BRIDGING EXEMPTION TEST
BIOLOGY (100 MARKS)

INSTRUCTIONS TO CANDIDATE:

1. **Do not open this question paper until you are told to do so.**
2. **Answer all questions.**
3. **All answers must be written in the answer booklet provided. Use a new page for each question.**
4. **All steps must be shown clearly.**
5. **Only non-programmable and non-graphing scientific calculators can be used.**
6. **You are not permitted to take the exam paper and the answer booklet(s) out of the exam hall.**

WARNING!

Students caught copying/cheating during the examination will be liable for disciplinary actions and SPACE may recommend the student to be expelled from the study.

PART A: MULTIPLE CHOICE QUESTIONS (70 MARKS)

Read each question carefully and select the best answer from the options provided.

1. Which biomolecule is distributed more widely in a cell?

   A. Chloroplast
   B. RNA
   C. DNA
   D. Lipid

2. Disulphide bonds may be formed in a protein's:

   I. Primary structure
   II. Secondary structure
   III. Tertiary structure
   IV. Quaternary structure

   A. I and II
   B. II and III
   C. II and IV
   D. III and IV

3. After a long period of fasting (not consuming any food), a person's urine sample is found to have high levels of nitrogen. What is the most likely explanation for this finding?

   A. Breakdown of body's protein
   B. Excessive secretion of insulin
   C. Hydrolysis of carbohydrates
   D. Breakdown of body's lipid

4. Which of the following contains a five-carbon sugar?

   I. DNA
   II. RNA
   III. Maltose
   IV. Glycogen

   A. I and II
   B. III and IV
   C. II, III and IV
   D. I, II, III and IV

5. Beta amylase is an enzyme that breaks down polysaccharides into component monosaccharides, are present in yeasts, bacteria and plants, but is absent in humans. Beta amylase is most effective in digesting which of the following?

    A. Glucose
    B. Starch
    C. Glycogen
    D. Cellulose

6. A frozen lake in winter with fish swimming below the surface is possible because of which property of water?

    A. Cohesion
    B. Adhesion
    C. Low molecular weight
    D. Universal solvent

7. Water carries out all of the following functions in life, except as a:

    A. Lubricant
    B. Cooling agent
    C. Source of Carbon
    D. Chemical agent

8. A polysaccharide is a polymer consisting of many units of _____ linked together through condensation.

    A. Monosaccharides
    B. Amylopectin
    C. Pentose
    D. Hexose

9. Which of the following are correct pairings of bases within the DNA double helix?

    A. Cytosine-adenine; thymine-guanine
    B. Cytosine-guanine; adenine-thymine
    C. Guanine-adenine; thymine-cytosine
    D. All of these are correct, base-pairing is a random process

10. Statements listed below are portions of a cell theory **EXCEPT**:

    A. All cells have nucleus.
    B. All organisms are composed of cells.
    C. New cells arise from preexisting cells.
    D. Cells are the basic functional unit of living things.

11. Which of the following clues would tell you whether a cell prokaryotic or eukaryotic?

A. The presence or absence of ribosomes.
B. The presence or absence of a rigid cell wall.
C. Whether or not the cell contains DNA.
D. Whether or not the cell is partitioned by internal membranes.

12. Which if the following are true about the functions of cytoskeletons?

I. They provide mechanical support to the cell, preventing tissues from collapsing.
II. They involve in transporting vesicles both towards the cell's plasma membrane and away from plasma membrane.
III. Absence or abnormal arrangement of cytoskeleton would greatly impair chromosomes separation in cell division.

A. I and II
B. I and III
C. II and III
D. I, II and III

13. Which structure is unique to plant cells and not found in most animal cells?

A. Nucleus
B. Cell wall
C. Mitochondrion
D. Endoplasmic reticulum

14. What is the role of the lysosomes in a cell?

A. Synthesize proteins
B. Detoxify poisons
C. Digest macromolecules
D. Store genetic information

15. What is the main difference between the smooth ER and rough ER?

A. Smooth ER is involved in protein synthesis, while rough ER is not.
B. Rough ER has ribosomes on its surface, while smooth ER does not.
C. Smooth ER contains DNA, while rough ER contains RNA.
D. Rough ER is only found in plant cells, while smooth ER is found in animal cells.

