

EXERCISES OF NUTRITIONAL BIOCHEMISTRY

The following exercises are based on the metabolism of proteins, carbohydrates, lipids, nucleic acids, hormones, water, minerals & vitamins). Read carefully each question and link it to each of the above-mentioned topics, then find the answer in the handouts. If any query, please do not hesitate to contact the lecturer.

1. Differentiate the following biochemical terms and explain their physiological importance in the functioning of the human body by giving at least 1 example of each term:
Anabolism and Catabolism
2. Explain the structure of aminoacids and proteins:
 - D & L forms of an aminoacid; - asymmetric carbon atom;
 - Primary, secondary, tertiary & quaternary structure of a protein (example of Hb);
 - Homo & hetero-proteins.
3. a) Explain the process of digestion of the food protein
b) In the human digestive tract, explain precisely and in details the enzymatic catabolic processes of the following food polypeptide: C- H- G - Y - V - W - N - P - L - R - Q - A - S - H - D - P - F- E- I- M
c) With your own food proteinic polymer (with at least 30 peptide bonds) in the human digestive tract, explain the enzymatic catabolic process of the dietary proteins (each digestive peptidase should catalyze at least 2 peptide bonds).
4. Metabolism of proteins & carbohydrates. The human body transforms the food nutrients into the needed biomolecules to be used in different cell activities. These anabolic and catabolic transformations involve enzymes to catalyse different biochemical reactions. List the major classes of enzymes working in the human body: (a) explain the link between enzyme and activation energy of a reaction, (b) explain the functional definition of each class, (c) provide at least one enzyme for each class, (d) explain the physiological importance of the reaction catalysed by that enzyme.
5. Metabolism of amino acids: explain the mechanism of the following reactions and (by giving at least 2 own examples of your own choice) explain their physiological importance in the functioning of the human body: Transamination, deamination, decarboxylation.
6. Metabolism of proteins.
 - a) Differentiate the terms *essential amino acids* and *non-essential amino acids* by giving at least 5 examples for the human beings.
 - b) Compare Glucogenic and ketogenic amino acids.
7. Explain in details the cause of appearance of the following metabolic disorders in the human body by linking them with the corresponding enzymes and the reaction these enzymes should normally catalyze:

	metabolic disorder	corresponding enzyme	Biochemical reaction	cause of appearance of metabolic disorder
1	<i>Phenylketonuria</i>			
2	<i>Alcaptonuria</i>			
3	<i>Scorbut</i>			
4	<i>Albinism</i>			
5	jaundice			

- a) Explain how G & Q are involved in the processes of *detoxication* of the human body.

- b) Explain briefly how the proteins (aminoacids) can be converted into lipids using the catabolic processes of F & Y.
- c) Explain precisely and in details the triple physiological importance of Y in the human body.

8. Outline your own proposed 20 proteinic hormones ($10 \leq \text{aminoacids} \leq 300$), indicate the total number of aminoacids and explain their physiological importance using the table here below:

S/N	Hormone & number of a.a	Physiological importance
1		
2		
3		
4		
5		
6		

9. Metabolism of amino acids: explain the mechanism of the following reactions and (by giving your own two examples of your choice) explain their physiological importance in the functioning of the human body: Transamination, deamination, decarboxylation.

10. a) Briefly describe the mechanism of urea cycle.
b) Briefly explain the physiological importance of urea cycle in the functioning of the human body.

11. Metabolism of creatine & glutathione:

- a) Briefly explain the creatine biosynthesis and indicate the organs involved in this process
b) Metabolism of glutathione: compare the chemical structures of GSH & GSSG
c) Explain the main functions of creatine & glutathione in the human body
d) Outline the main causes of high & lower creatinine levels
e) Discuss the purpose of creatinine blood test

12. Metabolism of proteins. The life expectance of red blood cells (RBCs) in the human body. The destruction of dead RBCs liberates a good number of Hemoglobin (Hb) molecules which undergo the catabolic process in different organs. Explain the role of carbohydrates in that process, indicate the organs involved in this process and the corresponding product of each organ.

S/N	organ	final product
1		
2		
3		
4		
5		
Role of carbohydrates		

13. Metabolism of proteins. Outline your own proposed 20 proteinic hormones ($5 \leq \text{aminoacids} \leq 500$), indicate the total number of aminoacids and explain their physiological importance using the table here below.

S/N	Hormone/No. of a.a	Physiological importance
1		
2		
3		
4		
5		

6		
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14. In the human digestive tract, explain precisely the enzymatic catabolic processes of the following food carbohydrates:

S/N	Name of the food carbohydrate	Type of bond to be broken down	corresponding enzyme (s)
1	sucrose		
2	lactose		
3	maltose		
4	trehalose		
5	amylose		
6	glycogen		
7	Cellulose		

15. Metabolism of carbohydrates. The human body oxidizes 3 biomolecules (Glc, Gal, Frc) to produce the maximum amount of energy (ATP) needed in cellular activities: Explain and show how this energy is produced by indicating only the steps by which the ATPs are produced using the table here below).

