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QUALIFICATION: **BACHELOR of MEDICAL LABORATORY SCIENCES**	
QUALIFICATION CODE: **08BMLS**	LEVEL: **6**
COURSE: **MOLECULAR DIAGNOSTICS**	COURSE CODE: **MOD621S**
DATE: **JANUARY 2025**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

SECOND OPPORTUNITY / SUPPLEMENTARY: EXAMINATION QUESTION PAPER

EXAMINER: ***Ms Vanessa Tjijenda***

MODERATOR: ***Mrs Roselin Belinda Tsauses***

INSTRUCTIONS:

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS:

1. Non-Programmable Calculator

ATTACHEMENTS

1. None

This question paper consists of 5 pages including this front page.

SECTION A: TRUE / FALSE [14 MARKS]

QUESTION 1: **[14 MARKS]**

Evaluate the statements and select whether the statement is true or false. Write the word 'True' or 'False' next to the corresponding number on your ANSWER SHEET.

1.1 Loading dye is used in gel electrophoresis to add weight and colour to the DNA. (1)

1.2 Chloroform is used to prevent foaming during nucleic acid extraction. (1)

1.3 In preparing 0.8 % agarose gel, 0.8 g agarose is dissolved in 250ml TAE buffer. (1)

1.4 Fluorescent in situ Hybridization is used to diagnose Philadelphia Chromosome in leukaemia patients. (1)

1.5 The detection of novel mutations in a gene is achieved by microarray. (1)

1.6 NGS technology that sequence DNA via three basic processes: amplify, sequencing and analyse using a bridging method is called pyrosequencing. (1)

1.7 The melting temperature of a primer is calculated using the following formula: 4(G+C) + 2 (A+T). (1)

1.8 **ACCTAGGT** is a palindrome sequence. (1)

1.9 Lysozyme inactivates nucleases. (1)

1.10 Short tandem repeats are found in the non-coding region of the DNA in each individual. (1)

1.11 Central Dogma of Molecular Biology includes translation, transcription and reverse transcription. (1)

1.12 When choosing a restriction enzyme, blunt sites are optimal for cloning. (1)

1.13 After 6 cycles of a PCR, 64 copies are created. (1)

1.14 Heparin is the preferred anticoagulant for blood specimen collected for molecular analysis. (1)

SECTION B: SHORT ANSWER QUESTIONS [50 MARKS]

Please answer ALL of the questions in this section.

QUESTION 2 [12]

2.1 Explain the function of the following enzymes:

2.1.1 RNA polymerase (1)

2.1.2 Proteinase K (1)

2.1.3 T4 PolynucleatideKinase (1)

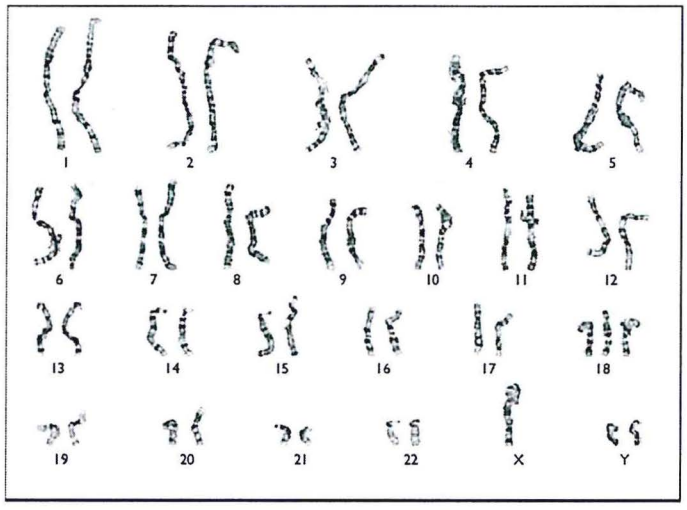
2.1.4 Taq polymerase (1)

2.1.5 Reverse transcriptase (1)

2.1.6 Type II restriction endonucleases (1)

2.1.7 S1 Nuclease (1)

2.2 A baby with Edwards' syndrome has chromosomal abnormality as observed in the image below. This affects the way the baby grows and develops. This abnormality usually happens by chance, because of a change in the sperm or egg before a baby is conceived.



