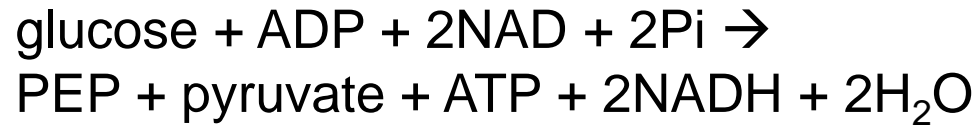


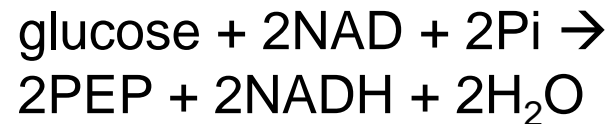
Solution E1

- First, write the four half-reactions from glucose to PEP/pyruvate (page 2)
- Second, write the four half-reactions from PEP/pyruvate to succinate (page 3)
- Third, combine the four \times four half-reactions, resulting in 16 possible reaction pathways (pages 4, 5, 6, 7)
- Last, summarize the findings, and propose a way to make succinate (pages 8, 9, 10)

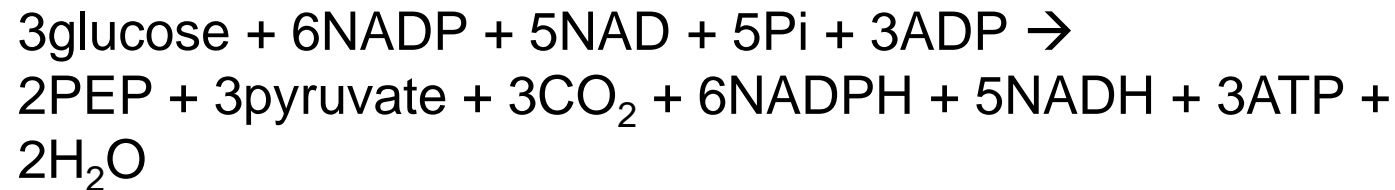
Glucose via PTS + EMP pathway



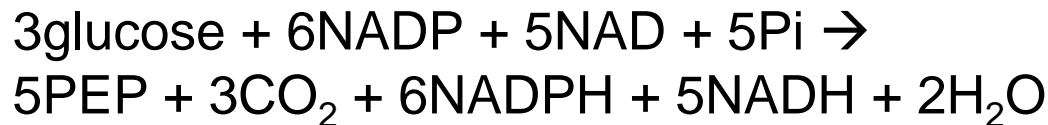
Glucose via glucokinase + EMP pathway



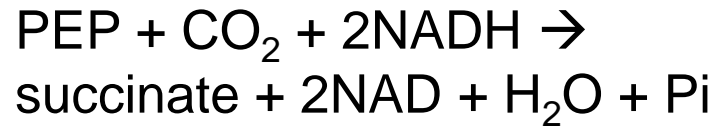
Glucose via PTS + PP pathway



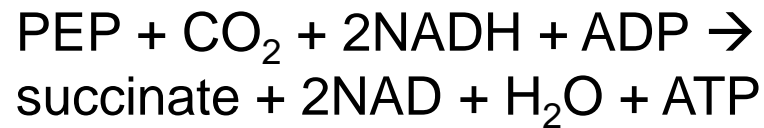
Glucose via glucokinase + PP pathway



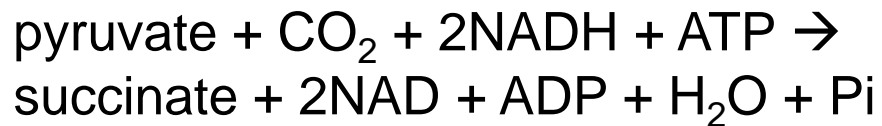
Succinate via PPC



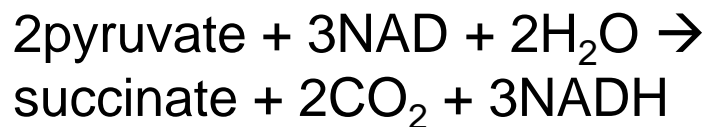
Succinate via PCK



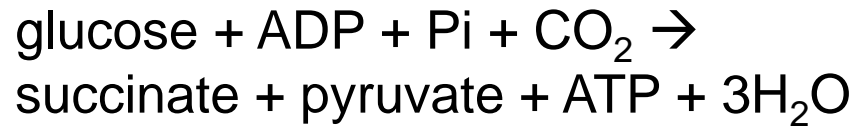
Succinate via PYC



