Name ___Key___

Chem 452 - Fall 2012 - Hand-in Assignment 1

Read Watson and Crick's 1953 article in *Nature* (Watson and Crick 1953)[1] and answer the following questions. Hand in your answers on Monday, 14. September, 2012.

1. In their article, Watson and Crick report being scooped in their effort to be the first to describe a structural model of deoxyribose nucleic acid (DNA).
   a. Who was the person who scooped Watson and Crick? Linus Pauling (& Corey)

   2/2

   b. Give the citation for the article written by the person identified above:

   2/2

   Pauling, L., and Corey, R. B. (1953) A Proposed Structure For The Nucleic Acids, *Proceedings of the National Academy of Sciences 39*, 84 –97.

   c. What were the two reasons given by Watson and Crick for why they felt that the model described in the above cited article was incorrect?
      i. Watson & Crick believe that the DNA is in the charged basic (salt) form instead of the neutral acid form. They could not see how the negatively charged phosphate groups could be packed tightly in the center of the the structure as proposed by Pauling and Corey

      2/2

      ii. They also stated that some of the van der Waals distances were too small, which means that Pauling and Corey's structure contained some atoms that were bumping into one another.

      2/2

2. What is the physical interpretation for the "van der Waals distance", and what defines it?
   Due to the induced-induced dipole interaction (London dispersion force) that all molecules experience with other molecules, all molecules are weakly attracted to one another. The strength of this attractive interaction increase as $1/r^6$ as two molelcules approach one another. However, at some point, as they approach one another, their electron cloads will begin to overlap, which will produce a strong repulsive interaction that increases as $1/r^{12}$ and quickly overcomes the attractive interaction. The combination of the two forces creates a free energy well that defines the distance appart that two molecules prefer to be with respect to one another. This distance is the "van der Waals distance"

   4/4

3. In words, describe Watson and Crick's proposed structure and how this structure well suits is function. (Use the back to give your answer. You may attach additional sheets if necessary, but keep in mind that Watson and Crick's Nobel Prize-winning article is only one page long.)
   As the repository of genetic information within a living cell, the DNA molecule must be able replicate faithfully so that upon cell division, each daughter cell will obtain a complete copy of the genomic information that is stored withing the DNA structure. Watson & Crick's model had this information stored as a linear sequence of nucleotide bases strung together along a phosphate-ribose backbone. Moreover, their model contained two such strands, which intertwined with one another and ran in opposite directions to each other to form a double helix. The nucleotide sequence on the two strands is not identical, but rather complementary, with an adenine purine nucleotide on one strand always pairing, through hydrogen bonding, with a thymine pyrimidine nucleotide on the other strand, and likewise the guanine purine nucleotide always pairing with a cytosine pyrimidine nucleotide. During cell division, the two strands separate from one another, but each contains the information required to regenerate the complementary strand. In Watson and Cricks's words, "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possbile copying mechanism for the genetic material."

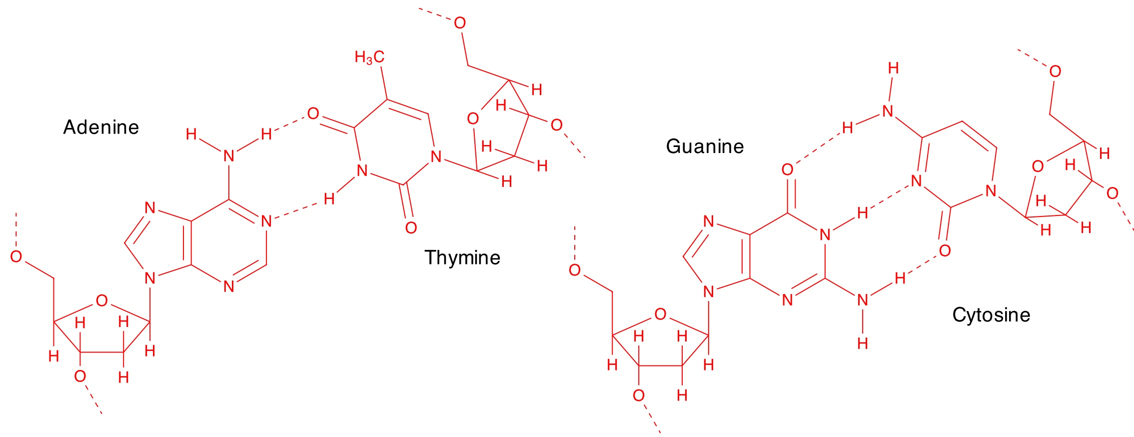
   6/6

---

1. Watson, J. D. and F. H. Crick (1953). "Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid." Nature **171**(4356): 737-738.

4. Draw chemical structures showing the base pairing that Watson and Crick proposed to explain the observations made by Erwin Chargaff

4/4



a.

b. What were Erwin Chargaff's observations?

3/3

Chargaff determined the relative quantities of the nucleotides from different organisms. He observed that the ratio of purines to pyrimidines was always 1:1. He also observed that regardess of the relative ratios of A to G or C to T, that the ratio of A to T was always 1:1, as well as the ratio of G to C. These observations helped to define the base pairing relationships for the DNA molecule.

25/25