Solutions to Practice Problems for Biochemistry, Session 3: Macromolecules: Lipids, Carbohydrates, Nucleic Acid

Question 1

The following structure is found in many biological systems.

\[
\begin{align*}
\text{H}_2 \text{H}_2 \text{H}_2 \text{H}_2 \text{H}_2 \text{O} \\
\text{H}_2 \text{C} \text{C} \text{C} \text{C} \text{C} \text{C} \\
\text{H}_3 \text{C} \text{C} \text{C} \text{C} \text{C} \text{C} \\
\text{O} \text{C} \text{C} \text{C} \text{C} \text{C} \text{C} \\
\text{O} \text{P} \text{O} \text{O}^- \\
\text{O} \text{P} \text{O} \text{O}^- \\
\end{align*}
\]

a) Name the molecule diagramed above. *Phospholipid*

b) Where are these molecules found in a living cell, and what purpose do they serve?  
*They are found as the major component in the cell membrane*

c) This molecule is sometimes drawn like this:

- If you were to add many of these molecules to a glass of water shown below, draw one of three configurations these molecules would assume.

\[
\begin{align*}
\text{bilayer} \\
\text{micelle} \\
\text{vesicle} \\
\end{align*}
\]

- What is the name of your configuration? *See label above*

d) Explain briefly why these molecules form the structure you have drawn.

*Phospholipids are amphipathic, i.e., they are molecules with two different ends. The polar end with the phosphorous and oxygen is hydrophilic and associates with the aqueous environment. The non-polar end composed of hydrocarbons is very hydrophobic and to excludes water.*

d) Explain briefly why these molecules form the structure you have drawn.
e) Another class of biological polymers contains phosphate. Draw another biological molecule that contains phosphate.

![ATP molecule]

f) What is the function of this molecule?

The two nucleic acids, DNA and RNA have different functions. DNA is the storage form of genetic material for most organisms. RNA is a molecule involved in the transfer of information from DNA to protein. ATP, which is drawn above, is a building block of RNA. ATP is also used as energy currency in the cell.

Question 2

Below is a segment of a cellulose molecule. A microfibril of cellulose is composed of about 80 molecules that lie parallel to each other and close together.

![Cellulose molecules]

What type of bond holds the parallel fibers together?

Hydrogen bonds between the hydroxyl groups attached to the carbon atom 3 on one molecule and carbon atom 6 on the adjacent molecule.
Question 3

a) Is the following a polymer of DNA or RNA? Explain how you can determine this.

*This is DNA because the 2' carbon is lacking a hydroxyl (DNA = deoxyribonucleic acid) and one of the bases is thymine not uracil.*

b) Which of the following arrangements is possible in an RNA molecule? The small lines \( \text{|||} \) represent hydrogen bonds.

*Arrangement A and B are possible because they maintain the anti-parallel direction of the two strands forming hydrogen bonds. Arrangement C is not possible because the two strands forming hydrogen bonds are parallel to each other.*