S/N	Step	No. of ATPs	Explanations (where necessary)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

16. Explain briefly the following biochemical processes and explain their physiological importance in the functioning of the human body: Glycogenesis & Pentose-Phosphate Pathway (for PPPW explain at least triple role).
17. Explain briefly the following biochemical processes and explain their physiological importance in the functioning of the human body: Glyconeogenesis & Glycogenolysis
18. a) Explain the process of conversion of galactose into glucose and its purpose.
b) Briefly explain how Galactosemia can occur in the human body.
19. Briefly explain when & how lactic and alcoholic fermentations take place inside the living organisms. Explain the causes of appearance of muscle cramps in the human body.

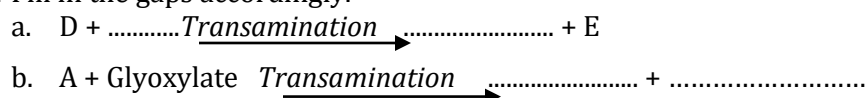
20. Metabolism of monosaccharides: in the human body the metabolism of the dietary galactose always starts by its conversion into glucose. This conversion occurs through a series of steps. Explain in detail the mechanism of the enzymatic conversion of galactose into glucose by indicating all the enzymes involved in that process.
21. Briefly describe the following metabolic processes and explain their physiological importance in the functioning of the human body:

S/N	Metabolic process (link them to hypoglycemia/hyperglycemia)	Brief description	physiological importance
1	Glycogenesis		
2	Glycogenolysis		
3	Glyconeogenesis		
4	Cellular aerobic respiration		
5	PPPW		

22. Explain briefly the following biochemical processes and explain their physiological importance in the functioning of the human body: aerobic cellular respiration (= Glycolysis + Krebs cycle). Explain in details how this process intervenes in production of energy (ATP). Explain lactic and alcoholic fermentations.
23. The genetic (metabolic) disorders (diseases) are caused by mutations in enzymes involved in the metabolism (anabolism/catabolism) of the human body. Explain the cause of appearance of the following genetic disorders in the human body (link them with the corresponding enzymes and the biochemical reactions catalyzed by these enzyme).

S/N	Metabolic disorder	Related enzyme	Related reaction	Physiological importance of reaction
1	Phenylketonuria			
2	Scorbut			
3	Albinism			
4	Jaundice			
5	Galactosemia			
6	<i>Von Gierke's</i> disorder			
7	<i>McArdle's</i> disorder			
8	<i>Pompe's</i> disorder			
9	<i>Tarui's</i> disorder			
10	<i>Cori's</i> disorder			
11	Hyperammonemia			
12	Argininosuccinate aciduria			
13	Ornithinemia			
14	Argininemia			
15	Citrullinemia			

24. Fill in the gaps accordingly.



- c. G Deamination →+
- d.Deamination→ pyruvate+
- e. E Decarboxylation → + CO₂
- f. F Decarboxylation → + CO₂
- g. Glycogen_(n residues) + glycogenolysis glycogen_(n-1 residues) +
- h. Glucose-6-phosphate the complete oxidative phase of PPPW → + + CO₂
- i. The biochemical process facilitating the temporally storage of the dietary monosaccharides not immediately used by the body is
- j. is the extramitochondrial process by which energy is synthesized.

25. Match the following:

a)

1. Albinism	A. Is a hypoglycemic process decreasing the level of glucose in blood
2. Glycogenolysis	B. Is a metabolic disorder caused by the deficiency of homogentisate oxydase in the body
3. Oxytocin	C. Is a metabolic disorder caused by the deficiency of tyrosinase in the body
4. Glucagon	D. Is a metabolic process increasing the level of glucose in blood
5. Glycogenesis	E. Participates in digestion of dietary polymers in the human gastrointestinal tract
6. PPPW	F. causes the uterine contraction and milk ejection in lactating females
7. sodium Taurocholate	G. Increases the glucose level in blood by stimulating glycogenolysis
8. Alcaptonuria	H. stimulates water reabsorption from the filtrate in kidney
9. Glutamine	I. produces the molecules of pentose-phosphates which are essential for the synthesis of nucleotides and nucleic acids
10. Antidiuretic hormone	J. Is one of the amino acids which participate in the process of detoxication of the human body by neutralizing the toxic compounds

b)

Biomolecule	Function
1. Antidiuretic hormone	A. It stimulates the growth and development of the male reproductive organs and promotes an increase in muscle mass and strength
2. DNA	B. It is used to cause contraction of the <u>uterus</u> in order to <u>start labor</u> or <u>increase the speed of labor</u> , and to stop <u>bleeding following delivery</u>
3. Progesterone	C. It functions to increase the level of glucose in the bloodstream
4. Sodium taurocholate	D. It speeds up the biochemical reaction by decreasing the activation energy
5. Testosterone	
6. Oxytocin	
7. Glucagon	

