

BIOLOGY 1A MIDTERM # 1 Prof. R. Malkin Oct. 2, 2000
 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.

0	1	2	3	4	5	6	7	8	9	WRITE I.D. NUMBER HERE	1
0	1	2	3	4	5	6	7	8	9		2
0	1	2	3	4	5	6	7	8	9	MARK I.D. NUMBER HERE	3
0	1	2	3	4	5	6	7	8	9		4
0	1	2	3	4	5	6	7	8	9	MARK I.D. NUMBER HERE	5
0	1	2	3	4	5	6	7	8	9		6
0	1	2	3	4	5	6	7	8	9	MARK I.D. NUMBER HERE	7
0	1	2	3	4	5	6	7	8	9		8
0	1	2	3	4	5	6	7	8	9	MARK I.D. NUMBER HERE	9
0	1	2	3	4	5	6	7	8	9		0
0	1	2	3	4	5	6	7	8	9	MARK I.D. NUMBER HERE	1
0	1	2	3	4	5	6	7	8	9		2

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

The last 2 digits of your section number goes into the bottom 2 boxes. (e.g. 123456789012)

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,** 53 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 you 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!** Always select the one best answer. Each question is worth 2 points unless indicated otherwise.

1. (1 pt) A dehydration reaction occurs when
 - (A) a nucleic acid is synthesized
 - (B) a peptide bond is formed
 - (C) a protein is degraded
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are correct

2. In a typical globular protein found in the cytosol of the cell, you would expect to find
 - (A) only hydrophobic amino acids
 - (B) hydrophilic amino acids on the surface of the protein
 - (C) only hydrophilic amino acids
 - (D) no tertiary structure
 - (E) only quaternary structure

3. Secondary structure in proteins involves
 - (A) hydrogen bonds involving atoms of the peptide bond
 - (B) phosphodiester bonds
 - (C) disulfide bonds
 - (D) ionic bonds involving R-group side chains
 - (E) hydrophilic bonds between R-group side chains

4. Which of the following statements is true?
 - (A) Myoglobin is a protein that has no quaternary structure
 - (B) Tertiary structure is only stabilized by non-covalent bonds
 - (C) Protein denaturation is always reversible
 - (D) Polar side chains of amino acids are usually found in the interior of proteins
 - (E) None of the above statements are true

5. (1 pt) Which of the following statements concerning DNA and RNA is true?
 - (A) only DNA contains phosphodiester bonds
 - (B) only RNA contains purines
 - (C) only DNA contains pyrimidines
 - (D) only RNA uses nucleotides as its building block
 - (E) none of the above are true

6. Nucleotides
 - (A) always contain a phosphate group
 - (B) always contain a pentose sugar
 - (C) always contain a purine base
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct

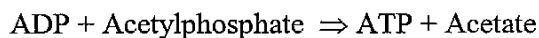
7. Phospholipids and diglycerides are similar because
 - (A) they both contain a phosphate group
 - (B) they both contain two fatty acid groups
 - (C) they both are extremely hydrophilic molecules
 - (D) they both contain ether linkages
 - (E) none of the above statements are true

8. The fatty acids in a phosphatidylcholine molecule would be localized
- (A) only in the nuclear membrane
 - (B) at the outer surface of a biological membrane
 - (C) randomly throughout the membrane
 - (D) in the interior of a biological membrane
 - (E) only in the plasma membrane
9. Glucose and fructose
- (A) are both disaccharides
 - (B) are both ketoses
 - (C) are components of cellulose
 - (D) both contain five carbon atoms
 - (E) are isomers
10. During the formation of a sucrose molecule from monosaccharides
- (A) a dehydration reaction occurs
 - (B) a glycosidic bond is formed
 - (C) an ester is produced
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are correct
11. Starch and cellulose differ because
- (A) only starch is found in autotrophic organisms
 - (B) only cellulose contains β -glucose
 - (C) only starch is a polysaccharide
 - (D) only cellulose contains glycosidic bonds
 - (E) only cellulose can be enzymatically degraded
12. (1 pt) All prokaryotic cells contain
- (A) genetic information
 - (B) a plasma membrane
 - (C) ribosomes
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct
13. Proteins that are localized in the Golgi complex
- (A) originate in the rough ER
 - (B) are imported from the cytosol
 - (C) are never modified
 - (D) are hydrolytically degraded
 - (E) are completely synthesized on free ribosomes
14. Peroxisomes
- (A) contain hydrolytic enzymes
 - (B) have an acidic internal environment
 - (C) use oxygen in degradative reactions
 - (D) use H_2O_2 to oxidize organic molecules
 - (E) synthesize fatty acids for phospholipids

