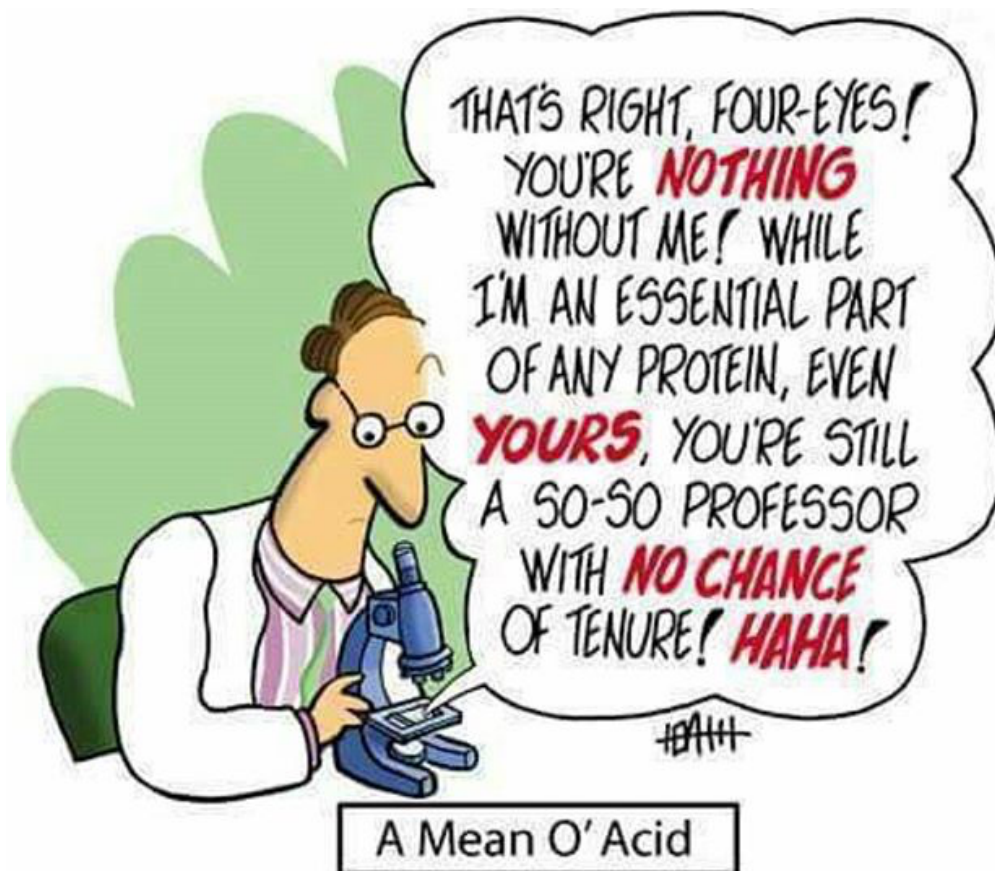


NAME KEY

Student number _____



Exam total 90 points

Multiple choice questions. *Note there may be more than 1 correct answer. Select all that are correct.*

1. A weak acid

- a. completely dissociates in water.
- b. has a conjugate acid.
- c. is predominantly protonated at pHs below the pKa.**
- d. behaves according to the Henderson-Hasselbalch equation.**
- e. none of the above.

2. At physiological pH (pH 7.4) what will the ratio of the concentration of imidazolium to imidazole be? The pKa of imidazolium salts is 7.05.

- a. 1.05
- b. 0.45**
- c. 0.35
- d. 2.24
- e. none of the above

3. Identify which answer(s) has (have) only one letter codes for amino acids containing aromatic rings?

- a. W, T, F
- b. H, N, P
- c. P, Y, W
- d. H, W, Y**
- e. none of the above

4. What is the pK_a for the alpha amino group and carboxylic acid common to all amino acids?

- a. 4.2 and 7.4
- b. 10.5 and 8.1
- c. 9.4 and 2.2**
- d. 6.0 and 9.4

5. What non-covalent force can occur between the *side chains* of Thr and Gln?

- a. electrostatic interactions
- b. London Forces**
- c. dipole-ion interactions
- d. hydrogen bonds**

/7

6. Which bases pair together in DNA?
- Guanine and Cysteine
 - Thymine and Adenine**
 - Adenine and Uracil
 - Guanine and Adenine

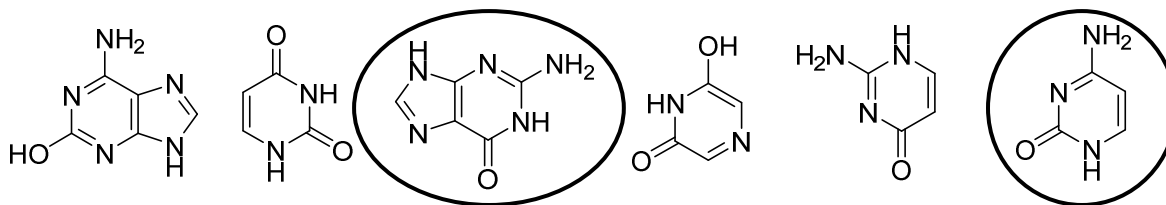
7. What is the charge on the peptide NSFC at pH 10.5?