8. Enzyme	<p>E. It functions to conserve body water by reducing the loss of water</p> <p>F. It contains the genetic information needed for the protein synthesis</p> <p>G. It encourages the endometrium to prepare for implantation and maintenance of pregnancy</p> <p>H. It is involved in emulsification of the food lipid in the human digestive tract</p>
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26. The molecules of acetyl-coA produced by β -oxidation can be used by the human body in different ways for synthesis of biomolecules. Give at least 4 ways where these molecules of acetyl-coA can be used and explain the importance of these biochemical processes.
27. Explain briefly the triple physiological importance of cholesterol in the human body.
28. In the functioning of the human body, explain the role of the following lipidic compounds: prostaglandins, leucotrienes, PAF acether, cerebroside, sulfatides.
29. Explain briefly the process of β -oxidation of fatty acids. Explain the completely oxidation of fatty acids and its physiological importance.
30. Explain briefly β -oxidation of saturated fatty acids. Explain the role of Krebs cycle in the oxidation of fatty acids and explain the completely oxidation of these two fatty acids.
31. Explain the process of ketogenesis and explain its physiological importance.
32. Explain precisely how acetoacetate can be used by some organs to produce the energy ATP.
33. In the cases of malnutrition or undernutrition, the human body can make the arrangements (in the term of his needs) for converting the proteins into carbohydrates or into lipids, the carbohydrates into lipids and vice versa. Explain precisely the process of conversion of lipids into carbohydrates and proteins using the glyoxylate cycle.
34. The human cell completely oxidizes one molecule of 9-methyl heptadecanoic acid to produce energy (ATPs) needed in various cellular activities: explain how this acid is completely oxidized and how those energetic molecules are synthesized by writing precisely the main steps on which ATPs are produced and by indicating the total number of ATP produced on each step. Finally, calculate the total number of ATPs gained by the cell.
35. Explain the enzymatic digestion of the following food lipids in the human digestive tract (by indicating exactly the bonds to be broken down): triglyceride, phosphatidylcholine.

Introduction			
S/N	Name of the food lipid	Type of bond to be broken down	corresponding enzyme (s)
1	Glycerolipid		
2	Glycerophospholipid		
3	steride		

36. The living cells of the human body use mainly the carbohydrates and lipids (and sometimes aminoacids) to produce the energy (ATPs) needed in the various cell activities; and it is known that

lipids produce more energy than carbohydrates. A cell has completely oxidized one molecule of glucose and one molecule of stearic acid to produce the maximum amount of energy: explain and show how the lipids produce more energy than carbohydrates by calculating the energy yield per carbon atom for lipids and for carbohydrates.

37. The living cells of the human body use mainly the carbohydrates and lipids to produce the energy (ATPs) needed in the various cell activities; and it is known that lipids produce more energy than carbohydrates. A cell has completely oxidized one molecule of fructose and one molecule of octadecanoate to produce the maximum amount of energy: explain and show how the lipids produce more energy than carbohydrates by indicating the energy yield per carbon atom for lipids and for carbohydrates.

38. a) Briefly describe the following metabolic processes and explain their main physiological importance in the functioning of the human body.

S/N	metabolic process	Description	Physiological importance
1	β -oxidation		
2	Ketogenesis		
3	Lipogenesis		
4	Glyoxylate cycle		

39. Match the following hormones with their corresponding functions in the functioning of the human body.

Hormone	Function
1) Antidiuretic Hormone	A. It stimulates the the growth and development of the male reproductive organs and promotes an increase in muscle mass and strength
2) Cortisol	B. It is needed to decrease the level of glucose in the bloodstream
3) Glucagon	C. It is used to cause contraction of the <u>uterus</u> in order to <u>start labor</u> or <u>increase the speed of labor</u> , and to stop <u>bleeding following delivery</u>
4) Progesterone	D. It stimulates the mammary glands to produce milk
5) Prolactin	E. It is needed to conserve body water by reducing the loss of water in urine
6) Oxytocin	F. It stimulates the increase of the amount of glucose in the bloodstream and makes it easier for the brain to use glucose
7) Insulin	G. It is needed to decrease the level of glucose in the bloodstream
8) Testosterone	H. It encourages the endometrium to prepare for implantation and maintenance of pregnancy

40. Some extrahepatic tissues can use the final product of ketogenesis (ketone bodies) to produce energy (ATP) needed in different cell activities.
- Explain how these organs can get energy from ketone bodies.
 - Calculate the total number of ATP produced if a tissue involves 7 molecules of β -hydroxybutyrate to make the needed energy.
 - Explain the relationship existing between the *ketogenesis* and the disease known as diabetes

41. In the cases of malnutrition (overnutrition or undernutrition), the human body can make some arrangements (in the term of his needs) to convert biomolecules into others. Explain the following conversions:

S/N	Type of conversion	Process of conversion
1	conversion of carbohydrates to proteins	
2	conversion of carbohydrates to lipids	
3	conversion of proteins to carbohydrates	
4	conversion of proteins to lipids	
5	conversion of lipids to proteins	
6	conversion of lipids to carbohydrates	

42. Biochemical processes taking place in the human body use the exogenous nutrients to synthesize the new biomolecules needed in different cell activities allowing the human being to stay alive: briefly describe the following biochemical processes and explain their physiological importance in the functioning of the human body:

- Transamination
- Deamination
- Decarboxylation
- Glycogenesis
- Glyconeogenesis
- PPPW
- Glycogenolysis
- Cellular aerobic respiration

43. Metabolism of lipids.

- a) Briefly describe (with your own words) the following biochemical processes, indicate the site (organ) where they take place and explain their physiological importance (link the sites and roles with the anatomy and physiology of the human body) using the table here below.

