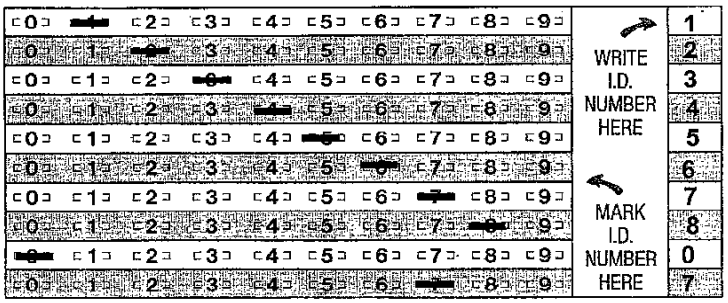
BIOLOGY 1A MIDTERM # 1 Prof. R. Malkin **Oct. 1, 2001**
NAME _____ SECTION # _____ GSI NAME _____

1. Sit every other seat and in the area near your GSI. Place all books and paper on the floor. **NO CALCULATORS ARE PERMITTED**.

Instructions for Scantron

2. Use a #2 pencil for the scantron form. **ERASE ALL MISTAKES COMPLETELY AND CLEARLY**.
3. On the scantron sheet, write in your student ID #, and the last two digits of your section number below that. Bubble in the appropriate numbers to the left as shown in the example below.



Your SID goes into the first 8 boxes, from top to bottom. (e.g. 12345678).

The last 2 digits of your section number goes into the bottom 2 boxes. (eg. 07).

4. On the back of the scantron, print your name **CLEARLY** in the space provided. Print your GSI's name in place of "subject".

EXAM Instructions:

5. Print your name on THIS COVER SHEET. **(otherwise, you get a ZERO)**.
6. Leave your exam **face up**. When told to begin, check your exam to see that there are **8 numbered pages**, 54 multiple choice questions.

   The exam is worth 100 pts. Each multiple choice question is worth 2 points unless otherwise indicated. You are NOT PENALIZED for guessing! (GUESS EVEN IF YOU NOT SURE)

7. **It is extremely important that your read all questions and choices carefully before bubbling in your response.**
8. Do not talk during the exam. The exam is closed book. You can not use a calculator, and no calculator is necessary. If you have a question, raise your hand; a GSI will help you. They will not give you the answer or explain scientific terms.
9. LOCATE YOUR SECTION. Turn in your SCANTRON form to the SCANTRON ENVELOPE and your EXAM to the EXAM ENVELOPE for your section. YOU MUST TURN IN **BOTH** or else you will get a ZERO.
10. WHEN TOLD TO STOP- **STOP**! Bubble in guesses **BEFORE** THIS TIME!

1. (1 pt) Amino acids differ because_____. Amino acids are linked together in proteins by_____.
   (A) they have different side chains, peptide bonds
   (B) some are found in nucleic acids, phosphodiester bonds
   (C) some contain bound nucleotides, ester bonds
   (D) some are associated with saturated fatty acids, hydrophobic interactions
   (E) some are resistant to hydroloysis, hydrogen bonds

2. Which of the following are considered part of the secondary structure of a protein?
   (A) the α helix
   (B) the β pleated sheet
   (C) the amino acid sequence
   (D) only (A) and (B) are correct
   (E) (A), (B) and (C) are correct

3. Proteins with a quaternary structure
   (A) contain more than one polypeptide chain
   (B) are only found in the lysosome
   (C) are made only on free ribsomes
   (D) always contain a prosthetic group
   (E) always contain bound metal ions

4. Which of the following is the strongest bond involved in the tertiary structure of a protein?
   (A) van der wall bond
   (B) ionic bond
   (C) disulfide bond
   (D) hydrogen bond
   (E) all of the above are approximately equal

5. Denaturation results in
   (A) cleavage of peptide bonds
   (B) a change in the tertiary structure
   (C) a change in the primary structure
   (D) irreversible modification of the shape of a protein
   (E) covalent modification of the protein

6. (1 pt) Fatty acids are found in
   (A) monoglycerides
   (B) diglycerides
   (C) triglycerides
   (D) phospholipids
   (E) all of the above

7. Phospholipids always contain
   (A) a phosphate group esterified to glycerol
   (B) a serine residue
   (C) three fatty acids
   (D) a choline residue
   (E) a cholesterol group

8. Fructose and galactose both have the structural formula $C_6H_{12}O_6$. They differ because
   (A) fructose is found in starch while galactose is found in glycogen
   (B) only fructose is polymerized to make a structural carbohydrate
   (C) fructose is a keto sugar while galactose is an aldol sugar
   (D) only galactose is found in glycogen
   (E) only fructose is found in starch

