



UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION
MARCH 2025 SEMESTER

COURSE CODE : HGB20603
COURSE TITLE : ENVIRONMENTAL MICROBIOLOGY
PROGRAMME NAME : BACHELOR OF ENVIRONMENTAL HEALTH (HONS)
DATE : 23 JUNE 2025
TIME : 2:00PM - 5:00PM
DURATION : 3 HOURS



INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. *Tick if applicable*
9. Refer to the attached Formula/ Appendies. *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Bacteria are described as the least structurally complex microorganisms, yet they have the greatest flexibility and diversity. This is because their relative simplicity allows them to _____.
 - A. maintain a stable internal environment
 - B. store large amounts of nutrients
 - C. avoid predation by other microbes
 - D. rapidly respond and adapt to changing conditions

2. What is the primary ecological role of fungi, such as molds and mushrooms, in the environment?
 - A. Decomposers
 - B. Primary producers
 - C. Chemolithotrophs
 - D. Nitrogen fixers

3. In filamentous fungi, what is the term for a mass of branching hyphae?
 - A. Mycelium
 - B. Chitin
 - C. Rhizoid
 - D. Conidia

4. An organism that uses inorganic compounds like H_2S or Fe^{2+} for energy and CO_2 as its carbon source is known as a _____.
- A. photoautotroph
 - B. photoheterotroph
 - C. chemolithotroph
 - D. chemoheterotroph
5. The vadose zone is best described as _____.
- A. the top layer of soil, rich in organic matter and microbial life
 - B. an unsaturated, oligotrophic environment between the surface soil and the water table
 - C. a saturated zone composed of porous parent material, also known as an aquifer
 - D. an area where the water table is at or above the Earth's surface, such as a swamp or marsh
6. An aerobic soil environment would be expected to have a _____.
- A. redox potential of -300 mV
 - B. positive redox potential
 - C. neutral redox potential
 - D. negative redox potential
7. The _____ is a multilayered, dormant form of bacterium, capable of withstanding adverse conditions such as heat, radiation, and desiccation.
- A. endospore
 - B. glycocalyx
 - C. plasmid
 - D. peptidoglycan

8. A key biochemical difference that distinguishes Archaea from Bacteria is that the cell wall of Archaea _____.
- A. contains a thick layer of peptidoglycan
 - B. compose of glycerol ester lipids
 - C. lacks peptidoglycan
 - D. compose primarily of chitin
9. Which class of plasmids encodes toxin genes in pathogenic bacteria?
- A. Fertility plasmid
 - B. Virulence plasmid
 - C. Degradative plasmid
 - D. Resistance plasmid
10. The production of antibiotics by one microbial species that harms or kills another is an example of _____ type of interaction.
- A. competition
 - B. parasitism
 - C. amensalism
 - D. commensalism
11. The process by which microorganisms interact to transform and cycle nutrients such as carbon, sulfur, and nitrogen through the environment is called _____.
- A. competitive exclusion
 - B. biogeochemical cycling
 - C. secondary succession
 - D. quorum sensing

12. The characteristic "earthy odor" of soil is produced by a compound called geosmin, which is produced by _____.
- A. Yeasts
 - B. Actinomycetes
 - C. *Pseudomonas*
 - D. Algae
13. In the process of nitrification in soil, which bacterial genus is responsible for converting ammonium (NH_4^+) to nitrite (NO_2^-)?
- A. *Nitrosomonas*
 - B. *Rhizobium*
 - C. *Nitrobacter*
 - D. *Acidithiobacillus*
14. Which of the following is NOT one of the five major soil-forming factors?
- A. Parent material.
 - B. Time.
 - C. Organisms.
 - D. Nutrient concentration.
15. The specific region around plant roots which contains a high concentration of microbes that are dependent on plant exudates is known as the _____.
- A. estuary
 - B. saturated zone
 - C. rhizosphere
 - D. ultrastructure

