Serine

Synthesis

1. Propose a pathway for the conversion of glucose to 3-phosphoglycerate (include chemical structures and enzyme names).

2. Convert C2 of 3-phosphoglycerate into a ketone (3-phosphohydroxypyruvate).
    a. Propose a name for the enzyme that catalyzes this reaction.
    b. Propose an appropriate cofactor, if needed.

3. Notice that you have created an α-keto acid and that serine is an α-amino acid.
    a. What type of reaction will convert an α-keto acid into an α-amino acid?
    b. Propose a source of fixed nitrogen.
    c. Propose an electron pushing mechanism for the conversion of 3-phosphohydroxypyruvate to the α-amino acid (3-phosphoserine) utilizing your proposed nitrogen source.

4. Compare the structure of 3-phosphoserine to that of serine.
    a. What type of reaction will convert 3-phosphoserine to serine?
    b. Propose a name for the enzyme that catalyzes this reaction.

    Serine!

Breakdown

1. Form an imine (C=N) between the amine group of serine and PLP (aldehyde form).

2. As in other PLP mechanisms the α-carbon is reasonably acidic (the attached proton is labile). Deprotonate the α-carbon and direct the bonding electrons toward the electron sink PLP cofactor.

3. Draw arrows for the movement of electrons between resonance structures and notice that the degree of conjugation can be extended by an additional bond if the hydroxyl group of serine leaves. Let the hydroxyl group of serine be protonated and leave.

4. Use water to hydrolyze the imine to yield PLP (aldehyde form) and a free serine remnant with a primary amine (aminoacrylate).

5. Tautomerize the amine form into the imine form (no enzyme required).

6. Hydrolyze the imine with water to yield an α-keto acid and ammonia.
    a. Propose a pathway for the conversion of the α-keto acid to glucose (include chemical and enzyme names). <u>Serine is a glucogenic amino acid!</u>
    b. Where does the ammonia go?