Summary

December 6, 2024

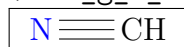# Contents

0.1 Loaded Graphs

0.1.1 g_{0}

$$N \equiv C \longrightarrow H$$

File: out/001_g_0_10300000

$$N \equiv CH$$

File: out/003_g_0_11310100

0.1.2 g_{1}

H   H
 \ /
  N
  |
  H
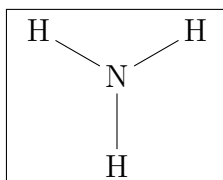
File: out/005_g_1_10300000

$$NH_3$$

File: out/007_g_1_11310100

0.1.3 g_{2}

H   H
 \   /
   O
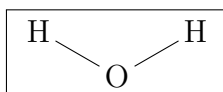
File: out/009_g_2_10300000

$$H_2O$$

File: out/011_g_2_11310100

0.2 Product Graphs

0.2.1 p_{0,56}

File: out/013_g_1088_10300000
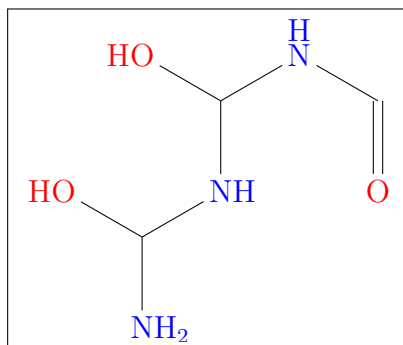
File: `out/015_g_1088_11310100`

0.3 Enumerated Flows

0.3.1 Solution 0

Overall Data

```
Objective value (non-integral): -0.0756449
Vertex/Graph In Out G          logK      t_order
g_{0}        3  0   -5.507152  -6.000000 0
g_{2}        3  0   -5.068043  -6.000000 0
p_{0,13}     0  0   -21.240678 -6.000000 65
p_{0,1}      0  0   -10.610101 -6.000000 1
p_{0,56}     0  1   -31.869324 -9.000000 67
p_{0,5}      0  0   -16.158998 -8.613824 2
```

Filtered Graph
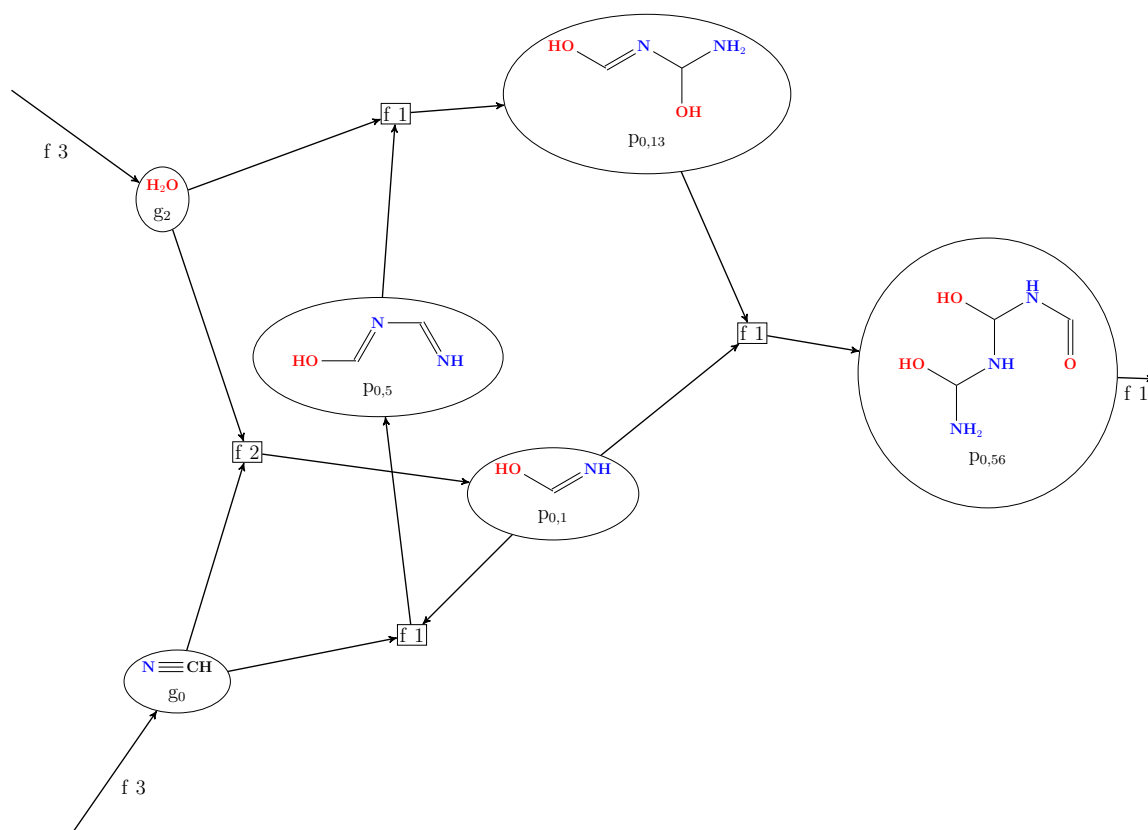
File: `out/027_dg_0_11100_f_0_0_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-6.0	-14478.980288	0
g_2	3	0	-13306.144961	-6.0	-13326.099672	0
$p_{0,1}$	0	0	-27856.817054	-6.0	-27876.771765	1
$p_{0,5}$	0	0	-42425.44262	-8.613824	-42454.090349	2
$p_{0,13}$	0	0	-55767.391129	-6.0	-55787.345839	65
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	2	-66.703128	-66.703128
14	$g_0, p_{0,1},$	$p_{0,5},$	1	-95.522873	-95.522873
123	$g_2, p_{0,5},$	$p_{0,13},$	1	0.006113	0.006113
263	$p_{0,1}, p_{0,13},$	$p_{0,56},$	1	-36.218915	-36.218915
Sum					-198.60557653035843

