Remarks:

* ***Before you start your project, you need to know what you are doing!***
* ***We provide some questions here to guide your self-study process.***
* ***Don’t hesitate to ask when you are confused!***

1. No more than 100 words per answer!!!
2. Use your own words or drawings to answer the questions
3. Insert picture(s) in the space provided for hand-drawn figures (either pictures of pencil-and-paper drawings or digital drawings are ok)
4. Submit the e-copy of your answer via electronic means

**1. Minimal biochemistry**

**1.1. Warm-up exercise**

*Recommend readings:* [*https://chem.libretexts.org/Bookshelves/Biological\_Chemistry/Supplemental\_Modules\_(Biological\_Chemistry)/Proteins/Peptides\_and\_Proteins/Proteins\_and\_Amino\_Acids*](https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Proteins/Peptides_and_Proteins/Proteins_and_Amino_Acids)

|  |  |
| --- | --- |
| Q1.1 | Based on your previous knowledge and/or from the recommended readings, what are the possible functions of **enzymes** among different proteins? |
| Ans |  |

**1.2. Protein structure**

**1.2.1. Amino acids**

*Recommended readings:*

[*https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals\_of\_Biochemistry\_(LibreTexts)/01%3A\_Unit\_I-\_Structure\_and\_Catalysis/03%3A\_Amino\_Acids\_Peptides\_and\_Proteins/3.01%3A\_Amino\_Acids*](https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(LibreTexts)/01%3A_Unit_I-_Structure_and_Catalysis/03%3A_Amino_Acids_Peptides_and_Proteins/3.01%3A_Amino_Acids)

|  |  |
| --- | --- |
| Q1.2.1 | Draw the **2D structure** of the following amino acids under physiological condition of pH 7.4 and provide their **one letter codes**. |
| Ans | |  |  |  |  | | --- | --- | --- | --- | | **Amino acid** | **Lysine** | **Aspartate** | **Glutamate** | | **2D structure** |  |  |  | | **1-letter code** |  |  |  | |

**1.2.2. Protein structures**

(detailed explanation of 3D representations will be discussed in the next handout)

*Recommended readings:* [*https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals\_of\_Biochemistry\_(LibreTexts)/01%3A\_Unit\_I-\_Structure\_and\_Catalysis/03%3A\_Amino\_Acids\_Peptides\_and\_Proteins/3.02%3A\_The\_Structure\_of\_Proteins-\_Primary\_Structure*](https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(LibreTexts)/01%3A_Unit_I-_Structure_and_Catalysis/03%3A_Amino_Acids_Peptides_and_Proteins/3.02%3A_The_Structure_of_Proteins-_Primary_Structure)

|  |  |
| --- | --- |
| Q1.2.2 | The following figure is extracted from figure 3.2.3 from the recommended reading (last access: Apr 6th, 2022).  In the **2D representation** there is an amino acid **with the wrong structure**. Name that aminos acid residue and draw the correct primary structure of that sequence. (hint: the sequence in the green box) |
| Ans |  |
| Q1.2.3 | What are the 3 types of protein secondary structures? |
| Ans |  |

**1.3. Nucleic acids**

**1.3.1. Nucleotides**

*Recommended readings:* <https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(LibreTexts)/01%3A_Unit_I-_Structure_and_Catalysis/08%3A_Nucleotides_and_Nucleic_Acids/8.01%3A_Nucleic_Acid_Structure>

|  |  |
| --- | --- |
| Q1.3.1 | Draw the **2D structure(s)** of guanine and adenine, also give their **1-letter code(s)**. |
| Ans |  |

1.3.2. RNA capping [project-specific question]

*General information of RNA cap:*

[*https://en.wikipedia.org/wiki/Five-prime\_cap*](https://en.wikipedia.org/wiki/Five-prime_cap)

*Structure of RNA caps:*

[*https://www.researchgate.net/figure/Structure-of-5-end-capped-mRNAs-The-cap-0-cap-1-and-cap-2-structures-and-5-5\_fig2\_293044451*](https://www.researchgate.net/figure/Structure-of-5-end-capped-mRNAs-The-cap-0-cap-1-and-cap-2-structures-and-5-5_fig2_293044451)

|  |  |
| --- | --- |
| Q1.3.2 | Referring to the information above, draw the 2D structures of a RNA cap-1 |
| Ans |  |

**1.4. Molecular interactions**

For questions 1.4.1.3-1.4.3, draw the 2D representation of the type of molecular interactions. Search on google to get the answer if you need.

|  |  |
| --- | --- |
| Q1.4.1 | Give an example of hydrogen bond. |
| Ans |  |
| Q1.4.2 | Give an example of charge-charge interaction. |
| Ans |  |
| Q1.4.3 | Give an example of pi-pi stacking. |
| Ans |  |

**1.5. [Bonus section] Minimal pharmacology and importance of selectivity**

*Recommended readings:*

<https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Book3A_Medicines_by_Design/01%3A_ABCs_of_Pharmacology/1.02%3A_A_Drug's_Life>

(Optional, more advanced details of the previous article) <https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Medicinal_Chemistry/Basic_Aspects_of_Drug_Activity>

|  |  |
| --- | --- |
| Q1.5.1 | Imagine that you have designed a molecule that perfectly inhibits our target protein. However it fails to work *in vivo* (i.e. when we test it in living organisms). Give a possible reason based on the article on a drug's life. |
| Ans |  |
| Q1.5.2 | Explain in your own words why is it important to design a selective drug when we would like to e.g. inhibit a viral protein? |
| Ans |  |