16. Which of the following is an example of a biotic stress factor in the soil environment?
- A. Low concentrations of carbon and nitrogen.
 - B. A soil pH range between 6 and 8.
 - C. Fluctuation in soil moisture.
 - D. Secretion of antibiotics by one microbe that harms another.
17. The microbes in bioaerosols are typically associated with _____.
- A. reactive oxygen species
 - B. a pure gaseous phase
 - C. other particles like dust or water
 - D. a nutrient-rich medium
18. 'PM10' refers to airborne particles with an aerodynamic diameter _____.
- A. greater than or equal to $10\mu\text{m}$
 - B. less than or equal to $10\mu\text{m}$
 - C. equal to $2.5\mu\text{m}$ exactly
 - D. equal to $10\mu\text{m}$ exactly
19. Compared to extramural environments, intramural environments provide suitable conditions for the accumulation of microbes primarily because they have _____.
- A. a lower concentration of nutrients
 - B. more air turbulence and higher humidity
 - C. higher concentrations of ozone and hydrocarbons
 - D. less UV radiation and controlled temperatures

20. What is the primary reason that smaller aerosol particles, such as PM_{2.5}, are generally a greater health concern than larger ones?
- A. They carry a higher electrical charge.
 - B. They tend to move farther into the respiratory system.
 - C. They are more likely to contain fungal spores.
 - D. They are composed of more toxic materials.
21. The heat-stable DNA polymerase enzyme isolated from the thermophile *Thermus aquaticus* is a critical component of which major biotechnology process?
- A. Fermentation
 - B. Bioremediation
 - C. DNA sequencing
 - D. Polymerase Chain Reaction (PCR)
22. An organism that thrives in an environment with a pH below 5, such as in the waters of an acid mine, is called an _____.
- A. thermophile
 - B. halophile
 - C. acidophile
 - D. alkaliphile
23. What is the primary osmotic challenge that a halophile must overcome to survive in a high-salinity environment?
- A. Synthesizing heat-stable proteins to prevent denaturation.
 - B. Maintaining an internal osmotic potential equal to the external environment to prevent water loss.
 - C. Pumping out excess water that passively enters the cell.
 - D. Preventing the cell wall from breaking down due to low ion concentration.

24. What is the general term for the unique enzymes produced by extremophiles that are capable of functioning in extreme conditions?
- A. Allozymes
 - B. Extremozymes
 - C. Isozymes
 - D. Ribozymes
25. A microbe that is adapted to thrive in high-temperature environments such as thermal vents and hot springs is known as a _____.
- A. psychrophile
 - B. thermophile
 - C. acidophile
 - D. halophile
26. Which group of pathogens causes most cases of Traveller's diarrhea?
- A. Bacteria
 - B. Helminths
 - C. Viruses
 - D. Fungi
27. *Helicobacter pylori* is a spiral-shaped bacterium that is the major cause of _____.
- A. hemolytic uremic syndrome (HUS)
 - B. liver infection
 - C. peptic ulcers and chronic gastritis
 - D. acute diarrhoeal infection

28. Which of the following is a characteristic symptom of giardiasis?
- A. Jaundice.
 - B. Bloody stools.
 - C. Leg cramps.
 - D. Greasy stool that can float.
29. The significant decline in Hepatitis A cases over the last several decades is primarily the result of _____.
- A. the vaccination of people at risk
 - B. improved sewage treatment
 - C. the development of new antibiotics
 - D. stricter regulations on food handling
30. What is the pathogenic mechanism of Shigellosis?
- A. It causes a highly contagious liver infection.
 - B. It produces a neurotoxin that causes paralysis.
 - C. It grows in the mucus lining of the stomach.
 - D. It invades and destroys epithelial cells of the colon.
31. Botulism is a foodborne illness most commonly associated with _____.
- A. a human carrier inoculating food during preparation
 - B. the germination of endospores in improperly canned low-acid foods
 - C. the consumption of undercooked ground meats
 - D. cross-contamination from raw poultry

