LS1101 Mid-semester Exam

Total = 20 marks **Duration = 1 hour**

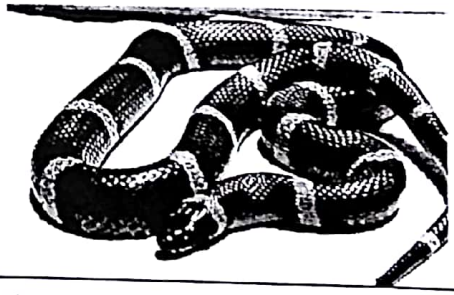
A) Answer the following 5 questions (each question carries 1 mark).

1) Mention two sensory abilities that humans lack. Also name one animal that has sensory ability you have mentioned.
2) Name the type of interaction in which both species involved have a negative impact following the interaction. Give one example.
3) Arrange the following in increasing order of complexity. Population, Ecosystem, Species, Community.
4) Cockroaches are known to wait for about 40 milliseconds to respond after they process the information that a predator is present in their vicinity. What is the reason for this delay in the cockroaches response?
5) Consider the behaviour of smiling in the chimps. Frame one proximate and one ultimate question regarding this behaviour.

B) Pick any 5 questions to answer (each question carries 2 marks)

7) A female butterfly of species X, has about 50% of its somatosensory space reserved to process information from its first pair of legs. The male of the same species has only 5% of its somatosensory space reserved to process information from its first pair of legs. What does this imply? Speculate on one reason why such a difference has come about.

The deadly Texas coral snake
Micrurus tener



The harmless Mexican milk snake
Lampropeltis triangulum annulata

8) Consider the two snakes given above. Mention which is the mimic and which is the model species. The population size of the mimic increased by three folds as compared to the model organism. Is this increase in population size sustainable, explain your answer?

9) Recently the complete genomic sequence of the Asian black bear was published. Based on this information, one newspaper reporter argued that we no longer have to worry about the conservation of bears. Would you agree with the reporter? Mention two reasons for your agreement or disagreement.

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10) Do you think that our religious belief comes in the way of our understanding of living organisms? Give two reasons for your answer.

11) Define Biological warfare and give one example.

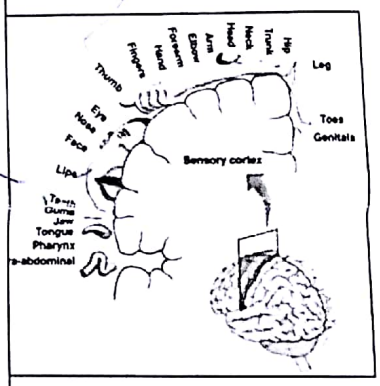
12) Cuckoos' are known to lay eggs which are very similar looking to their host eggs, what is this phenomenon? Why would the cuckoo need to produce eggs that match their host?

C) Pick one question to answer (it carries 5 marks)

13)

A middle aged lady lost her right thumb and index fingers in an accident. After about six months, she explained to her doctor that she could feel her missing fingers. Every time she put ice or hot water on her forehead she felt that her missing thumb was holding a cold or hot cup. Look at the somatosensory cortex given below (same as discussed in class).

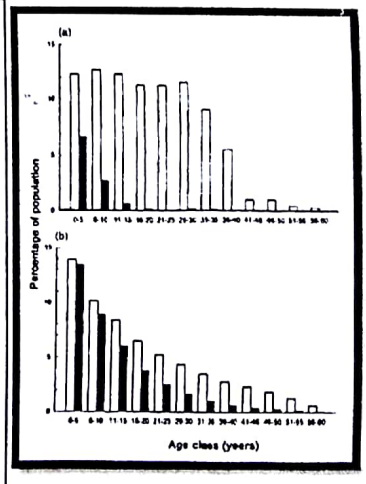
Can you come up with a possible explanation? Propose a method by which you can test your explanation. (marks distribution 2+3)



14)

In the graph, black bars represent male elephants and white bars female elephants. The upper box is the actual population at Periyar reserve forest in Kerala, while the bottom box is the expected distribution. Explain the graph. Do you see any difference between the observed and expected pattern?

