ENTRANCE EXAMINATION FOR ADMISSION, MAY 2011.

Ph.D. (BIOCHEMISTRY AND MOLECULAR BIOLOGY)

COURSE CODE : 102

Register Number : [ ]

Signature of the Invigilator
(with date)

COURSE CODE : 102

Time : 2 Hours Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you –1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. In meiosis, an inversion in one member of a pair of homologous chromosomes will most likely lead to which of the following?

(A) Nondisjunction of the affected chromosome

(B) Chromosomes with duplications and deficiencies

(C) Increased recombination frequency in the inverted region

(D) Mispairing of the affected chromosome with a non-homologous chromosome

2. One important mechanism for maintaining sequence identity among the many copies of a gene within a tandem array is

(A) unequal crossing-over

(B) gene conversion

(C) retrotransposition

(D) deletion

3. Which of the following conditions is likely to interfere with the transfer of genetic material by conjugation in bacteria?

(A) Pretreatment of the recipient cells with DNase

(B) Pretreatment of the recipient cells by application of strong shearing forces

(C) Treatment of the recipient cells with cycloheximide

(D) Treatment of the mating cell pairs by application of strong shearing forces

4. The zymogen chymotrypsinogen is converted to active chymotrypsin by

(A) binding of a necessary metal ion

(B) reduction of a disulfide bond

(C) proteolytic cleavage

(D) phosphorylation of an amino acid side chain

5. Chylomicrons deliver

(A) lipoproteins to tissues, where lipoprotein lipase releases free fatty acids for entry into cells

(B) triacylglycerols to tissues, where lipoprotein lipase releases free fatty acids for entry into cells

(C) both (A) and (B)

(D) lipoproteins, where lipoprotein lipase releases bound fatty acids for entry into blood stream

6. Which of the following statements is true regarding the polysaccharides starch, glycogen, cellulose, and chitin?

(A) All have 1-4 linkages

(B) Starch is built from a different monomer than are the others

(C) Each is built from a single type of monomer

(D) Only chitin has a core protein

7. All of the following statements about the fluid mosaic model of biological membranes are true EXCEPT

(A) Lipid molecules in the membrane readily undergo lateral diffusion.

(B) Lipid molecules in the membrane readily undergo transverse (flip-flop) diffusion.

(C) Integral membrane proteins can undergo lateral diffusion.

(D) The saturated hydrocarbon chains of lipid molecules in the membrane undergo carbon-carbon bond rotation.

8. The primary action of steroid hormones is at the level of

(A) RNA export from the nucleus (B) transcription

(C) pre-mRNA splicing (D) mRNA degradation

9. The first metabolic intermediate that is common to the aerobic metabolism of glucose and fatty acids is

(A) acetyl CoA (B) beta-hydroxybutyrate

(C) pyruvate (D) citrate

10. In an operon regulated only by attenuation, a mutation causing oversynthesis of the gene products is most likely to be in the part of the DNA corresponding to the

(A) operator (B) 3' terminal sequence of the RNA

(C) 5' terminal sequence of the RNA (D) introns of the RNA

11. A nonsense mutation involves

(A) a regulatory sequence

(B) an AG splice acceptor site

(C) the creation of a different amino acid

(D) the creation of a stop codon

12. The processes that lead to the synthesis of the functional light chain of an antibody molecule include

(A) DNA rearrangement but no RNA splicing

(B) DNA rearrangement but no gene duplication

(C) DNA rearrangement but no protein processing

(D) RNA splicing but no DNA rearrangement

13. A second mutation in the same gene restores the wild-type phenotype. This phenomenon is referred to as

(A) intergenic complementation

(B) gene conversion

(C) synthetic enhancement

(D) intragenic suppression

14. During the gluconeogenic conversion of pyruvate into glucose in the liver, all of the following are involved EXCEPT

(A) pyruvate carboxylase

(B) phosphoenolpyruvate carboxylase

(C) phosphoenolpyruvate carboxykinase

(D) glucose 6-phosphatase

15. Water is generally a good solvent for polar molecules and a poor solvent for nonpolar molecules. These solvent properties are best explained by

