

Midterm Exam

Note: Before beginning, please scan the entire exam so that you can budget your time. If necessary you may request a "challenge sheet" to present alternate interpretations of questions, but remember that you must choose an answer and justify it in order to receive credit if we agree.

The following questions refer to the molecules shown in Figure 4.8.

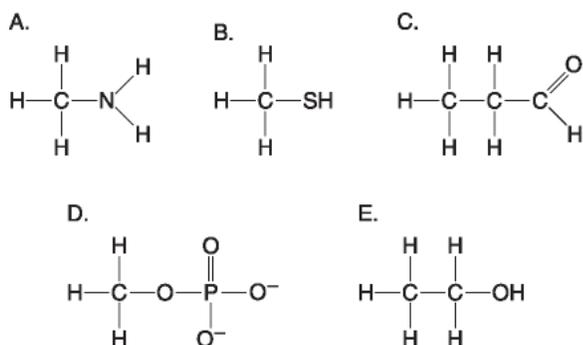


Figure 4.8

- 1) Which molecule contains a group that functions to transfer energy between organic molecules?
- 2) Which molecule can function as a base?
- 3) Which molecule contains a carbonyl functional group?
- 4) Which molecule is a thiol?
- 5) Which molecule contains a functional group known as an amino group?
- 6) A molecule containing which of the following would result in an increase in the concentration of hydrogen ions in the solution?
 - A) sulfhydryl
 - B) carboxyl
 - C) carbonyl
 - D) aldehyde
 - E) amino

- 7) Carbohydrates normally function in animals as
 - A) the functional units of lipids.
 - B) enzymes in the regulation of metabolic processes.
 - C) a component of triglycerides.
 - D) energy-storage molecules.
 - E) sites of protein synthesis.
- 8) Which of the following are polysaccharides?
 - A) RNA and DNA
 - B) glucose and sucrose
 - C) cholesterol and triacylglycerol
 - D) glycogen and starch
 - E) uracil and thymine

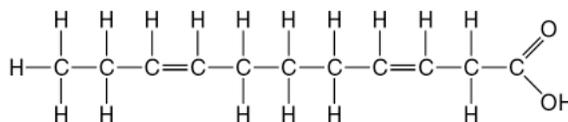


Figure 5.3

- 9) The molecule shown in Figure 5.3 is a
 - A) polysaccharide.
 - B) polypeptide.
 - C) saturated fatty acid.
 - D) nucleic acid.
 - E) unsaturated fatty acid.
- 10) The hydrogenation of vegetable oil would result in
 - A) a decrease in the number of carbon-carbon double bonds in the oil molecules.
 - B) an increase in the number of hydrogen atoms in the oil molecule.
 - C) the oil being a solid at room temperature.
 - D) B&C, but not A.
 - E) all of the above.

The following questions are based on the 15 molecules illustrated in Figure 5.8. Each molecule may be used once, more than once, or not at all.

