

KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2008/2009

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF MEDICINE (PAPER I)

HMB 203: MEDICAL BIOCHEMISTRY

DATE: Monday, 7th September, 2009

TIME: 9.00 a.m. – 12.00 p.m.

INSTRUCTIONS:

Section A: Fill in the empty gaps

Answer **ALL** the Questions (5 marks each)

1. Fill in the information missing in the following table.

Disease	Enzyme	Lipid accumulating	Clinical symptoms
Tay-Sach's	Hexosaminidase A		
Fabry's	Alpha- galactosidase		
Krabbe's	Beta- galactisidase		
Gaucher's	β - glucosidase		
Niemann- PiCK	sphingomyelinase		

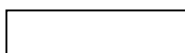
2. The energy of an electron transiting from $n = 3$ to $n = 4$ in a Bohr's atom can be calculated using the formula _____ (i) _____ which gives a value of

_____ (ii) _____ joules. This corresponds to a wavelength of _____ (iii) _____ metres and a frequency of _____ (iv) _____ Hertz.

In an experiment to determine the concentration of a given biological fluid, it was observed that the concentration of sodium acetate ions was 10^{-3} molar while that of acetate ions was 0.003 molar. Such a solution would have a pH value of _____ (v) _____ which corresponds to _____ (vi) _____ (neutral/acidic/basic) solution.

The maximum number of electrons which a 2p orbital can hold is _____ (vii) _____ while a 3d orbital can hold a maximum _____ (viii) _____ electrons. A $3d_z$ orbital has the shape _____ (ix) _____. The singly charged positive aluminium ion has a noble gas core abbreviated electron configuration of _____ (x) _____.

3.are stereoisomers exhibited by simple sugars with carbon atoms. pair have mirror images of each other but are and identical. These isomers differ in their ability to rotate light. One member of the pair rotate a plane polarized light in a clockwise direction and is referred to as while the other rotates the plane polarized light in direction is known as.....
4. The ability of glycolysis to provide ATP in the absence of oxygen is especially important because it allows _____ to perform at very high levels when oxygen supply is insufficient and because it allows tissues to survive _____. However, _____ muscle, which is adapted for aerobic performance, has relatively low glycolytic activity and poor survival under conditions of _____. Diseases in which enzymes of glycolysis (such pyruvate kinase) are deficient are mainly seen as _____ or, if the defect affects skeletal muscle (such phosphofructokinase), as _____. In fast-growing cancer cells, glycolysis proceeds at a higher rate than is required by the citric acid cycle, forming large amounts of _____, which is reduced to _____ and exported. This produces a relatively _____ local environment in the tumor which may have implications for _____.
5. (a)----- is a genetic regulatory mechanism which operates to equalize the [phenotypic](#) expression of characteristics determined by genes on the [X chromosome](#) so that they are equally expressed in the human XY [male](#) and the XX [female](#).
- (b)----- refers to the random inactivation of one of the X chromosomes in each cell of very early XX embryos. As a result, females are a mosaic of tissues in which one or the other X is active. This makes males and females equivalent for activity of most X-linked genes. ----- hypothesis. Once an X chromosome is inactivated, it remains inactive through subsequent mitotic divisions. The inactive X is seen in the nucleus and is known as - -----.
6. a) Below is a scheme showing biochemical activation of Folic acid. Name the missing intermediates



Folic acid

Tetrahydrofolic acid

Folic acid

b) Chemically, the structure of Folic acid is constitutes _____,
_____ and _____

Section B: Answer all the Questions (5 marks each)

1. a. What are the non-steroidal anti-inflammatory drugs (NSAIDs)?
b. Briefly explain the mechanism of acetyl-salicylic acid (aspirin) and its significance.

2. Draw structures corresponding to the following names

- i) 2,4-Dimethyl-2-pentanol
- ii) 2,2-Dimethylcyclohexanol
- iii) 3-Ethyl-3-hexanol

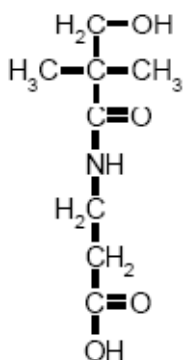
3. Distinguish between

- a. Salting in and salting out of a protein. [2 mark]
- b. Briefly describe the principle of ammonium sulfate precipitation in separating out proteins. [3 mark]

4. Name the Citric Acid Cycle reactions in which

- i. Elements of water are consumed (2 mark)
- ii. Carbon dioxide is liberated (2 mark)
- iii. Substrate phosphorylation occurs (1 mark)