(A) the high density of liquid water relative to polar solvents

(B) the ability to form intermolecular hydrogen bonds

(C) the density of solid water being less than the density of liquid water

(D) high surface tension

16. Which of the following is NOT an anabolic product of nitrogen assimilation?

(A) Glutamate (B) Glutamine (C) Urea (D) Aspartate

17. Consider the average *in viva* turnover rates for proteins, DNA, and mRNA. Which of the following orders best describes the turnover rate from fastest (shortest average lifetime) to slowest (longest average lifetime)?

(A) mRNA > DNA > proteins

(B) mRNA > proteins > DNA

(C) Proteins > mRNA > DNA

(D) Proteins > DNA > mRNA

18. Rhodopsin,-adrenergic receptors, and muscarinic acetylcholine receptors share which of the following features?

(A) Each causes an inhibitory intracellular response

(B) Each activates a tyrosine kinase cascade

(C) Each is composed of a dimer

(D) Each functions through a heterotrimeric G-protein

19. Retroviral oncogenes are probably aberrant forms of normal cellular genes that regulate cell proliferation. Which of the following gene products are LEAST likely to be encoded by an oncogene?

(A) GTP-binding proteins

(B) DNA-binding proteins

(C) Transmembrane proteins

(D) Capsid proteins

20. Which of the following best supports the endosymbiotic theory of the evolutionary origin of mitochondria?

(A) Mitochondria, chloroplasts, and prokaryotes contain electron carriers.

(B) Genes for mitochondrial pyruvate dehydrogenase subunits are found in the nuclear DNA.

(C) Mitochondrial and bacterial ribosomal functions are inhibited by the same antibiotics.

(D) The outer mitochondrial membrane contains the protein porin.

21. When the nucleus of a frog red blood cell, which does not replicate DNA, is transplanted into an enucleated frog egg, the egg goes through several cell divisions. Which of the following is the best interpretation for this phenomenon?

(A) The cytoplasm controls nuclear DNA synthesis.

(B) The nucleus plays no role in cell division.

(C) An enucleated frog egg can divide.

(D) Genes do not function during early cleavage.

22. The nuclear-synthesized poly-A sequence at the 3' end of eukaryotic messenger RNA is

(A) Added at the 3' end of the pre-mRNA transcript

(B) Found also as a common feature in rRNA and tRNA

(C) Transcribed from poly-T sequences in template DNA

(D) Transcribed by RNA polymerase II

23. A silent mutation in a gene results in

(A) No change in the nucleotide sequence of the mRNA encoded by the gene

(B) No change in the amino acid sequence of the protein encoded by the gene

(C) No expression of the protein encoded by the gene

(D) An amino acid substitution that has a significant effect on the functional activity of the protein encoded by the gene

24. Which of the following most accurately explains the cause for the abnormal numbers of chromosomes during human reproduction that can result in Down syndrome, Turner's syndrome, or Klinefelter's syndrome?

(A) The occurrence of nondisjunction of homologous chromosomes during meiosis

(B) The duplicative production of extra chromosomes during DNA replication

(C) The abnormal pairing of nonhomologous chromosomes during prophase of meiosis I

(D) The selective loss of particular chromosomes from the sex cells after formation of the mature gamete

25. The enzyme reverse transcriptase is useful in the generation of cDNA libraries for which of the following reasons?

(A) It is sensitive to high temperatures and so can be readily "killed" by heat treatment when the reaction is completed.

(B) It does not require a primer to initiate polymerization as do most DNA polymerases.

(C) It is insensitive to high temperatures and so can survive the many cycles of heating required to perform the polymerase chain reaction.

(D) It is an RNA-dependent DNA polymerase.

