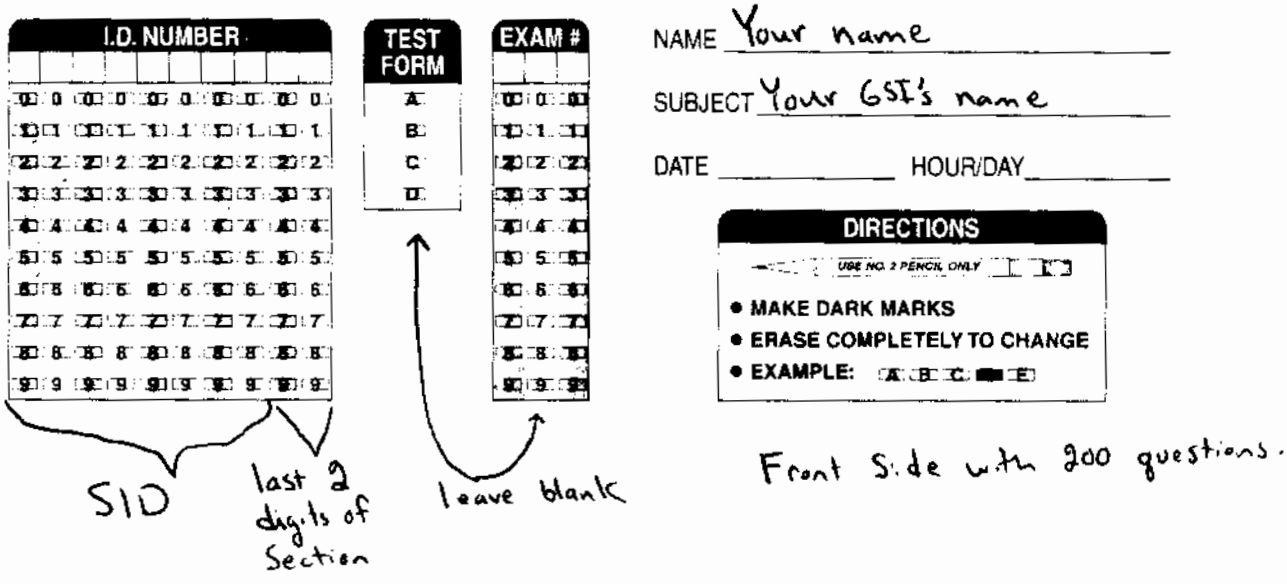
BIOLOGY 1A MIDTERM # 1 **September 29, 2003**

NAME _____ SECTION # _____ GSI NAME _____

1. Sit every other seat and sit by section number. Place all books and paper on the floor. **Turn off all phones, pagers, etc. and place them in your backpack. They cannot be visible. No calculator is permitted.**

Instructions for Scantron

2. Use a #2 pencil. **ERASE ALL MISTAKES COMPLETELY AND CLEARLY.**
3. On the front and top of the scantron write in your name and under subject write in your GSI's name. Write in your SID #AND the last two digits of your section number. Bubble in the appropriate numbers. See below.



EXAM Instructions:

5. Print your name on THIS COVER SHEET. (**otherwise, you will get a ZERO**).
6. Leave your exam **face up.** When told to begin, check your exam to see that there are **8 numbered pages,** 57 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 on **multiple choice questions!**

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. 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 GSI. Turn in your SCANTRON and EXAM to your GSI. 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) The most abundant molecule in a living cell is _____, which can represent ____ of the cell's total weight.
   (A) protein, 80%
   (B) water, 70%
   (C) glucose, 50%
   (D) ATP, 25%
   (E) DNA, 40%

2. (1 pt) Different amino acids are generally characterized by differences in _____.
   (A) how they form peptide bonds
   (B) where they are localized in different regions of the cell
   (C) the chemical nature of their side chains
   (D) the nature of their interactions with prosthetic groups
   (E) all of the above are correct

3. The tertiary structure of a protein _____.
   (A) is never stabilized by covalent bonds
   (B) involves more than one polypeptide chain
   (C) is stabilized by peptide bond hydrogen bonds
   (D) is associated with the alpha-helix structure
   (E) is the final three dimensional structure of a protein with one polypetide chain

4. Denaturation of a protein _____.
   (A) results in a loss of biological function
   (B) can be induced by some environmental conditions
   (C) can sometimes be reversible
   (D) only (A) and (B) are correct
   (E) (A), (B) and (C) are all correct

