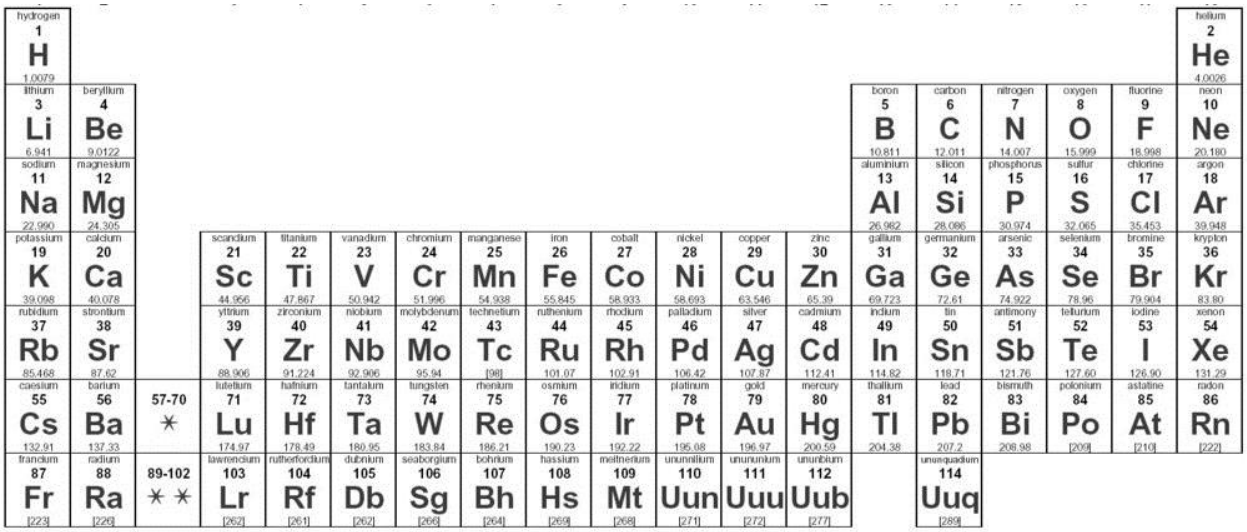
BCH2333A **Midterm 1 2016**

NAME_____**KEY**_____

Student number_____



Multiple choice questions. ***Note there may be more than 1 correct answer. Select all that are correct. 12pts***

1. A weak acid

a. completely dissociates in water.

b. is predominantly deprotonated at pHs above the pKa.

c. has a conjugate acid.

d. behaves according to the Henderson-Hasselbalch equation.

e. none of the above.

2. At pH 4.5 what will the ratio of carboxylic acid to carboxylate be for acetic acid? The pKa of acetic acid is 4.8.

a. 0.5

b. 0.3

c. 2.0

d. 3.33

e. none of the above

3. What is the pH of an aqueous solution with $[OH^-] = 3 \times 10^{-11}$ M?

a. 0.00033

b. -4.0

c. 3.8

d. 10.5

e. none of the above

4. What is the K_{eq} for this reaction $H_2CO_3 + Et_3N \rightleftharpoons HCO_3^{\ominus} + Et_3NH^{\oplus}$?

$$= \frac{[HCO_3^{\ominus}]+[Et_3NH^{\oplus}]}{[H_2CO_3][Et_3N]} \qquad = \frac{[H_2CO_3][Et_3N]}{[HCO_3^{\ominus}][Et_3NH^{\oplus}]} \qquad = \frac{[HCO_3^{\ominus}][Et_3NH^{\oplus}]}{[H_2CO_3][Et_3N]} = k_1[H_2CO_3][Et_3N]$$