Mention two interactions that elephants have with the biological world. What is its relationship with humans, mention one outcome for the elephant and one for humans. (marks distribution 1+1+2+0.5+0.5)



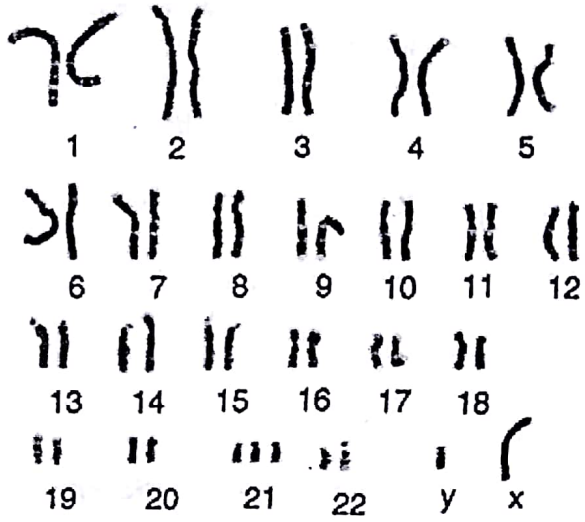
LS1101 End Semester Question Paper **D**

Instructors: Anindita Bhadra and Partho Sarothi Ray

Time: 3 h **Total Marks: 50**

Please read the questions carefully and choose the correct answer. All answers are to be given in the OMR sheet provided only. Each question carries 1 mark except when otherwise mentioned.

A child was diagnosed with intellectual disability; he had a flat and wide face with slanting eyes and a flat nose. Analysis of his genes showed the given karyotype (see image below). Questions 1-5 are connected to this image.



1. Identify the aberration in the karyotype.
   (a) Trisomy of chromosome 21
   (b) Monosomy of X chromosome
   (c) Deletion in chromosome 21
   (d) Monosomy of Y chromosome

2. Which genetic disorder is the child is suffering from?
   (a) Turner syndrome
   (b) Cri du chat syndrome
   (c) Down syndrome
   (d) Prader-Willi syndrome

3. The condition seen in the karyotype is:
   (a) Polyploidy (b) Monoploidy
   (c) Haplodiploidy (d) Aneuploidy

4. Karyotyping involves arresting cell division at a certain stage. In which of the following stages is this done?
   (a) Telophase (b) Anaphase
   (c) Prophase (d) Metaphase

5. In which stage of cell division does the nuclear membrane dissolve?
   (a) Anaphase (b) Metaphase
   (c) Prophase (d) Telophase

6. What is the term which refers to a contiguous set of bacterial genes which are under coordinate control?
   (a) homologue (b) allozygous
   (c) operon (d) exon

7. When comparing regulation of gene expression in eukaryotes versus prokaryotes, which of the following processes seems to be the most similar between the two?
   (a) DNA methylation (b) RNA splicing regulation
   (c) transcription (d) 5'-capping

8. Compared to prokaryotic chromosomes, eukaryotic chromosomes in gener...
   (a) all of the following
   (b) have interrupted genes
   (c) display lower gene density
   (d) are larger

9. Which of these is not a function of membrane proteins?
   (a) Cell-cell recognition
   (b) Phagocytosis
   (c) Transport
   (d) Attachment

10. Which of the following don't have genetic material?
   (a) Prokaryotes
   (b) Chloroplasts
   (c) Golgi bodies
   (d) Mitochondria

11. The immune system uses these proteins in the cell membranes to tell friendly cells from foreign invaders.
   (a) Symports
   (b) Marker Proteins
   (c) Carrier Proteins
   (d) Channel Proteins

12. Organelles composed of proteins and nucleic acids that have a temporary existence in the cell.
   (a) Lysosomes
   (b) Proteomes
   (c) Nucleosomes
   (d) Ribosomes

13. *A cell organelle with a highly folded inner membrane that increases surface area*
   (a) Ribosome
   (b) Mitochondria
   (c) Endoplasmic reticulum
   (d) Lysosome

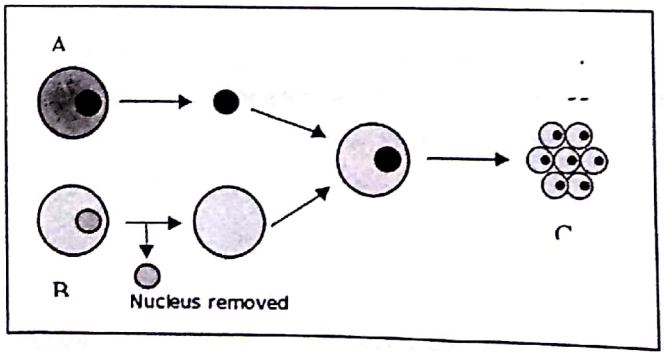
14. *Each of us has enough DNA to go from here to the Sun and back more than 300 times, or around Earth's equator 2.5 million times! How is this possible! The answer to this question lies in the fact that certain* _____ *compact chromosomal DNA into the microscopic space of the eukaryotic nucleus.*
   (a) Lipids
   (b) Polysaccharides
   (c) Amino acids
   (d) Proteins

15. Prokaryotes compress their DNA into smaller spaces through _____.
   (a) Proteins
   (b) Lipids
   (c) Compacting
   (d) Supercoiling

16. Which of the following is a characteristic of cancer cells?
   (a) ability to reproduce uncontrollably
   (b) all the remaining options are true
   (c) ability to metastasize
   (d) inability to perceive anti-growth signals from neighbouring cells

Questions 17 – 20 are related to the given figure.

