```mathematica
(* Pseudomonas putida (P. putida) -- Null space analysis *)

(* List of metabolite identifiers *)
metaboliteIds = {"2dda7p_c", "2ddg6p_c", "2dhglcn_c", "34dhbz_c", "3dhq_c",
    "3dhsk_c", "3pg_c", "6p2dhglcn_c", "6pgc_c", "ac_c", "xu5p__D_c", "acald_c",
    "succ_c", "accoa_c", "acon_c", "actp_c", "adp_c", "akg_c", "s7p_c", "amp_c",
    "nadph_c", "catechol_c", "ccmuac_c", "cit_c", "co2_c", "ru5p__D_c", "coa_c",
    "dhap_c", "e4p_c", "etoh_c", "f6p_c", "fdp_c", "fum_c", "r5p_c", "g3p_c",
    "g6p_c", "glc__D_c", "q8h2_c", "glcn_c", "gln__L_c", "q8_c", "glu__L_c",
    "pyr_c", "glx_c", "glyc3p_c", "glyc_c", "pi_c", "h2o_c", "pep_c", "h_c",
    "oaa_c", "hco3_c", "icit_c", "lac__D_c", "o2_c", "mal__L_c", "nh4_c",
    "nad_c", "nadh_c", "nadp_c", "atp_c", "mal__L_e", "nh4_e", "lac__D_e",
    "o2_e", "h_e", "h2o_e", "glyc_e", "pi_e", "glu__L_e", "pyr_e", "gln__L_e",
    "glc__D_e", "fum_e", "co2_e", "akg_e", "acald_e", "succ_e", "toh_e", "ac_e"};
(* List of reaction identifiers *)
reactionIds = {"2DHGLCK", "3-DEHYDROQUINATE-DEHYDRATASE-RXN",
    "3-DEHYDROQUINATE-SYNTHASE-RXN", "ACALD", "ACALDt", "ACKr", "ACONTa",
    "ACONTb", "ACt2r", "ADK1", "AKGDH", "AKGt2r", "ALCD2x", "ATPM", "ATPS4r",
    "Biomass_Ecoli_core_w_GAM", "CATECHOL-12-DIOXYGENASE-RXN", "CO2t", "CS",
    "CYTBD", "DAHPSYN-RXN", "DHSHIKIMATE-DEHYDRO-RXN", "D_LACt2", "ENO", "ETOHt2r",
    "EX_ac_e", "EX_acald_e", "EX_akg_e", "EX_co2_e", "EX_etoh_e", "EX_fum_e",
    "EX_glc_e", "EX_gln__L_e", "EX_glu__L_e", "EX_glyc_e", "EX_h2o_e", "EX_h_e",
    "EX_lac__D_e", "EX_mal__L_e", "EX_nh4_e", "EX_o2_e", "EX_pi_e", "EX_pyr_e",
    "EX_succ_e", "EX_xyl_e", "FBA", "FBP", "FRD7", "FUM", "FUMt2_2", "G3PD",
    "G6PDH2r", "GADktpp", "GAPD", "GLCDpp", "GLCabcpp", "GLNS", "GLNabc", "GLUDy",
    "GLUN", "GLUSy", "GLUt2r", "GLYCT", "GLYK", "GND", "GNK", "H2Ot", "HCO3E",
    "HEX1", "ICDHyr", "ICL", "KDPGALDOL", "LDH_D", "MALS", "MALt2_2", "MDH", "ME1",
    "ME2", "NADH16", "NADTRHD", "NH4t", "O2t", "PC", "PDH", "PGI", "PGL", "PGLCNDH",
    "PGLUCONDEHYDRAT", "PIt2r", "PPC", "PPCK", "PROTOCATECHUATE-DECARBOXYLASE-RXN",
    "PTAr", "PYK", "PYRt2", "RPE", "RPI", "SUCCt2_2", "SUCCt3", "TALA",
    "THD2", "TKT1", "TKT2", "TPI", "XYLA", "XYL_ABC", "muconate_sink"};
(* Matrix of stoichiometric coefficients
  (Rows=Metabolites; Columns=Reactions) *)
stoichiometryMatrix = {{0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
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      0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
    {-1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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      0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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    {0, -1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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      0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
      0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
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  -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, -1, 0, 0, 4, 0, 0, 0, 0, 2, 0, 0, -1, 0, -1, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, 0,
  1, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, 3, 0, 0,
  0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, -1, 0, 0, -2, -1, 0, -1, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
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{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
```

```
     0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 1, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0,
    0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
   {0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
    0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}};
(* Numerical tolerance, viz., the neighborhood of zero with
 respect to the matrix of stoichiometric coefficients. *)
tolerance = Times[Max[Dimensions[stoichiometryMatrix]],
   $MachineEpsilon, Norm[stoichiometryMatrix, Infinity]];
(* Extracellular metabolites are denoted by the "_e" suffix. *)
extracellularMetaboliteIds = Select[metaboliteIds,
   Function[string, Last[StringSplit[string, "_"]] == "e"]]; (* not used *)
(* Intracellular metabolites are denoted by the "_c" suffix. *)
intracellularMetaboliteIds =
  Select[metaboliteIds, Function[string, Last[StringSplit[string, "_"]] == "c"]];
(* The block of the matrix of stoichiometric coefficients
 for extracellular metabolites only. *)
extracellularStoichiometryMatrix =
  Drop[stoichiometryMatrix, Length[intracellularMetaboliteIds]]; (* not used *)
(* The block of the matrix of stoichiometric coefficients
 for intracellular metabolites only. *)
intracellularStoichiometryMatrix =
  Take[stoichiometryMatrix, Length[intracellularMetaboliteIds]];
(* The "null space" of the block of the matrix of stoichiometric
 coefficients for intracellular metabolites only. *)
intracellularNullspaceMatrix =
  Transpose[RowReduce[NullSpace[intracellularStoichiometryMatrix]]];

(* Print the matrix of stoichiometric coefficients. *)
Dimensions[stoichiometryMatrix]
MatrixForm[stoichiometryMatrix, TableHeadings → {metaboliteIds, reactionIds}]
```