ΔG = -26.51419254550853
ΔE = -0.07564486909230494
|E| = 5
|U| = 4

### 0.3.2 Solution 1

Overall Data

```
Objective value (non-integral): -0.0756449
Vertex/Graph In Out G          logK       t_order
g_{0}       3  0   -5.507141  -6.000000  0
g_{2}       3  0   -5.068033  -6.000000  0
p_{0,13}    0  0   -21.240678 -6.000000  23
p_{0,17}    0  0   -21.248887 -6.000000  45
p_{0,1}     0  0   -10.610101 -9.000000  21
p_{0,56}    0  1   -31.869324 -8.470766  67
p_{0,5}     0  0   -16.158998 -6.000000  22
```

Filtered Graph
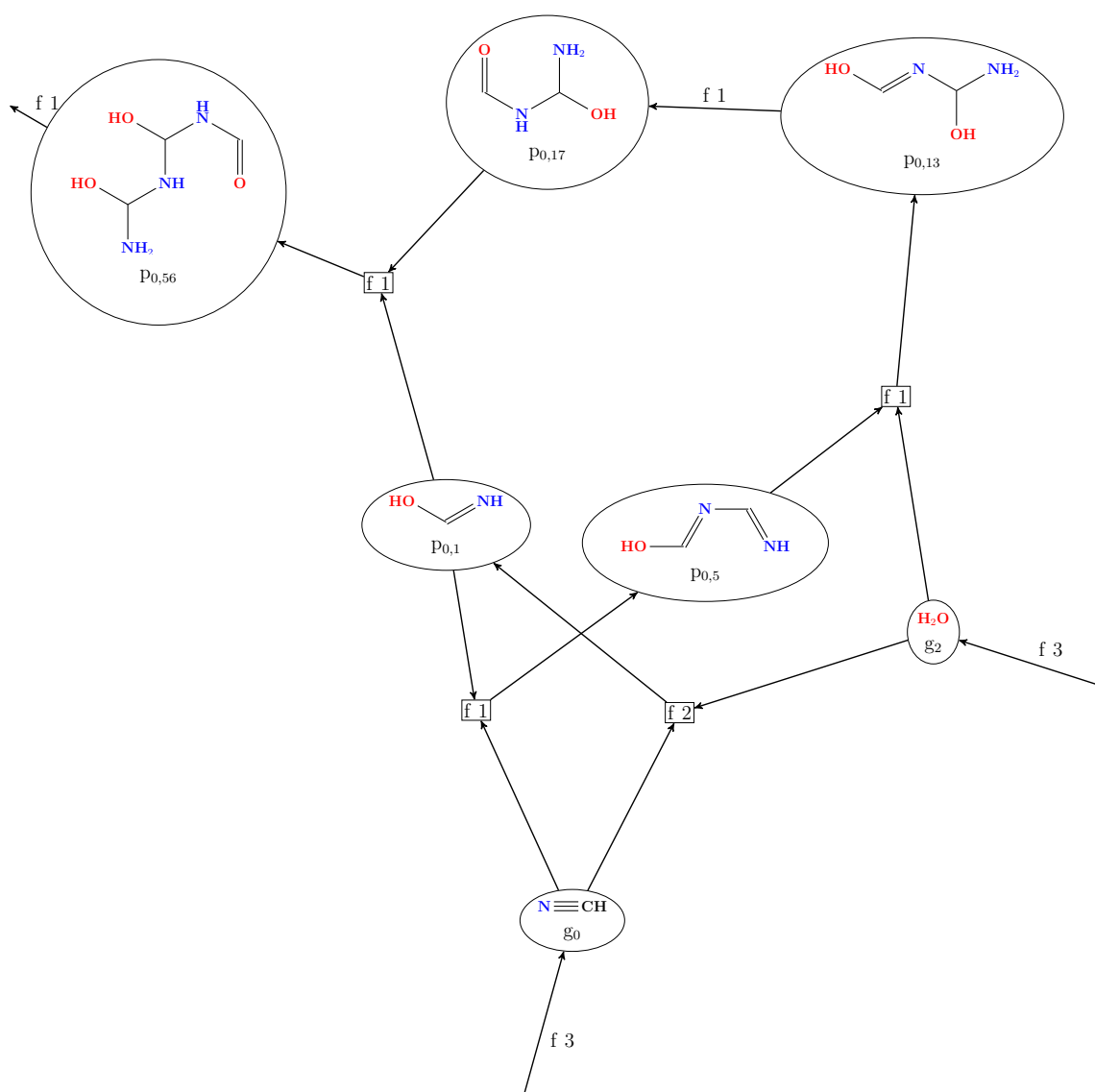
File: `out/038_dg_0_11100_f_0_1_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14458.99666	-6.0	-14478.95137	0
g_2	3	0	-13306.118349	-6.0	-13326.073059	0
$p_{0,1}$	0	0	-27856.817054	-9.0	-27886.74912	21
$p_{0,5}$	0	0	-42425.44262	-6.0	-42445.397331	22
$p_{0,13}$	0	0	-55767.391129	-6.0	-55787.345839	23
$p_{0,17}$	0	0	-55788.944315	-6.0	-55808.899025	45
$p_{0,56}$	0	1	-83672.898792	-8.470766	-83701.070739	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	2	-79.230352	-79.230352
14	$g_0, p_{0,1},$	$p_{0,5},$	1	-72.213824	-72.213824
123	$g_2, p_{0,5},$	$p_{0,13},$	1	-10.886772	-10.886772
196	$p_{0,1}, p_{0,17},$	$p_{0,56},$	1	0.006113	0.006113
250	$p_{0,13},$	$p_{0,17},$	1	-21.553186	-21.553186
Sum					-198.60557653035875