17. The figure depicts the process of
   (a) Fertilization
   (b) Cloning
   (c) Mutation
   (d) Stem cell production



18. In the figure, A is
(a) A stem cell
(b) An oocyte
(c) A sperm
(d) A somatic cell

19. In the figure, B is
(a) A stem cell
(b) An oocyte
(c) A sperm
(d) A somatic cell

20. In the figure, C is
(a) Stem cells
(b) The clone
(c) Metastasized cells
(d) Maternal tissue cells

21. The basic repeating structural (and functional) unit of chromatin is the
(a) Nucleoid
(b) Histone protein
(c) Nucleosome
(d) Chromosome

22. _____ contain enzymes that digest nucleic acids, proteins and lipids.
(a) Ribosomes
(b) Lysosomes
(b) Golgi apparatus
(d) Endoplasmic reticula

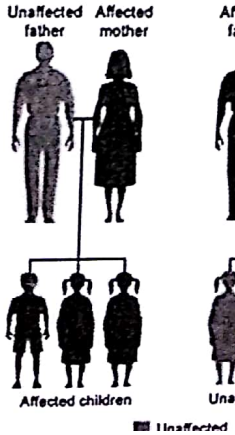
23. In this part of the cell cycle the cell grows and replicates in preparation for cell division.
(a) Metaphase
(b) Anaphase
(c) Prophase
(d) Interphase

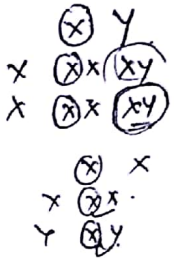
24. What is the name of the protein that, among other things, regulates the entry of cells into S phase, is mutated in most cancers, and is known as the "guardian of the genome?"
(a) *p34*
(b) p53
(c) *p102*
(d) cyclin

25. The structure of the cell membrane is understood by the
(a) Davson and Danielli model
(b) Fluid mosaic model
(c) Lipid-protein model
(d) Semipermeable membrane model

26. The process by which damaged or injured cells die is known as
(a) Metastasis
(b) Apoptosis
(c) Autophagy
(d) Necrosis

27. In the given figure, the dark shaded individuals are affected by a certain genetic mutation, while the light shaded individuals are unaffected. Name the kind of inheritance shown.
(a) X-linked
(b) Y-linked
(c) Autosomal
(d) Mitochondrial





28. _____ are derived from the inner cell mass of a blastocyst (an embryonic stage 4–5 days post fertilization), at which time they consist of 50–150 cells.
(a) Adult stem cells
(b) Cord blood cells
(c) Embryonic stem cells
(d) Fetal cells

29. _____ are networks of energy flow within communities.
(a) Food webs
(b) Food chains
(c) Populations
(d) Niches

30. Which of the following statements is most correct about the endosymbiosis theory?
(a) Both mitochondria and plastids contain single circular DNA that is different from that of the cell nucleus and that is similar to that of bacteria.
(b) Both (a) and (d) are true.
(c) None of the above
(d) Both plastids and mitochondria have ribosomes similar to those found in bacteria.

You are given the sequence of a double strand of DNA below. Answer the following questions using the information given in the sequence and the codon table

5'-ACTGTTACATGCTCGAAACGCTTTGACCCACC-3'

3'-TGACAATGTACGAGCTTTGCGAAACTGGGTGG-5'

31. What will be the correct sequence of the mRNA produced from this DNA?
a. 5'- UGACAAUGUACGAGCUUUGCGAAACUGGGUGG-3'
b. 5'-ACUGUUACAUGCUCGAAACGCUUUGACCCACC-3'
c. 5'-TGUCUUTGTUCGUGCTTTGCGUUUCTGGGTGG-3'
d. 5'-UCTGTTUCUTGCTCGUUUCGCUUUGUCCCUCC-3'

