SECTION III - ANSWERS

UNIT A - THE CHEMISTRY OF LIFE

CONCEPT CHECK-UP QUESTIONS:

A.1

1. An organic molecule is one that contains carbon.
2. A polar covalent bond is a bond between atoms that is formed by the unequal sharing of electrons.
3. H-bonding is caused by the attraction between opposite dipoles. H-bonding results in cohesion among water molecules.
4. Water's solvation properties are important to life because organisms contain a lot of water and the water transports dissolved particles. Blood plasma, for example, is mostly water.

A.2

1. An acid releases H^{1+} when in solution; a base releases OH^{1-} (which reduces the amount of free H^{1+}) when in solution.
2. Water is neutral because it dissociates to release H^{1+} and OH^{1-} in equal numbers therefore the pH remains at 7.0 (neutral).
3. A solution with a low pH is more acidic than one with a high pH.
4. Bicarbonate ions are buffers in blood. They resist pH changes.

A.3

1. Dehydration synthesis is the building of larger molecules from monomers involving the release of water. Hydrolysis is the opposite, namely the degradation of polymers into their components requiring the addition of water.
2. Lipids do not form true polymers because there is a limit to the number of monomers of lipids that can be combined together.
3. When monomers are bonded together, the bond forms between an atom that has a hydrogen atom attached to it and one that has a hydroxide group attached to it. When the bond forms, these attachments must be released. Their combination forms water.
4. Glucose is made in photosynthetic plant cells and used either for energy (by mitochondria), stored as starch, or used to build structural molecules like cellulose, which is used to make cell walls. In animals, glucose is a product of digestion and used for energy or stored in liver tissue in the form of glycogen.

A.4

1. Lipids are molecules that do not mix with water. They are essentially non-polar molecules, where water molecules are polar.
2. Fatty acids from animal tissues tend to be (more) saturated and therefore more solid at room temperature. Fatty acids from plant tissues, such as vegetable oils, are unsaturated and less solid.
3. Glycerides can vary in terms of the number and placement of the fatty acids on the glycerol backbone, the length of the fatty acids, and the nature of the fatty acids (saturated vs. unsaturated).
4. Steroids and waxes are lipids that do not contain glycerol.

A.5

1. Amino acids have an amino group (terminus, or end) and a carboxylic acid group, both of which are attached to a central carbon, creating the N-C-C backbone. To the central carbon atom are attached a hydrogen atom and an "R" group.
2. A peptide bond is a strong covalent bond. Peptide bonds join amino acids together.
3. The two conformations (shapes) of secondary structure in proteins are the α-helix and the β-pleated sheet. Each is caused by a difference in the way that H-bonding occurs between nearby amino acids during the formation of the protein.
4. The hydrogen bonds that help maintain tertiary structure are the weakest in the molecular structure and, therefore break first when conditions are altered. This results in denaturation.

A.6

1. DNA nucleotides contain the sugar, deoxyribose; where RNA nucleotides contain ribose. As well, the base thymine does not exist in RNA. It is replaced by uracil, a very similar pyrimidine.
2. Size is the most obvious difference. Purines are larger, composed of two ring structures; Pyrimidines are single-ring structures.
3. Chromosomes are comprised of DNA and small protein complexes, known as histones.
4. The P~P bonds in ATP are high-energy bonds, but they are weak bonds, meaning they can be formed and broken readily. When they are broken, releasing P and generating ADP, the bond energy is freed and can be used by the cell. When additional energy is available to the cell, ATP can be regenerated for future use.

MULTIPLE CHOICE QUESTIONS:

1. C	6. D	11. B	16. B	21. D	26. A	31. D	36. C	41. B
2. D	7. D	12. C	17. C	22. B	27. C	32. B	37. C	42. C
3. D	8. A	13. B	18. C	23. C	28. C	33. A	38. B	43. A
4. D	9. C	14. A	19. C	24. B	29. B	34. C	39. C	
5. D	10. C	15. B	20. D	25. C	30. A	35. B	40. D	

WRITTEN ANSWER QUESTIONS:

1. a. A water molecule consists of one atom of oxygen and two atoms of hydrogen bonded together by polar covalent bonds. Oxygen is the central atom. The molecule is bent, and the bonding electrons are shared unequally – used primarily by oxygen, which gives oxygen a negative dipole and leaves the hydrogen atoms with positive dipoles.
   b. The polarity of the molecules allows them to form hydrogen bonds with other water molecules. The presence of the hydrogen bonds and the fact that water is so abundant provides the unique properties.
   c. Water is significant in cells because it:
      a) has a high specific heat capacity, which means that takes a lot of energy to change the temperature of water. This is important for organisms because chemical reactions that are part of metabolism are temperature sensitive.
      b) is cohesive with other water molecules and, as such, moves through blood vessels as a continuous fluid transporting nutrients and cells around the body.
      c) Is a solvent for inorganic substances, therefore it transports ions as well as (non-polar) molecules that will not dissolve in it.

2. Acids and bases differ primarily in the amount of free hydrogen ions that are in their respective solutions. If there is more free hydrogen ions than OH^{1-} then the solution is called acidic (acids release hydrogen). If there are less free hydrogen ions, then the solution is called basic (alkaline). Bases often release ions, which combine with hydrogen, thus reducing the amount of hydrogen in the solution. Increasing the amount of hydrogen lowers the pH. pH is the negative logarithm of the hydrogen ion concentration.