Part A

Stoichiometric matrix (18 x 21):

	v1	v2	v3	v4	v5,f	v5,r	b1	b2	b3	b4	B5	B6	B7	B8	B9	B10	B11	B12	B13	H2O	H2O, REV
ATP	**-1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Citrulline	-1	0	0	1	2	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aspartate	-1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AMP	1	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0
PPi	1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0
Argininosuccinate	1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fumerate	0	1	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0
Arginine	0	1	-1	0	-2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H20	0	0	-1	0	4	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	1
Ornithine	0	0	1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urea	0	0	1	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0
Carbamoyl phosphate	0	0	0	-1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pi	0	0	0	1	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0
O2	0	0	0	0	-4	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
NADPH	0	0	0	0	-3	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
H+	0	0	0	0	-3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
NO	0	0	0	0	2	-2	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0
NADP+	0	0	0	0	3	-3	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0

Part B

Elemental balance matrix:

Metabolites	Elements					
	C	H	N	O	P	S
ATP	10	16	5	13	3	0
Citrulline	6	13	3	3	0	0
Aspartate	4	7	1	4	0	0
AMP	10	14	5	7	1	0
PPi	0	4	0	7	2	0
Argininosuccinate	10	18	4	6	0	0
Fumerate	4	4	0	4	0	0
Arginine	6	14	4	2	0	0
H20	0	2	0	1	0	0
Ornithine	5	12	2	2	0	0
Urea	1	4	2	1	0	0
Carbamoyl phosphate	1	4	1	5	1	0
Pi	0	3	0	4	1	0
O2	0	0	0	2	0	0
NADPH	21	30	7	17	3	0
H+	0	1	0	0	0	0
NO	0	0	1	1	0	0
NADP+	21	29	7	17	3	0

To determine if the cycle is elementally balanced, you can use the formula

$$E = A^T * S$$

My cycle is balanced because the first six entries are 0.

```
E =

  Columns 1 through 19

     0     0     0     0     0     0     1     4    -4    -1    10   -10     0     0     0    21     0     0   -21
     0     0     0     0     0     0     4     7    -4    -4    16   -14    -4    -3     0    30     1     0   -29
     0     0     0     0     0     0     1     1     0    -2     5    -5     0     0     0     7     0    -1    -7
     0     0     0     0     0     0     5     4    -4    -1    13    -7    -7    -4     2    17     0    -1   -17
     0     0     0     0     0     0     1     0     0     0     3    -1    -2    -1     0     3     0     0    -3
     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
```

Part C

We have the constraints

$$0 \leq v_i \leq kcat, i * E * \theta * \prod \frac{x_i}{K_M + x_i}$$

$$0 \leq b_i \leq 10 \frac{mmol}{gDW - hr}$$

The max flux is calculated to be:

```
julia> include("partc.jl")
maximum urea flux = 1.2710952000000002 mmol/gDW-hr
```