

NATURAL SCIENCES TRIPOS Part 1A

Tuesday 4 June 2013 9 to 12

BIOLOGY OF CELLS - THEORY

Answer **Question 1** (Section A) **and three questions** from Section B.

Section A carries 33% of the marks and Section B carries 67% of the marks for this paper.

Write on **one** side of the paper only.

Answers from **Section A** must be tied up in a **single bundle** with a blue coversheet.

Each answer from **Section B** must be **tied individually** with a blue coversheet, on which the question number is written clearly.

Enter the numbers of the 3 questions you have answered from Section B on the yellow coversheet and leave this loose on top of your pile of answers.

Candidates should write their examination number on each coversheet.

STATIONERY REQUIREMENTS

Script paper

Plain paper

Rough work pad

Blue coversheets

Yellow coversheet

Tags

SPECIAL REQUIREMENTS

Approved calculators allowed

**You may not start to read the questions
printed on the subsequent pages of this
question paper until instructed that you may
do so by the invigilator**

SECTION A

(Suggested time: not more than one hour. Lengthy answers are not required. Answer all parts of Question 1. Parts a–o of Question 1 carry equal marks.)

Question 1.

- (a) Explain what you could use a sucrose density gradient for, giving an example.
- (b) Briefly compare and contrast the chemical structures of RNA and DNA.
- (c) How and why do proline and glycine differ from other amino acids in a Ramachandran plot?
- (d) Suggest an experiment that could be used to detect lateral mobility of an integral protein in the cell membrane of a eukaryotic cell.
- (e) Briefly describe the major differences between photosynthesis and respiration.
- (f) Discuss the statement that “in mammals glucose cannot be synthesised from fat”.
- (g) Describe three mechanisms of horizontal gene transfer in bacteria (i.e. mechanisms by which genes can be transferred, directly or indirectly, from one bacterium to another). Which is likely to be the most efficient in the natural environment? Justify your answer.
- (h) Give TWO examples of how the study of bacteriophages contributed to our understanding of genetics in the second half of the twentieth century.
- (i) Describe the structure of the nucleosome.
- (j) How are hybridisation techniques used in the analysis of nucleic acids?
- (k) How is entry into mitosis regulated in eukaryotic cells?
- (l) How do genomes of animal and plant viruses encode enough information to make virus particles and damage the host cell?
- (m) What is the French flag model of pattern formation?
- (n) Describe an experiment to test the pluripotency of embryonic stem cells.
- (o) What are DELLA proteins?

SECTION B

(Suggested time: two hours. Answer three questions. All questions carry equal marks.)

2. Discuss the major components of the cytoskeleton. What are their roles in intracellular movement?
3. Describe how proteins acquire their three-dimensional structure and the forces that stabilise it.
4. Compare the different mechanisms used by cells to take up solutes.
5. Discuss how catabolism is regulated at the cellular and whole organism level. Give specific examples of pathways and enzymes.
6. Write an essay on non-Mendelian inheritance, illustrating your answer with examples from eukaryotes.
7. How were codons shown to be comprised of triplets of nucleotides, and how was the genetic code determined?
8. Describe the genetic and molecular methods used to clone the genes responsible for Cystic Fibrosis and Duchenne Muscular Dystrophy. What are the challenges for diagnosis that the cloning and subsequent analysis revealed?
9. Describe the processes that alter genes in cancer cells and how specific genetic changes affect cell behaviour.
10. Discuss the formation of axes in animal and plant embryos.

END OF PAPER