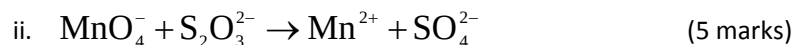
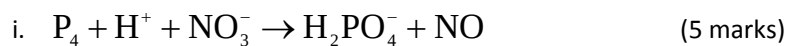
5. Identify the vitamin below and provide one sentence that describes the function of this vitamin. (5 marks)



6. Describe renal clearance as a measure of kidney function. (5 marks)

Section C: Answer any Four Questions (10 marks each)

1. Explain the mode of action of the following anti-cholesterol therapies.
 - a. Anion exchange resins.
 - b. Competitive inhibitors of HMG-CoA reductase.
2. Balance the following reaction equations both in acidic media



3. Explain the role of nucleotides and their derivatives (10 marks)
4. Discuss any three biochemical complications of diabetes mellitus (10 marks)
5. a) Describe biosynthesis of Coenzyme A (CoASH) from Pantothenate (5 marks)

b) Explain the biochemical role of Methotrexate (5 marks)
6. Draw the structure of an IgG molecule and describe in details the structure and functions of the L and H chains. (10 marks)

School of Health Sciences
Department of Medical Physiology
End of year/course University Professional Examination
Medical Biochemistry for MBChB year II
Paper II: Multiple choice questions
Time allowed 1 1/2 Hours
PAPER TWO
Multiple Choice Questions

Instructions: Answer All the Questions State True or False

1. The following statements refer to the roles of hormones sensitive lipases, which is true or false.
 - a. To hydrolyze the ester bond in hormones.
 - b. To hydrolyze dietary fat and the enzyme is stimulated by epinephrine.
 - c. To mobilize fat from adipose tissue.
 - d. To hydrolyze triacylglycerols in liver
 - e. None of the above.
2. In lipogenesis of fatty acids from pyruvate, an enzyme reaction occurs in the cytoplasm, indicate which is true or false.
 - a. Pyruvate dehydrogenase.
 - b. Citrate synthase.
 - c. Propionyl CoA carboxylase
 - d. ATP- citrate lyase
 - e. None of the above.
3. Mitochondrial membranes can transport the following metabolites, indicate which is true or false:
 - a. Fatty acid
 - b. Fatty acyl-coA
 - c. Malonyl-coA
 - d. Acyl-carnitine
 - e. None of the above.
4. All glycerol containing lipids are synthesized from the following metabolites, indicate which is true or false:
 - a. Triacylglycerol
 - b. Cephalin
 - c. Phosphatidic acid
 - d. Phosphatidyl glycerol
 - e. None of the above
5. Aufbau's Principle is an important concept in electron configuration
 - a. The noble gas core abbreviated electron configuration is only used to write electron configuration of noble gases
 - b. The electron configuration of sodium has the highest occupied orbital as the 3s
 - c. The Aufbau's principle does not negate the Hund's Rule
 - d. Electrons are filled in higher energy orbital after lower energy orbitals are full

- e. A half filled half outermost shell, for example in phosphorous 3p shell as stable as a full filled outermost shell
6. Hydrocarbons are the basis of organic compounds
 - a. Hydrocarbons will only contain carbon and hydrogen atoms only
 - b. Organic compounds will only contain halogens, carbon and hydrogen atoms only
 - c. Aromatic compounds are a class of hydrocarbons
 - d. Alkynes and halocarbons are hydrocarbons but not organic compounds
 - e. The chemistry of hydrocarbons is very different from aromatic chemistry
7. The Nernst Equation is very vital in electrochemistry
 - a. It can be applied to calculate the electric potential of a cell
 - b. It can help deduce the chemical equilibrium constant of a given reaction
 - c. The emf calculated using the equation is dependent on the number of electrons involved in a given reaction
 - d. The voltage of a given chemical reaction is dependent on the potential difference between the cathodic and anodic reactions
 - e. The electrons generated in the reaction can be used to do an external work
8. The standard reduction potential acts a reference point in electrochemical process
 - a. Standard hydrogen electrode (SHE) is one of most important reference electrode
 - b. SHE has a reduction potential of zero volts
 - c. Reduction potentials are measured/calculated from reduction half reactions involved
 - d. The overall reduction potential is a comparison of SHE and the electrode reaction of interest
 - e. The oxidation potential can also be used but the reaction involved is oxidation reaction
9. Light is an important parameter in day to day life. Consider a light with a wavelength of 15 nm
 - a. The light would have both particle and wave-like character
 - b. The light would travel in straight line
 - c. It would have the same speed as light with a wavelength of 30 nm
 - d. Its photons would posses energy equal to 1.27×10^{-21} joules/photon
 - e. It would be more brighter than a light with a wavelength of 30 nm
10. A chemical cell can be made by connecting two half cells
 - a. The overall potential is dependent on the potential difference between the two half cells
 - b. The connection between the two half cells can be done through a metal conductor and a salt bridge
 - c. The overall potential will be a function of the number of the electrons per mole of the reactants used
 - d. There will be no electric current generated when the two cells get to an equilibrium
 - e. The electric current generated cannot do external work

