BITS, PILANI, DUBAI CAMPUS
BIOLOGICAL CHEMISTRY (BIO C211)
I Semester 2008-2009
Test-I (Closed Book)

Time: 50 min **Date: 26.10.2008** **Max Marks: 50**

Note: a) Attempt all questions in the order
b) Answer to the point

1. How you relate biochemistry in the context of medicine and biotechnology?[1]
2. How may cells be disrupted in order to obtain subcellular organelles by centrifugal fractionation? Brief the principle involved in each method. [2]
3. What are microbodies and write the clinical significance? [2]
4. Write any 4 biological buffer systems. [2]
5. What is the systematic name for maltose and sucrose? [2]
6. Name any two tetroses. [1]
7. A solution of D-glucose contains predominantly the α and β anomers of D-glucopyranose, both of which are nonreducing. Why is a solution of D-glucose a strong reducing agent? [2]
8. Write short notes on ozone formation and how it is used for identification of carbohydrates? [2]
9. Give examples for heterocyclic aminoacids. Brief any one of its applications in biotechnology. [2]
10. All amino acids are amphoteric compounds. Why? [2]
11. What is a peptide bond and draw the general structure of a tripeptide? [2]
12. Mention different methods of protein purification. [1]
13. Explain activation energy and correlate with enzyme activity. [3]
14. Write short notes on Competitive and Non-competitive enzyme inhibition with a suitable diagram. [3]
15. Name any 4 different enzyme regulation discussed. Explain any one. [3]
16. Why enzymes maintain macromolecular structure and what are the different parameters which regulate enzyme activity? [2]
17. Write the Michaelis-Menton equation and mention its significance with suitable diagram. [2]
18. What are heteropolysaccharides and write three important biotechnological applications? [2]
19. Name any three essential fatty acids. [2]
20. What is the significance of Cod liver oil and why it is consumed in general?[1]
21. How micelles are formed and brief its applications in medicine? [1]
22. Write the structures of purine bases. [3]
23. Write any 3 amino sugars and its occurrence. [2]
24. Define saponification number and its importance. [2]
25. Write short notes on Tay-Sachs disease. [3]

BITS, PILANI-DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
FIRST SEMESTER 2008-2009
COURSE No. BIO C211
BIOLOGICAL CHEMISTRY TEST-II (OPEN BOOK)

Duration: 50 Min **Date: 14.12.2008** **Max Marks: 60**

Note: a) Attempt all questions in the order
b) Answer to the point with suitable diagrams/biochemical pathways/ enzymes involved

1. Glycolysis leads to the production of _____ and _____ molecules of ATP. Glycolysis plus the citric acid cycle can convert the carbons of glucose to _____, storing the energy as ATP, _____ and _____. [2.5]

2. Trematol is a metabolic poison derived from the white snake root. Cows eating this plant concentrate the poison in their milk. The poison inhibits liver enzymes that convert lactic acid to other compounds for metabolism. Why does physical exertion increase symptoms of poisoning by trematol? Why does the pH of the blood decrease in a person who has digested trematol? [5]

3. Explain why in anaerobic cells the ratio of pyruvate/ lactate is much less than 1 while under aerobic conditions the ratio of pyruvate/ lactate is much greater than 1. [5]

4. In the first step of glycolysis, the enzyme hexokinase uses ATP to transfer a phosphate to glucose to form glucose-6-phosphate. The product continues to be oxidized forming pyruvate in glycolysis and is a precursor to acetyl-CoA for the citric acid cycle. Suppose that a cell has only glucose available for energy and that the activity of hexokinase is suddenly stopped in this cell. What will happen to the cellular metabolism? [5]

5. As a result of glycolysis, pyruvate oxidation and the citric acid cycle, only a small portion of the energy of glucose has been converted to ATP. At this point, the majority of the usable energy is contained in ---------- [2.5]

6. During a heart attack, blood flowing to the heart muscle is interrupted by blockage of a coronary artery. How would you expect the metabolism in the heart to change? [5]