32. What will be the correct sequence of the polypeptide synthesized from this sequence?
a. Met-Leu-Glu-Thr-Leu
b. Leu-Leu-His-Ala-Arg-Asn-Leu-Thr-His
c. Thr-Val-Thr-Cys-Ser-Lys-Arg-Phe-Asp-Pro
d. Cys-Tyr-Met-Leu-Glu-Thr-Leu

GCA GCC GCG GCU	AGA AGG CGA CGC CGG CGU	GAC GAU	AAC AAU	UGC UGU	GAA GAG	CAA CAG	GGA GGC GGG GGU	CAC CAU	AUA AUC AUU	
Ala	Arg	Asp	Asn	Cys	Glu	Gln	Gly	His	Ile	
A	R	D	N	C	E	Q	G	H	I	
UUA UUG CUA CUC CUG CUU		AAA AAG	AUG	UUC UUU	CCA CCC CCG CCU	AGC AGU UCA UCC UCG UCU	ACA ACC ACG ACU	UGG	UAC UAU	GUA GUC GUG GUU	UAA UAG UGA
Leu	Lys	Met	Phe	Pro	Ser	Thr	Trp	Tyr	Val	stop	
L	K	M	F	P	S	T	W	Y	V		

Figure 6-50. Molecular Biology of the Cell, 4th Edition.

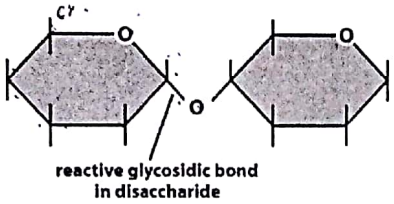
33. Which of the following mixture of chemicals did Urey and Miller use in their famous experiment to test the Oparin-Haldane hypothesis about the origin of life?

a. CO_2, N_2O_3, H_2O, H_2
b. CH_4, H_2, O_2, H_2O, NH_3
c. O_2, H_2, N_2, CO_2
d. CH_4, H_2, H_2O, NH_3

34. What did Alexander Oparin propose as the first spontaneously forming aggregate of molecules that could "grow" by fusion with other aggregates and "reproduce" by fission into daughter aggregates?

a. Micelles
b. Ribosomes
c. Liposomes
d. Coacervates

Look at the structure of the disaccharide below and answer the following questions: 1.5



35. How many carbons are there in the disaccharide?

a. 12
b. 8
c. 14
d. 10

36. What is the nature of the glycosidic bond

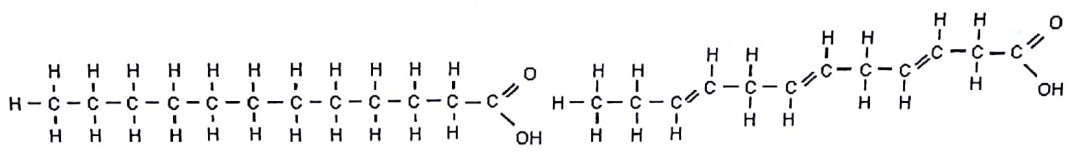
a. α 1-4
b. β 4-1
c. β 1-4
d. α 4-1

37. What will be the general formula for the disaccharide

a. $C_{12}H_{24}O_{12}$
b. $C_{10}H_{18}O_9$
c. $C_{12}H_{22}O_{11}$
d. $C_{10}H_{20}O_{10}$

Look at the two lipid molecules below and answer the following question:

a. b.



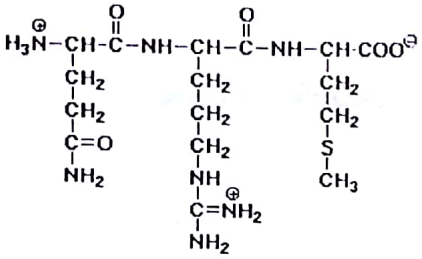
38. Which of the two fatty acids will be present more in an oil with a high melting point?

a. more a
b. more b
c. both a and b equally
d. none of the above will be present in oils

39. Which of the two fatty acids will be present more in a cell membrane that is more fluid?

a. more a
b. more b
c. both a and b equally
d. none of the above will be present in cell membranes

Look at the polypeptide below and answer the following questions: 1.5



40. What type of a polypeptide is this?

a. Tripeptide
b. Dipeptide
c. Tetrapeptide
d. Monopeptide

41. What is the chemical nature of the peptide bond?

a. diester
b. ester
c. ether
d. amide

42. What will be the overall nature of this polypeptide?

a. Basic
b. Neutral
c. Acidic
d. Polar

43. If you keep DNA and RNA in a solution of pH 8, which will degrade faster and why?

a. DNA, because of presence of 2' H
b. RNA, because of presence of uracil
c. DNA, because of presence of thymine
d. RNA, because of presence of 2'OH