11. From the abbreviated name of the compound Gal(β 1 $\rightarrow$ 4)Glc, we know that:
 - a. C-4' of glucose is joined to C-1' of galactose by a glycosidic bond.
 - b. The compound is a D- sugar.
 - c. The glucose residue is at the reducing end.
 - d. The glucose is in its pyranose form.
 - e. The galactose residue is the β -anomer.
12. In starch and glycogen
 - a. Amylose is unbranched; amylopectin and glycogen contain many (α 1 $\rightarrow$ 6) branches
 - b. Both are heteropolymers of glucose and fructose.
 - c. Both serve primarily as structural elements in cell walls.
 - d. Both are stored intracellularly as insoluble granules.
 - e. Glycogen is less branched than starch.
13. Lipids are the biomolecules of choice for storage of metabolic energy because they:
 - a. Are soluble in water
 - b. Yield a large amount of energy upon oxidation
 - c. Are less hydrated
 - d. Are easily hydrolyzed
 - e. Are amphipathic
14. In the classification of amino acids,
 - a. Aspartic acid and asparagine are acidic amino acids.
 - b. Alanine and valine are polar amino acids.
 - c. Serine and glutamine are non polar, uncharged amino acids.
 - d. Lysine and arginine are basic amino acids.
 - e. Tyrosine and phenylalanine are aromatic amino acids.
15. For amino acids and amino acid derivatives
 - a. GABA (γ -aminobutyric acid) is a potent inhibitory neurotransmitter derived from glutamic acid.
 - b. Ornithine is an important hormone.
 - c. Epinephrine is a hormone derived from tryptophan.
 - d. Serotonin is a neurotransmitter derived from tryptophan.
 - e. Histamine is a neurotransmitter derived from histidine
16. The following are gluconeogenic substrates
 - a. Lactate
 - b. Fructose
 - c. Glycerol
 - d. Amino acid
 - e. Phosphoenolpyruvate
17. The following are regulators of Pyruvate Dehydrogenase Complex
 - a. NADH
 - b. FADH_2
 - c. Pyruvate
 - d. Glucose
 - e. Acetyl-CoA
18. The following enzymes catalyze reaction in the Pentose Phosphate Pathway
 - a. Peroxidase
 - b. Lactonase
 - c. 6-Phosphogluconate Dehydrogenase
 - d. PEP carboxykinase
 - e. Glutathione Reductase
19. The following factors govern regulation of Citric Acid Cycle

- a. Substrate availability
 - b. Inhibition by accumulating products
 - c. Availability of fats
 - d. Inhibition of Gluconeogenesis
 - e. Allosteric feedback inhibition of the enzymes that catalyze early steps in the cycle.
20. The following agents inhibit the respiratory chain
- a. Barbiturates
 - b. Antimycin A
 - c. Kanamycin
 - d. Neomycin
 - e. Cyanide
21. The following agents uncouple oxidative phosphorylation from electron transport chain
- a. Atractyloside
 - b. Carbon Monoxide
 - c. H_2S
 - d. 2,4-Dinitrophenol
 - e. Oligomycin
22. In the globin gene family, human and mouse neuroglobins (Ngb) are more closely related to one another than they are to other globins, even those from the same species.
- a) This pattern is as a result of duplication and divergence
 - b) Human neuroglobin and mouse neuroglobin are orthologs
 - c) Human neuroglobin and mouse neuroglobin are paralogs
 - d) Human neuroglobin and mouse neuroglobin serve different functions
 - e) Human neuroglobin and mouse neuroglobin serve the same functions
23. Which of the following statements is true / false about microsatellite markers
- a) Microsatellites are simple sequence tandem repeats
 - b) They tend to occur in non-coding regions of the DNA
 - c) variability in microsatellites is due to slippage replication
 - d) microsatellites are dominant markers
 - e) microsatellites are codominant markers
24. In Sanger chain termination technique, the following is(are) required:
- a. Template ssDNA
 - b. Primer
 - c. Each of the 4 dNTPs
 - d. RNA polymerase
 - e. One of the 4 possible ddNTPs
25. Answer TRUE or FALSE
- a) One map unit = 1000 centimorgan (cM)
 - b) One map unit = one centimorgan (cM)
 - c) One map unit = one centimorgan (cM)
 - d) One map unit = 1% recombination between loci
 - e) One map unit 100% recombination between loci
26. Physical mapping of the genome can be achieved using:
- a) Expressed sequence tags (ESTs)
 - b) Sequence tagged sites (STSs)
 - c) Fluorescent in situ hybridization