$\Delta G = $ -26.31083683388228
$\Delta E = $ -0.07564486909230507
|E| = 6
|U| = 5

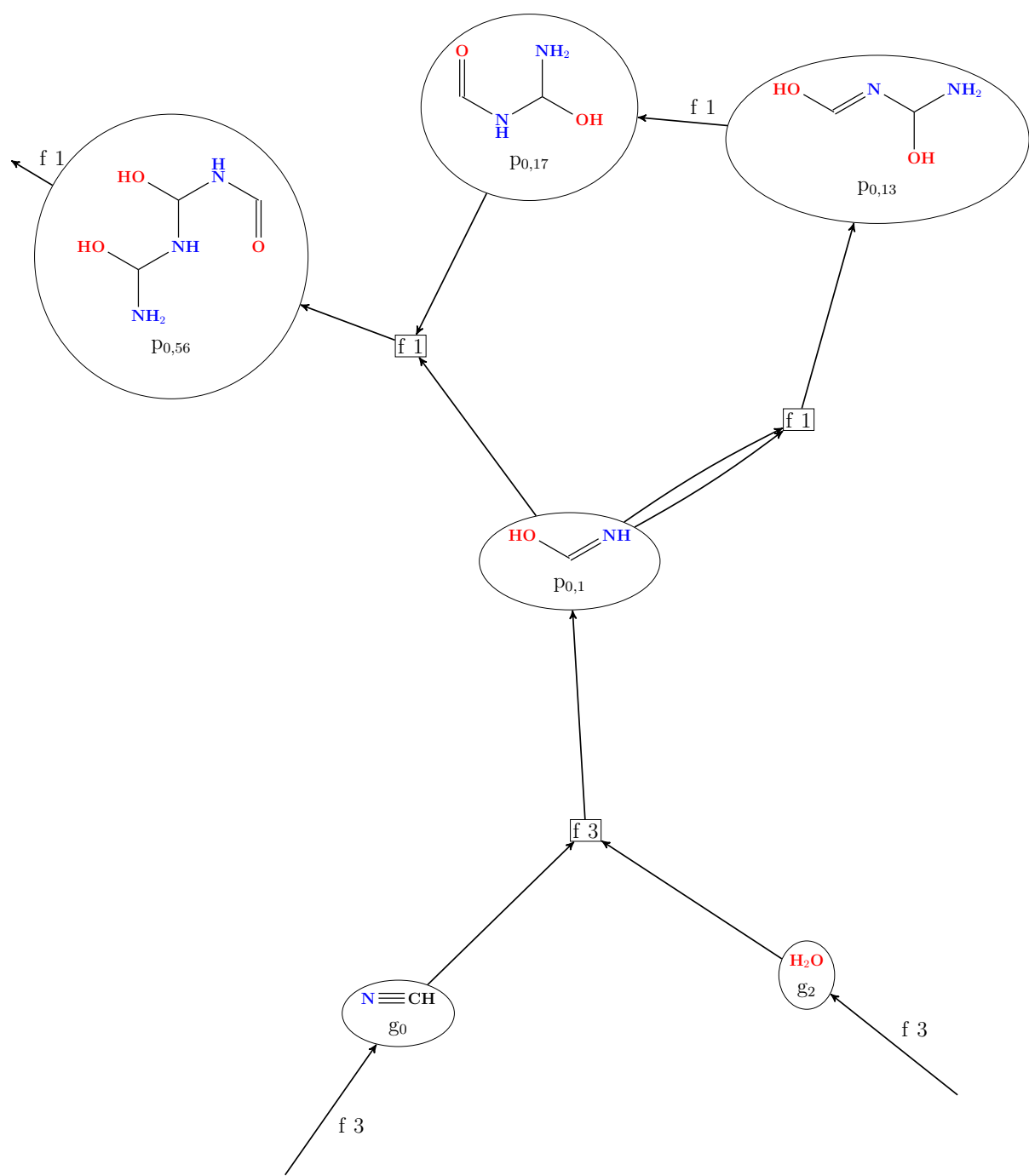### 0.3.3 Solution 2

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G          logK       t_order
g_{0}        3  0   -5.507152  -9.000000 0
g_{2}        3  0   -5.068033  -9.000000 0
p_{0,13}     0  0   -21.240635 -6.000000 64
p_{0,17}     0  0   -21.248844 -6.000000 65
p_{0,1}      0  0   -10.610080 -6.000000 1
p_{0,56}     0  1   -31.869324 -9.000000 67
```

Filtered Graph

File: `out/047_dg_0_11100_f_0_2_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-9.0	-14488.957643	0
g_2	3	0	-13306.118349	-9.0	-13336.050414	0
$p_{0,1}$	0	0	-27856.761341	-6.0	-27876.716051	1
$p_{0,13}$	0	0	-55767.279594	-6.0	-55787.234305	64
$p_{0,17}$	0	0	-55788.832737	-6.0	-55808.787447	65
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-41.730639	-41.730639
30	$p_{0,1}, p_{0,1},$	$p_{0,13},$	1	-28.813525	-28.813525
196	$p_{0,1}, p_{0,17},$	$p_{0,56},$	1	-14.83302	-14.83302
