SBML Model Report

# Model name: “Carbo2013 - Mucosal Immune Response during H.pylori Infection”

May 6, 2016

## 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Vijayalakshmi Chelliah[1] and Adria Carbo[2] at September 17th 2013 at 12:08 a. m. and last time modified at April eighth 2016 at 5:37 p. m. Table 1 gives an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

| Element | Quantity | Element | Quantity |
|---|---|---|---|
| compartment types | 0 | compartments | 4 |
| species types | 0 | species | 41 |
| events | 2 | constraints | 0 |
| reactions | 88 | function definitions | 13 |
| global parameters | 109 | unit definitions | 3 |
| rules | 54 | initial assignments | 4 |

### Model Notes

## 2 Unit Definitions

This is an overview of five unit definitions of which two are predefined by SBML and not mentioned in the model.

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### 2.1 Unit volume

**Name** volume

**Definition** ml

### 2.2 Unit time

**Name** time

**Definition** 86400 s

### 2.3 Unit substance

**Name** substance

**Definition** item

### 2.4 Unit area

**Notes** Square metre is the predefined SBML unit for area since SBML Level 2 Version 1.

**Definition** $m^2$

### 2.5 Unit length

**Notes** Metre is the predefined SBML unit for length since SBML Level 2 Version 1.

**Definition** m

## 3 Compartments

This model contains four compartments.

Table 2: Properties of all compartments.

| Id | Name | SBO | Spatial Dimensions | Size | Unit | Constant | Outside |
|---|---|---|---|---|---|---|---|
| c1 | Lumen | 0000290 | 3 | 1 | litre | ☑ | |
| c2 | Lamina Propia | 0000290 | 3 | 1 | litre | ☑ | |
| c4 | Epithelium | 0000290 | 3 | 1 | litre | ☑ | |
| c3 | Gastric Lymph Node | 0000290 | 3 | 1 | litre | ☑ | |

### 3.1 Compartment c1

This is a three dimensional compartment with a constant size of one ml.

**Name** Lumen

**SBO:0000290** physical compartment

### 3.2 Compartment c2

This is a three dimensional compartment with a constant size of one ml.

**Name** Lamina Propia

**SBO:0000290** physical compartment

### 3.3 Compartment c4

This is a three dimensional compartment with a constant size of one ml.

**Name** Epithelium

**SBO:0000290** physical compartment

### 3.4 Compartment c3

This is a three dimensional compartment with a constant size of one ml.

**Name** Gastric Lymph Node

**SBO:0000290** physical compartment

## 4 Species

This model contains 41 species. The boundary condition of seven of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 11 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

| Id | Name | Compartment | Derived Unit | Constant | Boundary Condition |
|---|---|---|---|---|---|
| s1 | HP | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_7 | HP Dose | c1 | item · ml$^{-1}$ | ☑ | ☑ |
| species_10 | LB | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_11 | LB Dose | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_12 | nTh1 | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_13 | nTh1_LP | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_14 | nTh17 | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_15 | nTh17_LP | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_16 | nTreg | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| species_17 | nTreg_LP | c1 | item · ml$^{-1}$ | ☐ | ☐ |
| s9 | eDC | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s13 | Th1 | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s15 | iTreg | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s16 | Th17 | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s19 | M1 | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s21 | M2 | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s22 | M0 | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s25 | tDC | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s17 | emT | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| s6 | HP | c2 | item · ml$^{-1}$ | ☐ | ☐ |
| species_1 | iDC | c2 | item · ml$^{-1}$ | ☐ | ☐ |

| Id | Name | Compartment | Derived Unit | Constant | Boundary Condition |
|---|---|---|---|---|---|
| species_2 | TotalDC | c2 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_3 | TotalM | c2 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_4 | TotalT | c2 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_18 | eDCLB | c2 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| species_19 | pEC | c2 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s2 | E | c4 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s3 | Ep | c4 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| species_5 | Edead | c4 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s4 | iDC | c4 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s26 | eDC | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s27 | tDC | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s28 | nT | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s29 | cmT | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s30 | Th17 | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s31 | Th1 | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| s33 | iTreg | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |
| species_6 | TotalDC | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_8 | TotalT | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_9 | TotalT-s | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ☑ |
| species_20 | eDCLB | c3 | $\mathrm{item} \cdot \mathrm{ml}^{-1}$ | ⊟ | ⊟ |

## 5 Parameters

This model contains 109 global parameters.

Table 4: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| parameter_1 | vHP | | 0.500 | | ☑ |
| parameter_2 | vHP2 | | 0.500 | | ☐ |
| parameter_3 | aTreg | | 1.000 | | ☑ |
| parameter_4 | aTh17 | | 0.300 | | ☑ |
| parameter_5 | aTh1 | | 0.700 | | ☐ |
| parameter_7 | kEB | | $10^{-6}$ | | ☑ |
| parameter_8 | @eIE | | 0.500 | | ☑ |
| parameter_9 | @eEI | | 1.000 | | ☑ |
| parameter_10 | atreg | | $10^{-6}$ | | ☑ |
| parameter_11 | ath1 | | $7 \cdot 10^{-7}$ | | ☐ |
| parameter_12 | ath17 | | $3 \cdot 10^{-7}$ | | ☑ |
| parameter_13 | @uT | | 0.143 | | ☑ |
| parameter_14 | @vT | | 0.100 | | ☑ |
| parameter_15 | toemT | | 0.006 | | ☐ |
| parameter_16 | tcmT | | 0.009 | | ☐ |
| parameter_17 | pt | | 512.000 | | ☐ |
| parameter_18 | pT | | 128.000 | | ☐ |
| parameter_19 | uHP | | 1.000 | | ☑ |
| parameter_20 | lHP | | 2.000 | | ☑ |
| parameter_21 | @uE | | 1.000 | | ☑ |
| parameter_22 | Stim_emT_Th17 | | $3 \cdot 10^{-7}$ | | ☐ |
| parameter_23 | Stim_emT_Th1 | | $7 \cdot 10^{-7}$ | | ☐ |
| parameter_24 | Stim_emT_iTreg | | $10^{-6}$ | | ☐ |
| parameter_25 | Stim_cmT_Th1 | | $7 \cdot 10^{-7}$ | | ☐ |
| parameter_26 | Stim_cmT_Th17 | | $3 \cdot 10^{-7}$ | | ☐ |
| parameter_27 | Stim_cmT_iTreg | | $10^{-6}$ | | ☐ |
| parameter_28 | Stim_t_Th1 | | $7 \cdot 10^{-13}$ | | ☐ |
| parameter_29 | Stim_t_Th17 | | $3 \cdot 10^{-13}$ | | ☐ |
| parameter_30 | Stim_t_iTreg | | $10^{-12}$ | | ☐ |
| parameter_31 | Bc | | 1000.000 | | ☑ |
| parameter_32 | uCE | | $10^{-4}$ | | ☑ |
| parameter_33 | @et | | 100.000 | | ☑ |
| parameter_34 | @ut | | 1.000 | | ☑ |
| parameter_35 | @lt | | $10^{8}$ | | ☑ |
| parameter_36 | Bp | | 1.000 | | ☑ |
| parameter_37 | cyto_change | | $10^{-6}$ | | ☐ |
| parameter_38 | uM1 | | $10^{-4}$ | | ☑ |

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| parameter_39 | Bd | | 1.000 | | ☑ |
| parameter_40 | Br | | 1000.000 | | ☑ |
| parameter_41 | er | | 1000.000 | | ☑ |
| parameter_42 | kTD | | $10^{-6}$ | | ☑ |
| parameter_44 | udi_LP | | 1.000 | | ☑ |
| parameter_45 | um | | 1.000 | | ☑ |
| parameter_47 | k_lumen | | $10^{-6}$ | | ☑ |
| parameter_48 | k_LP | | $10^{-6}$ | | ☑ |
| parameter_49 | @pt_0 | | 512.000 | | ☑ |
| parameter_50 | @pT_0 | | 128.000 | | ☑ |
| parameter_51 | m_reg | | 0.010 | | ☑ |
| parameter_52 | m_HP | | 0.010 | | ☑ |
| parameter_53 | kGLN | | $10^{-6}$ | | ☑ |
| parameter_54 | HP_Ep_Lumen | | $10^{-6}$ | | ☐ |
| parameter_55 | iDCtoeDC_Lumen | | 0.313 | | ☐ |
| parameter_56 | iDCtotDC_Lumen | | $5 \cdot 10^{-7}$ | | ☐ |
| parameter_57 | iDCtoeDC_LP | | 0.313 | | ☐ |
| parameter_58 | iDCtotDC_LP | | $5 \cdot 10^{-7}$ | | ☐ |
| parameter_59 | M0toM1_LP | | $5 \cdot 10^{-7}$ | | ☐ |
| parameter_60 | M0toM2_LP | | $5 \cdot 10^{-7}$ | | ☐ |
| parameter_61 | vm | | 1.000 | | ☑ |
| parameter_62 | uMA | | 0.022 | | ☑ |
| parameter_63 | n | | 2.000 | | ☑ |
| parameter_64 | T_deactivation | | 0.129 | | ☐ |
| parameter_43 | iDC percentage | | 0.010 | | ☑ |
| parameter_65 | lm | | 100000.000 | | ☑ |
| parameter_66 | ld | | 1000000.000 | | ☑ |
| parameter_6 | HP Dose Response | | $10^{-6}$ | | ☑ |
| parameter_67 | iTreg NS (rel) | | 0.000 | | ☐ |
| parameter_68 | Th1 NS (rel) | | 0.000 | | ☐ |
| parameter_69 | Th17 NS (rel) | | 0.000 | | ☐ |
| parameter_70 | Stimulation | | 10.000 | | ☑ |
| parameter_71 | iTreg S (rel) | | 0.000 | | ☐ |
| parameter_72 | Th1 S (rel) | | 0.000 | | ☐ |
| parameter_73 | Th17 S (rel) | | 0.000 | | ☐ |
| parameter_46 | @ud | | 0.500 | | ☑ |
| parameter_74 | vLB | | 0.500 | | ☑ |
| parameter_75 | vLB2 | | 0.500 | | ☐ |
| parameter_76 | k_LB | | 1.000 | | ☑ |
| parameter_77 | iDCtotDC_LB | | 0.500 | | ☐ |
| parameter_78 | iDCtoeDC_LB | | 0.313 | | ☐ |
| parameter_79 | new_iTreg_GLN | | 0.000 | | ☐ |

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| parameter_80 | new_Th1_GLN | | 14972.236 | | ⊟ |
| parameter_81 | new_Th17_GLN | | 6416.673 | | ⊟ |
| parameter_82 | new_emT_iTreg | | 0.000 | | ⊟ |
| parameter_83 | new_emT_Th1 | | 214.717 | | ⊟ |
| parameter_84 | new_emT_Th17 | | 92.022 | | ⊟ |
| parameter_85 | er_i | | 10000.000 | | ☑ |
| parameter_86 | et_i | | 10000.000 | | ☑ |
| parameter_87 | K_r17 | | 1.000 | | ☑ |
| parameter_88 | K_17r | | 2.500 | | ☑ |
| parameter_89 | v21 | | 2.000 | | ☑ |
| parameter_90 | v12 | | 1.000 | | ☑ |
| parameter_91 | ri_I | | 100000.000 | | ☑ |
| parameter_92 | ir_I | | 100000.000 | | ☑ |
| parameter_93 | phi_HP | | 0.001 | | ☑ |
| parameter_94 | uLB | | 0.071 | | ☑ |
| parameter_95 | ath17LB | | $3 \cdot 10^{-7}$ | | ☑ |
| parameter_96 | ath1LB | | $7 \cdot 10^{-7}$ | | ⊟ |
| parameter_97 | aTh17LB | | 0.300 | | ☑ |
| parameter_98 | aTh1LB | | 0.700 | | ⊟ |
| parameter_99 | Stim_emT-_Th17LB | | $3 \cdot 10^{-7}$ | | ⊟ |
| parameter-_100 | Stim_emT_Th1LB | | $7 \cdot 10^{-7}$ | | ⊟ |
| parameter-_101 | Stim_cmT_Th1LB | | $7 \cdot 10^{-7}$ | | ⊟ |
| parameter-_102 | Stim_cmT-_Th17LB | | $3 \cdot 10^{-7}$ | | ⊟ |
| parameter-_103 | Stim_t_Th1LB | | $7 \cdot 10^{-13}$ | | ⊟ |
| parameter-_104 | Stim_t_Th17LB | | $3 \cdot 10^{-13}$ | | ⊟ |
| parameter-_105 | vEC | | 0.000 | | ☑ |
| parameter-_106 | Bc2 | | 1.000 | | ☑ |
| parameter-_107 | k_LP1 | | 0.627 | | ☑ |
| ModelValue_3 | Initial for aTh17 | | 0.300 | | ☑ |
| ModelValue-_10 | Initial for ath17 | | $3 \cdot 10^{-7}$ | | ☑ |

# 6 Initialassignments

This is an overview of four initialassignments.

## 6.1 Initialassignment `s1`

**Derived unit** contains undeclared units

**Math** parameter_6 · [species_7]

## 6.2 Initialassignment `species_10`

**Derived unit** item · $\mathrm{ml}^{-1}$

**Math** [species_11]

## 6.3 Initialassignment `ModelValue_3`

**Derived unit** contains undeclared units

**Math** parameter_4

## 6.4 Initialassignment `ModelValue_10`

**Derived unit** contains undeclared units

**Math** parameter_12

# 7 Function definitions

This is an overview of 13 function definitions.