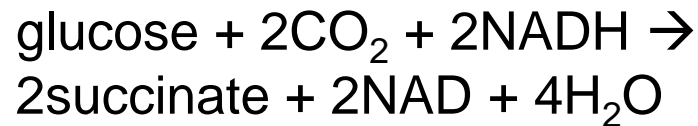
Succinate via Glyoxylate Shunt



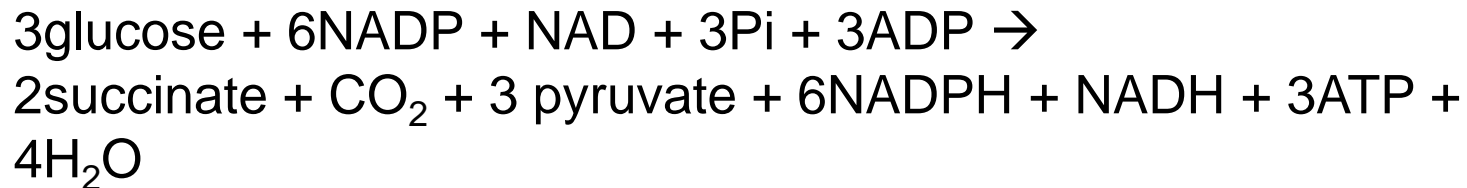
PTS/EMP/PPC



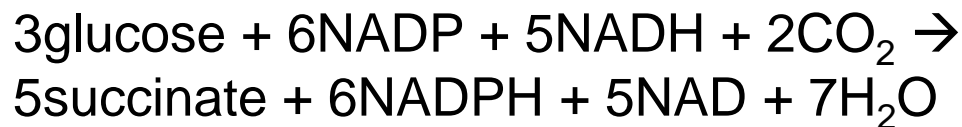
glucokinase/EMP/PPC



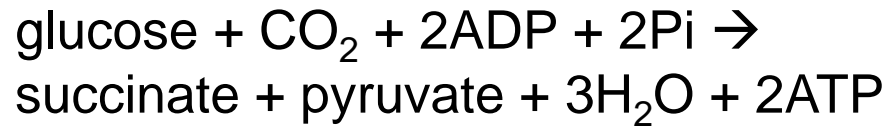
PTS/PP/PPC



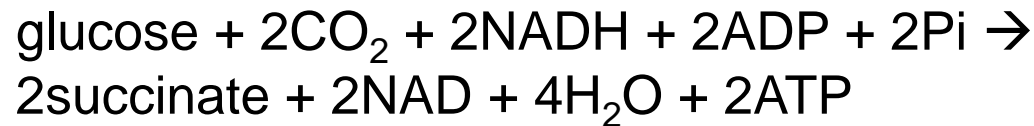
glucokinase/PP/PPC



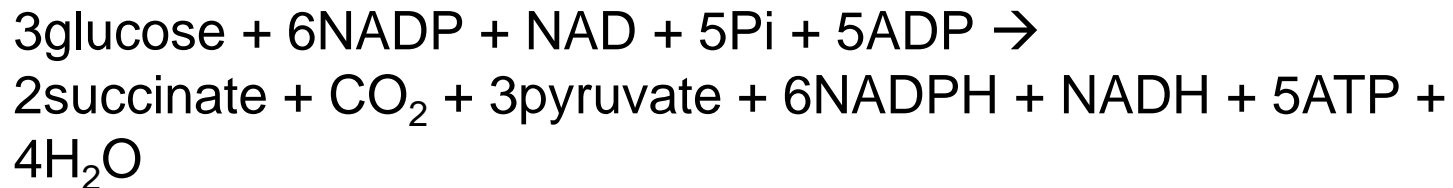
PTS/EMP/PCK



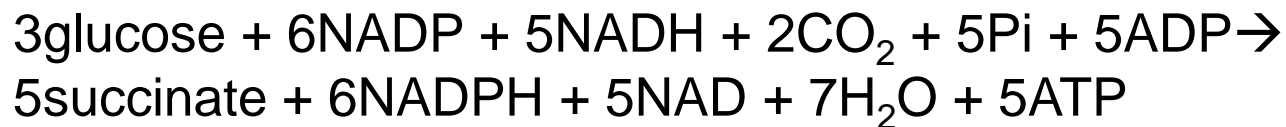
glucokinase/EMP/PCK



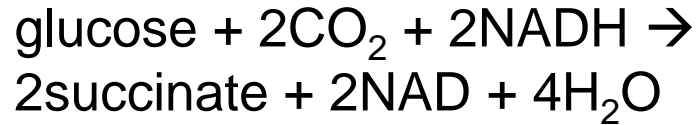
PTS/PP/PCK



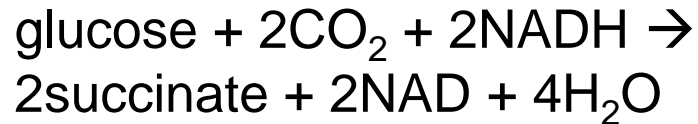
glucokinase/PP/PCK



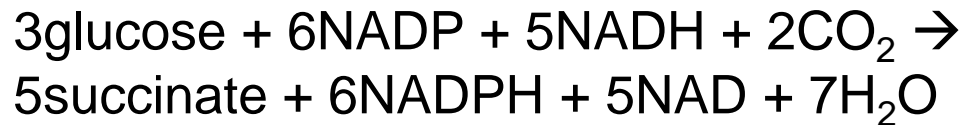
PTS/EMP/PYC



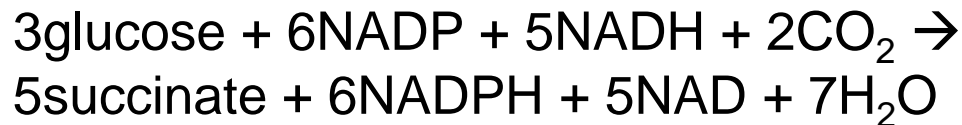
glucokinase/EMP/PYC



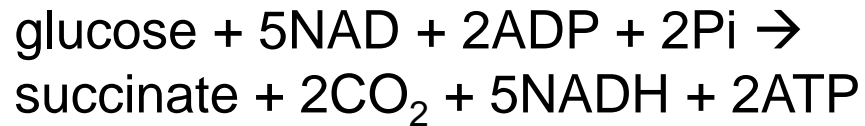
PTS/PP/PYC



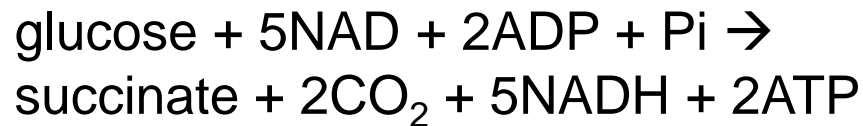
glucokinase/PP/PYC



PTS/EMP/Glyoxylate Shunt



glucokinase/EMP/Glyoxylate Shunt



PTS/PP/Glyoxylate Shunt



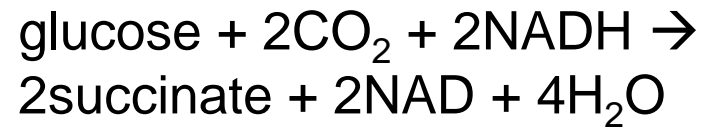