- +2
- +1
- 0
- 1
- 2**

8. What is the charge on the peptide NCWDA at pH 7.0?

- +2
- +1
- 0
- 1**
- 2

9. Circle the aromatic compounds below that are bases normally found in DNA?



10. In the “RNA World” hypothesis:

- life was thought to evolve 6 billion years ago.
- RNA was introduced onto the primordial earth from a meteorite.
- DNA later evolved due to the instability of RNA**
- prebiotic RNA catalyzed chemical reactions**
- stated that arginine, asparagine, and alanine were the first 3 amino acids.

True or False questions. If false explain why.

11. A hydrogen bond is a covalent bond between a hydrogen atom and an empty σ^* orbital.

True

False If false, explain why.

Non colvalent bond (1/2pt) between σ^* of a polarized X-H bond and a lone pair (1pt).

12. The charge of the peptide WREK at pH 8 is 0.

True

False If false, explain why.

The charge is +1.

13. The peptide Phe-Trp-Cys-Leu-Asn-Val contains 2 beta branched amino acids.

True

False If false, explain why.

It has only 1 beta branched amino acid, Val.

14. RNA and DNA are stereoisomers of each other.

True

False If false, explain why.

They are not stereoisomers or isomers at all. They have different molecular formulas.

15. Nuclear base pairing in DNA occurs via hydrogen bonds.

True

False If false, explain why.

/10

Short Answer

11. How would you prepare 4 liters of 0.45M acetate buffer at pH 4.57 starting with a 1.5M solution of acetic acid, a 2.0M solution of NaOH, and water? The pKa for acetic acid is 4.72.

pH = pKa + log([A-]/[HA])

4.57=4.72 + log([A-]/[HA])

-0.15 = log([A-]/[HA])

5 points

0.7079 = [A-]/[HA]

0.45M = [A-] + [HA]

0.45M = 0.7079[HA] + [HA]

[HA] = 0.45/(1.7079)

[HA] = 0.263M; [A-] = 0.187M

total acetic acid in mol to add $C=n/v$ **0.45M=n/4L** **n = 1.8 mol**

Stock HA in L to add $V = n/c$ **V=1.8mol/1.5M** **Volume of 1.5M acetic acid is 1.20 L**

Amount in mol of NaOH to add = [A-]*v **=0.187M*4L** **n=0.748 mol**

Stock NaOH in L to add = n/c **.748mol/2.0M** **Volume of 2.0M NaOH is 0.374 L**

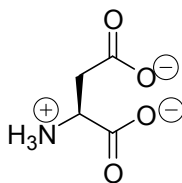
Volume of water = 4L – stock Acidic acid – stock NaOH = 4 L – 1.20 L – 0.374 L = 2.43 L

12. Order these interactions from strongest to weakest and give the relative strength of them in KJ/mol.

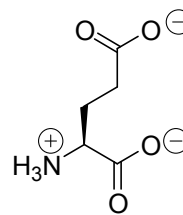
	Strongest		weakest	
Hydrogen bond	Covalent	H-bonding	London	5 pts,
London force	400 KJ/mol	10-40 KJ/mol	0.1-5 KJ/mol	
Covalent bond				

13. Draw the structure of and give the name, 3 letter code and 1 letter code for up to two amino acids that would be ideal for making a buffer at pH 4.5.

8 pts



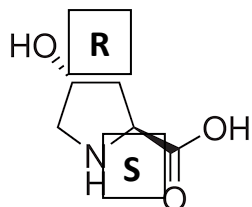
**aspartic acid
Asp, D**



**Glutamic acid
Glu, E**

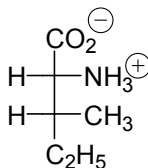
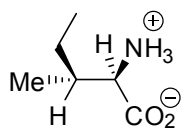
/18

14. Use the Cahn-Ingold-Prelog convention to determine the stereochemistry of the two stereogenic centers in hydroxyproline.



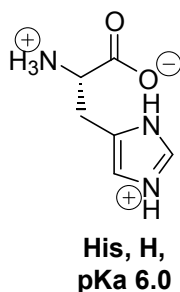
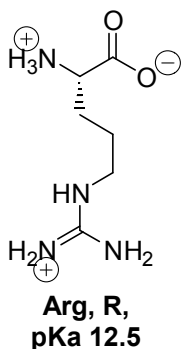
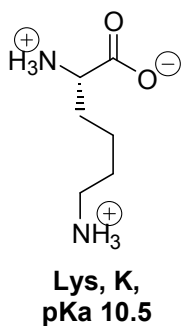
2 pts

15. Draw this amino acid in a Fischer project and determine the configuration at the alpha and beta carbons using the Fischer-Rosanoff convention.