S/N	Biochemical processes	Physiological importance	site (organ)
1	Ketogenesis		
2	β -oxidation		
3	Lipogenesis		
4	Krebs cycle		
5	Conversion of lipids to proteins and carbohydrates		

44. Briefly describe the following biochemical processes and precisely explain their physiological importance in the functioning of the human body using the table template here below:

S/N	Biochemical process	Brief description	Physiological importance
1	Digestion		
2	Cellular aerobic respiration		
3	Glycogenolysis		
4	Neoglucogenesis		

5	Ketogenesis		
6	Glyoxylate cycle		
7	Urea cycle		
8	β -oxidation		

- a) Explain the link existing between the diabetes conditions and biochemical processes “Ketogenesis-glycogenesis-glycogenolysis-gluconeogenesis” by indicating the relationship glycemia-ketone bodies and insulin-glucagon and vice-versa.

45. The human tissues use mainly carbohydrates and lipids to make energy (ATPs) needed in different cell activities. A molecule of linoleic acid has been completely oxidized to produce a maximum of energy.

- a) Calculate the total number of ATPs produced by this fatty acid.
b) With your own proposed example of a carbohydrate (do not use glucose), precisely explain in details how lipids (linoleic acid) produce more energy than carbohydrates in the human body.

46. Metabolism of the human body.

- a) The molecules of acetyl-coA produced by β -oxidation can be used by the human body in different pathways for synthesis of new biomolecules. List four pathways in which the acetyl-coA molecules can be involved and provide their physiological importance.

- b) During a prolonged starvation, some extrahepatic tissues can use ketone bodies to produce energy (ATP) needed in different cell activities.

- i) Briefly describe the mechanisms by which these extrahepatic tissues can use to get energy from ketone bodies.

- ii) Calculate the total number of ATPs that will be produced if an extrahepatic tissue involves 3 molecules of β -hydroxybutyrate to get the needed energy.

- c) The life expectancy of red blood cells (RBCs) in the human body is around 120 days, then they die at the end of this life period. The process of destruction of these cells liberates a good number of hemoglobin (Hb) molecules which undergo a degradation process in different organs.

- i) Indicate the organs involved in this process and their corresponding final products.

- ii) Explain the role of carbohydrates in this degradation process.

(N.B use the table here below):

S/N	organ	final product
Role of carbohydrates		

Metabolism of vitamins

47. a) Define the term *vitamin* and outline the major classes

- b) Briefly explain the functions of major water-soluble and fat-soluble vitamins in the functioning of human body
- c) Link the following disorders (diseases) with the corresponding vitamins using the table here below.

Disorder	Corresponding vitamin
Macrocytic anemia	vitamin B ₆
Microcytic hypochromic Anemia	vitamin B ₁₂
Pellagra	vitamin K
Pernicious anemia	vitamin D
Excessive bleeding	vitamin B ₁
Rickets/ Osteomalacia	vitamin B ₃
Beriberi	vitamin A
Night blindness	vitamin B ₂
Scorbut	vitamin B ₇
Glossitis & stomatitis/cheilosis	vitamin C
spinocerebellar ataxia and myopathies	vitamin E
Dermatitis	

d) Outline the main natural sources (worldwide/countrywide) of vitamins and indicate their daily dietary required quantity (show the general average of daily dietary required quantity, then show those with lower/higher comparing to the average).

Metabolism of minerals

48. Metabolism of minerals in the human body.

- Briefly explain the main functions of major & trace minerals
- Outline the main natural sources (worldwide/countrywide) of major & trace minerals and indicate their daily dietary required quantity (show the general average of daily dietary required quantity, then show those with lower/higher comparing to the average).
- Outline the metabolic disorders related to the major & trace minerals' deficiencies for the functioning of human body.

S/N	Mineral	Function	sources	daily dietary required quantity	related metabolic disorders
1					
2					
3					
4					

Metabolism of water

49. Metabolism of water in the human body.

- Outline the main functions of water in the human body.
- The needs in water vary widely among individuals and depend on a number of factors: list the main factors influencing water intake and indicate the individual variations.
- Outline the main locations of water in the human body (and their percentages). Explain the daily water intakes and losses for an adult human being and indicate the major sources of body water.

- d) Mrs Kibiriti (60 years) has a total weight of 120 kg. Calculate her total water amount (L) and explain the water distribution in different body locations and sublocations.
- e) Outline the major consequences (diseases) linked to the deficiency of water in the human body.

