ASSORTED BIOCHEMISTRY SAQ'S FROM DIFFERENT PAST PAPERS FOR MBCHB AND BPHARM LEVEL 2

A TRIBUTE TO THE LATE PROF. HASSAN SAIDI. BSc (Anatomy), MBChB, MMed (Surg), FACS.

TRIBUTE TO THE LATE PROFFESOR HASSAN SAIDI

1. List five major mechanism of antibiotic resistance.
2. Make brief notes on the following;
   (a) Beneficial mutations
   (b) Spontaneous mutations
   (c) Glycosylation
   (d) Molecular tags
3. Briefly explain five genetic mutations that confer resistance to infection by the malarial parasite in endemic areas.
4. State five reasons why parasites that live in micro-aerobic sites within the body have evolved anaerobic pathways for energy generation.
5. Illustrate and briefly explain the following chromosomal alternations stating possible phenotypic effect:
   (a) Inversion
   (b) Reciprocal translocation
6. Define the following and give an example of each:
   (a) Aneuploidy
   (b) Multiple alleles in a population
7. State any four exceptions to the Mendelian original principal of inheritance.
8. If a child and its mother are both blood group B explain the possible blood group(s) of the father.
9. Using illustrations where appropriate, describe how the normal cellular protein PrP^{c} can in the presence of minute quantities of abnormal PrP^{sc} protein become infectious leading to cell death.
10. Describe the mechanisms of action of:
    (a) Steroid hormones
    (b) Amine/peptide hormones
11. Discuss the applications of Polymerase Chain Reaction (PCR) in modern science.
12. Briefly discuss the major steps in the biosynthesis of peptidoglycan and outline the reasons why penicillin is an effective inhibitor of cell wall biosynthesis.
13. The Cori cycle and the Glucose-Alanine cycle are two important cycles illustrating the metabolic cooperation between muscle and liver.
    (a) In form of a scheme show the (I) Cori cycle (ii) Glucose-Alanine cycle.
    (b) Clearly differentiate between the role(s) of the two cycles.
14. State one difference between plasmodium and human metabolism with regards to the following:
    (a) Glycolysis
    (b) Kreb's cycle
    (c) Haemoglobin metabolism
    (d) Folate metabolism
    (e) Vitamin metabolism
15. Briefly describe the following mutation types:
    (a) Reversal mutation.
    (b) Transition mutation
    (c) Transversion mutation
    (d) Back mutation

(e) Forward mutation
(f) Suppressor mutation

16. Briefly state and explain the application of bioinformatics.
17. Describe the three steps in PCR amplification.
18. Answer the following:
    (a) The initiation of DNA replication occurs at specific points called?
    (b) DNA is unwound with the help of?
    (c) Single stranded DNA produced during replication is stabilized through the binding of?
    (d) After replication, the RNA primer in okazaki fragments is removed and the gaps are filled in by ____and ____?
    (e) The _____are the specific sequences on DNA template that regulate the transcription of one or more genes.
    (f) List two differences between replication and transcription.
19. Answer the following:
    (a) Give three main classes of RNA and state their role in protein synthesis.
    (b) A set of enzymes called _____are used to charge the tRNA with the proper amino acid.
    (c) The genetic code is _____since more than one codon is used for most amino acids.
    (d) The untranslated regions at the beginning and the end of mRNA are called _____and _____respectively.
20. A breed of dairy cattle is of **black coat** and **big body**. Occasionally, calves with recessive red coat are born. A dairy farmer purchased a prized **black big body** bull to improve on his livestock with the promise that it was a pure breeder. To his dismay, the bull produced a calf with recessive colour when mated to his undisputed pure breeding **black big body cow.** Using **R** for colour and **S** for body size,
    (a) What genotype did the farmer expect for the pure breeding prized bull?
    (b) What is the genotype of the above mentioned cow?
    (c) State the circumstances under which it was possible to get a **red calf** from the cross of the bull and the undisputed pure breeding cow?
    (d) If the bull mentioned above was mated with a true breeding **big red** cow, in a Punnet square show your phenotypes of the offspring (NB use the true genotypes for the bull: show all your genotypes clearly.
21. With the aid of illustrations, classify **eukaryotic chromosomes** on the basis of their size and centromere position. Identify one human chromosome that fits into each of the classes.
22. Briefly describe the asymmetric model of viroid replication.
23. Define the Wobble hypothesis and write the permitted anticodon-codon base pairing at the Wobble position.
24. With illustrations, briefly discuss the elongation cycle of prokaryotic protein biosynthesis.
25. Using structural illustration and aspartate as an example describe the transamination process.
26. Outline five fates of amino acids in the amino acid pool
27. Describe the biochemical basis of the excitation-contraction coupling in a skeletal muscle.
28. What is post-transcriptional regulation and how does it usually work?
29. Name the following
    (a) Full name of the two key enzymes of purine salvage pathways
    (b) The intermediate product leading to both GMP and AMP in de-novo purine biosynthesis.