## 7.1 Function definition `function_13`

**Name** Constant flux (irreversible)

**Argument** v

**Mathematical Expression**

v (1)

## 7.2 Function definition function_1

**Name** 1 reactant, 3 activators, KVW

**Arguments** Vf, r1, A1, n1, A2, n2, A3, n3

**Mathematical Expression**

$$\mathrm{Vf} \cdot \mathrm{r1} \cdot (\mathrm{n1} \cdot \mathrm{A1} + \mathrm{n2} \cdot \mathrm{A2} + \mathrm{n3} \cdot \mathrm{A3}) \tag{2}$$

## 7.3 Function definition function_3

**Name** 1sub 1 activator 1 parameter

**Arguments** substrate, a1, k1

**Mathematical Expression**

$$\mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{3}$$

## 7.4 Function definition function_8

**Name** 1sub 2 activators 2 parameters

**Arguments** substrate, k1, a1, k2, a2

**Mathematical Expression**

$$\mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \tag{4}$$

## 7.5 Function definition function_10

**Name** Constant Flux, 3 activators

**Arguments** c, k, A, n, kA, B, kB, C, kC

**Mathematical Expression**

$$\mathrm{c} + \mathrm{k} \cdot \left( \frac{\mathrm{A^n}}{\mathrm{A^n} + \mathrm{kA^n}} + \frac{\mathrm{B^n}}{\mathrm{B^n} + \mathrm{kB^n}} + \frac{\mathrm{C^n}}{\mathrm{C^n} + \mathrm{kC^n}} \right) \tag{5}$$

## 7.6 Function definition function_7

**Name** Constant Flux, 1 activator

**Arguments** k, A, n, kA, c

**Mathematical Expression**

$$\mathrm{c} + \mathrm{k} \cdot \frac{\mathrm{A^n}}{\mathrm{A^n} + \mathrm{kA^n}} \tag{6}$$

### 7.7 Function definition function_2

**Name** 1 sub 5 activators

**Arguments** k, substrate, A, n, kA, B, kB, C, kC, D, kD, E, kE

**Mathematical Expression**

$$k \cdot substrate \cdot \left( \frac{A^n}{A^n + kA^n} + \frac{B^n}{B^n + kB^n} + \frac{C^n}{C^n + kC^n} + \frac{D^n}{D^n + kD^n} + \frac{E^n}{E^n + kE^n} \right) \quad (7)$$

### 7.8 Function definition function_4

**Name** 1 sub 3 activators

**Arguments** k, substrate, A, n, kA, B, kB, C, kC

**Mathematical Expression**

$$k \cdot substrate \cdot \left( \frac{A^n}{A^n + kA^n} + \frac{B^n}{B^n + kB^n} + \frac{C^n}{C^n + kC^n} \right) \quad (8)$$

### 7.9 Function definition function_11

**Name** 1 sub 2 activators

**Arguments** k, substrate, A, n, kA, B, kB

**Mathematical Expression**

$$k \cdot substrate \cdot \left( \frac{A^n}{A^n + kA^n} + \frac{B^n}{B^n + kB^n} \right) \quad (9)$$

### 7.10 Function definition function_5

**Name** bact repo

**Arguments** k, sub, c

**Mathematical Expression**

$$\frac{k \cdot sub}{c + sub} \quad (10)$$

### 7.11 Function definition function_12

**Name** iDC_Ep replenishment

**Arguments** V, s, k, P

**Mathematical Expression**

$$V \cdot (s - k \cdot P) \quad (11)$$

### 7.12 Function definition function_9

**Name** 1 sub 2 act 2 params 1 const

**Arguments** substrate, k, k1, a1, k2, a2

**Mathematical Expression**

$$\text{substrate} \cdot \text{k} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2}) \tag{12}$$

### 7.13 Function definition function_6

**Name** 1 sub 3 activators 3 parameters

**Arguments** substrate, k1, a1, k2, a2, k3, a3

**Mathematical Expression**

$$\text{substrate} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2} + \text{k3} \cdot \text{a3}) \tag{13}$$

## 8 Rules

This is an overview of 54 rules.

### 8.1 Rule parameter_2

Rule parameter_2 is an assignment rule for parameter parameter_2:

$$\text{parameter\_2} = 1 - \text{parameter\_1} \tag{14}$$

### 8.2 Rule parameter_5

Rule parameter_5 is an assignment rule for parameter parameter_5:

$$\text{parameter\_5} = 1 - \text{ModelValue\_3} \tag{15}$$

### 8.3 Rule parameter_11

Rule parameter_11 is an assignment rule for parameter parameter_11:

$$\text{parameter\_11} = 1.0E - 6 - \text{ModelValue\_10} \tag{16}$$

### 8.4 Rule parameter_16

Rule parameter_16 is an assignment rule for parameter parameter_16:

$$\text{parameter\_16} = \text{parameter\_13} \cdot \text{parameter\_14} \cdot 0.6 \tag{17}$$

### 8.5 Rule parameter_15

Rule parameter_15 is an assignment rule for parameter parameter_15:

$$\text{parameter\_15} = \text{parameter\_13} \cdot 0.4 \cdot \text{parameter\_14} \tag{18}$$

### 8.6 Rule species_2

Rule species_2 is an assignment rule for species species_2:

$$\text{species\_2} = [\text{s9}] + [\text{species\_1}] + [\text{s25}] + [\text{s4}] \tag{19}$$

**Derived unit** $\text{item} \cdot \text{ml}^{-1}$

### 8.7 Rule species_3

Rule species_3 is an assignment rule for species species_3:

$$\text{species\_3} = [\text{s22}] + [\text{s19}] + [\text{s21}] \tag{20}$$

**Derived unit** $\text{item} \cdot \text{ml}^{-1}$

### 8.8 Rule species_4

Rule species_4 is an assignment rule for species species_4:

$$\text{species\_4} = [\text{s13}] + [\text{s16}] + [\text{s15}] + [\text{s17}] \tag{21}$$

**Derived unit** $\text{item} \cdot \text{ml}^{-1}$

### 8.9 Rule species_6

Rule species_6 is an assignment rule for species species_6:

$$\text{species\_6} = [\text{s26}] + [\text{s27}] \tag{22}$$

**Derived unit** $\text{item} \cdot \text{ml}^{-1}$

### 8.10 Rule species_8

Rule species_8 is an assignment rule for species species_8:

$$\text{species\_8} = [\text{s31}] + [\text{s30}] + [\text{s33}] + [\text{s29}] + [\text{s28}] \tag{23}$$

**Derived unit** $\text{item} \cdot \text{ml}^{-1}$

### 8.11 Rule species_9

Rule species_9 is an assignment rule for species species_9:

$$\text{species\_9} = 0.01 \cdot \left( [\text{s31}] + [\text{s30}] + [\text{s33}] + \frac{[\text{s28}] + [\text{s29}]}{\text{parameter\_70}} \right) \tag{24}$$

### 8.12 Rule parameter_17

Rule parameter_17 is an assignment rule for parameter parameter_17:

$$\text{parameter\_17} = \text{parameter\_49} \cdot \frac{1}{1 + \text{parameter\_51} \cdot [\text{s33}]} \tag{25}$$

### 8.13 Rule parameter_18

Rule parameter_18 is an assignment rule for parameter parameter_18:

$$\text{parameter\_18} = \text{parameter\_50} \cdot \frac{1}{1 + \text{parameter\_51} \cdot [\text{s15}] + \text{parameter\_52} \cdot [\text{s6}]} \tag{26}$$

### 8.14 Rule parameter_22

Rule parameter_22 is an assignment rule for parameter parameter_22:

$$\text{parameter\_22} = \text{parameter\_4} \cdot \text{parameter\_48} \tag{27}$$

### 8.15 Rule parameter_23

Rule parameter_23 is an assignment rule for parameter parameter_23:

$$\text{parameter\_23} = \text{parameter\_48} \cdot \text{parameter\_5} \tag{28}$$

### 8.16 Rule parameter_24

Rule parameter_24 is an assignment rule for parameter parameter_24:

$$\text{parameter\_24} = \text{parameter\_3} \cdot \text{parameter\_48} \tag{29}$$

### 8.17 Rule parameter_25

Rule parameter_25 is an assignment rule for parameter parameter_25:

$$\text{parameter\_25} = \text{parameter\_5} \cdot \text{parameter\_53} \tag{30}$$

### 8.18 Rule parameter_26

Rule parameter_26 is an assignment rule for parameter parameter_26:

$$\text{parameter\_26} = \text{parameter\_4} \cdot \text{parameter\_53} \tag{31}$$

### 8.19 Rule parameter_27

Rule parameter_27 is an assignment rule for parameter parameter_27:

$$\text{parameter\_27} = \text{parameter\_3} \cdot \text{parameter\_53} \tag{32}$$

### 8.20 Rule parameter_28

Rule parameter_28 is an assignment rule for parameter parameter_28:

$$\text{parameter\_28} = \text{parameter\_11} \cdot \text{parameter\_53} \tag{33}$$

### 8.21 Rule parameter_29

Rule parameter_29 is an assignment rule for parameter parameter_29:

$$\text{parameter\_29} = \text{parameter\_12} \cdot \text{parameter\_53} \tag{34}$$

### 8.22 Rule parameter_30

Rule parameter_30 is an assignment rule for parameter parameter_30:

$$\text{parameter\_30} = \text{parameter\_10} \cdot \text{parameter\_53} \tag{35}$$

### 8.23 Rule parameter_37

Rule parameter_37 is an assignment rule for parameter parameter_37:

$$\text{parameter\_37} = \text{parameter\_7} \cdot \text{parameter\_36} \tag{36}$$

### 8.24 Rule parameter_54

Rule parameter_54 is an assignment rule for parameter parameter_54:

$$\text{parameter\_54} = \text{parameter\_7} \cdot \text{parameter\_39} \tag{37}$$

### 8.25 Rule parameter_55

Rule parameter_55 is an assignment rule for parameter parameter_55:

$$\text{parameter\_55} = \text{parameter\_1} \cdot \text{parameter\_107} \tag{38}$$

### 8.26 Rule parameter_56

Rule parameter_56 is an assignment rule for parameter parameter_56:

$$\text{parameter\_56} = \text{parameter\_2} \cdot \text{parameter\_47} \tag{39}$$

### 8.27 Rule parameter_57

Rule parameter_57 is an assignment rule for parameter parameter_57:

$$\text{parameter\_57} = \text{parameter\_1} \cdot \text{parameter\_107} \tag{40}$$

### 8.28 Rule parameter_58

Rule parameter_58 is an assignment rule for parameter parameter_58:

$$\text{parameter\_58} = \text{parameter\_2} \cdot \text{parameter\_48} \tag{41}$$

### 8.29 Rule parameter_59

Rule parameter_59 is an assignment rule for parameter parameter_59:

$$\text{parameter\_59} = \text{parameter\_1} \cdot \text{parameter\_48} \tag{42}$$

### 8.30 Rule parameter_60

Rule parameter_60 is an assignment rule for parameter parameter_60:

$$\text{parameter\_60} = \text{parameter\_2} \cdot \text{parameter\_48} \tag{43}$$

### 8.31 Rule parameter_79

Rule parameter_79 is an assignment rule for parameter parameter_79:

$$\text{parameter\_79} = \text{parameter\_17} \cdot (\text{parameter\_27} \cdot [\text{s29}] + \text{parameter\_30} \cdot [\text{s28}]) \cdot [\text{s27}] \tag{44}$$

### 8.32 Rule parameter_64

Rule parameter_64 is an assignment rule for parameter parameter_64:

$$\text{parameter\_64} = (1 - \text{parameter\_14}) \cdot \text{parameter\_13} \tag{45}$$

### 8.33 Rule parameter_67

Rule parameter_67 is an assignment rule for parameter parameter_67:

$$\text{parameter\_67} = \frac{[\text{s33}]}{[\text{species\_8}]} \tag{46}$$

**Derived unit** dimensionless

### 8.34 Rule parameter_68

Rule parameter_68 is an assignment rule for parameter parameter_68:

$$\text{parameter\_68} = \frac{[\text{s31}]}{[\text{species\_8}]} \tag{47}$$

**Derived unit** dimensionless

### 8.35 Rule parameter_69

Rule parameter_69 is an assignment rule for parameter parameter_69:

$$\text{parameter\_69} = \frac{[\text{s30}]}{[\text{species\_8}]} \tag{48}$$

**Derived unit** dimensionless

### 8.36 Rule parameter_71

Rule parameter_71 is an assignment rule for parameter parameter_71:

$$\text{parameter\_71} = \frac{[\text{s33}]}{[\text{species\_9}]} \tag{49}$$

**Derived unit** dimensionless

### 8.37 Rule parameter_72

Rule parameter_72 is an assignment rule for parameter parameter_72:

$$\text{parameter\_72} = \frac{[\text{s31}]}{[\text{species\_9}]} \tag{50}$$

**Derived unit** dimensionless

### 8.38 Rule parameter_73

Rule parameter_73 is an assignment rule for parameter parameter_73:

$$\text{parameter\_73} = \frac{[\text{s30}]}{[\text{species\_9}]} \tag{51}$$

**Derived unit** dimensionless

### 8.39 Rule parameter_75

Rule parameter_75 is an assignment rule for parameter parameter_75:

$$\text{parameter\_75} = 1 - \text{parameter\_74} \tag{52}$$

### 8.40 Rule parameter_77

Rule parameter_77 is an assignment rule for parameter parameter_77:

$$\text{parameter\_77} = \text{parameter\_75} \cdot \text{parameter\_76} \tag{53}$$

### 8.41 Rule parameter_78

Rule parameter_78 is an assignment rule for parameter parameter_78:

$$\text{parameter\_78} = \text{parameter\_74} \cdot \text{parameter\_107} \tag{54}$$

### 8.42 Rule parameter_82

Rule parameter_82 is an assignment rule for parameter parameter_82:

$$\text{parameter\_82} = \text{parameter\_18} \cdot \text{parameter\_24} \cdot ([\text{s25}] + [\text{s21}]) \cdot [\text{s17}] \tag{55}$$

### 8.43 Rule parameter_96

Rule parameter_96 is an assignment rule for parameter parameter_96:

$$\text{parameter\_96} = 1.0E - 6 - \text{parameter\_95} \tag{56}$$

### 8.44 Rule parameter_98

Rule parameter_98 is an assignment rule for parameter parameter_98:

$$\text{parameter\_98} = 1 - \text{parameter\_97} \tag{57}$$

### 8.45 Rule parameter_100

Rule parameter_100 is an assignment rule for parameter parameter_100:

$$\text{parameter\_100} = \text{parameter\_48} \cdot \text{parameter\_98} \tag{58}$$

### 8.46 Rule parameter_83

Rule parameter_83 is an assignment rule for parameter parameter_83:

$$\begin{aligned}\text{parameter\_83} = {} & \text{parameter\_18} \\ & \cdot (\text{parameter\_23} \cdot ([\text{s19}] + [\text{s9}]) \cdot [\text{s17}] + [\text{s17}] \cdot [\text{species\_18}] \cdot \text{parameter\_100})\end{aligned} \tag{59}$$

### 8.47 Rule parameter_99

Rule parameter_99 is an assignment rule for parameter parameter_99:

$$\text{parameter\_99} = \text{parameter\_48} \cdot \text{parameter\_97} \tag{60}$$

### 8.48 Rule parameter_84

Rule parameter_84 is an assignment rule for parameter parameter_84:

$$\begin{aligned}\text{parameter\_84} = {} & \text{parameter\_18} \\ & \cdot (\text{parameter\_22} \cdot ([\text{s19}] + [\text{s9}]) \cdot [\text{s17}] + [\text{s17}] \cdot [\text{species\_18}] \cdot \text{parameter\_99})\end{aligned} \tag{61}$$

### 8.49 Rule parameter_101

Rule parameter_101 is an assignment rule for parameter parameter_101:

$$\text{parameter\_101} = \text{parameter\_53} \cdot \text{parameter\_98} \tag{62}$$

### 8.50 Rule parameter_102

Rule parameter_102 is an assignment rule for parameter parameter_102:

$$\text{parameter\_102} = \text{parameter\_53} \cdot \text{parameter\_97} \tag{63}$$

### 8.51 Rule parameter_103

Rule parameter_103 is an assignment rule for parameter parameter_103:

$$\text{parameter\_103} = \text{parameter\_53} \cdot \text{parameter\_96} \tag{64}$$

### 8.52 Rule parameter_80

Rule parameter_80 is an assignment rule for parameter parameter_80:

$$\begin{aligned}\text{parameter\_80} = \text{parameter\_17} \cdot ((\text{parameter\_25} \cdot [\text{s29}] + \text{parameter\_28} \cdot [\text{s28}]) \cdot [\text{s26}] \\ + ([\text{s29}] \cdot \text{parameter\_101} + [\text{s28}] \cdot \text{parameter\_103}) \cdot [\text{species\_20}])\end{aligned} \tag{65}$$

### 8.53 Rule parameter_104

Rule parameter_104 is an assignment rule for parameter parameter_104:

$$\text{parameter\_104} = \text{parameter\_95} \cdot \text{parameter\_53} \tag{66}$$

### 8.54 Rule parameter_81

Rule parameter_81 is an assignment rule for parameter parameter_81:

$$\begin{aligned}\text{parameter\_81} = \text{parameter\_17} \cdot ((\text{parameter\_26} \cdot [\text{s29}] + \text{parameter\_29} \cdot [\text{s28}]) \cdot [\text{s26}] \\ + [\text{species\_20}] \cdot ([\text{s29}] \cdot \text{parameter\_102} + [\text{s28}] \cdot \text{parameter\_104}))\end{aligned} \tag{67}$$

## 9 Events

This is an overview of two events. Each event is initiated whenever its trigger condition switches from false to true. A delay function postpones the effects of an event to a later time point. At the time of execution, an event can assign values to species, parameters or compartments if these are not set to constant.

