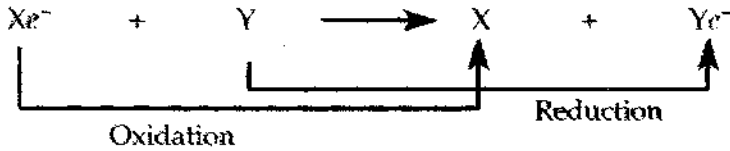


IQ

1. Write out the balanced equation for cellular respiration.
2. Fill in the appropriate terms in this equation.
- 3.

Fill in the appropriate terms in this equation.



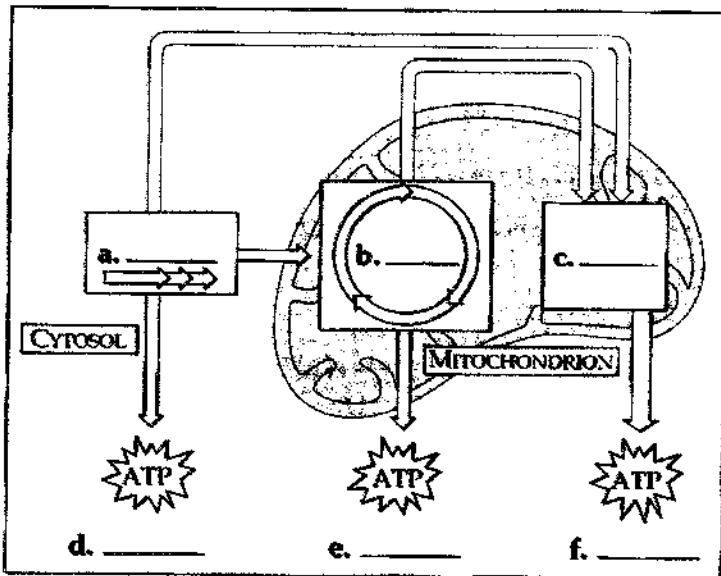
X is the reducing agent; it is a \_\_\_\_\_.

Y is the b. \_\_\_\_\_; it is c. \_\_\_\_\_.

4. In the equation in question 1., which molecule is reduced? Oxidized?
5. What happens to energy that is released in this reaction?
6.  $NAD^+$  is called \_\_\_\_\_.
7. Its reduced form is \_\_\_\_\_.
8. What is an electron transport chain?
9. What is oxidative phosphorylation?

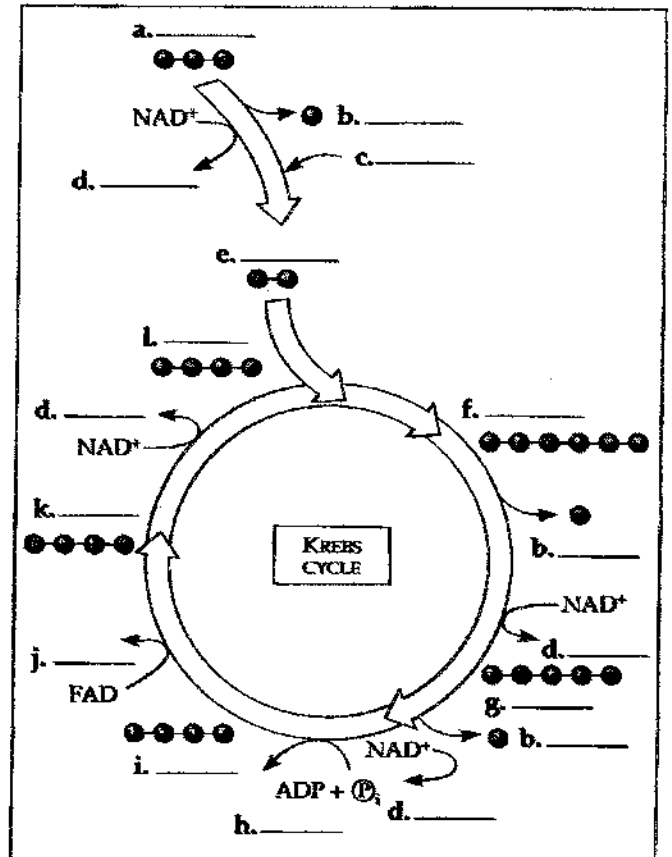
10.

Fill in the boxes with the three metabolic stages of respiration (a-c). Indicate whether the ATP is produced by substrate-level phosphorylation or oxidative phosphorylation (d-f). Label the arrows that show the flow of electrons via NADH.

