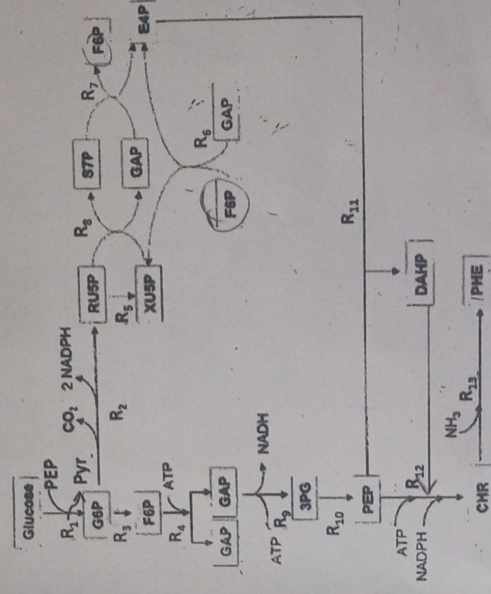
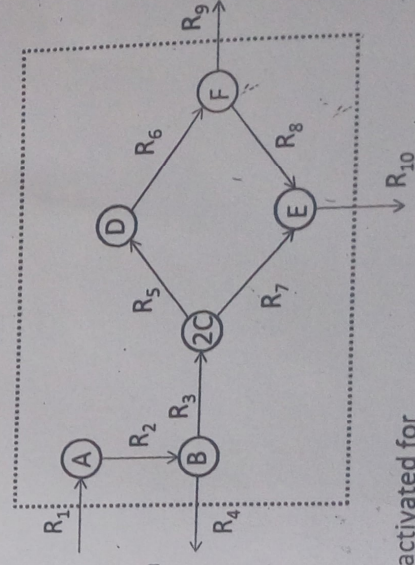


Attempt all parts of a question in the same location. No points will be given for attempting different parts of a question in different location. Make suitable assumptions wherever necessary and state them clearly. Show formulae and calculations clearly.



1. [7 pts] Given the pathway diagram shown on the right,
  - a. Identify the internal metabolites in the system
  - b. Determine the degrees of freedom in the system
  - c. Calculate the maximum molar yield of phenylalanine per mole of glucose considering cofactor and energetic requirements



- ~~a.~~ [9 pts] Given the pathway diagram on the right, Set up the internal stoichiometric matrix  $S$  of the network
- ~~b.~~ Calculate the null space vectors of  $S$  using linear algebra
- ~~c.~~ How many basis vectors does the null space have? Explain?
- ~~d.~~ Draw the flux distributions corresponding to the null space vectors
- ~~e.~~ From C, calculate maximal molar yield of E with respect to B; and all possible reaction combinations need to be obtaining maximal molar yield?



3. [4 pts] Given the values of  $\Delta G$  for different glycolytic intermediates leading from glucose to lactate, please calculate

- Approximate free energy change for the conversion of glucose to pyruvate?
- Given the concentrations,  $[ATP] = 1.0 \text{ mM}$ ,  $[ADP] = 0.1 \text{ mM}$ ,  $[P_i] = 1.0 \text{ mM}$ ,  $[fructose-6-P] = 10.0 \text{ uM}$  and  $[fructose-1,6-P] = 30 \text{ uM}$ , what would be  $\Delta G_0$  for the conversion of fructose-6-P to fructose-1,6-P neglecting water as a reactant/product in the reaction
- Briefly depict schematically pathways for central carbon metabolism of glucose