### 9.1 Event event_1

**Name** 2nd Dose

**Trigger condition**

$$\text{time} \geq 2 \tag{68}$$

**Assignments**

$$\text{s1} = [\text{s1}] + [\text{species\_7}] \cdot \text{parameter\_6} \tag{69}$$

$$\text{species\_10} = [\text{species\_10}] + [\text{species\_11}] \tag{70}$$

### 9.2 Event event_2

**Name** 3rd Dose

**Trigger condition**

$$\text{time} \geq 4 \tag{71}$$

**Assignments**

$$\text{s1} = [\text{s1}] + [\text{species\_7}] \cdot \text{parameter\_6} \tag{72}$$

$$\text{species\_10} = [\text{species\_10}] + [\text{species\_11}] \tag{73}$$

## 10 Reactions

This model contains 88 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 1 | re2 | re055 | $s2 \xrightarrow{s1,\ s2,\ s1} s3$ | |
| 2 | re3 | re066 | $s1 \xrightarrow{species\_5,\ s1,\ species\_5} s6$ | |
| 3 | re4 | re059 | $s3 \xrightarrow{s13,\ s16,\ s19,\ s3,\ s13,\ s16,\ s19} species\_5$ | |
| 4 | re6 | re105 | $species\_1 + s6 \xrightarrow{species\_1,\ s6} s9$ | |
| 5 | re11 | re074 | $s17 \xrightarrow{s21,\ s25,\ s17,\ s21,\ s25} s15$ | |
| 6 | re13 | re063 | $s4 + s1 \xrightarrow{s4,\ s1} s9$ | |
| 7 | re15 | re058 | $s2 \xrightarrow{s13,\ s16,\ s19,\ s2,\ s13,\ s16,\ s19} species\_5$ | |
| 8 | re16 | re070 | $s22 \xrightarrow{s19,\ s9,\ s13,\ s16,\ s3,\ s22,\ s19,\ s9,\ s13,\ s16,\ s3} s19$ | |
| 9 | re17 | re073 | $s22 \xrightarrow{s21,\ s15,\ s25,\ s22,\ s21,\ s15,\ s25} s21$ | |
| 10 | re18 | re072 | $s21 \xrightarrow{s13,\ s19,\ s9,\ s16,\ s3,\ s21,\ s13,\ s19,\ s9,\ s16,\ s3} s19$ | |
| 11 | re20 | re077 | $species\_1 + s6 \xrightarrow{species\_1,\ s6} s25$ | |
| 12 | re21 | re078 | $s9 \xrightarrow{s9} s26$ | |
| 13 | re22 | re079 | $s25 \xrightarrow{s25} s27$ | |
| 14 | re23 | re080 | $s28 \xrightarrow{s26,\ species\_20,\ s28,\ s26,\ species\_20} s30$ | |
| 15 | re24 | re081 | $s28 \xrightarrow{s26,\ s28,\ s26} s31$ | |
| 16 | re27 | re082 | $s28 \xrightarrow{s27,\ s28,\ s27} s33$ | |

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 17 | re28 | re083 | $s29 \xrightarrow{s26,\ species\_20,\ s29,\ s26,\ species\_20} s30$ | |
| 18 | re29 | re084 | $s29 \xrightarrow{s26,\ species\_20,\ s29,\ s26,\ species\_20} s31$ | |
| 19 | re31 | re085 | $s29 \xrightarrow{s27,\ s29,\ s27} s33$ | |
| 20 | re32 | re087 | $s30 \xrightarrow{s30} s16$ | |
| 21 | re33 | re088 | $s31 \xrightarrow{s31} s13$ | |
| 22 | re35 | re089 | $s33 \xrightarrow{s33} s15$ | |
| 23 | re41 | re091 | $s33 \xrightarrow{s31,\ s26,\ s30,\ s33,\ s31,\ s26,\ s30} s30$ | |
| 24 | re42 | re093 | $s15 \xrightarrow{s16,\ s9,\ s19,\ s13,\ s3,\ s15,\ s16,\ s9,\ s19,\ s13,\ s3} s16$ | |
| 25 | re43 | re095 | $s16 \xrightarrow{s16} s17$ | |
| 26 | re44 | re096 | $s13 \xrightarrow{s13} s17$ | |
| 27 | re45 | re097 | $s15 \xrightarrow{s15} s17$ | |
| 28 | re46 | re098 | $s16 \xrightarrow{s16} s29$ | |
| 29 | re47 | re099 | $s13 \xrightarrow{s13} s29$ | |
| 30 | re49 | re100 | $s15 \xrightarrow{s15} s29$ | |
| 31 | reaction_1 | re060 | $s3 \xrightarrow{s3} s2$ | |
| 32 | reaction_2 | re057 | $species\_5 \xrightarrow{species\_5} s2$ | |
| 33 | reaction_3 | re102 | $s6 \xrightarrow{s6} 2\,s6$ | |
| 34 | reaction_4 | re101 | $s6 \xrightarrow{s6} \emptyset$ | |
| 35 | reaction_5 | re052 | $s1 \xrightarrow{s1} 2\,s1$ | |
| 36 | reaction_6 | re065 | $s1 \xrightarrow{s1} \emptyset$ | |

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 37 | reaction_10 | re103 | $\mathrm{s17} \xrightarrow{\mathrm{s19,\ s9,\ species\_18,\ s17,\ s19,\ s9,\ species\_18}} \mathrm{s13}$ | |
| 38 | reaction_11 | re104 | $\mathrm{s17} \xrightarrow{\mathrm{s19,\ s9,\ species\_18,\ s17,\ s19,\ s9,\ species\_18}} \mathrm{s16}$ | |
| 39 | reaction_12 | re119 | $\mathrm{s16} \xrightarrow{\mathrm{s16}} \emptyset$ | |
| 40 | reaction_13 | re106 | $\emptyset \xrightarrow{\mathrm{s26,\ s26}} \mathrm{s28}$ | |
| 41 | reaction_14 | re107 | $\mathrm{s28} \xrightarrow{\mathrm{s28}} \emptyset$ | |
| 42 | reaction_16 | re061 | $\mathrm{s1} \xrightarrow{\mathrm{s3,\ s1,\ s3}} \mathrm{s6}$ | |
| 43 | reaction_17 | re062 | $\mathrm{s4} + \mathrm{s1} \xrightarrow{\mathrm{s4,\ s1}} \mathrm{s25}$ | |
| 44 | reaction_19 | re067 | $\mathrm{s6} \xrightarrow{\mathrm{s3,\ s19,\ s6,\ s3,\ s19}} \emptyset$ | |
| 45 | reaction_20 | re053 | $\mathrm{s1} \xrightarrow{\mathrm{s3,\ s1,\ s3}} \emptyset$ | |
| 46 | reaction_24 | re068 | $\emptyset \xrightarrow{\mathrm{s3,\ s19,\ s9,\ s3,\ s19,\ s9}} \mathrm{species\_1}$ | |
| 47 | reaction_27 | re069 | $\emptyset \xrightarrow{\mathrm{s19,\ s3,\ s9,\ s19,\ s3,\ s9}} \mathrm{s22}$ | |
| 48 | reaction_31 | re111 | $\mathrm{species\_1} \xrightarrow{\mathrm{species\_1}} \emptyset$ | |
| 49 | reaction_32 | re112 | $\mathrm{s22} \xrightarrow{\mathrm{s22}} \emptyset$ | |
| 50 | reaction_37 | re117 | $\mathrm{s19} \xrightarrow{\mathrm{s19}} \emptyset$ | |
| 51 | reaction_38 | re118 | $\mathrm{s21} \xrightarrow{\mathrm{s21}} \emptyset$ | |
| 52 | reaction_39 | re120 | $\mathrm{s13} \xrightarrow{\mathrm{s13}} \emptyset$ | |
| 53 | reaction_40 | re121 | $\mathrm{s15} \xrightarrow{\mathrm{s15}} \emptyset$ | |
| 54 | reaction_7 | re071 | $\mathrm{s19} \xrightarrow{\mathrm{s15,\ s21,\ s25,\ s19,\ s15,\ s21,\ s25}} \mathrm{s21}$ | |
| 55 | reaction_8 | re094 | $\mathrm{s16} \xrightarrow{\mathrm{s15,\ s25,\ s21,\ s16,\ s15,\ s25,\ s21}} \mathrm{s15}$ | |
| 56 | reaction_9 | re092 | $\mathrm{s30} \xrightarrow{\mathrm{s33,\ s27,\ s30,\ s33,\ s27}} \mathrm{s33}$ | |

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 57 | reaction_15 | re122 | $\mathrm{s22} + \mathrm{s6} \xrightarrow{\mathrm{s22,\ s6}} \mathrm{s19}$ | |
| 58 | reaction_18 | re123 | $\mathrm{s22} + \mathrm{s6} \xrightarrow{\mathrm{s22,\ s6}} \mathrm{s21}$ | |
| 59 | reaction_21 | re116 | $\mathrm{s26} \xrightarrow{\mathrm{s26}} \emptyset$ | |
| 60 | reaction_22 | re124 | $\mathrm{s27} \xrightarrow{\mathrm{s27}} \emptyset$ | |
| 61 | reaction_23 | re127 | $\mathrm{species\_1} \underset{\nwarrow}{\overset{\mathrm{species\_1,\ s4}}{\rightleftharpoons}} \mathrm{s4}$ | |
| 62 | reaction_25 | re128 | $\mathrm{s4} \xrightarrow{\mathrm{species\_10,\ s4,\ species\_10}} \mathrm{s25}$ | |
| 63 | reaction_26 | re129 | $\mathrm{s4} \xrightarrow{\mathrm{species\_10,\ s4,\ species\_10}} \mathrm{s9}$ | |
| 64 | reaction_28 | re130 | $\mathrm{species\_10} \xrightarrow{\mathrm{species\_10}} \emptyset$ | |
| 65 | reaction_29 | re131 | $\emptyset \longrightarrow \mathrm{s15}$ | |
| 66 | reaction_30 | re132 | $\emptyset \longrightarrow \mathrm{s13}$ | |
| 67 | reaction_33 | re133 | $\emptyset \longrightarrow \mathrm{s16}$ | |
| 68 | reaction_34 | re134 | $\emptyset \longrightarrow \mathrm{s33}$ | |
| 69 | reaction_35 | re135 | $\emptyset \longrightarrow \mathrm{s31}$ | |
| 70 | reaction_36 | re136 | $\emptyset \longrightarrow \mathrm{s30}$ | |
| 71 | reaction_41 | re137 | $\mathrm{species\_18} \xrightarrow{\mathrm{species\_18}} \mathrm{species\_20}$ | |
| 72 | reaction_42 | re138 | $\mathrm{species\_20} \xrightarrow{\mathrm{species\_20}} \emptyset$ | |
| 73 | reaction_43 | re139 | $\mathrm{s2} \xrightarrow{\mathrm{s13,\ s16,\ s9,\ s19,\ s3,\ s2,\ s13,\ s16,\ s9,\ s19,\ s3}} \mathrm{s3}$ | |
| 74 | reaction_44 | re140 | $\mathrm{species\_20} \xrightarrow{\mathrm{species\_20}} \emptyset$ | |
| 75 | reaction_45 | nTh1 creation | $\mathrm{s28} \xrightarrow{\mathrm{s28}} \mathrm{species\_12}$ | |
| 76 | reaction_46 | nTh1 trans | $\mathrm{species\_12} \xrightarrow{\mathrm{species\_12}} \mathrm{species\_13}$ | |
| 77 | reaction_47 | nTh1_LP deg | $\mathrm{species\_13} \xrightarrow{\mathrm{species\_13}} \emptyset$ | |
| 78 | reaction_48 | nTh1_LP expansion | $\mathrm{species\_13} \xrightarrow{\mathrm{species\_13}} 2\,\mathrm{species\_13}$ | |

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 79 | reaction_49 | nTh1 deg | $\text{species\_12} \xrightarrow{\text{species\_12}} \emptyset$ | |
| 80 | reaction_50 | nTh17 creation | $\text{s28} \xrightarrow{\text{s28}} \text{species\_14}$ | |
| 81 | reaction_51 | nTh17 trans | $\text{species\_14} \xrightarrow{\text{species\_14}} \text{species\_15}$ | |
| 82 | reaction_52 | nTh17_LP deg | $\text{species\_15} \xrightarrow{\text{species\_15}} \emptyset$ | |
| 83 | reaction_53 | nTh17 deg | $\text{species\_14} \xrightarrow{\text{species\_14}} \emptyset$ | |
| 84 | reaction_54 | nTreg creation | $\text{s28} \xrightarrow{\text{s28}} \text{species\_16}$ | |
| 85 | reaction_55 | nTreg trans | $\text{species\_16} \xrightarrow{\text{species\_16}} \text{species\_17}$ | |
| 86 | reaction_56 | nTreg_LP deg | $\text{species\_17} \xrightarrow{\text{species\_17}} \emptyset$ | |
| 87 | reaction_57 | nTreg deg | $\text{species\_16} \xrightarrow{\text{species\_16}} \emptyset$ | |
| 88 | reaction_58 | Th17 to Treg | $\text{species\_15} \xrightarrow{\text{species\_15}} \text{species\_17}$ | |

## 10.1 Reaction re2

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re055

### Reaction equation

$$\mathrm{s2} \xrightarrow{\mathrm{s1,\ s2,\ s1}} \mathrm{s3} \tag{74}$$

### Reactant

Table 6: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s2 | E | |

### Modifiers

Table 7: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s1 | HP | |
| s2 | E | |
| s1 | HP | |