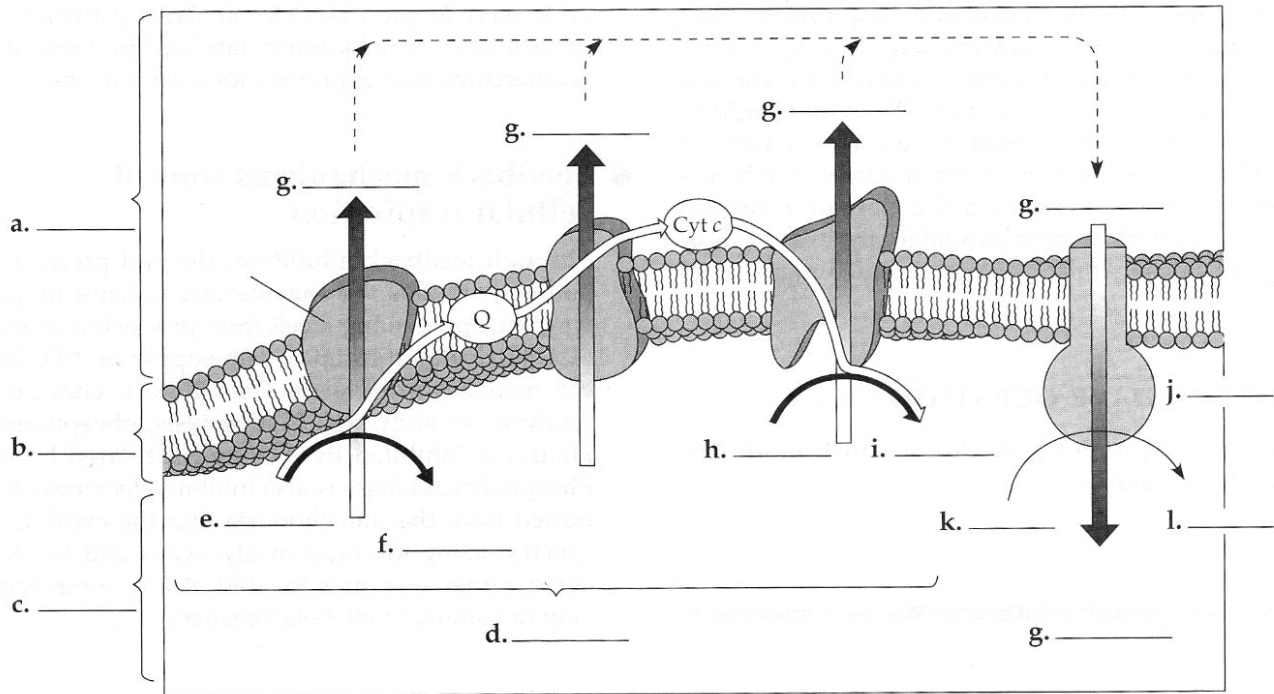


11.

Fill in the blanks in the summary figure of the Krebs cycle. Some letters are used more than once to indicate repetitive steps.



12..Label the blanks on this diagram of the electron transport chain and oxidative phosphorylation in mitochondria.



13. Fill in the tally for maximum ATP yield from the oxidation of one molecule of glucose to six molecules of carbon dioxide.

Process	# ATP
Initial phosphorylation of glucose:	a. _____
Substrate-level phosphorylation: in glycolysis	b. _____
in c. _____	2
Oxidative phosphorylation:*	d. _____
<b>Total</b>	e. _____
*approximately 3 ATP for each of the f. _____ NADH produced in Krebs cycle, and g. _____ ATP for each of the h. _____ FADH <sub>2</sub> from Krebs and the i. _____ NADH from glycolysis.	

14. Why does respiration generate so much more ATP than fermentation? Compare the two processes.

SYK

15. Fill in the following table to summarize the major inputs and outputs of glycolysis, the Krebs cycle, the electron transport chain and oxidative phosphorylation, and fermentation.

Process	Main Function	Inputs	Outputs
Glycolysis			
Pyruvate to acetyl CoA			
Krebs cycle			
Electron transport chain and oxidative phosphorylation			
Fermentation			

