

Student Name:

(Family Name)

(Given Name)

Student ID:

Griffith University

School of Biomolecular & Biomedical Science

3010BBS (NA) - Molecular and Applied Microbiology

3010BBS (LG) - Molecular and Applied Microbiology

Semester 2 - 2002 End of Semester

WORKING TIME: 2 Hrs 00 Mins

PERUSAL TIME: 10 Mins

EXAMINATION TYPE: Closed Book

PERUSAL INSTRUCTIONS: Students may write on the Examination Paper during perusal

EXAMINATION INSTRUCTIONS TO STUDENTS:

N/A

STUDENTS ARE PERMITTED TO BRING THE FOLLOWING MATERIALS INTO THE EXAMINATION VENUE:

CALCULATOR: Non-programmable calculator

DICTIONARY: English translation dictionary

OTHER MATERIALS ALLOWED: Electronic Dictionaries are NOT permitted

THE FOLLOWING MATERIALS ARE SUPPLIED BY GRIFFITH UNIVERSITY:

14 PAGE ANSWER BOOK: 1

6 PAGE ANSWER BOOK: 1

THIS EXAMINATION PAPER MUST NOT BE REMOVED FROM THE EXAMINATION VENUE.

Molecular And Applied Microbiology

Total Marks Allocated: 120

Total Time Allocated: 2hrs

Answer all five (5) questions. Section I consists of four (4) questions, which should be answered, in the main answer book. Section II consist of one (1) question and should be answered in the additional supplementary answer book provided.

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SECTION I

Question 1 Answer all the following multiple choice questions. Write the correct alphabet answer against the question number in your answer book. All questions are of equal marks (13 marks)

1. Which statement is true?
 - a. The methanogens are obligate aerobes; the extreme halophiles are obligate anaerobes
 - b. The methanogens are obligate anaerobes; the extreme halophiles are obligate aerobes
 - c. Both the methanogens and the extreme halophiles are obligate aerobes
 - d. Both the methanogens and the extreme halophiles are obligate anaerobes

2. The cytoplasmic proteins of *Halobacterium* are
 - a. Highly acidic
 - b. Highly basic
 - c. Generally neutral
 - d. Variable, depending on the species

3. The organism presently thought to explain the origin of hydrocarbon-like materials in hot oceanic sediments is
 - a. *Picrophilus*
 - b. *Methanopyrus*
 - c. *Methanococcus*
 - d. *Pyrococcus*

4. Archaea may constitute up to _____% of the procaryotic biomass in Antarctic surface waters.
 - a. 23
 - b. 28
 - c. 34
 - d. 43

5. Whole blocks of genes that have been copied from one chromosome to another are referred to as
- single-copy genes.
 - segmental duplications.
 - multigene families.
 - tandem clusters.
6. How are the four different bases distinguished in automated sequencing systems?
- each base has a different radioactive tag
 - each base has a distinctive fluorescent tag
 - each base has a unique antibody bound to it
7. The goal of _____ is to determine the location of specific genes within the genome.
- cloning
 - annotation
 - proteomics
8. Which of these organisms has the smallest genome?
- Haemophilus influenzae*
 - Mycoplasma genitalium*
 - Mycobacterium tuberculosis*
9. The minimum set of genes required for life is approximately:
- 50-100 genes
 - 250-350 genes
 - 1000-1500 genes
10. *Deinococcus radiodurans* is able to survive massive exposure to radiation because
- it produces a thick shell which acts as a shield from the radiation
 - it has unique DNA repair mechanisms
 - it has many copies of genes encoding DNA repair
11. In the time since *E. coli* and *Salmonella* diverged evolutionarily
- There has been little change in either genome
 - E. coli* has lost approximately 50% of its genome
 - E. coli* has acquired many genes via horizontal transfer
12. Protein synthesis studies using *Sulfolobus* (Archaea), yeast (*Eukarya*), and *Escherichia coli* (*Bacteria*) indicate the ribosomal proteins of ----- and ----- are more closely related to each other than they are to the ribosomal proteins of -----
- Archaea / Bacteria / Eukarya
 - Archaea / Eukarya / Bacteria
 - Bacteria / Eukarya / Archaea
 - None of the above because the studies indicate these proteins all seem to be similar.

