# Topic 1:  Chemistry of Life Answer key

Level 1

1. B
2. C
3. A
4. D
5. A
6. B
7. C
8. D
9. D
10. C
11. B
12. C
13. B
14. B
15. D
16. C
17. B
18. C

Level 2

1. D
2. A
3. B
4. D
5. D
6. D
7. C
8. D
9. A

Grid in

1. 92
2. 10,000

FRQ

to pH 2 is a change of 4 units, $10 \times 10 \times 10 \times 10 = 10{,}000$. Since from pH 6 *more* hydrogen ions, the sign is positive and does not need to be recorded in your response. If you had been asked to compare pH 2 to pH 6, there are 10,000 fewer $H^+$ ions in a solution with pH 6.

*Questions*

(a) A phospholipid molecule contains a hydrophilic "head" (containing a glycerol molecule and a phosphate group) and two hydrophobic fatty acid tails. In cell membrane surfaces, phospholipids are arranged in a bilayer in which the hydrophilic heads are in contact with the cell's watery interior and exterior, whereas the tails are pointed away from water and toward each other in the interior of the membrane. The fatty acid chains of phospholipids can contain double bonds, which makes them unsaturated. Because of the kinks in the tails, phospholipids aren't packed together tightly, which contributes to the fluidity of the membrane. The fluidity of the cell membrane is very important in its function; the less fluid the membrane is, the more impermeable it is. There is an optimum permeability for the cell membrane at which all the substances necessary for metabolism can pass into and out of the cell.

The fluidity of cell membranes enables hydrophobic molecules such as hydrocarbons, carbon dioxide, and oxygen to dissolve in the bilayer and easily cross the membrane. However, ions and polar molecules (including water, glucose, and other sugars) cannot readily pass through because of the hydrophobic interior. Protein channels and transport proteins allow these required substances to cross membranes.

**(b)** If all the fatty acid chains of phospholipids were saturated, no "kinks" would occur in the phospholipids resulting in membranes that would be less fluid. At very low temperatures, this would lead to plant membranes with drastically reduced fluidity. The loss of fluidity would make the movement of essential nutrients across the membrane much less efficient, which could lead to the death of the plant.

**(c)** There are numerous functions of proteins in the membrane. One important function is that some proteins protrude on the extracellular side of the membrane and serve as receptors for signaling molecules. A second function is seen with proteins that extend through the interior of the bilayer and serve as channels for the passage of molecules or ions that cannot pass through the phospholipids.

**(d)** Receptor proteins have regions or domains that are made up of unique amino acids to bind only specific ligands. The specificity of amino acid sequences makes this possible.

Transport proteins may act as channels for molecules and ions that cannot pass through the phospholipid bilayer. Ligands that bind to transport proteins can help alter their conformation to permit the passage of molecules through them and into the cell interior.

*This response shows thorough knowledge of the processes of the structure of phospholipids, cell membrane structure and components, and movement across membranes. A strong response to this item requires an understanding of topics from Units 1 and 2 of the textbook.*

*The student's response could have used other protein functions, including specific examples of cell-cell signaling or enzymatic function.*