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University Examinations 2024/2025

THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF MEDICAL MICROBIOLOGY

HMM 3316: TECHNIQUES IN MOLECULAR GENETICS

DATE: JANUARY 2025 **TIME: 3 HOURS**

INSTRUCTIONS:
Answer ***All*** *questions*
Ensure that all your answers are properly numbered
Part I multiple Choice Questions (MCQ): Write the correct answer on the space provided in the answer booklet. Each MCQ is one mark
Part II: Short Answer Questions – Answer questions following each other on the answer booklet
Part III: Long Answer Questions – Answer each question on the answer booklet

SECTION A: MULTIPLE CHOICE QUESTIONS (20 marks)

1. What is the basic structure of DNA?

   A) DNA is a single-stranded helix.

   B) DNA is a double-stranded helix.

   C) DNA is a triple-stranded helix.

   D) DNA is a circular structure.

2. Which of the following describes a function of RNA?

   A) RNA stores genetic information.

   B) RNA catalyzes biochemical reactions.

   C) RNA synthesizes proteins.

D) RNA performs all of the above functions.

3. What is the primary purpose of phenol-chloroform extraction in nucleic acid isolation?
   A) The method is used to precipitate DNA.
   B) The method separates DNA from proteins.
   C) The method removes RNA from samples.
   D) The method concentrates nucleic acids.
4. Which technique is commonly employed for RNA extraction from microbial samples?
   A) Phenol-chloroform extraction is the only method used.
   B) Column-based purification is commonly employed.
   C) Magnetic bead-based isolation is commonly used.
   D) All of the above techniques are utilized.
5. What is the main principle of PCR?
   A) Amplification of specific DNA sequences.
   B) Separation of DNA fragments based on size.
   C) Sequencing of DNA molecules.
   D) Visualization of proteins in a sample.
6. Which variant of PCR is used for quantifying DNA?
   A) Reverse transcription PCR (RT-PCR).
   B) Quantitative PCR (PCR).
   C) Nested PCR.
   D) Multiplex PCR.
7. What role does Taq polymerase play in PCR?
   A) Taq polymerase degrades DNA.
   B) Taq polymerase synthesizes DNA.
   C) Taq polymerase denatures DNA.
   D) Taq polymerase ligates DNA fragments.
8. What is the primary purpose of gel electrophoresis?
   A) Amplification of DNA sequences.
   B) Separation of DNA fragments based on size.

C) Sequencing of DNA molecules.

D) Purification of proteins from a sample.

9. Which type of gel is typically used for separating larger DNA fragments?

A) Agarose gel is preferred for larger fragments.

B) Polyacrylamide gel is used for large fragments.

C) Starch gel is commonly used.

D) Cellulose gel is effective for larger fragments.

10. What is the primary purpose of Western blotting?

A) Western blotting is used for DNA sequencing.

B) Western blotting separates and identifies proteins.

C) Western blotting analyzes RNA samples.

D) Western blotting amplifies DNA sequences.

11. What is used to detect specific proteins in Western blotting?

A) Nucleotides are used in detection.

B) Antibodies are utilized for detection.

C) Primers are necessary for detection.

D) Gel stains are employed for visualization.

12. What does the Southern blotting technique primarily detect?

A) Southern blotting detects RNA molecules.

B) Southern blotting identifies proteins.

C) Southern blotting detects DNA fragments.

D) Southern blotting analyzes lipids.

13. What is the main difference between Southern blotting and Northern blotting?

A) Southern blotting detects proteins, while Northern blotting detects DNA.

B) Southern blotting detects RNA, while Northern blotting detects DNA.

C) Southern blotting detects DNA, while Northern blotting detects RNA.

D) There is no difference between the two techniques.

14. What is the primary use of ELISA in microbiology?
    A) ELISA is used for detecting DNA sequences.
    B) ELISA is employed for measuring RNA levels.
    C) ELISA detects microbial antigens or antibodies.
    D) ELISA amplifies DNA samples.
15. What is the role of the enzyme linked to the antibody in ELISA?
    A) The enzyme degrades the antigen.
    B) The enzyme amplifies the signal for detection.
    C) The enzyme binds specifically to the target antigen.
    D) The enzyme acts as a substrate for reactions.
16. What is the first step in the molecular cloning process?
    A) Transformation of host cells is initiated.
    B) Insertion of DNA into a vector is performed.
    C) Isolation of the target DNA is conducted.
    D) Screening for recombinant clones is carried out.
17. Which of the following is commonly used as a vector in molecular cloning?
    A) Plasmids are often used as vectors.
    B) PCR products serve as vectors.
    C) Gel electrophoresis is used as a vector.
    D) RNA transcripts function as vectors.
18. What is a key feature of Sanger sequencing?
    A) The method uses fluorescent dyes to label nucleotides.
    B) The method amplifies DNA prior to sequencing.
    C) The method uses RNA as a template for sequencing.
    D) The method sequences proteins instead of DNA.
19. What type of DNA fragments are generated during Sanger sequencing?
    A) Sanger sequencing produces equal-sized fragments.
    B) Varying lengths of fragments terminated by dideoxynucleotides are produced.
    C) Only large DNA fragments are generated.

D) Sanger sequencing produces single-stranded fragments exclusively.

20. What is a key advantage of Next-Generation Sequencing (NGS) over traditional sequencing methods?
    A) NGS offers higher accuracy than traditional methods.
    B) NGS can sequence multiple genomes simultaneously.
    C) NGS provides a lower cost per base sequenced compared to traditional methods.
    D) Both B and C highlight advantages of NGS.

SECTION B: SHORT ANSWER ALL QUESTIONS (40 MARKS)

a) Describe the principle of separation in gel electrophoresis (6 marks)

b) Tabulate differences between Southern and Northern blotting (6 marks)

c) In western blotting, distinguish the purpose of the primary and secondary antibodies (5 marks)

d) Outline the key components in ELISA (5 marks)

e) Describe the key components of molecular cloning (5 marks)

f) Describe the steps in PCR (6 marks)

g) List the applications of Next Generation Sequencing in microbial genomics (7 marks)

SECTION C: LONG ANSWER TWO QUESTIONS (40 MARKS)

QUESTION ONE

Discuss the key steps in western blotting (20 marks)

QUESTION TWO

Discuss the key steps in DNA/ RNA extraction (20 marks)

QUESTION THREE

Discuss the Sanger sequencing procedure (20 marks)