Name: _____

Chem 462 - Biochemistry
Hour Exam III

Nucleic acids

1. (15 points) Draw the structure of an Adenine and Uracil hydrogen bonded to each other in a Watson-Crick Base pair.

Look at page 332, figure 10-11 for this answer

2. (15 points) Most people know about the three dimensional structure of DNA, so what can you tell me about the three dimensional structure of **RNA**.

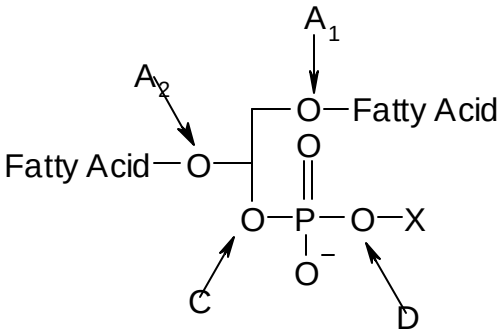
Under perfect conditions RNA will form a single stranded right handed helix that would look like DNA with on strand removed. However this structure is not very stable. The purine base stacking is stronger than the pyrimidine base stacking interaction so the purines tend to start stacking on top of each other leaving the pyrimidines out of the helix. Further, if there is any self-complementarity, double stranded helixes will form wherever they can, further destroying the single helix.

T-RNA and ribozymes have a sophisticated 3-D structure in which double stranded regions are mixed with non-Watson-Crick base pairing to create well defined stable structures. A molecule like t-RNA will appear to have a clover-leaf like secondary structure, but has an V-like tertiary structures, so the correspondence between secondary and tertiary structure can be minimal.

Lipids

3A. The venom of the Eastern Diamondback rattler contains phospholipase A_2, which catalyzes the hydrolysis of fatty acids at the C-2 position of glycerophospholipids.

(10 points) Make a diagram of a generic glycerophospholipid, and show on this molecule the actions of the phospholipases, A_1, A_2, C, and D.

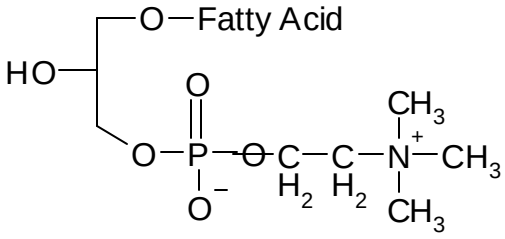


B. One of the major components of red blood cell membranes is phosphatidyl choline. When the venom phospholipase A_2 acts on this molecule the product, called lysophophatidyl choline acts as a detergent to dissolve the red blood cell membrane. The resulting hemolysis is one of the life-threatening effects of the venom.

(5 points) What is the structure of Choline?

$HO\text{-}CH_2\text{-}CH_2\text{-}N^+(CH_3)_3$

(5 points) Make a diagram of the resulting lysophosphatidyl choline. Why would this molecule act like a detergent?



The fatty acid would act as a long polar tail, while the OH,PO_4^- and $N^+(CH_3)_3$ would act as a strongly polar head group that would be typical of a detergent.

(5 points) The pain and swelling of the snakebite may be treated with certain steroids. What is the basis of this treatment?

Pain and swelling typically due to release of prostaglandins by the cell. Steroid drugs like Prednisone and Prednisolone act by inhibiting the release of arachidonate by phospholipase A2 form the cellular membrane, thus stopping the synthesis and release of the prostaglandins.

(5 points) While the snake uses large amounts of phospholipase A_2 as a weapon to kill critters, most animals already have a phospholipase A_2 built into their cells. Why do cells already have a built-in phospholipase A_2?

All cells membranes are constantly being degraded and reformed, so all cells have to have phopholipases present for the degradation process. Further, as seen in the answer above, the first step in the synthesis of eicosanoids depends on the release of arachadonic acid form the 2 position in membrane phospholipids, and this relese depends on the presence of phospholipase A_2.

Membranes

Since everyone seems to be getting the flu...

4. (15 points) Explain how the influenza virus gets its DNA into a cell. If possible provide a diagram showing the steps in this process and explain what this process has to do with membrane fusion

Diagram like figure 12-21 page 407

1. Virus adheres to carbohydrates (sialic acid) on the cell surface via hemagglutinin on virus surface
2. Cell does endocytosis to pull virus into the cell inside an endosome
3. pH within endosome is lowered as cell attempts to digest it's contents
4. Low pH triggers change in hemagglutinin structure to expose a short hydrophobic fusion peptide
5. Peptide serves to fuse virus membrane with endosome membrane
6. As part of fusion process the contents of the virus, including its genetic material is dumped into the cell cytoplasm.

5. (15 points) Explain the model given in the text of how the Glucose $GluT_1$ transporter is supposed to work. How is this similar to or different from the way the Na^+/K^+ ATPase transporter works.

$Glu\ T_1$
Facilitated diffusion
No E
Diagram like figure 12-27 page 412
Protein opens to exterior, binds a Glu
Conformation changes
opens to interior releases Glu
Conformation changes opens to exterior

Na^+/K^+
Active transport
ATP used to phosphorylate Enzyme
Diagram like figure 12-34 page 421
Opens to interior, binds 3 Na^+
Phosphorylation changes conformation
Opens to exterior, release Na, binds 2 K
dephophorylation causes conformation change
Now opens to interior

6.The third step of the glycolytic pathway is the reaction:

Fructose-6-phosphate + ATP → fructose 1,6-Bisphosphate + ADP $\Delta G^{o'}$ = -14.2 kJ/mole

In this reaction we are coupling an unfavorable reaction:

Fructose-6-phosphate+ P → fructose 1,6-Bisphosphate

With the very favorable reaction:

ATP→ADP + Pi $\Delta G^{o'}$ =-30.5 kJ /mole

In order to get the fructose phosphorylated

(10 points) Determine the Δ**G°' and the** K_{eq} for the unfavorable reaction:

Fructose-6-phosphate+ P → fructose 1,6-Bisphosphate

From the above information at 25°C .

Let's call

Fructose-6-phosphate + ATP → fructose 1,6-Bisphosphate + ADP	Rxn1
Fructose-6-phosphate+ P → fructose 1,6-Bisphosphate	Rxn2
ATP→ADP + Pi $\Delta G^{o'}$ =-30.5 kJ /mole	Rxn3

You should see that rxn1 = rxn2 + rxn3, or

rxn 2 (the one we want) = rxn1-rxn3

So do the same with the $\Delta G^{o'}$

$\Delta G^{o'}_{rxn2} = \Delta G^{o'}_{rxn1} - \Delta G^{o'}_{rxn3}$

$= -14.2 - (-30.5) = +16.3$ kJ/mol

$\Delta G^{o'} = -RT \ln K$

But you have to change the ΔG from kJ to joules and the temp to K before you start

16,300 J = -8.314 (298) lnK

-6.58=lnK

$e^{-6.58} = K$

K=.0014