13. A chemical reaction involving ----- may have been one of the first reactions by which organisms were able to conserve energy.

- a. Iron, oxygen, and hydrogen
- b. Sulfur, oxygen, and hydrogen
- c. Iron, sulfur, and oxygen
- d. Iron, sulfur and hydrogen

Question 2. State True or False All questions are of equal marks (7 marks).

1. In general, the cold-dwelling crenarchaeotes are evolving more slowly than the hyperthermophilic crenarchaeotes.
2. In chemolithotrophy in the *Archaea*, H₂ is a common electron donor.
3. Parasitic bacteria typically possess many more metabolic genes than do free-living bacteria.
4. Life can be considered an imperfect replicating system because evolution is an ongoing process.
5. Phylogenetic community analyses generally show a multitude of distinct organisms whose RNA sequences do not match any of those in present databases.
6. Archaeal RNA polymerases are generally less complex than those of Bacteria
7. DNA polymerases are less precise than RNA polymerases.

Question 3 Answer the following in brief. All questions are of equal marks. (20 marks)

1. On the basis of the following sequences, calculate an evolutionary distance between these three organisms and predict which two of the three are most closely related.

Organism 1: AGGUACGUUA

Organism 2: UGCCACGGUU

Organism 3: AGGUACGGUA

2. Determine the GC ratio of the following stretch of DNA:

TAAGCCTGCAAGCTTAGCTAATTCGGACGTTCTGAATCGAT

3. Why aren't GC base ratios useful for making phylogenetic determinations? In what situation are GC base ratios of use in taxonomic studies?
4. Imagine that you are debating someone who is arguing against the theory of endosymbiosis. List five forms of evidence you would use to convince your opponent that endosymbiosis did occur.

Question 4. Answer any one (1) out of the three (3) questions.

(40 marks)

1. This question is composed of four (4) parts, all of which are to be answered.

- (i) Why are 16S rRNAs thought to be the best molecules for undertaking phylogenetic studies?
- (ii) What major evolutionary findings emerged from the study of 16S rRNA sequences?
- (iii) Describe and discuss the structure of 16S rRNA with respect to its functions in a bacterial cell.
- (iv) What are signature sequences and of what phylogenetic value are they?

OR

2. Briefly describe the different strategies available for obtaining a complete microbial genome sequence (ie ordered clone approach, shotgun approach). Describe one experimental approach in more detail including library construction, sequencing, gap filling and sequence analysis and annotation.

OR

3. Discuss the salient properties that allow members of domain Archaea to thrive in “extreme environments”. Provide examples.

END OF SECTION I

SECTION II

Answer questions in the supplementary answer book provided

Question 5: Answer any FOUR of the following six questions briefly (approximately a paragraph, or in note form). Answer in a separate examination booklet provided. Diagrams can be used if appropriate. Each question is worth 10 marks (total 40 marks for the section)

1. Outline the problems caused by microorganisms in industrial processes. What types of industries are affected in particular?
2. Discuss why microbiological testing programs are used in industry. Give some examples of tests undertaken.
3. What are the 3 ways microorganisms can be used beneficially in industry? What are the desired properties of industrial microorganisms?
4. How is penicillin produced industrially? What steps have been taken to improve the production since it was first discovered?
5. Why is yeast preferred over bacteria for the production of alcoholic beverages? Besides the production of alcoholic beverages, what other industrial processes utilise yeast?
6. The recovery of natural resources such as oil and metals are vital for our society. Explain how microorganisms can be used in the recovery of **either** oil from reservoirs **or** metals

END OF EXAM