

1. The entire exam will be corrected by the examiner, so in order to reduce the amount of paper, please DO answer more than 1 question on the same sheet of paper.
2. The written exam is in English only thus it is allowed to have a dictionary at the exam. Other useful tools allowed at the exam are calculator and colored pens.
3. Other materials such as notes, lecture slides, books, computers and other paper or electronic items and devices that can store information are NOT allowed during the examination.
4. There are 18 questions and the points are expressed in %. It is possible to get maximally 95% from this written exam. The remaining 5% were obtainable with the lab exercise report. There are no negative points and it is possible to get partial points in the answer.
5. If you write in this document, don't forget to put your student code on your copy and include it when you submit your exam. Also, mark on your papers that the answer is in the exam copy, so I know where to find your answer.

STUDENT CODE:

UCM010-10

Course

UCM010

Introduction to Cell and Molecular Biology

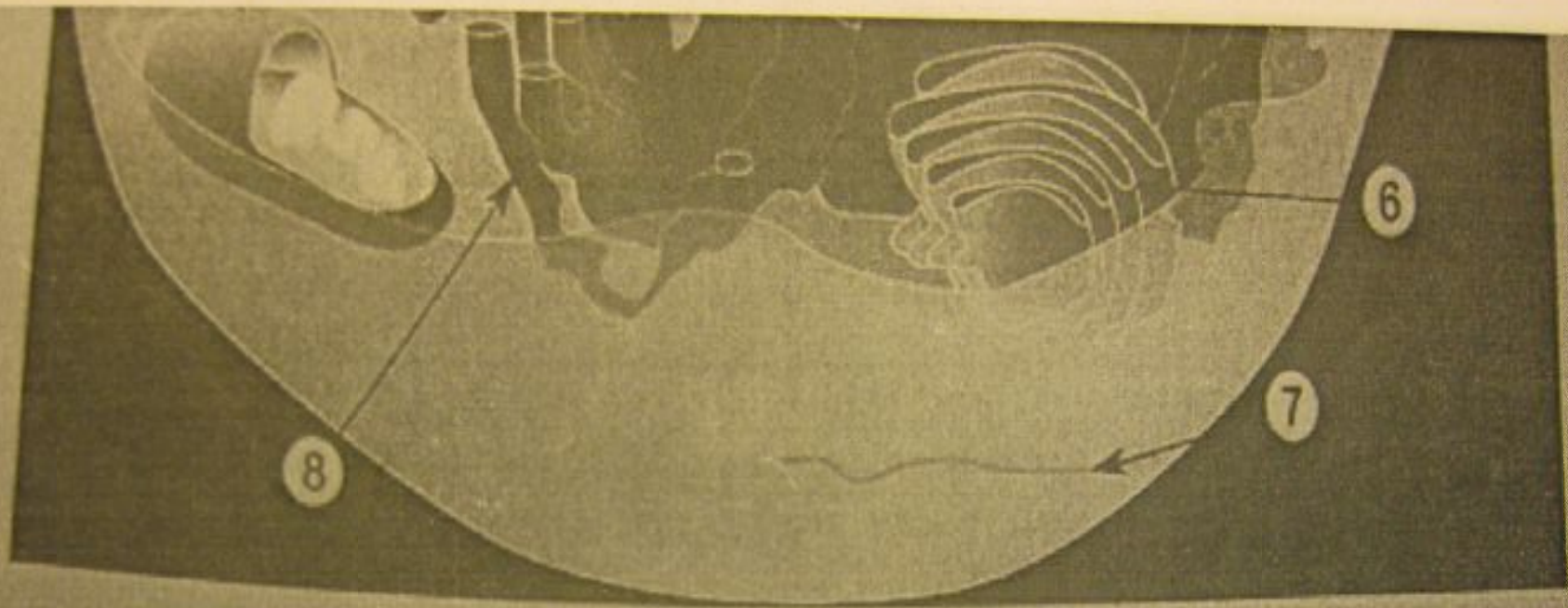
Written exam, August 26th 2010, 14:00-18:00

