CELLULAR RESPIRATION QUESTIONS - ANSWERS

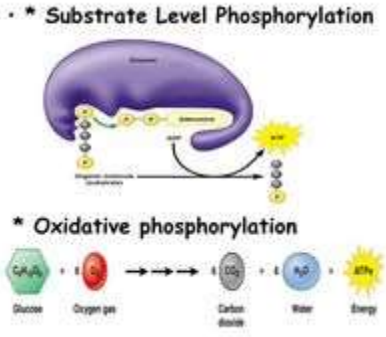
1. Write the balanced word and chemical equation for aerobic respiration.

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{Cellular respiration}} 6CO_2 + 6H_2O + ATP$$

2. What is the purpose of cellular respiration?
   Generate ATP

3. Why is NADH called an electron shuttle bus?
   Carries electrons from glycolysis & Krebs cycle to the ETC, then returns to original processes as NAD+ to get more

4. What are the two mechanisms in which ATP is generated? Briefly describe each mechanism.
   Substrate level phosphorylation: uses enzymes to add phosphate to ADP to create ATP
   Oxidative phosphorylation: uses processes driven by oxygen (redox reactions) that result in the addition of phosphate to ADP to create ATP



5. Make a comparison chart to show how much ATP is produced from substrate level phosphorylation versus oxidative phosphorylation (use the equivalent amount of ATP for coenzymes).
   Substrate level phosphorylation: 2 from glycolysis, 2 from Krebs
   Oxidative phosphorylation: 32 from ETC & chemiosmosis

6. Define the following terms:
   a. Aerobic cellular respiration **O2 present**
   b. Anaerobic cellular respiration **fermentation, no O2 present**
   c. Substrate level phosphorylation **use of an enzyme to add a phosphate**
   d. Oxidative phosphorylation **use of oxygen to drive a process that results in the addition of a phosphate**
   e. Chemiosmosis **movement of ions across a semiperimable membrane down their concentration gradient**
   f. Carboxylation **addition of carbon, decarboxylation – removal of carbon in form of CO2**

7. Identify two instances where **de**carboxylation occurs during cellular respiration.
   Pyruvate oxidation
   Krebs Cycle: between iso-citrate & alpha-ketoglutarate and between alpha-ketoglutarate and succinyl-CoA

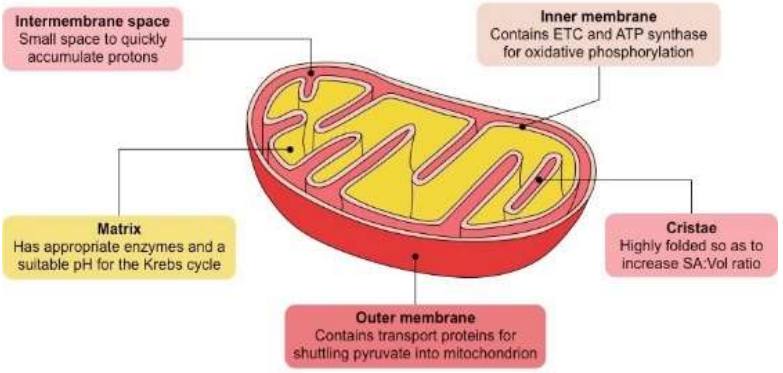
8. What role do the following molecules have in cellular respiration?
   a. NADH & FADH2 **shuttle electrons from glycolysis & Krebs to the ETC**
   b. Hydrogen ions **used to create concentration gradient in mitochondria (chemiosmosis)**
   c. Acetyl-CoA **a coenzyme used in Krebs cycle – helps deliver acetyl group to Krebs as acetyl-CoA**
   d. electrons **move through ETC via redox reactions, allowing H+ to be pumped into the intermembrane space and set up a concentration gradient**

e. oxygen **final electron acceptor in ETC**

9. a. What is the purpose of glycolysis? **break down glucose into 2x 3-carbon molecules (pyruvate)**
   b. What are the products of glycolysis? **2 NADH, 2 ATP (net), 2 pyruvate**
   c. What gets oxidized? **glyceraldehyde 3-phosphate (G3P)** Reduced? **NAD+**