glucokinase/PP/Glyoxylate Shunt



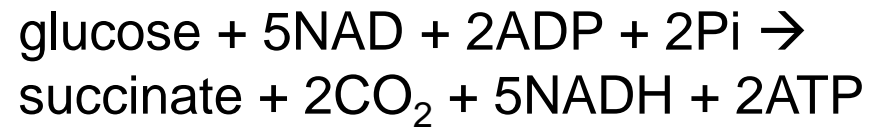
Summary

| | | | mol/mol | | | | | |
|-----------------|--------|-------------------|----------------------|----------------------|----------------------|----------------------|------------------------|-----------------------|
| PTS/Glucokinase | EMP/PP | PPC/PCK/PYC/Glyox | Y _{SUC/Glu} | Y _{PYR/Glu} | Y _{CO2/Glu} | Y _{ATP/Glu} | Y _{NADPH/Glu} | Y _{NADH/Glu} |
| PTS | EMP | PPC | 1.00 | 1.00 | -1.00 | 1.00 | 0.00 | 0.00 |
| Glucokinase | EMP | PPC | 2.00 | 0.00 | -2.00 | 0.00 | 0.00 | -2.00 |
| PTS | PP | PPC | 0.67 | 1.00 | 0.33 | 1.00 | 2.00 | 0.33 |
| Glucokinase | PP | PPC | 1.67 | 0.00 | -0.67 | 0.00 | 2.00 | -1.67 |
| PTS | EMP | PCK | 1.00 | 1.00 | -1.00 | 2.00 | 0.00 | 0.00 |
| Glucokinase | EMP | PCK | 2.00 | 0.00 | -2.00 | 2.00 | 0.00 | -2.00 |
| PTS | PP | PCK | 0.67 | 1.00 | 0.33 | 1.67 | 2.00 | 0.33 |
| Glucokinase | PP | PCK | 1.67 | 0.00 | -0.67 | 1.67 | 2.00 | -1.67 |