250	$p_{0,13},$	$p_{0,17},$	1	-21.553143	-21.553143
Sum					-131.9026321376035

ΔG = -19.039159302041345

ΔE = -0.05023905932195359

$|\text{E}| = 6$

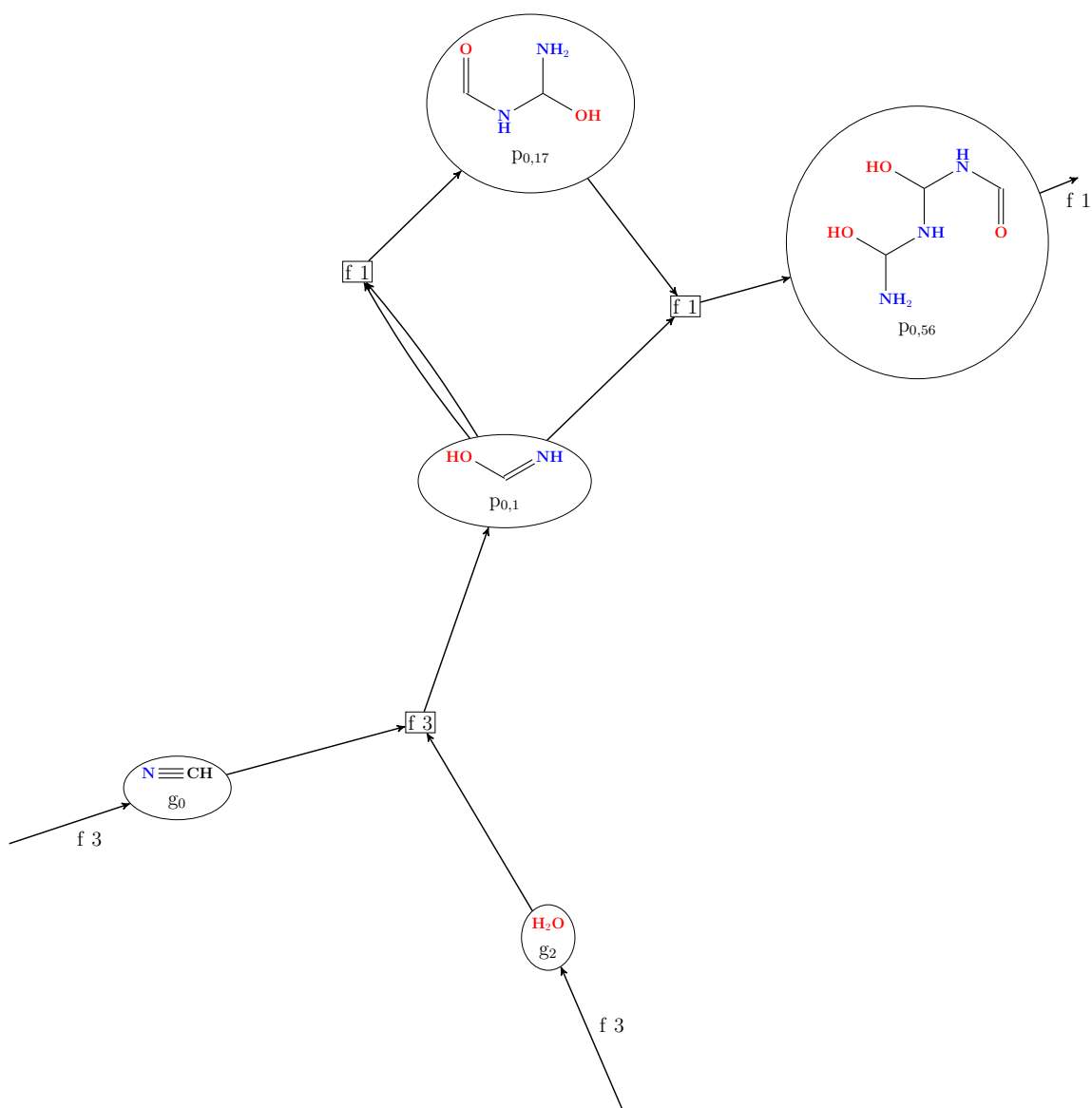$|\text{U}| = 4$

0.3.4 Solution 3

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G         logK      t_order
g_{0}        3  0   -5.507152 -6.000000 0
g_{2}        3  0   -5.068043 -6.000000 0
p_{0,17}     0  0   -21.248844 -6.000000 45
p_{0,1}      0  0   -10.610080 -6.000000 21
p_{0,56}     0  1   -31.869324 -9.000000 67
```

Filtered Graph

File: `out/056_dg_0_11100_f_0_3_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-6.0	-14478.980288	0
g_2	3	0	-13306.144961	-6.0	-13326.099672	0
$p_{0,1}$	0	0	-27856.761341	-6.0	-27876.716051	21
$p_{0,17}$	0	0	-55788.832737	-6.0	-55808.787447	45
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-66.647414	-66.647414
40	$p_{0,1}, p_{0,1},$	$p_{0,17},$	1	-50.366668	-50.366668
196	$p_{0,1}, p_{0,17},$	$p_{0,56},$	1	-14.83302	-14.83302
Sum					-131.90263213760318