5. A globular protein found in the cytosol has its ____ in the interior of the molecule and its _____ on the surface of the molecule.
   (A) charged amino acids, sulfur containing amino acids
   (B) prosthetic groups, cofactors
   (C) hydrophobic amino acids, charged amino acids
   (D) N-terminus, C-terminus
   (E) polar amino acid, prosthetic groups

6. Phospholipids are characterized by
   (A) having a polar region
   (B) having a non-polar region
   (C) being associated with glycolytic enzymes
   (D) only (A) and (B) are both correct
   (E) (A), (B) and (C) are all correct

7. A monoacylglycerol (monoglyceride) contains
   (A) two fatty acids
   (B) a single fatty acid component
   (C) a phosphate group
   (D) a cholesterol molecule
   (E) a phosphodiester bond

8. Plant oils tend to be liquid at room temperature while animal fats tend to be solids at room temperature. This is because _____.

(A) oils contain phosphate groups while fats do not
(B) only animal cells contain cholesterol
(C) oils contain a higher proportion of unsaturated fatty acids in comparison with animal fats
(D) animal fats are less hydrophobic than plant oils
(E) animal fats contain shorter chain fatty acids than plant oils

9. The synthesis of sucrose _____.

(A) requires glucose and fructose
(B) results in the formation of a glycosidic bond
(C) requires sucrase
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

10. (1 pt) Starch contains _____ while cellulose contains _____.

(A) galactose, glucose
(B) alpha-glucose, beta-glucose
(C) monosaccharides, disaccharides
(D) modified sugars, non-modified sugars
(E) non-branched sugars, branched sugars

11. A phosphodiester bond

(A) is found in phospholipids
(B) is found in nucleic acids
(C) is found in serine phosphate
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

12. (1 pt) One difference between a prokaryote and a eukaryote is that

(A) only eukaryote cells have linear DNA
(B) only eukaryotic cells have ribosomes
(C) only prokaryotic cells contain phospholipids
(D) only prokaryotic cells have circular DNA
(E) only eukaryotic cells carry out oxygen evolving photosynthesis

13. Proteins in the lumen of the rough endoplasmic reticulum _____.

(A) are targeted to the mitochondrion
(B) are modified by the addition of carbohydrate groups
(C) are always secreted from the cell
(D) are rapidly degraded
(E) are fully synthesized on free ribosomes

14. (1 pt) The Golgi complex _____.

(A) enzymatically modifies proteins
(B) is involved in lipid synthesis
(C) contains the enzymes of glycolysis
(D) proteolytically degrades proteins
(E) is not considered to be part of the endomembrane system

15. Proteins imported into the nucleus _____ while those imported into the mitochondrion _____.
(A) are associated with RNA, are associated with histones
(B) are synthesized on bound ribosomes, are synthesized on free ribosomes
(C) pass through a pore, are transported across a membrane
(D) always have a quaternary structure, never have a quaternary structure
(E) are structural proteins, are always enzymes

16. The signal hypothesis
(A) describes how proteins are targeted in the cell
(B) describes how DNA is replicated
(C) describes how organelles move in the cell
(D) outlines the effects of post-translational modification
(E) explains the stability of biological membranes

17. (1 pt) Lysosomes are characterized by ____.
(A) being a component of the endomembrane system
(B) containing hydrolytic enzymes
(C) having a relatively acidic internal pH
(D) none of the above.
(E) A, B and C are all correct.

18. Chloroplasts and mitochondria are believed to have an endosymbiotic origin because
(A) they contain their own DNA
(B) they contain ribosomes
(C) their membranes contain some phospholipids
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

19. (1 pt) Which of the following does NOT involve cytoskeleton elements?
(A) ATP synthesis
(B) chromosome movement
(C) flagellar motion
(D) cytoplasmic streaming
(E) muscle contraction

20. Which statement about ribosomes is FALSE?
(A) Ribosmes are composed of two subunits
(B) Ribosomes are found in all cellular organelles
(C) Ribosomes are either "free" or "bound"
(D) Ribosomes are required for protein synthesis
(E) Ribosomes always contain RNA and protein

21. (1 pt) An intrinsic protein _____.
(A) is tightly associated with a biological membrane
(B) is located in the cytosol of the cell
(C) contains mostly polar amino acids
(D) is found only in plasma membranes
(E) is always secreted from the cell

22. According to the fluid mosaic model that describes biological membranes
(A) lipids can move in the plane of the membrane
(B) fluidity is unaffected by the degree of unsaturation of the fatty acids
(C) proteins cannot move in the membrane
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

