1. Explain the amphoteric properties of amino acids. Write the appropriate reactions.

2. Classify the amino acids: Arg, Val, Met, Asp, Tyr, Ser. Give the definition of:
   - Essential amino acid
   - Non-essential amino acid

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<th>Arg</th>
<th>Val</th>
<th>Met</th>
<th>Asp</th>
<th>Tyr</th>
<th>Ser</th>
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<td>Essential</td>
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<td>Non-essential</td>
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<td>Hydrophobic (nonpolar)</td>
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<td>Hydrophilic (polar, neutral)</td>
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<td>Acidic</td>
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<td>Basic</td>
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3. Give the definition of the isoelectric point (pI) of an amino acid.
   Write the structure of ionized forms of alanine (pI=6.11) at different pH values: at pH=pI, at pH below pI and above pI.
The chemical reactions of amino acids and peptides

4. Describe the structure and properties of the peptide bond. Write the tautomeric forms of a peptide bond.

5. Draw a structural formula for tripeptide: Asp-Tyr-Ser. Mark each peptide bond, the N-terminal amino acid, and the C-terminal amino acid?

6. Explain the differences between the primary structure of a protein and its amino acid composition.

7. All amino acids give a purple colour when stained with ninhydrin. Only proline and hydroxyproline give a yellowish colour. Give a reason why those amino acids stain differently? Write the structure of serine and proline.
The chemical reactions of amino acids and peptides

8. Explain the principle of the xanthoproteic reaction. Write the reaction for phenylalanine/tyrosine.

9. Identification of cysteine. After hydrolysis of protein, cysteine and cystine in strongly basic solution are transformed to pyruvic acid. Write the reaction of the appropriate amino acid and name the product.

10. List the major posttranslational modifications of amino acids. Which amino acids in protein can undergo modifications.
   a)
   b)
   c)
   d)
   e)

11. What product of biologically importance do you obtain after the decarboxylation of histidine.
   Write down the reaction.
The chemical reactions of amino acids and peptides

12. Outline the steps of adrenaline synthesis in our body.