30. Draw a clearly labelled diagram of a DNA replication fork.
31. With regards to eukaryotic RNA polymerases, highlight on the main product of; and the effect of α-amanitin on;
    (a) Polymerase I
    (b) Polymerase II
    (c) Polymerase III
32. Outline the major four enzymes responsible for protein degradation and list down two functions of HCL acid indigestion process.
33. List the metabolic fuel/energy related pathways/processes which take place in the human hepatocyte in;
    (a) Mitochondria
    (b) Cytosol
    (c) Both
34. Briefly explain the following terms;

(a) Inclusion cell disease
(b) Zellwerger syndrome
(c) Signal sequence
(d) Operon
(e) Operator

35. Discuss the structural features of proteins which serve as signals for their degradation.
36. Briefly discuss the Aspartate-Arginosuccinate shunt that links Krebs-Henseleit Cycle and Citric Acid cycle and list four diseases associated with urea elimination.
37. Discuss how prokaryotic organisms use lac operon to regulate gene expression in response to their environment.
38. Define the following terms and give an example in each case;
    (a) Multiple alleles
    (b) Codominance
39. Carefully study statements (a) and (b) below and answer the questions that follow; use clearly presented illustrations:
    (a) A woman has a daughter. There are three men whom she claims might have been the father of the child. The judge in the paternity court orders that all the three men, the child and the mother have blood tests. The results are: mother type A; daughter type O;
        - Man#1, Type AB
        - Man #2, Type B
        - Man #3, Type O

    The mother claims that this proves that man #3 must be the girl's father.

    (I) Is the mother correct? Why or why not?

    (ii) The judge isn't satisified, so he asks for the medical records of the people involved. He

Discovers that the little girl is colour blind. Men #1 and 2 are also colour blind. Man #3 has normal colour vision, as does the mother (NB colour blindness is X-linked and recessive). Assuming that one of these three men must be the father, can you now determine which of the three it is?

(b) Three babies were mixed up in a hospital. After considerations of the data below, which of the following represent the correct baby and parent combinations?

	Couple#1	Couple#2	Couple#3
Parent's blood groups	A and A	A and B	B and O
Baby's blood group	B	O	AB

Assign the babies to the parents and justify, use clearly represented illustrations.

40. In the table below, fill in the information on chromosomal basis of sex determination in the animal kingdom.

	System used	Male chromosomes	Female chromosomes	Example?
1				
2				
3				
4				

41. Using illustrations, briefly explain the genetic basis of 'mosaic traits' in animals.
42. Differentiate between expressivity and penetrance in a dominant trait.
43. Draw a diagram illustrating how a retra-troposon moves within a genome.
44. In human genomes, name any three types of sequences that contributes to the non-coding DNA
45. Give the full names of the following; LINEs, FISH
46. Define the terms; genome length and genome complexity. (B) A genome is made up of the following sequences. 2.5Mb of unique sequences, 2500 copies of a moderately repeating sequences that is 1Kb long and 500,000 copies of a highly repeating sequence that is 50 base pairs long. Showing your work clearly determine (I) The genome length in base pairs(bp) (ii) The genome complexity in base pairs.
47. Answer the following.
    (a) Define $Cot_{1/2}$ value and state three factors that influence it.
    (b) Draw a clearly labelled illustration to show the theoretical Cot-curve of a human genome and mention the OD at which this is determined.
48. With regards to muscle contraction, list the functions of the following proteins;
    (a) Actin
    (b) Myosin
    (c) Tropomyosin
    (d) Troponin
49. Describe the process of DNA replication in E. Coli.
50. Explain the difference between a missense mutation and a nonsense mutation
51. Describe a frame shift mutation.
52. Explain the genetic background and symptoms/appearance of the following;
    (a) Mosaicism
    (b) Klinefelter syndrome
53. Write short notes on lactose intolerance in humans.
54. Describe the mechanism of action of steroid hormones.
55. Using structural illustrations and alanine as an example describe the transamination process.

