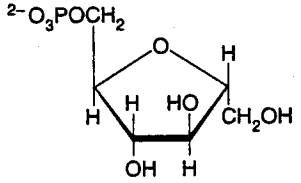
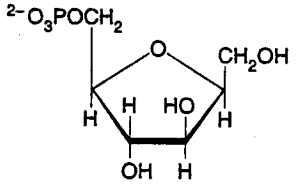
5. In solution, 80% of the fructose 6-phosphate is in the β-anomeric form and 20% is in the α-anomeric form, with the half-time for anomerization being about 1.5 seconds. To determine which of the two anomers is a substrate for phosphofructokinase (PFK), Voll and his colleagues employed two model substrates (shown below) that have C-2 configurations corresponding to the anomeric forms of fructose 6-phosphate.

a. Why will neither of the substrates in the margin undergo mutarotation?

b. When the mannitol derivative is incubated with PFK and ATP, its rate of phosphorylation is about 80% of that for fructose 6-phosphate; K_M for fructose 6-phosphate is 0.04 mM, whereas K_M for the mannitol derivative is 0.40 mM. The glucitol derivative binds to PFK with an affinity almost equal to that of the mannitol derivative, but it is not phosphorylated by PFK; it is a competitive inhibitor of fructose 6-phosphate, with a K_i of 0.35 mM. On the basis of these observations, which anomer of fructose 6-phosphate is a substrate for PFK? Clearly explain your choice.



5-Anhydro-D-mannitol 6-phosphate
(in β configuration)



2,5-Anhydro-D-glucitol 6-phosphate
(in α configuration)

6. The energetics of glycyolyis shows that there ia a large drop in free energy upon oxidation of glyceraldehydes 3-phosphate (GAP) to 1,3-bisphsphglycerate (1,3-BPG)(reaction 6). In the presence of oxygen, some of this energy is ultimately converted into ATP production. However, no such conversion happens under anaerobic conditions. Explain why.