Name_____ TA_____Section____

7.012 F'04 Problem Set 1 September 10th 2004

This completed problem set must be turned into the wooden box outside
Problem sets will not be accepted late.
Solutions will appear on the web after the due time.

Question 1

A.

a) Explain what an ion is.

b) Explain what a van der Waals force is.

c) Match the atoms and molecules listed below with the appropriate descriptive.
Choose from:

cation anion polar non-charged nonpolar non-charged

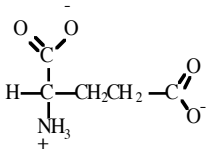
Cl^- _____

H_2O _____

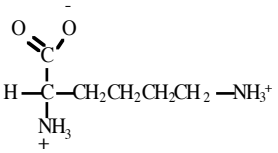
Na^+ _____

CH_4 _____

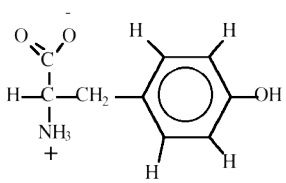
d) Circle the "side chain" in each of the amino acids given below.



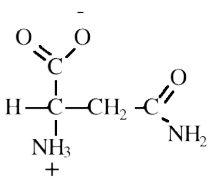
GLUTAMIC ACID



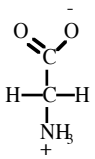
LYSINE



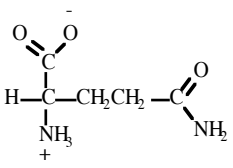
TYROSINE



ASPARAGINE



GLYCINE



GLUTAMINE

e) Check the following terms to describe the side chains of the amino acids you circled above.

Side Chain of…	Charged	Non Charged	Polar	Non Polar	Hydrophobic	Hydrophilic
Glutamic Acid						
Lysine						
Tyrosine						
Asparagine						
Glycine						
Glutamine						

f) Explain why ethane (C_2H_6) is a non-polar molecule while ethanol (C_2H_5 - OH) is a polar molecule. (A diagram of each molecule may help.)

B.

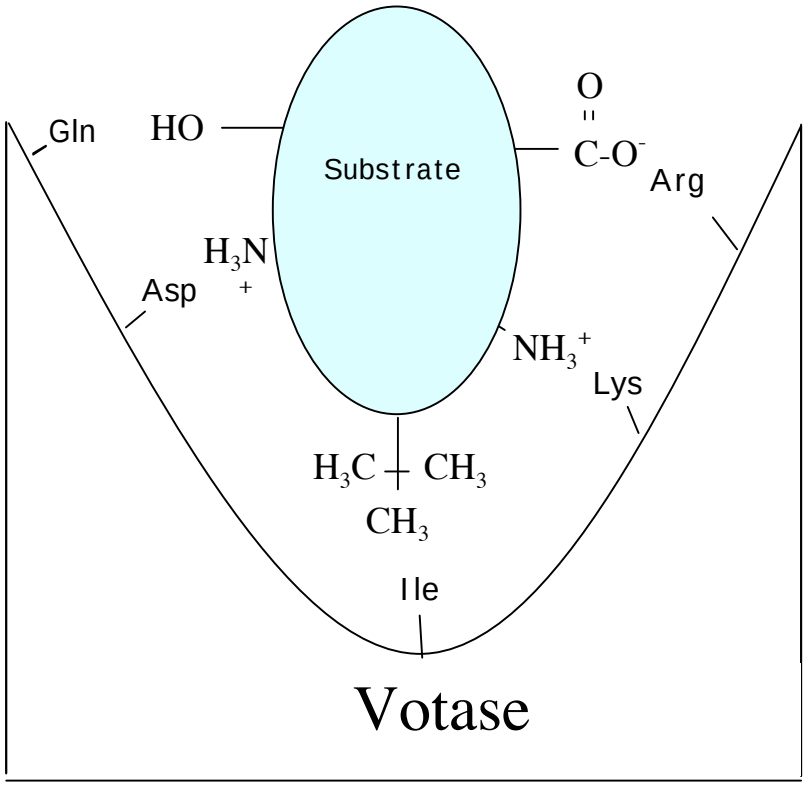
a) What are two main differences between prokaryotic cells and eukaryotic cells?

b) Match the letter of the organelle on the left with the function or characteristic on the right.