$\Delta G = $ -26.51419254550853

$\Delta E = $ -0.05023905932195347

$|E| = 5$
$|U| = 3$

0.3.5 Solution 4

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G          logK       t_order
g_{0}       3   0   -5.507152  -9.000000 0
g_{2}       3   0   -5.068043  -9.000000 0
p_{0,13}    0   0   -21.240635 -8.601514 4
p_{0,15}    0   0   -10.625174 -6.000000 2
p_{0,17}    0   0   -21.248844 -6.000000 65
p_{0,1}     0   0   -10.610080 -6.000000 1
p_{0,56}    0   1   -31.869324 -9.000000 67
```

Filtered Graph
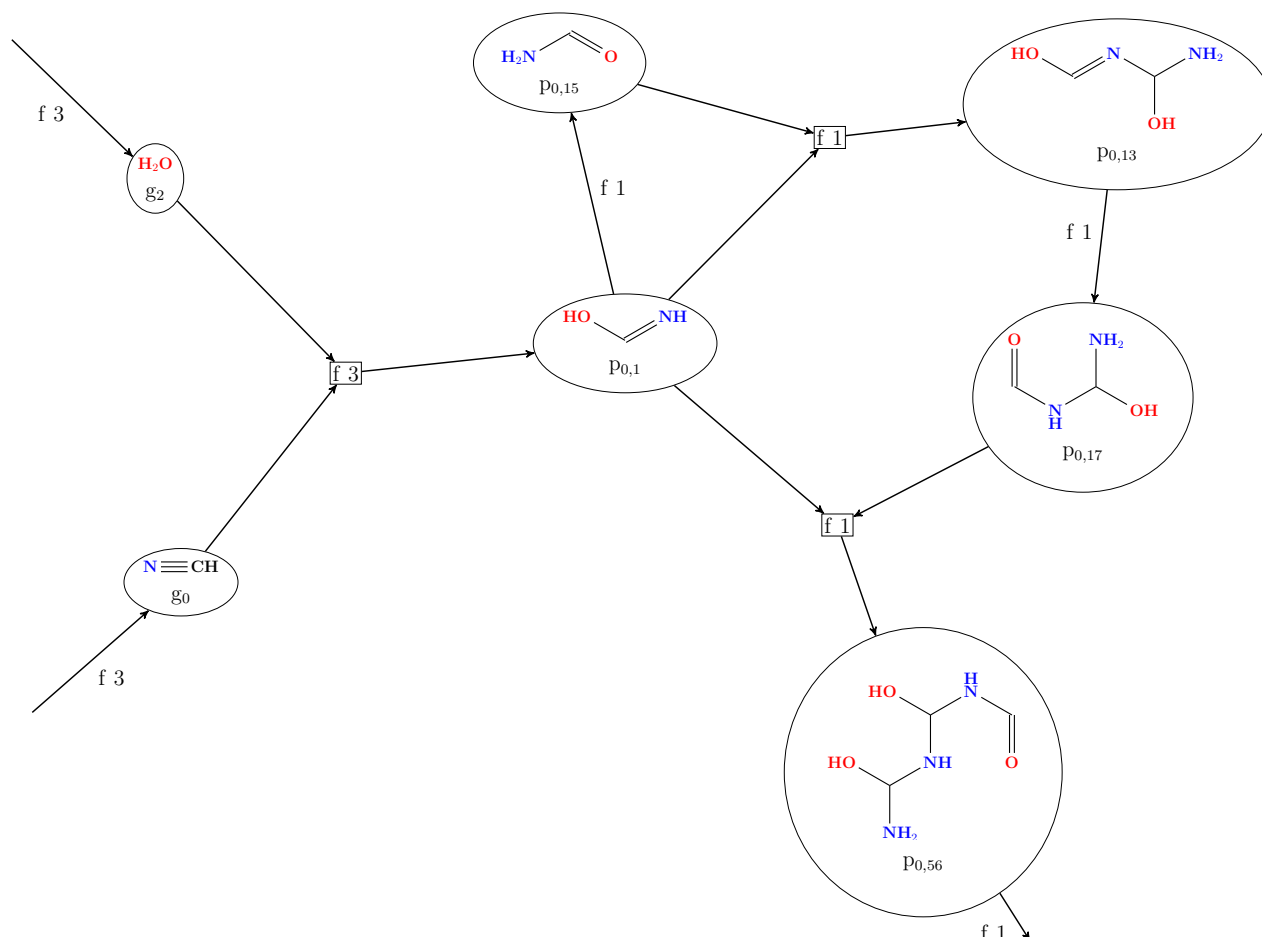
File: `out/067_dg_0_11100_f_0_4_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-9.0	-14488.957643	0
g_2	3	0	-13306.144961	-9.0	-13336.077027	0
$p_{0,1}$	0	0	-27856.761341	-6.0	-27876.716051	1
$p_{0,13}$	0	0	-55767.279594	-8.601514	-55795.886382	4