Out[371]= {80, 107}

Out[372]//MatrixForm=

2DHGLCK 3-DEHYDROQUINATE-DEHYDRATASE-RXN 3-DEHYDROQUINATE-SYNTHASE-RX

2dda7p_c	0	0	−1
2ddg6p_c	0	0	0
2dhglcn_c	−1	0	0
34dhbz_c	0	0	0
3dhq_c	0	−1	1
3dhsk_c	0	1	0
3pg_c	0	0	0
6p2dhglcn_c	1	0	0
6pgc_c	0	0	0
ac_c	0	0	0
xu5p__D_c	0	0	0
acald_c	0	0	0
succ_c	0	0	0
accoa_c	0	0	0
acon_c	0	0	0
actp_c	0	0	0
adp_c	1	0	0
akg_c	0	0	0
s7p_c	0	0	0
amp_c	0	0	0
nadph_c	0	0	0
catechol_c	0	0	0
ccmuac_c	0	0	0
cit_c	0	0	0
co2_c	0	0	0
ru5p__D_c	0	0	0
coa_c	0	0	0
dhap_c	0	0	0
e4p_c	0	0	0
etoh_c	0	0	0
f6p_c	0	0	0
fdp_c	0	0	0
fum_c	0	0	0
r5p_c	0	0	0
g3p_c	0	0	0
g6p_c	0	0	0
glc__D_c	0	0	0
q8h2_c	0	0	0
glcn_c	0	0	0
gln__L_c	0	0	0
q8_c	0	0	0
glu__L_c	0	0	0
pyr_c	0	0	0
glx_c	0	0	0
glyc3p_c	0	0	0
glyc_c	0	0	0
pi_c	0	0	1
h2o_c	0	1	0
pep_c	0	0	0
h_c	−2	0	0
oaa_c	0	0	0

hco3_c	0	0	0
icit_c	0	0	0
lac__D_c	0	0	0
o2_c	0	0	0
mal__L_c	0	0	0
nh4_c	0	0	0
nad_c	0	0	0
nadh_c	0	0	0
nadp_c	0	0	0
atp_c	-1	0	0
mal__L_e	0	0	0
nh4_e	0	0	0
lac__D_e	0	0	0
o2_e	0	0	0
h_e	0	0	0
h2o_e	0	0	0
glyc_e	0	0	0
pi_e	0	0	0
glu__L_e	0	0	0
pyr_e	0	0	0
gln__L_e	0	0	0
glc__D_e	0	0	0
fum_e	0	0	0
co2_e	0	0	0
akg_e	0	0	0
acald_e	0	0	0
succ_e	0	0	0
toh_e	0	0	0
ac_e	0	0	0

In[345]:= **(* Print the "null space",**
then replace values in the neighborhood of zero with zero. *)
Dimensions[intracellularNullspaceMatrix]
MatrixForm[intracellularNullspaceMatrix, TableHeadings → {reactionIds}]
MatrixForm[intracellularNullspaceMatrix /. x_ /; (Abs[x] ≤ tolerance) → 0,
 TableHeadings → {reactionIds}]