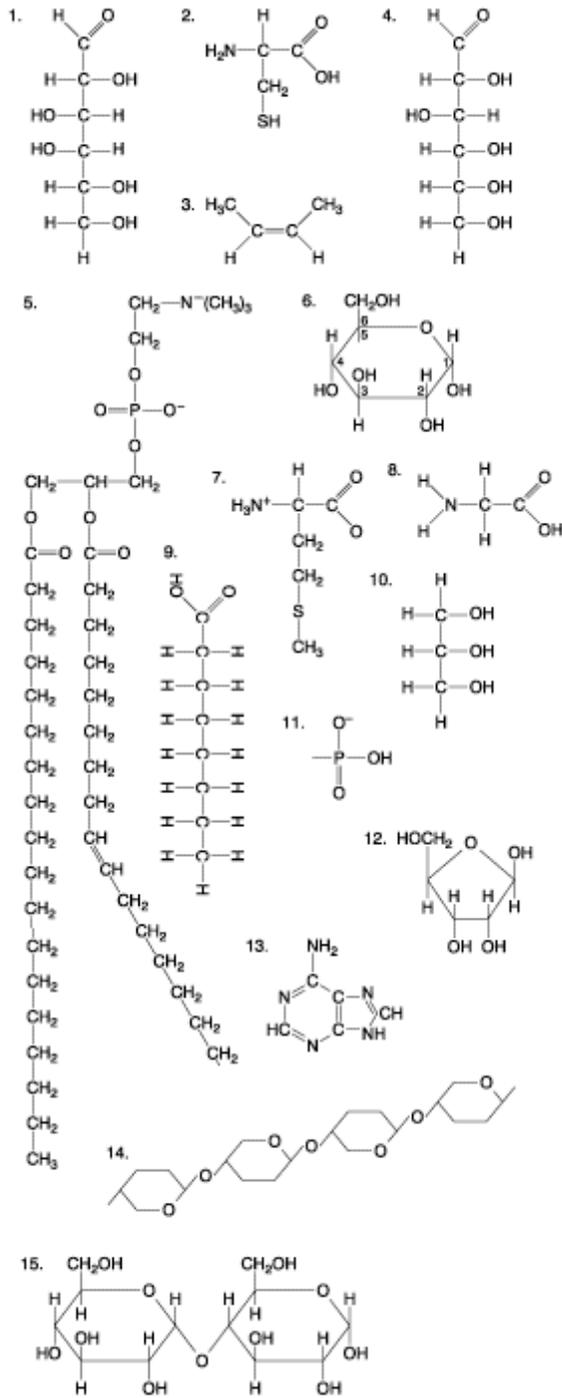


Figure 5.8

- Which of the following molecules is a saturated fatty acid?
 - 5
 - 7
 - 9
 - 10
 - 14
- Which of the following molecules is a purine type of nitrogen base?
 - 5
 - 7
 - 8
 - 12
 - 13
- Which of the following molecules could form a peptide bond as a result of a dehydration reaction?
 - 2 and 3
 - 3 and 7
 - 7 and 8
 - 8 and 9
 - 12 and 13
- Large organic molecules are usually assembled by polymerization of a few kinds of simple subunits. Which of the following is an *exception* to the above statement?
 - a steroid
 - cellulose
 - DNA
 - an enzyme
 - a contractile protein
- What interaction maintains the secondary structure of a protein?
 - peptide bonds
 - hydrogen bonds
 - disulfide bridges
 - ionic bonds
 - electrostatic charges

- Which of the following combinations could be linked together to form a nucleotide?
 - 1 and 4
 - 2, 7, and 8
 - 5, 9, and 10
 - 11, 12, and 13
 - 14 and 15

- 17) How many different kinds of polypeptides, each composed of 6 amino acids, could be synthesized using the 20 common amino acids?
- 6
 - 20^6
 - 120
 - 6^6
 - 6^{20}

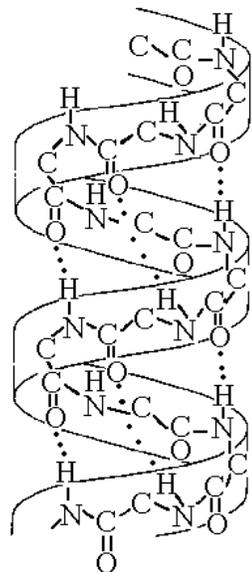


Figure 5.7

- 18) Figure 5.7 shows
- the linear form of glucose.
 - the α -helix of starch.
 - the α -helix of DNA.
 - a polynucleotide folding into a double helix.
 - an α -helix of a polypeptide.
- 19) The structural feature that allows DNA to replicate itself is the
- sugar-phosphate backbone.
 - complementary pairing of the bases.
 - phosphodiester bonding of the helices.
 - twisting of the molecule to form an α -helix.
 - three-part structure of the nucleotides.