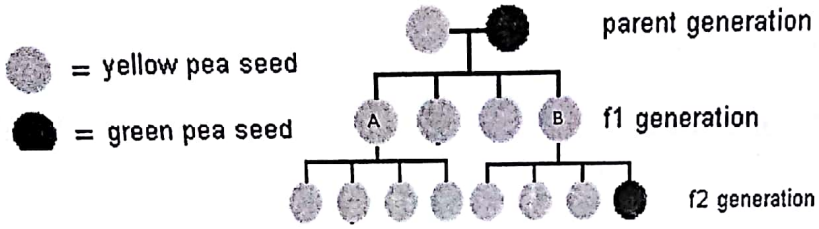
44. You have analyzed a DNA molecule and it shows the presence of 10% A, 30% T, 20% G and 40% C. What is your opinion about the structure of the DNA molecule?

a. It is not DNA but RNA
b. It is double stranded
c. It is degraded
d. It is single stranded

45. If you are starving for one day, what carbohydrate will your body be using as the major source of energy?

a Glycogen
b. Lactose
c. Glucose
d. Starch

46. In the Mendelian cross between pea plants bearing yellow and green seeds, all plants in the f1 generation produced yellow seeds. However when two plants of the f1 generation were crossed with themselves, one (A) gave all yellow seeds, whereas the other (B) gave yellow and green seeds in 3:1 ratio. Why?



a. *B is dominant over A*
b. *B is homozygous*
c. *A is heterozygous*
d. *A is homozygous*

47. With which of the following organisms did Thomas Hunt Morgan do his pathbreaking experiments on chromosomal basis of inheritance?

a. pea plants
b. bacteria
c. fruit flies
d. mice

48. When a scientist tried to repeat Mendel's experiments of crossing of two pea plants, one with yellow seeds and purple flowers, and the other with green seeds and white flowers, they found that in the progeny plants, there were many more of the plants with yellow seeds and purple flowers and green seeds and white flowers, than plants with yellow seeds and white flowers and green seeds and purple flowers. They already knew that yellow seeds were dominant over white, and purple flowers were dominant over white. The reason for their observation was later found out to be:

a. The genes for yellow seeds and green seeds were present on the same chromosome
b. There was no dominant-recessive relationship between the genes
c. The genes for white flowers and purple flowers were present on the same chromosome
d. The genes for yellow seeds and purple flowers were present on the same chromosome

49. In the process of DNA replication which of the following chemical reactions occur?

a. Nucleophilic attack by 5'-phosphate of the primer strand on the 3'-OH of the incoming dNTP
b. Nucleophilic attack by 3'-OH of the primer strand on the 5'-phosphate of incoming dNTP
c. Nucleophilic attack by the 5'-phosphate of the incoming dNTP on the 3'OH of the primer strand
d. Nucleophilic attack by the 3'-OH of the incoming dNTP on the 5'-phosphate of the primer strand

50. During Griffith's experiments with *Streptococcus pneumoniae* infection in mice, material from _____ bacteria transformed _____ bacteria, showing that a chemical substance from one cell can genetically transform another cell.

a. living virulent, dead non-virulent
b. living non-virulent, dead virulent
c. dead virulent, living non-virulent
d. dead non-virulent, living virulent

51. Which technique was most useful for Watson and Crick to develop their double helical model of DNA?

a. X-ray crystallography
b. Random mutagenesis
c. Trangenic animals
d. Density gradient ultracentrifugation

52. The backbone of a DNA strand is composed of:

a. carbon-phosphate bonds between deoxyribose molecules
b. covalent bonds between nitrogen atoms in the nucleotide bases
c. covalent bonds between carbon atoms in deoxyribose molecules
d. hydrogen bonds between nucleotide bases

53. Of the three major types of RNA in the cell, translation requires:

a. messenger RNA
b. transfer RNA
c. ribosomal RNA
d. All of the above

54. In the Messelson-Stahl experiment, after growing E. coli for two rounds in presence of N^{14} after first growing them for several rounds in N^{15} , and density-gradient ultracentrifugation, two DNA bands were observed. One band was of low density (contained only N^{14}) whereas one was of intermediate density (contained both N^{14} and N^{15}). This suggested that:

a. The low density band only contained parental DNA strands
b. The intermediate density band contained only parental DNA strands
c. The low density band contained only parental DNA strands but the intermediate density band contained both parental and daughter DNA strands
d. Both the bands contained parental and daughter DNA strands.