Out[345]= $\{107, 51\}$

Out[346]//MatrixForm=

2DHGLCK	1	0	0
3-DEHYDROQUINATE-DEHYDRATASE-RXN	0.	1	0
3-DEHYDROQUINATE-SYNTHASE-RXN	-2.37917×10^{-15}	1.	0
ACALD	0.	0.	1
ACALDt	0.	0.	0.
ACKr	0.	0.	0.
ACONTa	0.	0.	0.
ACONTb	9.85888×10^{-16}	6.79745×10^{-15}	4.0464×10^{-16}	$-$
ACt2r	-1.30775×10^{-17}	-1.62384×10^{-15}	-6.63595×10^{-16}	$-$
ADK1	-4.34181×10^{-16}	1.07348×10^{-15}	-7.62245×10^{-16}	
AKGDH	0.	0.	0.
AKGt2r	0.	0.	0.
ALCD2y	4.46825×10^{-16}	9.59441×10^{-16}	1

ALCD2x	4.46825×10	9.59441×10	1.
ATPM	0.	0.	0.
ATPS4r	0.	0.	0.
Biomass_Ecoli_core_w_GAM	0.	0.	0.
CATECHOL-12-DIOXYGENASE-RXN	-1.39553×10^{-15}	1.	-1.90535×10^{-15}
CO2t	0.	0.	0.
CS	-4.48311×10^{-16}	-2.2273×10^{-15}	2.45058×10^{-15}
CYTBD	0.	0.	0.
DAHPSYN-RXN	-4.29306×10^{-16}	1.	1.1177×10^{-15}
DHSHIKIMATE-DEHYDRO-RXN	-9.30027×10^{-16}	1.	2.58857×10^{-15}
D_LACt2	0.	0.	0.
ENO	0.	0.	0.
ETOHt2r	9.1889×10^{-16}	-4.0601×10^{-15}	1.
EX_ac_e	0.	0.	0.
EX_acald_e	0.	0.	0.
EX_akg_e	0.	0.	0.
EX_co2_e	0.	0.	0.
EX_etoh_e	0.	0.	0.
EX_fum_e	0.	0.	0.
EX_glc_e	0.	0.	0.
EX_gln__L_e	0.	0.	0.
EX_glu__L_e	0.	0.	0.
EX_glyc_e	0.	0.	0.
EX_h2o_e	0.	0.	0.
EX_h_e	0.	0.	0.
EX_lac__D_e	0.	0.	0.
EX_mal__L_e	0.	0.	0.
EX_nh4_e	0.	0.	0.
EX_o2_e	0.	0.	0.
EX_pi_e	0.	0.	0.
EX_pyr_e	0.	0.	0.
EX_succ_e	0.	0.	0.
EX_xyl_e	0.	0.	0.
FBA	0.	0.	0.
FBP	-1.62957×10^{-16}	-1.49394×10^{-16}	-1.70375×10^{-16}
FRD7	0.	0.	0.
FUM	0.	0.	0.
FUMt2_2	-1.95548×10^{-16}	-2.31561×10^{-15}	1.70375×10^{-16}
G3PD	0.	0.	0.
G6PDH2r	0.	0.	0.
GADktpp	1.	3.64523×10^{-15}	-1.63177×10^{-14}
GAPD	-2.16202×10^{-16}	-2.36802×10^{-15}	2.10993×10^{-16}
GLCDpp	0.	0.	0.
GLCabcpp	0.	0.	0.
GLNS	0.	0.	0.
GLNabc	0.	0.	0.
GLUDy	0.	0.	0.
GLUN	-1.59698×10^{-15}	1.	$-2.$
GLUSy	8.79966×10^{-16}	$-1.$	2.
GLUt2r	-9.88925×10^{-16}	1.	$-2.$