2.2.1 Identify the chromosomal abnormality observed in the image above. (2)

2.2.2 Which molecular test is performed to identify the abnormality? (1)

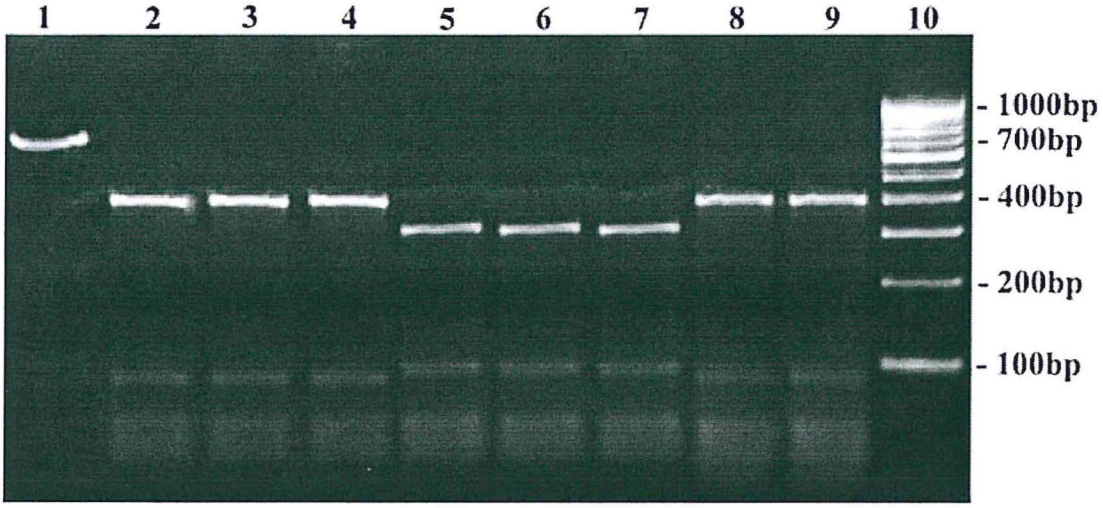
2.2.3 Briefly describe the probes used to detect the abnormality? (2)

QUESTION 3 [20]

3.0 Analyse the case study below and answer the question.

"On August 28, 2022, the Ministry of Health and Social Services was notified by a private hospital emergency department of a suspected foodborne outbreak. On the previous day, 4 members of a sports team were admitted to the emergency room with complaints of abdominal pain, nausea, vomiting, and diarrhoea; all patients reported to have had the same dinner at the same local restaurant 3 h before. They did not eat together at any other restaurant on the day they became unwell. Two of these patients needed medical care. From 8.30 to 9.30 p.m., a total of 42 meals were served and at 11.30 p.m., the first set of customers started manifesting gastrointestinal symptoms. Microbiological analyses of biological, hand swabs from the food handlers, and food samples were performed, and an epidemiological investigation was conducted to characterize the outbreak."

Results obtained from the samples analysed from NIP molecular unit are shown below:



Lane 1 is the positive control; **Lane 2** is from one of the food handlers sample; **lane 3 & 4** is dessert (cream cheesecake) eaten by the team members; **lane 5-7** is from the environmental surfaces; **lane 8 & 9** is from the stool samples from the two team members. **Lane 10** is the DNA ladder.

3.1 Explain the principle of Polymerase Chain Reaction. (2)

3.2 Identify and describe the reagents that form part of a "master mix" in a qPCR and their function. (10)

3.2 Discuss the results from the laboratory in relation to the report above. (8)

QUESTION 4: **[18]**

4.0 Tabulate Northern, Southern and Western blot techniques based on:

4.1 Sample type (3)

4.2 Probe used (3)

4.3 Gel type (3)

4.4 Detection method (3)

4.5 Principle (6)

SECTION B: LONG ANSWER QUESTIONS [36 MARKS]

Please answer ALL of the questions in this section.

QUESTION 5:

5.1 Microarray is a technique used for gene expression profiling. Discuss in detail the principle of this technique and mention one advantage and one disadvantage of using this method. (10)

5.2 Nested PCR and Touch Down PCR are Conventional PCR method that can be modified to increase specificity. Explain how specificity is achieved in each method. (16)

5.3 Explain the steps involved in Pyrosequencing in the correct order. (10)

END OF QUESTION PAPER