| PTS | EMP | PYC | 2.00 | 0.00 | -2.00 | 0.00 | 0.00 | -2.00 |
| Glucokinase | EMP | PYC | 2.00 | 0.00 | -2.00 | 0.00 | 0.00 | -2.00 |
| PTS | PP | PYC | 1.67 | 0.00 | -0.67 | 0.00 | 2.00 | -1.67 |
| Glucokinase | PP | PYC | 1.67 | 0.00 | -0.67 | 0.00 | 2.00 | -1.67 |
| PTS | EMP | Glyox | 1.00 | 0.00 | 2.00 | 2.00 | 0.00 | 5.00 |
| Glucokinase | EMP | Glyox | 1.00 | 0.00 | 2.00 | 2.00 | 0.00 | 5.00 |
| PTS | PP | Glyox | 0.83 | 0.00 | 2.67 | 1.67 | 2.00 | 4.17 |
| Glucokinase | PP | Glyox | 0.83 | 0.00 | 2.67 | 1.67 | 2.00 | 4.17 |

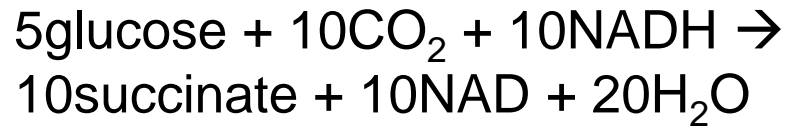
PTS/EMP/PYC



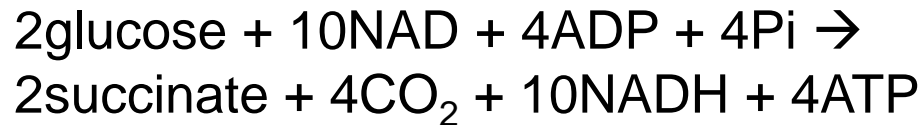
PTS/EMP/Glyoxylate Shunt



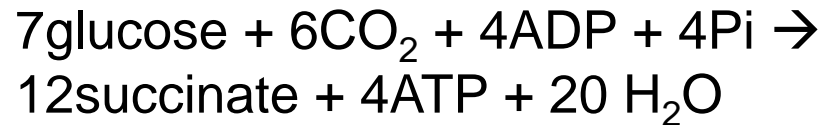
PTS/EMP/PYC (5×)



PTS/EMP/Glyoxylate Shunt (2×)



Complete Reaction



$$Y_{\text{SUC/Glu}} = 1.71 \text{ mol/mol}$$

$$Y_{\text{CO}_2/\text{Glu}} = -0.86 \text{ mol/mol}$$

$$Y_{\text{ATP/Glu}} = 0.57 \text{ mol/mol}$$