### Product

Table 8: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_1 = \mathrm{vol}(\mathrm{c4}) \cdot \mathrm{function\_3}([\mathrm{s2}], [\mathrm{s1}], \mathrm{parameter\_7}) \tag{75}$$

$$\mathrm{function\_3}(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{76}$$

$$\mathrm{function\_3}(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{77}$$

## 10.2 Reaction re3

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re066

### Reaction equation

$$\mathrm{s1} \xrightarrow{\text{species\_5, s1, species\_5}} \mathrm{s6} \tag{78}$$

### Reactant

Table 9: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s1 | HP | |

### Modifiers

Table 10: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_5 | Edead | |
| s1 | HP | |
| species_5 | Edead | |

### Product

Table 11: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_2 = \text{function\_3}\left([\mathrm{s1}], [\text{species\_5}], \text{parameter\_7}\right) \tag{79}$$

$$\text{function\_3}\left(\text{substrate}, \mathrm{a1}, \mathrm{k1}\right) = \text{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{80}$$

## 10.3 Reaction re4

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re059

### Reaction equation

$$\text{s3} \xrightarrow{\text{s13, s16, s19, s3, s13, s16, s19}} \text{species\_5} \tag{81}$$

### Reactant

Table 12: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

### Modifiers

Table 13: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |
| s16 | Th17 | |
| s19 | M1 | |
| s3 | Ep | |
| s13 | Th1 | |
| s16 | Th17 | |
| s19 | M1 | |

### Product

Table 14: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_5 | Edead | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_3 = \mathrm{vol}\,(\mathrm{c4}) \cdot \mathrm{function\_1}\,(\mathrm{parameter\_48}, [\mathrm{s3}], [\mathrm{s13}], \mathrm{parameter\_32}, [\mathrm{s16}], \mathrm{parameter\_32}, [\mathrm{s19}], \mathrm{parameter\_38}) \quad (82)$$

$$\mathrm{function\_1}\,(\mathrm{Vf}, \mathrm{r1}, \mathrm{A1}, \mathrm{n1}, \mathrm{A2}, \mathrm{n2}, \mathrm{A3}, \mathrm{n3}) = \mathrm{Vf} \cdot \mathrm{r1} \cdot (\mathrm{n1} \cdot \mathrm{A1} + \mathrm{n2} \cdot \mathrm{A2} + \mathrm{n3} \cdot \mathrm{A3}) \quad (83)$$

$$\mathrm{function\_1}\,(\mathrm{Vf}, \mathrm{r1}, \mathrm{A1}, \mathrm{n1}, \mathrm{A2}, \mathrm{n2}, \mathrm{A3}, \mathrm{n3}) = \mathrm{Vf} \cdot \mathrm{r1} \cdot (\mathrm{n1} \cdot \mathrm{A1} + \mathrm{n2} \cdot \mathrm{A2} + \mathrm{n3} \cdot \mathrm{A3}) \quad (84)$$

## 10.4 Reaction `re6`

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re105

### Reaction equation

$$\mathrm{species\_1} + \mathrm{s6} \xrightarrow{\mathrm{species\_1,\ s6}} \mathrm{s9} \quad (85)$$

### Reactants

Table 15: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `species_1` | iDC | |
| `s6` | HP | |

### Modifiers

Table 16: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `species_1` | iDC | |
| `s6` | HP | |

### Product

Table 17: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s9` | eDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_4 = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_57} \cdot [\mathrm{species\_1}] \cdot [\mathrm{s6}] \tag{86}$$

## 10.5 Reaction `re11`

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

**Name** re074

### Reaction equation

$$\mathrm{s17} \xrightarrow{\mathrm{s21,\ s25,\ s17,\ s21,\ s25}} \mathrm{s15} \tag{87}$$

### Reactant

Table 18: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s17 | emT | |

### Modifiers

Table 19: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |
| s25 | tDC | |
| s17 | emT | |
| s21 | M2 | |
| s25 | tDC | |

### Product

Table 20: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_5 = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{function\_8}\,([\mathrm{s17}], \mathrm{parameter\_24}, [\mathrm{s21}], \mathrm{parameter\_24}, [\mathrm{s25}]) \tag{88}$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \tag{89}$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \tag{90}$$

## 10.6 Reaction `re13`

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re063

### Reaction equation

$$\mathrm{s4} + \mathrm{s1} \xrightarrow{\mathrm{s4,\ s1}} \mathrm{s9} \tag{91}$$

### Reactants

Table 21: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s4` | iDC | |
| `s1` | HP | |

### Modifiers

Table 22: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s4` | iDC | |
| `s1` | HP | |

### Product

Table 23: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s9 | eDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_6 = \text{parameter\_55} \cdot [\text{s4}] \cdot [\text{s1}] \tag{92}$$

## 10.7 Reaction re15

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re058

### Reaction equation

$$\text{s2} \xrightarrow{\text{s13, s16, s19, s2, s13, s16, s19}} \text{species\_5} \tag{93}$$

### Reactant

Table 24: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s2 | E | |

### Modifiers

Table 25: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |
| s16 | Th17 | |
| s19 | M1 | |
| s2 | E | |
| s13 | Th1 | |
| s16 | Th17 | |
| s19 | M1 | |

### Product

Table 26: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_5 | Edead | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_7 = \mathrm{vol}\,(\mathrm{c4}) \cdot \mathrm{function\_1}\,(\mathrm{parameter\_48}, [\mathrm{s2}], [\mathrm{s13}], \mathrm{parameter\_32}, [\mathrm{s16}], \mathrm{parameter\_32}, [\mathrm{s19}], \mathrm{parameter\_38}) \quad (94)$$

$$\mathrm{function\_1}\,(\mathrm{Vf}, \mathrm{r1}, \mathrm{A1}, \mathrm{n1}, \mathrm{A2}, \mathrm{n2}, \mathrm{A3}, \mathrm{n3}) = \mathrm{Vf} \cdot \mathrm{r1} \cdot (\mathrm{n1} \cdot \mathrm{A1} + \mathrm{n2} \cdot \mathrm{A2} + \mathrm{n3} \cdot \mathrm{A3}) \quad (95)$$

$$\mathrm{function\_1}\,(\mathrm{Vf}, \mathrm{r1}, \mathrm{A1}, \mathrm{n1}, \mathrm{A2}, \mathrm{n2}, \mathrm{A3}, \mathrm{n3}) = \mathrm{Vf} \cdot \mathrm{r1} \cdot (\mathrm{n1} \cdot \mathrm{A1} + \mathrm{n2} \cdot \mathrm{A2} + \mathrm{n3} \cdot \mathrm{A3}) \quad (96)$$

## 10.8 Reaction re16

This is an irreversible reaction of one reactant forming one product influenced by eleven modifiers.

**Name** re070

### Reaction equation

$$\mathrm{s22} \xrightarrow{\mathrm{s19,\ s9,\ s13,\ s16,\ s3,\ s22,\ s19,\ s9,\ s13,\ s16,\ s3}} \mathrm{s19} \quad (97)$$

### Reactant

Table 27: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |

### Modifiers

Table 28: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |
| s9 | eDC | |
| s13 | Th1 | |
| s16 | Th17 | |
| s3 | Ep | |
| s22 | M0 | |
| s19 | M1 | |
| s9 | eDC | |
| s13 | Th1 | |
| s16 | Th17 | |
| s3 | Ep | |

### Product

Table 29: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_8 = \mathrm{vol}(c2) \cdot \mathrm{function\_2}(\mathrm{parameter\_61}, [s22], [s19], \mathrm{parameter\_63}, \mathrm{parameter\_91}, [s9], \mathrm{parameter\_91}, [s13], \mathrm{parameter\_91}, [s16], \mathrm{parameter\_91}, [s3], \mathrm{parameter\_106}) \quad (98)$$

$$\mathrm{function\_2}(k, \mathrm{substrate}, A, n, kA, B, kB, C, kC, D, kD, E, kE) = k \cdot \mathrm{substrate} \cdot \left( \frac{A^n}{A^n + kA^n} + \frac{B^n}{B^n + kB^n} + \frac{C^n}{C^n + kC^n} + \frac{D^n}{D^n + kD^n} + \frac{E^n}{E^n + kE^n} \right) \quad (99)$$

$$\mathrm{function\_2}(k, \mathrm{substrate}, A, n, kA, B, kB, C, kC, D, kD, E, kE) = k \cdot \mathrm{substrate} \cdot \left( \frac{A^n}{A^n + kA^n} + \frac{B^n}{B^n + kB^n} + \frac{C^n}{C^n + kC^n} + \frac{D^n}{D^n + kD^n} + \frac{E^n}{E^n + kE^n} \right) \quad (100)$$

## 10.9 Reaction re17

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re073

### Reaction equation

$$\text{s22} \xrightarrow{\text{s21, s15, s25, s22, s21, s15, s25}} \text{s21} \tag{101}$$

### Reactant

Table 30: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |

### Modifiers

Table 31: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |
| s15 | iTreg | |
| s25 | tDC | |
| s22 | M0 | |
| s21 | M2 | |
| s15 | iTreg | |
| s25 | tDC | |

### Product

Table 32: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_9 = \text{vol}(\text{c2}) \cdot \text{function\_4}(\text{parameter\_61}, [\text{s22}], [\text{s21}], \text{parameter\_63}, \text{parameter\_92}, [\text{s15}], \text{parameter\_92}, [\text{s25}], \text{parameter\_92}) \tag{102}$$

$$\text{function\_4}\left(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}\right) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} \right) \tag{103}$$

$$\text{function\_4}\left(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}\right) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} \right) \tag{104}$$

## 10.10 Reaction `re18`

This is an irreversible reaction of one reactant forming one product influenced by eleven modifiers.

**Name** re072

### Reaction equation

$$\text{s21} \xrightarrow{\text{s13, s19, s9, s16, s3, s21, s13, s19, s9, s16, s3}} \text{s19} \tag{105}$$

### Reactant

Table 33: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Modifiers

Table 34: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |
| s19 | M1 | |
| s9 | eDC | |
| s16 | Th17 | |
| s3 | Ep | |
| s21 | M2 | |
| s13 | Th1 | |
| s19 | M1 | |

| Id | Name | SBO |
|---|---|---|
| s9 | eDC | |
| s16 | Th17 | |
| s3 | Ep | |

### Product

Table 35: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{10} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_2}(\mathrm{parameter\_89}, [\mathrm{s21}], [\mathrm{s13}], \mathrm{parameter\_63}, \mathrm{parameter\_91}, [\mathrm{s19}], \mathrm{parameter\_91}, [\mathrm{s9}], \mathrm{parameter\_91}, [\mathrm{s16}], \mathrm{parameter\_91}, [\mathrm{s3}], \mathrm{parameter\_31}) \quad (106)$$

$$\mathrm{function\_2}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}, \mathrm{D}, \mathrm{kD}, \mathrm{E}, \mathrm{kE}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} + \frac{\mathrm{D}^{\mathrm{n}}}{\mathrm{D}^{\mathrm{n}} + \mathrm{kD}^{\mathrm{n}}} + \frac{\mathrm{E}^{\mathrm{n}}}{\mathrm{E}^{\mathrm{n}} + \mathrm{kE}^{\mathrm{n}}} \right) \quad (107)$$

$$\mathrm{function\_2}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}, \mathrm{D}, \mathrm{kD}, \mathrm{E}, \mathrm{kE}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} + \frac{\mathrm{D}^{\mathrm{n}}}{\mathrm{D}^{\mathrm{n}} + \mathrm{kD}^{\mathrm{n}}} + \frac{\mathrm{E}^{\mathrm{n}}}{\mathrm{E}^{\mathrm{n}} + \mathrm{kE}^{\mathrm{n}}} \right) \quad (108)$$

## 10.11 Reaction re20

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re077

### Reaction equation

$$\mathrm{species\_1} + \mathrm{s6} \xrightarrow{\mathrm{species\_1,\ s6}} \mathrm{s25} \quad (109)$$

### Reactants

Table 36: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_1 | iDC | |
| s6 | HP | |

### Modifiers

Table 37: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_1 | iDC | |
| s6 | HP | |

### Product

Table 38: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s25 | tDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{11} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_58} \cdot [\mathrm{species\_1}] \cdot [\mathrm{s6}] \tag{110}$$

## 10.12 Reaction re21

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re078

### Reaction equation

$$\mathrm{s9} \xrightarrow{\mathrm{s9}} \mathrm{s26} \tag{111}$$

### Reactant

Table 39: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s9 | eDC | |

### Modifier

Table 40: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s9 | eDC | |

### Product

Table 41: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{12} = \text{parameter\_9} \cdot [\text{s9}] \tag{112}$$

## 10.13 Reaction re22

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re079

### Reaction equation

$$\text{s25} \xrightarrow{\text{s25}} \text{s27} \tag{113}$$

### Reactant

Table 42: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s25 | tDC | |

### Modifier

Table 43: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s25 | tDC | |

### Product

Table 44: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s27 | tDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{13} = \text{parameter\_9} \cdot [\text{s25}] \tag{114}$$

## 10.14 Reaction re23

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

**Name** re080

### Reaction equation

$$\text{s28} \xrightarrow{\text{s26, species\_20, s28, s26, species\_20}} \text{s30} \tag{115}$$

### Reactant

Table 45: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifiers

Table 46: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |
| species_20 | eDCLB | |
| s28 | nT | |
| s26 | eDC | |
| species_20 | eDCLB | |

### Product

Table 47: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{14} = \text{vol}(\text{c3}) \cdot \text{function\_8}([\text{s28}], \text{parameter\_29}, [\text{s26}], \text{parameter\_104}, [\text{species\_20}]) \quad (116)$$

$$\text{function\_8}(\text{substrate}, \text{k1}, \text{a1}, \text{k2}, \text{a2}) = \text{substrate} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2}) \quad (117)$$

$$\text{function\_8}(\text{substrate}, \text{k1}, \text{a1}, \text{k2}, \text{a2}) = \text{substrate} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2}) \quad (118)$$

## 10.15 Reaction re24

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re081

### Reaction equation

$$\text{s28} \xrightarrow{\text{s26, s28, s26}} \text{s31} \quad (119)$$

### Reactant

Table 48: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifiers

Table 49: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |
| s28 | nT | |
| s26 | eDC | |

### Product

Table 50: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{15} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{function\_8}\,([\mathrm{s28}], \mathrm{parameter\_28}, [\mathrm{s26}], \mathrm{parameter\_103}, [\mathrm{s26}]) \tag{120}$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \tag{121}$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \tag{122}$$

## 10.16 Reaction re27

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re082

### Reaction equation

$$\mathrm{s28} \xrightarrow{\mathrm{s27,\ s28,\ s27}} \mathrm{s33} \tag{123}$$

### Reactant

Table 51: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifiers

Table 52: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s27 | tDC | |
| s28 | nT | |
| s27 | tDC | |

### Product

Table 53: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{16} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{function\_3}\,([\mathrm{s28}], [\mathrm{s27}], \mathrm{parameter\_30}) \tag{124}$$

$$\mathrm{function\_3}\,(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{125}$$

$$\mathrm{function\_3}\,(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{126}$$