16. What are Facultative anaerobes?
17. What happens when a substrate is phosphorylated?
18. Which of the following is *not* true of oxidative phosphorylation?
- It uses oxygen as the ultimate electron donor.
  - It involves the redox reactions of the electron transport chain.
  - It involves an ATP synthase located in the inner mitochondrial membrane.
  - It produces approximately three ATP for every NADH that is oxidized.
  - It depends on chemiosmosis.
19. Substrate-level phosphorylation
- involves the shifting of a phosphate group from ATP to a substrate.
  - can use NADH or FADH<sub>2</sub>.
  - takes place only in the cytosol.
  - accounts for 10% of the ATP formed by fermentation.
  - is the energy source for facultative anaerobes under anaerobic conditions.
20. The major reason that glycolysis is not as energy-productive as respiration is that
- NAD<sup>+</sup> is regenerated by alcohol or lactate production, without the high-energy electrons passing through the electron transport chain.
  - it is the pathway common to fermentation and respiration.
  - it does not take place in a specialized membrane-bound organelle.
  - pyruvate is more reduced than CO<sub>2</sub>; it still contains much of the energy from glucose.
  - substrate-level phosphorylation is not as energy efficient as oxidative phosphorylation.
21. The electron carrier molecules Q and cytochrome c
- are reduced as they pass electrons on to the next molecule.
  - contain heme prosthetic groups.
  - shuttle protons to ATP synthase.
  - transport H<sup>+</sup> into the mitochondrial matrix, establishing the proton-motive force.
  - are mobile carriers that transfer electrons between the electron carrier complexes.
22. When electrons move closer to a more electronegative atom,
- energy is released.
  - energy is consumed.
  - a proton gradient is established.
  - water is produced.
  - ATP is synthesized.
23. When pyruvate is converted to acetyl CoA,
- CO<sub>2</sub> and ATP are released.
  - a multienzyme complex removes a carboxyl group and attaches a coenzyme.
  - one turn of the Krebs cycle is completed.
  - NAD<sup>+</sup> is regenerated so that glycolysis can continue.
  - phosphofructokinase is activated and glycolysis continues.
24. How many molecules of CO<sub>2</sub> are generated for each molecule of acetyl CoA introduced into the Krebs cycle?
- 1
  - 2
  - 3
  - 4
  - 6
25. In the chemiosmotic mechanism,
- ATP production is linked to the proton gradient established by the electron transport chain.
  - the difference in pH between the intermembrane space and the cytosol drives the formation of ATP.
  - the flow of H<sup>+</sup> through ATP synthases from the matrix to the intermembrane space drives the phosphorylation of ADP.
  - the energy released by the reduction and subsequent oxidation of components of the electron transport chain is transferred as a phosphate to ADP.
  - the production of water in the matrix by the reduction of oxygen leads to a net flow of water out of a mitochondrion.
26. Which of the following reactions is incorrectly paired with its location?
- ATP synthesis/inner membrane of the mitochondrion
  - fermentation/cell cytosol
  - glycolysis/cell cytosol
  - substrate-level phosphorylation/cytosol and matrix
  - Krebs cycle/cristae of mitochondrion
27. When glucose is oxidized to CO<sub>2</sub> and water, approximately 38% of its energy is transferred to
- heat.
  - ATP.
  - acetyl CoA.
  - water.
  - the Krebs cycle.

28. What do muscle cells in oxygen deprivation gain from the conversion of pyruvate?
- ATP and lactate
  - ATP,  $\text{NAD}^+$ , and lactate
  - $\text{CO}_2$  and lactate
  - ATP and alcohol
  - ATP, lactate, and  $\text{CO}_2$
29. Glucose, made from six radioactively labeled carbon atoms, is fed to yeast cells in the absence of oxygen. How many molecules of radioactive alcohol ( $\text{C}_2\text{H}_5\text{OH}$ ) are formed from each molecule of glucose?
- 0
  - 1
  - 2
  - 3
  - 6
30. Which of the following produces the most ATP per gram?
- glucose, because it is the starting place for glycolysis
  - glycogen or starch, because they are polymers of glucose
  - fats, because they are highly reduced compounds
  - proteins, because of the energy stored in their tertiary structure
  - amino acids, because they can be fed directly into the Krebs cycle
31. Fats and proteins can be used as fuel in the cell because they
- can be converted to glucose by enzymes.
  - can be converted to intermediates of glycolysis or the Krebs cycle.
  - can pass through the mitochondrial membrane to enter the Krebs cycle.
  - contain unstable phosphate bonds.
  - contain more energy than glucose.
32. Which is *not* true of the enzyme phosphofructokinase? It is
- an allosteric enzyme.
  - inhibited by citrate.
  - the pacemaker of glycolysis and respiration.
  - inhibited by ADP.
  - an early enzyme in the glycolytic pathway.
33. Substrate-level phosphorylation accounts for what percentage of ATP formation when glucose is oxidized to  $\text{CO}_2$  and water?
- 0%
  - 4%
  - 11%
  - 15%
  - 20%
34. Cyanide is a poison that blocks the passage of electrons along the electron transport chain. Which of the following is a metabolic effect of this poison?
- The pH of the intermembrane space is much lower than normal.
  - Electrons are passed directly to oxygen, causing cells to explode.
  - Alcohol would build up in the cells.
  - $\text{NADH}$  supplies would be exhausted, and ATP synthesis would cease.
  - No proton gradient would be produced, and ATP synthesis would cease.