26. Gene rearrangements play a role in which of the following processes?

(A) Adaptation to carbon source by bacteria

(B) Surface antigen changes in trypanosomes

(C) Sex determination in nematodes

(D) Host range modification in bacteriophage T4

27. A mutant of *E. coil* with a heat-sensitive DNA ligase (25°C permissive, 37°C non-permissive) has been used to show that DNA synthesis is discontinuous. Examination of DNA replication in the presence of [^{3}H]-thymidine in the mutant would demonstrate which of following?

(A) The accumulation of short segments of unlabeled DNA at 25°C and at 37°C

(B) The accumulation of short segments of unlabeled DNA at 25°C but not at 37°C

(C) The accumulation of short segments of radioactive DNA at 37°C but not at 25°C

(D) The accumulation of short segments of radioactive DNA at 25°C but not at 37°C

28. All of the following statements are true about damage by ultraviolet light to DNA in living cells EXCEPT

(A) The damage blocks normal DNA replication.

(B) The most damaging wavelength is about 260 nm.

(C) Covalent bonds are formed that join neighboring pyrimidines.

(D) Neighboring phosphodiester bonds are cleaved.

29. Which of the following best predicts the direction of a chemical reaction?

(A) S (entropy change) (B) H (enthalpy change)

(C) E (internal energy change) (D) G (Gibbs free energy change)

30. Which of the following events occurs first as a result of EGF binding to its receptor?

(A) Activation of a serine/threonine kinase

(B) Activation of a tyrosine phosphatase

(C) Activation of a tyrosine kinase

(D) Activation of a phospholipase

31. Which one of the following fixes CO_2 into carbohydrates?

(A) Rhizobium (B) Bacillus

(C) Nitrobacter (D) Rhodospirillium

32. The ferns, in which the entire sporangium develops from a single superficial cell of the sporophyll is known as

(A) Eusporangiate (B) Unisporangiate

(C) Mesosporangiate (D) None of the above

33. Cell A has osmotic potential of - 16 bars and pressure potential of 8 bars, whereas cell B has osmotic potential of - 12 bars and pressure potential 2 bars. The direction of flow of water will be

(A) From cell B to cell A (B) From cell A to cell B

(C) No flow of water (D) In both the directions

34. Linear sori and false indusium are characteristics of

(A) Pteris (B) Dryopteris (C) Polypodium (D) Adiantum

35. Fruits are not formed in gymnospermous plants because

(A) They have no ovary

(B) They are not pollinated

(C) They are seedless plants

(D) Process of fertilization does not take place

36. Essential oils are those which

(A) Are essential to the plant itself
(B) Are used as lubricants
(C) Are used to make perfumes
(D) Are essential for human beings

37. Cytochromes are found in

(A) Matrix of mitochondria
(B) Cristae of mitochondria
(C) Lysosomes
(D) Outer wall of mitochondria

38. Single stranded DNA is found in

(A) Coliphage $\phi \times 174$ virus
(B) Reovirus
(C) Wound tumor virus
(D) TMV

39. The PDH complex contains three enzymes namely-pyruvate dehydrogenase (E1), dihydrolipoyl transacetylase (E2), and

(A) dihydrolipoyl dehydrogenase
(B) pyruvate transacetylase
(C) dihydrolipoyl transferase
(D) pyruvate kinase

40. The glyoxylate cycle is active in the germinating seeds of some plants and in certain microorganisms that can live on

(A) acetate as the sole carbon source
(B) glucose as the sole carbon source
(C) mannose as the sole carbon source
(D) lactate as the sole carbon source

41. The main chain angles in a-helix are approximately

(A) $\varphi = 40^\circ$ and $\psi = -160^\circ$
(B) $\varphi = -120^\circ$ and $\psi = -180^\circ$
(C) $\varphi = \psi = -60^\circ$
(D) $\varphi = \psi = -180^\circ$

42. An analogous enzymes can be defined as

(A) Protein with different EC number but with detectable sequence similarity with each other
(B) Protein with different EC number and also no detectable sequence similarity with each other
(C) Protein with same EC number but with no detectable sequence similarity with each other
(D) Protein with same EC number and also detectable sequence similarity with each other