## 10.17 Reaction re28

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

**Name** re083

### Reaction equation

$$\mathrm{s29} \xrightarrow{\mathrm{s26,\ species\_20,\ s29,\ s26,\ species\_20}} \mathrm{s30} \tag{127}$$

### Reactant

Table 54: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Modifiers

Table 55: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |
| species_20 | eDCLB | |
| s29 | cmT | |
| s26 | eDC | |
| species_20 | eDCLB | |

### Product

Table 56: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{function\_8}\,([\mathrm{s29}], \mathrm{parameter\_26}, [\mathrm{s26}], \mathrm{parameter\_102}, [\mathrm{species\_20}]) \quad (128)$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (129)$$

$$\mathrm{function\_8}\,(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (130)$$

## 10.18 Reaction re29

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

**Name** re084

### Reaction equation

$$\mathrm{s29} \xrightarrow{\mathrm{s26,\ species\_20,\ s29,\ s26,\ species\_20}} \mathrm{s31} \quad (131)$$

### Reactant

Table 57: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Modifiers

Table 58: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |
| species_20 | eDCLB | |
| s29 | cmT | |
| s26 | eDC | |
| species_20 | eDCLB | |

### Product

Table 59: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{18} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{function\_8}([\mathrm{s29}], \mathrm{parameter\_25}, [\mathrm{s26}], \mathrm{parameter\_101}, [\mathrm{species\_20}]) \quad (132)$$

$$\mathrm{function\_8}(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (133)$$

$$\mathrm{function\_8}(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (134)$$

## 10.19 Reaction re31

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re085

### Reaction equation

$$\mathrm{s29} \xrightarrow{\mathrm{s27,\ s29,\ s27}} \mathrm{s33} \tag{135}$$

### Reactant

Table 60: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Modifiers

Table 61: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s27 | tDC | |
| s29 | cmT | |
| s27 | tDC | |

### Product

Table 62: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{function\_3}\,([\mathrm{s29}], [\mathrm{s27}], \mathrm{parameter\_27}) \tag{136}$$

$$\mathrm{function\_3}\,(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{137}$$

$$\mathrm{function\_3}\,(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{138}$$

## 10.20 Reaction re32

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re087

### Reaction equation

$$\mathrm{s30} \xrightarrow{\mathrm{s30}} \mathrm{s16} \tag{139}$$

### Reactant

Table 63: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Modifier

Table 64: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Product

Table 65: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{20} = \mathrm{parameter\_8} \cdot [\mathrm{s30}] \tag{140}$$

## 10.21 Reaction re33

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re088

### Reaction equation

$$\mathrm{s31} \xrightarrow{\mathrm{s31}} \mathrm{s13} \tag{141}$$

### Reactant

Table 66: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |

### Modifier

Table 67: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |

### Product

Table 68: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{21} = \text{parameter\_8} \cdot [\text{s31}] \tag{142}$$

## 10.22 Reaction re35

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re089

### Reaction equation

$$\text{s33} \xrightarrow{\text{s33}} \text{s15} \tag{143}$$

### Reactant

Table 69: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Modifier

Table 70: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Product

Table 71: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{22} = \text{parameter\_8} \cdot [\text{s33}] \tag{144}$$

## 10.23 Reaction re41

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re091

### Reaction equation

$$\text{s33} \xrightarrow{\text{s31, s26, s30, s33, s31, s26, s30}} \text{s30} \tag{145}$$

### Reactant

Table 72: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Modifiers

Table 73: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |
| s26 | eDC | |
| s30 | Th17 | |
| s33 | iTreg | |
| s31 | Th1 | |
| s26 | eDC | |
| s30 | Th17 | |

### Product

Table 74: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{23} = \mathrm{vol}(\mathrm{c3}) \cdot \mathrm{function\_4}(\mathrm{parameter\_87}, [\mathrm{s33}], [\mathrm{s31}], \mathrm{parameter\_63}, \mathrm{parameter\_91}, [\mathrm{s26}], \mathrm{parameter\_91}, [\mathrm{s30}], \mathrm{parameter\_91}) \tag{146}$$

$$\mathrm{function\_4}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \tag{147}$$

$$\mathrm{function\_4}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \tag{148}$$

## 10.24 Reaction re42

This is an irreversible reaction of one reactant forming one product influenced by eleven modifiers.

**Name** re093

### Reaction equation

$$\text{s15} \xrightarrow{\text{s16, s9, s19, s13, s3, s15, s16, s9, s19, s13, s3}} \text{s16} \tag{149}$$

### Reactant

Table 75: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Modifiers

Table 76: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |
| s9 | eDC | |
| s19 | M1 | |
| s13 | Th1 | |
| s3 | Ep | |
| s15 | iTreg | |
| s16 | Th17 | |
| s9 | eDC | |
| s19 | M1 | |
| s13 | Th1 | |
| s3 | Ep | |

### Product

Table 77: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{24} = \text{vol}(\text{c2}) \cdot \text{function\_2}(\text{parameter\_87}, [\text{s15}], [\text{s16}], \text{parameter\_63}, \text{parameter\_91}, [\text{s9}], \text{parameter\_91}, [\text{s19}], \text{parameter\_91}, [\text{s13}], \text{parameter\_91}, [\text{s3}], \text{parameter\_31}) \tag{150}$$

$$\text{function\_2}\,(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}, \text{D}, \text{kD}, \text{E}, \text{kE}) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} + \frac{\text{D}^{\text{n}}}{\text{D}^{\text{n}} + \text{kD}^{\text{n}}} + \frac{\text{E}^{\text{n}}}{\text{E}^{\text{n}} + \text{kE}^{\text{n}}} \right) \tag{151}$$

$$\text{function\_2}\,(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}, \text{D}, \text{kD}, \text{E}, \text{kE}) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} + \frac{\text{D}^{\text{n}}}{\text{D}^{\text{n}} + \text{kD}^{\text{n}}} + \frac{\text{E}^{\text{n}}}{\text{E}^{\text{n}} + \text{kE}^{\text{n}}} \right) \tag{152}$$

## 10.25 Reaction `re43`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re095

### Reaction equation

$$\text{s16} \xrightarrow{\text{s16}} \text{s17} \tag{153}$$

### Reactant

Table 78: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s16` | Th17 | |

### Modifier

Table 79: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s16` | Th17 | |

### Product

Table 80: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s17` | emT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{25} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_15} \cdot [\mathrm{s16}] \tag{154}$$

## 10.26 Reaction `re44`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re096

### Reaction equation

$$\mathrm{s13} \xrightarrow{\mathrm{s13}} \mathrm{s17} \tag{155}$$

### Reactant

Table 81: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s13` | Th1 | |

### Modifier

Table 82: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s13` | Th1 | |

### Product

Table 83: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s17` | emT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{26} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_15} \cdot [\mathrm{s13}] \tag{156}$$

## 10.27 Reaction re45

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re097

### Reaction equation

$$\mathrm{s15} \xrightarrow{\mathrm{s15}} \mathrm{s17} \tag{157}$$

### Reactant

Table 84: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Modifier

Table 85: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Product

Table 86: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s17 | emT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{27} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_15} \cdot [\mathrm{s15}] \tag{158}$$

## 10.28 Reaction re46

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re098

### Reaction equation

$$\mathrm{s16} \xrightarrow{\mathrm{s16}} \mathrm{s29} \tag{159}$$

### Reactant

Table 87: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Modifier

Table 88: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Product

Table 89: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{28} = \mathrm{parameter\_16} \cdot [\mathrm{s16}] \tag{160}$$

## 10.29 Reaction re47

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re099

### Reaction equation

$$\mathrm{s13} \xrightarrow{\mathrm{s13}} \mathrm{s29} \tag{161}$$

### Reactant

Table 90: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Modifier

Table 91: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Product

Table 92: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{29} = \text{parameter\_16} \cdot [\text{s13}] \tag{162}$$

## 10.30 Reaction re49

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re100

### Reaction equation

$$\text{s15} \xrightarrow{\text{s15}} \text{s29} \tag{163}$$

### Reactant

Table 93: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Modifier

Table 94: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Product

Table 95: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s29 | cmT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{30} = \text{parameter\_16} \cdot [\text{s15}] \tag{164}$$

## 10.31 Reaction reaction_1

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re060

### Reaction equation

$$\text{s3} \xrightarrow{\text{s3}} \text{s2} \tag{165}$$

### Reactant

Table 96: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

### Modifier

Table 97: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

### Product

Table 98: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s2 | E | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{31} = \mathrm{vol}\,(\mathrm{c4}) \cdot \mathrm{parameter\_21} \cdot [\mathrm{s3}] \tag{166}$$

## 10.32 Reaction reaction_2

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re057

### Reaction equation

$$\mathrm{species\_5} \xrightarrow{\mathrm{species\_5}} \mathrm{s2} \tag{167}$$

### Reactant

Table 99: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_5 | Edead | |

### Modifier

Table 100: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_5 | Edead | |

### Product

Table 101: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s2 | E | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{32} = \mathrm{vol}\,(\mathrm{c4}) \cdot \mathrm{parameter\_21} \cdot [\mathrm{species\_5}] \tag{168}$$

## 10.33 Reaction reaction_3

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re102

### Reaction equation

$$\mathrm{s6} \xrightarrow{\mathrm{s6}} 2\,\mathrm{s6} \tag{169}$$

### Reactant

Table 102: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Modifier

Table 103: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Product

Table 104: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{33} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{function\_5}\,(\mathrm{parameter\_20}, [\mathrm{s6}], \mathrm{parameter\_93}) \tag{170}$$

$$\mathrm{function\_5}\,(\mathrm{k}, \mathrm{sub}, \mathrm{c}) = \frac{\mathrm{k} \cdot \mathrm{sub}}{\mathrm{c} + \mathrm{sub}} \tag{171}$$

$$\mathrm{function\_5}\,(\mathrm{k}, \mathrm{sub}, \mathrm{c}) = \frac{\mathrm{k} \cdot \mathrm{sub}}{\mathrm{c} + \mathrm{sub}} \tag{172}$$

## 10.34 Reaction reaction_4

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re101

### Reaction equation

$$\mathrm{s6} \xrightarrow{\mathrm{s6}} \emptyset \tag{173}$$

### Reactant

Table 105: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Modifier

Table 106: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{34} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_19} \cdot [\mathrm{s6}] \tag{174}$$

## 10.35 Reaction `reaction_5`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re052

### Reaction equation

$$\mathrm{s1} \xrightarrow{\mathrm{s1}} 2\,\mathrm{s1} \tag{175}$$

### Reactant

Table 107: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s1` | HP | |

### Modifier

Table 108: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s1` | HP | |

### Product

Table 109: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s1` | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{35} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{function\_5}\,(\mathrm{parameter\_20}, [\mathrm{s1}], \mathrm{parameter\_93}) \tag{176}$$

$$\text{function\_5}\left(\text{k}, \text{sub}, \text{c}\right) = \frac{\text{k} \cdot \text{sub}}{\text{c} + \text{sub}} \tag{177}$$

$$\text{function\_5}\left(\text{k}, \text{sub}, \text{c}\right) = \frac{\text{k} \cdot \text{sub}}{\text{c} + \text{sub}} \tag{178}$$

## 10.36 Reaction `reaction_6`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re065

### Reaction equation

$$\text{s1} \xrightarrow{\text{s1}} \emptyset \tag{179}$$

### Reactant

Table 110: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s1` | HP | |

### Modifier

Table 111: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s1` | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{36} = \text{vol}\left(\text{c1}\right) \cdot \text{parameter\_19} \cdot \left[\text{s1}\right] \tag{180}$$

## 10.37 Reaction `reaction_10`

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re103

### Reaction equation

$$\text{s17} \xrightarrow{\text{s19, s9, species\_18, s17, s19, s9, species\_18}} \text{s13} \tag{181}$$

### Reactant

Table 112: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s17 | emT | |

### Modifiers

Table 113: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |
| s9 | eDC | |
| species_18 | eDCLB | |
| s17 | emT | |
| s19 | M1 | |
| s9 | eDC | |
| species_18 | eDCLB | |

### Product

Table 114: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{37} = \text{vol}(\text{c2}) \cdot \text{function\_6}([\text{s17}], \text{parameter\_23}, [\text{s19}], \text{parameter\_23}, [\text{s9}], \text{parameter\_100}, [\text{species\_18}]) \tag{182}$$

$$\text{function\_6}(\text{substrate}, \text{k1}, \text{a1}, \text{k2}, \text{a2}, \text{k3}, \text{a3}) = \text{substrate} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2} + \text{k3} \cdot \text{a3}) \tag{183}$$

$$\text{function\_6}(\text{substrate}, \text{k1}, \text{a1}, \text{k2}, \text{a2}, \text{k3}, \text{a3}) = \text{substrate} \cdot (\text{k1} \cdot \text{a1} + \text{k2} \cdot \text{a2} + \text{k3} \cdot \text{a3}) \tag{184}$$

## 10.38 Reaction reaction_11

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re104

### Reaction equation

$$\text{s17} \xrightarrow{\text{s19, s9, species\_18, s17, s19, s9, species\_18}} \text{s16} \tag{185}$$

### Reactant

Table 115: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s17 | emT | |

### Modifiers

Table 116: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |
| s9 | eDC | |
| species_18 | eDCLB | |
| s17 | emT | |
| s19 | M1 | |
| s9 | eDC | |
| species_18 | eDCLB | |

### Product

Table 117: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{38} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_6}([\mathrm{s17}], \mathrm{parameter\_22}, [\mathrm{s19}], \mathrm{parameter\_22}, [\mathrm{s9}], \mathrm{parameter\_99}, [\mathrm{specie8}]) \quad (186)$$

$$\mathrm{function\_6}(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}, \mathrm{k3}, \mathrm{a3}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2} + \mathrm{k3} \cdot \mathrm{a3}) \quad (187)$$

$$\mathrm{function\_6}(\mathrm{substrate}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}, \mathrm{k3}, \mathrm{a3}) = \mathrm{substrate} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2} + \mathrm{k3} \cdot \mathrm{a3}) \quad (188)$$

## 10.39 Reaction `reaction_12`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re119

### Reaction equation

$$\mathrm{s16} \xrightarrow{\mathrm{s16}} \emptyset \quad (189)$$

### Reactant

Table 118: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s16` | Th17 | |

### Modifier

Table 119: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s16` | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{39} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{parameter\_64} \cdot [\mathrm{s16}] \quad (190)$$

## 10.40 Reaction `reaction_13`

This is an irreversible reaction of no reactant forming one product influenced by two modifiers.