15. Which of the following is not considered to be part of the endomembrane system?
- (A) the nuclear membrane
 - (B) the vacuole
 - (C) the smooth ER
 - (D) the plasma membrane
 - (E) all of the above are part of the endomembrane system
16. The rough ER has a function in
- (A) synthesis of secreted proteins
 - (B) synthesis of soluble nuclear proteins
 - (C) polysaccharide biosynthesis
 - (D) synthesis of mitochondrial proteins
 - (E) synthesis of DNA
17. The smooth ER
- (A) is involved in steroid hormone synthesis
 - (B) is required for peroxisomal protein synthesis
 - (C) contains nucleases
 - (D) contains oxidative enzymes
 - (E) produces ATP
18. You have discovered a new stain that specifically reacts with DNA. If you were to stain a eukaryotic autotrophic cell, you would find DNA in
- (A) the nucleus
 - (B) the chloroplast
 - (C) the mitochondria
 - (D) only (A) and (B)
 - (E) in (A), (B) and (C)
19. Free ribosomes are
- (A) required for the synthesis of mitochondrial proteins
 - (B) involved in the synthesis of cytosolic proteins
 - (C) found only in eukaryotic cells
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct
20. (1 pt) A major stabilizing force in most biological membranes is
- (A) covalent interactions between fats
 - (B) hydrophobic interactions between phospholipids
 - (C) glycosidic bonds between carbohydrate monomers
 - (D) phosphodiester bonds
 - (E) binding of peripheral proteins

21. Which of the following statements is correct?
- (A) Membranes with high amounts of saturated fatty acids are generally more fluid than membranes with high amounts of unsaturated fatty acids.
 - (B) Peripheral proteins are tightly associated with membranes
 - (C) Phospholipids can readily flip across a biological membrane
 - (D) Fatty acid structure can have a substantial effect on membrane fluidity
 - (E) Membranes are always symmetrical
22. During active transport,
- (A) Na^+ is always pumped into a cell
 - (B) K^+ is always pumped out of a cell
 - (C) an input of energy is required
 - (D) a uniport is always required
 - (E) a peripheral protein is involved
23. Many cells contain an enzyme that transports one H^+ and one glucose molecule into the cell. This would be an example of _____.
- (A) active transport
 - (B) an antiport
 - (C) a uniport
 - (D) passive transport
 - (E) a symport
24. (1 pt) The free energy change for a chemical reaction
- (A) gives information on the mechanism of the reaction
 - (B) provides kinetic constants for the reaction
 - (C) allows one to evaluate the K_m for the reaction
 - (D) indicates whether an enzyme is required
 - (E) none of the above are correct
25. Enzymes affect reactions by
- (A) having a specific active site at which substrates bind
 - (B) lowering the activation energy for a reaction
 - (C) changing the free energy of a reaction
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct
26. According to the induced fit model for enzyme action
- (A) substrates bind at an allosteric site on the enzyme
 - (B) the active site of the enzyme changes shape as the substrate binds
 - (C) prosthetic groups must be present at the active site
 - (D) the substrate molecule must change shape to bind to the enzyme
 - (E) the enzyme must have a quaternary structure

27. Prosthetic groups
- (A) are always inhibitors of enzyme activity
 - (B) are always organic molecules
 - (C) are bound at the active site of an enzyme
 - (D) bind only at allosteric sites on an enzyme
 - (E) are found only in enzymes that have a quaternary structure
28. A competitive inhibitor
- (A) binds at an allosteric site on an enzyme
 - (B) can compete with the substrate for binding
 - (C) requires a prosthetic group to bind to an enzyme
 - (D) is usually chemically unrelated to the substrate
 - (E) only binds to hydrophobic regions in an enzyme
29. Which of the following statements concerning allosteric enzymes is true?
- (A) Allosteric activators bind at regulatory sites on these enzymes
 - (B) Allosteric enzymes show sigmoid kinetics when substrate concentration is varied
 - (C) Allosteric enzymes have a quaternary structure
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct
30. Which of the following affects the activity of an enzyme
- (A) binding of a prosthetic group
 - (B) post-translational modification
 - (C) varying the substrate concentration
 - (D) changing the tertiary structure
 - (E) all of the above
31. You have isolated an active enzyme that contains the amino acid, N-acetyl lysine. When the acetyl group is removed from the enzyme, the activity is lost. This would be an example of _____.
- (A) allosteric activation
 - (B) post-translational modification
 - (C) competitive inhibition
 - (D) reversible inhibition
 - (E) allosteric inhibition
32. The free energy change for the reaction shown below would be _____.



