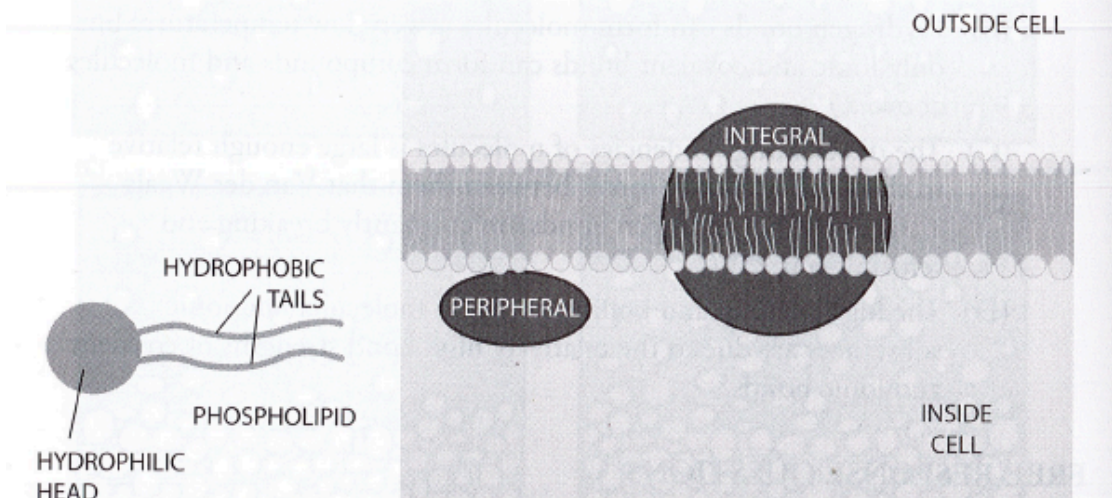


Questions 150–153 refer to proteins. Proteins are polymers of amino acids that take on three-dimensional shapes due to complex folding of the amino acid chain. The 20 amino acids that are used to make proteins can be classified by the chemistry of their R-groups. They can be classified as polar, nonpolar, positively charged, negatively charged, neutral, basic, or acidic. Many R-groups fall into more than one category.

- 150. Propose** an explanation of how weak forces such as Van der Waals and hydrogen bonding can impart stability to large molecules like proteins.
- 151. Draw** a diagram representing the three-dimensional folding of an amino acid chain.
Identify three types of interactions between the amino acids in the chain that contribute to the three-dimensional shape.
- 152.** Enzymes are biological catalysts. They are typically proteins (see question 150) that have a groove or port with a specific shape to which a specific substrate binds. **Propose** a mechanism by which substrates can reversibly bind to an enzyme and **explain** how the conversion of substrate to product allows the release of the product from the active site.

Question 153 refers to the following information regarding proteins in cell membranes.

Cell membranes are composed of a bilayer of phospholipids arranged with their hydrophobic tails facing each other and their hydrophilic heads outward facing the aqueous intracellular and extracellular fluids (shown below).



Integral membrane proteins are embedded in the bilayer with parts of the proteins facing the aqueous compartments of the tissue and parts that interface with the phospholipid tails. Peripheral proteins interact with the phospholipid heads.

- 153. Propose** an explanation of protein structure that accounts for the ability of proteins to form stable, three-dimensional shapes in solution and in membranes, both peripherally and embedded (integral). Only the specific structural features that allow the protein to exist in their specific environments need to be addressed.
- 154.** Use the data that follows to **explain** why water is a liquid but ammonia is a gas under standard conditions. Include in your explanation:
- A structural comparison
 - A mechanism based on intermolecular attractions
 - A thermodynamic comparison. Assume the average kinetic energy of molecules at 25° C is 2.5 kJ mol⁻¹.

Polar bond •••hydrogen bond••• atom in another molecule	Strength of hydrogen bond (kJ mol ⁻¹)	Length of hydrogen bond (nm)
O-H ••• N	29	0.29
O-H ••• O	21	0.27
N-H ••• N	13	0.31
N-H ••• O	8	0.29

Formula	NH ₃	H ₂ O
Molar mass (g mol ⁻¹)	17.031	18.015
Boiling point (°C)	-33.340	100.000
Melting point (°C)	-77.730	0.000
Molecular shape	Trigonal pyramidal	Bent