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

a. electrostatic interactions

b. London Forces

c. dipole-ion interactions

d. hydrogen bonds

6. Which bases pair together in DNA?

a. Adenine and Uracil

b. Guanine and Cysteine

c. Thymine and Adenine

d. Guanine and Adenine

7. What is the charge on the peptide ACE at pH 9.0?

a. +2

b. +1

c. 0

d. -1

e. -2

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

a. +2

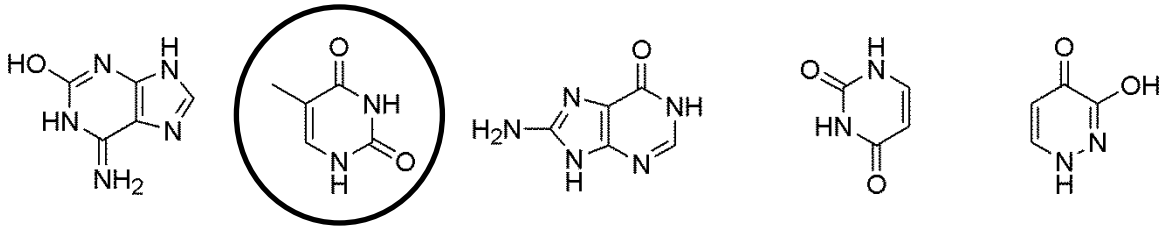
b. +1

c. 0

d. -1

e. -2

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



10. In the "RNA World" hypothesis:

a. life was thought to evolve 6 billion years ago.

b. RNA was introduced onto the primordial earth from a meteorite.

c. DNA later evolved due to the instability of RNA

d. prebiotic RNA catalyzed chemical reactions

e. stated that arginine, asparagine, and alanine were the first 3 amino acids.

True or False questions. If false explain why. 10pts

11. Hydrogen bonds are noncovalent bonds between two hydrogens covalently linked to carbon atoms.

True

False If false, explain why.

H bonds are between X-H and :X where X = N or O.

12. The charge of the peptide WRECK at pH 6 is 0.

True

False If false, explain why.

The charge is +1

13. The peptide Ser-Leu-Cys-Trp-Gln-Val contains 2 beta branched peptides.

True

False If false, explain why.

It has only 1 beta branched amino acid, Val

14. RNA and DNA are isomers of each other.

True

False If false, explain why.

Isomers have the same formula, DNA and RNA differ by a Oxygen.

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

True

False If false, explain why.

Short Answer

11. 2M Sodium bicarbonate, 2M sodium carbonate, and water are provided to make 0.250 L of a 0.2 M buffer at pH 7.4. How much of each solution and water do you need to mix together to make the desired buffer. The bicarbonate-carbonate pKa is 6.1. **5pts**

pH = pKa + log([A-]/[HA]) **7.4=6.1 + log([A-]/[HA])**

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

19.95 = [A-]/[HA]

0.2M = [A-] + [HA]

[HA]19.95 = 0.2 – [HA]

[HA] = 0.2/(1.19.95)

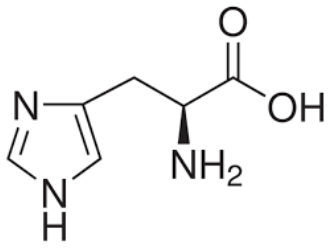
[HA] = 0.0095M; [A-] = 0.1905M

1.2 mL of 2M bicarbonate plus 23.8 mL of carbonate plus 225 mL water

12. Order these interactions from strongest to weakest and give the strength of ONE of them in either KJ/mol or kcal/mol. **3pts**

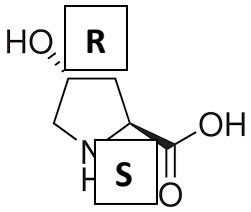
	Strongest		weakest
Hydrogen bond	**Covalent**	**H-bond**	**London**
London force	**400 KJ/mol**	**10-40KJ/mol**	**5 KJ/mol**
covalent bond	**100 kcal/mol**	**2-10kcal/mol**	**1 kcal/mol**

13. Draw the structure of and give the name, 3 letter code and 1 letter code for the amino acid that would be best for making a buffer at pH 6.5. **4pts**

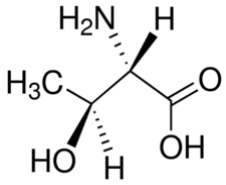


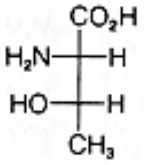
Histidine, His, H

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**





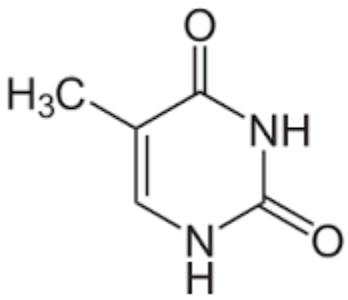
16. From this list of amino acids in 3 letter code identify which ones have ionisable side chains and place those amino acids using the 1 letters code in order from most acidic to least acidic side chains. **5 pts**