7. Insulin facilitates energy storage in liver. Which enzymes of carbohydrate metabolism are coordinately regulated in liver and in muscle in response to insulin signaling? [10]

8. An obese individual is brought to the emergency room by a concerned friend. The patient has been on a self-imposed "starvation diet" for four months, and has lost 60 pounds while consuming only water and vitamin pills. If extensive blood studies were performed, what would be the expected results of the following and concentrations? Explain. [5]

9. The symptoms for pyruvate dehydrogenase complex deficiencies are most apparent in the central nervous system because this complex is necessary for the complete oxidation of _____ and the brain is highly reliant upon _____for energy. [2.5]

10. Two types of compounds that can be used for anaplerotic reactions are--- [2.5]

11. Explain with a suitable diagram for the key enzymes and regulatory steps gluconeogenesis and TCA cycle. [10]

12. How Acetyl CoA is considered to be the central to the metabolism? [5]

BITS, PILANI, DUBAI CAMPUS
BIOLOGICAL CHEMISTRY (BIO C211)
II-Semester 2008-2009
Quiz-I (Closed Book)

Time: 30 min **22nd October** **2008 Max. Marks: 20**

ID No: **Section No:** **Name:**

1. Xylose has the chemical formula $C_5H_{10}O_5$. What type of substance is it?
   a. A fatty acid
   b. An amino acid
   c. A monosaccharide
   d. A nucleotide

2. Which of these is usually true of lipids?
   a. The ratio of hydrogen to oxygen atoms is always 2:1
   b. They do not dissolve well in water
   c. They contain nitrogen
   d. They contain many hydrogen bonds

3. Which base in an RNA molecule is complementary to adenine?
   a. cytosine
   b. guanine
   c. thymine
   d. uracil

4. Triglycerides are a type of:
   a. Carbohydrate
   b. Lipid
   c. Protein
   d. Nucleic acid

5. What does transfer RNA normally bind to?
   a. DNA
   b. mRNA
   c. amino acids
   d. Both B and C

6. A substance that tastes sweet and is soluble in water could be:
   a. A monosaccharide
   b. A disaccharide
   c. A polysaccharide
   d. Either A or B

7. How many fatty acid chains are there in a phospholipid molecule?
   a. 1
   b. 2
   c. 3
   d. 4

8. A molecule that is attracted to water is called:
   a. Hydrostatic
   b. Hydrolytic
   c. Hydrophilic
   d. Hydrophobic

9. The two strands of a DNA molecule are held together by:
   a. Glycosidic bonds
   b. Ester bonds
   c. Peptide bonds
   d. Hydrogen bonds

10. Alpha helices and beta pleated sheets form which aspect of a protein's structure?
   a. Primary structure
   b. Secondary structure
   c. Tertiary structure
   d. Quaternary structure

11. What is a codon?
   a. The set of mRNA bases that specifies an amino acid
   b. The set of tRNA bases that binds to an amino acid
   c. The set of DNA bases that specifies a protein
   d. The set of amino acids that makes a protein

12. Which of these molecules contains the greatest number of carbon atoms?
   a. Ribose
   b. Deoxyribose
   c. Glucose
   d. Glycerol

13. Which of these is not made entirely from glucose molecules?
   a. Sucrose
   b. Amylose
   c. Cellulose
   d. Glycogen

14. Which of these sugars does not normally react with Benedict's reagent?
   a. Fructose; b. Galactose
   c. Glucose; d. Sucrose

15. Which of these molecules consists of coiled, unbranched chains?
    a. Amylose
    b. Amylopectin
    c. Cellulose
    d. Both A and B

16. Which is true of saturated fats?
    a. They are healthier than unsaturated fats
    b. They contain double bonds
    c. They are usually solids at room temperature
    d. They have bent fatty acid chains

17. Which of these tests is used to find out if a sample contains protein?
    a. Benedict's test
    b. The emulsion test
    c. The Biuret test
    d. The iodine test

18. Which of the following amino acids would most likely be found on the surface of a protein molecule?
    a. Alanine
    b. Arginine
    c. Isoleucine
    d. Leucine