Examiner: Assistant Professor Dina Petranovic

Dina will visit the students two times during the exam:
Around 14:45/15:00h and again 16:30/16:45h

STUDENT CODE:

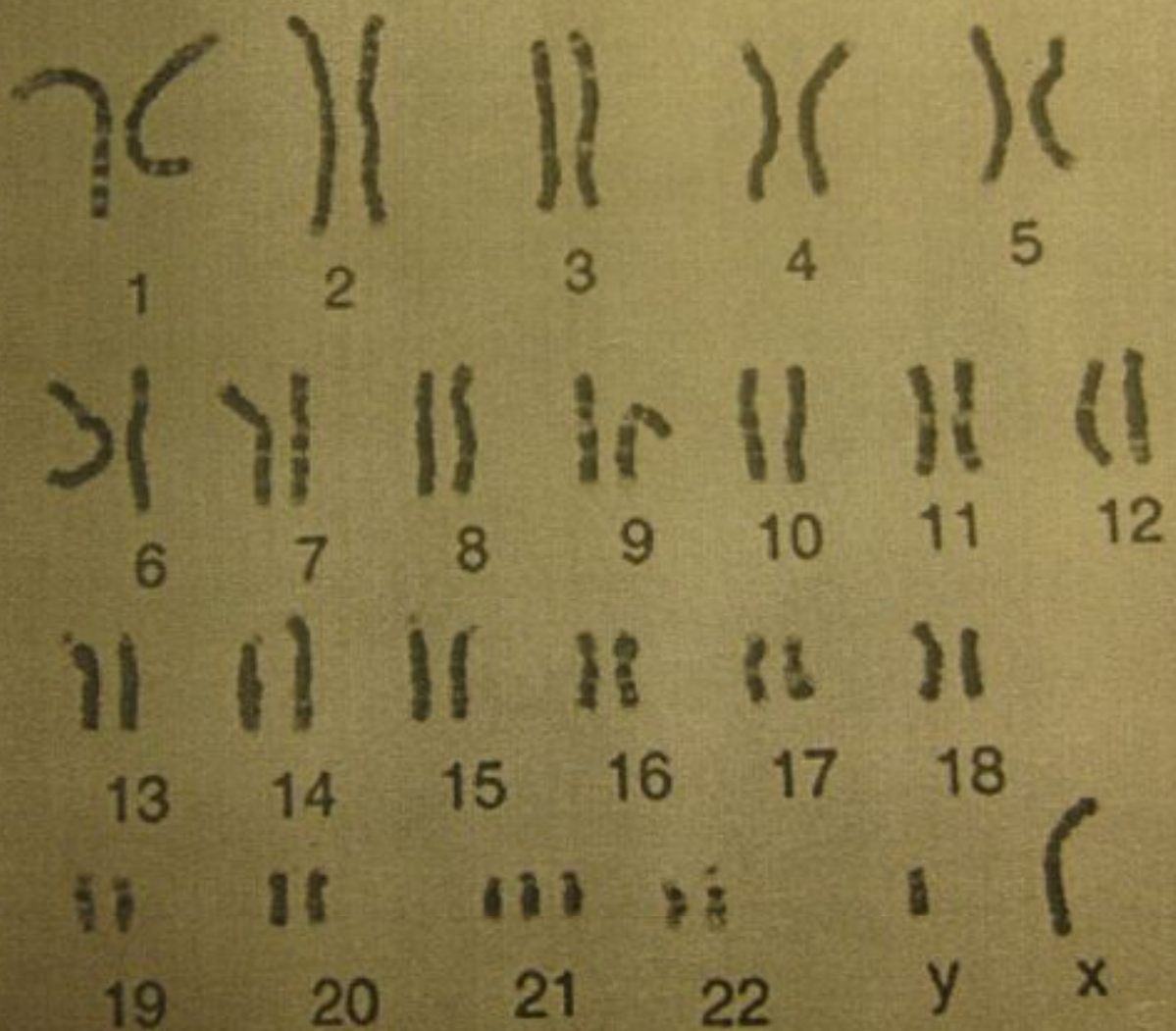
- 1) List the properties of life and explain each term. (4%)
- 2) Living cells are made of 4 main categories of organic molecules. What are they? (2%)
- 3) What is your genome made of and where is it situated? (2%)
- 4) Name the 3 main categories of RNA molecules and explain briefly the role of each. (3%)
- 5) Annotate the cellular compartments: (5%)