43. DNA super coiling was achieved by

(A) Topoisomerase (B) Helicases

(C) DNA dependent DNA polymerase (D) DNAse

44. Sliding clamp is involved in

(A) DNA replication (B) Transcription

(C) RNA editing (D) Southern blotting

45. Angiogenesis is a term involved in

(A) Formation of golgi complex (B) Formation of new blood vessels

(C) Evolution of angiogerms (D) Development of androecium

46. A method for detecting protein-DNA interactions is

(A) Southern Blotting (B) Northern Blotting

(C) Western Blotting (D) South Western Blotting

47. The approximate size of the foreign DNA used for cloning in Cosmid vector is

(A) ~ 50 kb size (B) ~250 kb (C) ~500 kb (D) ~1000 kb

48. What is the function of DNA polymerase Ill?

(A) It attaches the RNA primers to the DNA strand

(B) It adds nucleotide pairs to the growing DNA strand

(C) It adds single nucleotides to the growing DNA strand

(D) It unwinds the DNA

49. The replicative polymerase in *E. coli* is

(A) DNA polymerase I (B) DNA polymerase II

(C) DNA polymerase III (D) DNA polymerase IV

50. Ames Test is for checking

(A) pathogenecity of an organism (B) mutagenecity of a chemical

(C) stability of a substance (D) none of the above

51. Ethidium bromide acts as mutagen by

(A) substituting Adinine by its structural analogue

(B) chonical modification of base

(C) production of interstrand cross link in DNA

(D) intercalating between DNA bases interfering with proper base stacking

52. The SOS repair mechanism is activated by which of the following?

(A) 5-bromouracil
(B) acrydine orange
(C) hydroxylamine
(D) thymidine dimmers

53. A mouse in which one particular gene has been replaced by its inactivated form generated in vitro is called

(A) transgenic mouse
(B) knockout mouse
(C) nude mouse
(D) mutant mouse

54. Radioactive iodine can be incorporated into

(A) sereine (B) threonine (C) tyrosine (D) leucine

55. Leukopenia is a term used to described

(A) high WBC count
(B) low WBC count
(C) high RBC count
(D) low RCB count

56. High throughput screens such as the yeast two-hybrid system and affinity purification experiments can have false-positive results because

(A) Some proteins are inherently sticky
(B) Some bait proteins that are introduced into cells become mislocalized
(C) Some protein complexes form only very transiently
(D) Affinity tags or epitope tags can interfere with protein-protein interactions

57. Homology modeling may be distinguished from ab initio prediction because

(A) Homology modeling requires a model to be built
(B) Homology modeling requires alignment of a target to a template
(C) Homology modeling is usefully applied to any protein sequence
(D) The accuracy of homology modeling is independent of the percent identity between the target and the template

58. In analyzing cDNA libraries, a pitfall is that

(A) The libraries may be derived from different tissues
(B) The libraries may contain thousands of sequences
(C) The libraries may have been normalized differently
(D) The libraries may contain many rarely expressed transcripts

59. What advantage do oligonucleotide-based microarrays have over cDNA based arrays?

(A) Two samples can be simultaneously and competitively hybridized to the same chip.

(B) It is easier for the experimenter to verify the identity of each gene that is represented on the array.

(C) It is possible to identify expression of alternatively spliced transcripts.

(D) They are far more sensitive.

60. The instrument commonly used to estimate electrolytes is

(A) ultracentrifuge (B) polarimeter

(C) spectrophotometer (D) flame photometer

61. A mediated transport system would be expected

(A) to exhibit increasing initial rate of transport with increasing substrate conc.

(B) not to exhibit structural and/or stereo specificity for the substance transported.

(C) to be slower than that of a simple diffusion system

(D) to establish a concentration gradient across the membrane if there is an expenditure of energy

62. An ionophore need not

(A) diffuse back and forth across a membrane

(B) form a channel across a membrane through which an ion may diffuse

(C) catalyze electrogenic mediated transport of an ion.