19. Which of the following structures is common to all sphingolipids?
    a. Carnitine
    b. Ceramide
    c. Diacylglycerol
    d. Sphingomyelin

20. A 2-year-old retarded child is evaluated by a metabolic specialist. The child's history is significant for failure to thrive and progressive neurologic deterioration, including deafness and blindness. Physical examination is remarkable for hepatospleno-megaly, as well as a cherry-red spot on funduscopic examination. These symptoms are consistent with a diagnosis of
    a. Hunter syndrome
    b. Niemann-Pick disease
    c. Pompe's disease
    d. tyrosinosis

BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
FIRST SEMESTER 2008 – 2009
BIOLOGICAL CHEMISTRY COURSE No: BIOC 211
QUIZ-II (CLOSED BOOK)

Duration: 15 min. **Date: 30.11.2008** **Max. Marks 15**

Note:
Attempt all the questions
Answer to the point

1. How oxidation and reduction involved in metabolism? (1.0)
2. How are coenzymes used in biologically important redox reactions? (1.0)
3. How are the production and use of energy coupled? (1.0)
4. How much energy can be produced by glycolysis? (1.0)
5. Name any 4 glycogen storage diseases? (1.0)
6. Write the enzymes involved in glycogen synthesis and degradation. (2.0)
7. Write the structure or the components of Coenzyme-A. (2.0)
8. Give 6 examples of Glucogenic aminoacids. (1.0)
9. What are the other names for Glycolysis and HMP shunt? (2.0)
10. How the citric acid cycle is regulated (mention only the enzymes)? (1.0)
11. Write the functions of Cori cycle and Glyoxylate cycle. (2.0)

BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
FIRST SEMESTER 2008 – 2009
BIOLOGICAL CHEMISTRY COURSE No: BIOC 211
QUIZ-III (CLOSED BOOK)

Duration: 15 min. **Date: 16.11.2008** **Max. Marks 15**

Note:
Attempt all the questions
Answer to the point

1. Why phosphoenolpyruvate is a high-energy compound? [3]
2. How important the metals in biochemistry? Briefly explain with one example. [3]
3. Write the dietary sources and clinical significance of Vitamin C, Folate and Vitamin E. [1.5]
4. What is the role of biotin in gluconeogenesis? [1.5]
5. Briefly outline the role of UDPG in glycogen biosynthesis. [3]
6. Briefly explain HMP shunt in biochemistry with enzymes? [3]

BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
FIRST SEMESTER 2008 – 2009
BIO C211 BIOLOGICAL CHEMISTRY
COMPREHENSIVE EXAMINATION
PART – A (CLOSED BOOK)

Duration: 1 Hour **Date: 05.01.2009** **Max. Marks: 40**

ID No:

Note: Questions carry 1 mark each.
Answer the questions in the space provided.

1. Glycosidic bonds
   a) connect sugar molecules in both linear and branches of complex carbohydrates.
   b) only connect carbon-1 of one sugar to carbon-4 of another.
   c) destroy the asymmetric character of the participating carbons.
2. Which of the following is NOT true of a competitive inhibitor?
   a) It irreversibly inhibits the enzyme by chemically modifying a group at the active site.
   b) It often resembles the substrate for the enzyme it inhibits.
   c) Its effects can be overcome by increasing the concentration of substrate.
3. V_{max}, the maximum velocity, of an enzyme catalyzed reaction is
   a) the rate observed when all enzyme active sites are saturated with substrate
   b) independent of the amount of enzyme present
   c) the rate observed at the highest substrate concentration which can be experimentally obtained.
4. The alteration of enzyme structure on binding of a substrate to an active site is referred to as
   a) Enzyme denaturation
   b) Enzyme inhibition
   c) Induced fit
5. Enzymes that are activated by specific proteolytic cleavage are called

   _____
6. In phosphoglyerides, fatty acids are esterified at
   a) glycerol carbons 1 and 2.
   b) glycerol carbons 1 and 3.
   c) any two of the three glycerol.
7. Unsaturated fatty acids have double bonds that are in the cis, rather than the trans, configuration. One of the consequences of this is
   a) an alteration in the charge of the molecule.
   b) an alteration in the number of carbons in the molecule.
   c) a bend in the molecule.