Mixtures

50. Fill in the blanks accordingly:

- A. The main biochemical processes by which fatty acids are completely oxidized and transformed into carbon dioxide and water by producing energy are
- B. is the biochemical process by which ketone bodies are synthesized in the liver.
- C. is the process of the transfer of genetic information from mRNA to rRNA
- D. The biochemical process by which the molecules of acetyl-CoA which are not immediately used by the human body are stored is
- E. is a congenital metabolic disorder caused by the deficiency of the enzyme "phosphogalactose uridyl transferase".
- F. The process of the transfer of genetic information from DNA to mRNA is called
- G. The albinism is a metabolic disorder caused by the deficiency of enzyme called.....
- H. The deficiency of *vitamin*..... leads to the disease called *Beriberi* as it is involved in the process of ATP production and synthesis of DNA and RNA.
- I. The classification of bacteria into *Gram-positive* and *Gram-negative* is based on the specific type of carbohydrate known as found inside the cell wall of bacteria.
- J. The nucleic acid that functions to transfer genetic information from one generation to the next generation is commonly known as.....
- K. The metabolic process by which the human body stores temporarily the acetyl-CoA molecules in form of ketone bodies is called
- L. The failure of conjugating bilirubin in the liver leads to the metabolic disorder known as
- M. The deficiency of *vitamin* leads to anemia as it is needed for the human body to make an adequate number of blood cells.

51. Answer by *True (T)* or *False (F)* to the following questions

- A. Because fat-soluble vitamins are stored in the body, there is a higher risk for toxicity.
- B. Ketone bodies are utilized by extrahepatic tissues through the conversion of β -hydroxybutyrate to acetoacetate and of acetoacetate to acetoacetyl-CoA.
- C. In the human body ketosis occurs when the acidic ketone bodies lowers blood pH below 7.4 (case of acidosis).

- D. The synthesis of fatty acids from acetyl CoA (lipogenesis) takes place in mitochondria (*cytosol*), uses reduced coenzyme NADPH₂ and requires an acyl carrier protein.
- E. In the human body the process of lipogenesis is activated by glucagon and lower blood glucose while β -oxidation is activated by insulin and high blood glucose.
- F. The proteins that are in the bloodstream, in the cells, and in the spaces surrounding the cells work together to keep fluids moving across these spaces in the proper quantities to maintain fluid balance and blood pressure.
- G. Cholesterol is an important lipidic compound in the functioning of the human body by the fact that it is a precursor of many physiological substances like bile salts, reproductive hormones and enzymes.
- H. The conversion of lipids to proteins and carbohydrates passes always through the reactions of glyoxylate cycle and Krebs cycle where succinate is the key compound.
- I. The highly toxic ammonia in the human being is usually neutralized through urea cycle by converting it to urate (urea) which will finally be excreted to outside the body through urine.
- J. Enzymes catalyze chemical reactions by lowering the activation energy (energy that is required for a chemical reaction to occur).
- K. At physiologic pH (pH 7.4) the carboxyl group of amino acid is dissociated, forming a negatively charged carboxylate ion and the amine group is protonated.
- L. *Jaundice* is a metabolic disorder caused by the failure of conjugation of bilirubin due to the deficiency of glucuronic acid in the liver.
- M. The deficiency of *vitamin B₁₂* leads to the anemia as it is needed for the human body to make an adequate number of blood cells.
- N. Glycogenolysis is a pathway by which the human body stores the monosaccharides while Glycogenesis is an opposite pathway by which glycogen is degraded to provide the monosaccharides.
- O. The classification of bacteria into *Gram-positive* and *Gram-negative* is based on the specific type of carbohydrate known as "*peptidoglycan*" found in the structure bacteria cell wall.
- P. *Vitamin A* plays an important role in the functioning of the human body as it assists in differentiation and maturation of tissues and organs during embryonic growth.
- Q. The main function of RNA is to transfer genetic information from one generation to the next generation while the main function of DNA is to direct synthesis of proteins in the human body.

52. List the main stages of Nutritional biochemistry
53. Briefly describe the *fed* and *fast* states and give 4 examples of biochemical processes related to each state in the functioning of the human body.
54. a) Outline the classification of vitamins and explain the difference between them.
b) Explain the main functions of vitamins in the functioning of the human body.

55. Which vitamins the deficiencies lead to the following disorders: Beriberi, glossitis, Osteomalacia, microcytic anemia, stomatitis, pernicious anemia, pellagra, Macrocytic anemia, excessive bleeding, scurvy, night blindness?
56. Give the main local natural sources of vitamins and indicate their daily dietary required quantity for the functioning of human body (indicate the general average of daily dietary required quantity, then show those with lower/higher comparing to the average).
57. Outline the classification of minerals and indicate their main local natural sources and their dietary required quantity for the functioning of human body (indicate the general average of daily dietary required quantity, then show those with lower/higher comparing to the average).
58. Explain the main functions of minerals and indicate the major disorders (diseases) linked to their deficiencies in the functioning of human body.
59. Which minerals the deficiencies lead to the disorders: anemia, decay and goiter?
60. Explain the main functions of water in the human body.
61. Outline the main factors influencing water intakes and indicate the individual variations.
62. a) Outline the main locations of water in the human body (and their percentages).
b) Explain the daily water intakes and losses for an adult human being and indicate the major sources of body water.
c) Outline the major consequences (diseases) linked to the deficiency of water in the human body.
63. Mr Kalisa is the adult human being (45 ans) with the total weight of 120 kg.
Calculate the total amount of water (in Liters) of Kalisa's body and show its quantitative distribution in different locations and sublocations.

