix.
 - Hydrogen bonds that stabilize alpha helices form between main chain atoms 3-4 amino acids apart.
 - Peptide bonds show partial double bond characteristics
 - Beta-strands are held together by hydrogen bonds between R-groups.
 - Amino acid R-groups project outward from the alpha helices.

17. Alpha helices are right-handed helical structures that are hollow at the center of the helix. **True False.**

18. The structure in **Figure 1** is:
- Lipid
 - DNA
 - Protein
 - RNA



19. The **amino acid** sequence of a yeast protein is 80% identical to its human homolog, but the **DNA** sequences of the genes that encode these two proteins are only 65% identical. How can this be?
- Changes in amino acid sequence are tolerated more easily than changes in DNA sequence.
 - Changes in amino acid sequence rarely result in loss of function, while changes in DNA coding sequence generally does result in a change in the function of the coded protein.
 - Mutations leading to differences in DNA sequence might not lead to differences in amino acid sequence because the genetic code is degenerate.