- 20) At which level of protein structure are interactions between R groups *most* important?
- primary
 - secondary
 - tertiary
 - quaternary
 - They are equally important at all levels.
- 21) Which of the following is *not* found in a prokaryotic cell?
- DNA
 - cell wall
 - plasma membrane
 - ribosomes
 - endoplasmic reticulum
- 22) A primary objective of cell fractionation is
- to view the structure of cell membranes.
 - to identify the enzymes outside the organelles.
 - to determine the size of various organelles.
 - to separate the major organelles so their particular functions can be determined.
 - to crack the cell wall so the cytoplasmic contents can be released.

For the following questions, use the lettered answers to match the structure to its proper cell type. Choose the most inclusive category. Each answer may be used once, more than once, or not at all.

- a feature of all cells
 - found in prokaryotic cells only
 - found in eukaryotic cells only
 - found in plant cells only
 - found in animal cells only
- 23) plasma membrane
- 24) nucleoid
- 25) In what way are a plant cell and a bacterial cell alike but different from an animal cell?
- They both have a Golgi apparatus.
 - They both have mitochondria.
 - They both have transport proteins for active transport of ions.
 - They both have a cell wall.
 - They both have a cell membrane.

- 26) Large numbers of ribosomes are present in cells that specialize in producing which of the following molecules?
- lipids
 - starches
 - proteins
 - steroids
 - glucose
- 27) Which of the following is *not* a part of the endomembrane system?
- mitochondria
 - Golgi apparatus
 - rough endoplasmic reticulum
 - lysosomes
 - smooth endoplasmic reticulum
- 28) Which structure is the site of the synthesis of proteins that may be exported from the cell?
- rough ER
 - lysosomes
 - plasmodesmata
 - Golgi vesicles
 - tight junctions
- 29) Which of the following pairs is mismatched?
- nucleolus—ribosomal RNA
 - nucleus—DNA replication
 - lysosome—protein synthesis
 - cell membrane—lipid bilayer
 - cytoskeleton—microtubules
- 30) secretes many polysaccharides
- 31) contains hydrolytic enzymes
- 32) contains its own DNA and ribosomes
- 33) All of the structures listed below are associated with movement in cells or by cells *except*
- cilia.
 - dynein.
 - myosin.
 - flagella.
 - peroxisomes.
- 34) All of the following are functions of integral membrane proteins *except*
- enzyme synthesis.
 - active transport.
 - hormone reception.
 - cell adhesion.
 - cytoskeleton attachment.
- 35) One of the functions of cholesterol in animal cell membranes is to
- facilitate transport of ions.
 - store energy.
 - maintain membrane fluidity.
 - speed diffusion.
 - phosphorylate ADP.
- 36) Which of the following would likely move through the lipid bilayer of a plasma membrane most rapidly?
- CO₂
 - an amino acid
 - glucose
 - K⁺
 - starch

Refer to the following five terms to answer the following questions. Choose the most appropriate term for each phrase. Each term may be used once, more than once, or not at all.

- lysosome*
- tonoplast*
- mitochondrion*
- Golgi apparatus*
- peroxisome*

30) secretes many polysaccharides

31) contains hydrolytic enzymes

32) contains its own DNA and ribosomes

37) Glucose diffuses slowly through artificial phospholipid bilayers. The cells lining the small intestine, however, rapidly move large quantities of glucose from the glucose-rich food into their glucose-poor cytoplasm. Using this information, which transport mechanism is most probably functioning in the intestinal cells?

- simple diffusion
- phagocytosis
- active transport pumps
- exocytosis
- facilitated diffusion

- 38) Carrier molecules in the membrane and metabolic energy are required for
- osmosis.
 - facilitated diffusion.
 - active transport.
 - B and C.
 - A, B, and C.