Multiple choice questions

Proteins

64. All biological proteins working in the human body are always synthesized using essential and non essentials aminoacids. The non essential aminoacids can be synthesized through which of the following biochemical reactions?
 - A. Transamination, deamination, decarboxylation, conversion processes
 - B. PPPW, lipogenesis, ketogenesis, β -oxidation
 - C. Transamination, deamination, gluconeogenesis
 - D. Transamination, decarboxylation, conversion processes
65. The catabolic process of hemoglobin molecules provided by the dead red blood cells takes place in different organs of the human body including spleen, liver, kidney, small intestine. The final product of this catabolic process in kidney is called _____
 - A. Bilirubin
 - B. Urobilin
 - C. Stercobilin

D. Bilirubindiglucuronide

66. The main function of Hb in the human body is _____
A. to carry O₂ molecules from the lungs to the tissue cells
B. to carry CO₂ molecules from the tissue cells to the lungs
C. to carry blood from the heart to the tissue cells and lungs
D. Both A and B are correct
67. The process of detoxication of the human body involves some biomolecules to neutralize harmful molecules to harmless ones. *Glutamine* and *Glycine* are aminoacids used in this process to transform harmful phenylacetate and benzoate into respectively _____
A. harmless phenylacetyl-glutamine and harmless hippuric acid
B. harmless glyoxylate and harmless α -ketoglutarate
C. harmless hippuric acid and harmless phenylacetyl-glycine
D. non essential aminoacids *glutamate* and *glyoxylic acid*
68. In the human digestive tract the process of emulsification of dietary lipids is facilitated by _____
A. Lipase
B. Bile salts
C. Phospholipid
D. Peptidase
69. Which of the following is the final product of Hemoglobin degradation in the spleen?
A. Stercobilin
B. Bilirubin
C. Biliverdin
D. Bilirubin-diglucuronide

Carbohydrates

70. The blood glucose in the human body is elevated within 30 minutes following a meal containing carbohydrates. The elevated level of glucose stimulates the secretion of _____
A. Glucagon
B. Insulin
C. Oxytocin
71. Prolactin One of the following biochemical processes is *hyperglycemic* _____
A. Glycolysis
B. Glyconeogenesis
C. PPPW
D. Glycogenesis
72. In the human body the glycogenesis occurs mainly in _____

- A. Liver
 - B. Small intestines
 - C. Muscles
 - D. Both a and c are correct
73. When the blood glucose level drops in the human body, the level of glucagon increases and this hormone will stimulate
- A. The breakdown of glycogen to yield glucose molecules.
 - B. The glycolysis to yield energy in form of ATP
 - C. The cellular aerobic respiration to yield the maximum energy
 - D. Both A and B are correct
74. The enzyme "*Glucose-6-Phosphatase*" present only in the liver functions to _____
- A. store glucose molecules in form of glycogen inside hepatocytes
 - B. synthesize the molecule of glucose from non carbohydrate compound by the process known as gluconeogenesis
 - C. allow glucose molecules to leave the liver and be transported to different organs according to the needs
 - D. allow glucose molecules to enter the process of cellular aerobic respiration to produce energy needed by hepatocytes.
75. The appearance of genetic disorders in the human body is linked to the failure to synthesize the enzymes that catalyze the biochemical reactions. The genetic disorder *Galactosemia* is linked to the deficiency of which of the following enzymes?
- A. UTP-phosphorylase
 - B. Glucose-Galactose transferase
 - C. UDP-glc: gal-1-P-uridyltransferase
 - D. Galactose-1,6-phosphatase
76. Which of the following biochemical processes is *hyperglycemic*?
- A. Cellular aerobic respiration
 - B. Glycogenesis
 - C. Glycolysis
 - D. Glycogenolysis
77. In the human body the glycogen molecules are mainly stored in _____
- A. liver and muscles
 - B. Digestive tract and adipose tissues
 - C. Muscles and bile
 - D. liver and adipose tissues
78. The main nutrients provided by the food carbohydrates in the human body are _____

- A. Glycogen, starch, cellulose
- B. Glucose, ribose, fructose
- C. Glucose, galactose, fructose
- D. sucrose, lactose, glucose

79. *Cellular aerobic respiration* includes which of the following metabolic processes?
- A. Glycolysis, Glyconeogenesis, Krebs cycle
 - B. Glycolysis, Krebs cycle, Electron transport chain
 - C. Glycogenolysis, Krebs cycle, Electron transport chain
 - D. Glycogenolysis, Glycolysis, Krebs cycle, acetyl-CoA, Electron transport chain