56. Briefly explain the Baltimore classification of viruses.
57. Discuss the biochemical and functional differences between the red skeletal muscles and the white skeletal muscles in humans.
58. Answer the following;
    (a) List two infective stages of the plasmodium life cycle.
    (b) The end product of glucose metabolism in bloodstream form of T. brucei is_____ while the vector form of T. brucei is _____.
    (c) Trichomonas vaginalis contain hydrogenosome which performs energy metabolism as _____do in other protozoa and the major end product of this metabolism are hydrogen and_____.
    (d) List two enzymes in folic acid synthesis that are targeted by chemotherapeutic agents in treatment of parasitic infections.
    (e) State the role of pentose phosphate pathways in parasitic protozoa.
59. Answer the following;
    (a) In control of gene regulation, DNA methylation inhibit transcription by?
    (b) Describe the occurrence of inclusion cell disease and Zellwenger syndrome in relation to protein targeting.
60. State five factors that distort the Mendelian inheritance ratio. (b) Explain why it is important to perform a test cross.
61. Outline the five major steps in biosynthesis of peptidoglycan.
62. (a) List the four phases of pharmacokinetics in their order. (b) List six major modes of excretion of drugs.
63. Describe the biosynthetic pathway of adrenaline from phenylalanine.
64. Describe the occurrence and causes of DNA mutation.
65. Outline five reasons why parasitic protozoa prefer anaerobic energy metabolism to aerobic metabolism.
66. Outline five applications of bacteria in science and technology.
67. Outline five applications of polymerase chain reaction (PCR) on modern medicine.
68. Outline five factors that contribute to selective toxicity to chemotherapy in parasitic protozoa.
69. Outline the three major reactions shared by branched chain amino acids degradation. (B) List the enzymes and co-factor involved in each reaction above.
70. Outline the major diseases associated with the Krebs-Henseleit cycle and the enzymes involved.
71. Outline fates of amino acids in the amino acids pool.
72. Outline the effect of insulin and glucagon on the following

Metabolic action	Insulin	Glucagon
Glycogenolysis.		
Lipolysis		
Glycogenesis		
Ketogenesis		
Gluconeogenesis		
Amino acid uptake in the liver		
Glycogen synthase activity- Glycogen phosphorylase activity- Protein synthesis-		

73. (a) Briefly explain any 4 factors that are known to cause deviation from the normal Mendelian inheritance pattern. (b) Differentiate between euchromatin and heterochromatin.
74. Describe how benzoate (found in cordial juices as preservative) is metabolized and excreted in humans.
75. Describe the mechanism of action of peptide hormone.
76. Describe the mechanism by which introns are removed from nuclear pre-mRNA
77. Explain how multiple mRNAs can arise from one pre-mRNA
78. Differentiate between pathogenicity and virulence, briefly describe the mechanism of pathogenicity
79. Interferons mediate anti-viral activity by three pathways;
    (a) List these three pathways
    (b) Describe how any two of these pathways bring about the antiviral activity.
80. Discuss post-transcriptional modification of mRNA
81. (a) Draw a diagram illustrating how retra-troposons move within genomes (b) define genomic imprinting (c) in human genome, name any three types of sequences that contributes to the non-coding DNA (d) LINEs mean?
82. Outline the functions of the following;
    (a) RNA polymerase I
    (b) RNA Polymerase II
    (c) Taq polymerase
    (d) Photolyase
    (e) DNA ligase
83. Based on your knowledge of bacterial Biochemistry;
    (a) Outline the components of a cell wall
    (b) List down the differences between gram positive and negative
    (c) List down the differences between endotoxins and exotoxins
    (d) Giving an example in each case, outline the various mechanisms of action of antimicrobial drugs.
84. State five mechanisms of how an individual's genetic background can increase resistance to malarial infection in endemic areas.
85. State the Mendelian 1st and 2nd laws. State five factors that cause deviation from Mendel's original principle of inheritance.
86. With regards to protein biosynthesis, illustrate and name the components of an initiation complex. Mention the accessory factors involved in this step and their roles.
    (a) Briefly describe the three steps of the elongation cycle of protein biosynthesis with the enzymes involved.
    (b) Give any three inhibitors of prokaryotic protein biosynthesis and mention their mode of action.
87. Distinguish between de novo and salvage biosynthesis and highlight two key differences between de novo purine and pyrimidine biosynthesis.
88. Describe de novo purine biosynthesis in humans and highlight on the regulation of different pathways; whether activation or feedback inhibition.
89. Describe in detail the active methyl cycle (methionine cycle).

90. Identify three key differences between DNA replication and transcription. Highlight on the supramolecular assembly in which proteins are synthesized.
91. Outline five features that enhance microorganism's ability to cause diseases.
92. Attempt the following;
    (a) List two genetic factors that promote gout.
    (b) What causes neurological disorder in Lesch-Nyhan?
    (c) What is the role of folic acid in deoxythymidilate synthesis?
    (d) List two amino acids required in pyrimidine synthesis.
    (e) Azaserine is a powerful inhibitor of glutamine amidotransferases. If growing cells are treated with azaserine , what intermediates of nucleotide biosynthesis will accumulate? Explain .
93. Describe in detail the process of DNA replication.
94. A gene is made up of the following nucleotide sequence;
    Coding strand; GCC-AGT-CGA-ATG-CTA
    Anti-sense strand; CGG-TCA-GCT-TAC-GAT
    (a) Write down the mRNA sequence clearly showing its 5' and 3' ends.
95. Given the DNA duplex below;
    3' ATGACTCTCTAGTCCAT- sense strand
    5' TACTGAGAGATCAGGTA- anti-sense strand
    (a) Write the sequence of the mRNA
    (b) Write all the base sequences of the first three anticodons of the cognate tRNA

