Solution 12-2
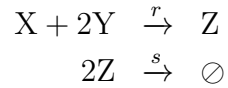
This is an example solution from the forthcoming book Networks and Complexity.
Find more exercises at https://github.com/NC-Book/NCB

Ex 12.2: Mass action laws [1]

Write the differential equations for x, y and z that correspond to the reaction diagram

$$X + 2Y \xrightarrow{r} Z$$
$$2Z \xrightarrow{s} \oslash$$

Solution

The first reaction occurs proportional to r, x and y^2. It decreases x by one unit, y by two units and increases z by one unit. So taking only this reaction into account would give us

$$\dot{x} = -rxy^2 \tag{1}$$
$$\dot{y} = -2rxy^2 \tag{2}$$
$$\dot{z} = rxy^2 \tag{3}$$

The second reaction occurs proportional to s and z^2 and reduces z by two units. Adding the term from this reaction we find the final result

$$\dot{x} = -rxy^2 \tag{4}$$
$$\dot{y} = -2rxy^2 \tag{5}$$
$$\dot{z} = rxy^2 - 2sz^2 \tag{6}$$