Name:____________________ Major/Exp.Grad Year_______________S17BioE11 Biochem Midterm 3/23/17

Formal charges not necessarily drawn in given structures.

1. Evolution favors blueprints that are able to effectively compete for survival. Multicellular Eukaryotes have many advantages through specialization (on the cellular level: organelles, on the organism level: tissues). What is the major advantage of bacteria in their competition with these multicellular Eukaryotes? (*4 pts.*)

2. What three things must an organism do at a minimum to be considered living? (*6 pts.*)

3. The ability of water to form a solid (ice) that is less dense than the liquid form is critical for sustaining life on our planet. Explain, on the atomic level, why ice is less dense than water. (*5 pts.*)

4. A. Name the polymers involved in Central Dogma (*3 pts.*) and B. the cellular machinery that are involved in the information flow through Central Dogma. (*3 pts.*) Extra credit (need to get 100% correct to get any of the (*4 pts.*): What polymers are these cellular machineries made of themselves?

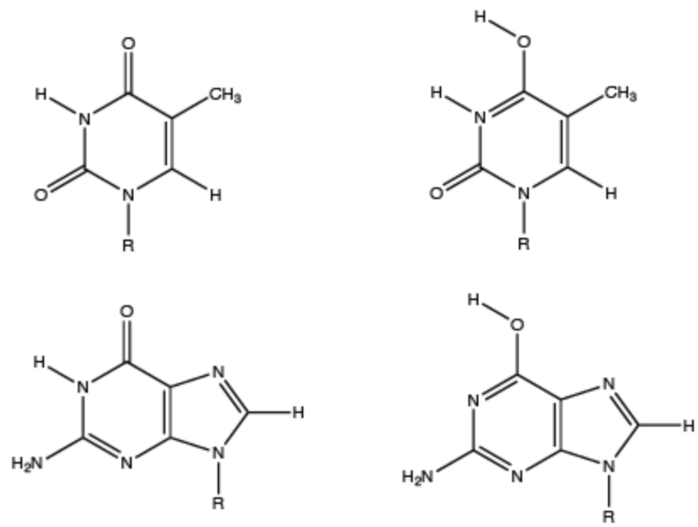
5. RNA uses uracil to base pair with adenine, whereas DNA uses thymine. What did you find in your homework assignment to explain why the cell invests additional energy to use thymines for DNA instead of also using uracil? (*6 pts.*)

6. The phosphate backbone of DNA presents a potential problem for the cell, a plethora of anionic charge in close proximity. How is this potential problem ameliorated? (*4 pts.*)

7. Watson and Crick (for whom Watson-Crick base pairing is named) had an officemate who provided a critical insight for deriving the double helix model: that both purine and pyrimidine bases are predominantly in the keto form. Circle which of the below structures is the keto form and explain why is this was a critical insight for their model? (*6 pts.*)

thymine
(a pyrimidine)

guanine
(a purine)



8. From where does the energy for driving RNA polymerization extracted/coupled? (*4 pts.*)

9. A. Peptide bond is rigid. Draw a peptide bond and explain why this bond is rigid. (*2.5 pts.*)

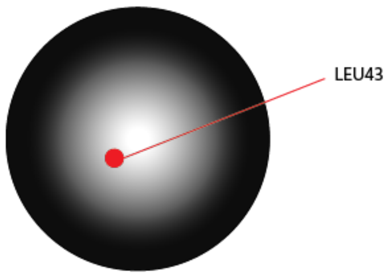
B. Draw the structure of the following peptide at pH=7: MEG (*6 pts.*)

10. What type of force is most responsible for stabilizing protein folds? (*6 pts.*)

11. Name the three things all enzymes must do to catalyze a reaction. (*7.5 pts.*)

12. Draw a plot of Free energy as a function of reaction coordinate (i.e., proceeding from starting substrate to product) with and without an enzyme to describe how an enzyme catalyzes a reaction. (*6 pts.*)

13. True or False: An Enzyme increases the fraction of product to substrate (i.e., [product]/[substrate] is greater when enzyme is added after a long period of time)? (*5 pts.*)
14. Which would you predict to be a more deleterious mutation in the below protein: LEU43ASP (leucine at the 43rd position mutated to an aspartic acid) or LEU43VAL? Explain your reasoning. (*4 pts.*)



