System of equations (25 unknows & 25 equations)

```
syms Mpa Msa1 Msa2 Msa3 P1 P2 P3 P4 P5 P6 P7 P8 P9 P2p P3p P5p P7p P9p P3pp
P5pp P7pp P1ppp P3ppp P5ppp P7ppp

ff1  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P1/rhoA -
(1+kent)*(Mpa/rhoA/A1)^2/2;

ff2  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P1/rhoA +
P2/rhoT + (1+kbend+kexp)*(Mpa/rhoT/A2)^2/2 - (Mpa/rhoA/A1)^2/2 + g*z2;

ff3  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P2/rhoT +
P3/rhoT + (1+kcont)*(Mpa/rhoT/A3)^2/2 - (Mpa/rhoT/A2)^2/2 + g*(z3-z2) +
C1*(z3-z2)/rhoT/A2*Mpa + C2*(z3-z2)/rhoT/A2^2*Mpa^2;

ff4  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P3/rhoT +
P3ppp/rhoT + g*(z3pp-z3) + C1*(z3pp-z3)/rhoT/A3*Mpa + C2*(z3pp-
z3)/rhoT/A3^2*Mpa^2;

ff5  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P3p/rhoA -
g*z3p;

ff6  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P3pp/rhoA +
P3p/rhoA - (1+kent)*(Msa1/rhoA/A3pp)^2/2;

ff7  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P3pp/rhoA +
P3ppp/rhoT + C1*d4/2/rhoT/A3pp*Msa1 + C2*d4/2/rhoT/A3pp^2*Msa1^2;

ff8  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P3ppp/rhoT +
P4/rhoT + (1+kexp)*((Mpa+Msa1)/rhoT/A4)^2/2 - ((Mpa+Msa1)/rhoT/A3)^2/2 +
g*(z4-z3pp) + C1*(z4-z3pp)/rhoT/A4*(Mpa+Msa1) + C2*(z4-
z3pp)/rhoT/A4^2*(Mpa+Msa1)^2;

ff9  = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P4/rhoT +
P5/rhoT + (1+kexp)*((Mpa+Msa1)/rhoT/A5)^2/2 - ((Mpa+Msa1)/rhoT/A4)^2/2 +
g*(z5-z4);

ff10 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P5/rhoT +
P5ppp/rhoT + g*(z5pp-z5);

ff11 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P2p/rhoA +
P5p/rhoA + g*(z5p-z2) ;
ff12 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P5pp/rhoA +
P5p/rhoA - (0+kent)*(Msa2/rhoA/A5pp)^2/2 ;
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ff13 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P5pp/rhoA +
P5ppp/rhoT + (Msa2/rhoT/A5pp)^2/2 - (Msa2/rhoA/A5pp)^2/2 ;

ff14 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P5ppp/rhoT +
P6/rhoT + g*(z6-z5pp);

ff15 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P6/rhoT +
P7/rhoT + g*(z7-z6) + (1)*((Mpa+Msa1+n1*Msa2)/rhoT/A7)^2/2 -
((Mpa+Msa1+n1*Msa2)/rhoT/A6)^2/2;

ff16 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P7/rhoT +
P7ppp/rhoT + g*(z7pp-z7);

ff17 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P5p/rhoA +
P7p/rhoA + g*(z7p-z5p);

ff18 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P7pp/rhoA  +
P7p/rhoA - (0+kent)*(Msa3/rhoA/A7pp)^2/2;

ff19 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P7pp/rhoA +
P7ppp/rhoT + (Msa3/rhoT/A7pp)^2/2 - (Msa3/rhoA/A7pp)^2/2 ;

ff20 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P7ppp/rhoT +
P8/rhoT + g*(z8-z7pp);

ff21 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P8/rhoT +
P9/rhoT + g*(z9-z8) + (1)*((Mpa+Msa1+n1*Msa2+n2*Msa3)/rhoT/A9)^2/2 -
((Mpa+Msa1+n1*Msa2+n2*Msa3)/rhoT/A8)^2/2;

ff22 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P9/rhoT +
P9p/rhoT  - (1+kexit)*((Mpa+Msa1+n1*Msa2+n2*Msa3)/rhoT/A9)^2/2;

ff23 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P9p/rhoA -
g*z9;

ff24 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P1ppp/rhoA +
P2p/rhoA  + (1+kbend+kexp)*((n1*Msa2+n2*Msa3)/rhoA/A2p)^2/2 -
((n1*Msa2+n2*Msa3)/rhoA/A1ppp)^2/2 + g*z2 ;

ff25 = @(Mpa, Msa1, Msa2, Msa3, P1, P2, P3, P4, P5, P6, P7, P8, P9, P2p, P3p,
P5p, P7p, P9p, P3pp, P5pp, P7pp, P1ppp, P3ppp, P5ppp, P7ppp)  -P1ppp/rhoA -
(1+kent)*((n1*Msa2+n2*Msa3)/rhoA/A1ppp)^2/2;
```