32. Microbes multiply most rapidly in foods that are _____.
- A. moist, nutrient-poor, and alkaline
 - B. moist, nutritionally rich, and pH neutral
 - C. dry, nutrient-poor, and acidic
 - D. dry, nutritionally rich, and pH neutral
33. What is the primary reason spoiled food is considered unsafe?
- A. It is always toxic and harmful if consumed.
 - B. A high number of spoilage organisms may be a sign that foodborne pathogens are present.
 - C. It has lost all of its nutritional value.
 - D. The taste and smell are unpleasant.
34. The transfer of *Salmonella* from raw poultry to a vegetable on a shared cutting board is an example of _____.
- A. pasteurization
 - B. fermentation
 - C. cross-contamination
 - D. food intoxication
35. What is the primary goal of pasteurization?
- A. To destroy all organisms, including endospores.
 - B. To reduce the number of spoilage organisms without significantly altering taste.
 - C. To stop microbial growth by making water unavailable as ice.
 - D. To inhibit microbial growth by decreasing water availability.

36. According to the Biodegradation Triangle, which of the following is one of the essential components required for biodegradation to occur?
- A. Electron acceptors.
 - B. Cometabolism.
 - C. Acclimatization period.
 - D. Environmental conditions.
37. What is the term for the transformation of an organic compound by a microorganism that unable the compound as an energy source?
- A. Anaerobic respiration
 - B. Cometabolism
 - C. Mineralization
 - D. Fermentation
38. Bioremediation that depends only on the natural ability of microbes to break down contaminants, without any human help or added stimulation, is called _____.
- A. bioventing
 - B. ex situ bioremediation
 - C. intrinsic bioremediation
 - D. in situ bioremediation
39. Bioremediation of a contaminated site can be improved by adding _____ to stimulate the natural microorganisms.
- A. an electron acceptor, nutrients, and an energy source
 - B. chemical surfactants to dissolve contaminants
 - C. new, genetically engineered bacteria
 - D. a mechanism to increase the temperature to sterilizing levels

40. Which of the following classes of compounds is the most difficult to degrade?
- A. Simple hydrocarbons.
 - B. Alcohols and esters.
 - C. Chlorinated hydrocarbons.
 - D. Aromatic hydrocarbons.

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

The atmosphere is generally an inhospitable environment for microorganisms due to various physical and chemical stresses. However, different microbes possess characteristics that influence their ability to survive and remain viable in the air.

- (a) Examine how relative humidity acts as a critical environmental factor influencing the airborne survival of both Gram-positive and Gram-negative bacteria.
(6 marks)

- (b) Differentiate how high temperature and radiation inactivate airborne microorganisms.
(6 marks)

- (c) Identify the similarity and difference on the survival of enveloped viruses and naked viruses in aerosols with respect to relative humidity.
(4 marks)

- (d) Distinguish between microbial inactivation caused by oxygen toxicity and by Open Air Factors (OAFs).
(4 marks)

Question 2

Understanding the causes of foodborne illness and the principles of food preservation are fundamental to food microbiology.

- (a) Differentiate between foodborne intoxication and foodborne infection.
(10 marks)

- (b) Determine how different food preservation methods suppress microbial growth by adjusting the intrinsic and extrinsic factors.
(10 marks)

Question 3

Microbial ecology is the study of the complex relationships between microorganisms and their environment. These interactions, both positive and negative, are fundamental in shaping the structure and function of microbial communities.

- (a) Identify the similarity and difference of the symbiotic relationships between mutualism and cooperation.
(8 marks)

- (b) Differentiate between the interactions of predation and parasitism in a microbial context.
(6 marks)

- (c) Examine the role of commensalism in the development of a microbial community,
(6 marks)

Question 4

The bacterium *Vibrio cholerae* is a significant water-borne pathogen responsible for the acute disease called cholera. A comprehensive understanding of this agent and illness is important to ensure effective strategies are used to manage and control its spread.

- (a) Differentiate between the environmental reservoir of *Vibrio cholerae* and the primary source of bacterial contamination during a cholera epidemic.
(4 marks)
- (b) Outline the progression of symptoms in a severe cholera infection.
(6 marks)
- (c) Distinguish between the treatment strategies for mild cholera infections and those required for severe infections.
(4 marks)
- (d) Identify six strategies that can be used for preventing the spread of cholera.
(6 marks)

END OF EXAMINATION PAPER

