BIOCHEMISTRY IA #1

1. The substitution that would most likely cause a change in a protein's tertiary structure is

A. serine to threonine. B. arginine to lysine.

C. valine to leucine. D. glutamate to aspartate. E**. histidine to tryptophan**

2. The peptide bond has all of the following attributes except:

A.     a partial double bond character

B.     ability to form an H-bond with the side chain of leucine

C.     cis and trans isomers

D.     **partial positive and negative charges on carbonyl oxygen and nitrogen**

E. flat planar character (with substituents).

3. Which of the following would most likely provide information regarding the isoelectric point of a protein?

A. protein quaternary structure **B. protein solubility as a function of pH**

C. protein size D. protein shape

E. protein tertiary structure

Match the immunoglobulins (A – E) with statements in 4 – 9 *(one to one matching only)*

A. IgG B. IgA C. IgD D. IgE E. IgM

4. . Predominantly secreted as a dimer although monomers exist IgA

5. Pathogen-specific immunoglobulin of this class indicate a recent infection **IgD**

6. First to be secreted in response to an antigenic challenge **IgM**

7. Each molecule contains four identical antigen binding sites **IgM**

8. Actively secreted into external body fluids IgA

9. Implicated in allergic reactions **IgE**

Questions 10 - 15: Select:

A - for increase/attainable/most probable

B - for decrease/unattainable/least probable

C - for no change

Shin Okubo a renowned Haematologist developed a blood agent called Shaku-Ji that improved tissue oxygenation by increasing the percentage of oxygen that is released from haemoglobin during its passage through the capillaries of extra-pulmonary tissues.

10. This agent will increase the intracellular pH of RBCs, and subsequently stabilize the R state of Hb.  **B**

11. This agent will increase the intracellular pH of RBCs, subsequently leading to an increase in oxygen affinity **B**

12. Decrease the intracellular pH of RBCs and subsequently lead to an increase in oxygen affinity and destabilization of the R state of Hb A

13. Decrease the intracellular pH of RBCs and subsequently lead to a decrease in oxygen affinity and stabilization of the T state of Hb A

14. Increases the concentration 2,3-BPG leading to an increase in oxygen affinity B

15. Increase the concentration 2,3-BPG leading to a destabilization of the R state and destabilization of the T state.

16. The clinical manifestation of sickle cell disease are not present at birth because:

a. the spleen of the neonate filters out sickled cells

b. there are no reliable methods to detect it

c. maternal erythrocytes protect the neonatal erythrocyte from sickling

**d. HbF interferes with the sickling phenomenon**

e. the concentration of HS is too low

17. A new form of insulin has been produced which gives a more rapid response. To produce this new form of insulin, one amino acid in the original molecule was replaced. Which of the following is the replacement scheme?

**a. Asp replacing a Pro**

b. Gly repacing a Pro

c. Glu replacing Asp

d. Lys replacing Arg

e. Phe replacing Ala

18. In a eukaryotic cell,

a. metabolism is by anaerobic and aerobic means:

b. the DNA is found in the cytoplasm

**c. there is a nuclear envelope**

d. there is no cytoskeletal metabolism

e. none of the above apply

19.. These lipids predominate in the plasma membrane except:

a. phosphatidylcholine b. cholesterol

c. triacylglycerol d. phosphatidylinositol

**e. garri**

20. Which of the following is not true about functions of the membrane protein?

a. they transport ions

b. they are a source of energy for the cell

c. they bind hormones

d. they take part in signal transduction

e. all of the above are true

Questions 21 & 22: Mrs. Mendes reported at the Mamprobi polyclinic with a 2-year old child who had a fever which did respond to malaria therapy. Blood samples were taken for bacteria cultures and rod shaped bacteria were isolated from blood. After staining the bacteria with gram stain, it could not be decolorized with alcohol.

21. The sub-cellular structure which took up the gram stain is:

**a. cell envelope** b. nucleoid c. cytoplasm

d. cytoskeleton e. all of the above

22. The bacteria cells isolated probably lack

a. ribosomes **b. outer plasma membrane**

c. nucleiod d. pili e. none of the above

Questions 23 & 24: During clinical trials of a new drug, Appiah Stadium was accidentally injected with ouabain. Within 30 minutes, Appiah Stadium became extremely dizzy and weak, and fell into coma.