Lipids

80. The process of emulsification always precedes the enzymatic digestion of the dietary lipids in the human GI tract. Which of the following biomolecules facilitates the process of emulsification in the small intestine ?
- A. Phospholipase enzyme
 - B. Bile acids
 - C. Sodium taurocholate
 - D. Lipase enzyme
81. The neurotransmitters are the biomolecules working in the human nervous system to increase the speed of transmission of nerve impulses. Which of the following lipidic molecules act as a neurotransmitter in the human body?
- A. Cardiolipid
 - B. Sulfatide
 - C. Antigen
 - D. Phospholipid
82. The bacterial cell wall provides strength and rigidity for the living organism and it determines the gram staining characteristic of the bacteria. This gram staining characteristic is determined by the specific carbohydrate known as _____
- A. Cerebroside
 - B. Peptidoglycan
 - C. Gram positive and gram negative bacteria
 - D. Triglyceride
83. The human blood group system is determined by specific lipids called *antigens* found in the cell membranes of red blood cells. Which of the following antigens is found on red blood cells of blood group O?
- A. Antigen A
 - B. Antigen B

- C. Antigen H
- D. Both Antigens A and B

84. The acetyl-CoA molecules produced by β -oxidation can be involved in different pathways according to the needs of the living cells. Which of the following biochemical processes can use these acetyl-CoA to synthesize the needed biomolecules?
- A. Ketogenesis, glyoxylate cycle, urea cycle, Krebs cycle
 - B. β -oxidation, glycogenesis, ketogenesis, electron transport chain
 - C. Lipogenesis, gluconeogenesis, Glyoxylate cycle, cellular aerobic respiration
 - D. Glyoxylate cycle, Lipogenesis, ketogenesis, Krebs cycle
85. When the blood glucose level drops in the human body, the secretion of glucagon increases, which stimulates _____
- A. Breakdown of glycogen to avail glucose molecules.
 - B. Glycolysis to generate energy in form of ATP
 - C. Ketogenesis to avail ketone bodies in the the liver
 - D. Lipogenesis to synthesize the needed fatty acids

Enzymes

86. The enzymes are specific proteins that act in the human body to _____
- A. increase the energy of biochemical processes and reactions
 - B. stimulate the biological processes and reactions
 - C. decrease the speed of biochemical reactions
 - D. catalyze the biochemical reactions
87. The class of enzymes that catalyze the transfer of electrons from one molecule called *electron donor* to another molecule called *electron acceptor* is _____
- A. Oxidoreductase
 - B. Ligase
 - C. Hydrolase
 - D. Transferase
88. The class of enzymes that catalyze the cleavage of carbon-carbon, carbon-oxygen, carbon-nitrogen bonds by other means than by hydrolysis or oxidation. is called _____
- A. Ligase
 - B. Lyase
 - C. Hydrolase
 - D. Isomerase
89. The class of enzymes that catalyze the transfer of specific functional groups intramolecularly without adding or removing atoms from the substrate. is known as _____
- A. Transferase

- B. Oxidoreductase
- C. Ligase
- D. Isomerase

Minerals

90. The major minerals are required in greater amounts than _____ per day
- A. 100 g
 - B. 0.1g
 - C. 1000 mg
 - D. 100 µg**
91. Which of the following minerals the function is to facilitate the process of iron metabolism in the human body?
- A. Iodine
 - B. Potassium
 - C. Copper
 - D. Zinc
92. Which of the following minerals is involved in muscle contractions in the human body?
- A. Potassium
 - B. Sodium
 - C. Magnesium
 - D. All the above
93. The minerals that are required respectively in smaller and greater amounts in the human body are _____
- A. Magnesium and Fluorine
 - B. copper and Phosphorus
 - C. Iodine and Calcium
 - D. Iron and Selenium
94. Which of the following minerals is involved in making the bones stronger and the teeth more resistant to decay?
- A. Iron
 - B. Fluoride
 - C. Chloride
 - D. Iodine
95. One of the following minerals is needed in the human body to facilitate the process of iron metabolism _____
- A. Iodine
 - B. Manganese
 - C. Zinc
 - D. None of the above

96. The minerals that are required respectively in large quantity and smaller quantity in the human body are _____
- a. Fluorine and Magnesium
 - b. Potassium and copper
 - c. Iron and Sodium
 - d. Calcium and iodine
97. Which of the minerals the deficiency leads to *rickets in children and osteomalacia in adults*?
- A. Copper
 - B. Chloride
 - C. Phosphorus
 - D. Zinc
98. The major mineral that is involved in the process of protein synthesis for cells is _____
- a. Magnesium
 - b. Sulfur
 - c. Manganese
 - d. Both a and c are correct

Water

99. Most of water in the human body is contained in _____
- A. Blood plasma
 - B. transcellular fluid
 - C. living cells
 - D. Interstitial fluid
100. Which of the following is not true for fat-soluble vitamins?
- A. Fat-soluble vitamins require bile acids to help absorb them
 - B. The excess of fat-soluble vitamins is excreted easily and quickly from the body
 - C. Fat-soluble vitamins are absorbed in the small intestines
 - D. Many fat-soluble require protein carriers for transportation
101. Which of the following is not a way the human body uses to excrete water?
- A. Urination through kidney
 - B. Breathing through lungs
 - C. Skin perspiration
 - D. Metabolism through biochemical processes
102. All the followings are the factors that can influence the human body to get water, except _____
- A. Level of activity

- B. Illness
- C. Gender
- D. Age
- E. All the above are factors that influence to get water