16. Which is the site of enzyme synthesis in cells?

A. Golgi body
B. Lysosome
C. Ribosome
D. Smooth endoplasmic reticulum

17. Figure 1 shows the fluid mosaic model of the membrane structure.

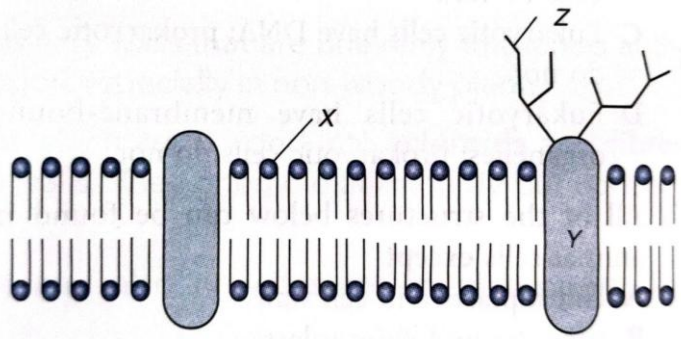

Figure 1

What are X, Y and Z?

	X	Y	Z
A.	Lipid	Carbohydrate	Protein
B.	Lipid	Protein	Carbohydrate
C.	Protein	Carbohydrate	Lipid
D.	Protein	Lipid	Carbohydrate

18. Which of the following organelles is involved in the cleaning up of worn-out organelles and foreign particles in cells?

A. Smooth endoplasmic reticulum
B. Microtubules
C. Lysosomes
D. Golgi apparatus

19. What is an allele?

A. The location of a gene on a chromosome
B. A heritable unit consisting of a specific nucleotide sequence
C. The observable characteristics of an organism
D. An alternative form of a gene for a trait occupying the same locus on homologous chromosomes

20. What does Mendel's First Law, the Law of Segregation, state?

A. Alleles of two different genes get sorted into gametes independently of each other.
B. Genetic material from two parents blends together to form offspring.
C. During the formation of gametes, each gene separates so that each gamete carries only one allele for each gene.
D. Genes are always inherited together if they are located close to each other on the same chromosome

21. What is a test cross used for?

    A. To determine the genotype of an organism with a dominant phenotype
    B. To blend the genetic material of two parents
    C. To observe independent assortment of alleles
    D. To create a Punnett square

22. Genes which exist at identical positions on a pair of homologous chromosomes are known as:

    A. Double helix
    B. Genotypes
    C. Phenotypes
    D. Alleles

23. A test cross is the crossing of an individual with a:

    A. Heterozygous parent
    B. Hybrid
    C. Homozygous recessive individual
    D. Homozygous dominant individual

24. An organism which has two allelic forms of a particular gene is a:

    A. Homozygote
    B. Heterozygote
    C. Genotype
    D. Hybrid

25. What is the concept of a gene pool?

    A. The collection of all genes in an individual.
    B. The aggregate of all copies of every type of allele at all loci in every individual in a population.
    C. A group of individuals of different species that interbreed.
    D. The study of genes in a laboratory setting.

26. In a population of 10000 individuals with genotypes AA, Aa, and aa, where 6000 have genotype AA, 2000 have genotype Aa, and 2000 have genotype aa, what is the total number of alleles in the gene pool for this character?

    A. 10000
    B. 20000
    C. 30000
    D. 40000

27. What is the frequency of the B allele in a population of rabbits where there are 40 black rabbits (BB), 30 black rabbits (Bb), and 10 white rabbits (bb)?

    A. 0.25
    B. 0.50
    C. 0.6875
    D. 0.3125

28. If the frequency of a recessive allele (q) in a population is 0.4, what is the frequency of the dominant allele (p)?

    A. 0.6
    B. 0.4
    C. 0.8
    D. 1.0

29. What does the study of population genetics focus on?

    A. The study of genetic variability in a population and the forces that act on it.
    B. The study of individual genetic makeup.
    C. The study of non-inheritable traits.
    D. The study of genes within a single organism.

30. Which condition will cause a population to evolve and change allele frequencies?

    A. Genetic equilibrium
    B. No mutation
    C. No migration
    D. Natural selection

31. Which is the correct Hardy-Weinberg equation?

    A. $p^2 + 2pq + 2q^2 = 1$
    B. $2p^2 + 2pq + 2q^2 = 1$
    C. $p^2 + pq + q^2 = 1$
    D. $p^2 + 2pq + q^2 = 1$

32. The Hardy-Weinberg is applicable if:

    A. Population size is small
    B. Migration only occurs at the beginning of the breeding season
    C. Natural selection does not occur
    D. Mutations occur at a constant rate

33. Which of the following statements best describes the Central Dogma of molecular biology?

    A. Genetic information flows from RNA to DNA and then to protein.
    B. Genetic information flows from DNA to RNA to protein.
    C. Genetic information flows from protein to RNA and then to DNA.
    D. Genetic information flows from RNA to protein and then to DNA.

