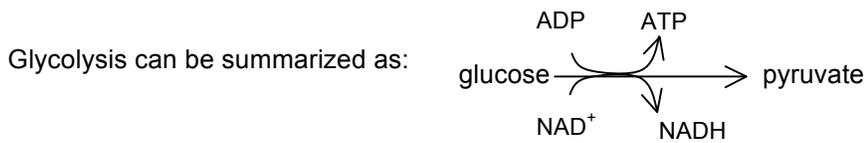


Practice Problems for Biochemistry, Session 6: Glycolysis, Respiration and Fermentation

Question 1



- a) In a yeast cell, what is the fate of the carbon in pyruvate under anaerobic conditions?
- b) In a yeast cell, what is the fate of the carbon in pyruvate under aerobic conditions?
- c) In step 7 of glycolysis 1,3-Bisphosphoglycerate (BPG) is converted into 3-Phosphoglycerate (3PG). Which of these molecules, BPG or 3PG would you expect is at a higher energy level? Explain your answer.
- d) The enzyme triose phosphate isomerase, catalyzes step 5. In this step Dihydroxyacetone phosphate is converted into Glyceraldehyde-3-phosphate ($DAP \leftrightarrow G3P$). Glyceraldehyde-3-phosphate (G3P) is immediately used in step 6. Dihydroxyacetone phosphate must be converted to Glyceraldehyde-3-phosphate (G3P) before it can continue through glycolysis. Cells lacking triose phosphate isomerase can't convert ($DAP \leftrightarrow G3P$). These cells can remain alive but only under aerobic conditions. Explain why cells lacking triose phosphate isomerase are alive only under aerobic conditions.
- e) Assume that you have a cell that is able to complete glycolysis, the citric acid cycle, and the steps of oxidative phosphorylation involving the electron transport chain. However, the ATP synthase in this cell allows passage of H^+ ions but does not produce ATP. When grown in aerobic conditions, you expect this cell to generate... (circle the best answer from below)
- the same amount of ATP as a cell that was fermenting.
 - a little more ATP than a cell that was fermenting.
 - a little less ATP than a cell that was fermenting.
 - about the same amount of ATP as a cell that was respiring normally under aerobic conditions.
- Explain your choice.
- f) Assume that you have a cell that completes glycolysis, the citric acid cycle, and the first steps of oxidative phosphorylation normally. However, in this cell you inhibit the transfer of electrons to the last protein in the electron transport chain. Explain why glycolysis in this cell stops almost immediately, even before all of the ATP is depleted.

Question 2

In the 1860's, Louis Pasteur observed the following phenomenon, which has come to be called "the Pasteur Effect". If you grow a culture of *E. coli* bacteria (which can grow anaerobically or aerobically) without O₂, they consume large amounts of glucose as they grow and they produce lactic acid from the glucose. If you now supply this culture with O₂, you make two observations:

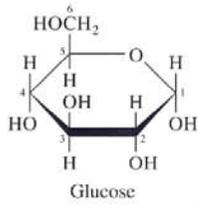
1) Lactic acid is no longer produced.

2) The rate of glucose consumption (glycolysis) decreases even though the rate of cell growth is constant.

a) Explain both of these results in terms of fermentation and respiration.

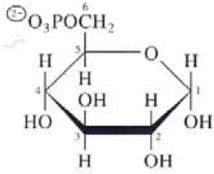
b) Fermentation is one example of a pathway by which the electron carrier used in glycolysis is regenerated. Draw the appropriate structures of the reactants and the products of fermentation in the boxes below.

c) Where does the oxidative phosphorylation in *E. coli* cells take place compared to a eukaryotic cell?



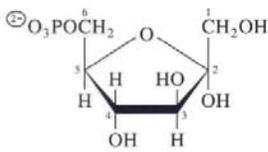
Step 1

Hexokinase,
glucokinase



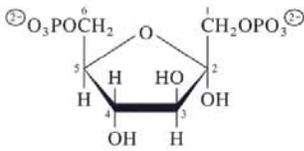
Step 2

Glucose 6-phosphate
isomerase



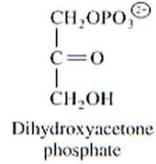
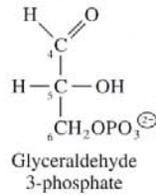
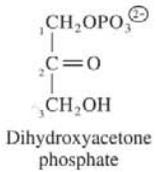
Step 3

Phosphofructokinase-1

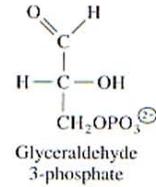


Step 4

Aldolase



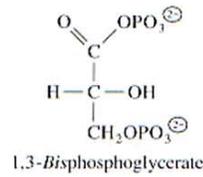
Isomerase
Step 5



Triose phosphate
isomerase

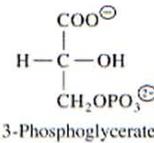
Step 6

Glyceraldehyde
3-phosphate
dehydrogenase

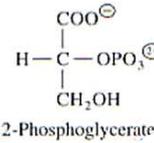


Step 7

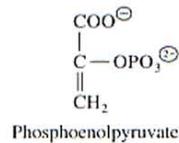
Phosphoglycerate
kinase



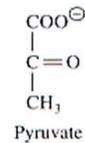
Phosphoglycerate
mutase



Enolase



Pyruvate
kinase



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