(Note that ΔG for the hydrolysis of acetylphosphate is -10.1 kcal/mole)

- (A) + 7.3 kcal/mole
- (B) - 7.3 kcal/mole
- (C) -17.4 kcal/mole
- (D) -2.8 kcal/mole
- (E) The reaction will not occur

33. What would the free energy change be if all three phosphate groups in one mole of ATP were hydrolyzed?
- (A) -14.6 kcal
 - (B) -21.9 kcal
 - (C) -17.6 kcal
 - (D) +7.3 kcal
 - (E) none of the above are correct
34. (1 pt) During the light phase of photosynthesis
- (A) carbohydrates are oxidized
 - (B) chlorophyll is degraded
 - (C) water is oxidized
 - (D) NADH is formed
 - (E) carbon dioxide is fixed
35. Which of the following statements is true?
- (A) Chlorophyll *b* is found in all O₂-evolving organisms while chlorophyll *a* is absent from most of these organisms
 - (B) Chlorophyll *b* is only found in photosynthetic reaction center complexes
 - (C) Chlorophyll *a* is only found in photosynthetic reaction center complexes
 - (D) Carotenoids are found in all O₂-evolving organisms
 - (E) None of the above statements are true
36. The presence of several different pigments in a photosynthetic membrane from an oxygen evolving organism
- (A) allows for a greater capture of light
 - (B) results in the utilization of infrared light for photosynthesis
 - (C) is an absolute requirement for photosynthesis
 - (D) is because some pigments are hydrophilic and others are hydrophobic
 - (E) is because chlorophyll only absorbs green light
37. Some photosynthetic prokaryotes cannot use water as their electron donor during photosynthesis. This means
- (A) these organisms have no chlorophyll
 - (B) these organisms have special chloroplasts
 - (C) these organisms have no PSII
 - (D) these organisms do not synthesize ATP
 - (E) these organisms produce O₂ in the light
38. Hydroxylamine is a compound that specifically inhibits water oxidation in the chloroplast. In the presence of hydroxylamine, which of the following would still occur in the light:
- (A) P680⁺ would be converted back to P680
 - (B) ATP would be formed
 - (C) O₂ would be produced
 - (D) PGA would be formed
 - (E) NADPH would be formed

39. PSI and PSII differ because
- (A) only PSI has chlorophyll *a* and chlorophyll *b*
 - (B) only PSII generates a very strong oxidant
 - (C) only PSI contains pigment-protein complexes
 - (D) only PSII contains integral proteins
 - (E) only PSI contains carotenoids
40. During chloroplast electron transfer,
- (A) the lumen becomes acidic
 - (B) an ion gradient is established
 - (C) water is always oxidized
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are all correct
41. Which of the following statements concerning Rubisco is true?
- (A) Rubisco reacts with ATP during CO₂ fixation
 - (B) Rubisco can react with O₂ as well as with CO₂
 - (C) Rubisco is localized in the chloroplast lumen
 - (D) Mutants that are lacking Rubisco could still grow photosynthetically
 - (E) Rubisco is important for the structure of thylakoid membranes
42. C₄ and CAM photosynthesis are similar in that
- (A) they both produce PGA as the first product of CO₂ fixation
 - (B) they both involve two different cell types in the leaf
 - (C) they both form C₄ acids as their first products of CO₂ fixation
 - (D) neither requires ATP for the synthesis of glucose
 - (E) both have high rates of photorespiration
43. Substrate level phosphorylation can be distinguished from oxidative phosphorylation because
- (A) only substrate level phosphorylation requires membrane-bound components
 - (B) only oxidative phosphorylation occurs in the mitochondrion
 - (C) only oxidative phosphorylation requires an aerobic environment
 - (D) only substrate level phosphorylation is linked to an oxidation reaction
 - (E) only oxidative phosphorylation occurs in the cytosol of the cell
44. The conversion of glucose to pyruvate in a cell
- (A) is an aerobic process
 - (B) is catalyzed by membrane-bound enzymes
 - (C) is linked to the chemiosmotic synthesis of ATP
 - (D) generates NAD⁺
 - (E) involves enzymes localized in the cytosol

45. The enzymes of the Krebs cycle, which are in the _____, produce _____ as products
- (A) the cytosol, ATP and CO₂
 - (B) the lumen, NAD⁺ and NADH
 - (C) the matrix, CO₂, ATP, NADH and FADH₂
 - (D) the intermembrane space, NADH and FADH₂
 - (E) the mitochondrial inner membrane, O₂ and ATP
46. Cytochromes, which contain _____, are found in _____.
- (A) copper, the mitochondrial inner membrane
 - (B) iron, the matrix
 - (C) manganese, the outer mitochondrial membrane
 - (D) heme, complex III and complex IV
 - (E) biotin, the ATP synthase
47. You have discovered an organism that can grow directly on NADH. The oxidation of NADH by O₂ in its mitochondria has a free energy change of -44 kcal. What would be the efficiency of energy conversion for ATP formation in this organism?
- (A) approx. 10%
 - (B) approx. 25%
 - (C) approx. 40%
 - (D) approx. 50%
 - (E) approx. 60%
48. During alcoholic fermentation, there is a net synthesis of ___ ATPs by substrate level phosphorylation while during respiration, there is a net synthesis of ___ ATPs by substrate level phosphorylation.
- (A) 2, 4
 - (B) 4, 36
 - (C) 8, 32
 - (D) 4, 2
 - (E) 0, 36
49. Which of the following combinations is NOT correct?
- (A) matrix:Krebs cycle
 - (B) inner mitochondrial membrane:ATP synthase
 - (C) outer mitochondrial membrane:cytochrome oxidase
 - (D) intermembrane space:acidified region
 - (E) cytosol-glyceraldehyde:3-phosphate dehydrogenase
50. During alcoholic fermentation,
- (A) pyruvate is converted to methanol
 - (B) ATP is made by oxidative phosphorylation
 - (C) oxygen is consumed
 - (D) lactic acid is the final product
 - (E) carbon dioxide is one of the final products