103. One of the following is not a consequence of water deficiency in the human body _____
- A. Fatigue
 - B. Constipation
 - C. Rheumatism
 - D. Protection of joints
104. All the followings are the functions of water in the human body, except ____
- A. Transportation
 - B. Regulation
 - C. Lubrication
 - D. Perspiration
105. One of the following is not a way the human being uses to loose water
- A. Normal inhalation
 - B. Urination
 - C. Defecation
 - D. Perspiration

Vitamins

106. All the following statements are TRUE for vitamins, except _____
- A. Vitamins are obtained by diet, rumen bacteria or sun
 - B. Vitamins are required in small amounts of the order of milligrams or micrograms per day
 - C. Vitamins are required for the maintenance of normal health and metabolic integrity
 - D. Vitamins catalyze the biochemical processes and reactions in the human body
107. The deficiency of Vitamin K in the human body leads to which of the following disorders?
- A. Pellagra
 - B. Microcytic anemia
 - C. excessive bleeding
 - D. night blindness
108. The vitamin D is needed for the metabolism of calcium and phosphorus which are involved in strengthening the bones. Its deficiency in the human body leads to disease called ____
- A. Pellagra
 - B. Dermatitis
 - C. Rickets
 - D. Beriberi
109. One of the following is the function of *Vitamin D*
- A. It promotes growth and keeps nervous system, muscles and heart functioning normally

- B. It regulates the blood calcium concentration, gene expression and cell differentiation
 - C. It reduces high blood pressure and increases energy through proper utilization of food
 - D. It acts as a component of some coenzymes and carrier proteins
110. The metabolic disorder called is caused by the deficiency of vitamin D
- A. Beriberi
 - B. Osteomalacia
 - C. Microcytic anemia
 - D. Blinsness
111. The deficiency of vitamin B₁₂ can cause which of the following genetic disorders in human body?
- A. Pernicious anemia
 - B. Microcytic anemia
 - C. Osteomalacia
 - D. Macrocytic anemia
112. Coenzyme A plays an important role in biochemical process as it acts as transportor of acyls. Which of the following vitamins is a component of CoA ?
- A. B₅
 - B. B₃
 - C. B₆
 - D. B₉
113. The *blindness* is a metabolic disorder caused by the deficiency of ____
- A. vitamin A
 - B. Vitamin B₆
 - C. vitamin K
 - D. Vitamin E
114. All the following statements are TRUE for vitamins, except_____
- A. Vitamins are organic compounds that are required for the maintenance of normal health and metabolic integrity
 - B. Vitamins are obtained by diet, rumen bacteria or sun
 - C. Vitamins are required in very small amounts, of the order of milligrams or micrograms per day
 - D. Vitamins catalyze the biochemical processes and reactions
115. Cobalamin is a water-soluble vitamin needed to make an adequate number of mature red blood cells; its deficiency causes the metabolic disorder called_____
- A. Macrocytic anemia
 - B. Pernicious anemia
 - C. Microcytic anemia
 - D. Osteomalacia
116. The disorder called *Pellagra* is caused by the deficiency of vitamin ____
- A. Vitamin C

- B. Biotin
 - C. Niacin
 - D. Vitamin K
117. All the following statements are TRUE for vitamins, except_____
- A. Vitamins are required in small amounts, of the order of milligrams or micrograms per day
 - B. Vitamins are organic compounds that are required for the maintenance of normal health and metabolic integrity
 - C. Vitamins act as enzymes which catalyze the biochemical processes and reactions
 - D. Vitamins are obtained by diet, rumen bacteria or sun
118. Which of the following vitamins has a function of *production of normal red blood cells*?
- A. Folate
 - B. Niacin
 - C. Phylloquinone
 - D. Cobalamin
119. Which of the following vitamins acts as *antioxidant* in the human body?
- a. Vitamin C
 - b. Vitamin B₃
 - c. Vitamin E
 - d. Both a and c are correct
120. The deficiency of Vitamin B₁₂ leads to anemia as this vitamins functions to _____
- A. participate in blood clotting
 - B. maintain the levels of calcium and phosphate
 - C. participate in redox reactions related to energy metabolism
 - D. make an adequate number of blood cells
121. The deficiency of Vitamin K in the human body leads to _____
- A. glossitis
 - B. scurvy
 - C. excessive bleeding
 - D. night blindness
122. Which of the following vitamins has a function of *production of normal red blood cells*?
- A. Vitamin B₁₂
 - B. Vitamin D
 - C. Vitamin B₅
 - D. Vitamin K

Mixtures

123. In the human body the term “metabolism” refers to the _____
- A. digestion of the food polymers to monomers in digestive tract
 - B. anabolic and catabolic processes
 - C. synthesis of polymers from monomers
 - D. breaking down of polymers to monomers
124. The blood groups are determined by which of the following biomolecules?
- E. Nucleoproteins
 - F. Glycolipids
 - G. Glycoproteins
 - H. Cholesterol
125. Which of the following is NOT a metabolic disorder?
- A. Phenylketonuria
 - B. Scorbut
 - C. Albinos
 - D. Alcaptonuria
 - E. All the above are metabolic disorders
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