# Revision questions BIOL1XX7 Module 1

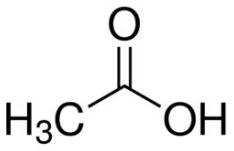
From Molecules to Ecosystems (University of Sydney)

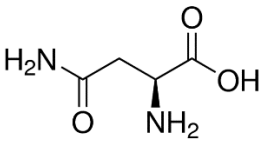
**Problem Sheet Module 1**

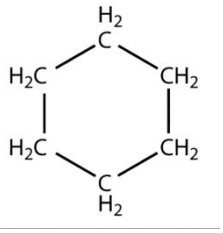
**Try these out, you will learn better if you tackle the questions on your own and come up with the answers rather than having the answers given to you and for that reason you will not be given a set of sample answers. The plan is to go over some these questions in the Live Q&A session (I will set up a upvoting option available on canvas in Padlet to vote for which questions to talk about as we won't have time to go over all of these) to prioritise which questions to go over**

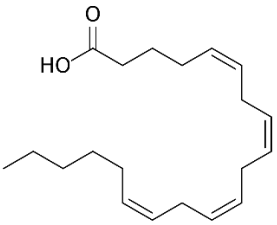
**Lecture 2**

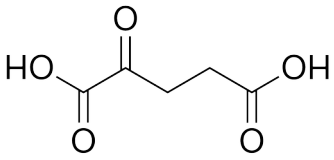
1) What are the key characteristics of living organisms?
2) Classify these organisms as prokaryotic or eukaryotic: humans, mushrooms, fish, bacteria, algae, gum trees
3) What properties of carbon make it central to life as we know it (i.e. carbon-based life)?
4) True or false: Hydrophobic things like to be in aqueous (water-based) environments.
5) Which of these types of molecules is **mostly** hydrophobic and which are **mostly** polar? (remember that O = red and N= blue)

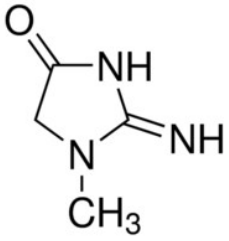
A) 


B) 


C) 


D) 


E) 


F) 


7) What are the five main types of molecules used in Biology and what are their uses?

8) True or False: The only role of Sugars/Carbohydrates is as energy sources?

9) Name three functions of lipids.

10) What are the differences between amino acids and nucleotides?

11) What chemical properties can different amino acids have (name at least 3)?

**Lecture 3**

1) Match the end to the biopolymer type to indicate the direction.

| **Biopolymer type** | **End** |
|---|---|
| Nucleic acid/ Protein | C-terminal, 5', N-terminal,3' |

2) What type of sequence is each of the following (DNA/RNA/Protein)?
   A. AATTCGCGCTCTAGCT
   B. AAHWYLDDEEPNQGS
   C. AAUUCGCGCUCUAGCU

3) Sketch a single stranded generic nucleic acid sequence to show the arrangement of sugars, phosphates and nucleobases (you don't need to show the chemical formulas – square/triangles/circles or similar is fine).
4) Which nucleobases base-pair with each other (A,C,G,T,U), which are considered to have stronger base-pairing and why?
5) What properties of RNA mean that it is less suitable as a source of genetic material than DNA?
6) Make a sketch of the dsDNA helix (B-DNA) showing (and labelling) the following features (NB I'm not asking for chemical formula or precise dimensions etc just enough detail so that you can point out where these features appear):
    A. sugar-phosphate backbone
    B. Base-pairing
    C. Base-stacking
    D. Major groove
    E. Minor groove
    F. Directions of each strand

**Lecture 4**

1) According to the central dogma of molecular biology, which of the following flows of information can take place directly in biology?
    A. DNA to RNA
    B. Protein to RNA
    C. DNA to Protein
    D. DNA to DNA
    E. RNA to DNA
    F. Protein to DNA
    G. Protein to Protein
    H. RNA to RNA
2) Match the type of information containing biopolymer to its main role in the central dogma of Molecular Biology:

| Molecule | Role |
|---|---|
| 1. DNA | A. Doing molecules |
| 2. RNA | B. Genetic Store |
| 3. Protein | C. Messenger |

3) Consider muscle cells and skin cells from the same individual. In general terms describe the genome, transcriptome and proteome for each cell type (are they the same or different and if different how/why are they different). What about skin cells from a mouse versus a cat?
4) What are the main differences between genomes and chromosomes from bacteria and eukaryotes?