GLYCT	3.61459×10^{-16}	1.10607×10^{-15}	5.43842×10^{-17}	$-$
GLYK	3.29452×10^{-16}	1.19706×10^{-15}	-3.98455×10^{-16}	$-$
GND	1.45235×10^{-15}	0.5	-2.24362×10^{-15}	$($
GNK	$-1.$	-4.11317×10^{-15}	1.67143×10^{-14}	$($
H2Ot	-2.65591×10^{-15}	0.5	$-4.$	
HCO3E	$0.$	$0.$	$0.$	
HEX1	-9.8372×10^{-17}	1.11504×10^{-15}	-8.98386×10^{-16}	$-$
ICDHyr	4.41596×10^{-16}	$-1.$	$2.$	
ICL	1.96763×10^{-16}	$1.$	$-2.$	
KDPGALDOL	-4.74144×10^{-16}	0.5	4.94145×10^{-15}	$-$
LDH_D	-1.66751×10^{-16}	7.3016×10^{-16}	-4.37225×10^{-16}	$($
MALS	-7.97845×10^{-17}	$1.$	$-2.$	
MALt2_2	-6.01875×10^{-16}	-2.5	$3.$	
MDH	$0.$	$0.$	$0.$	
ME1	$0.$	$0.$	$0.$	
ME2	-1.23847×10^{-15}	-1.5	$1.$	$-$
NADH16	-5.30044×10^{-16}	2.32094×10^{-15}	-4.00482×10^{-16}	$-$
NADTRHD	$0.$	$0.$	$0.$	
NH4t	1.21389×10^{-15}	$-1.$	$2.$	
O2t	-1.88758×10^{-15}	$1.$	1.62612×10^{-15}	$-$
PC	$0.$	$0.$	$0.$	
PDH	3.00862×10^{-16}	$1.$	$-3.$	
PGI	-4.51799×10^{-16}	-1.16138×10^{-15}	1.28374×10^{-15}	$-$
PGL	-9.1503×10^{-16}	$1.$	-1.79137×10^{-14}	$-$
PGLCNDH	$1.$	-2.24877×10^{-15}	1.62156×10^{-15}	$-$
PGLUCONDEHYDRAT	-7.99247×10^{-16}	0.5	2.63118×10^{-15}	$-$
PIt2r	1.56235×10^{-15}	$-1.$	6.38679×10^{-15}	$\angle$
PPC	9.7774×10^{-17}	1.34455×10^{-15}	8.51874×10^{-17}	$-$
PPCK	9.29672×10^{-16}	-9.17814×10^{-16}	1.12195×10^{-15}	$($
PROTOCATECHUATE-DECARBOXYLASE-RXN	-1.81355×10^{-15}	$1.$	2.05277×10^{-15}	$-$
PTAr	4.744×10^{-16}	-1.8341×10^{-15}	1.97902×10^{-16}	$($
PYK	9.45149×10^{-16}	$-1.$	1.44819×10^{-15}	$($
PYRt2	1.42916×10^{-18}	$3.$	$-4.$	
RPE	1.35531×10^{-15}	-3.62676×10^{-16}	-3.34957×10^{-15}	$($
RPI	-6.69205×10^{-16}	-0.5	7.1437×10^{-16}	$($
SUCCt2_2	-0.333333	-1.66667	$2.$	
SUCCt3	-0.333333	-0.666667	2.86628×10^{-15}	
TALA	2.70501×10^{-16}	0.5	9.10771×10^{-16}	$\{$
THD2	$1.$	$1.$	$-1.$	$($
TKT1	-4.36633×10^{-16}	-0.5	-2.79777×10^{-16}	$($
TKT2	4.60158×10^{-16}	-0.5	-2.36506×10^{-15}	
TPI	4.15975×10^{-17}	-1.15779×10^{-15}	1.55466×10^{-15}	$-$
XYLA	$0.$	$0.$	$0.$	
XYL_ABC	3.00696×10^{-15}	$-1.$	-4.72645×10^{-17}	$-$
muconate_sink	-1.40706×10^{-15}	$1.$	1.35055×10^{-15}	$-$

Out[347]//MatrixForm=

2DHGLCK	1	0	0	0	0
3-DEHYDROQUINATE-DEHYDRATASE-RXN	0	1	0	0	0
3-DEHYDROQUINATE-SYNTHASE-RXN	0	1.	0	0	0
ACALD	0	0	1	0	0
ACALDt	0	0	0	1	0
ACKr	0	0	0	0	1
ACONTa	0	0	0	0	0
ACONTb	0	0	0	0	0
ACt2r	0	0	0	0	1.
ADK1	0	0	0	0	0
AKGDH	0	0	0	0	0
AKGt2r	0	0	0	0	0
ALCD2x	0	0	1.	−1.	0
ATPM	0	0	0	0	0
ATPS4r	0	0	0	0	0
Biomass_Ecoli_core_w_GAM	0	0	0	0	0
CATECHOL-12-DIOXYGENASE-RXN	0	1.	0	0	0
CO2t	0	0	0	0	0
CS	0	0	0	0	0
CYTBD	0	0	0	0	0
DAHPSYN-RXN	0	1.	0	0	0
DHSHIKIMATE-DEHYDRO-RXN	0	1.	0	0	0
D_LACt2	0	0	0	0	0
ENO	0	0	0	0	0
ETOHt2r	0	0	1.	−1.	0
EX_ac_e	0	0	0	0	0
EX_acald_e	0	0	0	0	0
EX_akg_e	0	0	0	0	0
EX_co2_e	0	0	0	0	0
EX_etoh_e	0	0	0	0	0
EX_fum_e	0	0	0	0	0
EX_glc_e	0	0	0	0	0
EX_gln__L_e	0	0	0	0	0
EX_glu__L_e	0	0	0	0	0
EX_glyc_e	0	0	0	0	0
EX_h2o_e	0	0	0	0	0
EX_h_e	0	0	0	0	0
EX_lac__D_e	0	0	0	0	0
EX_mal__L_e	0	0	0	0	0
EX_nh4_e	0	0	0	0	0
EX_o2_e	0	0	0	0	0
EX_pi_e	0	0	0	0	0
EX_pyr_e	0	0	0	0	0
EX_succ_e	0	0	0	0	0
EX_xyl_e	0	0	0	0	0
FBA	0	0	0	0	0
FBP	0	0	0	0	0
FRD7	0	0	0	0	0
FUM	0	0	0	0	0
FUMt2_2	0	0	0	0	0
G3PD	0	0	0	0	0
G6PDH2r	0	0	0	0	0