34. What is the role of helicase in DNA replication?

    A. It synthesizes RNA primers.
    B. It unwinds the parental DNA double helix and separates the DNA strands.
    C. It relieves the strain of unwound DNA by breaking and rejoining DNA strands.
    D. It catalyses the formation of phosphodiester bonds between Okazaki fragments.

35. Which process is responsible for the removal of introns and recombination of exons in pre-mRNA?

    A. Transcription
    B. Translation
    C. DNA replication
    D. RNA splicing

36. The information that is needed in the production of an enzyme is located in the:

    A. DNA molecule
    B. Ribosome
    C. Nucleus
    D. Polysome

37. With reference to the mRNA codon – amino acid in Table 1 below, predict the nitrogenous base sequence on the DNA for the following polypeptide:

Leucine – arginine – glycine – methionine – isoleucine

mRNA codon	Amino acid
UUA	Leucine
AUG	Methionine
CGA	Arginine
GGU	Glycine
AUU	Isoleucine

Table 1

    A. AATGCTCCATACTAA
    B. TTAGCTCCATACTAA
    C. AATCGAGGTATGATT
    D. UUACGAGGUAUGAUU

38. Which of the following statements about translation is not true?

A. product of translation is a polypeptide chain.
B. Translation takes place at the ribosome surface.
C. The triplet codes on tRNA are translated into amino acid sequences in polypeptides.
D. In the translation process, the base adenine is complementary to uracil.

39. Which of the following best defines a mutation?
A. A temporary change in the amount, arrangement, or structure of DNA.
B. A permanent change in the amount, arrangement, or structure of DNA.
C. A temporary change in the chromosome number of an organism.
D. A permanent change in the phenotype of an organism.

40. What is a mutagen?
A. An organism that has undergone mutation.
B. A physical or chemical agent that increases the rate of mutation.
C. A type of mutation that involves a change in the chromosome number.
D. An enzyme that repairs mutations in DNA.

41. Which of the following is NOT a type of chromosomal aberration?
A. Translocation
B. Inversion
C. Duplication
D. Point mutation

42. A nonsense mutation:

A. Results from the deletion of one or two bases, leading to a shift in the reading frame
B. Causes one amino acid to be substituted for another in a polypeptide chain
C. Results from the insertion of one or two bases, leading to a shift in the reading frame
D. Usually results in the formation of an abnormally short polypeptide chain

43. The gene arrangement on a chromosome changes from ABCDEFGH to ABCDGFEH. This is an example of:

A. Deletion
B. Duplication
C. Inversion
D. Insertion

44. Which of the following statements is not correct?

A. Base substitution occurs when one nucleotide is replaced by another nucleotide with a different base
B. Base inversion involves the reversal of a portion of a nucleotide sequence
C. Base deletion involves the loss of a nucleotide or chromosome fragment
D. Translocation in chromosomal mutation is a change in the position of a chromosome segment from one region to another within the same chromosome only

45. What is the definition of recombinant DNA technology?

A. The process of sequencing DNA from different organisms
B. The technique to splice together DNA from two different organisms to produce a new genetic combination
C. The method of extracting DNA from a single organism for study
D. The technique of editing genes within a single organism to correct mutations

46. What is the role of a cloning vector in recombinant DNA technology?

A. To cut DNA at specific sequences
B. To carry foreign DNA fragments into a host cell
C. To modify the sequence of target DNA
D. To replicate target DNA outside a cell

47. What is a characteristic feature of plasmids that makes them useful as cloning vectors?

A. They contain an origin of replication
B. They are linear pieces of DNA
C. They can replicate only within eukaryotic cells
D. They always cause mutations in the host cell

48. Which of the following is not a tool used in recombinant DNA technology?

A. Target DNA
B. RNA Polymerase
C. Cloning vector
D. DNA ligase

49. Restriction enzymes:

I. often produces staggered cuts in DNA that are useful in splicing genes.
II. are like most enzymes in being very specific in their action.
III. are natural defense mechanisms evolved in bacteria to guard against or counteract bacteriophages.
IV. are used along with ligase and plasmids to produce a DNA library.