8. Which of the following would be expected to lower the Tm for a phospholipid bilayer?
    a) replacing a lipid containing unsaturated fatty acids with one containing saturated fatty acids
    b) replacing a lipid containing 18-C fatty acids with one containing 16-C fatty acids
    c) adding ions to bind to charged groups in the polar head groups
9. In a metabolic pathway,
    a) a reaction with a positive ΔG can occur if coupled to a reaction with a greater negative Δ G.
    b) a reaction with a positive Δ G cannot occur.
    c) it is ΔG^{o}, not ΔG, which determines whether a reaction can occur.
10. Although ATP is the major energy currency in the cell, other nucleoside triphosphates such as UTP, CTP, and GTP are also used in some reactions. These are produced from the corresponding mono- and diphosphates by
    a) sequential additions of inorganic phosphate by phosphatase enzymes.
    b) transfer of phosphates from ATP by nucleoside monophosphate and diphosphate kinases.
    c) enzymatic breakdown of reservoir of nucleotides present in DNA & RNA.
11. Acyl groups generated during metabolic processes involving carbohydrates and fatty acids are activated by attachment to_____
12. Controlling the catalytic activity of enzymes is important in regulation of metabolic pathways. Two ways in which this may be accomplished are
    a) allosteric regulation and reversible covalent modification.
    b) allosteric regulation and irreversible covalent modification.
    c) allosteric regulation and decreasing the intracellular enzyme concentration through secretory processes.
13. The hydrolysis of ATP drives metabolism by
    a) shifting the equilibrium of the reaction.
    b) providing a part of the activation energy for a key reaction.
    c) providing energy in the form of heat.
14. During catabolic processes, the oxidation of energy-rich molecules often results in the reduction of NAD to NADH. What comparable molecule is the most commonly used reductant for reductive steps in anabolic processes?
    a) FAD
    b) NADPH
    c) coenzyme A
15. The three major regulatory enzymes in the glycolytic pathway are_____
16. A suspension of yeast cells performing gluconeogenesis using pyruvate as a starting material requires carbon dioxide. The suspension of cells is being grown in the presence of ^{14}C-labelled CO_2. What will be the status of the radiolabeled carbon in the newly synthesized glucose?
    a) Carbons 1 and 6 will be labeled.
    b) Carbons 3 and 4 will be labeled.
    c) None of the carbons of glucose will be labeled.

17. A suspension of yeast cells is being grown under anaerobic conditions such that glucose is degraded to ethanol and carbon dioxide. If one wishes to follow this process by monitoring the release of $^{14}CO_2$, at which positions in the glucose molecule would the ^{14}C label need to be incorporated?
    a) carbons 1 and 6
    b) carbons 3 and 4
    c) carbons 3 and 6
18. The mechanism of glyceraldehyde-3-phosphate dehydrogenase does NOT involve
    a) phosphorylation of the substrate using ATP.
    b) oxidation and phosphorylation of the substrate
    c) a covalent intermediate
19. A yeast mutant has a defective triose phosphate isomerase that is totally inactive. Which of the following would you expect if this yeast mutant were grown under anaerobic conditions?
    a) The ATP produced/glucose degraded ratio would be the same as for normal cells.
    b) The ATP produced/glucose degraded ratio would be one-half that of normal cells.
    c) The ATP produced/glucose degraded ratio would be zero.
20. In the reaction catalyzed by the pyruvate dehydrogenase complex, the two carbons constituting the acetyl group are
    a) transferred directly to the lipoamide cofactor.
    b) transferred to the lipoamide by an earlier intermediate in the process.
    c) oxidized by NAD while attached to the lipoamide.
21. Although the pyruvate dehydrogenase complex is subject to allosteric control, especially inhibition by reaction products, the main regulatory process controlling the enzymes' activity in eukaryotes is
    a) phosphorylation by ATP that turns off the complex and dephosphorylation that turns it on.
    b) phosphorylation by ATP that turns on the complex and dephosphorylation that turns it off.
    c) exchange of ADP and ATP on the pyruvate dehydrogenase complex.
22. Although not present in animals, many plants and animals can use a modified form of the citric acid cycle known as the glyoxylate cycle. This is beneficial in that
    a) it allows the organisms which possess it to grow on acetate.
    b) it provides a source of glyoxylate which is an essential molecule in biosynthetic pathways in these organisms.
    c) it does not release CO_2 which is toxic to these organisms.
23. The presence of uncoupling proteins allows _____ energy from the mitochondrial electron transport chain to be used for ATP synthesis and _____ for the production of heat.
    a) more, less
    b) less, more
    c) all, none
24. The purpose of anaplerotic reactions is_____

