1. L-carnitine, a dipeptide consisting of Lys-Met, transports the chains of fatty acids into the mitochondrial matrix allowing the cells to break down fat and get energy from the stored fat reserves. Since it speeds up fat burning in the body it is used for weight loss and for improved exercise performance of athletes.

a) Draw the structure of L-carnitine. (5 pts)

b) Name the dipeptide using dipeptide nomenclature rules. (3 pts)

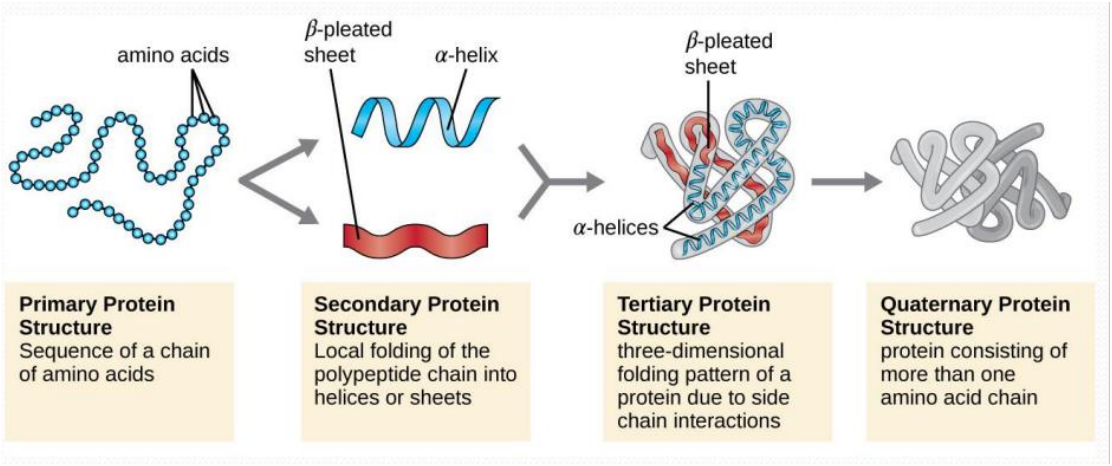
c) Indicate N- and C-terminal aminoacids in L-carnitine structure. (2 points)

d) Calculate the theoretical pI of the dipeptide using the pKa values in the following table. (10 pts)

Aminoacid	pK_1(-COOH)	pK_2(-NH_3^+)	pK_R
Alanine	2,34	9,69	
Arginine	2,17	9,04	12,48
Asparagine	2,02	8,80	
Aspartic Acid	2,09	9,82	3,86
Cysteine	1,71	10,78	8,33
Glutamic Acid	2,19	9,67	4,25
Glutamine	2,17	9,13	
Glycine	2,34	9,60	
Histidine	1,82	9,17	6,00
Isoleucine	2,36	9,60	
Leucine	2,36	9,60	
Lysine	2,18	8,95	10,53
Methionine	2,28	9,21	
Phenylalanine	1,83	9,13	
Proline	1,99	10,60	
Serine	2,21	9,15	
Threonine	2,63	10,43	
Tryptophan	2,83	9,39	
Tyrosine	2,20	9,11	10,07
Valine	2,32	9,62	

e) Why do you think burning fat improves exercise performance of athletes? (5 pts)

2. Explain levels of protein structure? (10 points)



3. Describe directionality of proteins, nucleic acids and carbohydrates briefly. (10 points)

4. What are the constituents of a nucleotide and which bond types bond those constituents together? (10 points)

5. What are the fates of pyruvate produced as the end product of glycolysis pathway? What are the contributions of those fates to cell? (10 points)

The pyruvate formed by glycolysis is further metabolized via one of three

:catabolic routes

١. Pyruvate is oxidized, with loss of its carboxyl

group as CO2, to yield the acetyl group of acetyl coenzyme A; the acetyl group is then oxidized