23. Biochemical analysis of Appiah Stadium’s serum is expected to show:

**a. hyponatremia** b. hypokalemia c. hypercalcemia

d. hyperchloremia e. all of the above

24. Appiah Stadium’s ill-health has arisen from defective:

a. ATP synthesis b. ATP hydrolysis c. Enzyme phosphorylation

**d. membrane transport** e. none of the above

Questions 25 – 27: A child was found to be susceptible to bacterial infection. Detailed tests revealed defective phagocytosis by the white blood cells.

25. What cytoskeletal structure is most likely defective?

**a. actin** b. intermediate fibers c. dyein

d. cytosol e. microtubules

26. What other cellular function may also be altered?

a. mitotic chromatid separation

b. flagellar movement

**c. cytokinensis**

d. secretion of proteins

e. glucuronidation

27. This child’s mother later admitted that her child had ingested an unknown chemical. This chemical is most likely to be:

a. cyanide **b. cytochalasin** c. colchicines

d. oubain e. paracetamol

28. Analysis of a group of cells showed extreme damage to the lipid component of the plasma membrane by free radicals. Which sub-cellular structure is most likely defective?

a. lysosomes **b. Peroxisomes**

c. mitochondria d. endoplasmic reticulum

e. liver

29. Post-translational modification of proteins occurs in Golgi apparatus. In the cis-golgi, proteins, destined for the lysosomes are attached with:

a. glucose-6-phospahte b. sialic acid

**c. Mannose-6-phosphate** d. glyceraldehyde-3-phosphate

e. fructose

30. Defective degradation of worn out organelles within the cells would likely be due to:

a. higher than normal organelle turnover

b. excessive cell proliferation resulting from growth factors

**c. Defective ATP-dependent pump in lysosomal membrane**

d. modified proteins and lipids found in the sub-cellular structures

e. creatine kinase

31. Erythrocytes suspended in solution for 15 minutes were centrifuged at 2500 g for 10 minutes. The supernatant was deep red. The process that explains the color of the supernatant is:

a. active transport b. simple diffusion

c. facilitated diffusion **d. membrane dissolution**

e. Osmosis

32. A new species of *Streptococcus aureus* (bacteria) was found to be resistant to the antibiotic Penicillin. What sub-cellular structure is most likely responsible for its resistance?

a. nucleoid b. ribosome **c. plasmid**

d. phage (virus inhibiting bacteria) e. nannose

33. A characteristic of heterochromatin is that it is:

a. basic b. relatively extended and dispersed

c. transcriptionally inactive d. not attached to any protein

e. rich in arachidonic acid

34. After incubating a group of cells with drug B, it was found that they had lost their ciliary motion. Drug B is most likely:

**a. colchicines** b. ouabain c. salicyclate

d. fodrine e. celebrex

Questions 35 & 36: Jayzee homogenized a piece of liver in 0.2 M sucrose solution and subjected the mixture to centrifugation at 1000 g for 10 minutes.

35. Jayzee carried out the homogenization in solution because it:

**a. creates an osmotic pressure within the organelles**

b. dissolves plasma membranes, facilitating organelle isolation

c. prevents organelles from adhering to each other

d. maintains the osmolarity of the homogenizing solution

e. facilitates homogenization

36. After 10 minutes initial centrifugation, the supernatant most likely contains:

a. cytoskeleton b. nuclei

c. plasma membrane d. mitochondria

e. all of the above

37. Identify the option that ranks amino acids in order of increasing polarity at physiological pH.

a. Val, Asn, Met, Tyr b. Met, Tyr, Val, Asn

c. Met, Val, Asn, Tyr d. Tyr, Val, Met, Asn

e. Val, Met, Tyr, Asn

38. Binding of the first molecule of oxygen to sickle-cell hemoglobin produces all of the following except:

a. a conformational change in the quaternary structure

b. a cooperative effect comparable to that of normal hemoglobin

c. a decrease in the probability of sickling

d. an enhancement of carbamate formation

e. release of protons

39. Proteins are effective buffers because they contain:

a. a large number of amino acids

**b. amino acid residues with different pKs**

c. peptide bonds that can readily hydrolyze, consuming OH- and H+ ions

d. a large number of hydrogen bonds in helices

e. amino acid residues with same pKs

40 . All of the following are true about the pK(s) of an amino acid except:

A. are unique for the α-amino group and α-carboxyl group, i.e., have at least two buffering regions.  
B. exist for all side chains or R-groups.  
C. are the pH value(s) at which 50% of that amino acid functional group is ionized and 50% is not ionized.  
D. ionizable side chains determine the charge of the protein at physiological pH of 7.4.  
E. any amino acid must have at least three different protonation states.

41. A new form of insulin has been produced which gives a more rapid response. To produce this new form of insulin, one amino acid in the original molecule was replaced. Which of the following is the most likely replacement scheme?

**a. Asp replacing a Pro** b. Gly repacing a Pro c. Glu replacing Asp

d. Lys replacing Arg e. Phe replacing Ala

42. Which of the following statements about amino acids is INCORRECT? Amino acids may be categorized according to their:

A. polar and non-polar nature.  
B. chemical properties of the side chains.  
C. functional groups attached to the side chains.  
D. ability to form covalent bonds in secondary structures after being incorporated into proteins.  
E. ability to form disulfide bonds in multimeric proteins

43 . Amino acid side chains:  
A. are expected to be mostly hydrophobic, if they face the interior of the native conformation.  
B. of glutamine and asparagine categorize these as acidic amino acids.  
C. of leucine, isoleucine, tryptophan and phenylalanine are hydrophobic.  
D. of serine and threonine are considered to be hydrophilic.  
E. of the basic and acidic amino acids are normally expected to be ionized or charged at physiological pH

44 . The pI of a protein is the:  
A. pK value of the functional groups attached to the a-carbon.  
B. pH value at which it has no charge.  
C. pH value at which the protein is generally most soluble.  
**D. pH value at which its net charge is zero.**  
E. net pK value of all the ionizable side chains and R-groups.

45. Which of the following statements about Hb S is correct?

A. It is a normal hemoglobin found in adults.

B. It is a form of hemoglobin modified by the addition of a cysteine at the C-terminus.

C. It is a mutant form of hemoglobin in which a glutamic acid of each beta chain has been replaced by a valine.

D. The molecule does not aggregate in red cells as well as does HbA.

E. Aggregation of molecules of this form of hemoglobin is promoted by high oxygen concentration

46. All of the following may characterize sickle cell anemia EXCEPT that

A. sickling occurs when there is a high concentration of the deoxygenated form of Hb S.

B. Hb S is altered by the change of a single amino acid in the b chain.

C. Hb S has an unchanged electrophoretic mobility relative to normal hemoglobin.

D. the disease can be diagnosed in fetal DNA by restriction enzyme digestion.

E. the solubility of deoxygenated Hb S is abnormally low.

47. Which of the following states binds oxygen with the greatest affinity?

A. Hb(O2)2 B. Hb C. Hb(O2)4

D. HbO2 E. Hb(O)3

48. Analysis of electrophoretic patterns of hemoglobin isolated from blood of patients heterozygous for the sickle cell gene would show \_\_\_\_ bands.

A. one B. five C. four D. two E. three

49. Deoxygenated sickle hemoglobin differs from deoxygenated normal hemoglobin in:

A. Quaternary structure B. secondary and tertiary structure

C. primary and tertiary structure D. Quaternary and tertiary structure

E. primary structure

Questions 50 – 53: SELECT:

A if your answer is INCREASE, B if your answer is DECREASE, C if your answer is NO CHANGE

As part of your medical internship in a new laboratory, you have been asked to perform detailed analysis of human tissue (skin, aortic tissue) from a copper-deficient patient. Indicate (*by circling the best answer*) how you would expect the following to vary:

50. Lysyl oxidase activity in skin tissue: increase decrease no change

51. Lysine cross-linking in aortic tissue: increase decrease no change

52. hydroxylation of lysine residues in aortic tissue: increase decrease no change

53. Hydroxylation of Proline in aortic tissue: increase decrease no change