| First position (5′ end) | Second position U | C | A | G | Third position (3′ end) |
|---|---|---|---|---|---|
| U | Phe | Ser | Tyr | Cys | U |
| | Phe | Ser | Tyr | Cys | C |
| | Leu | Ser | STOP | STOP | A |
| | Leu | Ser | STOP | Trp | G |
| C | Leu | Pro | His | Arg | U |
| | Leu | Pro | His | Arg | C |
| | Leu | Pro | Gln | Arg | A |
| | Leu | Pro | Gln | Arg | G |
| A | Ile | Thr | Asn | Ser | U |
| | Ile | Thr | Asn | Ser | C |
| | Ile | Thr | Lys | Arg | A |
| | Met | Thr | Lys | Arg | G |
| G | Val | Ala | Asp | Gly | U |
| | Val | Ala | Asp | Gly | C |
| | Val | Ala | Glu | Gly | A |
| | Val | Ala | Glu | Gly | G |

Figure 22-3 Principles of Biochemistry, 4/e


5) What is the "start codon" and what amino acid does it encode?
6) What peptide sequence does the following mRNA sequence encode [hint: find the start codon first and use the codon table above]?

   UCAUGGGUUGGACUCUUUAACCG

7) What would be the effect on the peptide of the following mutations?

   UCAUGGGUUGGACUCU**A**UAACCG

   UCAUGGGUU**C**GACUCUUUAACCG

   UCAUG--UUGGACUCUUUAACCG (2-base pair deletion)

   UCAUGGGUUGGACUCUUUA**C**CCG

   UCAU**C**GGUUGGACUCUUUAACCG

**Lecture 5 – Copying DNA**

1) What does semi-conservative replication mean?
2) What are the main challenges in copying DNA from DNA and how are they overcome?
3) What are the roles of the following proteins in DNA replication: DNA polymerase, gyrase, helicase, ligase, primase?
4) How are RNA polymerases different from DNA polymerases?
5) What are the signals for transcription initiation and termination?
6) How can different genes be transcribed into RNA at different rates?

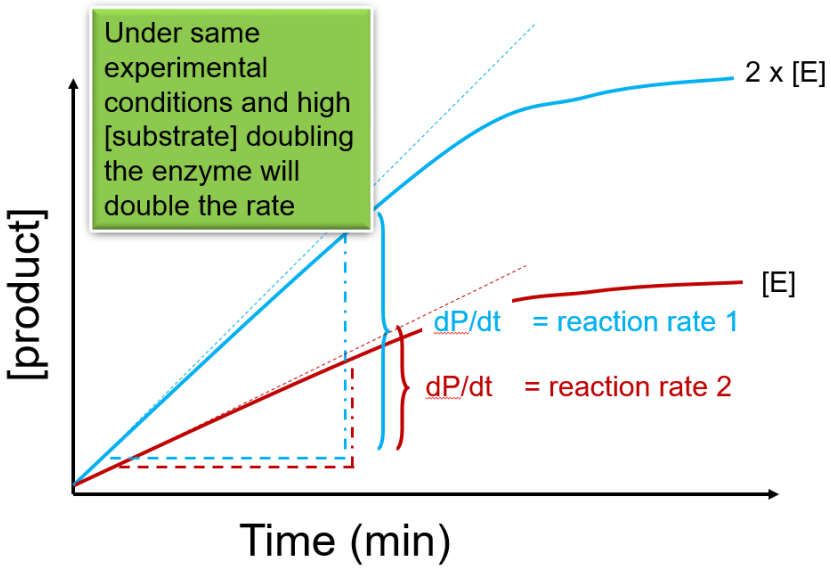
**Lecture 6 – Making Proteins /Protein synthesis and structure**

1) How do tRNA and aminoacyl RNA synthetases work together to correctly translate an mRNA sequence translated into a protein/peptide sequence?
2) What roles does the ribosome have in protein synthesis initiation, elongation and termination?
3) True or False: Release Factor is a tRNA that binds to the stop codon to terminate protein synthesis
4) What are the differences between primary, secondary, tertiary and quaternary structure of proteins?
5) What types of bonds and forces hold protein structure held together?
6) Describe how an element of protein secondary structure can complement dsDNA structure to allow protein-DNA interactions.

**Lecture 7 - Enzymes**

1) If a reaction is at equilibrium which of the following statements is true?
    a. The reaction is favourable
    b. Substrate molecules are probably exchanging with product molecules and vice versa
    c. The total energy of the substrate population is higher than the product population

2) What does it mean if a reaction is under kinetic rather than thermodynamic control?
3) True or False? A reaction (Substrate <-> Product) can be driven to the right by adding more substrate or removing the product.
4) Consider this graph from Lecture 7B where we saw faster initial reaction rates when twice as much enzyme was added. What would happen to these two curves if we let the reactions run for a long time?




5) What are three properties of enzymes that are important for biology and/or medicine?
6) How can the hydrolysis of pyrophosphate drive unfavourable interactions?