A. I and II
B. I, II and III
C. I, II and IV
D. I, II, III and IV

50.The characteristics of a plasmid include:

I. present in most bacteria
II. circular DNA
III. carries genes for the deactivation of certain antibiotics
IV. capable of autonomic replication, free from the influence of the chromosome

A. I, II and III
B. I, III and IV
C. II, III and IV
D. I, II, III and IV

51. What is the primary role of cellular respiration in living organisms?

A. To produce oxygen
B. To generate ATP and heat
C. To break down fat
D. To synthesize glucose

52. What is the end product of glycolysis?

A. Lactate
B. Carbon dioxide
C. Pyruvate
D. Water

53. What is the net gain of ATP molecules per glucose molecule in glycolysis?

A. 1 ATP
B. 2 ATP
C. 4 ATP
D. 6 ATP

54. Which enzyme catalyses the conversion of glucose to glucose-6-phosphate in glycolysis?

A. Phosphofructokinase
B. Hexokinase
C. Pyruvate kinase
D. ATP synthase

55. Oxidative phosphorylation is the:

A. addition of phosphate to glucose in the first step of glycolysis.
B. addition of phosphate to ADP using energy gained by transferring electron along a chain of carriers.
C. addition of phosphate to ADP using energy gained by transferring electron between chlorophyll molecules.
D. removal of phosphate from ATP with the release of energy for work within the cell.

56. Which of the following releases most energy during respiration?

A. Phosphorylation of glucose.
B. Oxidation of triose phosphate to pyruvate.
C. Oxidation of pyruvate to carbon dioxide and water.
D. Conversion of glucose to ethanol and carbon dioxide.

57. Which of the following statements are true about anaerobic respiration in plant?

I. net ATP produced is 2.
II. net ATP produced is 4.
III. the end products are ethanol and carbon dioxide.
IV. NADH is used for pyruvate reduction.

A. I and IV
B. I, III and IV
C. II and III
D. II, III and IV

58. Which pigment is primarily responsible for absorbing light in photosynthesis?

A. Carotenoids
B. Chlorophyll a
C. Chlorophyll b
D. Xanthophylls

59. During the light-dependent reactions of photosynthesis, what is produced?

A. ATP and NADPH
B. Glucose and oxygen
C. Carbon dioxide and water
D. ADP and NADP+

60. In which part of the chloroplast do the light-independent reactions (Calvin cycle) occur?

    A. Thylakoid membrane
    B. Stroma
    C. Grana
    D. Thylakoid lumen

61. What is the role of the pigment molecules in the light-harvesting complexes of the photosystems?

    A. To split water molecules
    B. To absorb and transfer light energy to the reaction-centre chlorophyll
    C. To produce ATP directly
    D. To release oxygen

62. The main purpose of the photosynthetic process is to:

    A. produce water.
    B. produce oxygen.
    C. produce chlorophyll.
    D. convert light energy to chemical energy.

63. During non-cyclic photophosphorylation, water is oxidized and the electrons from water pass through photosystem II and photosystem I before reducing:

    A. FAD
    B. $NADP^+$
    C. carbon dioxide
    D. plastoquinones

64. Which reactants are used in the Calvin cycle?

    A. Oxygen, ATP and $NADP^+$.
    B. Oxygen, ADP and reduced $NADP^+$.
    C. Carbon dioxide, ADP and $NADP^+$.
    D. Carbon dioxide, ATP and reduced $NADP^+$.

65. Which of the following is a primary example of a negative feedback mechanism?

    A. Childbirth contractions
    B. Blood clotting
    C. Regulation of body temperature
    D. Fruit ripening

66. What role does the effector play in a homeostatic control system?

A. Detects changes in the environment
B. Analyzes information and determines the response
C. Carries out the response to restore balance
D. Transports hormones throughout the body

67. Which statement correctly describes the role of insulin in blood glucose regulation?

A. Insulin increases blood glucose levels by stimulating gluconeogenesis
B. Insulin decreases blood glucose levels by promoting glycogen synthesis
C. Insulin converts glycogen into glucose for energy
D. Insulin stimulates the release of glucagon

68. How does the body respond to a decrease in blood glucose levels?

A. Pancreas releases insulin to increase glucose uptake
B. Liver converts glucose into glycogen for storage
C. Pancreas releases glucagon to stimulate glycogen breakdown
D. Cells increase the rate of glycolysis

69. What is the primary function of the loop of Henle in the kidney?

A. Filtration of blood plasma
B. Concentration of urine
C. Production of erythropoietin
D. Regulation of blood pressure

70. What is the process called when the liver produces glucose from non-carbohydrate sources like amino acids and glycerol?

A. Glycogenesis.
B. Glycogenolysis.
C. Gluconeogenesis.
D. Glycolysis.

PART B: STRUCTURED QUESTIONS (30 MARKS)

This part consists of four (4) questions. Answer ALL questions.