9. (1 pt) Amylose, amylopectin and cellulose _____.
   (A) all contain fructose
   (B) are all polymers of glucose
   (C) are all found in animal cells
   (D) are all structural polymers
   (E) all contain beta-glucose

10. RNA and DNA differ because
   (A) DNA contains phosphodiester bonds while RNA contains phosphoester bonds
   (B) only RNA contains ribose
   (C) only DNA is single stranded
   (D) only RNA contains purines
   (E) only DNA contains pyrimidines

11. (1 pt) The most prevalent molecule in a cell is
   (A) Water
   (B) ATP
   (C) Hemoglobin
   (D) Nucleic acid
   (E) Sodium

12. The Miller-Urey experiment was important because
   (A) it showed biological molecules could be synthesized in a non-biological environment
   (B) it proved spontaneous origin had occurred
   (C) it disproved the special creation theory
   (D) it showed how cells synthesize amino acids
   (E) it directly led to the theory of an early RNA world

13. In eukaryotes, free and bound ribosomes differ in that
   (A) only bound ribosomes are involved in the synthesis of integral plasma membrane proteins
   (B) only free ribosomes synthesize secreted proteins
   (C) only free ribosomes are excreted from the cell
   (D) only bound ribosomes are required for the synthesis of cytosolic proteins
   (E) none of the above are correct

14. Which of the following most accurately represents the pathway of synthesis for a protein that is localized in the mitochondrial inner membrane?
   (A) Synthesis on free ribosomes $\Rightarrow$ Golgi complex $\Rightarrow$ mitochondrial inner membrane
   (B) Synthesis on the rough ER $\Rightarrow$ lysosome $\Rightarrow$ mitochondrial inner membrane
   (C) Synthesis in cytosol $\Rightarrow$ peroxisome $\Rightarrow$ mitochondrial inner membrane
   (D) Synthesis on the rough ER $\Rightarrow$ Golgi complex $\Rightarrow$ mitochondrial inner membrane
   (E) None of the above are correct

15. The fractionation of individual organelles within the cell is based upon _____.
(A) the realization that some cells do not have a nucleus
(B) the fact that different organelles have different sizes
(C) the hydrophobic and hydrophilic nature of cellular components
(D) the soluble nature of many cellular enzymes
(E) the fact that all cells are surrounded by a plasma membrane

16. Prokaryotic and eukaryotic cells both contain ___ but **only** eukaryotic cells contain ____.
(A) a plasma membrane, membrane bound organelles
(B) lysosomes, DNA
(C) mitochondrial DNA, peroxisomes
(D) a nucleus, RNA
(E) an endomembrane system, a Golgi complex

17. Sugar groups are added to proteins _____. These are important for _____.
(A) in the cytosol of the cell, cytoskeleton formation
(B) in the smooth ER, the biosynthesis of lipids
(C) in the rough ER and the Golgi, targeting to specific cellular locations
(D) in the plasma membrane, secretion
(E) lysosome, hydrolytic digestion

18. The rough ER plays a role in ____ while the smooth ER is involved in _____.
(A) the synthesis of cytosolic proteins, protein degradation
(B) the synthesis of lipids, oxidative metabolism
(C) the synthesis of mitochondrial proteins, the synthesis of peroxisomal proteins
(D) the degradation of polysaccharides, the degradation of lipids
(E) the synthesis of secreted proteins, synthesis of hydrophobic molecules

19. The Golgi complex
(A) is found in all eukaryotic cells
(B) receives material from the rough ER
(C) is part of the endomembrane system
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are correct

20. Which of the following is a property of an enzyme found in the lysosome?
(A) the enzyme would function in oxidative metabolism
(B) the enzyme would be a hydrolase
(C) the enzyme would function at an acidic pH
(D) only (B) and (C) are correct
(E) (A), (B) and (C) are correct

21. Two organelles specifically involved in oxygen-consuming reactions are
(A) vacuoles and mitochondria
(B) mitochondria and peroxisomes
(C) nucleus and mitochondria
(D) mitochondria and lysosomes
(E) the nucleus and ribosomes

22. Support for the endosymbiotic hypothesis comes from the fact that
(A) plants contain both chloroplasts and mitochondria
(B) only chloroplasts have an internal membrane system
(C) chloroplasts contain RNA while mitochondria contain both RNA and DNA
(D) chloroplasts and mitochondria contain their own ribosomes
(E) peroxisomes cannot synthesize their own proteins

