Candidate Number……

"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES
DEPARTMENT OF BIOMEDICAL AND LABORATORY SCIENCES

NSLS 105 GENETICS AND MOLECULAR BIOLOGY

END OF SEMESTER FINAL EXAMINATION

NOVEMBER 2022

LECTURER: MRS L. KASHIRI

DURATION: 3HRS

INSTRUCTIONS

Write your Student Number on the top of every page of this question paper

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Section A: Ten (20) Multiple Choice Questions
State whether each statement is True (T) or False (F)
Answer **ALL** questions onto this question paper

Section B: Answer **ALL** questions on the separate answer sheet provided
Write your Student Number on every page that you use

Section C: Answer any **THREE (3)** out of **FIVE (5)** questions on the separate answer sheet provided
Write your Student Number on every page that you use

Candidate Number……

Section A: Answer **ALL** questions **[40 marks]**

Circle True (T) **OR** False (F)

1. Prokaryotes differ from eukaryotes in that

T F (a) Eukaryotic genome is more complex than that of prokaryotes.
T F (b) Cell division is by mitosis in eukaryotes and meiosis in prokaryotes.
T F (c) Eukaryotic DNA is linear and prokaryotic DNA is circular
T F (d) DNA in eukaryotes is wound on proteins called histones and that in prokaryotes is naked.

2. The features of Mitosis and Meiosis are

T F (a) Mitosis is division of somatic cells, meiosis is division of sex cells
T F (b) division occurs twice in meiosis and once in mitosis
T F (c) Sex cells are produced by mitosis
T F (d) mitosis produces diploid cells

3. Which of the following is not a stage of mitosis?

T F (a) Anaphase
T F (b) Metaphase
T F (c) Interphase
T F (d) Prophase

4. The nucleic acid sequence in mRNA is determined by

T F (a) The order of amino acids in the protein
T F (b) Nucleotide sequence in DNA
T F (c) Nucleotide sequence in t-RNA
T F (d) addition of other molecules like sugars and lipids

5. In Genetic diseases: -

T F (a) the diseases are always inherited
T F (b) the diseases are always inherited in an autosomal recessive fashion
T F (d) laboratory diagnosis is only confirmed by PCR
T F (e) Gene therapy is not useful as a treatment option.

6. The PCR technique involves the use of

T F (a) Synthesized oligonucleotide primers
T F (b) Cloned probes
T F (c) DNA polymerase
T F (d) Metaphase chromosomes

7. The following are key ingredients of polymerase chain reaction:

T F (a) Buffer with magnesium chloride

T F (b) Nucleotides
T F (c) DNA template
T F (d) Helicases

8. Disadvantages of using allele-specific oligonucleotides for genetic diagnosis include:
T F (a) Part of the gene's DNA sequence must be known
T F (b) Other family members affected with the disorder must also be studied
T F (c) A different oligonucleotide must be used for each disease-causing mutation
T F (d) The mutation must occur at a restriction site

9. Dineo is said to be suffering from Albinism which is an autosomal dominant related disease, which of the following could be his genotype?
T F (a) Ss
T F (b) ss
T F (c) sq
T F (d) SS

10. Sickle-cell disease is the result of a single nucleotide substitution that produces a single amino acid substitution. This is best described as a
T F (a) Frameshift mutation
T F (b) Nonsense mutation
T F (c) Missense mutation
T F (d) Duplication mutation

11. The following is a sequence of a DNA strand:

TTTCCTAATGGTTTTCCCAACGGT

Which of the following would be the corresponding RNA strand.