10. a. What are the products of **one** turn of Krebs cycle? **2 CO_2, 3 NADH, 1 $FADH_2$, 1 ATP**
    b. How many turns of the Krebs cycle are required to metabolize one molecule of glucose? **TWO**

11. Draw a diagram of a mitochondria and label its parts.



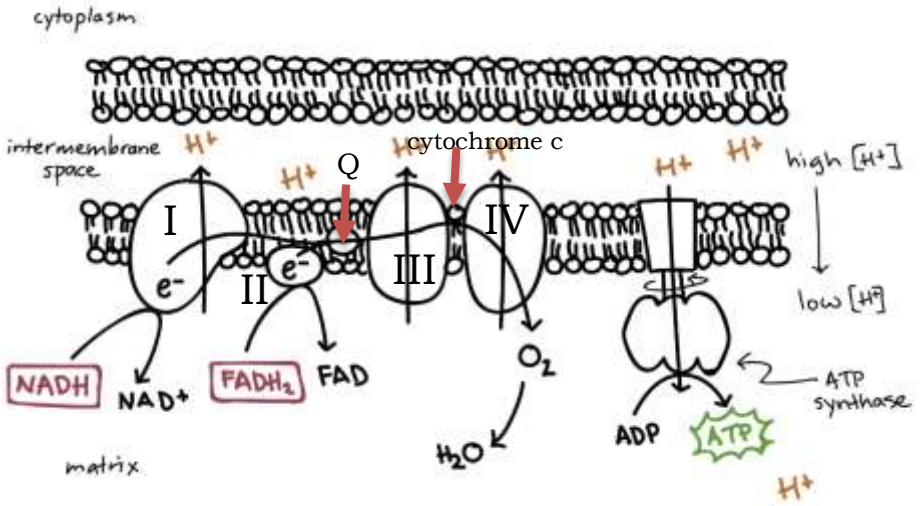
12. What happens to pyruvic acid before it enters the Krebs cycle?
decarboxylation, oxidation, addition of CoA

13. What happens to the substance entering the Krebs cycle?
acetyl-CoA enters the cycle by binding with oxaloacetate

14. During Krebs, what products are formed? **CO_2, NADH, $FADH_2$, ATP**
How many for one molecule of glucose? **4 CO_2, 6 NADH, 2 $FADH_2$, 2 ATP**

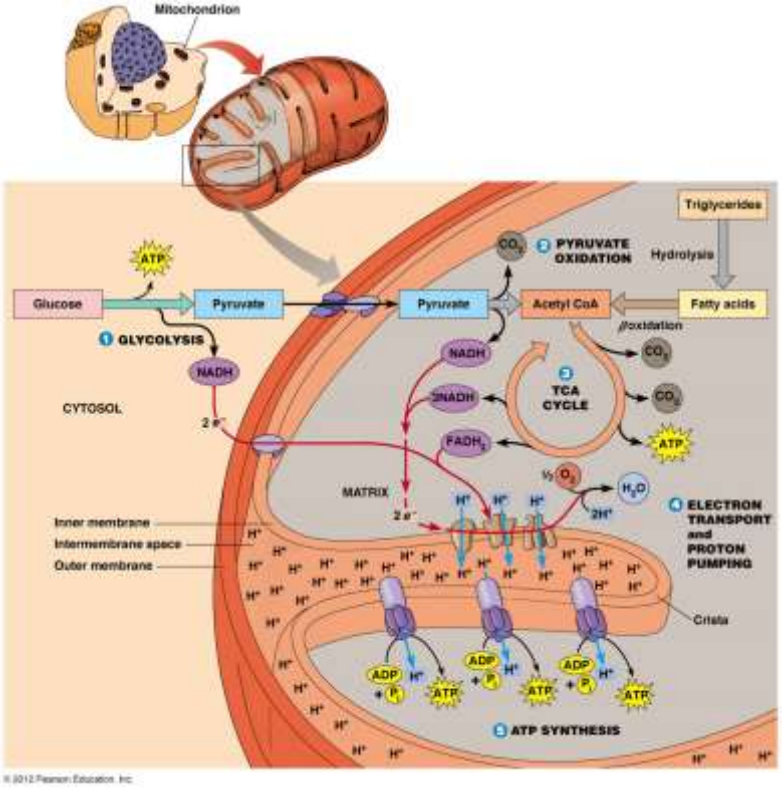
15. How is the electron transport chain organized, and what is its purpose?
Series of proteins with increasing electronegativity
Purpose is to establish concentration gradient of H+

Draw a labeled sketch that shows all of the protein complexes, energy molecules, electron movement, protons and location.