23. (1 pt) Microfilaments contain _____ and are involved in _____.
(A) actin, contractile functions
(B) keratin, fiber formation
(C) phospholipids, membrane formation
(D) tubulin, muscle contraction
(E) kinesin, cellular movement

24. An important factor that determines the fluidity of a membrane is
(A) the degree of binding of the cytoskeleton to the membrane
(B) whether bound ribosomes are present on the membrane surface
(C) the relative amount of unsaturated fatty acids in the membrane
(D) whether the membrane is involved in active transport
(E) the amount of bound carbohydrates attached to the membrane

25. Integral proteins _____ while peripheral proteins _____.
(A) are loosely associated with the membrane, are tightly associated with the membrane
(B) are found in the rough ER, are found in the smooth ER
(C) are only found in mitochondria, are only found in the cytosol
(D) interact with the hydrophobic core of the membrane, bind on the hydrophilic portion of the membrane
(E) can be removed from the membrane by the addition of salt, require a detergent for solubilization

26. Nerve cells contain 5 mM Na^+ and outside these cells, the concentration of Na^+ is 440mM. However, these cells transport Na^+ out of the cell. This would be an example of____ and requires _____.
(A) active transport, an energy source
(B) facilitated diffusion, protein channels
(C) uniport transport, both Na^+ and K^+
(D) passive transport, the Na^+/K^+ transporter
(E) downhill transport, ATP

27. The oxidation of NADH by molecular oxygen has a ΔG^o of -53 kcal/mole. This means
(A) the reaction occurs at a very rapid rate
(B) a mitochondrial electron transport chain is required
(C) there is no activation energy for the reaction
(D) the reaction is exergonic
(E) the reaction requires a net input of energy

28. Facilitated diffusion and active transport are similar in that
(A) they both require ATP
(B) they both have saturation kinetics
(C) they both require a uniport
(D) they both occur in the cytosol

(E) they both are required for the Na+/K+ ATP-ase

29. (1 pt) Enzymes are _____ that function by _____.
(A) proteins, changing the free energy of a reaction
(B) RNA-protein complexes, changing conformation
(C) Catalysts, lowering the activation energy of a reaction
(D) Hydrophilic proteins, binding to membranes
(E) Ribozymes, making non-spontaneous reactions occur

30. Allosteric **enzymes** are characterized by
(A) effector binding sites
(B) sigmoidal kinetic behavior
(C) catalytic and regulatory subunits
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are correct

31. The energy of the terminal phosphate group in ATP is _____.
(A) higher than the energy of all other phosphorylated compounds in a cell
(B) is used to drive many of the endergonic reactions of the cell
(C) never released as heat
(D) higher than the energy of the carbon-carbon covalent bond
(E) lower than the energy of a phosphoester bond

32. (1 pt) The active site of an enzyme is _____.
(A) where the substrate binds
(B) where a prosthetic group, if present, is located
(C) where a non-competitive inhibitor binds
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

33. Zymogens are _____ and can be converted into _____.
(A) inactive precursor forms of enzymes, active proteases
(B) enzymes that have a quaternary structure, denatured proteins
(C) active only at acidic pHs, structural proteins
(D) synthesized on the rough ER, glycoproteins in the Golgi complex
(E) denatured proteins, renatured proteins

34. According to the induced fit model for the mechanism of enzyme action,
(A) the substrate must bind to a prosthetic group at the active site
(B) the active site of the enzyme is complimentary in shape to the substrate
(C) allosteric effectors induce a change in the structure of the active site
(D) the enzyme changes conformation in response to substrate binding
(E) competitive inhibitors do not bind at the active site of the enzyme

35. The products of glycolysis are ____while the products of alcoholic fermentation are ___.

(A) 2 pyruvate and 2 ATP	2 lactic acids and 2 ATP
(B) glucose, 2 ATP and 2 NADH	2 ethanol and 2 ATP
(C) 2 pyruvate, 2 ATP and 2 NADH	2 ethanol, 2 CO_2 and 2 ATP
(D) 2 ethanol and 2 ATP	2 pyruvate and 2 ATP
(E) 2 lactic acid, 4 ATP and 4 NADH	2 pyruvate, 2 ATP and 2 NADH

36. The enzyme pyruvate kinase catalyzes the following reaction:

Phosphoenolpyruvate (PEP) + ADP $\Rightarrow$ Pyruvate + ATP

The approximate free energy change for the hydrolysis of the phosphate group of PEP (to produce pyruvate and inorganic phosphate) is _____. The enzyme-catalyzed reaction would be an example of _____.