QUESTION ONE (8 MARKS)

In the garden pea, yellow seeds are dominant to green seeds and round seeds are dominant to wrinkled seeds. A cross was made between pure breeding pea plants with yellow and round seeds with green and wrinkled seeds. The F1 offspring were then allowed to self-pollinate and the seeds produced were grown. Mendel selected 556 peas from F2 generation and the following results are obtained:

315 round and yellow
101 wrinkled and yellow
108 round and green
32 wrinkle and green

a) Explain by using a cross diagram for the above result.

[6 marks]

b) From this result, Mendel had created a Law. State and explain the Law.

[2 marks]

QUESTION TWO (7 MARKS)

FIGURE 1 below summarizes the process of translation.

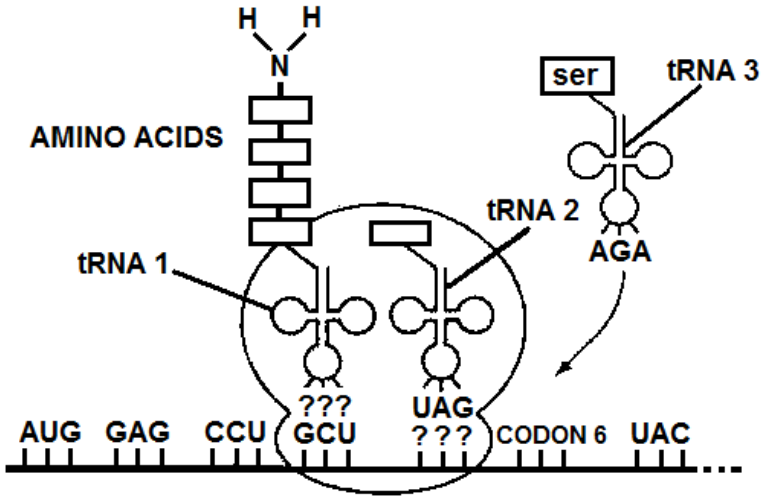

FIGURE 1

a) tRNA 1 has a 5' – phosphate end and a 3' – hydroxyl end. What is the function of 3'OH end in tRNA 1?

[1 mark]

b) Name the enzyme that catalyzes the formation of the peptide bond between amino acids carried by tRNA 1 and tRNA 2.

[1 mark]

c) According to the figure, explain what will occur to allow codon 6 to be translated.

[3 marks]

d) List **TWO** ways in which transcription differs from translation process.

[2 marks]

QUESTION THREE (8 MARKS)

Mutation is the changes that happen to genetic materials, the chromosomal genes. These changes can occur spontaneously but the rate can be increased by mutagen. There are two types of mutation, gene mutation and chromosomal mutation. Chromosome mutation involves aberration and changes in the number of the chromosomes.

Based on the explanation above, answer these questions.

a) Give an example for each of these mutagens:
   i. Physical agent:
   ii. Chemical agent:

[2 marks]

b) Sickle cell anemia is a disease because of gene mutation.
   i. Name the type of mutation that causes the disease.

[1 mark]

   ii. Explain how this disease occurs.

[2 marks]

c) What is the meaning of chromosome aberration?

[1 marks]

d) If a diploid number (2n) of a species is 24, determine the number of chromosome if the species undergoes the following condition:
   i. Monosomy
   ii. Triploid

[2 marks]

QUESTION FOUR (7 MARKS)

….T A G A A T T C G T G A A T T C…..
….A T C T T A A G C A C T T A A G…..

Donor DNA

….T C G A A T T C C G…..
….A G C T T A A G G C…..

Plasmid DNA

FIGURE 2

a) A restriction enzyme is used to cut the DNA donor and plasmid in **FIGURE 2**.

i. The base sequence which is being recognized by the enzyme is

[1 mark]

ii. Name the restriction enzyme which can cut the donor DNA and the plasmid.

[1 mark]

b) Donor DNA can be digested into several fragments by a restriction enzyme.

i. Draw a line(s) to show the exact place where the restriction enzyme will cut in the figure below:

….T A G A A T T C G T G A A T T C…..
….A T C T T A A G C A C T T A A G…..

[1 mark]

c) Plasmid will also be digested by the same restriction enzyme.

i. Draw a line(s) to show the exact place that will be cut by restriction enzyme within the plasmid sequence below.

….T C G A A T T C C G…..
….A G C T T A A G G C…..

[1 mark]

ii. Make a drawing of the above digested plasmid.

[1 mark]

d) List down 2 importance of recombinant DNA technology in agriculture.

[2 marks]