Complex or Organelle		Function or Characteristic
a. Mitochondria	____	Site of lipid synthesis; where hydrophobic toxins→ water soluable and thus excretable
b. Nucleus	____	Digests macromolecules and degrades worn-out organelles
c. Smooth Endoplasmic Reticulum	____	Catalyzes protein synthesis
d. Golgi Apparatus	____	Contains all genomic DNA in eukaryotic cell
e. Lysosome	____	Uses sunlight to build sugar
f. Ribosome	____	Where ribosomal RNA is made
g. Chloroplast	____	Prepares proteins for export from the cell
h. Nucleolus	____	Powerhouse of the cell; where the Krebs Cycle occurs

Question 2

One day in lab while studying your favorite enzyme, Votase, you discover the following potential interactions that could occur between this amazing enzyme and its substrate of choice.



a) At each site between the chemical group on the substrate and the closest side chain of an amino acid on Votase determine if a favorable interaction is likely to take place. If a favorable interaction is likely to take place, give the name for the strongest direct intermolecular interaction. Choose from ionic interaction, covalent bond, hydrogen bond, and van der Waals force.

Amino Acid	Will a favorable interaction take place? Circle one.	If yes, Name the Strongest Interaction ionic interaction, covalent bond, hydrogen bond, or van der Waals force.
Gln	Yes/No	
Asp	Yes/No	
Ile	Yes/No	
Lys	Yes/No	
Arg	Yes/No	

b) For all cases where a potential interaction seemed unfavorable, explain why.

Question 3

a) In your continuing work with the enzyme votase you discover that the enzyme is also a transmembrane protein (part of the protein crosses the lipid bilayer of the cell). Circle the portion of the sequence below that you would expect to be the transmembrane region of the protein.

$+NH_3$ - glu - trp - asp - arg - his - asp - phe - glu - ser - gly – pro - thr - phe -

ile - trp - leu - ile - trp - leu - val - ile - ala – val - leu - phe - leu - leu - ile -

trp – ala - val - leu – arg - pro - gly - cys - ser - lys - ala - tyr - ala - lys -- val

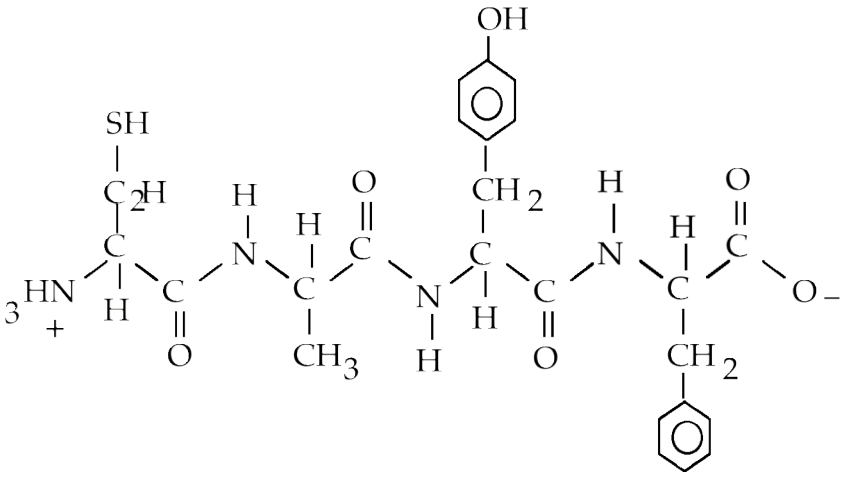
- cys - ala - gly - cys - ser - asp - lys - gly - glu - COOH

b) Why will the section you circled be embedded in the membrane?

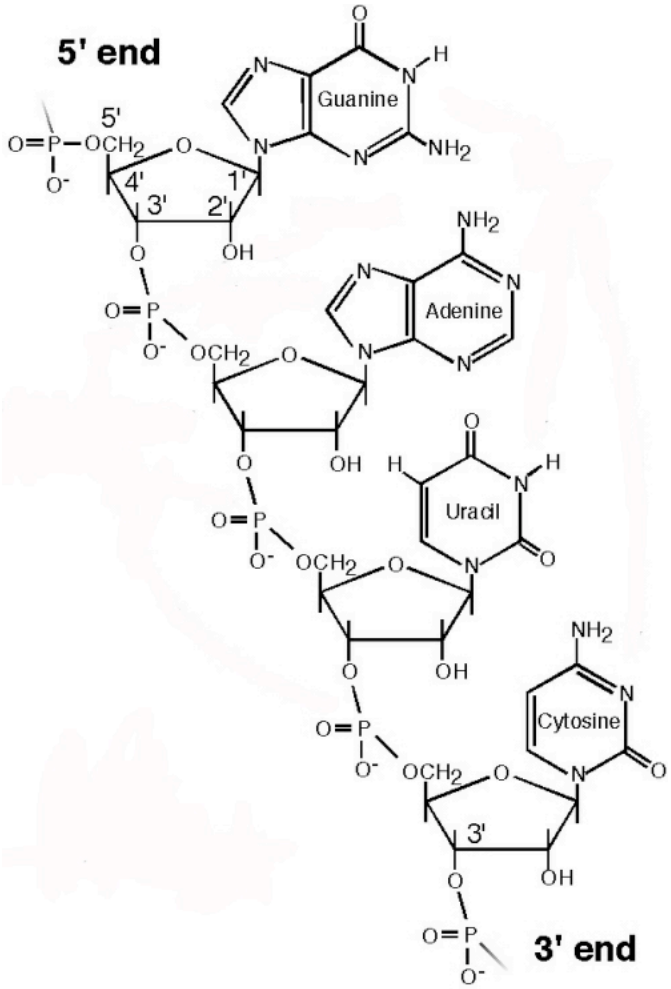
c) Draw a schematic of the phospholipid bilayer. Label the lipid hydrocarbon chains, phosphate hydrophilic heads, and water.