GADktpp	1.	0	0	0	0
GAPD	0	0	0	0	0
GLCDpp	0	0	0	0	0
GLCabcpp	0	0	0	0	0
GLNS	0	0	0	0	0
GLNabc	0	0	0	0	0
GLUDy	0	0	0	0	0
GLUN	0	1.	−2.	1.	0
GLUSy	0	−1.	2.	−1.	0
GLUt2r	0	1.	−2.	1.	0
GLYCT	0	0	0	0	0
GLYK	0	0	0	0	0
GND	0	0.5	0	0	0
GNK	−1.	0	0	0	0
H2Ot	0	0.5	−4.	2.	−1.
HCO3E	0	0	0	0	0
HEX1	0	0	0	0	0
ICDHyr	0	−1.	2.	−1.	0
ICL	0	1.	−2.	1.	0
KDPGALDOL	0	0.5	0	0	0
LDH_D	0	0	0	0	0
MALS	0	1.	−2.	1.	0
MALt2_2	0	−2.5	3.	−1.	1.
MDH	0	0	0	0	0
ME1	0	0	0	0	0
ME2	0	−1.5	1.	0	1.
NADH16	0	0	0	0	0
NADTRHD	0	0	0	0	0
NH4t	0	−1.	2.	−1.	0
O2t	0	1.	0	0	0
PC	0	0	0	0	0
PDH	0	1.	−3.	1.	−1.
PGI	0	0	0	0	0
PGL	0	1.	0	0	0
PGLCNDH	1.	0	0	0	0
PGLUCONDEHYDRAT	0	0.5	0	0	0
PIt2r	0	−1.	0	0	0
PPC	0	0	0	0	0
PPCK	0	0	0	0	0
PROTOCATECHUATE-DECARBOXYLASE-RXN	0	1.	0	0	0
PTAr	0	0	0	0	−1.
PYK	0	−1.	0	0	0
PYRt2	0	3.	−4.	1.	−2.
RPE	0	0	0	0	0
RPI	0	−0.5	0	0	0
SUCCt2_2	−0.333333	−1.66667	2.	−0.666667	0.333333	−0
SUCCt3	−0.333333	−0.666667	0	0.333333	0.333333	−0
TALA	0	0.5	0	0	0
THD2	1.	1.	−1.	0	−1.
TKT1	0	−0.5	0	0	0
TKT2	0	−0.5	0	0	0
TPI	0	0	0	0	0
XYLA	0	0	0	0	0
XYL_ABC	0	−1.	0	0	−1.
muconate sink	0	1.	0	0	0

In[348]:= **(* Print the application of the "null space" to the "whole" matrix,**
then replace values in the neighborhood of zero with zero. *)
(* By definition, all elements of the block for
** intracellular metabolites are in the neighborhood of zero. *)**
Dimensions[stoichiometryMatrix.intracellularNullspaceMatrix]
MatrixForm[stoichiometryMatrix.intracellularNullspaceMatrix,
** TableHeadings → {metaboliteIds}]**
MatrixForm[stoichiometryMatrix.intracellularNullspaceMatrix /.
** x_ /; (Abs[x] ≤ tolerance) → 0, TableHeadings → {metaboliteIds}]**