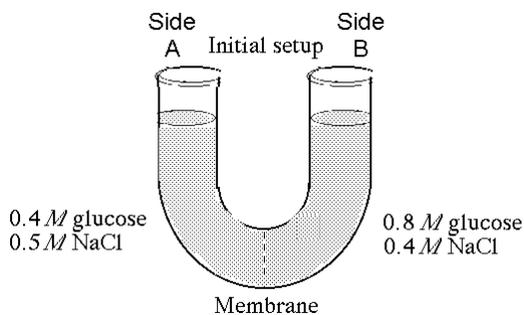


Figure 8.3

Refer to Figure 8.3 to answer the following questions. The solutions in the arms of a U-tube are separated at the bottom of the tube by a selectively permeable membrane. The membrane is permeable to sodium chloride but not to glucose. Side A is filled with a solution of 0.4 molar glucose and 0.5 molar sodium chloride (NaCl) and side B is filled with a solution containing 0.8 molar glucose and 0.4 molar sodium chloride. Initially, the volume in both arms is the same.

- 39) If you examine side A after 3 days, you should find
- a decrease in the concentration of NaCl and glucose and an increase in the water level.
 - a decrease in the concentration of NaCl, an increase in water level, and no change in the concentration of glucose.
 - no net change in the system.
 - a decrease in the concentration of NaCl and a decrease in the water level.
 - no change in the concentration of NaCl and glucose and an increase in the water level.
- 40) At the beginning of the experiment,
- side A is hypertonic to side B.
 - side A is hypotonic to side B.
 - side A is isotonic to side B.
 - side A is hypertonic to side B with respect to glucose.
 - side A is hypotonic to side B with respect to sodium chloride.

- 41) A cell lacking oligosaccharides on the external surface of its plasma membrane would likely be inefficient in
- transporting ions against an electrochemical gradient.
 - cell-cell recognition.
 - maintaining fluidity of the phospholipid bilayer.
 - attaching to the cytoskeleton.
 - establishing the diffusion barrier to charged molecules.
- 42) Celery stalks that are immersed in fresh water for several hours become stiff and hard. Similar stalks left in a salt solution become limp and soft. From this we can deduce that the cells of the celery stalks are
- hypotonic to both fresh water and the salt solution.
 - hypertonic to both fresh water and the salt solution.
 - hypertonic to fresh water but hypotonic to the salt solution.
 - hypotonic to fresh water but hypertonic to the salt solution.
 - isotonic with fresh water but hypotonic to the salt solution.
- 43) All of the following membrane activities require ATP energy *except*
- facilitated diffusion.
 - active transport.
 - Na⁺ ions moving out of the cell.
 - proton pumps.
 - translocation of potassium into a cell.
- 44) The common essential function of enzymes in biochemical reactions is best described by which of the following?
- Change the direction of reversible reactions.
 - Provide energy to drive energy-requiring reactions.
 - Break carbon-carbon covalent bonds.
 - Lower the need for activation energy.
 - Create new hydrogen bonds.

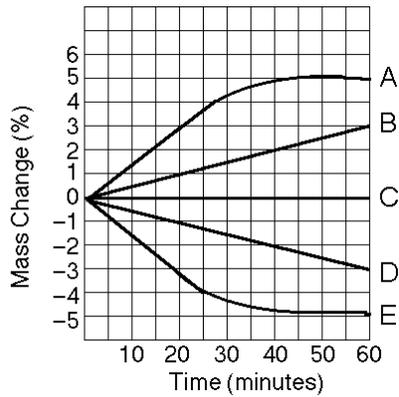
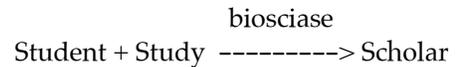


Figure 8.4

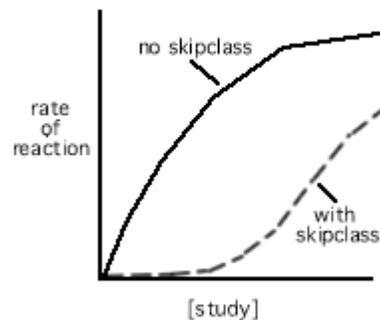
Read the following information and refer to Figure 8.4 to answer the following questions. Five dialysis bags, impermeable to sucrose, were filled with various concentrations of sucrose and then placed in separate beakers containing an initial concentration of 0.6 M sucrose solution. At 10-minute intervals, the bags were massed (weighed) and the percent change in mass of each bag was graphed.

