

## NCERT Exemplar Solutions of Class 11 Biology – Chapter 9: Biomolecules

### SHORT ANSWER TYPE QUESTIONS

1. Medicines are either man-made (i.e., synthetic) or obtained from living organisms like plants, bacteria, animals etc. and hence the latter are called natural products. Sometimes natural products are chemically altered by man to reduce toxicity or side effects. Write against each of the following whether they were initially obtained as a natural product or as a synthetic chemical:

- Penicillin \_\_\_\_\_
- Sulfonamide \_\_\_\_\_
- Vitamin C \_\_\_\_\_
- Growth Hormone \_\_\_\_\_

**Solution:** a. **Penicillin** - Natural product (obtained from fungus *Penicillium notatum*) b. **Sulfonamide** - Synthetic product c. **Vitamin C** - Natural product d. **Growth Hormone** - Natural product

**Enhanced Explanation:** Penicillin was discovered by Alexander Fleming from the mold *Penicillium notatum*. Sulfonamides were among the first synthetic antibiotics. Vitamin C occurs naturally in citrus fruits and many vegetables. Growth hormone is naturally produced by the pituitary gland.

2. Select an appropriate chemical bond among ester bond, glycosidic bond, peptide bond and hydrogen bond and write against each of the following:

- Polysaccharide \_\_\_\_\_
- Protein \_\_\_\_\_
- Fat \_\_\_\_\_
- Water \_\_\_\_\_

**Solution:** a. **Polysaccharides** – Glycosidic bond, formed by elimination of water molecule b. **Protein** - Peptide bond, it is the -CO-NH- bond formed by elimination of water molecules c. **Fats** - Ester bond, derived from an acid in which at least one -OH (hydroxyl) group is replaced by an -O-alkyl (alkoxy) group d. **Water** - Hydrogen bond, formed between the hydrogen of one water molecule and oxygen of another water molecule

**Enhanced Explanation:**

- Glycosidic bonds link monosaccharides in polysaccharides
- Peptide bonds connect amino acids in proteins through dehydration synthesis
- Ester bonds form between fatty acids and glycerol in lipids
- Hydrogen bonds provide water's unique properties and molecular cohesion

3. Write the name of any one amino acid, sugar, nucleotide and fatty acid:

**Solution:**

- Amino acid** - Glycine

- **Sugar** - Glucose
- **Nucleotide** - Adenosine monophosphate (AMP)
- **Fatty acid** - Oleic acid

**Enhanced Explanation:** These represent fundamental biological molecules: glycine is the simplest amino acid, glucose is a primary energy source, AMP is a nucleotide building block of RNA, and oleic acid is an unsaturated fatty acid common in many organisms.

**4. The reaction given below is catalysed by oxidoreductase between two substrates A and A'. Complete the reaction: A reduced + A' oxidized →**

**Solution:** A[reduced] + A'[oxidized] → A[oxidized] + A'[reduced]

**Enhanced Explanation:** Oxidoreductases catalyze redox reactions where one substrate is oxidized (loses electrons) while another is reduced (gains electrons). The enzyme facilitates the transfer of electrons, hydrogen atoms, or oxygen atoms between the substrates.

**5. How are prosthetic groups different from co-factors?**

**Solution:** Cofactors are non-proteinaceous, may be organic or inorganic constituents of enzymes. Prosthetic groups belong to organic cofactors and remain tightly bound with apoenzymes.

**Enhanced Explanation:** Cofactors are essential non-protein helpers for enzyme function and can be:

- **Inorganic ions** (like  $Mg^{2+}$ ,  $Zn^{2+}$ )
- **Organic molecules** (coenzymes) Prosthetic groups are a specific type of organic cofactor that are covalently or very tightly bound to the enzyme, such as heme in hemoglobin or FAD in certain enzymes.