Out[348]= {80, 51}

Out[349]//MatrixForm=

2dda7p_c	1.94986×10^{-15}	7.66054×10^{-15}	1.1177×10^{-15}	1.02214×10^{-15}	-1.51638
2ddg6p_c	-3.25103×10^{-16}	3.33067×10^{-15}	-2.31026×10^{-15}	-1.33139×10^{-15}	-6.9928
2dhglcn_c	-6.66134×10^{-16}	3.64523×10^{-15}	-1.63177×10^{-14}	-3.71331×10^{-14}	2.45814
34dhbz_c	8.83519×10^{-16}	-7.10543×10^{-15}	5.35799×10^{-16}	7.96999×10^{-15}	-7.04539
3dhq_c	-2.37917×10^{-15}	-7.66054×10^{-15}	$0.$	$0.$	$0.$
3dhsk_c	9.30027×10^{-16}	1.04361×10^{-14}	-2.58857×10^{-15}	-4.88608×10^{-15}	2.06925
3pg_c	-2.16202×10^{-16}	-2.36802×10^{-15}	2.10993×10^{-16}	3.10657×10^{-16}	-1.57949
6p2dhglcn_c	-8.88178×10^{-16}	2.24877×10^{-15}	-1.62156×10^{-15}	2.89611×10^{-16}	-1.59384
6pgc_c	-9.7711×10^{-16}	-9.99201×10^{-16}	3.46284×10^{-17}	6.46206×10^{-16}	-7.83254
ac_c	-1.30775×10^{-17}	-1.62384×10^{-15}	-6.63595×10^{-16}	-1.99134×10^{-15}	1.77636
xu5p__D_c	4.58521×10^{-16}	4.44089×10^{-16}	-1.26429×10^{-15}	1.57523×10^{-15}	-6.61992
acald_c	4.46825×10^{-16}	9.59441×10^{-16}	4.44089×10^{-16}	1.44329×10^{-15}	-3.25933
succ_c	2.22045×10^{-16}	-9.99201×10^{-16}	-3.97651×10^{-15}	2.44249×10^{-15}	-7.77156
accoa_c	3.54557×10^{-16}	1.61205×10^{-15}	-1.97902×10^{-16}	2.26965×10^{-15}	2.22045
acon_c	-9.85888×10^{-16}	-6.79745×10^{-15}	-4.0464×10^{-16}	2.35185×10^{-15}	-3.81423
actp_c	4.744×10^{-16}	-1.8341×10^{-15}	1.97902×10^{-16}	1.06102×10^{-15}	-8.88178
adp_c	2.338×10^{-15}	6.66134×10^{-16}	1.33085×10^{-14}	-1.5524×10^{-14}	-2.33147
akg_c	-4.3837×10^{-16}	-3.10862×10^{-15}	-6.66134×10^{-16}	4.44089×10^{-16}	4.02293
s7p_c	1.66132×10^{-16}	8.88178×10^{-16}	-6.30994×10^{-16}	-1.2248×10^{-15}	-6.75668
amp_c	4.34181×10^{-16}	-1.07348×10^{-15}	7.62245×10^{-16}	-8.3415×10^{-16}	1.3626
nadph_c	-2.33147×10^{-15}	-1.33227×10^{-15}	7.77156×10^{-16}	2.47846×10^{-15}	6.66134
catechol_c	-4.18018×10^{-16}	-3.33067×10^{-15}	3.95812×10^{-15}	-1.30882×10^{-15}	2.42834
ccmuac_c	1.15365×10^{-17}	1.55431×10^{-15}	-3.2559×10^{-15}	2.22258×10^{-15}	-1.43852
cit_c	-4.48311×10^{-16}	-2.2273×10^{-15}	2.45058×10^{-15}	-1.43166×10^{-15}	5.82795
co2_c	7.24584×10^{-17}	-2.66454×10^{-15}	3.61882×10^{-15}	-4.02476×10^{-16}	6.40406
ru5p__D_c	-5.7217×10^{-16}	-8.88178×10^{-16}	1.82032×10^{-15}	-1.25022×10^{-15}	1.61563
coa_c	-3.54557×10^{-16}	-1.61205×10^{-15}	1.97902×10^{-16}	-2.26965×10^{-15}	-2.22045
dhap_c	4.15975×10^{-17}	-1.15779×10^{-15}	1.55466×10^{-15}	-2.34797×10^{-16}	5.84881
e4p_c	2.3965×10^{-16}	1.25455×10^{-14}	2.15813×10^{-15}	-8.11351×10^{-16}	1.02625
etoh_c	4.72065×10^{-16}	-5.01954×10^{-15}	4.44089×10^{-16}	6.66134×10^{-16}	-5.81406
f6p_c	1.15903×10^{-16}	-2.9976×10^{-15}	-3.4092×10^{-16}	9.39867×10^{-16}	4.63059
fdp_c	1.62957×10^{-16}	1.49394×10^{-16}	1.70375×10^{-16}	9.66515×10^{-17}	4.29101