- 45) What is the best explanation for the shape of line E after 50 minutes?
- Water is no longer leaving the bag.
 - Water is no longer entering the bag.
 - Water is leaving and entering the bag at the same rate.
 - Water is entering the bag at the same rate that sucrose is leaving the bag.
 - Sucrose is entering and leaving the bag at the same rate.
- 46) Which line or lines represent(s) bags that contain a solution that is hypertonic at the end of 60 minutes?
- A and B
 - B
 - C
 - D
 - D and E

- 47) The following is an enzymatic reaction discovered in BS 111:



It was found that a substance called "skipclass" could inhibit this reaction. The graph below shows the reaction rate as you increase the amount of the reactant "study", either without skipclass (solid line) or with skipclass (dashed line). Based on the data shown, what kind of inhibitor is "skipclass"?



- Competitive Inhibitor
 - Noncompetitive Inhibitor
 - Feedback Inhibitor
 - Cofactor Inhibitor
 - Irreversible Inhibitor
- 48) During exercise, an athlete's muscle cells may use up all their available oxygen. Which of the following respiratory processes would be most directly unable to continue due to the lack of additional oxygen?
- Glycolysis.
 - The electron transport chain (oxydative phosphorylation).
 - Calvin cycle.
 - Krebs cycle.
 - Pyruvate/ Acetyl CoA conversion.

- 49) During protein synthesis, each new peptide bond forms when _____ is removed from the _____ group of one amino acid and _____ is removed from the _____ group of the next amino acid to be added.
- OH, phosphate, H, amino
 - H, phosphate, OH, amino
 - H, carboxyl, OH, amino
 - OH, carboxyl, H, amino
 - OH, carboxyl, H, hydroxyl
- 50) The overall reaction of glucose metabolism via aerobic cellular respiration is:

$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$$
 If we supply the heavy isotope of oxygen, $^{18}\text{O}_2$, in which product would we expect to first observe the presence of the heavy oxygen?
- Pyruvate
 - Acetyl coA
 - NADH
 - CO_2
 - H_2O
- 51) You have a friend who lost 15 pounds of fat on a diet. Where did the mass go?
- The mass was released as CO_2 and H_2O .
 - The mass was converted to energy which was used up.
 - The mass was converted to ATP, which weighs much less than fat.
 - The mass was broken down to amino acids and eliminated from the body.
 - The mass was converted to urine and feces and eliminated from the body.
- 52) Phosphofructokinase is an important control enzyme. All of the following statements concerning this enzyme are true *except*:
- It is activated by citrate.
 - It is inhibited by ATP.
 - It is activated by AMP.
 - It is a coordinator of the processes of glycolysis and the Krebs cycle.
 - It is an allosteric enzyme.
- 53) Of the following, the structure of NAD^+ is most closely related to
- a basic amino acid
 - a pair of RNA nucleotides
 - a phospholipid
 - a double helix
 - a disaccharide
- 54) Which of the following would decrease the entropy within a system?
- dehydration reactions
 - hydrolysis
 - respiration
 - digestion
 - catabolism
- 55) During a laboratory experiment, you discover that an enzyme-catalyzed reaction has a ΔG of -4 kcal/mol. If you double the amount of enzyme in the reaction, what change would you predict in the ΔG ?
- It would be -2 kcal/mol.
 - It would be -8 kcal/mol.
 - It would remain unchanged
 - It would become $+4$ kcal/mol.
 - It is not possible to predict.
- 56) Consider the following: Succinic acid dehydrogenase catalyzes the reaction of succinic acid to fumaric acid. The reaction is inhibited by malonic acid, which resembles succinic acid but cannot be catalyzed by succinic dehydrogenase. Increasing the ratio of succinic acid to malonic acid reduces the inhibitory effect of malonic acid. Which of the following is correct?
- Succinic acid dehydrogenase is the enzyme, and fumaric acid is the substrate.
 - Succinic acid dehydrogenase is the enzyme, and malonic acid is the substrate.
 - Succinic acid is the substrate, and malonic acid is a competitive inhibitor.
 - Fumaric acid is the product, and malonic acid is a noncompetitive inhibitor.
 - Malonic acid is the product, and fumaric acid is a competitive inhibitor.