- 6) From figure above (see numbers) explain what is and what is its role in the cell: (3%)
- a. Number 1
 - b. Number 6 *311*
 - c. Number 13
- 7) Explain briefly what is the central dogma of molecular biology (2%)

E:

8. Look at the photo below and answer: (5%)
- What does the picture represent and how is this called?
 - From what species is this sample (probably)?
 - From what gender?
 - Is this a somatic cell or a germ cell?
 - Is this aneuploidy or euploidy? Be as specific as possible.



What represents the Ramachandran plot? It is suggested that you explain different angles by using a drawing of a polypeptide chain. (3%)

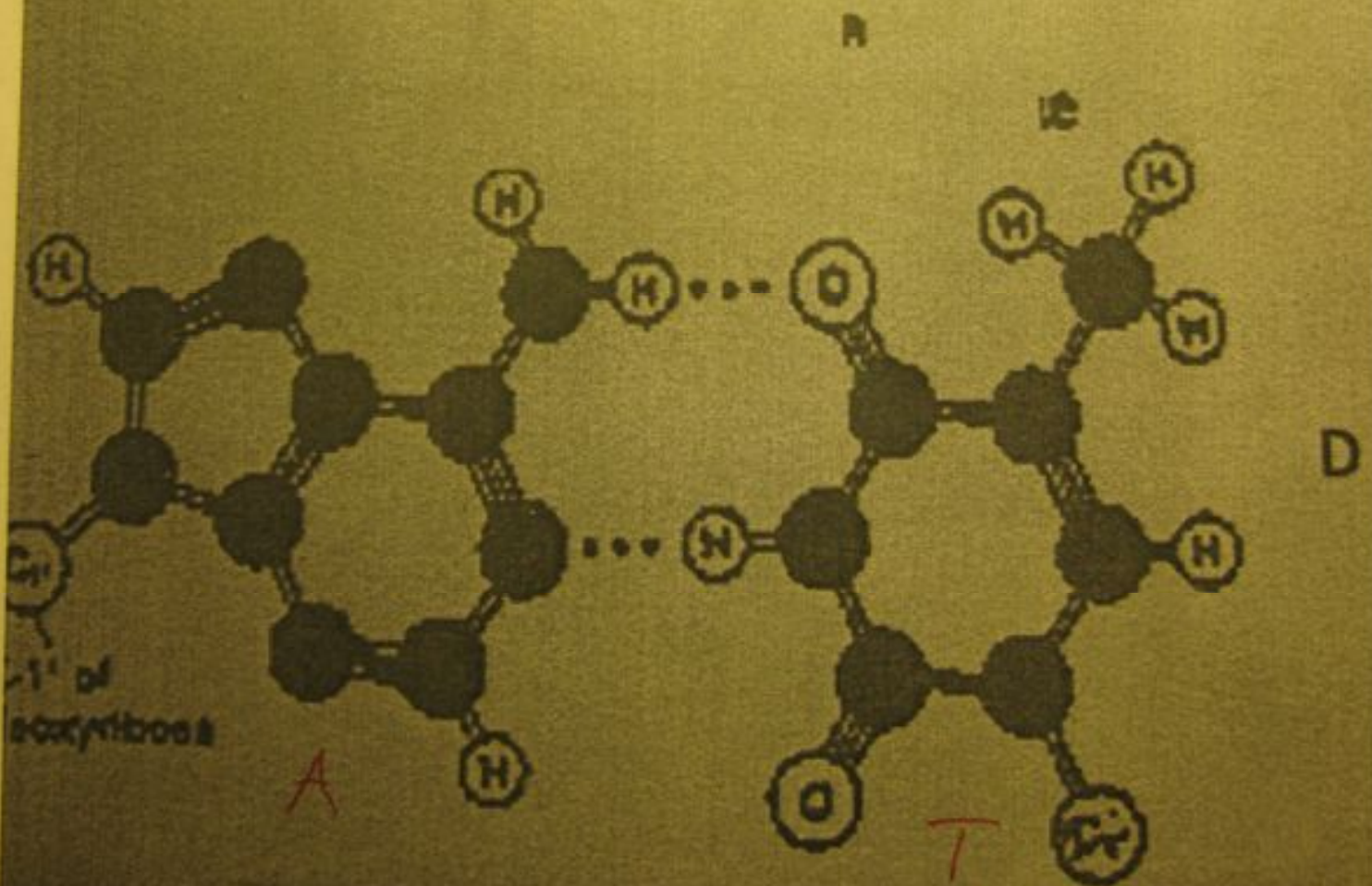
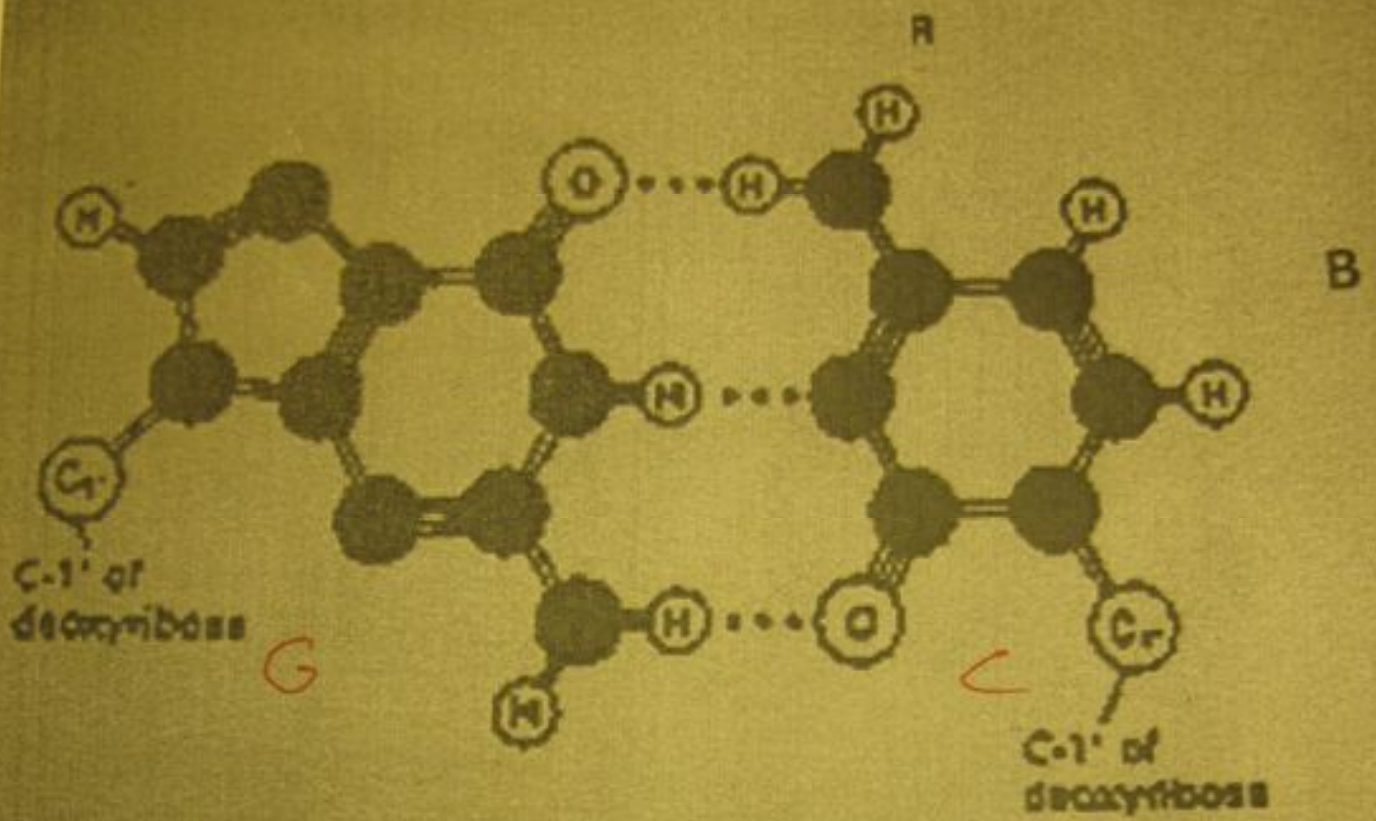
9) What represents the Ramachandran plot? It is suggested that you explain the 2 different angles by using a drawing of a polypeptide chain. (3%)