Constants for 25 equations

Name	Value
[A1...]	0.0024
A1ppp	0.0030
A2	0.0064
A2p	0.0120
A3	0.0064
A3pp	0.0018
A4	0.0064
A5	0.0064
A5p	0.0120
A5pp	1.3273e-04
A6	0.0064
A7	0.0064
A7p	0.0120
A7pp	1.3273e-04
A8	0.0064
A9	0.0064
Agr	0.0240
b1	0.0800
b2	0.0800
b3	0.0800
b3pp	0.0600
b4	0.0800
b5pp	0.0800
b7	0.0800
b7pp	0.0800
BG	0.0800
c1	180
C1	328.1896
c2	1.8000
C2	2.9101e+03
Cb	0.0500
d1h	0.0436
d2	0.0800
d2h	0.0800
d3	0.0800
d4	0.0800
d7	0.0800
Dchar	0.0200
Dgr	0.1000
e	1.5562e-07
e_max	1.0000e-06
e_n	1.5562e-07
EPchar	0.3500
f	-2.7500
ff1	@(Mpa,Msa1,M
ff10	@(Mpa,Msa1,M
ff11	@(Mpa,Msa1,M
ff12	@(Mpa,Msa1,M
ff13	@(Mpa,Msa1,M

Name	Value
ff14	@(Mpa,Msa1,
ff15	@(Mpa,Msa1,
ff16	@(Mpa,Msa1,
ff17	@(Mpa,Msa1,
ff18	@(Mpa,Msa1,
ff19	@(Mpa,Msa1,
ff2	@(Mpa,Msa1,
ff20	@(Mpa,Msa1,
ff21	@(Mpa,Msa1,
ff22	@(Mpa,Msa1,
ff23	@(Mpa,Msa1,
ff24	@(Mpa,Msa1,
ff25	@(Mpa,Msa1,
ff3	@(Mpa,Msa1,
ff4	@(Mpa,Msa1,
ff5	@(Mpa,Msa1,
ff6	@(Mpa,Msa1,
ff7	@(Mpa,Msa1,
ff8	@(Mpa,Msa1,
ff9	@(Mpa,Msa1,
ffun	25x1 cell
ffun_numeric	25x1 double
Fo	0.0300
g	9.8100
Gh	0.0300
Hd	0.0130
i	25
iter	7
j	25
J	25x25 cell
JJ	25x25 double
kbend	1
kcont	0.3000
kent	0.5000
kexit	1
kexp	0.4000
kgrate	3.1886
Kp	1
LG	0.0500
Lgr	0.0800
M_pa	16.1516
M_sa1	6.5411
M_sa2	95.7600
M_sa3	67.0320
Mpa	1x1 sym
Msa1	1x1 sym
Msa2	1x1 sym
Msa3	1x1 sym
muT	3.4700e-05

Name	Value
n1	10
n2	7
Ngr	3
P1	1x1 sym
P1ppp	1x1 sym
P2	1x1 sym
P2p	1x1 sym
P3	1x1 sym
P3p	1x1 sym
P3pp	1x1 sym
P3ppp	1x1 sym
P4	1x1 sym
P5	1x1 sym
P5p	1x1 sym
P5pp	1x1 sym
P5ppp	1x1 sym
P6	1x1 sym
P7	1x1 sym
P7p	1x1 sym
P7pp	1x1 sym
P7ppp	1x1 sym
P8	1x1 sym
P9	1x1 sym
P9p	1x1 sym
rhoA	1.1729
rhoT	0.4689
SAp1	0.0130
SAp2	0.0130
SAr1	0.0300
SAr2	0.0060
SAr3	0.0295
Tamb	28
Tcs	480
v_pa	0.1122
v_sa1	0.0606
v_sa2	1.2024
v_sa3	1.2024
var	1x25 sym
X1	25x1 cell
X1_corr	25x1 double
z1	0
z2	0.0300
z3	0.0800
z3p	0.0950
z3pp	0.0950
z4	0.1100
z5	0.1400
z5p	0.1465
z5pp	0.1465

Name	Value
P2p	1x1 sym
P3	1x1 sym
P3p	1x1 sym
P3pp	1x1 sym
P3ppp	1x1 sym
P4	1x1 sym
P5	1x1 sym
P5p	1x1 sym
P5pp	1x1 sym
P5ppp	1x1 sym
P6	1x1 sym
P7	1x1 sym
P7p	1x1 sym
P7pp	1x1 sym
P7ppp	1x1 sym
P8	1x1 sym
P9	1x1 sym
P9p	1x1 sym
rhoA	1.1729
rhoT	0.4689
SAp1	0.0130
SAp2	0.0130
SAr1	0.0300
SAr2	0.0060
SAr3	0.0295
Tamb	28
Tcs	480
v_pa	0.1122
v_sa1	0.0606
v_sa2	1.2024
v_sa3	1.2024
var	1x25 sym
X1	25x1 cell
X1_corr	25x1 double
z1	0
z2	0.0300
z3	0.0800
z3p	0.0950
z3pp	0.0950
z4	0.1100
z5	0.1400
z5p	0.1465
z5pp	0.1465
z6	0.1530
z7	0.1590
z7p	0.1655
z7pp	0.1655
z8	0.1720
z9	0.2015

Results

Mpa = 16.15 LPM

Msa1 = 6.54 LPM

Msa2 = 95.76 LPM

Msa3 = 67.03 LPM

P1   = -0.011 Pa

P1ppp = -0.720 Pa

P2   = -0.146 Pa

P2p   = -0.657 Pa

P3   = -1.540 Pa

P3p   = -1.093 Pa

P3pp   = -1.096 Pa

P3ppp = -1.958 Pa

P4   = -2.580 Pa

P5   = -2.720 Pa

P5p   = -1.997 Pa

P5pp   = -2.421 Pa

P5ppp = -2.750 Pa

P6   = -2.780 Pa

P7   = -2.808 Pa

P7p   = -2.216 Pa

P7pp   = -2.640 Pa

P7ppp = -2.838 Pa

P8   = -2.867 Pa

P9   = -3.003 Pa

P9p   = -2.319 Pa