

### Part 1

Biomedical Engineering

BE1-HMCP

MOLECULES, CELLS AND PROCESSES, Main Exam

[Click here to enter a date.](#), 10.00-11.30

Duration: 90 minutes

The paper has 10 COMPULSORY questions.

Answer 10 question(s).

Each question is worth 10 marks.

Marks for questions and parts of questions are shown next to the question. The marks for questions (and parts thereof) are indicative, and they may be slightly moderated at the discretion of the examiner.

### Question 5

a) Name the 4 bases of RNA?

**5 marks**

Uracil, Adenine, Cytosine and Guanine

b) Describe the differences between DNA and RNA?

**5 marks**

RNA has a different sugar (ribose versus deoxy-ribose) in the backbone, it has Uracil instead of Thymine as base, it is single-stranded, encodes a single gene and consequently its average size is much smaller than DNA, has a short half life, and mature RNA has a different composition (exons only, poly-AAA tail, and 5' cap)

### Question 6

a) What are the form and function of tRNA?

**5 marks**

tRNA is of 80 nt long that form a clover leaf. It has an anti-codon structure and a structure that binds the amino acids. Its function is to add a single amino acid to a peptide. The specific amino acid is determined by matching the codon (on the mRNA) and the anti-codon on the tRNA. There are 48 tRNAs in the human cell

b) What is the difference between a triplet and a codon?

**5 marks**

A triplet is on the DNA and a codon is on the (mature) mRNA. As a consequence, a triplet of ATA on the DNA is a codon of AUA on RNA. They code for amino acids, with exception of start and stop codons.

### Question 7

a) Describe the structure of DNA. What is meant by the terms, nucleotide bases, and backbone?

**5 marks**

DNA is a double stranded string of nucleotides, that forms a double helix. Each nucleotide consists of a sugar moiety (deoxy-ribose), a phosphor molecule and a base. Each base consists of either pyrimidine or purine bases. The backbone is the sugar with the phosphor group that attach to each other on the 3' and 5' sites

b) Describe the difference between a nucleosome and a histone

**5 marks**

*Histone is a protein, that wraps DNA around its cylindrical part twice. Nucleosome consists of four pairs of 8 histone's interspaced with a linker DNA of 147 bp*

**5 marks**

### Question 8

- a) Describe the difference between translation and transcription of DNA

**5 marks**

Transcription is the formation of pre-RNA or immature RNA from DNA in the nucleus under the influence of RNA-polymerase. Translation is the formation of peptide from mature mRNA in the ribosome in the cytoplasm.

- b) And between protein and a peptide

**5 marks**

A peptide is a linear sequence of amino-acids, while proteins have a characteristic tertiary and/or quaternary structure. A peptide has peptide bonds between the amino-acids, but no special structure. The secondary (alpha helices and beta sheets) form through charge hydrogen bonds. Tertiary structures arise from bonding of secondary structures, there are multiple mechanism for tertiary structures to arise.

### Question 9

- a) What are the different RNA's in the cell?

**5 marks**

The majority of the genes carry the information specifying the amino-acid sequence of a protein, so first the messenger RNA (mRNA) is transcribed from the DNA of the gene and later used for the translation into protein.

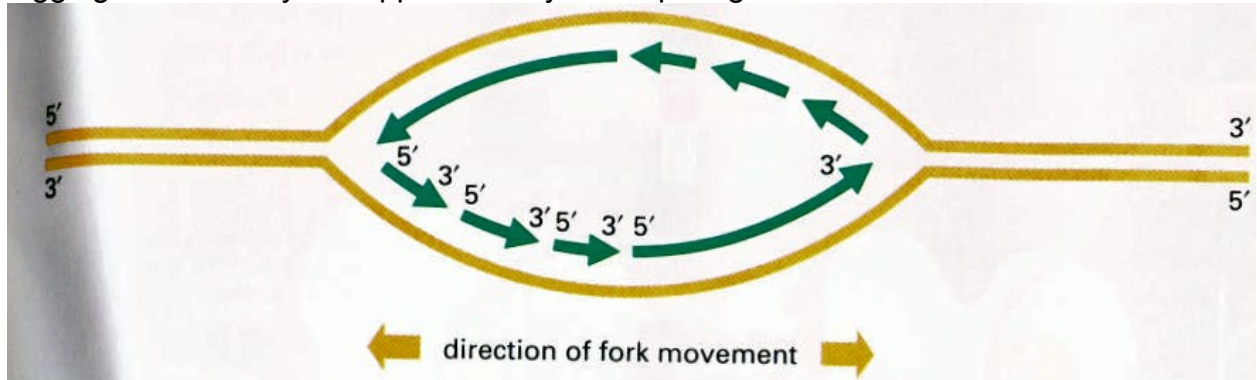
However there are some other genes that produce their RNA's as final products - these have structural and enzymatic functions:-

1. Ribosomal RNA (rRNA) - forms the core of ribosomes both structural and enzymatic
2. Transfer RNA (tRNA) - carries the amino acids for protein manufacture to the translation machinery
3. Small microRNA – regulates mRNA, and is believed to have resulted from virus invasion in germ cells.
4. Other small RNA sequences (snRNA's) with various function including enzymatic

b) What are Okazaki fragments?

**5 marks**

Okazaki fragments arise during DNA replication, where they are present at the lagging strand. They are approximately 1000bp long.



**5**

### Question 10

a) What is the function of the nucleus?

**5 marks**

The nucleus forms an internal milieu for DNA, its transcription, the formation of RNA and its maturation. Specific regions synthesize histones, and nucleosomes. Nuclear pores are highly specific openings in the nuclear envelope for interacting of nuclear material with the cytoplasm.

b) What is the function of the cytoskeleton?

**5 marks**

1. forming stiff projections in the membrane to support microvilli (and other projections) which are common in the gut to increase area for absorption.
2. supporting cell shape, so found particularly around the edges of cells.
3. amoeboid cell movement ('crawling') - pseudopodia
4. assisting the cell to split in two during cell division
5. assisting cells to engulf material (phagocytosis)
6. to move organelles (especially vesicles) about the cell
7. pull apart the paired chromosomes during cell division so the daughter cells have equal numbers.
8. they are also involved in the mechanism that causes specialised cellular projections like cilia and flagella to move in a wave-like fashion