- d) Random Amplified Polymorphic DNA analysis
 - e) Fluorescent in situ hybridization (FISH)
27. The following are early stage symptoms of Pellagra
- a. Anorexia
 - b. Indigestion
 - c. Dermatitis
 - d. Muscle weakness
 - e. Diarrhea
28. Pyridoxine antagonists are
- a. Isoniazid
 - b. Hydralazine
 - c. Cycloserine
 - d. Methotrexate
 - e. Nicotinic acid
29. The following are fat-soluble vitamins?
- a. A
 - b. C
 - c. Folate
 - d. E
 - e. K
30. The following statements describe Thiamine
- a. It has the odor and flavor of yeast
 - b. It is slowly destroyed by moist heat
 - c. It is hydrolyzed in acid or alkaline medium
 - d. It is a yellow viscous oil
 - e. It is involved in the transketolase reactions of the triose phosphate pathway
31. The following enzymes require biotin as a coenzyme
- a. Pyruvate Carboxylase
 - b. Pyruvate Dehydrogenase
 - c. Succinyl-CoA synthetase
 - d. Propionyl-CoA Carboxylase
 - e. Glutathione Reductase
32. Retinol binding protein occurs in plasma in combination with transthyretin. The role of thyretin in the complex is:
- a. To bind vitamin A
 - b. To prevent renal excretion of retinol binding protein
 - c. To bind thyroxine
 - d. To transport iron
 - e. To bind oligosaccharides.
33. Which of the following proteins helps to prevent loss of iron in the kidneys
- a. Albumins
 - b. Transferrin
 - c. Ceruloplasmin
 - d. Haptoglobulins
 - e. Ferroxidases.
34. A protein which binds a first messenger, and is involved in mediating its biological effects, is known as
- a. Receptor
 - b. Transducer
 - c. Translator
 - d. Mediator

- e. Regulator
35. Hydrophobic hormones
- a. Do not dissolve in water easily and they therefore require plasma transport proteins with hydrophobic pockets.
 - b. Are protected (by these pockets) and have therefore long half-lives.
 - c. Cross plasma membrane, bind to cytoplasmic or nuclear receptors and elicit direct cellular effects.
 - d. Are difficult to store as they cross membranes easily and therefore are synthesized as needed (except thyroid hormones).
 - e. Are transported free in the serum-as a result they are rapidly eliminated from the circulation.
36. The following metabolic effects of are all caused by insulin deficiency in the body:
- a. Accelerated glycogenolysis in liver
 - b. Increased gluconeogenesis
 - c. Hyperglycemia
 - d. Accelerated oxidation of fatty acids in liver
 - e. Overproduction of ketone bodies
37. Cholecalciferol (vitamin D3) and ergocalciferol (vitamin D2 or ergosterol) are generally considered vitamins but can be considered hormones because:
- a. The chemical structure of vitamin D resemble that of steroid hormones
 - b. Very small quantities of the active form of vitamin D are required for full biologic activity
 - c. Are synthesized by one organ (skin) from precursor molecules (provitamin) by photoactivation while small amounts are obtained from the diet.
 - d. They are transported by blood in the bound form to target cells which are primarily in intestine and bone
 - e. They enhance rate of existing reactions in target cells leading to physiological response
38. Hormone regulation takes place through
- a. positive feedback systems only
 - b. positive and negative feedback systems only
 - c. Physiological system
 - d. positive, negative feedback and physiological system
 - e. Hypothalamic axis
39. In which of the following individuals would you expect to observe hypertonic contraction:
- a. Those suffering from diabetes insipidus.
 - b. Those overusing diuretics
 - c. Those receiving copious quantities of salt-free fluids
 - d. Those with severe diarrhoea.
 - e. Those receiving long term doses of vasopressin.
40. Pyridoxine participates as a coenzyme in the following
- a. Transamination reactions
 - b. Formation of Sphingolipids
 - c. Redox reactions
 - d. Hydroxylation reactions
 - e. Methylation reactions