TRIBUTE TO THE LATE PROFFESOR HASSAN SAIDI

PROF. SAIDI WAS A CELEBRATED GENERAL AND LAPARASCOPIC SURGEON AT KENYATTA NATIONAL HOSPITAL AND AGA KHAN HOSPITALS, A FELLOW OF THE AMERICAN COLEGE OF SURGEONS AND MEMBER OF THE KENYA MEDICAL ASSOCIATION. CHAIRMAN DEPARTMENT OF HUMAN ANATOMY, PRESIDENT SURGICAL SOCIETY OF KENYA, EDITOR IN CHIEF OF THE ANNALS OF AFRICAN SURGERY JOURNAL, ASSOCIATE DEAN SCHOOL OF MEDICINE UNIVERSITY OF NAIROBI, BOARD CHAIR NARIOBI SURGICAL SKILLS CENTRE.

We celebrate his life legacy for being an excellent teacher of Anatomy, with a thirty-year experience in instruction and teaching Human Anatomy at the University of Nairobi, Aga Khan University Nairobi and University of Pennsylvania. He has mastery of Embryology, Gross Anatomy, Histology and molecular biology, with surgical anatomy as his pet subject. Having taught over 4000 undergraduate medical students, supervised over 40 B.Sc. Anatomy students, 30 Master of Medicine Surgery students, and 4 Master of Anatomy students. He mentored many renowned surgeons, doctors and clinical officers.

Prof. Hassan Saidi was able to publish over 60 high impact peer reviewed articles in local and international journals. His research activity focused on clinical anatomy in all its aspects, trauma, oncology and surgery of the digestive tract. He published a book on histology and was in the process of publishing a text book of Surgical Anatomy. Prof. Hassan Saidi held many leadership roles in the University of Nairobi, initially as a course coordinator and rising to become the chairman of thematic areas within the department. He was the substantive Chairman of the Department of Human Anatomy until the time of his death. Prof. Hassan Saidi was also the associate dean, Preclinical departments of the University of Nairobi. During his tenure as a chairman, he shepherded the establishment of the Nairobi Surgical Skills Centre, publication of the Kimani's Histology Text and Atlas, Establishment of the Anatomy Journal of Africa, supported staff development, training and promotion as well as supporting many local and international staff retreats.

Prof Hassan indeed had many friends. He definitely did not know all of them, but yet he would never deny any genuine person seeking assistance. Taking time to engage with different age groups and this he did effortlessly. An opportunity to watch football, play some basketball or just have a 'chat' (always very insightful and refreshing) over some coffee snack was a sought-after opportunity by many. In his 36hr day, he would still find time to call up and catch up with his friends, his objective to savour every moment with friends to improve them in one way or another. What better HE WAS!

Prof. Hassan Saidi was married, with three sons. He was actively involved in charity and volunteer activities through HAIBA foundation and other charity groups. He was a mentor, a great teacher, researcher and a surgeon.He surely fought a good fight and finished the race. He will be missed by many but his legacy lives on forever in our hearts and lives, till always and forever!!!

TRIBUTE TO THE LATE PROFFESOR HASSAN SAIDI

WHAT ARE YOU DOING TO EMULATE THE KIND OF LIFE PROF. SAIDI LIVED? IN ALL THE ABOVE CITED ACHIEVEMENTS, AND THE IMPACT HE GENERATED IN ALL WALKS OF LIFE, DO YOU THINK IT'S POSSIBLE TO LEAVE A TRAIL OF THE SAME MAGNITUDE OF EXQUISITION?

YES IT IS! START WITHIN YOUR SPHERE OF INFLUENCE. LOOK FOR A WAY TO BLESS AND MOULD YOUR FELLOW MEDICS. STUDY MEDICINE WITH PASSION, TRANSFORMATIVE PURPOSE AND PURSUE EXCELLENCE WITH DISTINCTIONS IN ALL YOU DO. ABOVE IT ALL, PURSUE GOD WITH ALL OF YOUR BEING, WHILE PLUGGING INTO HIS SOURCE TO HELP YOU ACHIEVE IT ALL IN KEEPING PROF. SAIDI'S LEGACY ALIVE!!!

ALL THE BEST IN YOUR STUDIES AND UPCOMING EXAMS AS GOD LEADS YOU INTO THE GREAT DOCTORS HE ORCHESTRATED YOU TO BE!!!

WHERE GOD LEADS, HE PROVIDES. WHERE HE GUIDES, HIS GRACE IS SUFFICIENT!