51. The role of the mitochondrion in respiration is to ____.
- (A) oxidize pyruvate completely
 - (B) regenerate NADP^+ from NADPH
 - (C) convert glucose into PGA
 - (D) hydrolyze ATP
 - (E) oxidize water to molecular oxygen
52. The chloroplast and mitochondrial electron transport chains contain
- (A) quinones
 - (B) cytochromes
 - (C) integral membrane proteins complexes
 - (D) only (A) and (B) are correct
 - (E) (A), (B) and (C) are correct
53. Chloroplasts and mitochondria have many similarities. Among them is the fact that
- (A) both organelles are part of the endomembrane system
 - (B) both organelles are believed to have an endosymbiotic origin
 - (C) both organelles carry out glycolysis
 - (D) both organelles use carbon dioxide as a substrate
 - (E) both organelles carry out substrate level phosphorylation

THE END.

ANSWERS ON THE NEXT PAGE

Answers Exam 1 Bio 1A, Fall 2000

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

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.

- 1) B is clearly obvious. Polymerization of Nucleic acids also results in the release of water.
- 4) Myoglobin consists of only one protein subunit.
- 6) Nucleotides do not always contain a purine base as there are also pyrimidines.
- 10) A large number missed this one. Glycosidic bonds link sugars (ether not ester linkage).
- 14) H₂O₂ is produced as a result of the addition of II to Oxygen. They use oxygen to degrade organic molecules and the H₂O₂ is produced as a result of these reactions.
- 15) Components of the endomembrane system are connected directly (nuclear membrane, ER) or indirectly by vesicles (plasma membrane, vacuole, lysosome).
- 18) This question requires students to know that an autotrophic eukaryotic cell contains all three organelles and that each of these contain DNA.
- 19) D is the correct choice. Dr. Malkin mentioned that both chloroplasts and Mt require proteins synthesized by cytosolic ribosomes (free ribosomes). Bacteria have soluble proteins and therefore need to have free ribosomes.
- 27) Students seem to struggle with quaternary structure—it is more than one protein subunit. Prosthetic groups bind at the active site.
- 29) Dr. Malkin stressed that allosteric enzymes have more than one subunit and therefore they have quaternary structure.
- 33) In lecture it was stated that delta G for the anhydride bonds is 7.3 Kcal and for the ester bond it is 3 Kcal.
- 35) Lots of people missed this question. One of those none of the above choices that are always difficult for students because they may interpret a question one way and quickly select that answer. WORDING IS IMPORTANT—i.e. the placement of ONLY makes a difference. “Only chl a is found” is very, very different than “Chl a is only found”.
- 37) Prokaryotes do NOT contain membrane bound organelles! B is wrong (22% chose B). Water lysis occurs in PSII.
- 38 and 40 are somewhat interconnected. 38 deals with blocking non-cyclic electron transport and 40 would include both cyclic and non-cyclic. In 38 you can only have cyclic which creates a proton gradient that is used to make ATP (from ADP and Pi)
- 41) C₄ plants have a physical separation of initial carbon fixation and the Calvin cycle and CAM plants have a temporal separation.
- 46) Tough question. Cytochromes contain heme groups as a prosthetic group but the metal ion can be different depending upon the specific cytochrome (Cu or Fe).

- 47) This involved students knowing several things: each mitochondrial NADH yields 3 ATP, each of which is worth 7.3 Kcal of energy. Therefore about 21.9 or 22 Kcal of energy is captured for the 44 Kcal.
- 48) 2 ATP by SLP in fermentation (from glycolysis). In respiration 4 ATP by SLP (2 from glycolysis and 2 from Krebs cycle).
- 49) Location and metabolic activities had to be correlated.
- 50) The question specifically referred to alcoholic fermentation. The alcohol is ethanol—not methanol. Good thing or we would have lots of blind people (methanol is added to ethanol to denature it so that it can't be consumed as methanol causes blindness)