

ENGINEERING TRIPOS PART IIA

Thursday 29 April 2010 2:30 to 4:00

Module 3G1

INTRODUCTION TO BIOSCIENCE

*Answer all of Section A and **two** questions from Section B.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

There are no attachments.

STATIONERY REQUIREMENTS

Single-sided script paper

SPECIAL REQUIREMENTS

None

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 of this section.

- 1 (a)
- (i) What is a chromosome?
 - (ii) How is chromosomal DNA packaged in prokaryotes and eukaryotes?
 - (iii) What is meant by the *genome* of an organism? [30%]
- (b)
- (i) How do the two strands of the DNA double-helix fit together?
 - (ii) How does this facilitate DNA replication?
 - (iii) Explain why the width of the DNA double-helix is constant. [30%]
- (c)
- (i) What is a clone library?
 - (ii) When aligning biologically related sequences of different lengths, it is necessary to include gap characters in the alignment. These are often found to occur in runs. Why is this the case?
 - (iii) A *C. elegans* nematode worm gene is cloned into a bacterial plasmid. The plasmid contains promoters that, when transformed into bacteria, result in the production of a double-stranded RNA version of the gene. If such bacteria are fed to the worms, what happens? [40%]

SECTION B

Answer any **two** of the following questions with a short essay, using diagrams where appropriate.

- 2 How do we deduce the evolutionary origin of different species? How did the eukaryotic domain emerge, and how are its members distinct from the prokarya and archaea? [100%]
- 3 A researcher has cloned a gene that expresses GFP into *E. coli*. However, despite confirming that the transformation of the DNA was successful, the bacteria do not fluoresce. Describe how the polymerase chain reaction is used to clone a gene. What are the different types of mutation that might have occurred during the PCR of this gene? Which of these are likely to be responsible for the inactivity of the clone? How would the scientist show that it was indeed a mutation that had caused the inactivity, rather than a problem with the host strain itself? [100%]
- 4 What is the central dogma of molecular biology? Describe each of the processes involved. Has any violation of the central dogma been discovered? [100%]
- 5 Compare and contrast the evolution of the original Sanger DNA sequencing method with the latest developments in the field. [100%]
- 6 Describe the key steps in genome annotation. Consider differences between the approach taken for prokaryotes and eukaryotes. What kinds of conservation can help with genome annotation? [100%]

END OF PAPER