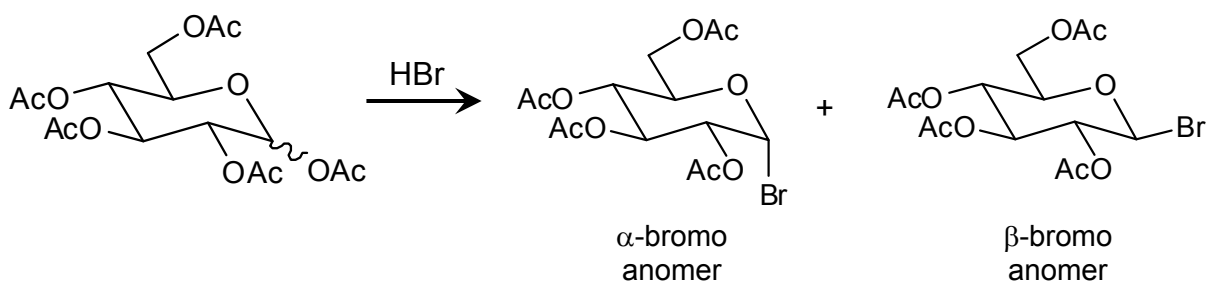


**Workshop 21**  
**Mechanisms of Glycolysis**

1. Pentaacetylglucose reacts with HBr to give 1- $\alpha$ - and 1- $\beta$ -bromo-tetraacetylglucose. If the reaction is done cold and quickly ( $-30\text{ }^{\circ}\text{C}$ , 10 min), the isolated product mixture is mostly the  $\beta$ -anomer. However, if the reaction is allowed to warm slowly to room temperature over a few hours, the  $\alpha$ -bromo anomer predominates.



Reaction conditions:

$-30\text{ }^{\circ}\text{C}$ , 10 min

10%

90%

$25\text{ }^{\circ}\text{C}$ , 2h

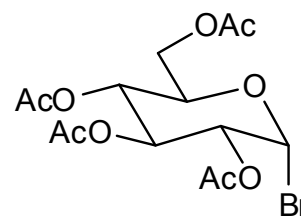
>98%

<2%

(The squiggle on the starting material structure means a mixture of  $\alpha$ - and  $\beta$ -anomers.) In this problem, we'll try to explain the selectivity of this reaction.

- a) Draw a mechanism that explains the formation of both anomers.

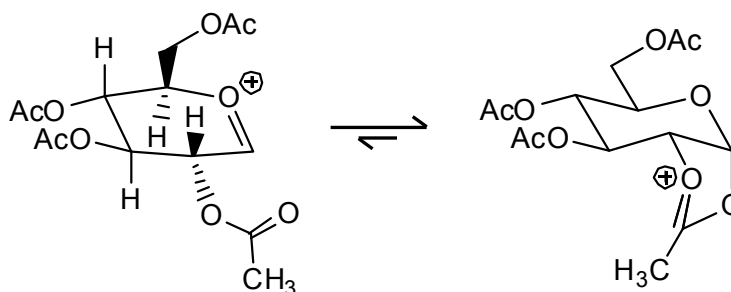
- b) For now, let's just consider the outcome of the higher-temperature reaction (that favors the  $\alpha$ -anomer). In class, we said that there were two competing effects that contributed to relative stability of  $\alpha$ - and  $\beta$ -anomers: steric (1,3-diaxial) effects, and the anomeric effect. Which effect stabilizes which anomer? On the  $\alpha$ -anomer structure at right, illustrate these competing effects.



- c) Assuming these are the only effects, which product should be favored if steric effects predominate? Which should be favored if the anomeric effect is stronger than sterics?

- d) Hammond's Postulate (which you may or may not have learned about in CHEM 2301) says that, for many reactions that choose between two different paths, effects that govern the relative stabilities of the two paths' products also govern the relative stabilities of their two transition states. Given the product distributions on the first page, is that true here? Which product represents kinetic control, and which represents thermodynamic control?

- e) (*Hard!*) One possibility that has been used to explain the different product distributions in this anomeric substitution reaction is that it follows a different, unusual mechanism, by which the C2 -OAc group traps the intermediate carbocation: (This is sometimes called "neighboring group participation" or "anchimeric assistance".)



Assuming this happens, draw a new mechanism that explains the formation of both anomers. (*Hint*: Maybe each cation intermediate on the previous page is responsible for one of the two anomer products?)

- f) (*Hard!*) Finally, draw a potential energy diagram that explains the product distributions in terms of this alternative mechanism.