

NATURAL SCIENCES TRIPOS Part 1A

Tuesday 4 June 2019 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 your examination number on each answer booklet cover.

Section A: put all short question answers from Question 1 into one or more 20 page answer booklets, tied up in a single bundle.

Section B: start a new 8 page answer booklet for each question and write the question number clearly on its cover. When using more than one answer booklet for a question, tie together the answer booklets containing parts of the same answer.

Yellow coversheet: enter the numbers of the 3 essay questions you answered from Section B and leave this loose on top of your pile of answer booklets.

STATIONERY REQUIREMENTS

Answer booklets (1 x 20 page and 3 x 8 page)
allowed

Yellow coversheet

Tags

SPECIAL

Approved calculators

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

(Answer all parts of Question 1. Each part carries equal marks.

Suggested total time: not more than one hour. Lengthy answers are not required.)

Question 1

- (a) Excluding DNA replication, summarise two ways in which the information encoded in DNA sequence can be "read" by cellular processes.
- (b) Summarise the advantages and disadvantages of electron microscopy, as compared with confocal light microscopy, for examining the structure and function of cells.
- (c) How many chiral carbons are present in the linear form of D-glucose, and does this change in the pyranose ring form? Why is stereochemistry important for the biochemistry of sugars?
- (d) How does the structural diversity of membrane lipids help cells to function as temperature varies?
- (e) Briefly outline the different mechanisms used by organisms to synthesize glutamate.
- (f) How does GluT4 regulate glycolysis in skeletal muscle and adipose tissue?
- (g) Describe the structure of glycogen and starch with reference to how the structure influences their roles as energy stores.
- (h) Why is it appropriate to refer to dominant and recessive phenotypes, but not to dominant and recessive alleles of genes? Illustrate your answer with one specific example.
- (i) What is a sigma factor and how is it important for the initiation of transcription in bacteria such as *E. coli*?
- (j) Name, and briefly describe, the characteristics and functions of three types of RNA involved in the process of protein translation.
- (k) Briefly describe the main challenges in annotating eukaryotic genome sequence and how they can be overcome?
- (l) Name and briefly contrast two alternative cycles of viral replication.
- (m) Describe how the membrane phospholipid phosphatidylinositol 4,5-bisphosphate is used to generate second messengers.

- (n) How could you experimentally test if the sequence responsible for the localisation of an mRNA to the anterior of the developing *Drosophila* egg (oocyte) is in the 3'UTR (untranslated region)? Briefly describe one experiment and one control.
- (o) What sets the apico-basal axis of the plant embryo, for example in *Arabidopsis*?