Steady-State Analysis

① $\frac{da}{dt} = -r_1 a + r_{-1} b - r_3 ac$

$0 = -r_1 a + r_{-1} b - r_3 ac$

$r_1 a + r_3 ac = r_{-1} b \quad \Rightarrow \quad c = \frac{r_{-1} b}{r_3 a} - \frac{r_1 a}{r_3 a}$

$$\boxed{c = \frac{r_{-1}}{r_3} \cdot \frac{b}{a} - \frac{r_1}{r_3}}$$

② $\frac{db}{dt} = r_1 a - r_{-1} b + r_{-2} c - r_2 b + 2 r_3 ac$

$0 = r_1 a - r_{-1} b + r_{-2} c - r_2 b + 2 r_3 ac$

$r_{-1} b + r_2 b = r_1 a + r_{-2} c + 2 r_3 ac$

$r_{-1} b = r_1 a + r_{-2} c + 2 r_3 ac - r_2 b$

Plug in $r_{-1} b$ from ① ...

$r_{-1} b = \cancel{r_1 a} + r_{-2} c + 2 r_3 ac - r_2 b = \cancel{r_1 a} + r_3 ac$

$r_{-2} c + r_3 ac = r_2 b \qquad *$

$c(r_{-2} + r_3 a) = r_2 b$

$$\boxed{c = \frac{r_2 b}{r_{-2} + r_3 a}}$$

③ $\frac{dc}{dt} = -r_{-2} c + r_2 b - r_3 ac$

$0 = -r_{-2} c + r_2 b - r_3 ac$

$r_{-2} c + r_3 ac = r_2 b \rightarrow$ same as * in ②

Lsquared.

$$\frac{r_2 b}{r_{-2} + r_3 a} = \frac{r_{-1} b}{r_3 a} - \frac{r_1 a}{r_3 a}$$

$$\frac{r_2 b}{r_{-2} + r_3 a} = \frac{r_{-1} b - r_1 a}{r_3 a}$$

$$r_2 b \cdot r_3 a = (r_{-1} b - r_1 a)(r_{-2} + r_3 a)$$

$$r_2 r_3 ab = r_{-1} r_{-2} b + r_{-1} r_3 ab - r_1 r_{-2} a - r_1 r_3 a^2$$

$$0 = -r_1 r_3 a^2 - r_1 r_{-2} a + ab(r_{-1} r_3 - r_2 r_3) + r_{-1} r_{-2} b$$