(A) ΔG^o = -9.0 kcal	protein phosphorylation
(B) ΔG^o = +7.3 kcal	oxidative phosphorylation
(C) ΔG^o = -2.0 kcal	allosteric activation
(D) ΔG^o = -12.0 kcal	substrate-level phosphorylation
(E) ΔG^o = -7.3 kcal	allosteric phosphorylation

37. The products of the Krebs cycle are _____.

(A) CO_2, NADH and $FADH_2$
(B) O_2 and ATP
(C) Pyruvate, H_2O and a H^+ gradient
(D) Ethanol, CO_2 and ATP
(E) NADH, $FADH_2$, ATP and CO_2

38. During lactic acid fermentation, glucose is converted to lactate with a ΔG^o = -50 kcal/mole. The overall equation for this reaction is _____ and the efficiency of energy conversion is about ____.

(A) Glucose + 2 NAD^+ +ADP + Pi $\Rightarrow$ 2 lactates + 2NADH + $2H^+$ + ATP, 38% efficient
(B) Glucose + 2ADP + 2Pi $\Rightarrow$ 2 lactates + 2ATP, 29% efficient
(C) Glucose + 4ADP + 4 Pi $\Rightarrow$2 lactates + 4 ATP, 59% efficient
(D) Glucose + NAD^+ + 2 ADP + 2 Pi$\Rightarrow$1 lactate + 2 NADH + 2 H^+ + 2 ATP, 20% efficient
(E) Glucose + O_2 + ADP + Pi $\Rightarrow$ 2 lactates + ATP, 50% efficient

39. Which of the following are characteristics of substrate-level phosphorylation?

(A) It can occur in the cytosol of the cell
(B) It can occur in the absence of oxygen
(C) It requires at least 7.3 kcal of energy to make an ATP
(D) It does not require membrane-bound enzymes
(E) All of the above are correct

40. During the complete oxidation of glucose (to CO_2 and H_2O), _____ NADH are produced. The oxidation of these NADH in the mitochondrion results in the synthesis of ____ ATP.

(A) 20, 20
(B) 2, 6
(C) 4, 12
(D) 8, 20
(E) 10, 30

41. The portion of aerobic respiration that produces the most ATP per glucose is _____. The number of ATPs produced in this one portion of respiration is ____.

(A) glycolysis, 2
(B) oxidative phosphorylation, 32
(C) substrate-level phosphorylation, 36

(D) alcoholic phosphorylation, 4
(E) photosynthetic phosphorylation, 32

42. When electrons pass through the mitochondrial electron transport chain, which of the following occurs?
(A) the concentration of H^+ in the matrix decreases
(B) NAD^+ is oxidized
(C) The cytochromes in the electron transport chain phosphorylate ADP to form ATP
(D) The electrons gain energy
(E) ATP is synthesized in the intermembrane space

43. Cytochromes are _____ that are found in _____.
(A) copper containing proteins, the plasma membrane
(B) heme containing proteins, thylakoids as well as the mitochondrial inner membranes
(C) transport proteins, the Golgi complex
(D) proteolytically digested, secretory vesicles
(E) thiamine containing enzymes, the chloroplast lumen

44. The ATP synthetase is a key enzyme in mitochondria and chloroplasts because
(A) it uses ATP to drive ion transport
(B) it is directly involved in substrate level phosphorylation
(C) it can convert a H^+ gradient into ATP
(D) it is a very hydrophilic protein
(E) it is easily removed from these membranes

45. Which of the following can be absent from oxygen-evolving organisms?
(A) Chlorophyll *b*
(B) Chlorophyll *a*
(C) Photosystems I and II
(D) ATP synthetase
(E) None of the above can ever be absent

46. Photosynthetic reaction center complexes _____
(A) are directly involved in CO_2 fixation
(B) are found in the stroma
(C) contain a special chlorophyll molecule that is oxidized in the light
(D) are composed of primarily hydrophilic proteins
(E) are directly involved in the synthesis of ATP

47. Rubisco has two different activities, one of which is as a _____and the second as a _____. The ratio of these activities is effected by _____.
(A) dehydrogenase, oxidase, phosphate concentrations
(B) carboxylase, oxygenase, the ratio of CO_2 to O_2 in solution
(C) kinase, phosphatase, ATP concentrations
(D) protease, nuclease, the protein concentration
(E) phosphorylase, ATP synthetase, the ratio of ADP to ATP

48. (1 pt) The products of the light reactions of photosynthesis are _____.
(A) CO_2, O_2 and ATP
(B) NADPH, O_2 and ATP