(D) require the input of metabolic energy for mediated transport of an ion.

63. At 37°C, -2.202 RT = -1.42 kcalmol^{-1}. For the reaction $A \leftarrow\rightarrow B$, if Δ G°= -7.1 kcal mol^{-1}, what is the equilibrium ratio of B/A?

(A) 10,000,000/1 (B) 100,000/1 (C) 1000/1 (D) 1/100,000

64. Which of the following tricarboxylic acid cycle intermediates may be added or removed by other metabolic pathways?

(A) oxalosuccinate (B) α – ketoglutarate

(C) isocitrate (D) geranyl phosphate

65. If rotenone is added to the mitochondrial electron transport chain

(A) the P/O ratio of NADH is reduced from 3/1 to 2/1

(B) the rate of NADH oxidation is diminished to 2/3 of its initial value

(C) succinate oxidation remains normal

(D) electron flow is inhibited at site II

66. In glycolysis ATP synthesis is catalyzed by

(A) hexokinase

(B) phosphofructokinase

(C) glyceraldehydes-3-phosphate dehydrogenase

(D) phosphoglycerate kinase

67. The uncontrolled production of NADH from NAD^+ during ethanol metabolism blocks gluconeogenesis from

(A) alpha-ketoglutarate (B) oxaloacetate

(C) inositol (D) galactose

68. AMP activates

(A) aspartate-oxaloacetate transaminase (B) succinic dehydrogenase

(C) glycogen phosphorylase (D) hexokinase

69. Transketolase

(A) transfers a C2 fragment to an aldehyde acceptor

(B) transfers a C3 ketone containing fragment to an acceptor

(C) converts the ketose sugar ribulose 5 phosphate to ribose 5 phosphate.

(D) converts two C5 sugar phosphates to fructose phosphate and erythrose phosphate

70. Antibody dependent cell mediated cytotoxicity (ADCC)

(A) is carried out by B cells.

(B) is the main mechanism for killing intracellular microbes

(C) involves Fc receptors on the effector cells

(D) is primarily mediated by IgE antibody

71. In recombinant DNA technology, a plasmid vector must be cleaved by

(A) four separate enzymes

(B) modified DNA ligase

(C) a heated alkaline solution

(D) the same enzyme that cleaves the donor gene

72. Which of the following alterations of the codons ATTGCC is most serious?

(A) ATCGCC (B) ATTGCA (C) ATTCCCGCC (D) ATTTGCC

73. Down's syndrome is an example of

(A) aneuploidy (B) polytene (C) polyploidy (D) monoploidy

74. Beginning with a single bacterium, how large will the population be if there is logistic growth, with a carrying capacity of 18, for a period of 3 hours?

(A) 18 (B) 440 (C) 512 (D) 1024

75. Variegated coloration of leaves, first studied by K. Correns in 1909, is inherited only from the female parent. The genes coding for this trait are located in the

(A) plastids (B) endoplasmic reticulum

(C) nucleus (D) plasma membrane

76. About how long ago was the earth formed?

(A) 20 billion years ago (B) 10 billion years ago

(C) 5 billion years ago (D) 3 billion years ago

77. A taxonomic system based only on the traits that reflect the order in time in which branches arose in a phylogenetic tree is called

(A) phylogeny (B) cladistics

(C) classical evolutionary taxonomy (D) phenetics

78. The human population first began to grow exponentially at the time of the

(A) tool using revolution (B) agricultural revolution

(C) industrial revolution (D) First world war

79. The different shells in which the electrons of an atom are arranged reflect different

(A) sizes of electrons (B) weights of electrons

(C) levels of energy (D) isotopes of the atom

80. Imagine a population of 100 snails in which shell color is controlled by two alleles B (black) and b (yellow). What is the total number of loci for the gene for shell color in this population?