25. Proton flow through the ATP synthase enzyme
    a) provides the energy for adding a phosphate to ADP to make ATP.
    b) results in the release of ATP from its tightly bound state in the active site.
    c) produces local pH changes in the active site which alter the equilibrium constant for the reaction.
26. The endosymbiotic hypothesis used to explain the origin of mitochondria has also been invoked to explain the origin of chloroplasts. From what type of organism is the chloroplast thought to have originated?
    a) a photosynthetic bacterium such as that from which the bacterial reaction center has been characterized.
    b) a cyanobacterium.
    c) a bacteria capable of synthesizing heme which was altered such that chlorophyll is produced.
27. The rubisco enzyme also catalyzes a wasteful reaction in which ribulose 1,5-bisphosphate is broken down into 3-phosphoglycerate and phosphoglycolate. In this reaction (which is the first of the process called photorespiration), the enzyme utilizes what as a substrate instead of CO_2?
    a) Phosphate
    b) Oxygen
    c) ammonia
28. Many tropical plants use a C4 pathway of carbon fixation. In these types of plants
    a) the Calvin Cycle is absent and not used in the CO_2 fixation process
    b) the Calvin Cycle is localized in specific types of cells where the CO_2 concentration is increased by the C4 pathway.
    c) The Calvin Cycle is present but only used as a backup when the C4 pathway cannot meet the needs of the plant.
29. The major use of NADPH generated by the pentose phosphate pathway is
    a) serving as a replacement for NADPH generated by photosynthesis in carbon fixation.
    b) linking the oxidation of sugars to the mitochondrial electron transport chain.
    c) serving as a reductant in biosynthetic pathways
30. Transketolase is an enzyme involved in the interconversion of 3-, 4-, 5-, 6-, and 7-carbon sugars in the nonoxidative branch of the pentose phosphate pathway. This enzyme uses what cofactor to stabilize a carbanionic intermediate in the reaction mechanism?
    a) a Schiff's base
    b) thiamine pyrophosphate
    c) divalent cation
31. Glucose-6-phosphate can be utilized by either the glycolytic or the pentose phosphate pathway. What is the major factor regulating how the use of glucose-6-phosphate is distributed between these two pathways?
    a) the relative levels of NADP and NADPH
    b) the different location of the two pathways within the cell
    c) allosteric inhibition of the glucose-6-phosphate dehydrogenase enzyme by ATP