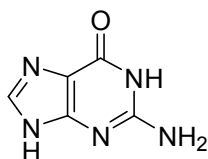
3 pts

16. Draw the structures, give the three letter codes, and give the 1 letter codes for the three charged basic proteinogenic amino acids. Provide the pKas for their side chain ionizable groups.

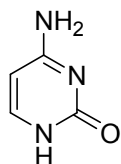


9 pts

17. Draw the structures of guanine and cytosine. Indicate if each is used in DNA, RNA or both.



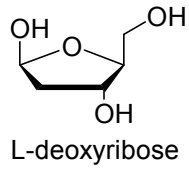
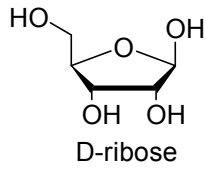
guanine, both



Cytosine, both

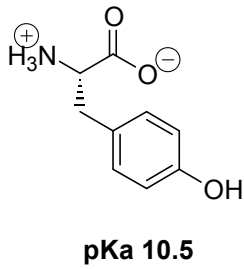
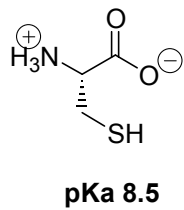
4 pts

18. Draw the sugar from RNA and the **enantiomer** of the sugar from DNA.



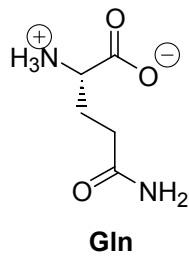
2 pts

19. Draw the 2 amino acids with ionisable side chains that are neutral at pH 5. Give the side chain pKas.



4 pts

20. What is the structure (at pH 6.0) and three letter code of the amino acid with the 1 letter code Q?



2 pts

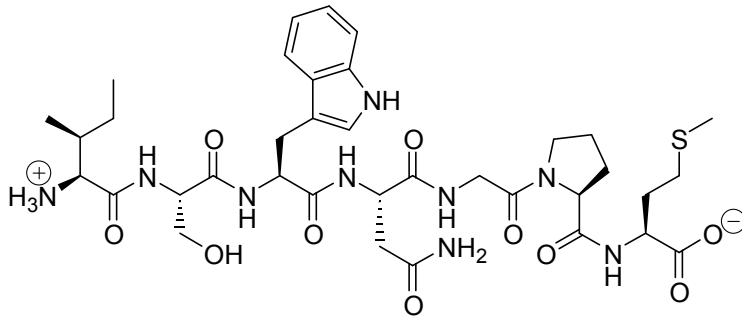
/8

Long answer

21 A. Draw the structure of the heptapeptide shown below at pH 7.4.

Isoleucine-Serine-Tryptophan- Asparagine- Glycine-Proline-Methionine

10 pts



B Give the peptide sequence using 3 letter codes

2 pts

Ile-Ser-Trp-Asn-Gly-Pro-Met

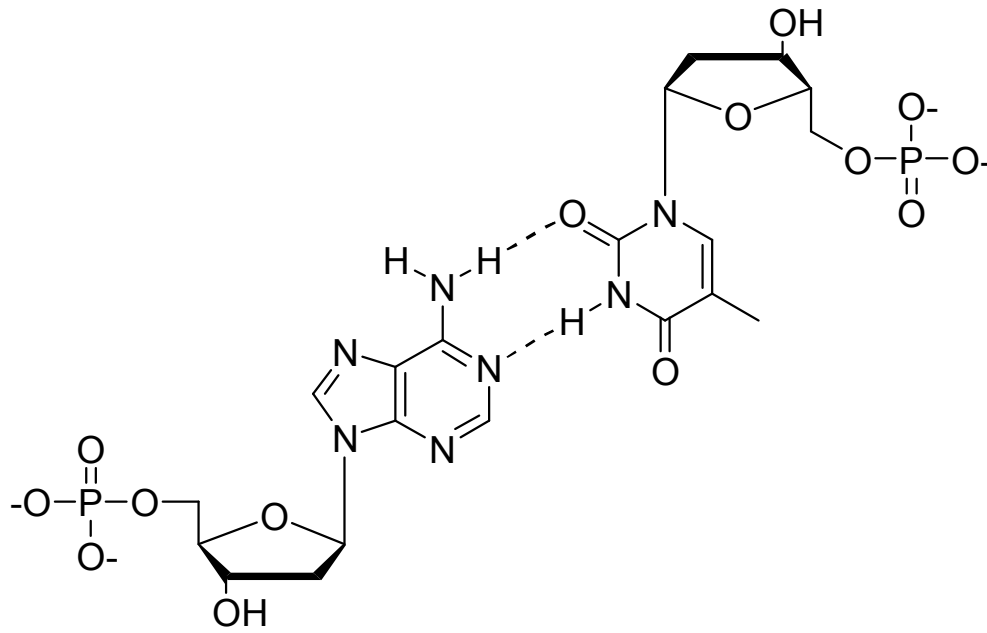
C. Give the peptide sequence using 1 letter codes.

3 pts

ISWNGPM

/15

22. Draw the structure of adenosine monophosphate hydrogen bonded to thymine monophosphate.



7 pts

/7