The following questions are based on the reaction $A + B \rightarrow C + D$ shown in Figure 6.2

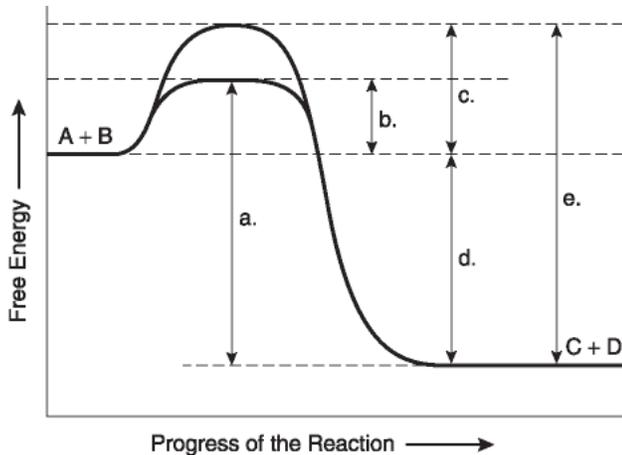


Figure 6.2

- 57) Which item represents the E_A of the reaction in the absence of enzyme?
- a
 - b
 - c
 - d
 - e
- 58) Which of the following best describes the reaction?
- negative ΔG , spontaneous
 - positive ΔG , nonspontaneous
 - positive ΔG , exergonic
 - negative ΔG , endergonic
 - ΔG of zero, chemical equilibrium
- 59) Which of the following is a correct statement regarding the reaction in the graph above?
- The amount of free energy initially presented in the reactants is indicated by "a."
 - The amount of free energy present in the products is indicated by "e."
 - The amount of free energy released as a result of the noncatalyzed reaction is indicated by "c."
 - The amount of free energy released as a result of the catalyzed reaction is indicated by "d."
 - Both C and D are correct.

- 60) Assume that the reaction described in the graph above has a ΔG of -5.6 kcal/mol. Which of the following would be true?
- The reaction could be coupled to power an endergonic reaction with a ΔG of -6.2 kcal/mol.
 - The reaction could be coupled to power an endergonic reaction with a ΔG of $+8.8$ kcal/mol.
 - The reaction could be coupled to power an exergonic reaction with a ΔG of -4.2 kcal/mol.
 - The reaction would result in an increase in entropy (S) and the products would have less free energy than the reactants.
 - The reaction would result in products ($C + D$) with a greater free-energy content than in the initial reactants ($A + B$).

The next question(s) is based on the following information: A series of enzymes catalyze the reaction $X \rightarrow Y \rightarrow Z$. Substance A binds to the enzyme that converts X to Y at a position remote from its active site. This binding increases the activity of the enzyme.

- 61) This pathway is best described as an example of what type of control?
- Competitive activation
 - Allosteric regulation
 - Feedback regulation
 - Competitive inhibition
 - Noncompetitive inhibition
- 62) Substance Y is
- a coenzyme
 - an allosteric inhibitor
 - a substrate
 - an intermediate
 - a product
- 63) When you contract a muscle, your muscle cells use ATP as an energy source. What is the source of this ATP?
- The blood carrying ATP made in other parts of the body.
 - The mitochondria of the muscle cell.
 - The cytoplasm of the muscle cell.
 - Both B&C are correct.
 - A, B, and C are correct.