32. Under conditions where NADPH is NOT needed, how are five-carbon sugars, such as ribose-5-phosphate, generated?
    a) through the normal pentose phosphate pathway
    b) by withdrawing 3-carbon units from the glycolytic pathway and converting them into 5-carbon sugars via the nonoxidative branch of the pentose phosphate pathway
    c) It is not possible to produce 5-carbon sugars under these circumstances.
33. The glycogen molecule has two types of linkages between the glucose molecules of which it is comprised. Of these, the _____ linkage is broken by the glycogen phosphorylase enzyme and the _____ linkage is not.
34. The fact that liver tissue contains glucose-6-phosphatase while muscle tissue does not is physiologically important because
    a) one of the major functions of the liver is to maintain the blood glucose level.
    b) the muscle tissue does not use glucose as an energy source.
    c) glycogen is found only in the liver and not in muscle tissue.
35. Glycogen synthase adds glucose units to growing glycogen molecules using?
    a) free glucose (b) UDP-glucose (c) glucose-1-phosphate
36. In order for regulation of glycogen metabolism to function, there must also be a means to reverse the regulatory effects of the various kinases. This is accomplished by protein phosphatase-1,
    a) that transfers the phosphate from a modified enzyme back to ADP.
    b) that hydrolyzes the phosphate from the modified enzyme.
    c) that recombines cyclic AMP and pyrophosphate to turn off the signal activating the kinases.
37. Animals are not capable of converting fatty acids into glucose because
    a) They cannot convert acetyl-Coenzyme A into pyruvate to initiate the gluconeogenesis pathway.
    b) Fatty acid degradation through the citric acid cycle does not lead to a net increase in oxaloacetate.
    c) Fatty acid degradation does not produce sufficient energy in the form of ATP to drive gluconeogenesis.
38. Which of the following is NOT a source of carbon skeletons for amino acid biosynthesis?
    a) citric acid cycle
    b) pentose phosphate pathway
    c) β-oxidation pathways of fatty acids
39. Inhibitors of dihydrofolate (DHF) reductase (methotrexate, for example) are also often used in cancer treatment. The basis for their action is that
    a) dihydrofolate reductase is involved in regeneration of tetrahydrofolate that is required for UTP to CTP.
    b) dihydrofolate reductase is involved in regeneration of tetrahydrofolate that is required for conversion of dUMP to dTMP.
    c) dihydrofolate reductase is involved in the reductive conversion of ribonucleotides to deoyribonucleotides.

40. The mouse genome is now sequenced and considered as a good animal model for drug development studies. Which of the following does NOT contribute to this viewpoint?
    a) The gene content of the mouse genome is much smaller than that of the human genome so that fewer genes have to be examined as potential drug targets.
    b) Despite the difference in sizes of the organisms, the mouse and human genomes are very similar.
    c) Methods exist for disrupting specific genes in mice to determine whether they might be potential drug targets.

BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY
FIRST SEMESTER 2008 – 2009
BIO C211 BIOLOGICAL CHEMISTRY
COMPREHENSIVE EXAMINATION
PART – B (OPEN BOOK)

Duration: 2 Hour **Date: 05.01.2009** **Max. Marks: 80**

Note: Attempt all parts of a question in a sequence
Support your answer with suitable example

1. Glycine is a highly conserved aminoacid residue in the evolution of proteins. Why? [2.0]
2. Proteins that span biological membranes often contain alpha helices. Given that the insides of membranes are highly hydrophobic. [4.0]
   (a) What type of amino acids would be in such a helix?
   (b) Why is an alpha helix particularly suited to exist in the hydrophobic environment of the interior of a membrane?
3. The kinetics of an enzyme are measured as a function of substrate concentration in the presence and in the absence of 2mM inhibitor (I). [6.0]

[S] (μM)	Velocity (μmol/minute)	
	No Inhibitor	Inhibitor
3	10.4	4.1
5	14.5	6.4
10	22.5	11.3
30	33.8	22.6
90	40.5	33.8

   (a) What are the values of V_{max} and K_M in the absence of inhibitor? In its presence?
   (b) What type of inhibition is it?
   (c) What is the binding constant of this inhibitor?
   (d) If [S] = 10μM and [I] = 2 mM, what fraction of the enzyme molecules have a bound substrate? A bound inhibitor?
4. In Chymotrypsin, a mutant was constructed with Ser 189, which is in the bottom of the substrate-specificity pocket, changed to Asp. What effect would you predict for this Ser 189 Asp 189 mutation? [3.0]
5. Treatment of carbonic anhydrase with high concentrations of the metal chelator EDTA (ethylenediaminetetraacetic acid) results in the loss of enzyme activity. Propose an explanation. [2.0]
6. How many different oligosaccharides can be made by linking one glucose, one mannose, and one galactose? Assume that each sugar is in its pyranose form.