**Name** re106

### Reaction equation

$$\emptyset \xrightarrow{\text{s26, s26}} \text{s28} \tag{191}$$

### Modifiers

Table 120: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |
| s26 | eDC | |

### Product

Table 121: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{40} = \text{vol}\,(\text{c3}) \cdot \text{function\_7}\,(\text{parameter\_33}, [\text{s26}], \text{parameter\_63}, \text{parameter\_86}, \text{parameter\_35}) \tag{192}$$

$$\text{function\_7}\,(\text{k}, \text{A}, \text{n}, \text{kA}, \text{c}) = \text{c} + \text{k} \cdot \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} \tag{193}$$

$$\text{function\_7}\,(\text{k}, \text{A}, \text{n}, \text{kA}, \text{c}) = \text{c} + \text{k} \cdot \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} \tag{194}$$

## 10.41 Reaction `reaction_14`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re107

### Reaction equation

$$\text{s28} \xrightarrow{\text{s28}} \emptyset \tag{195}$$

### Reactant

Table 122: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifier

Table 123: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{41} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{parameter\_34} \cdot [\mathrm{s28}] \tag{196}$$

## 10.42 Reaction reaction_16

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re061

### Reaction equation

$$\mathrm{s1} \xrightarrow{\mathrm{s3,\ s1,\ s3}} \mathrm{s6} \tag{197}$$

### Reactant

Table 124: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s1 | HP | |

### Modifiers

Table 125: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

| Id | Name | SBO |
|---|---|---|
| s1 | HP | |
| s3 | Ep | |

### Product

Table 126: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{42} = \text{function\_3}\left([\text{s1}], [\text{s3}], \text{parameter\_37}\right) \tag{198}$$

$$\text{function\_3}\left(\text{substrate}, \text{a1}, \text{k1}\right) = \text{substrate} \cdot \text{a1} \cdot \text{k1} \tag{199}$$

## 10.43 Reaction reaction_17

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re062

### Reaction equation

$$\text{s4} + \text{s1} \xrightarrow{\text{s4, s1}} \text{s25} \tag{200}$$

### Reactants

Table 127: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s4 | iDC | |
| s1 | HP | |

### Modifiers

Table 128: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s4 | iDC | |
| s1 | HP | |

### Product

Table 129: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s25 | tDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{43} = \text{parameter\_56} \cdot [\text{s4}] \cdot [\text{s1}] \tag{201}$$

## 10.44 Reaction reaction_19

This is an irreversible reaction of one reactant forming no product influenced by five modifiers.

**Name** re067

### Reaction equation

$$\text{s6} \xrightarrow{\text{s3, s19, s6, s3, s19}} \emptyset \tag{202}$$

### Reactant

Table 130: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s6 | HP | |

### Modifiers

Table 131: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |
| s19 | M1 | |
| s6 | HP | |
| s3 | Ep | |
| s19 | M1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{44} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_9}([\mathrm{s6}], \mathrm{parameter\_48}, \mathrm{parameter\_39}, [\mathrm{s3}], \mathrm{parameter\_38}, [\mathrm{s19}]) \quad (203)$$

$$\mathrm{function\_9}(\mathrm{substrate}, \mathrm{k}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot \mathrm{k} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (204)$$

$$\mathrm{function\_9}(\mathrm{substrate}, \mathrm{k}, \mathrm{k1}, \mathrm{a1}, \mathrm{k2}, \mathrm{a2}) = \mathrm{substrate} \cdot \mathrm{k} \cdot (\mathrm{k1} \cdot \mathrm{a1} + \mathrm{k2} \cdot \mathrm{a2}) \quad (205)$$

## 10.45 Reaction reaction_20

This is an irreversible reaction of one reactant forming no product influenced by three modifiers.

**Name** re053

### Reaction equation

$$\mathrm{s1} \xrightarrow{\mathrm{s3,\ s1,\ s3}} \emptyset \quad (206)$$

### Reactant

Table 132: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s1 | HP | |

### Modifiers

Table 133: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |
| s1 | HP | |
| s3 | Ep | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{45} = \mathrm{vol}(\mathrm{c1}) \cdot \mathrm{function\_3}([\mathrm{s1}], [\mathrm{s3}], \mathrm{parameter\_54}) \tag{207}$$

$$\mathrm{function\_3}(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{208}$$

$$\mathrm{function\_3}(\mathrm{substrate}, \mathrm{a1}, \mathrm{k1}) = \mathrm{substrate} \cdot \mathrm{a1} \cdot \mathrm{k1} \tag{209}$$

## 10.46 Reaction reaction_24

This is an irreversible reaction of no reactant forming one product influenced by six modifiers.

**Name** re068

### Reaction equation

$$\emptyset \xrightarrow{\mathrm{s3,\ s19,\ s9,\ s3,\ s19,\ s9}} \mathrm{species\_1} \tag{210}$$

### Modifiers

Table 134: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |
| s19 | M1 | |
| s9 | eDC | |
| s3 | Ep | |
| s19 | M1 | |
| s9 | eDC | |

### Product

Table 135: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_1 | iDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{46} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_10}(\mathrm{parameter\_66}, \mathrm{parameter\_41}, [\mathrm{s3}], \mathrm{parameter\_63}, \mathrm{parameter\_40}, [\mathrm{s19}], \mathrm{parameter\_85}, [\mathrm{s9}], \mathrm{parameter\_85}) \quad (211)$$

$$\mathrm{function\_10}(\mathrm{c}, \mathrm{k}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{c} + \mathrm{k} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \quad (212)$$

$$\mathrm{function\_10}(\mathrm{c}, \mathrm{k}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{c} + \mathrm{k} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \quad (213)$$

## 10.47 Reaction reaction_27

This is an irreversible reaction of no reactant forming one product influenced by six modifiers.

**Name** re069

### Reaction equation

$$\emptyset \xrightarrow{\mathrm{s19,\ s3,\ s9,\ s19,\ s3,\ s9}} \mathrm{s22} \quad (214)$$

### Modifiers

Table 136: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |
| s3 | Ep | |
| s9 | eDC | |
| s19 | M1 | |
| s3 | Ep | |
| s9 | eDC | |

### Product

Table 137: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{47} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_10}(\mathrm{parameter\_65}, \mathrm{parameter\_41}, [\mathrm{s19}], \mathrm{parameter\_63}, \mathrm{parameter\_85}, [\mathrm{s3}], \mathrm{parameter\_40}, [\mathrm{s9}], \mathrm{parameter\_85}) \quad (215)$$

$$\mathrm{function\_10}(\mathrm{c}, \mathrm{k}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{c} + \mathrm{k} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \quad (216)$$

$$\mathrm{function\_10}(\mathrm{c}, \mathrm{k}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{c} + \mathrm{k} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \quad (217)$$

## 10.48 Reaction reaction_31

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re111

### Reaction equation

$$\mathrm{species\_1} \xrightarrow{\mathrm{species\_1}} \emptyset \quad (218)$$

### Reactant

Table 138: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_1 | iDC | |

### Modifier

Table 139: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_1 | iDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{48} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_44} \cdot [\mathrm{species\_1}] \tag{219}$$

## 10.49 Reaction reaction_32

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re112

### Reaction equation

$$\mathrm{s22} \xrightarrow{\mathrm{s22}} \emptyset \tag{220}$$

### Reactant

Table 140: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |

### Modifier

Table 141: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{49} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_45} \cdot [\mathrm{s22}] \tag{221}$$

## 10.50 Reaction reaction_37

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re117

### Reaction equation

$$\mathrm{s19} \xrightarrow{\mathrm{s19}} \emptyset \tag{222}$$

### Reactant

Table 142: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Modifier

Table 143: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{50} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_62} \cdot [\mathrm{s19}] \tag{223}$$

## 10.51 Reaction reaction_38

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re118

### Reaction equation

$$\mathrm{s21} \xrightarrow{\mathrm{s21}} \emptyset \tag{224}$$

### Reactant

Table 144: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Modifier

Table 145: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{51} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_62} \cdot [\mathrm{s21}] \tag{225}$$

## 10.52 Reaction reaction_39

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re120

### Reaction equation

$$\mathrm{s13} \xrightarrow{\mathrm{s13}} \emptyset \tag{226}$$

### Reactant

Table 146: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Modifier

Table 147: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{52} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_64} \cdot [\mathrm{s13}] \tag{227}$$

## 10.53 Reaction `reaction_40`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re121

### Reaction equation

$$\mathrm{s15} \xrightarrow{\mathrm{s15}} \emptyset \tag{228}$$

### Reactant

Table 148: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `s15` | iTreg | |

### Modifier

Table 149: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `s15` | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{53} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_64} \cdot [\mathrm{s15}] \tag{229}$$

## 10.54 Reaction `reaction_7`

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re071

### Reaction equation

$$\text{s19} \xrightarrow{\text{s15, s21, s25, s19, s15, s21, s25}} \text{s21} \tag{230}$$

### Reactant

Table 150: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Modifiers

Table 151: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |
| s21 | M2 | |
| s25 | tDC | |
| s19 | M1 | |
| s15 | iTreg | |
| s21 | M2 | |
| s25 | tDC | |

### Product

Table 152: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{54} = \text{vol}(\text{c2}) \cdot \text{function\_4}(\text{parameter\_90}, [\text{s19}], [\text{s15}], \text{parameter\_63}, \text{parameter\_92}, [\text{s21}], \text{parameter\_92}, [\text{s25}], \text{parameter\_92}) \tag{231}$$

$$\text{function\_4}\left(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}\right) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} \right) \tag{232}$$

$$\text{function\_4}\left(\text{k}, \text{substrate}, \text{A}, \text{n}, \text{kA}, \text{B}, \text{kB}, \text{C}, \text{kC}\right) = \text{k} \cdot \text{substrate} \cdot \left( \frac{\text{A}^{\text{n}}}{\text{A}^{\text{n}} + \text{kA}^{\text{n}}} + \frac{\text{B}^{\text{n}}}{\text{B}^{\text{n}} + \text{kB}^{\text{n}}} + \frac{\text{C}^{\text{n}}}{\text{C}^{\text{n}} + \text{kC}^{\text{n}}} \right) \tag{233}$$

## 10.55 Reaction `reaction_8`

This is an irreversible reaction of one reactant forming one product influenced by seven modifiers.

**Name** re094

### Reaction equation

$$\text{s16} \xrightarrow{\text{s15, s25, s21, s16, s15, s25, s21}} \text{s15} \tag{234}$$

### Reactant

Table 153: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s16 | Th17 | |

### Modifiers

Table 154: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |
| s25 | tDC | |
| s21 | M2 | |
| s16 | Th17 | |
| s15 | iTreg | |
| s25 | tDC | |
| s21 | M2 | |

### Product

Table 155: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{55} = \mathrm{vol}(\mathrm{c2}) \cdot \mathrm{function\_4}(\mathrm{parameter\_88}, [\mathrm{s16}], [\mathrm{s15}], \mathrm{parameter\_63}, \mathrm{parameter\_92}, [\mathrm{s25}], \mathrm{parameter\_92}, [\mathrm{s21}], \mathrm{parameter\_92}) \tag{235}$$

$$\mathrm{function\_4}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \tag{236}$$

$$\mathrm{function\_4}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} \right) \tag{237}$$

## 10.56 Reaction reaction_9

This is an irreversible reaction of one reactant forming one product influenced by five modifiers.

**Name** re092

### Reaction equation

$$\mathrm{s30} \xrightarrow{\mathrm{s33,\ s27,\ s30,\ s33,\ s27}} \mathrm{s33} \tag{238}$$

### Reactant

Table 156: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s30 | Th17 | |

### Modifiers

Table 157: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |
| s27 | tDC | |
| s30 | Th17 | |
| s33 | iTreg | |
| s27 | tDC | |

### Product

Table 158: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{56} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{function\_11}\,(\mathrm{parameter\_88}, [\mathrm{s30}], [\mathrm{s33}], \mathrm{parameter\_63}, \mathrm{parameter\_92}, [\mathrm{s27}], \mathrm{parameter\_92}) \tag{239}$$

$$\mathrm{function\_11}\,(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} \right) \tag{240}$$

$$\mathrm{function\_11}\,(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} \right) \tag{241}$$

## 10.57 Reaction reaction_15

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re122

### Reaction equation

$$\mathrm{s22} + \mathrm{s6} \xrightarrow{\mathrm{s22,\ s6}} \mathrm{s19} \tag{242}$$

### Reactants

Table 159: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |
| s6 | HP | |

### Modifiers

Table 160: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |
| s6 | HP | |

### Product

Table 161: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s19 | M1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{57} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_59} \cdot [\mathrm{s22}] \cdot [\mathrm{s6}] \tag{243}$$

## 10.58 Reaction reaction_18

This is an irreversible reaction of two reactants forming one product influenced by two modifiers.

**Name** re123

### Reaction equation

$$\mathrm{s22} + \mathrm{s6} \xrightarrow{\mathrm{s22,\ s6}} \mathrm{s21} \tag{244}$$

### Reactants

Table 162: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |
| s6 | HP | |

### Modifiers

Table 163: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s22 | M0 | |
| s6 | HP | |

### Product

Table 164: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s21 | M2 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{58} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{parameter\_60} \cdot [\mathrm{s22}] \cdot [\mathrm{s6}] \tag{245}$$

## 10.59 Reaction reaction_21

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re116

### Reaction equation

$$\mathrm{s26} \xrightarrow{\mathrm{s26}} \emptyset \tag{246}$$

### Reactant

Table 165: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |

### Modifier

Table 166: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s26 | eDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{59} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{parameter\_46} \cdot [\mathrm{s26}] \tag{247}$$

## 10.60 Reaction reaction_22

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re124

### Reaction equation

$$\mathrm{s27} \xrightarrow{\mathrm{s27}} \emptyset \tag{248}$$

### Reactant

Table 167: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s27 | tDC | |

### Modifier

Table 168: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s27 | tDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{60} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{parameter\_46} \cdot [\mathrm{s27}] \tag{249}$$

## 10.61 Reaction `reaction_23`

This is a reversible reaction of one reactant forming one product influenced by two modifiers.

**Name** re127

### Reaction equation

$$\mathrm{species\_1} \overset{\mathrm{species\_1,\ s4}}{\rightleftharpoons} \mathrm{s4} \tag{250}$$

### Reactant

Table 169: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| `species_1` | iDC | |

### Modifiers

Table 170: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| `species_1` | iDC | |
| `s4` | iDC | |

### Product

Table 171: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s4` | iDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{61} = \text{function\_12}\,(\text{V}, [\text{species\_1}], \text{k}, [\text{s4}]) \tag{251}$$

$$\text{function\_12}\,(\text{V}, \text{s}, \text{k}, \text{P}) = \text{V} \cdot (\text{s} - \text{k} \cdot \text{P}) \tag{252}$$

Table 172: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| V | V | | 94.376 | | ☑ |
| k | k | | 1.359 | | ☑ |

## 10.62 Reaction reaction_25

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re128

### Reaction equation

$$\text{s4} \xrightarrow{\text{species\_10, s4, species\_10}} \text{s25} \tag{253}$$

### Reactant

Table 173: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s4 | iDC | |

### Modifiers

Table 174: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_10 | LB | |
| s4 | iDC | |
| species_10 | LB | |

### Product

Table 175: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s25 | tDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{62} = \text{function\_3}\left([\text{s4}], [\text{species\_10}], \text{parameter\_77}\right) \tag{254}$$

$$\text{function\_3}\left(\text{substrate}, \text{a1}, \text{k1}\right) = \text{substrate} \cdot \text{a1} \cdot \text{k1} \tag{255}$$

## 10.63 Reaction reaction_26

This is an irreversible reaction of one reactant forming one product influenced by three modifiers.

