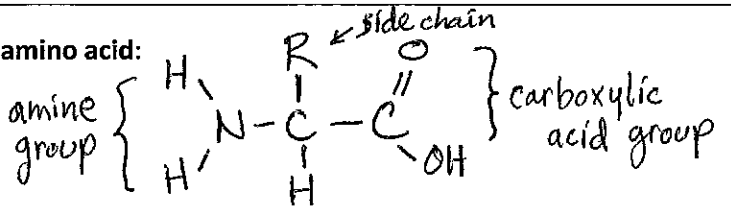
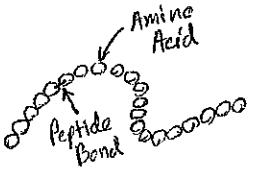
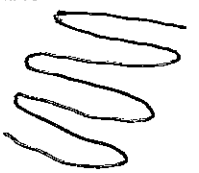
**IB Biology:** Proteins & Enzymes Review (2.4, 2.5, & 7.3) NAME: KEY

1. Draw a generalized **amino acid**:




2. Explain the four levels of protein structure:

| | Primary (1°) | Secondary (2°) | | Tertiary (3°) | Quaternary (4°) |
|---|---|---|---|---|---|
| What is it? | Sequence of amino acids | Folding of amino acid chain into α helix or β sheet | | 3D folded structure | Two or more globular proteins |
| What bonds hold it in place? | Peptide bonds (from condensation) | Hydrogen bonds | | Ionic<br>Hydrogen<br>Disulfide<br>Van der Waals ←→ | |
| Simple drawing |  | Alpha (α)-helix  | Beta (β)-pleated sheet  |  |  |





3. Explain how changes in pH and temperature lead to **denaturation** of proteins:

Denaturation occurs when environmental factors disrupt protein structure and, as a result, impair their function. Hydrogen ion changes associated with pH can disrupt ionic / Hydrogen protein bonds. Increased molecular motion associated w/ high temps. can also destroy structure.

4. Outline the significance of these structures in the R-groups (side-chains) of amino acids (think about what type of bonds they might form in either secondary or tertiary structures).
   - *Polar R-groups:* Hydrogen bonding
   - *Non-polar R-groups:* Hydrophobic interactions / Van der Waals forces
   - *Positively or negatively charged R-groups:* Ionic bonds
   - *Sulphur-containing R-groups:* Disulfide bonds

5. Compare fibrous and globular proteins:

| | Fibrous | Globular |
|---|---|---|
| ***What does it look like?*** | long, thin, linear | round, spherical |
| ***Solubility*** | no | yes |
| ***Functions*** | structural | functional |
| ***Examples*** | collagen, keratin, myosin, actin | hemoglobin, rubisco, immunoglobulin, catalase |

6. Proteins are used on the plasma membrane and for other diverse functions. Complete the table below:

| Protein Function | Example | What does it do? |
|---|---|---|
| Gas / Nutrient Transport | Hemoglobin | Binds oxygen molecules to red blood cells |
| Catalyst / Enzyme | Catalase | Breaks down toxic hydrogen peroxide in cells |
| Immunity / Defense | Immunoglobulin / Antibodies | Marks pathogens for immune system attack |
| Hormones | Insulin | Lowers blood-glucose levels |
| Structure / Tensile Strength | Collagen | Builds up skin, bone, and other tissues |
| Movement / Muscle Contraction | Myosin / Actin | Muscle fibers that contract |
| DNA Packaging | Histones | Super-coil DNA to package into chromosomes |

7. Complete the table describing the functions of the six specific protein example, below:

| Protein Example | Function |
|---|---|
| Rubisco | Fixes carbon from $CO_2$ as glucose in photosynthesis. |
| Insulin | Triggers uptake of glucose by cells, lowering blood sugar. |
| Immunoglobulin (Antibodies) | Marks pathogens for destruction by immune system. |
| Collagen | Most common structural protein. Builds bone, skin, etc. |
| Rhodopsin | Light receptor in eye cells that sends signals to brain. |
| Spider silk | Fibrous protein with incredibly high tensile strength. |

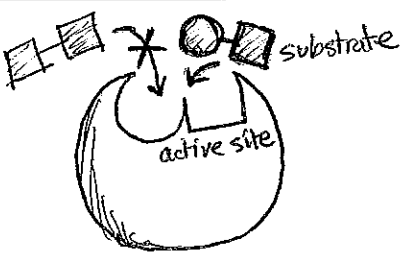
8. Define the following:

| | |
|---|---|
| **enzyme** | *"globular protein which acts as a catalyst for biological reactions"* |
| **active site** | Part of enzyme structure where the substrate binds |
| **denaturation** | The deterioration of a protein's structure |