Compare this number with the number of tripeptides that can be made from three different aminoacids. [2.0]

7. Indicate whether each of the following pairs of sugars consists of anomers, epimers or an aldose-ketose pair: [3.0]
   (a) D-glyceraldehyde and dihydroxyacetone
   (b) D-glucose and D-mannose
   (c) D-glucose and D-fructose
   (d) α-D- glucose and β-D-glucose
   (e) D-ribose and D-ribulose
   (f) D-galactose and D-glucose
8. Glucose reacts slowly with hemoglobin and other proteins to form covalent compounds. Why is glucose reactive? Name any one disease in which glycosylated hemoglobin is a marker protein? What is the nature of the adduct formed? [2.0]
9. Why might most unsaturated fatty acids in phospholipids be in cis rather than the trans conformation? Draw the structure of a 16-carbon fatty acid as (a) saturated, (b) trans monounsaturated, and (c) cis monounsaturated. [3.0]
10. A culture of bacteria growing at 37°C was shifted to 25 °C. How would you expect this shift to alter the fatty acid composition of the membrane phospholipids? Explain. [2.0]
11. Patients in shock often suffer from lactic acidosis owing to a deficiency of O_2. Why does a lack of O_2 lead to lactic acid accumulation? One treatment for shock is to administer dichloroacetate, which inhibits the kinase associated with the pyruvate dehydrogenase complex. What is the biochemical rationale for this treatment? [4.0]
12. The activity of the citric acid cycle can be monitored by measuring the amount of O_2 consumed. The greater the rate of O_2 consumption, the faster the rate of the cycle. Hans Krebs used this assay to investigate the cycle in 1937. He used as his experimental system minced pigeon-breast muscle, which is rich in mitochondria. In one set of experiments, Krebs measured the O_2 consumption in the presence of carbohydrate only and in the presence of carbohydrate and citrate. The results are shown in the following table. [6+2 = 8]

Time (min.)	Micromoles of oxygen consumed	
	Carbohydrate only	Carbohydrate plus 3μmol of citrate
10	26	28
60	43	62
90	46	77
150	49	85

   (a) How much O_2 would be absorbed if the added citrate were completely oxidized to H_2O and CO_2? Draw the TCA cycle.
   (b) On the basis of your answer to part a, what do the results given in the table suggest?
13. The immediate administration of nitrite is a highly effective treatment for cyanide poisoning. What is the basis for the action of this antidote? Explain your

reasoning with respect to oxidative phosphorylation/electron transport chain. [Hint: Nitrite oxidizes ferrohemoglobin to ferrighemoglobin.] [4.0]

14. Glucose labeled with ^{14}C at C-6 is added to a solution containing the enzymes of the oxidative phase of the pentose phosphate pathway. What is the fate of the radioactive label? Write the sequence of the biochemical pathway. [6.0]
15. A strain of mice has been developed that lack the enzyme phophorylase kinase. Yet, after strenuous exercise, the glycogen stores of a mouse of this strain are depleted. Explain how this depletion is possible at the level of regulation. [4.0]
16. Write a balanced equation for the synthesis of alanine from glucose? [3.0]
17. How the glucose and TCA cycle is interrelated with respect to aminoacid biosynthesis? [4.0]
18. What major biosynthetic reactions utilize methionine and ribose-5-phosphate? Explain. [6.0]
19. What is the distribution of isotopic labeling in cholesterol synthesized from each of the following precursors? Expain. [6.0]
    (a) Mevalonate labeled with ^{14}C in its carboxyl carbon atom
    (b) Malonyl CoA labeled with ^{14}C in its carboxyl carbon atom
20. Compare and contrast fatty acid oxidation and synthesis with respect to [6.0]
    (a) site of the process.
    (b) Acyl carrier.
    (c) Reductants and oxidants
    (d) Stereochemistry of the intermediates.
    (e) Direction of synthesis or degradation.
    (f) Organization of the enzyme system.