(C) H_2CO_3, sucrose and starch
(D) H_2O_2 and ATP
(E) PGA and glucose

49. Photorespiration produces _____ but does not produce _____.
(A) NADH and O_2, NADPH
(B) NADPH and ATP, O_2
(C) Pyruvate, ethanol
(D) Glucose, starch
(E) CO_2, ATP

50. Which of the following statements about C4 photosynthesis is FALSE?
(A) C4 plants contain two different photosynthetic cell types
(B) C4 plants fix CO_2 into an organic acid as their first product
(C) C4 plants have two different carboxylases that are involved in CO_2 fixation
(D) C4 plants have a temporal separation in the two phases of CO_2 fixation
(E) C4 plants have low rates of photorespiration

51. Oligomycin is an inhibitor that reacts specifically with a membrane-bound ATP synthetase. Which of the following reactions would be inhibited by oligomycin?
(A) The coupled oxidation of NADH by oxygen in mitochondria
(B) Cyclic electron transport and phosphorylation
(C) The coupled oxidation of water and reduction of $NADP^+$
(D) The synthesis of ATP from phosphoenolpyruvate and ADP
(E) Only (A), (B) and (C) would be inhibited

52. The Calvin cycle in plants _____.
(A) fixes CO_2 via PEP carboxylase
(B) utilizes many enzymes that are localized in the chloroplast lumen
(C) generates ATP and NADPH that can be used for biosynthesis
(D) produces a C-3 sugar as its major product
(E) is directly activated by light

53. Oxidative phosphorylation produces ATP via a chemiosmotic mechanism. Which of the following statements concerning this mechanism is **NOT** correct?
(A) Oxidative phosphorylation requires only cytochrome c
(B) Oxidative phosphorylation requires a H^+ gradient across a membrane
(C) Oxidative phosphorylation uses the energy released from chemical reactions to make ATP
(D) Oxidative phosphorylation utilizes a membrane-bound ATP synthesizing enzyme
(E) Oxidative phosphorylation couples electron transport to the synthesis of ATP

54. Photosynthetic phosphorylation can be distinguished from oxidative phosphorylation because
(A) only photosynthetic phosphorylation involves cytochromes
(B) only photosynthetic phosphorylation requires intrinsic proteins
(C) only oxidative phosphorylation requires oxygen
(D) only oxidative phosphorylation occurs in the cytosol
(E) only photosynthetic phosphorylation requires a proton gradient

ANSWERS ON THE NEXT PAGE.

Answers Exam 1 Bio 1A, Fall 2001 Exam given 10/1/2001

1	A	11	A	21	B	31	B	41	B	51	E
2	D	12	A	22	D	32	D	42	A	52	D
3	A	13	A	23	A	33	A	43	B	53	A
4	C	14	E	24	C	34	D	44	C	54	C
5	B	15	B	25	D	35	C	45	A	55	
6	E	16	A	26	A	36	D	46	C	56	
7	A	17	C	27	D	37	E	47	B	57	
8	C	18	E	28	B	38	B	48	B	58	
9	B	19	E	29	C	39	E	49	E	59	
10	B	20	D	30	E	40	E	50	D		

Usually only about 10% of the students missed a given question. A brief description of the answers for those questions that proved to be more difficult are given below.

10) Both DNA and RNA contain phosphodiester bonds.
13) Ribosomes bind to a mRNA and make a protein, the final destination of the protein product determines if the ribosome remains free in the cytosol or binds to the RER. If it goes to the RER then the final protein product must be associated with some component of the endomembrane system.
14) Mt are not part of the endomembrane system, thus their proteins either come from their own ribosomes or imported (after being synthesized by free ribosomes).
15) Organelles are large and fractionation is based upon size, not hyrophobicity/hydrophillicity.
20) Lysosomal enzymes are hydrolytic and function at acidic pH.
28) Both facilitated and active transport use protein carriers/channels which show saturation kinetics.
36) Delta G is less than -7.3 (negative number) and this is an example of SLP.
38) 2 X 7.3 = 14.6. 14.6/50 = 29.2/100 = 29%.
40) Complete oxidation means CH2O is completely oxidized into CO2.
42) ATP is made in the matrix as H+ move from the intermembrane space into the matrix.
45) Dr. Malkin stress that Chl a is essential because of its role in the reaction centers, the other pigments help to increase the wavelengths that are useful for PSN but they are not essential.
49) Photorespiration means CO2 is given off in the light.
50) C4 plants have a spatial separation of PEPCase versus Rubisco.
51) This was a difficult question but Dr. Malkin stressed the interplay of the systems. When 1 component of the ETC is altered it will affect other components.
52) Calvin cycle is the the plain old C# pathway. The first product formed is a 3 carbon molecule (2 of them).