T F (a) TTTCCTAATGGTTTTCCCAACGGT
T F (b) AAAGGAUUACCAAAAGGGUUGCCA
T F (c) AAAGGATTACCAAAAGGGTTGCCA
T F (d) None of the above

12. Arrange the following steps about ELISA (Enzyme-linked immunosorbent assay) in chronological order.

i. incubate with antibody-enzyme complex that binds primary antibody
ii. coat surface with antigen, block unoccupied sites with nonspecific protein
iii. add substrate, formation of colored product indicates presence of specific antigen
iv. incubate with primary antibody against specific antigen

T F (a) i, iv, ii, iii
T F (b) i, iv, iii, ii
T F (c) ii, iv, iii, i
T F (d) ii, iv, i, iii

13. What is/are the most appropriate confirmation tests for hepatitis B?
T F (a) surface antigen (HBsAg) screening
T F (b) enzyme immunoassay (EIA)
T F (c) Flow cytometry
T F (d) Chromatography

14. Which of the processes are linked to post transcriptional modifications
T F (a) splicing of Exons
T F (b) splicing of Introns
T F (c) Addition of the polyA tail
T F (d) addition of other molecules like sugars and lipids

15. The following processes take part in gene expression.
T F (a) Transcription
T F (b) RNA processing
T F (c) Replication
T F (d) Translation

16. Which of the following can be used for the separation of nucleic acids?
T F (a) Northern Blotting
T F (b) Southern blotting
T F (c) Western blotting
T F (d) Microarrays

17. DNA sequencing refers to a technique used to determine the:
T F (a) sugar sequence in a DNA molecule.
T F (b) phosphate sequence in a DNA molecule.
T F (c) base sequence in a DNA molecule.
T F (d) amino acid sequence in a DNA molecule.

18. Semiconservative replication of DNA means
T F (a) only one strand is used as a template
T F (b) a double-stranded DNA is split into two single-stranded DNAs
T F (c) only half the genes are copied into the new cells
T F (d) each DNA made contains one old strand and one new strand.

19. Regarding HIV antibody assays, which is correct about third generation antibody assays?
T F (a) Uses whole virus lysate
T F (b) Uses IgM + IgG
T F (c) Uses antibodies + P24 antigen
T F (d) Uses Recombinant virus protein + P24 antigen.

20. Which of the following have been mismatched?
T F (a) Polymerase – Taq polymerase
T F (b) Template – double stranded DNA

T F (c) Primer – oligonucleotide
T F (d) Synthesis – 5’ to 3’ direction

Section B: Answer **ALL** questions on the separate answer sheet provided **[20 marks].** Answer each question on a fresh page.

1. Write short notes on the following
   (a) DNA polymerase and RNA polymerase [5]
   (b) Start and stop codons [5]
   (c) DNA sequencing [5]
   (d) Laboratory Hygiene in a PCR Lab [5]

Section C: Essay type questions **[75 marks]**

Answer any **THREE (3)** questions on the separate answer sheet provided. Each question carries **25 marks**

1. Successful control of a disease requires accurate diagnosis. Modern biotechnology offers many applications to diagnose diseases caused by pathogens as well as diseases caused by intrinsic genetic disorders of an organism. Discuss **THREE (3)** of the currently available and deployed molecular techniques used in laboratory diagnosis of diseases clearly outlining the principles behind the techniques **[25].**

2. (a) Discuss the similarities and differences in Eukaryotic and Prokaryotic DNA Replication **[12]**

   (b) Describe how theories around DNA replication, transcription and translation are being exploited for industrial use. **[13]**

3. (a) A newly married couple wants to have a baby. Both the husband and wife however, are carriers of an autosomal recessive trait of the disease called TAY-SACHS. With the aid of a diagram, give a description of the possibility of their child developing the genetic disorder TAY – SACHS. **[10].**

   (b) Hereditary diseases often present with no previous family history of the disorder. Briefly describe three situations in which you would be most likely to observe a genetic disorder for which there is no previous family history of the disease phenotype (three brief sentences with short explanations should be sufficient). **[15].**

4. (a)You are employed in a molecular biology laboratory at a referral hospital where you are supposed to evaluate antimicrobial resistance in an unknown bacteria from a pus swab. Outline procedures that you will do in the laboratory to identify the bacteria and establish antimicrobial resistance in the bacteria. **[20].**

   (b) Outline the mechanisms by which bacteria acquire antimicrobial resistance **[5].**

5. (a) Outline the features of the genetic code. **[13]**

   (b) The ability of a cell to switch a gene on or off (gene regulation) is an important survival mechanism in prokaryotes. Explain how lactose fermenting bacteria like *Escherichia coli* are able to regulate the metabolism of lactose in their environment **[12]**

THE END