Fill-in the blanks (1 pt each space, 15 pts total)  ___ / 15

1. In a disaccharide two simple sugars are connected by a ____________________ bond.

2. Fructose is nearly 100% in ____________________ form when in a polysaccharide.

3. Photoautotroph describes the metabolism of an organism that uses ____________________ as a carbon source and ____________________ as energy source.

4. Living organisms engage in three types of work, ____________________, ____________________ and ____________________.

5. By converting glycolytic pyruvate to lactate the cell is able to regenerate ____________________, which was reduced during glycolysis.

6. The main source of energy for the brain is ____________________.

7. The TCA cycle reactions are located in the: ____________________.

8. The product of the Pyruvate DH reaction is ____________________ which then enters the actual TCA cycle.

9. In the second phase of the TCA cycle succinate is ____________________ to regenerate OxAc.

10. Anaplerotic reactions are necessary to replenish ____________________.

11. The electron transport chain consists of a series of ____________________.

12. A large positive reduction potential equals a strong tendency to ____________________ electrons.
T / F (2 pts each, total of 16 pts)

13. T / F  Dihydroxy acetone phosphate comes in D and L conformation.

14. T / F  The anomeric carbon designates the α- and β- configuration of a monosaccharide.

15. T / F  ATP consists of an Adenine, a ribose and phosphate.

16. T / F  The rational behind the isomerization reaction of Glucose 6P to fructose 6P is the that the C1 carbon in Fructose is easier to phosphorylate.

17. T / F  The first step in glycolysis can be catalyzed by hexokinase. This enzyme is very specific and only phosphorylates glucose.

18. T / F  The malate DH reaction in the TCA cycle is a very endergonic reaction, however in vivo the reaction is "pulled" toward the right by the citrate synthase reaction.

19. T / F  During the glyoxylate cycle the carbons of Acetyl CoA are lost as CO₂.

20. T / F  The free energy released by the transfer of 2 electrons from FADH₂ (E°' = - 0.219V) to O₂ is greater than the free energy that can be released during the transfer of 2 electrons from NADH + H⁺ (E°' = -0.320V) to O₂.
Short answer type questions (69 pts total)

(2 pts)
21. A tetrose would have how many carbons?

(6 pts)
22. Take the carbohydrate below (D-mannose) and draw
   a. The L-form of the sugar
   b. an epimer of the sugar
   c. How many diastereomers do you expect this sugar to have?

\[ \begin{align*}
 &\text{D-Mannose} \\
 &\text{H} \quad \text{C-O} \\
 &\text{ROCH} \\
 &\text{HOCCH} \\
 &\text{HOC-OH} \\
 &\text{HOC-OH} \\
 &\text{HOC-OH} \\
\end{align*} \]

(4 pts)
23. What are the two branches of metabolism and what characteristics are associated with each one (name at least one characteristic each).
24. Below you find an outline of a part of the glycolytic pathway starting with glucose and ending with the aldolase reaction. Fill-in the structure of the intermediates to the product of the aldolase reaction and indicate where ATP, NADH and FADH$_2$ are consumed or produced.

\[ \text{Glucose} \]
\[ \rightarrow \text{hexokinase} \]
\[ \downarrow \text{phosphoglucoisomerase} \]
\[ \rightarrow \text{Phosphofructokinase} \]
\[ \downarrow \text{Aldolase} \]

25. Which step of glycolysis is considered the commitment step?

24. What are the three steps that are bypassed in gluconeogenesis. Show the balanced reactions. (No structures necessary)
(4 pts)
25. Lactate accumulates in the muscle with strenous exercise and then transported to the liver where it is reoxidized.
   a. What is the substrate for the reaction?
   
   b. Which enzyme catalyses the reaction?
   
   c. Why is the reoxidation in the liver favorable?
   
   d. Why does the body produce lactate to begin with?

(2 pts)
26. Which of the following coenzymes is not part of the Pyruvate DH multienzyme complex.
   - thiamine P~P
   - ATP
   - lipoic acid
   - CoA
   - FAD
   - NAD^+
(10 pts)
27. Please, complete the TCA cycle below. Fill in the structures and label the arrows to complete the reactions.
(6 pts)
28. The glyoxylate cycle is important in germinating plants and in bacteria growing on acetate? What are the two unique enzymes and what reaction do they catalyze? (just the reactions, no structures necessary)

(6 pts)
29. Label the cartoon below of a mitochondrion. Indicate where the Electron transport chain is located and where protons are accumulating.

1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. Location of ETC ___________________________
6. location of higher proton concentration ___________________________
(8 pts)
30. Label the cartoon representing the Electron transfer chain below.

(4 pts)
31. What are the two components of the proton motive force.

1. ________________________________

2. ________________________________

(4 pts)
32. What does an "uncoupler" "uncouple" and what effect can that have on electron transport?