Question 4

a) In the peptide below, circle the peptide bonds. What are the amino acids in this peptide?

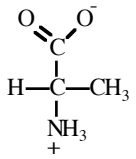


b) What is the name of the macromolecule below? _____

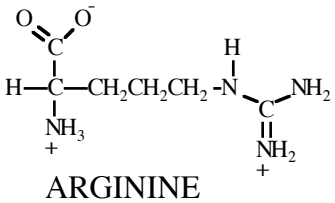


c) What is the chemical difference between the pentose sugar in DNA and the pentose sugar in RNA? (See page 48 in text book.)

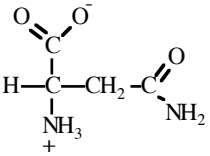
STRUCTURES OF AMINO ACIDS at pH 7.0



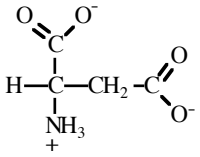
ALANINE
(ala)



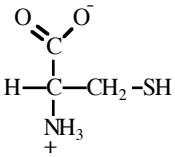
ARGININE
(arg)



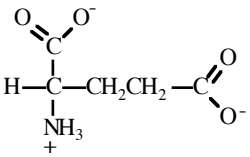
ASPARAGINE
(asn)



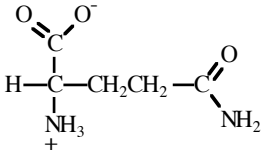
ASPARTIC ACID
(asp)



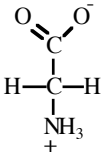
CYSTEINE
(cys)



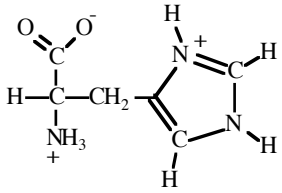
GLUTAMIC ACID
(glu)



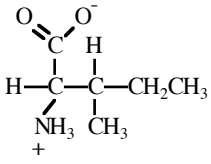
GLUTAMINE
(gln)



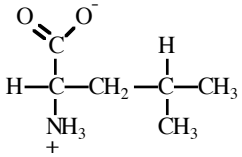
GLYCINE
(gly)



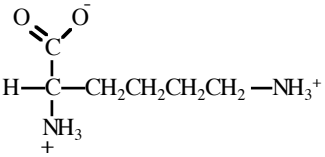
HISTIDINE
(his)



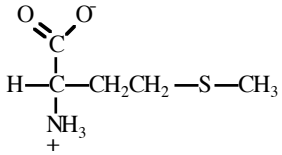
ISOLEUCINE
(ile)



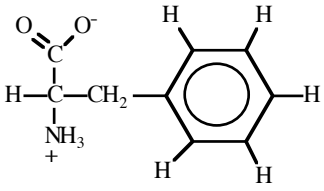
LEUCINE
(leu)



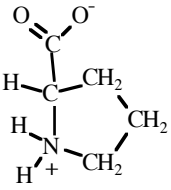
LYSINE
(lys)



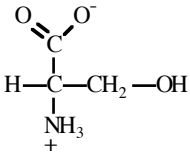
METHIONINE
(met)



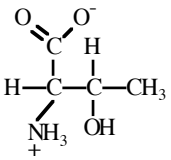
PHENYLALANINE
(phe)



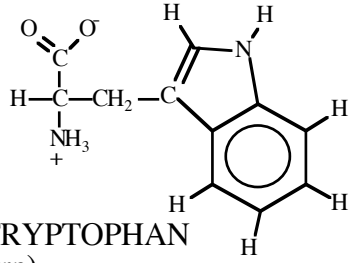
PROLINE
(pro)



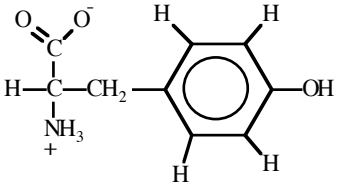
SERINE
(ser)



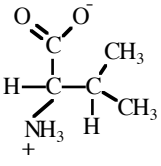
THREONINE
(thr)



TRYPTOPHAN
(trp)



TYROSINE
(tyr)



VALINE
(val)