10) A wild type (WT) *E. coli* cell (WT means normal) is happily growing in a minimal medium that contains all necessary for growth.

In another tube, a mutant *E. coli* is growing in the same conditions. The mutant is exactly the same as the WT, except that the *trp*-operon repressor is unable to bind tryptophan. (12%)

- Is there any difference between the growth of the WT and the mutant in the mentioned conditions?
- Suddenly, you add a certain amount of tryptophan (Trp) to both tubes. What happens in the WT cells? What happens in the mutant cells?
- Explain why the mutant is less favored in this experiment after the addition of Trp.
- In which tube will the tryptophan (added in step b) to the medium) will be used up first?

1A. pairing in DNA. What is A, B, C and D? (4%):



12) Explain briefly what is a plasmid: what is it, what is its role, what do we use it for and what elements does it have? (3%)

13) What is: (2%)

- a) a polysome
- b) cholesterol

14) What would happen to a cell that is exposed to a compound which is an inhibitor of proteins that contain the hem prosthetic group? The inhibitor binds irreversibly to the hem. (2%)

15) Explain the main similarities and main differences between (5%):

- a. Nucleus and nucleolus
- b. Meiosis and mitosis
- c. Centrosome and centromere

16) (12%) A germ line cell ($2n = 2$) is first dividing mitotically and then after some time, each of those cells is undergoing meiosis, resulting in creation of gametes.

- a. Draw one diploid cell undergoing mitosis. Mark in each stage how many chromosomes are there and how many chromatids are there.
- b. Draw one diploid cell undergoing meiosis. Mark in each stage how many chromosomes are there and how many chromatids are there.

17) (8%) Control of the cell cycle is happening at several different check points. One of the major checkpoints is the entry into mitosis by activating the M-Cdk. Explain the regulatory pathways that are part of the M-Cdk activation mechanism. It is suggested that you make a schematic drawing of the regulatory systems.

18) (18%) This is a piece of double stranded DNA and this is its sequence:

TATGGCCTAGAGCTAAATTGGCATGAC

- a. Annotate the 5' and the 3'
- b. Write the sequence of the mRNA. The template for mRNA is on the 3' → 5' strand
- c. Translate the codons using the table below

| | | | | |
|---|---|---|---|-----|
| U | C | A | G | ... |
|---|---|---|---|-----|

| | | | | | |
|----------|-----|-----|-----|-----|---|
| | 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 |

- Draw the peptide obtained by translation.
- What are the names of the aminoacids in the peptide that you obtained by translation?
- What are the single letter abbreviations of the aminoacids in the peptide?
- What is the net charge of this peptide?
- What chromatographic method would you use to purify this peptide from a mixture of other small peptides?