.completely to CO2 by the citric acid cycle

٢. The second route for pyruvate is its reduction to

.lactate via lactic acid fermentation

٣. The third major route of pyruvate catabolism is

alcohol fermentation that results in ethanol

.production

6. Describe conformation of DNA. What are the contributions of bases in the nucleic acid structure to the double helical conformation of DNA? Comment on the antiparallelity of the DNA strands. (10 points)

A-DNA

Dehydrated DNA

B-DNA

Normally occuring one

Z-DNA

GC rich regions

All organisms have enzymes that can break DNA, unwind or overwind the double helix, and rejoin the strands to alter the topology. These enzymes, called topoisomerases, are .responsible for adding and removing supercoils

 Localized unwinding is an essential step in the initiation of .DNA replication, recombination, repair, and transcription

Thus, negative supercoiling plays an important biological role in these processes by storing the energy needed for local unwinding

This twisting also contributes to the energetically favorable .conformation of the DNA double helix

Four types of interactions affect the conformation of :double stranded DNA

١. Stacking interactions. The stacked base pairs form van der Waals contacts. Although the forces between individual stacked base pairs are weak, they are additive so in large DNA molecules the van der .Waals contacts are an important source of stability

٢. Hydrogen bonds. Hydrogen bonding between base pairs is a significant stabilizing force.

٣. Hydrophobic effects. Burying hydrophobic purine and pyrimidine rings in the interior of the double helix increases the stability of the helix.

٤. Charge–charge interactions. Electrostatic repulsion of the negatively charged phosphate groups of the backbone is a potential source of instability in the DNA helix. However, repulsion is minimized by the presence of cations such as Mg2+ and cationic proteins (proteins that contain an abundance of the basic residues (arginine and lysine

7. Describe the structure of biological membranes. Which parts of the biological membranes are involved in transport of molecules across membranes? (10 points)

The structure of biological membranes is best described via the fluid .mosaic model

The lipids in a bilayer are in constant motion giving lipid bilayers many of the properties

of fluids.The individual lipid and protein units in a membrane form a fluid mosaic with a

.pattern that is free to change constantly

 The membrane mosaic is fluid because most of the interactions among its components

are noncovalent, leaving individual lipid and protein molecules free to move laterally in

.the plane of the membrane

 Phospholipids form a bilayer in which the nonpolar regions of the lipid molecules in each

layer face the core of the bilayer and their polar head groups face outward, interacting

.with the aqueous phase on either side

 Proteins are embedded in this bilayer sheet, held by hydrophobic interactions between

the membrane lipids and hydrophobic domains in the proteins. Some proteins protrude

from only one side of the membrane; others have domains exposed on both sides. The

orientation of proteins in the bilayer is asymmetric, giving the membrane :”“sidedness

the protein domains exposed on one side of the bilayer are different from those exposed

on the other side, reflecting functional asymmetry

Passive transport. Passive transport is the movement of molecules across biological membranes down concentration gradients. This type of transport does not require energy. Channels form water-filled pores and

thus create a hydrophilic path that enables ions to travel through the .hydrophobic membrane

?How does transport occur across biological membranes

Diffusion is a passive process of transport. A single substance tends to move from an area of high concentration to an area of low concentration until the concentration is equal across a space. ... Materials move within the cell 's cytosol by diffusion, and certain materials move through the .plasma membrane by diffusion

8. Answer the questions below.

a) What is the theory behind energy production in oxidative phosphorylation? Explain. (10 points)

Oxidative phosphorylation (OP) is the last step of energy

.yielding metabolism in aerobic organisms

, All oxidative steps in the degradation of carbohydrates

fats, and amino acids converge at this final stage of cellular

respiration, in which the energy of oxidation drives the

.synthesis of ATP

 It involves the reduction of O2 to H2O with electrons

.donated by NADH and FADH2

 Oxidative phophorylation produces energy according to

.chemiosmotic theory

 Chemiosmotic theory states that transmembrane

differences in proton concentration are the reservoir for the

.energy extracted from biological oxidation reactions

Oxidative Phosphorylation 10 NADH x 2.5 ATP + 2 FADH2

x 1.5 ATP

ATP ٤ +

b) What happens if the body breaks down fatty acids in excess amount in situations of starvation and untreated diabetes? (5 points)