$p_{0,15}$	0	0	-27896.389963	-6.0	-27916.344673	2
$p_{0,17}$	0	0	-55788.832737	-6.0	-55808.787447	65
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-41.704026	-41.704026
36	$p_{0,1},$	$p_{0,15},$	1	-39.628622	-39.628622
192	$p_{0,1}, p_{0,15},$	$p_{0,13},$	1	0.0	0.0
196	$p_{0,1}, p_{0,17},$	$p_{0,56},$	1	-14.83302	-14.83302
250	$p_{0,13},$	$p_{0,17},$	1	-10.738046	-10.738046
Sum					-131.90263213760318

ΔG = -19.03117594528758
ΔE = -0.05023905932195347
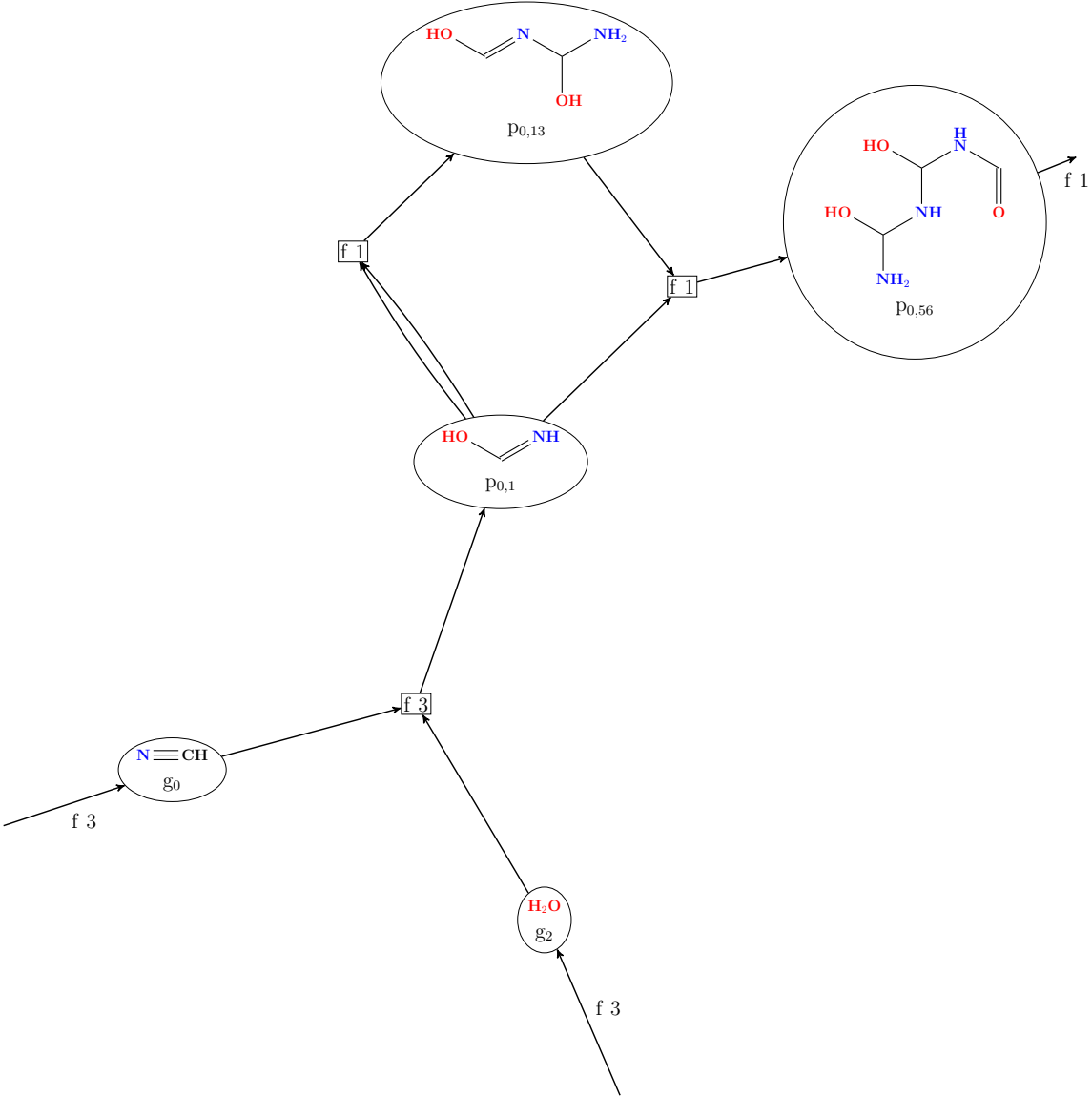|E| = 7
|U| = 5

0.3.6   Solution 5

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G          logK       t_order
g_{0}        3   0   -5.507152  -9.000000  0
g_{2}        3   0   -5.068033  -9.000000  0
p_{0,13}     0   0   -21.240635 -6.000000  45
p_{0,1}      0   0   -10.610080 -6.000000  21
p_{0,56}     0   1   -31.869324 -9.000000  67
```