9. List three examples of enzymes, with their functions.
   - Catalase – breaks down hydrogen peroxide
   - Lactase – digest lactose to glucose and galactose
   - Amylase – digests starch

10. Explain *enzyme-substrate specificity*. Include a diagram:

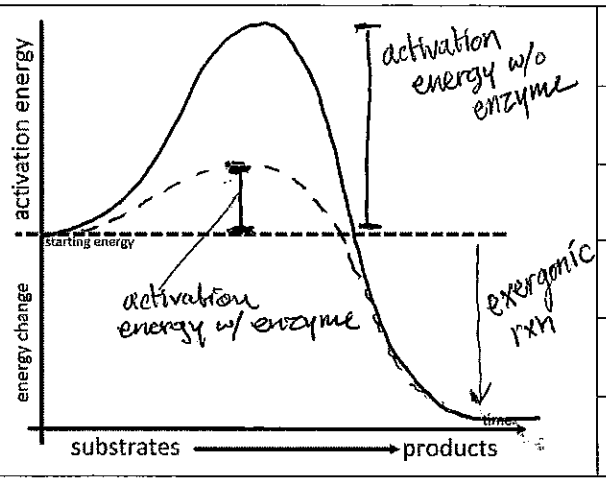
Due to the shape/structure of the active site, each enzyme will only catalyze/work with specific types of substrates




11. State the function of *polar regions* of amino acids on the active site of the enzyme.

Polar amino acid side chains help attract substrates to active site

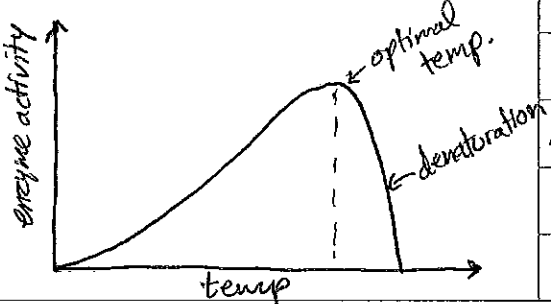
**12.** Explain the lowering of *activation energy* by enzymes.




enzymes lower activation energy by bringing substrates into proximity of one another in the proper orientation. lower activation energy allows the reaction to proceed much faster

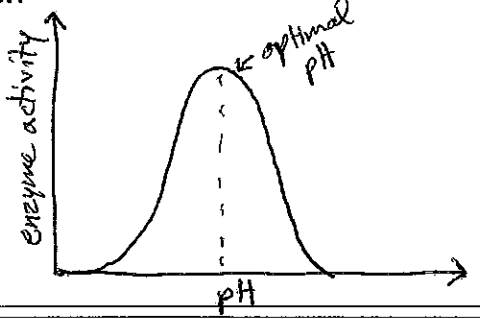
**13.** Explain the effects of temperature, pH and substrate concentration on the rate of an enzyme-controlled reaction. Draw a sample graph in the space on the left and then explain/ describe on the right:

**Temperature**



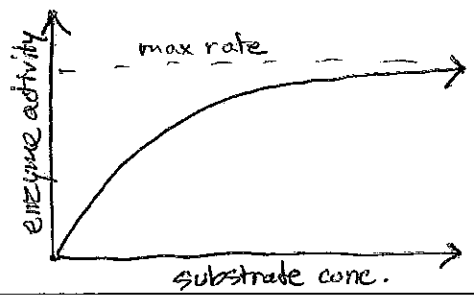

- At low temps, may not be enough energy for reaction to occur.
- Increasing temp increases enzyme-substrate collisions and reaction rate/ activity until extreme heat causes denaturation

**pH**



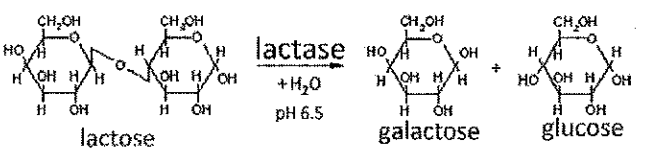

- enzymes all have optimal pH levels — variation from optimal pH will reduce activity and eventually cause denaturation

**Substrate concentration**




- Increasing substrates increases frequency of collisions + enzyme activity
- Eventually a max rate is reached when active sites are saturated by substrates.

**14.** Explain the industrial production of lactose-free milk, including two advantages of lactose-free milk:




Milk is poured through immobilized lactase enzymes to make lactose-free milk. Lactose-free milk is sweeter and makes a creamier ice cream since glucose/galactose are sweeter sugars and do not crystallize the same way as lactose