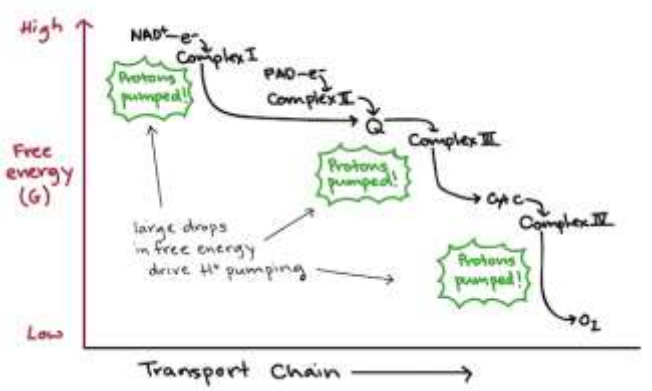


16. Where is the H+ reservoir located in the mitochondria? **intermembrane space (between the outer membrane & the inner membrane/cristae)**

Indicate where each part of cellular respiration occurs.



17. What happens to the electrons as they are passed along the electron chain? **They lose energy**



18. Ex plain how ATP is made by chemiosmosis.

H+ move through ATP synthase because of concentration gradient and repulsion of like charges

19. At what point on the ETC do the electrons stop from getting passed on?

When they join with oxygen

20. What happens to theses electrons after that point?

They become part of H2O

21. What happens to the NAD+ and FAD after it gives electrons to the ETC?

They go back to Krebs cycle – they are recycled.

22. What is the significance of the inner membrane and intramembrane space in the mitochondria?

Inner membrane is where the ETC takes place – the complexes are located there

Intra/intermembrane space is where there is a high concentration of H+ allowing creation of ATP

via ATP synthase

23. Compare alcoholic fermentation and lactic acid fermentation in terms of where it occurs, starting substrate, end products, and amount of energy produced.

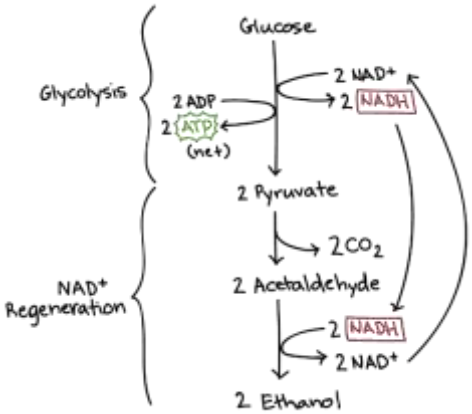
Alcohol Fermentation:

Where: **cytoplasm**

Starting substrate: **pyruvate**

Products: **O2**

Energy produced: **2 ATP**



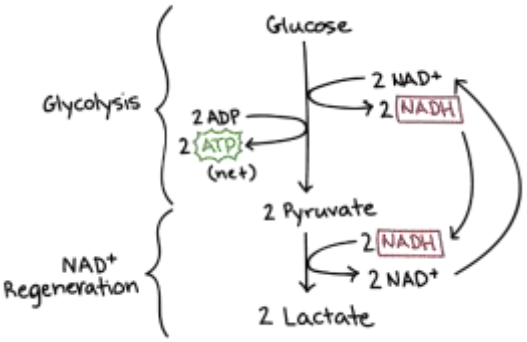
Lactic Acid Fermentation:

cytoplasm

pyruvate

2 lactate, 2 NAD+

2 ATP



24. When does fermentation occur? **Where oxygen is not present**

25. What is being oxidized and reduced in fermentation?

Oxidized – NADH **Reduced- pyruvate or acetaldehyde**

Contrast this to pyruvate oxidation and Krebs cycle phase.

Oxidized – carbon molecules **Reduced- NAD+, FAD**

26. What are the differences between alcoholic fermentation and lactic acid fermentation?

end products – see above, both serve to regenerate NAD+