23. (1 pt) Removal of intrinsic proteins from membranes
(A) can never occur
(B) requires disruption of the membrane with a detergent
(C) occurs after the addition of low concentrations of salt
(D) never disrupts the structure of the membrane
(E) requires chaperones

24. Facilitated diffusion and active transport
(A) are both protein-mediated
(B) both require an energy source
(C) can both move a molecule against its concentration gradient
(D) both require a cation
(E) both require an electrochemical gradient

25. (1 pt) If the free energy, ΔG, for a reaction is negative,
(A) the reaction will require a net input of energy
(B) the reaction is exergonic
(C) the reaction is at equilibrium
(D) the reaction will proceed at a high rate
(E) the reaction will proceed at a low rate

26. (1 pt) A biological catalyst
(A) affects the rate of a reaction
(B) changes the free energy for the reaction
(C) is always a protein
(D) is irreversibly altered during the course of a reaction
(E) is rarely required in the cell

27. According to the **induced** fit model for enzyme function,
(A) the catalytic activity of the enzyme is unaffected by temperature
(B) the enzyme must contain a prosthetic group
(C) the enzyme undergoes a conformational change during substrate binding
(D) the activity of the enzyme is regulated by metal ions
(E) the enzyme must have a quaternary structure

28. Cooperativity in an enzyme is usually associated with
(A) multiple active sites
(B) allosteric regulation
(C) post-translational modification
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

29. (1 pt) Thiamine pyrophosphate (TPP), a derivative of vitamin B1, is found to be covalently bound at the active site in pyruvate dehydrogenase. TPP would be an example of

(A) a prosthetic group
(B) a substrate
(C) a covalent inhibitor
(D) an allosteric effector
(E) a non-competitive inhibitor

30. Allosteric regulation of enzyme activity requires

(A) that an enzyme contain multiple polypeptide chains
(B) an allosteric effector binding site
(C) catalytic and regulatory subunits
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

31. Zymogens are

(A) involved in DNA synthesis
(B) phosphorylated proteins
(C) inactive proteases
(D) located in the ER lumen
(E) inactive nucleases

32. Protein phosphorylation

(A) can inactivate an enzyme
(B) involves the addition of a phosphate group to a serine, threonine or tyrosine located within a protein
(C) transfers a phosphate group to a glucose molecule
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

33. ATP contains

(A) two phosphate groups
(B) two phosphoanhydride bonds
(C) two phosphoester bonds
(D) one phosphoester and one phosphoanhydride bond
(E) three so-called "high energy" phosphate bonds

34. What is ΔG° for the following reaction

glycerol + ATP → glycerol-3-phosphate + ADP

(ΔG° for the hydrolysis of glycerol-3-phosphate is –2.2 kcal)

(A) – 3.4 kcal
(B) + 3.4 kcal
(C) – 2.2 kcal
(D) – 5.1 kcal
(E) – 7.3 kcal

35. The glycolytic pathway
(A) involves soluble enzymes in the cytosol
(B) yields a net synthesis of 2 ATP
(C) produces pyruvate as a product
(D) does not require oxygen
(E) all of the above are correct

36. The conversion of glyceraldehyde-3-phosphate to 1,3-diphosphoglycerate is an important reaction in glycolysis because
(A) energy is required for the oxidation of an aldehyde to an acid
(B) a high-energy phosphate compound is the product
(C) it is an example of oxidative phosphorylation
(D) it is the only step in glycolysis that requires oxygen
(E) it is the only step in glycolysis that requires a membrane-bound enzyme

37. The reactions of the Krebs cycle _____ while the reactions of oxidative phosphorylation _____.
(A) occur in the mitochondrial matrix, occur in the mitochondrial inner membrane
(B) utilize membrane-bound cytochromes, utilize soluble enzymes
(C) only occur in eukaryotes, only occur in prokaryotes
(D) occur under aerobic conditions, occur under anaerobic conditions
(E) result in the synthesis of ADP, result in the utilization of ATP

38. Cytochromes
(A) are found in both mitochondrial and chloroplast membranes
(B) contain heme groups that are involved in electron transfer reactions
(C) are involved in the transport of oxygen in animal cells
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

39. During the oxidation of pyruvate in the mitochondrion
(A) acetyl-coenzyme A is produced
(B) water is oxidized
(C) NAD^+ is produced
(D) citric acid is formed
(E) NADPH is produced