64) A research group has discovered an organism with cells that contain a previously undescribed organelle. They isolate a large quantity of these organelles by homogenization and differential fractionation by centrifugation. Next, they do some tests on the isolated organelle to see if it is involved in any major metabolic reactions. They incubate the organelles for a brief period of time and determine changes in the amount of various substances in the suspending solution. (Note: you can assume that various starting substrate materials for the pathways are provided in sufficient quantity by the researchers.) The results are:

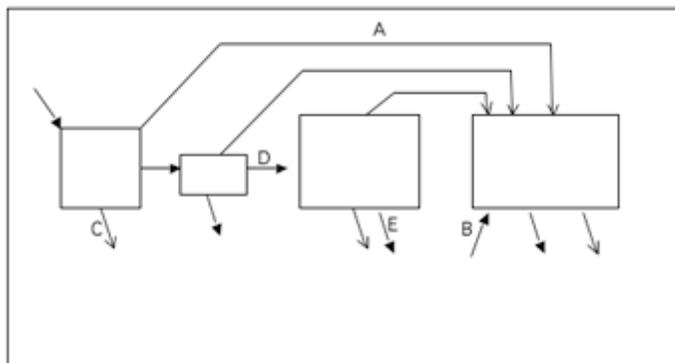
Glucose	No change
CO ₂	No change
O ₂	Decrease
ATP	Increase
NADH	Decrease

Based on this analysis, which metabolic process do you conclude is taking place in this organelle?

- A) Pyruvate Oxidation
 - B) Krebs Cycle
 - C) Glycolysis
 - D) Electron Transport Chain/Oxidative Phosphorylation
 - E) Both Glycolysis and the Krebs Cycle
- 65) Inside an active mitochondrion, most electrons follow which pathway?
- A) glycolysis → NADH → oxidative phosphorylation → ATP → oxygen
 - B) Krebs cycle → FADH₂ → electron transport chain → ATP
 - C) electron transport chain → Krebs cycle → ATP
 - D) pyruvate → Krebs cycle → ATP → NADH → oxygen
 - E) Krebs cycle → NADH → electron transport chain → oxygen

- 66) Yeast cells living in an oxygen-free environment gain _____ by converting _____ to _____.
- A) ATP, lactate, ethanol
 - B) ethanol, ATP, ADP
 - C) ethanol, pyruvate, NADH
 - D) NAD⁺, pyruvate, ethanol
 - E) NADH, pyruvate, ethanol

The four processes of Cellular Respiration



This diagram represents the processes of aerobic cellular respiration as 4 simple boxes. Many of the "inputs" and "outputs" are shown as arrows. Open arrows represent energy management molecules, while closed arrows represent other inputs and outputs such as substrates and products. Use this diagram to answer the following questions.

- 67) Which arrow in the figure above represents NADH?
- 68) Which arrow in the figure above represents ATP?
- 69) Which arrow in the figure above represents Acetyl coA?
- 70) Which arrow in the figure above represents CO₂?
- 71) Suppose a yeast cell uses 5 moles of glucose for energy production. No oxygen is available. What will be the maximum net yield of ATP in moles?
- A) 10
 - B) 20
 - C) 60
 - D) 120
 - E) 380

- 72) Approximately how many moles of ATP are produced per mole of glucose in cellular respiration by oxidative phosphorylation?
- A) 2
 - B) 4
 - C) 20
 - D) 34
 - E) 38

The questions below are based on the stages of glucose oxidation listed below.