**6. Glycine and Alanine are different with respect to one substituent on the  $\alpha$ -carbon. What are the other common substituent groups?**

**Solution:**  $-COOH$ ,  $-NH_2$ , and  $-H$  are the common substituents.

**Enhanced Explanation:** All amino acids share the same basic structure around the  $\alpha$ -carbon:

- **$-COOH$**  (carboxyl group)
- **$-NH_2$**  (amino group)
- **$-H$**  (hydrogen atom)
- **$-R$**  (variable side chain - H in glycine,  $CH_3$  in alanine)

**7. Starch, Cellulose, Glycogen, Chitin are polysaccharides found among the following.**

**Choose the one appropriate and write against each:**

Cotton fibre \_\_\_\_\_

Exoskeleton of cockroach \_\_\_\_\_

Liver \_\_\_\_\_

Peeled potato \_\_\_\_\_

**Solution:**

- **Cotton fibre** - Cellulose [more than 90%]
- **Exoskeleton of cockroach** - Chitin
- **Liver** - Glycogen
- **Peeled potato** - Starch

**Enhanced Explanation:** Each polysaccharide serves different functions:

- **Cellulose:** Structural support in plant cell walls
- **Chitin:** Structural component in arthropod exoskeletons
- **Glycogen:** Energy storage in animal liver and muscles
- **Starch:** Energy storage in plant tissues like tubers

**SHORT ANSWER TYPE QUESTIONS**

1. Enzymes are proteins. Proteins are long chains of amino acids linked to each other by peptide bonds. Amino acids have many functional groups in their structure. These functional groups are, many of them at least, ionisable. As they are weak acids and bases in chemical nature, this ionization is influenced by the pH of the solution. For many enzymes, activity is influenced by the surrounding pH. This is depicted in the curve below, explain briefly.



**Solution:** The dependence of enzyme on pH is due to the presence of charged amino acids at its active site. pH variation causes changes in the charge of amino acids. The enzymatic activity decreases when pH is less than or greater than the optimum pH.

**Enhanced Explanation:**

- **Enzyme structure is pH-sensitive** because amino acid side chains can be protonated or deprotonated
- **Active site geometry** changes with pH, affecting substrate binding
- **Optimum pH** represents the condition where the enzyme has its most favorable conformation
- **Extreme pH values** can denature the enzyme by disrupting ionic interactions and hydrogen bonds
- **Different enzymes** have different optimal pH ranges (e.g., pepsin works best at pH 2, while trypsin prefers pH 8)

**2. Is rubber a primary metabolite or a secondary metabolite? Write four sentences about rubber.**

**Solution:** Rubber is a secondary metabolite because of its unknown function in plant physiology.

- It is obtained from plants as an exudate which is sticky
- Rubber is used for synthesizing tyre, eraser etc.
- It provides protection against herbivores and pathogens
- Natural rubber is a polymer of isoprene units

**Enhanced Explanation:** Secondary metabolites are not directly involved in growth, development, or reproduction but often serve defensive or attraction functions. Rubber latex serves as a defense mechanism against insects and herbivores while also sealing wounds in plants.

**3. Schematically represent primary, secondary and tertiary structures of a hypothetical polymer say for example a protein.**



**Solution:** [The document includes a detailed diagram showing:]

**Primary Structure:** Linear sequence of amino acids connected by peptide bonds (represented as a beaded chain)

**Secondary Structure:** Local folding patterns including:

- **$\alpha$ -helix:** Right-handed spiral structure
- **$\beta$ -pleated sheet:** Extended strand arrangements

**Tertiary Structure:** Three-dimensional folding pattern of the entire polypeptide chain due to side chain interactions

**Enhanced Explanation:**

- **Primary structure:** Determined by genetic code, forms the foundation for all higher structures
- **Secondary structure:** Stabilized by hydrogen bonds between backbone atoms
- **Tertiary structure:** Stabilized by various interactions including hydrogen bonds, disulfide bridges, ionic interactions, and hydrophobic effects
- **Quaternary structure (not shown):** Multiple polypeptide chains associating together