PART 1: Matching. Match the organelle to its function (11 points)________

____ 1. Proton motive force  a. A molecule containing both hydrophilic and hydrophobic regions
____ 2. Fluid Mosaic  b. Enzymatic transporter that generates ATP.
____ 3. Oxidative Phosphorylation  c. The model used to describe the composition and movement of molecules in a membrane
____ 4. Pyruvate dehydrogenase  d. A molecule that has lost electrons
____ 5. Electrochemical Force  e. The process in which ATP formation is driven by the phosphorylation of carbon intermediates.
____ 6. Chemiosmotic Coupling  f. The combined chemical and electrical force that determines transport across a membrane
____ 7. Aliphatic  g. Mechanism in which a pH gradient across a membrane is used to drive an energy-requiring process.
____ 8. Substrate-Level Phosphorylation  h. Protein complex that oxidizes pyruvate into Acetyl-Coenzyme A, releasing CO₂ and NADH.
____ 9. ATP Synthase  i. A force that moves protons across a membrane as a result of an electrochemical proton gradient.
____ 10. Reduced  j. Process in which ATP formation is driven by the transfer of electrons from food molecules to molecular oxygen.
____ 11. Oxidized  k. A molecule that has gained electrons
PART 2: Multiple Choice (5 points each/30 points Total)

1. Membrane lipids are capable of many different types of movement. Which of these does NOT occur spontaneously in biological membranes?
   (a) switching between lipid layers
   (b) lateral movement
   (c) rotation
   (d) flexing of hydrocarbon chains

2. Which of the following is NOT a property of transporters?
   (a) specific binding to solutes
   (b) fluctuates between open and closed states
   (c) changes conformation to allow passage
   (d) can use ATP to move molecules

3. Which of the following is used to move molecules against a concentration or electrical gradient?
   (a) active transport
   (b) free diffusion
   (c) facilitated diffusion
   (d) passive transport

4. A mouse and human cell are fused together in an experiment. Which of the following statements are true about the movement of the membrane proteins of each species?
   (a) An increase in temperature will cause the proteins of each species to evenly distribute slower.
   (b) The length of the phospholipid tails would not have an effect on the movement of membrane proteins
   (c) Under any condition, the proteins of each species will be restricted to their original location
   (d) The removal of cholesterol will cause the proteins of each species to evenly distribute faster

5. To the right is the structure of the amino acid asparagine. What can you tell about the R group of asparagine (shaded gray) just by looking at its structure?
   (a) It is non-polar.
   (b) It is hydrophobic.
   (c) It is hydrophilic.
   (d) It is negatively charged.

6. Using the image below, predict the direction of the electrochemical gradient of a molecule across a membrane. The black triangle is the chemical gradient and the white triangle is the electrical gradient.
   (a) no net movement
   (b) 
   (c) 

1. (a) What is the chemical property of the lipid bilayer that determines permeability? (2 points)

(b) Rate the order from fastest (1) to slowest (5) the speed each molecule would move across a synthetic lipid bilayer. Refer to the labeled structures below for reference. (5 points)

[Diagram showing labeled structures]

- a. Cl
- b. CO₂
- c. adenine
- d. H₂O
- e. isoleucine

(c) A calcium channel protein has been added to the synthetic lipid bilayer. How could this affect the rate of transport and why? (3 points)

2. Answer the questions below using the figure to the right.

(a) Match the following terms to the figure on the graph (5 points)

- Resting Potential
- Threshold
- Depolarization
- Repolarization
- Hyperpolarization
(b) Using the figure in part (a), identify whether voltage-gated Na\(^+\) channels are more likely open, closed, or inactivated (7 points)

A. _________________________
B. _________________________
C. _________________________
D. _________________________
E. _________________________
F. _________________________
G. _________________________

(c) Describe how voltage-gated K\(^+\) channels contribute to the repolarization and hyperpolarization of the action potential. (3 points)

Repolarization:

Hyperpolarization:

(d) Explain the general relationship between membrane potential, the shape of the voltage-gated Na\(^+\) channels, and the movement of ions in regards to the phases of the action potential mentioned in part 3A. (5 points total)

3. For the following, indicate how each contributes to resting membrane potential. Circle which factor (a-c) that is the main regulator of resting membrane potential. (7 points)

(a) Distribution of ions inside the cell compared to outside

(b) Sodium-Potassium Transporter

(c) K\(^+\) leak channels
4. (a). Label the figure using the terms below. (4 points)
A. Inner membrane
B. Outer membrane
C. Matrix
D. Intermembrane Space

(b) Indicate A-D Indicate where the following would be located (6 points)
______1. Pyruvate dehydrogenase
______2. Cytochrome β Oxidase (Electron Transport Chain Protein)
______3. Enzymes of the citric acid cycle
______4. Porins which act as portals for many small molecules
______5. Storage of ATP
______6. High concentration of H+ ions (protons)
______7. ATP synthase

5. (a) Name the final electron acceptor in aerobic respiration (3 points)

(b) Name a final electron acceptor in anaerobic respiration (3 points)

6. Complete the reactions below by filling in the blank spaces. Be sure to identify the substrates, products, and energy carriers. Include the number of molecules of each that are formed. BONUS: Identify whether the indicated molecules are oxidized or reduced.

(a). Glycolysis (3 points)
(b). Ethanol Fermentation (4 points)

(c) Citric Acid Cycle (3 points)

D. Electron Transport Chain (4 points)

BONUS: Name the 1 other energy molecule produced
(e). Using the figure in part (d) (5 points)
   1) Draw how ATP is made using the electron transport chain (you may use the figure in d).
   2) Describe how this process and how it relates to the electron transport chain.

4. Normally the mitochondrial inner membrane is highly impermeable to ions. A drug is added to a cell that makes the mitochondrial inner membrane freely permeable to H⁺ ions.

(a). How would this effect the proton motive force? (10 points)

(b). What would be the effect on ATP production and why? (10 points)
You have prepared lipid vesicles (spherical lipid bilayers) that contain Na\(^+\)-K\(^+\) pumps as the sole membrane protein. All of the Na\(^+\)-K\(^+\) pumps are oriented in such a way that the portion of the molecule that normally faces the cytosol is on the inside of the vesicle and the portion of the molecule that normally faces the extracellular space is on the outside of the vesicle. Assume that each pump transports one Na\(^+\) ion in one direction and one K\(^+\) ion in the other direction during each pumping cycle. In this experiment, you are altering the concentration of ions both inside and outside of the cell. Use the figure below as a reference for how the Na\(^+\)-K\(^+\) pump normally functions in the plasma membrane and draw out concentrations.

Predict what would happen in each of the following conditions:

(a) The solutions inside and outside the vesicles contain both Na\(^+\) and K\(^+\) ions but no ATP. (10 points)

(b) The solution outside contains Na\(^+\); the solution inside contains Na\(^+\) and ATP. (10 points)