Filtered Graph

File: `out/076_dg_0_11100_f_0_5_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-9.0	-14488.957643	0
g_2	3	0	-13306.118349	-9.0	-13336.050414	0
$p_{0,1}$	0	0	-27856.761341	-6.0	-27876.716051	21
$p_{0,13}$	0	0	-55767.279594	-6.0	-55787.234305	45
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-41.730639	-41.730639
30	$p_{0,1}, p_{0,1},$	$p_{0,13},$	1	-28.813525	-28.813525
263	$p_{0,1}, p_{0,13},$	$p_{0,56},$	1	-36.386163	-36.386163
Sum					-131.90263213760318

ΔG = -19.039159302041345
ΔE = -0.05023905932195347
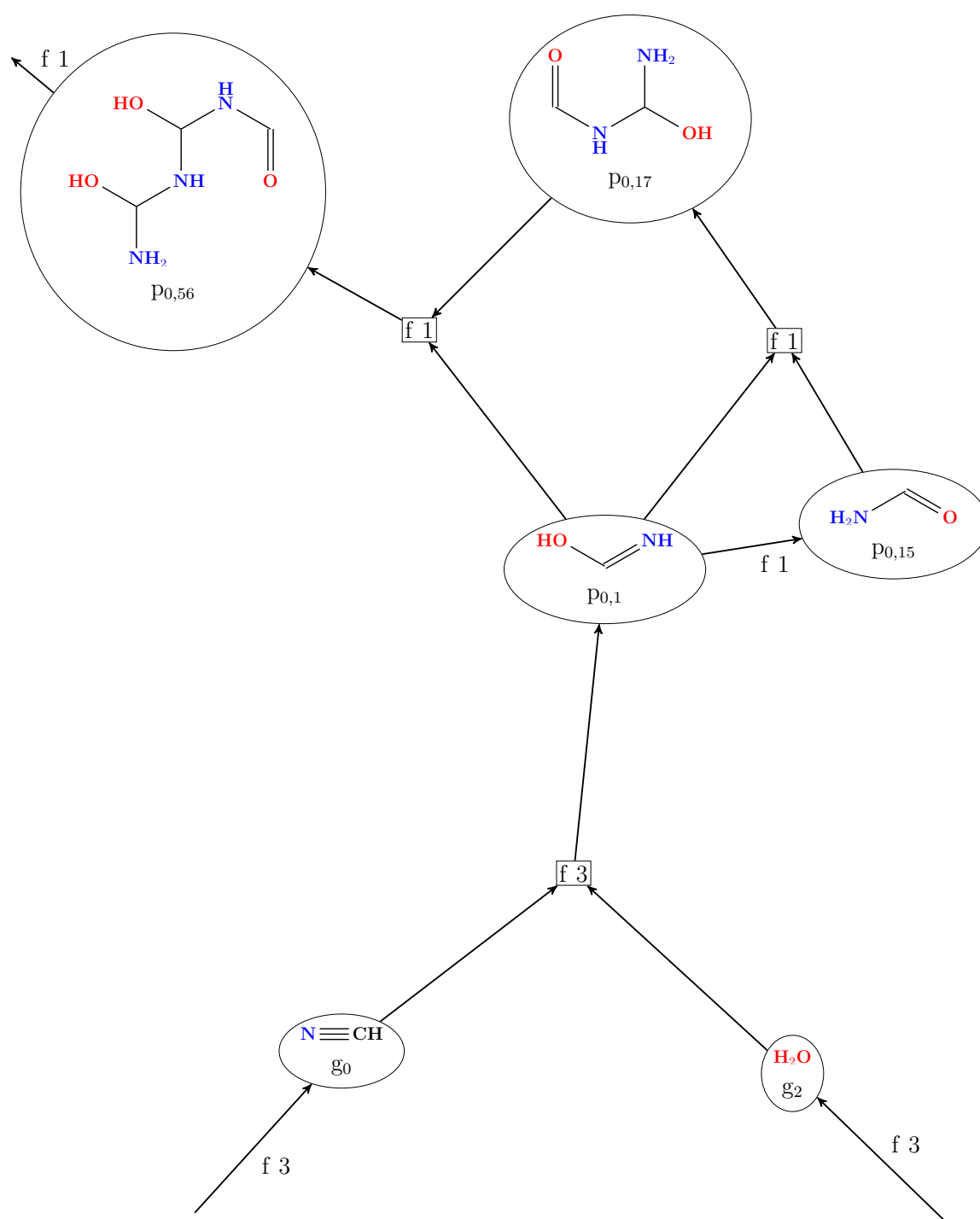
|E| = 5
|U| = 3

