4.

$$\frac{d\langle n\rangle}{dt} = k_1 (N - 2\langle n\rangle) + \frac{k_3}{v^2} (3N \langle n\rangle^2 - N^2 - 2\langle n\rangle^3)$$

5. For steady state set $\frac{\partial \langle n\rangle}{\partial t} = 0$

$$0 = k_1 (N - 2\langle n\rangle) + \frac{k_3}{v^2} (3N\langle n\rangle^2 - N^2\langle n\rangle - 2\langle n\rangle^3)$$

$$0 = k_1 N - 2k_1\langle n\rangle + \frac{3k_3}{v^2} N\langle n\rangle^2 - \frac{2k_3}{v^2}\langle n\rangle^3 - \frac{k_3}{v^2} N^2 \langle n\rangle$$

$$-\frac{2k_3}{v^2}\langle n\rangle^3 + \frac{3k_3}{v^2} N\langle n\rangle^2 - \left(2k_1 + \frac{k_3}{v^2} N^2\right)\langle n\rangle + k_1 N = 0$$

rename: $r_1 = k_1$, $r_2 = k_2/v$, $r_3 = \frac{k_3}{v^2}$, $x = \langle n\rangle$

and fix: $N = 50$

by the symmetry of the system we can see that 25 is a steady state

$$-2r_3x^3 + 150r_3x^2 - (2r_1 + r_3^{\,50^2}) \cdot 50^2 \cancel{x^2} + 50\cancel{k}_1 = 0$$

$$-2r_3x^3 + 150r_3x^2 - (2r_1 + r_3^{\,50^2})\, 50^2 x + 50r_1 \qquad \frac{|x - 25}{-2r_3x^2 + 100xr_3 - 2r_1}$$

$$+2r_3x^3 - 50r_3x^2$$

$$100r_3x^2 - (2r_1 + r_3 \cdot 50^2) + 50r_1$$

$$-100r_3x^2 + 2500\, xr_3$$

$$-2r_1x + 50r_1$$

$$2r_1x - 50r_1$$

$A_1 = 25$ is a steady state.

The equation can be written as:

$$(x - 25)\underbrace{(-2r_3x^2 + 100x r_3 - 2r_1)}_{\text{Solve this eq.}} = 0$$