Cellular Respiration Concept Questions

1. Describe how photosynthesis and cellular respiration are reverse processes. (The products of one are the starting materials for the other. Cellular respiration is essentially an oxidation while photosynthesis is a reduction.)

2. Identify the feature of mitochondria that is an adaptation for carrying out cellular respiration. Explain how this feature increases the amount of cellular respiration that can occur inside a mitochondrion. (The inner mitochondrial membrane is highly folded. The large surface area that results from this folding is able to accommodate the enzymes of the ETC.)

3. Propose a reason that cells that are more active have a higher number of mitochondria. (Active cells require more ATP and so have more mitochondria to produce the needed ATP from fuel more quickly.)

4. Cellular respiration uses glucose, a high energy molecule and produces CO_2 and water, low energy molecules.
   a) State whether it is spontaneous or not. Provide reasoning for your response. (Yes, because it releases energy.)
   b) State whether it is exergonic or not. Provide reasoning for your response. (Yes, because it releases energy.)
   c) Describe the purpose of the energy released from glucose. (The energy released is used to make ATP.)

5. Describe the importance of the energy-releasing reactions that take place in living cells. (These reactions release energy which can be used to make ATP. ATP is used to do cell work.)

6. Describe the difference between oxidation and reduction reactions. (Reactions in which electrons are lost are oxidations. Those which involve a gain of electrons are reductions.)

7. a) Describe how ADP is converted into ATP. (Energy is used to attach a phosphate to ADP.)
   b) Describe why oxidation reactions are often coupled to the production of ATP. (Oxidation reactions release energy which can be used to make ATP.)

8. Explain how the citric acid (Krebs) cycle contributes to the production of ATP. (The citric acid cycle makes NADH which carries electrons to the ETC. Some ATP is also made during substrate level phosphorylation.)

9. When you exhale, your breath contains carbon dioxide. Identify the source of this carbon dioxide. (The carbon atoms in food are released as CO_2 during the citric acid cycle.)

10. Describe the importance of an electron transport system to living organisms. (The transport of electrons releases energy from fuel in a slow, controlled fashion.)

11. Explain how energy is released in a slow, controlled fashion through the ETC. (Energy is released stepwise at each cytochrome as it is used to transport protons across the mitochondrial membrane.)

12. Provide evidence to support the claim that cellular respiration is more efficient than glycolysis alone. (Cellular respiration produces 36 ATP per glucose rather than the 2 ATP produced by glycolysis.)

13. a) Identify when animal cells perform photosynthesis. (Never.)
    b) Identify when plant cells perform photosynthesis. (In light.)
    c) Identify when animal cells perform cellular respiration. (Always.)
    d) Identify when plant cells perform cellular respiration. (Always.)

14. Compare and contrast alcoholic fermentation in yeast cells, lactic acid fermentation (in human cells), and glycolysis. (They all have glycolysis in common. In yeast, CO_2 is released and alcohol is produced while in humans lactic acid is produced. The goal is to produce NAD^+ to enable glycolysis to continue.)

15. Think of the difference between alcohol fermentation in yeast and lactic acid fermentation in humans. Predict the result if an enzyme in your body removed the carbon dioxide from pyruvate before lactic acid formed. (CO_2 would be released in cells and alcohol would be formed.)

16. a) Describe the conditions under which lactic acid fermentation occurs in muscle cells. (Lactic acid is formed under anaerobic conditions when the oxygen demand exceeds the supply.)
    b) Identify the symptoms of lactic acid fermentation in muscle cells. (It causes pain and eventual cramping and seizing of the muscle.)

17. After a heart attack, small amounts of lactic acid can be found in heart muscle cells. Make a claim about what happens during a heart attack based on this observation. (The heart did not receive the oxygen it required and the lactic acid was produced during anaerobic respiration in the heart muscle cells.)

18. Complete the chart below:

	Aerobic Respiration	Anaerobic Respiration
a) net amount of ATP produced	36	2
b) terminal electron acceptor	O_2	pyruvate
c) location in cell	mitochondrion	cytosol
d) final products	CO_2, H_2O, ATP	lactic acid, NAD^+, Ethanol, ATP

19. Explain why hard (or distilled) liquor is available at concentrations of up to 75% alcohol while the maximum alcohol concentration in wine is usually no more than 12-14%. (Concentrations above ~14% are toxic to yeast.)

20. If yeast cells were large organisms, they could not live anaerobically. Provide evidence to support or refute this claim. (They could not. The two ATP produced per glucose would be insufficient.)

21. a) Describe what happens to the NADH produced by yeast cells that are living in anaerobic conditions. (It is oxidized back to NAD^+ by reducing pyruvate.)
    b) Describe why it is important for this to happen. (This allows glycolysis to continue.)

22. Identify the use of each of the reactants in cellular respiration and the source of each of the products. (O_2 is the terminal e^- acceptor; glucose is the source of e^-, CO_2 is produced in the citric acid cycle, H_2O is produced when O_2 accepts e^-.)

23. Describe how a cell can use noncarbohydrate foods such as proteins and fats as a source of energy.

(A variety of fuel molecules can be used because they enter cellular respiration at different places. They all have carbon atoms which can be oxidized.)

24. Explain why it is useful for AMP to stimulate cellular respiration and ATP to inhibit it. (The presence of AMP indicates a high demand for ATP so more should be produced. The presence of ATP means no more is needed.)