- A. stage I: glycolysis
- B. stage II: oxidation of pyruvate to acetyl CoA
- C. stage III: Krebs cycle
- D. stage IV: oxidative phosphorylation

(chemiosmosis)

- 73) Which one of the stages occurs in the cytosol of the cell?
- 74) Carbon dioxide is released during which stage(s)?
- A) stage III only
 - B) stages II and III
 - C) stages III and IV
 - D) stages I, II, and III
 - E) stages II, III, and IV
- 75) All of the following statements about NAD^+ are true *except*:
- A) NAD^+ is reduced to NADH during both glycolysis and the Krebs cycle.
 - B) NAD^+ has more chemical energy than NADH.
 - C) NAD^+ is reduced by the action of dehydrogenases.
 - D) NAD^+ can receive electrons for use in oxidative phosphorylation.
 - E) In the absence of NAD^+ , glycolysis cannot function.
- 76) A young relative of yours has never had much energy. He goes to a doctor for help and is sent to the hospital for some tests. There they discover his mitochondria can use only fatty acids and amino acids for respiration, and his cells produce more lactate than normal. Of the following, which is the best explanation of his condition?
- A) His mitochondria lack the transport protein that moves pyruvate across the outer mitochondrial membrane.
 - B) His cells cannot move NADH from glycolysis into the mitochondria.
 - C) His cells contain something that inhibits oxygen use in his mitochondria.
 - D) His cells lack the enzyme in glycolysis that forms pyruvate.
 - E) His cells have a defective electron transport chain, so glucose goes to lactate instead of to acetyl CoA.
- 77) The direct energy source that drives ATP synthesis during respiratory oxidative phosphorylation is
- A) oxidation of glucose to CO_2 and water.
 - B) the thermodynamically favorable flow of electrons from NADH to the mitochondrial electron transport carriers.
 - C) the final transfer of electrons to oxygen.
 - D) the difference in H^+ concentrations on opposite sides of the inner mitochondrial membrane.
 - E) the thermodynamically favorable transfer of phosphate from glycolysis and the Krebs cycle intermediate molecules of ADP.
- 78) The terminal electron acceptor in lactic acid fermentation is
- A) O_2
 - B) Lactic Acid
 - C) NAD^+
 - D) NADH
 - E) Pyruvate

- 79) The end products of fermentation have _____ free energy than pyruvate, having _____ energy via _____ of _____.
- A) more, gained, oxidation, acetyl-coA
 - B) more, gained, oxidation, NADH
 - C) less, lost, reduction, NADH
 - D) less, lost, reduction, ethanol
 - E) more, gained, oxidation, ethanol
- 80) Carbon skeletons to be broken down during cellular respiration can be obtained from
- A) polysaccharides.
 - B) proteins.
 - C) lipids.
 - D) A and B.
 - E) A, B, and C.

Answer Key

Testname: MIDTERM_VA

- | | |
|-------|-------|
| 1) D | 50) E |
| 2) A | 51) A |
| 3) C | 52) A |
| 4) B | 53) B |
| 5) A | 54) A |
| 6) B | 55) C |
| 7) D | 56) C |
| 8) D | 57) C |
| 9) E | 58) A |
| 10) E | 59) D |
| 11) D | 60) D |
| 12) C | 61) B |
| 13) E | 62) D |
| 14) C | 63) D |
| 15) A | 64) D |
| 16) B | 65) E |
| 17) B | 66) D |
| 18) E | 67) A |
| 19) B | 68) C |
| 20) C | 69) D |
| 21) E | 70) E |
| 22) D | 71) A |
| 23) A | 72) D |
| 24) B | 73) A |
| 25) D | 74) B |
| 26) C | 75) B |
| 27) A | 76) A |
| 28) A | 77) D |
| 29) C | 78) B |
| 30) D | 79) B |
| 31) A | 80) E |
| 32) C | |
| 33) E | |
| 34) A | |
| 35) C | |
| 36) A | |
| 37) E | |
| 38) C | |
| 39) D | |
| 40) B | |
| 41) B | |
| 42) C | |
| 43) A | |
| 44) D | |
| 45) C | |
| 46) B | |
| 47) A | |
| 48) B | |
| 49) D | |