40. The complete oxidation of **<u>one molecule</u>** of pyruvate yields _____ molecules of ATP.
(A) 10
(B) 15
(C) 24
(D) 36
(E) 38

41. As a consequence of mitochondrial electron transport
(A) ATP is synthesized in the matrix
(B) the intermembrane space becomes acidified
(C) O_2 is produced by cytochrome oxidase
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

42. The ATP synthase plays a key role in aerobic respiration because
(A) it is the only respiratory enzyme in the mitochondrial matrix
(B) it is an enzyme that can convert a proton gradient into ATP
(C) it is the only soluble enzyme in the respiratory process
(D) it is the only membrane component in respiration
(E) it is the only enzyme localized in the intermembrane space

43. During lactic acid fermentation glucose is converted into lactic acid. What is the approximate energy efficiency of this series of reactions?
Glucose -> 2 lactate, (ΔG° is -47 kcal).
(A) 15%
(B) 20%
(C) 30%
(D) 40%
(E) 50%

44. During lactic acid fermentation,
(A) oxygen is required
(B) lactic acid is converted into ethanol
(C) pyruvate is converted into lactic acid
(D) oxidative phosphorylation produces ATP
(E) there is no net ATP synthesis

45. Which of the following pigments is/are found in photosystem II of eukaryotic photosynthetic organisms?
(A) carotenoids
(B) chlorophyll *a*
(C) chlorophyll *b*
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

46. The main function of a photochemical reaction center is to
(A) transfer light energy to chlorophyll molecules
(B) protect photochemical pigments from oxidative damage
(C) convert light energy into chemical products
(D) react with oxygen intermediates
(E) none of the above are correct

47. Photosystems I and II are required for
(A) electron transfer from water to $NADP^+$
(B) noncyclic photophosphorylation
(C) carbon dioxide fixation
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

48. The _____ is/are localized in the chloroplast stroma while the _____ are found in the chloroplast thyakoid membranes.
(A) ribulosebisphosphate carboxylase, ribulosebisphosphate oxygenase
(B) enzymes of the Calvin cycle, pigments and electron transfer chain
(C) enzymes involved in starch synthesis, enzymes involved in cellulose synthesis
(D) electron-transfering cytochromes, carbon dioxide fixation enzymes
(E) C-3 pathway enzymes, C-4 pathway enzymes

49. Both Photosystem I and Photosystem II contain
(A) a reaction center chlorophyll
(B) a primary electron acceptor
(C) chlorophyll *a*
(D) antenna pigments
(E) all of the above

50. During the chloroplast non-cyclic electron transfer of electrons, _____.
(A) the thylakoid lumen becomes acidified
(B) water is oxidized
(C) oxidation-reduction energy is used to create a proton gradient
(D) only (A) and (B) are correct
(E) (A), (B) and (C) are all correct

51. (1 pt) A key enzyme in the Calvin cycle is Rubisco because it _____.
(A) reacts with CO_2 to form carbonic acid
(B) synthesizes sucrose
(C) reacts with CO_2 to form 2 molecules of PGA
(D) reacts with the ATP and NADPH formed in the light reactions
(E) reacts with phosphoenolpyruvate (PEP) to form the C-4 acid, oxaloacetic acid

52. Photorespiration occurs in plants because
(A) CO_2 is produced during glycolysis
(B) Rubisco can react with oxygen as well as with carbon dioxide
(C) carbonic anhydrase can liberate CO_2 from carbonic acid
(D) peroxisomes can release CO_2 from oxaloacetic acid
(E) the vacuole releases stored CO_2 in the light

53. C-4 plants have an additional CO_2-fixing reaction when compared with C-3 plants. This C-4 mechanism allows these plants to
(A) directly produce sugars without the Calvin cycle
(B) convert CO_2 to carbonic acid using carbonic anhydrase
(C) inhibit the Krebs cycle
(D) decrease the loss of CO_2 from photorespiration
(E) inhibit cytochrome oxidase by a competition between CO_2 and O_2

Refer to the following choices to answer Questions 54-57. Each choice may be used once, more than once or not all. Indicate whether the following events occur during
(A) photosynthesis
(B) respiration
(C) fermentation
(D) only (A) and (B)
(E) occurs during (A), (B) and (C)

54. chemical oxidation-reduction energy is converted into ATP

55. utilization of membrane-bound electron carriers in the synthesis of ATP

56. electron flow involving different cytochromes

57. uses **only** substrate-level phosphorylation for the synthesis of ATP