(A) 3 (B) 60 (C) 100 (D) 200

81. The free energy change for the hydrolysis of AlP to ADP + Pi under physiological conditions is –12 kcal/mol. What can you conclude from this information?

(A) The reaction will never occur in a closed system

(B) The reaction requires in input of energy

(C) The reaction is endergonic

(D) The reaction is exergonic

82. Which of the following is NOT a computational method?

(A) Gene allocation
(B) Gene prediction
(C) Multiple sequence alignment
(D) Phylogenetic analysis

83. Cellular components that play an important role in the structure and function of chromosomes include

(A) Protein
(B) DNA
(C) RNA
(D) All of the above

84. When looking at a DNA sequence, we find a stretch of DNA that begins with the "start" codon ATG and continues for 900 base pairs before ending with a "stop" codon. This "coding region" is referred to as

(A) a transposon
(B) an intron
(C) an open reading frame
(D) structural DNA

85. Which of the following amino acids is NOT considered to be hydrophobic?

(A) phenylalanine
(B) leucine
(C) arginine
(D) valine

86. The arithmetic average of the pair wise distance values 10, 14, 16 and 8 is

(A) 9 (B) 18 (C) 12 (D) 48

87. If you flip a coin five times, what are the odds of getting four tails?

(A) one in five (B) one in ten (C) one in three (D) one in sixteen

88. A cookbook recipe for chocolate chip cookies has many of the attributes of

(A) an operating system
(B) a database
(C) an algorithm
(D) a programming language

89. How many different kinds of fertilized eggs, with regard to kinds of chromosomes, can a particular man and woman produce?

(A) 2^{22} (B) 2^{23} (C) $(2^{23})(2^{23})$ (D) $(23^2)(23^2)$

90. The statistical frequency of the occurrence of a particular restriction enzyme cleavage site that is 6 bases long can be estimated to be approximately

(A) once every 4096 bases
(B) once every 1024 bases
(C) once every 256 bases
(D) once every 24 bases

91. In the human body what is the average rate of cycling of a molecule of ATP?

(A) 40 times a day
(B) 400 times a day
(C) 4000 times a day
(D) 100 times a day

92. If A's salary is 25% higher than B's salary, how much percent is B's salary lower than A's?

(A) 15% (B) 20% (C) 25% (D) 33.33%

93. A train running at the speed of 90 km/hr crosses a platform of length 160 m in 10 seconds. What is the length of the train (in metres)?

(A) 60 (B) 90 (C) 150 (D) 140

94. Which of the following diseases is caused by the expansion of triple repeats in the DNA replication?

(A) Huntington's disease
(B) Alzheimer's disease
(C) Cystic fibrosis
(D) Diabetes mellitus

95. Barbara McClintock discovered transposable elements in the late 1940s in which of the species

(A) Rice (B) Maize (C) C. elegans (D) E. coli

96. The ribosome is involved in all of the following EXCEPT

(A) Peptide bond formation
(B) Amino acylation of tRNA
(C) Binding of protein factors during elongation
(D) Binding of aminoacyl tRNA to mRNA

97. What was the first product that was commercialized using the anti sense RNA technology?

(A) Dolly
(B) Flavr Savr
(C) Bt cotton
(D) Terminator seeds

98. If you wish to perform ABO blood group typing on a person to whom you were about to give a blood transfusion, which of the following immunologic test would be best?

(A) Radial immunodiffusion
(B) Immunoelectrophoresis
(C) Flow cytometry
(D) Agglutination

99. If the M phase promoting factor is injected into a *Xenopus* primary oocyte, which of the following occurs?

(A) S phase begins
(B) The oocyte enters G_0 apoptosis begins
(C) The germinal vesicle (nucleus) breaks down
(D) Mitosis is completed

100. Heat shock proteins were originally described as proteins produced in response to heat stress. Some are now known to act as

(A) Molecular chaperones that regulate protein folding
(B) Protein tyrosine kinases
(C) Proteases that degrade ubiquitin tagged proteins
(D) GTPase-activating proteins