**Name** re129

### Reaction equation

$$\text{s4} \xrightarrow{\text{species\_10, s4, species\_10}} \text{s9} \tag{256}$$

### Reactant

Table 176: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s4 | iDC | |

### Modifiers

Table 177: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_10 | LB | |
| s4 | iDC | |
| species_10 | LB | |

### Product

Table 178: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s9 | eDC | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{63} = \text{function\_3}\left([\text{s4}], [\text{species\_10}], \text{parameter\_78}\right) \tag{257}$$

$$\text{function\_3}\left(\text{substrate}, \text{a1}, \text{k1}\right) = \text{substrate} \cdot \text{a1} \cdot \text{k1} \tag{258}$$

## 10.64 Reaction reaction_28

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re130

### Reaction equation

$$\text{species\_10} \xrightarrow{\text{species\_10}} \emptyset \tag{259}$$

### Reactant

Table 179: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_10 | LB | |

### Modifier

Table 180: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_10 | LB | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{64} = \text{vol}\left(\text{c1}\right) \cdot \text{parameter\_94} \cdot [\text{species\_10}] \tag{260}$$

## 10.65 Reaction reaction_29

This is an irreversible reaction of no reactant forming one product.

**Name** re131

### Reaction equation

$$\emptyset \longrightarrow \mathrm{s15} \tag{261}$$

### Product

Table 181: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s15 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{65} = \mathrm{vol}\left(\mathrm{c2}\right) \cdot \mathrm{function\_13}\left(\mathrm{parameter\_82}\right) \tag{262}$$

$$\mathrm{function\_13}\left(\mathrm{v}\right) = \mathrm{v} \tag{263}$$

$$\mathrm{function\_13}\left(\mathrm{v}\right) = \mathrm{v} \tag{264}$$

## 10.66 Reaction reaction_30

This is an irreversible reaction of no reactant forming one product.

**Name** re132

### Reaction equation

$$\emptyset \longrightarrow \mathrm{s13} \tag{265}$$

### Product

Table 182: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{66} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{function\_13}\,(\mathrm{parameter\_83}) \tag{266}$$

$$\mathrm{function\_13}\,(\mathrm{v}) = \mathrm{v} \tag{267}$$

$$\mathrm{function\_13}\,(\mathrm{v}) = \mathrm{v} \tag{268}$$

## 10.67 Reaction `reaction_33`

This is an irreversible reaction of no reactant forming one product.

**Name** re133

### Reaction equation

$$\emptyset \longrightarrow \mathrm{s16} \tag{269}$$

### Product

Table 183: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s16` | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{67} = \mathrm{vol}\,(\mathrm{c2}) \cdot \mathrm{function\_13}\,(\mathrm{parameter\_84}) \tag{270}$$

$$\mathrm{function\_13}\,(\mathrm{v}) = \mathrm{v} \tag{271}$$

$$\mathrm{function\_13}\,(\mathrm{v}) = \mathrm{v} \tag{272}$$

## 10.68 Reaction `reaction_34`

This is an irreversible reaction of no reactant forming one product.

**Name** re134

### Reaction equation

$$\emptyset \longrightarrow \text{s33} \tag{273}$$

### Product

Table 184: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s33 | iTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{68} = \text{vol}\,(\text{c3}) \cdot \text{function\_13}\,(\text{parameter\_79}) \tag{274}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{275}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{276}$$

## 10.69 Reaction reaction_35

This is an irreversible reaction of no reactant forming one product.

**Name** re135

### Reaction equation

$$\emptyset \longrightarrow \text{s31} \tag{277}$$

### Product

Table 185: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s31 | Th1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{69} = \text{vol}\,(\text{c3}) \cdot \text{function\_13}\,(\text{parameter\_80}) \tag{278}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{279}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{280}$$

## 10.70 Reaction `reaction_36`

This is an irreversible reaction of no reactant forming one product.

**Name** re136

### Reaction equation

$$\emptyset \longrightarrow \text{s30} \tag{281}$$

### Product

Table 186: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| `s30` | Th17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{70} = \text{vol}\,(\text{c3}) \cdot \text{function\_13}\,(\text{parameter\_81}) \tag{282}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{283}$$

$$\text{function\_13}\,(\text{v}) = \text{v} \tag{284}$$

## 10.71 Reaction `reaction_41`

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** re137

### Reaction equation

$$\text{species\_18} \xrightarrow{\text{species\_18}} \text{species\_20} \tag{285}$$

### Reactant

Table 187: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_18 | eDCLB | |

### Modifier

Table 188: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_18 | eDCLB | |

### Product

Table 189: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_20 | eDCLB | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{71} = \text{parameter\_9} \cdot [\text{species\_18}] \tag{286}$$

## 10.72 Reaction reaction_42

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re138

### Reaction equation

$$\text{species\_20} \xrightarrow{\text{species\_20}} \emptyset \tag{287}$$

### Reactant

Table 190: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_20 | eDCLB | |

### Modifier

Table 191: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_20 | eDCLB | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{72} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{parameter\_46} \cdot [\mathrm{species\_20}] \tag{288}$$

## 10.73 Reaction reaction_43

This is an irreversible reaction of one reactant forming one product influenced by eleven modifiers.

**Name** re139

### Reaction equation

$$\mathrm{s2} \xrightarrow{\mathrm{s13,\ s16,\ s9,\ s19,\ s3,\ s2,\ s13,\ s16,\ s9,\ s19,\ s3}} \mathrm{s3} \tag{289}$$

### Reactant

Table 192: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s2 | E | |

### Modifiers

Table 193: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |
| s16 | Th17 | |
| s9 | eDC | |
| s19 | M1 | |
| s3 | Ep | |
| s2 | E | |

| Id | Name | SBO |
|---|---|---|
| s13 | Th1 | |
| s16 | Th17 | |
| s9 | eDC | |
| s19 | M1 | |
| s3 | Ep | |

### Product

Table 194: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| s3 | Ep | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{73} = \mathrm{vol}(\mathrm{c4}) \cdot \mathrm{function\_2}(\mathrm{parameter\_105}, [\mathrm{s2}], [\mathrm{s13}], \mathrm{parameter\_63}, \mathrm{parameter\_91}, [\mathrm{s16}], \mathrm{parameter\_91}, [\mathrm{s9}], \mathrm{parameter\_91}, [\mathrm{s19}], \mathrm{parameter\_91}, [\mathrm{s3}], \mathrm{parameter\_106}) \tag{290}$$

$$\mathrm{function\_2}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}, \mathrm{D}, \mathrm{kD}, \mathrm{E}, \mathrm{kE}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} + \frac{\mathrm{D}^{\mathrm{n}}}{\mathrm{D}^{\mathrm{n}} + \mathrm{kD}^{\mathrm{n}}} + \frac{\mathrm{E}^{\mathrm{n}}}{\mathrm{E}^{\mathrm{n}} + \mathrm{kE}^{\mathrm{n}}} \right) \tag{291}$$

$$\mathrm{function\_2}(\mathrm{k}, \mathrm{substrate}, \mathrm{A}, \mathrm{n}, \mathrm{kA}, \mathrm{B}, \mathrm{kB}, \mathrm{C}, \mathrm{kC}, \mathrm{D}, \mathrm{kD}, \mathrm{E}, \mathrm{kE}) = \mathrm{k} \cdot \mathrm{substrate} \cdot \left( \frac{\mathrm{A}^{\mathrm{n}}}{\mathrm{A}^{\mathrm{n}} + \mathrm{kA}^{\mathrm{n}}} + \frac{\mathrm{B}^{\mathrm{n}}}{\mathrm{B}^{\mathrm{n}} + \mathrm{kB}^{\mathrm{n}}} + \frac{\mathrm{C}^{\mathrm{n}}}{\mathrm{C}^{\mathrm{n}} + \mathrm{kC}^{\mathrm{n}}} + \frac{\mathrm{D}^{\mathrm{n}}}{\mathrm{D}^{\mathrm{n}} + \mathrm{kD}^{\mathrm{n}}} + \frac{\mathrm{E}^{\mathrm{n}}}{\mathrm{E}^{\mathrm{n}} + \mathrm{kE}^{\mathrm{n}}} \right) \tag{292}$$

## 10.74 Reaction `reaction_44`

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** re140

### Reaction equation

$$\mathrm{species\_20} \xrightarrow{\mathrm{species\_20}} \emptyset \tag{293}$$

### Reactant

Table 195: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_20 | eDCLB | |

### Modifier

Table 196: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_20 | eDCLB | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{74} = \mathrm{vol}\,(\mathrm{c3}) \cdot \mathrm{parameter\_46} \cdot [\mathrm{species\_20}] \tag{294}$$

## 10.75 Reaction reaction_45

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTh1 creation

### Reaction equation

$$\mathrm{s28} \xrightarrow{\mathrm{s28}} \mathrm{species\_12} \tag{295}$$

### Reactant

Table 197: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifier

Table 198: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Product

Table 199: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_12 | nTh1 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{75} = \mathrm{k1} \cdot [\mathrm{s28}] \tag{296}$$

Table 200: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.003 | | ☑ |

## 10.76 Reaction reaction_46

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTh1 trans

### Reaction equation

$$\mathrm{species\_12} \xrightarrow{\mathrm{species\_12}} \mathrm{species\_13} \tag{297}$$

### Reactant

Table 201: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_12 | nTh1 | |

### Modifier

Table 202: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_12 | nTh1 | |

| Id | Name | SBO |
|---|---|---|

### Product

Table 203: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{76} = \mathrm{vol}(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_12}] \tag{298}$$

Table 204: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.106 | | ☑ |

## 10.77 Reaction reaction_47

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTh1_LP deg

### Reaction equation

$$\mathrm{species\_13} \xrightarrow{\mathrm{species\_13}} \emptyset \tag{299}$$

### Reactant

Table 205: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Modifier

Table 206: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{77} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_13}] \tag{300}$$

Table 207: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.158 | | ☑ |

## 10.78 Reaction reaction_48

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTh1_LP expansion

### Reaction equation

$$\mathrm{species\_13} \xrightarrow{\mathrm{species\_13}} 2\,\mathrm{species\_13} \tag{301}$$

### Reactant

Table 208: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Modifier

Table 209: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Product

Table 210: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_13 | nTh1_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{78} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_13}] \tag{302}$$

Table 211: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.1 | | ☑ |

## 10.79 Reaction reaction_49

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTh1 deg

### Reaction equation

$$\mathrm{species\_12} \xrightarrow{\mathrm{species\_12}} \emptyset \tag{303}$$

### Reactant

Table 212: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_12 | nTh1 | |

### Modifier

Table 213: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_12 | nTh1 | |

| Id | Name | SBO |
|---|---|---|

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{79} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_12}] \tag{304}$$

Table 214: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.108 | | ☑ |

## 10.80 Reaction reaction_50

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTh17 creation

### Reaction equation

$$\mathrm{s28} \xrightarrow{\mathrm{s28}} \mathrm{species\_14} \tag{305}$$

### Reactant

Table 215: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifier

Table 216: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Product

Table 217: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_14 | nTh17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{80} = \mathrm{k1} \cdot [\mathrm{s28}] \tag{306}$$

Table 218: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.002 | | ☑ |

## 10.81 Reaction reaction_51

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTh17 trans

### Reaction equation

$$\mathrm{species\_14} \xrightarrow{\mathrm{species\_14}} \mathrm{species\_15} \tag{307}$$

### Reactant

Table 219: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_14 | nTh17 | |

### Modifier

Table 220: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_14 | nTh17 | |

### Product

Table 221: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_15 | nTh17_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{81} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_14}] \tag{308}$$

Table 222: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.117 | | ☑ |

## 10.82 Reaction reaction_52

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTh17_LP deg

### Reaction equation

$$\mathrm{species\_15} \xrightarrow{\mathrm{species\_15}} \emptyset \tag{309}$$

### Reactant

Table 223: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_15 | nTh17_LP | |

### Modifier

Table 224: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_15 | nTh17_LP | |

| Id | Name | SBO |
|---|---|---|

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{82} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_15}] \tag{310}$$

Table 225: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.1 | | ☑ |

## 10.83 Reaction reaction_53

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTh17 deg

### Reaction equation

$$\mathrm{species\_14} \xrightarrow{\mathrm{species\_14}} \emptyset \tag{311}$$

### Reactant

Table 226: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_14 | nTh17 | |

### Modifier

Table 227: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_14 | nTh17 | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{83} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_14}] \tag{312}$$

Table 228: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.1 | | ☑ |

## 10.84 Reaction reaction_54

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTreg creation

### Reaction equation

$$\mathrm{s28} \xrightarrow{\mathrm{s28}} \mathrm{species\_16} \tag{313}$$

### Reactant

Table 229: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Modifier

Table 230: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| s28 | nT | |

### Product

Table 231: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_16 | nTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{84} = \mathrm{k1} \cdot [\mathrm{s28}] \tag{314}$$

Table 232: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.003 | | ☑ |

## 10.85 Reaction reaction_55

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** nTreg trans

### Reaction equation

$$\mathrm{species\_16} \xrightarrow{\mathrm{species\_16}} \mathrm{species\_17} \tag{315}$$

### Reactant

Table 233: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_16 | nTreg | |

### Modifier

Table 234: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_16 | nTreg | |

### Product

Table 235: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_17 | nTreg_LP | |

| Id | Name | SBO |
|---|---|---|

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{85} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_16}] \tag{316}$$

Table 236: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.1 | | ☑ |

## 10.86 Reaction reaction_56

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTreg_LP deg

### Reaction equation

$$\mathrm{species\_17} \xrightarrow{\mathrm{species\_17}} \emptyset \tag{317}$$

### Reactant

Table 237: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_17 | nTreg_LP | |

### Modifier

Table 238: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_17 | nTreg_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{86} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_17}] \tag{318}$$

Table 239: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.1 | | ☑ |

## 10.87 Reaction reaction_57

This is an irreversible reaction of one reactant forming no product influenced by one modifier.

**Name** nTreg deg

### Reaction equation

$$\mathrm{species\_16} \xrightarrow{\mathrm{species\_16}} \emptyset \tag{319}$$

### Reactant

Table 240: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_16 | nTreg | |

### Modifier

Table 241: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_16 | nTreg | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{87} = \mathrm{vol}\,(\mathrm{c1}) \cdot \mathrm{k1} \cdot [\mathrm{species\_16}] \tag{320}$$

Table 242: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.119 | | ☑ |

## 10.88 Reaction reaction_58

This is an irreversible reaction of one reactant forming one product influenced by one modifier.