f6p_c	1.62957×10	1.49394×10	1.70375×10	-9.66515×10	4.29101
fum_c	-1.95548×10^{-16}	-2.31561×10^{-15}	1.70375×10^{-16}	9.66515×10^{-16}	-1.00719
r5p_c	2.32572×10^{-16}	2.55351×10^{-15}	-9.94147×10^{-16}	3.49338×10^{-16}	4.86664
g3p_c	3.2675×10^{-16}	2.49005×10^{-15}	1.79746×10^{-16}	-1.84087×10^{-15}	1.95606
g6p_c	3.53427×10^{-16}	2.27642×10^{-15}	-2.18213×10^{-15}	2.27309×10^{-16}	-3.14332
glc__D_c	9.8372×10^{-17}	-1.11504×10^{-15}	8.98386×10^{-16}	4.56966×10^{-16}	1.70522
q8h2_c	-5.30044×10^{-16}	2.32094×10^{-15}	-4.00482×10^{-16}	-4.5155×10^{-16}	2.38611
glcn_c	8.88178×10^{-16}	4.67944×10^{-16}	-3.96558×10^{-16}	-1.00536×10^{-15}	-1.38753
gln__L_c	7.1701×10^{-16}	1.22125×10^{-15}	-6.66134×10^{-16}	-2.22045×10^{-16}	-1.31114
q8_c	5.30044×10^{-16}	-2.32094×10^{-15}	4.00482×10^{-16}	4.5155×10^{-16}	-2.38611
glu__L_c	-8.25968×10^{-16}	-4.21885×10^{-15}	3.77476×10^{-15}	1.33227×10^{-15}	1.62383
pyr_c	-9.00147×10^{-16}	-1.77636×10^{-15}	-1.77636×10^{-15}	1.55431×10^{-15}	8.88178
glx_c	2.76547×10^{-16}	-1.55431×10^{-15}	1.9984×10^{-15}	-4.44089×10^{-16}	2.98448
glyc3p_c	3.29452×10^{-16}	1.19706×10^{-15}	-3.98455×10^{-16}	-4.46504×10^{-17}	-2.04762
glyc_c	3.20068×10^{-17}	-9.09962×10^{-17}	4.52839×10^{-16}	-2.15614×10^{-16}	-2.63518
pi_c	1.43746×10^{-15}	2.44249×10^{-15}	6.96314×10^{-15}	-1.56846×10^{-14}	-3.33067
h2o_c	-4.74567×10^{-15}	2.22045×10^{-16}	-1.20485×10^{-14}	1.47907×10^{-14}	$0.$
pep_c	3.16056×10^{-16}	1.82077×10^{-14}	-1.52912×10^{-15}	-8.13669×10^{-17}	1.55307
h_c	3.34003×10^{-15}	-2.16493×10^{-14}	1.41636×10^{-14}	-1.78582×10^{-14}	-5.55112
oaa_c	-3.83587×10^{-16}	4.48967×10^{-15}	-3.48735×10^{-15}	1.04283×10^{-16}	-1.04859
hco3_c	-9.7774×10^{-17}	-1.34455×10^{-15}	-8.51874×10^{-17}	6.44343×10^{-16}	-4.29101
icit_c	3.47529×10^{-16}	4.88498×10^{-15}	1.77636×10^{-15}	-1.55431×10^{-15}	2.47963
lac__D_c	-1.66751×10^{-16}	7.3016×10^{-16}	-4.37225×10^{-16}	2.72438×10^{-17}	7.37889
o2_c	-4.92056×10^{-16}	-1.55431×10^{-15}	3.53147×10^{-15}	-2.13719×10^{-15}	2.36568
mal__L_c	5.56812×10^{-16}	-1.9984×10^{-15}	4.44089×10^{-16}	-9.81354×10^{-16}	-2.22045
nh4_c	-3.83085×10^{-16}	-3.21965×10^{-15}	2.22045×10^{-16}	-2.22045×10^{-16}	-3.01911
nad_c	-1.66533×10^{-15}	-4.44089×10^{-15}	2.22045×10^{-16}	-3.46819×10^{-16}	$0.$
nadh_c	1.66533×10^{-15}	4.44089×10^{-15}	-2.22045×10^{-16}	3.46819×10^{-16}	$0.$
nadp_c	2.33147×10^{-15}	1.33227×10^{-15}	-7.77156×10^{-16}	-2.47846×10^{-15}	-6.66134
atp_c	-2.67107×10^{-15}	4.44089×10^{-16}	-1.40707×10^{-14}	1.63581×10^{-14}	8.88178
mal__L_e	6.01875×10^{-16}	2.5	$-3.$	$1.$	-1
nh4_e	-1.21389×10^{-15}	$1.$	$-2.$	$1.$	1.12435
lac__D_e	$0.$	$0.$	$0.$	$0.$	$0.$
o2_e	1.88758×10^{-15}	$-1.$	-1.62612×10^{-15}	3.91228×10^{-15}	1.42737
h_e	-2.77556×10^{-15}	$4.$	$-2.$	$1.$	-1
h2o_e	2.65591×10^{-15}	-0.5	$4.$	$-2.$	$1.$
glyc_e	-3.61459×10^{-16}	-1.10607×10^{-15}	-5.43842×10^{-17}	2.60265×10^{-16}	4.68281
pi_e	-1.56235×10^{-15}	$1.$	-6.38679×10^{-15}	-4.00275×10^{-14}	1.30614
glu__L_e	9.88925×10^{-16}	$-1.$	$2.$	$-1.$	1.76005
pyr_e	-1.42916×10^{-18}	$-3.$	$4.$	$-1.$	$2.$
gln__L_e	$0.$	$0.$	$0.$	$0.$	$0.$
glc__D_e	$0.$	$0.$	$0.$	$0.$	$0.$