0.3.7 Solution 6

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G          logK      t_order
g_{0}       3  0   -5.507152  -6.000000 0
g_{2}       3  0   -5.068033  -6.000000 0
p_{0,15}    0  0   -10.625195 -8.571030 2
p_{0,17}    0  0   -21.248844 -6.000000 4
p_{0,1}     0  0   -10.610080 -6.000000 1
p_{0,56}    0  1   -31.869324 -9.000000 67
```

Filtered Graph

File: `out/085_dg_0_11100_f_0_6_filt`

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-6.0	-14478.980288	0
g_2	3	0	-13306.118349	-6.0	-13326.073059	0
$p_{0,1}$	0	0	-27856.761341	-6.0	-27876.716051	1
$p_{0,15}$	0	0	-27896.445756	-8.57103	-27924.951159	2
$p_{0,17}$	0	0	-55788.832737	-6.0	-55808.787447	4
$p_{0,56}$	0	1	-83672.898792	-9.0	-83702.830857	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-66.674026	-66.674026
36	$p_{0,1},$	$p_{0,15},$	1	-50.372781	-50.372781
183	$p_{0,1}, p_{0,15},$	$p_{0,17},$	1	0.006113	0.006113
196	$p_{0,1}, p_{0,17},$	$p_{0,56},$	1	-14.83302	-14.83302
Sum					-131.9026321376035

$\Delta G = $ -26.522176164812258
$\Delta E = $ -0.05023905932195359
|E| = 6
|U| = 4
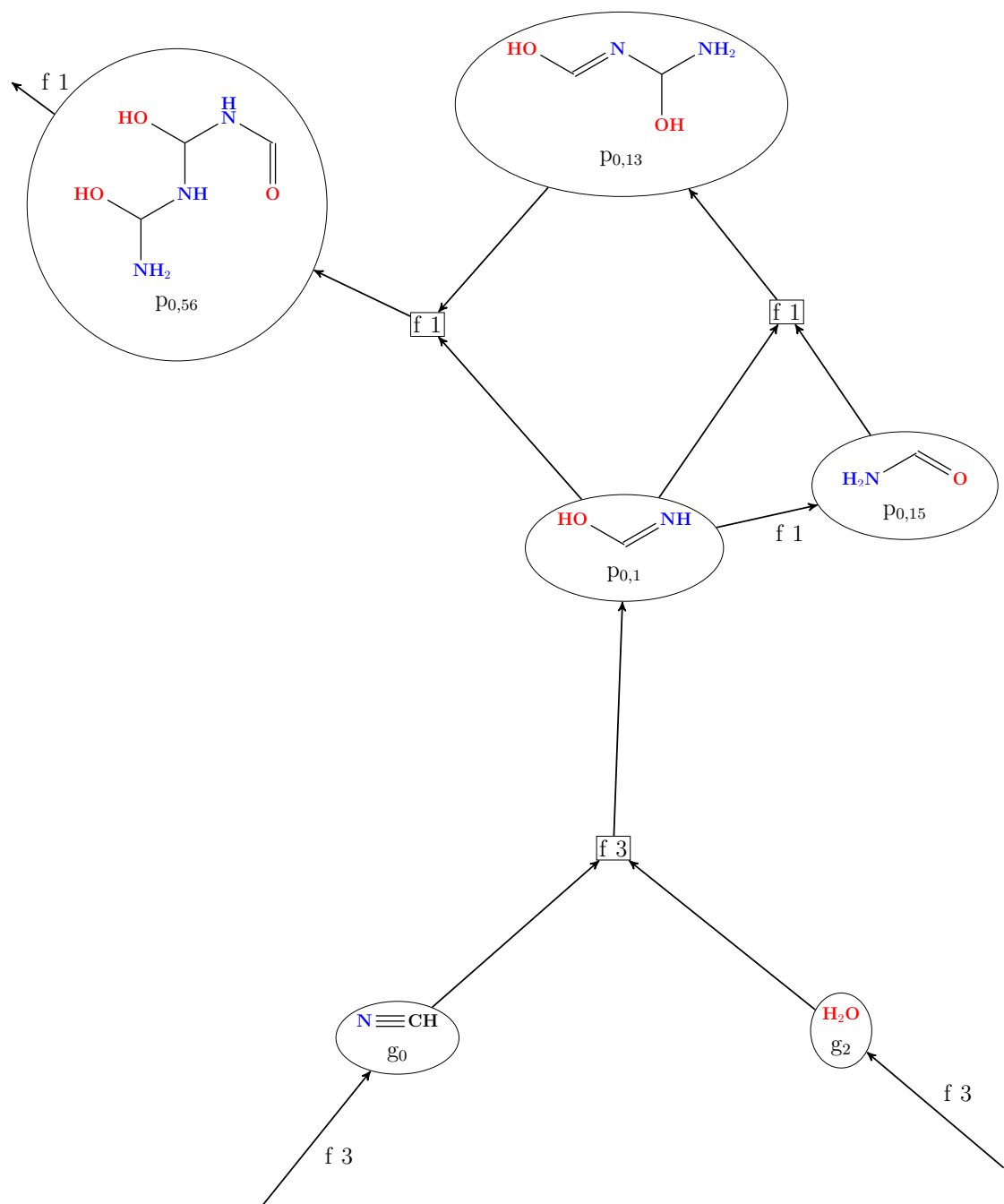
0.3.8   Solution 7

Overall Data

```
Objective value (non-integral): -0.0502391
Vertex/Graph In Out G          logK       t_order
g_{0}         3   0   -5.507152  -6.000000 0
g_{2}         3   0   -5.068043  -6.000000 0
p_{0,13}      0   0   -21.240678 -8.586617 52
p_{0,15}      0   0   -10.625174 -6.000000 50
p_{0,1}       0   0   -10.610101 -6.000000 1
p_{0,56}      0   1   -31.869260 -6.000000 67
```

Filtered Graph

File: out/094_dg_0_11100_f_0_7_filt

Vertex	InFlow	OutFlow	$x_v^{\Delta G^0}$	x_v^K	$x_v^{\Delta G}$	t_v
g_0	3	0	-14459.025578	-6.0	-14478.980288	0
g_2	3	0	-13306.144961	-6.0	-13326.099672	0
$p_{0,1}$	0	0	-27856.817054	-6.0	-27876.771765	1
$p_{0,13}$	0	0	-55767.391129	-8.586617	-55795.94837	52
$p_{0,15}$	0	0	-27896.389963	-6.0	-27916.344673	50
$p_{0,56}$	0	1	-83672.731446	-6.0	-83692.686157	67

Hyperedge	Source	Target	Flow	$x_e^{\Delta G}$	$\overline{x}_e^{\Delta G}$
6	$g_0, g_2,$	$p_{0,1},$	3	-66.703128	-66.703128
36	$p_{0,1},$	$p_{0,15},$	1	-39.572909	-39.572909
192	$p_{0,1}, p_{0,15},$	$p_{0,13},$	1	0.006113	0.006113
263	$p_{0,1}, p_{0,13},$	$p_{0,56},$	1	-12.826712	-12.826712
Sum					-131.90263213760286

ΔG = -25.25028830871131

ΔE = -0.050239059321953355

|E| = 6

|U| = 4