UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

MARCH 2025 SEMESTER

COURSE CODE	:	HDB30903
COURSE TITLE	:	MOLECULAR DIAGNOSTIC TECHNOLOGY
PROGRAMME NAME	:	BACHELOR OF BIOMEDICAL SCIENCE (HONOURS)
DATE	:	04 JULY 2025
TIME	:	3:00PM - 6:00PM
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*

THERE ARE 8 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Answer the following questions:

(a) Define gel electrophoresis.

(2 marks)

(b) State the components of agarose gel electrophoresis.

(4 marks)

(c) Compare Southern Blotting with Northern Blotting.

(4 marks)

Question 2

Answer the following questions:

(a) Describe the function of each reagent in regards to DNA extraction:

i. Ethanol

(2 marks)

ii. Phenol

(2 marks)

(b) Each group in a laboratory prepares a primer mix. The forward and reverse primers are at a concentration of 100 µM each. The primer mix is prepared by combining 5 µl of each two primers to give a total combined volume of 10 µl. Calculate the new concentration of each primer. Show working calculations in your answer.

(6 marks)

Question 3

Answer the following questions:

(a) Define DNA sequencing.

(1 marks)

(b) Describe **THREE (3)** benefits of Human Genome Project.

(3 marks)

(c) Discuss the advantages and disadvantages of Next Generation Sequencing.

(6 marks)

Question 4

Answer the following questions:

(a) State **TWO (2)** methods to purify proteins.

(2 marks)

(b) Explain the steps to do Western Blotting.

(8 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Answer the following questions:

(a) Describe the actions that should be taken under the following situations:

i. An unlabeled collection tube with a requisition for a V Leiden test is received in the laboratory.

(2 marks)

ii. After PCR, the amplification control has failed to yield a product.

(2 marks)

iii. DNA is stored overnight in a refrigerator set at 8°C but due to thermostat problem, the actual temperature is 14 °C

(2 marks)

iv. An isolated DNA sample is to be stored for at least 6 months.

(2 marks)

v. The expiration date on a reagent has passed.

(2 marks)

(b) Explain briefly about prenatal genetic testing, including the importance of prenatal genetic testing and the disorder that it can detect.

(5 marks)

(c) Describe the ethical concerns related to genetic diagnosis and genetic screening.

(5 marks)

Question 2

A 6-month-old infant is experiencing frequent respiratory infections, persistent coughing, and salty-tasting skin. The physician suspects a genetic disorder called cystic fibrosis. The family has no known history of the condition.

Answer the following questions:

(a) Define each the following term, and provide **ONE (1)** example each:
(i) Autosomal dominant disorder
(ii) Autosomal recessive disorder
(iii) Trinucleotide repeat expansion disorder

(6 marks)

(b) Describe the molecular basis of cystic fibrosis.

(2 marks)

(c) Identify **TWO (2)** molecular tests that can be used to diagnose cystic fibrosis, and briefly explain the steps involved in performing each test.

(12 marks)

Question 3

A plasmid was digested with the enzyme, Hpa*II*. Sara observed three bands; 100, 230, and 500 base pair (bp), on the agarose gel.

Using the information above, answer the following questions:

(a) Identify the number of *Hpa*II sites present on this plasmid. Explain your answer.

(4 marks)

(b) Calculate the size of the plasmid. Show your working calculation.

(2 marks)

(c) A second cut of the plasmid with *Bam*H1 yields two pieces; 80 bp and a fragment of unknown size. Using this information, answer the following questions:

i. Identify the number of *Bam*H1 sites in the plasmid. Explain your answer.

(3 marks)

ii. Calculate the size of the unknown fragment in base pair (bp). Show your working calculation.

(2 marks)

(d) Explain the steps involved in the DNA cloning process.

(5 marks)

(e) Describe **TWO (2)** benefits of cloning.