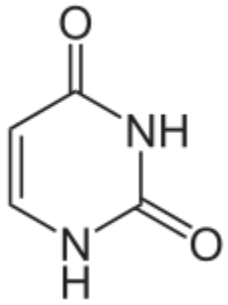
Ala, Arg, Asn, Cys, Glu, Gly, Ile, Lys, Pro, Trp

Most acidic least acidic

E C K R

17. Draw the structures of uracil and thymine. Which is used in RNA and which is used in DNA? **3 pts**

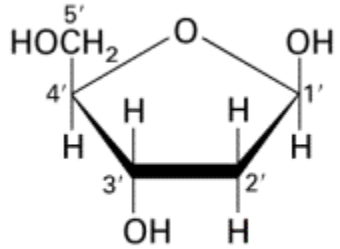




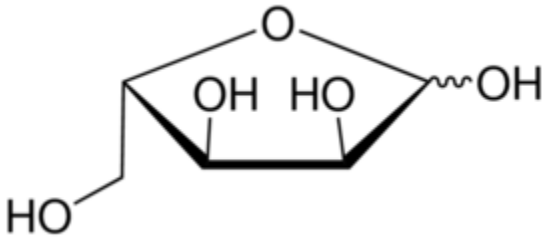
Thymine, DNA **, RNA**

A

18. Draw the sugar from DNA and the enantiomer of the sugar from RNA. **3 pts**



2-Deoxyribose

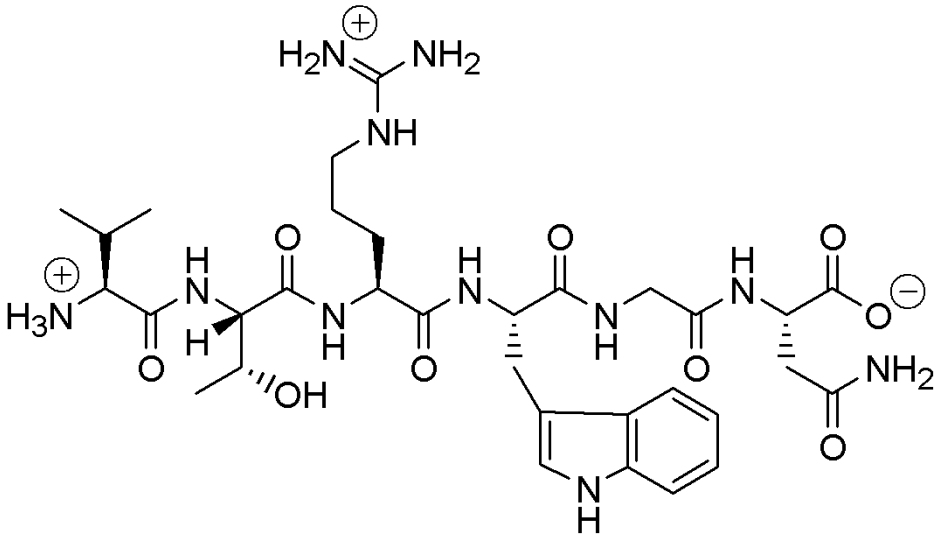


DNA RNA

Long answer

19 **A**. Draw the structure of the hexapeptide shown below at pH 6.5. **9 pts**

Valine-Threonine-Arginine-Tryptophan-Glycine-Asparagine



B Give the peptide sequence using 3 letter codes **2 pts**

Val-Thr-Arg-Trp-Gly-Asn

C. Give the peptide sequence using 1 letter codes. **3 pts**

VTRWGN

20. Draw the structure of guanosine monophosphate hydrogen bonded to cytosine monophoaphate.

6pts (don't grade the sugars and phosphates, just the bases and Hbonds)