fum_e	1.95548×10^{-16}	2.31561×10^{-15}	-1.70375×10^{-16}	-9.66515×10^{-16}	1.00719
co2_e	$0.$	$0.$	$0.$	$0.$	$0.$
akg_e	$0.$	$0.$	$0.$	$0.$	$0.$
acald_e	$0.$	$0.$	$0.$	$-1.$	$0.$
succ_e	$0.$	$1.$	$-2.$	$1.$	2.77556
toh_e	-9.1889×10^{-16}	4.0601×10^{-15}	$-1.$	$1.$	9.07339
ac_e	1.30775×10^{-17}	1.62384×10^{-15}	6.63595×10^{-16}	1.99134×10^{-15}	-1

Out[350]//MatrixForm=

2dda7p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2ddg6p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2dhglcn_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34dhbz_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3dhq_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3dhsk_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3pg_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6p2dhglcn_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6pgc_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ac_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
xu5p__D_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
acald_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
succ_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
accoa_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
acon_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
actp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
adp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
akg_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
s7p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
amp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
nadph_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
catechol_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ccmuac_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cit_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
co2_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ru5p__D_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
coa_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
dhap_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e4p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
etoh_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f6p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fdp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fum_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
r5p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g3p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
g6p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glc__D_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
q8h2_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glcn_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gln__L_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
q8_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glu__L_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

pyr_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glx_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glyc3p_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glyc_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pi_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
h2o_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pep_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
h_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
oaa_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hco3_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
icit_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lac__D_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o2_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mal__L_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
nh4_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
nad_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
nadh_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
nadp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
atp_c	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mal__L_e	0	2.5	-3.	1.	-1.	1.	0	1.	0	0	13.7696	2.	1.	-1.	-1.	0
nh4_e	0	1.	-2.	1.	0	-1.	0	0	0	0	5.9425	1.	1.	-1.	-1.	0
lac__D_e	0	0	0	0	0	0	0	0	0	0	0	0	0	-1.	0	0
o2_e	0	-1.	0	0	0	0	0	0	0	0	0	0	-0.5	0	0	0
h_e	0	4.	-2.	1.	-1.	1.	0	1.	0	0	24.4529	2.	1.	-1.	1.	0
h2o_e	0	-0.5	4.	-2.	1.	0	0	-1.	0	0	-18.7278	-2.	-1.	2.	1.	0
glyc_e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pi_e	0	1.	0	0	0	0	0	0	0	0	-0.5191	0	0	0	1.	0
glu__L_e	0	-1.	2.	-1.	0	1.	0	0	0	0	-11.3953	-1.	-1.	1.	1.	0
pyr_e	0	-3.	4.	-1.	2.	-3.	0	-1.	0	0	-20.9884	-2.	-1.	2.	3.	0
gln__L_e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
glc__D_e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fum_e	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
co2_e	0	0	0	0	0	0	0	0	0	0	0	-1.	0	0	0	0
akg_e	0	0	0	0	0	0	0	-1.	0	0	0	0	0	0	0	0
acald_e	0	0	0	-1.	0	0	0	0	0	0	0	0	0	0	0	0	-
succ_e	0	1.	-2.	1.	0	0	0	1.	0	0	10.3164	1.	1.	-1.	-1.	0
toh_e	0	0	-1.	1.	0	0	0	0	0	0	0	0	0	0	0	0
ac_e	0	0	0	0	-1.	0	0	0	0	0	0	0	0	0	0	-1.