15. Name 3 of the 4 mechanisms by which enzymes catalyze reactions. (*3 pts.*)

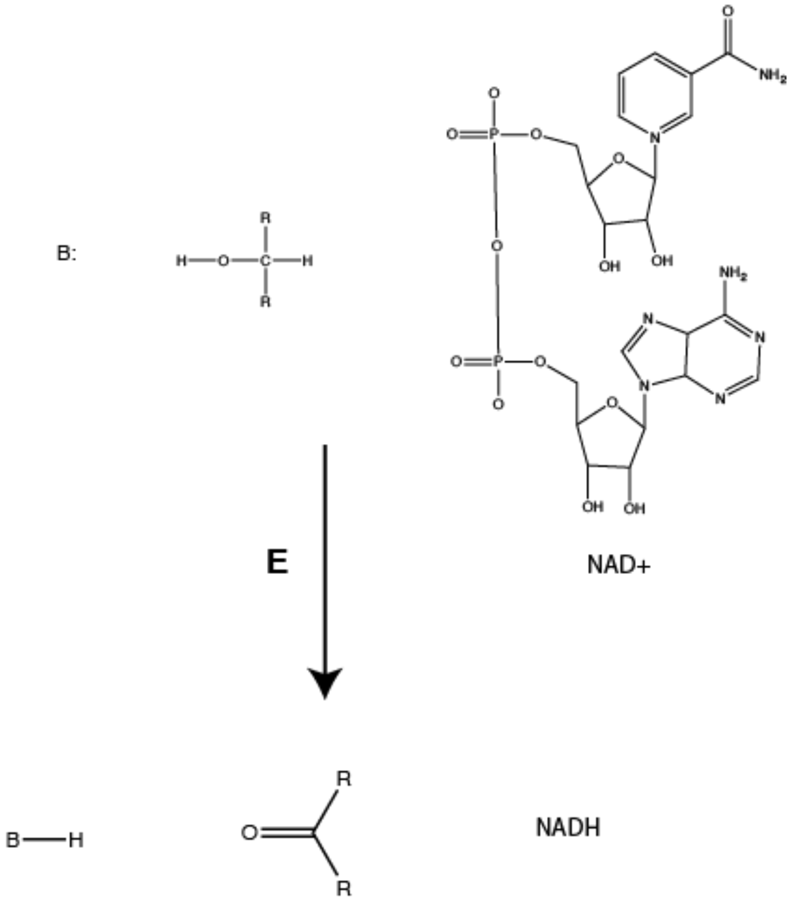
16. The following duplex DNA is transcribed right to left as printed here:

phosphate-CTGCCCTTACACAATCATTTTCATAATGCG-OH
OH-GACGGGAATGTGTTAGTAAAAGTATTACGC-phosphate

What is the resultant amino acid sequence of the polypeptide that this DNA sequence encodes assuming that translation starts at the first initiation codon (AUG)? (*7 pts.*)

17. What types of bases do you think are highly enriched in promoters (the sequences of DNA that encode for the transcription initiation site)? Hint: the limiting step of transcription is forming the initiation DNA bubble to allow RNA polymerase to bind. (*6 pts.*)

18. For the following reaction, is enzyme E an oxidase or reductase (i.e., is the substrate being oxidized or reduced)? (*3 pts.*). Draw the arrow-pushing mechanism and the structure of NADH. (*3 pts.*)



Codon Table

Seconed Position

First Position	U code	U Amino Acid	C code	C Amino Acid	A code	A Amino Acid	G code	G Amino Acid	Third Position
U	UUU	phe	UCU	ser	UAU	tyr	UGU	cys	U
U	UUC	phe	UCC	ser	UAC	tyr	UGC	cys	C
U	UUA	leu	UCA	ser	UAA	STOP	UGA	STOP	A
U	UUG	leu	UCG	ser	UAG	STOP	UGG	trp	G
C	CUU	leu	CCU	pro	CAU	his	CGU	arg	U
C	CUC	leu	CCC	pro	CAC	his	CGC	arg	C
C	CUA	leu	CCA	pro	CAA	gln	CGA	arg	A
C	CUG	leu	CCG	pro	CAG	gln	CGG	arg	G
A	AUU	ile	ACU	thr	AAU	asn	AGU	ser	U
A	AUC	ile	ACC	thr	AAC	asn	AGC	ser	C
A	AUA	ile	ACA	thr	AAA	lys	AGA	arg	A
A	AUG	met	ACG	thr	AAG	lys	AGG	arg	G
G	GUU	val	GCU	ala	GAU	asp	GGU	gly	U
G	GUC	val	GCC	ala	GAC	asp	GGC	gly	C
G	GUA	val	GCA	ala	GAA	glu	GGA	gly	A
G	GUG	val	GCG	ala	GAG	glu	GGG	gly	G

Amino Acid Table