(4 marks)

Question 4

During a holiday weekend at a luxury hotel, guests began to complain of stomach flu with nausea and vomiting. More than 100 of the 200 guests who had dined at the hotel on the previous evening described the same symptoms. Eight people had symptoms severe enough to warrant hospitalization. However, most of them recovered within 24-48 hours of the onset of symptoms. Health officials were notified. Interviews and epidemiological analyses pointed to a Norwalk-like virus, or Norovirus, infection, probably foodborne. Stool specimens and specimens from suspected food sources were sent for laboratory analysis by quantitative reverse transcription polymerase chain reaction (qRT-PCR). Strain-specific PCR primers were used to amplify the viral gene. The amplicons, resolved by agarose gel electrophoresis, are shown in the figure below (Gel 1 and Gel 2). Direct sequencing of the qRT-PCR products revealed identical sequences for all positive specimens, confirming that all amplified products are consistent with Norovirus.

Legend:

Gel 1: amplicons from four affected individuals (lanes 1-4); lane 5, positive control; lane 6, sensitive control; lane 7, negative control; lane 8, reagent blank. Gel 2: Specimens from suspected food sources (lane 1, chicken; lane 2, lettuce; lane 3-4, fruits); lane 5, salad lettuce from the distributor; lane 6-8, specimens from three hotel employees working the day of the outbreak; lane 9, molecular weight.

Refer Below - Figure1 : qRT-PCR products were resolved on a separate gel. .

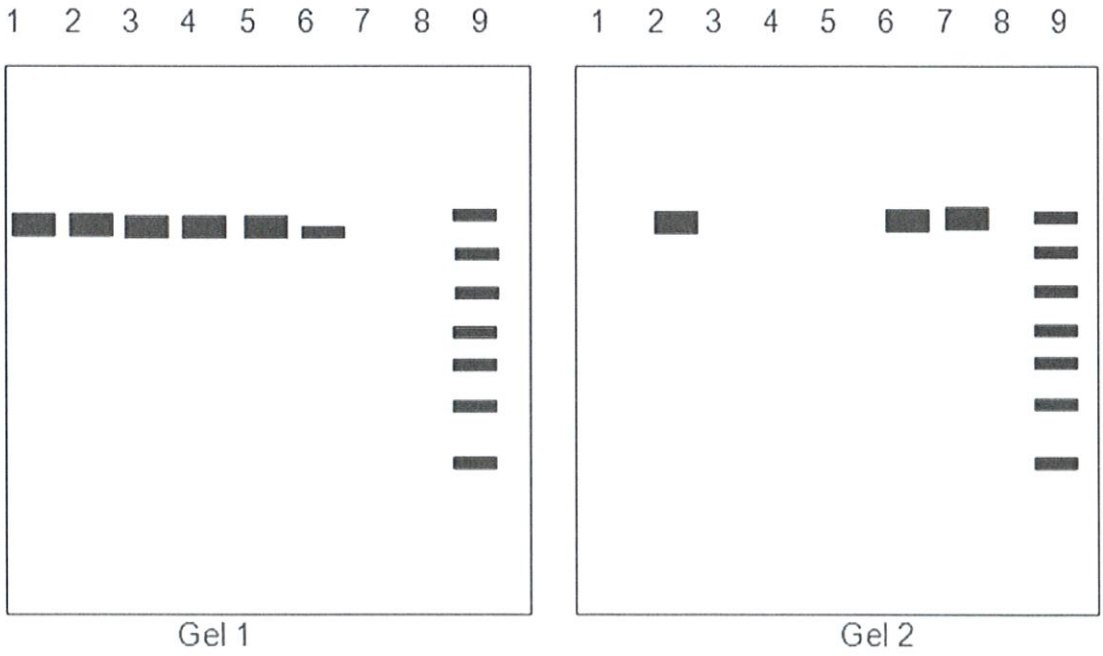

Figure 1: qRT-PCR products were resolved on a separate gel.

(a) Describe **THREE (3)** differences between quantitative reverse transcription PCR versus conventional PCR.

(6 marks)

(b) Which of these patients have Norovirus? Justify your answer.

(2 marks)

(c) Identify the source(s) of food that may contain Norovirus. Justify your answer.

(2 marks)

(d) If you were asked to amplify a DNA sequence through conventional PCR, state the reagents or components needed, including their functions.

(10 marks)

END OF EXAMINATION PAPER