**Name** Th17 to Treg

### Reaction equation

$$\text{species\_15} \xrightarrow{\text{species\_15}} \text{species\_17} \tag{321}$$

### Reactant

Table 243: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| species_15 | nTh17_LP | |

### Modifier

Table 244: Properties of each modifier.

| Id | Name | SBO |
|---|---|---|
| species_15 | nTh17_LP | |

### Product

Table 245: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| species_17 | nTreg_LP | |

### Kinetic Law

**Derived unit** contains undeclared units

$$v_{88} = \text{vol}\,(\text{c1}) \cdot \text{k1} \cdot [\text{species\_15}] \tag{322}$$

Table 246: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | | 0.167 | | ☑ |

# 11 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

Identifiers for kinetic laws highlighted in gray cannot be verified to evaluate to units of SBML substance per time. As a result, some SBML interpreters may not be able to verify the consistency of the units on quantities in the model. Please check if

- parameters without an unit definition are involved or
- volume correction is necessary because the hasOnlySubstanceUnits flag may be set to false and spacialDimensions> 0 for certain species.

## 11.1 Species s1

**Name** HP

**Initial concentration** $5.34 \cdot 10^{-8}$ item $\cdot$ ml$^{-1}$

**Initial assignment** s1

**Involved in events** event_1, event_2

This species takes part in 17 reactions (as a reactant in re3, re13, reaction_5, reaction_6, reaction_16, reaction_17, reaction_20 and as a product in reaction_5 and as a modifier in re2, re2, re3, re13, reaction_5, reaction_6, reaction_16, reaction_17, reaction_20).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s1} = 2\,v_{35} - v_2 - v_6 - v_{35} - v_{36} - v_{42} - v_{43} - v_{45} \tag{323}$$

Furthermore, two events influence this species' rate of change.

## 11.2 Species species_7

**Name** HP Dose

**Initial concentration** 0.0534 item $\cdot$ ml$^{-1}$

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_7} = 0 \tag{324}$$

## 11.3 Species species_10

**Name** LB

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

**Initial assignment** species_10

**Involved in events** event_1, event_2

This species takes part in six reactions (as a reactant in reaction_28 and as a modifier in reaction_25, reaction_25, reaction_26, reaction_26, reaction_28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_10} = -\,v_{64} \tag{325}$$

Furthermore, two events influence this species' rate of change.

## 11.4 Species species_11

**Name** LB Dose

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_11} = 0 \tag{326}$$

## 11.5 Species species_12

**Name** nTh1

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in five reactions (as a reactant in reaction_46, reaction_49 and as a product in reaction_45 and as a modifier in reaction_46, reaction_49).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_12} = v_{75} - v_{76} - v_{79} \tag{327}$$

## 11.6 Species species_13

**Name** nTh1_LP

**Initial concentration** $150000\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in six reactions (as a reactant in reaction_47, reaction_48 and as a product in reaction_46, reaction_48 and as a modifier in reaction_47, reaction_48).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_13} = v_{76} + 2\,v_{78} - v_{77} - v_{78} \tag{328}$$

## 11.7 Species species_14

**Name** nTh17

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in five reactions (as a reactant in reaction_51, reaction_53 and as a product in reaction_50 and as a modifier in reaction_51, reaction_53).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_14} = v_{80} - v_{81} - v_{83} \tag{329}$$

## 11.8 Species species_15

**Name** nTh17_LP

**Initial concentration** $150000\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in five reactions (as a reactant in reaction_52, reaction_58 and as a product in reaction_51 and as a modifier in reaction_52, reaction_58).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_15} = v_{81} - v_{82} - v_{88} \tag{330}$$

## 11.9 Species species_16

**Name** nTreg

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in five reactions (as a reactant in reaction_55, reaction_57 and as a product in reaction_54 and as a modifier in reaction_55, reaction_57).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_16} = v_{84} - v_{85} - v_{87} \tag{331}$$

## 11.10 Species species_17

**Name** nTreg_LP

**Initial concentration** $150000\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in four reactions (as a reactant in reaction_56 and as a product in reaction_55, reaction_58 and as a modifier in reaction_56).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_17} = v_{85} + v_{88} - v_{86} \tag{332}$$

## 11.11 Species s9

**Name** eDC

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 21 reactions (as a reactant in re21 and as a product in re6, re13, reaction_26 and as a modifier in re16, re16, re18, re18, re21, re42, re42, reaction_10, reaction_10, reaction_11, reaction_11, reaction_24, reaction_24, reaction_27, reaction_27, reaction_43, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s9} = v_4 + v_6 + v_{63} - v_{12} \tag{333}$$

## 11.12 Species s13

**Name** Th1

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 21 reactions (as a reactant in re44, re47, reaction_39 and as a product in re33, reaction_10, reaction_30 and as a modifier in re4, re4, re15, re15, re16, re16, re18, re18, re42, re42, re44, re47, reaction_39, reaction_43, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s13} = v_{21} + v_{37} + v_{66} - v_{26} - v_{29} - v_{52} \tag{334}$$

## 11.13 Species s15

**Name** iTreg

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 18 reactions (as a reactant in re42, re45, re49, reaction_40 and as a product in re11, re35, reaction_8, reaction_29 and as a modifier in re17, re17, re42, re45, re49, reaction_40, reaction_7, reaction_7, reaction_8, reaction_8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s15} = v_5 + v_{22} + v_{55} + v_{65} - v_{24} - v_{27} - v_{30} - v_{53} \tag{335}$$

## 11.14 Species s16

**Name** Th17

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 24 reactions (as a reactant in re43, re46, reaction_12, reaction_8 and as a product in re32, re42, reaction_11, reaction_33 and as a modifier in re4, re4, re15, re15, re16, re16, re18, re18, re42, re42, re43, re46, reaction_12, reaction_8, reaction_43, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s16} = v_{20} + v_{24} + v_{38} + v_{67} - v_{25} - v_{28} - v_{39} - v_{55} \tag{336}$$

## 11.15 Species s19

**Name** M1

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 29 reactions (as a reactant in reaction_37, reaction_7 and as a product in re16, re18, reaction_15 and as a modifier in re4, re4, re15, re15, re16, re16, re18, re18, re42, re42, reaction_10, reaction_10, reaction_11, reaction_11, reaction_19, reaction_19, reaction_24, reaction_24, reaction_27, reaction_27, reaction_37, reaction_7, reaction_43, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s19} = v_8 + v_{10} + v_{57} - v_{50} - v_{54} \tag{337}$$

## 11.16 Species s21

**Name** M2

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 15 reactions (as a reactant in re18, reaction_38 and as a product in re17, reaction_7, reaction_18 and as a modifier in re11, re11, re17, re17, re18, reaction_38, reaction_7, reaction_7, reaction_8, reaction_8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s21} = v_9 + v_{54} + v_{58} - v_{10} - v_{51} \tag{338}$$

## 11.17 Species s22

**Name** M0

**Initial concentration** $1000000\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in eleven reactions (as a reactant in re16, re17, reaction_32, reaction_15, reaction_18 and as a product in reaction_27 and as a modifier in re16, re17, reaction_32, reaction_15, reaction_18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s22} = v_{47} - v_8 - v_9 - v_{49} - v_{57} - v_{58} \tag{339}$$

## 11.18 Species s25

**Name** tDC

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 13 reactions (as a reactant in re22 and as a product in re20, reaction_17, reaction_25 and as a modifier in re11, re11, re17, re17, re22, reaction_7, reaction_7, reaction_8, reaction_8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s25} = v_{11} + v_{43} + v_{62} - v_{13} \tag{340}$$

## 11.19 Species s17

**Name** emT

**Initial concentration** 1198199.01671451 item · ml$^{-1}$

This species takes part in nine reactions (as a reactant in re11, reaction_10, reaction_11 and as a product in re43, re44, re45 and as a modifier in re11, reaction_10, reaction_11).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s17} = v_{25} + v_{26} + v_{27} - v_5 - v_{37} - v_{38} \tag{341}$$

## 11.20 Species s6

**Name** HP

**Initial concentration** 0 item · ml$^{-1}$

This species takes part in 17 reactions (as a reactant in re6, re20, reaction_3, reaction_4, reaction_19, reaction_15, reaction_18 and as a product in re3, reaction_3, reaction_16 and as a modifier in re6, re20, reaction_3, reaction_4, reaction_19, reaction_15, reaction_18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s6} = v_2 + 2\,v_{33} + v_{42} - v_4 - v_{11} - v_{33} - v_{34} - v_{44} - v_{57} - v_{58} \tag{342}$$

## 11.21 Species species_1

**Name** iDC

**Initial concentration** 1000000 item · ml$^{-1}$

This species takes part in nine reactions (as a reactant in re6, re20, reaction_31, reaction_23 and as a product in reaction_24 and as a modifier in re6, re20, reaction_31, reaction_23).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_1} = v_{46} - v_4 - v_{11} - v_{48} - v_{61} \tag{343}$$

## 11.22 Species species_2

**Name** TotalDC

**Initial concentration** 5501140.56260765 item · ml$^{-1}$

**Involved in rule** species_2

One rule determines the species' quantity.

## 11.23 Species species_3

**Name** TotalM

**Initial concentration** 1000000 item · ml$^{-1}$

**Involved in rule** species_3

One rule determines the species' quantity.

## 11.24 Species species_4

**Name** TotalT

**Initial concentration** 1198199.01671451 item · ml$^{-1}$

**Involved in rule** species_4

One rule determines the species' quantity.

## 11.25 Species species_18

**Name** eDCLB

**Initial concentration** 1 item · ml$^{-1}$

This species takes part in six reactions (as a reactant in reaction_41 and as a modifier in reaction_10, reaction_10, reaction_11, reaction_11, reaction_41).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_18} = -v_{71} \tag{344}$$

## 11.26 Species species_19

**Name** pEC

**Initial concentration** 1 item · ml$^{-1}$

This species does not take part in any reactions. Its quantity does hence not change over time:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_19} = 0 \tag{345}$$

## 11.27 Species s2

**Name** E

**Initial concentration** 10000 item · ml$^{-1}$

This species takes part in eight reactions (as a reactant in re2, re15, reaction_43 and as a product in reaction_1, reaction_2 and as a modifier in re2, re15, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s2} = v_{31} + v_{32} - v_1 - v_7 - v_{73} \tag{346}$$

## 11.28 Species s3

**Name** Ep

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 24 reactions (as a reactant in re4, reaction_1 and as a product in re2, reaction_43 and as a modifier in re4, re16, re16, re18, re18, re42, re42, reaction_1, reaction_16, reaction_16, reaction_19, reaction_19, reaction_20, reaction_20, reaction_24, reaction_24, reaction_27, reaction_27, reaction_43, reaction_43).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s3} = v_{1} + v_{73} - v_{3} - v_{31} \tag{347}$$

## 11.29 Species species_5

**Name** Edead

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in six reactions (as a reactant in reaction_2 and as a product in re4, re15 and as a modifier in re3, re3, reaction_2).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{species\_5} = v_{3} + v_{7} - v_{32} \tag{348}$$

## 11.30 Species s4

**Name** iDC

**Initial concentration** $4501139.56260765\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in ten reactions (as a reactant in re13, reaction_17, reaction_25, reaction_26 and as a product in reaction_23 and as a modifier in re13, reaction_17, reaction_23, reaction_25, reaction_26).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s4} = v_{61} - v_{6} - v_{43} - v_{62} - v_{63} \tag{349}$$

## 11.31 Species s26

**Name** eDC

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 15 reactions (as a reactant in reaction_21 and as a product in re21 and as a modifier in re23, re23, re24, re24, re28, re28, re29, re29, re41, re41, reaction_13, reaction_13, reaction_21).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s26} = v_{12} - v_{59} \tag{350}$$

## 11.32 Species s27

**Name** tDC

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in nine reactions (as a reactant in reaction_22 and as a product in re22 and as a modifier in re27, re27, re31, re31, reaction_9, reaction_9, reaction_22).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s27} = v_{13} - v_{60} \tag{351}$$

## 11.33 Species s28

**Name** nT

**Initial concentration** $10^{7}\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in 15 reactions (as a reactant in re23, re24, re27, reaction_14, reaction_45, reaction_50, reaction_54 and as a product in reaction_13 and as a modifier in re23, re24, re27, reaction_14, reaction_45, reaction_50, reaction_54).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s28} = v_{40} - v_{14} - v_{15} - v_{16} - v_{41} - v_{75} - v_{80} - v_{84} \tag{352}$$

## 11.34 Species s29

**Name** cmT

**Initial concentration** $4.17752018460542 \cdot 10^{7}\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in nine reactions (as a reactant in re28, re29, re31 and as a product in re46, re47, re49 and as a modifier in re28, re29, re31).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s29} = v_{28} + v_{29} + v_{30} - v_{17} - v_{18} - v_{19} \tag{353}$$

## 11.35 Species s30

**Name** Th17

**Initial concentration** $0\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in ten reactions (as a reactant in re32, reaction_9 and as a product in re23, re28, re41, reaction_36 and as a modifier in re32, re41, re41, reaction_9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s30} = v_{14} + v_{17} + v_{23} + v_{70} - v_{20} - v_{56} \tag{354}$$

## 11.36 Species s31

**Name** Th1

**Initial concentration** $0\ \mathrm{item} \cdot \mathrm{ml}^{-1}$

This species takes part in seven reactions (as a reactant in re33 and as a product in re24, re29, reaction_35 and as a modifier in re33, re41, re41).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s31} = v_{15} + v_{18} + v_{69} - v_{21} \tag{355}$$

## 11.37 Species s33

**Name** iTreg

**Initial concentration** $0\ \mathrm{item} \cdot \mathrm{ml}^{-1}$

This species takes part in ten reactions (as a reactant in re35, re41 and as a product in re27, re31, reaction_9, reaction_34 and as a modifier in re35, re41, reaction_9, reaction_9).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{s33} = v_{16} + v_{19} + v_{56} + v_{68} - v_{22} - v_{23} \tag{356}$$

## 11.38 Species species_6

**Name** TotalDC

**Initial concentration** $0\ \mathrm{item} \cdot \mathrm{ml}^{-1}$

**Involved in rule** species_6

One rule determines the species' quantity.

## 11.39 Species species_8

**Name** TotalT

**Initial concentration** $5.17752018460542 \cdot 10^{7}\ \mathrm{item} \cdot \mathrm{ml}^{-1}$

**Involved in rule** species_8

One rule determines the species' quantity.

### 11.40 Species species_9

**Name** TotalT-s

**Notes** `Multiplied by 0.01 to account for the fact that the data is in percent.`

**Initial concentration** $51775.2018460542\ \text{item} \cdot \text{ml}^{-1}$

**Involved in rule** species_9

One rule determines the species' quantity.

### 11.41 Species species_20

**Name** eDCLB

**Initial concentration** $1\ \text{item} \cdot \text{ml}^{-1}$

This species takes part in eleven reactions (as a reactant in reaction_42, reaction_44 and as a product in reaction_41 and as a modifier in re23, re23, re28, re28, re29, re29, reaction_42, reaction_44).

$$\frac{\mathrm{d}}{\mathrm{d}t}\text{species\_20} = v_{71} - v_{72} - v_{74} \tag{357}$$

## A Glossary of Systems Biology Ontology Terms

**SBO:0000290 physical compartment:** Specific location of space, that can be bounded or not. A physical compartment can have 1, 2 or 3 dimensions

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