**SBML Model Report**

# Model name: "Butenas2004_BloodCoagulation"

May 5, 2016

## 1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by Michael Schubert[1] at August 26th 2011 at 4:36 p. m. and last time modified at October nineth 2014 at 5:08 p. m. Table 1 provides 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 | 1 |
| species types | 0 | species | 34 |
| events | 0 | constraints | 0 |
| reactions | 33 | function definitions | 0 |
| global parameters | 45 | unit definitions | 0 |
| rules | 1 | initial assignments | 0 |

### Model Notes

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To cite BioModels Database, please use: Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C (2010)

[1] EBI, schubert@ebi.ac.uk

BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. BMC Syst Biol., 4:92.

# 2 Unit Definitions

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

## 2.1 Unit `substance`

**Notes** Mole is the predefined SBML unit for `substance`.

**Definition** mol

## 2.2 Unit `volume`

**Notes** Litre is the predefined SBML unit for `volume`.

**Definition** l

## 2.3 Unit `area`

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

**Definition** $m^2$

## 2.4 Unit `length`

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

**Definition** m

## 2.5 Unit `time`

**Notes** Second is the predefined SBML unit for `time`.

**Definition** s

# 3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

| Id | Name | SBO | Spatial Dimensions | Size | Unit | Constant | Outside |
|---|---|---|---|---|---|---|---|
| compartment_1 | compartment_1 | | 3 | 1 | litre | ☑ | |

### 3.1 Compartment compartment_1

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

**Name** compartment_1

## 4 Species

This model contains 34 species. Section 8 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 |
|---|---|---|---|---|---|
| TF | TF | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VII | TF_VII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VII | VII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa | TF_VIIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VIIa | VIIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| Xa | Xa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IIa | IIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa_X | TF_VIIa_X | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| X | X | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa_Xa | TF_VIIa_Xa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IX | IX | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa_IX | TF_VIIa_IX | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IXa | IXa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| II | II | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VIII | VIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VIIIa | VIIIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IXa_VIIIa | IXa_VIIIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IXa_VIIIa_X | IXa_VIIIa_X | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VIIIa1_L | VIIIa1_L | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| VIIIa2 | VIIIa2 | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| V | V | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| Va | Va | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |

| Id | Name | Compartment | Derived Unit | Constant | Boundary Condition |
|---|---|---|---|---|---|
| Xa_Va | Xa_Va | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| Xa_Va_II | Xa_Va_II | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| mIIa | mIIa | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TFPI | TFPI | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| Xa_TFPI | Xa_TFPI | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa_Xa_TFPI | TF_VIIa_Xa_TFPI | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| ATIII | ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| Xa_ATIII | Xa_ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| mIIa_ATIII | mIIa_ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IXa_ATIII | IXa_ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| IIa_ATIII | IIa_ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |
| TF_VIIa_ATIII | TF_VIIa_ATIII | compartment_1 | $\mathrm{mol} \cdot \mathrm{l}^{-1}$ | ⊟ | ⊟ |

## 5 Parameters

This model contains 45 global parameters.

Table 4: Properties of each parameter.

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k1 | k1 | 0000038 | 0.003 | | ☑ |
| k2 | k2 | 0000036 | 3200000.000 | | ☑ |
| k3 | k3 | 0000038 | 0.003 | | ☑ |
| k4 | k4 | 0000036 | $2.3 \cdot 10^{7}$ | | ☑ |
| k5 | k5 | 0000036 | 440000.000 | | ☑ |
| k6 | k6 | 0000036 | $1.3 \cdot 10^{7}$ | | ☑ |
| k7 | k7 | 0000036 | 23000.000 | | ☑ |
| k8 | k8 | 0000038 | 1.050 | | ☑ |
| k9 | k9 | 0000036 | $2.5 \cdot 10^{7}$ | | ☑ |
| k10 | k10 | 0000035 | 6.000 | | ☑ |
| k11 | k11 | 0000038 | 19.000 | | ☑ |
| k12 | k12 | 0000036 | $2.2 \cdot 10^{7}$ | | ☑ |
| k13 | k13 | 0000038 | 2.400 | | ☑ |
| k14 | k14 | 0000036 | $10^{7}$ | | ☑ |
| k15 | k15 | 0000035 | 1.800 | | ☑ |
| k16 | k16 | 0000036 | 7500.000 | | ☑ |
| k17 | k17 | 0000036 | $2 \cdot 10^{7}$ | | ☑ |
| k18 | k18 | 0000038 | 0.005 | | ☑ |
| k19 | k19 | 0000036 | $10^{7}$ | | ☑ |
| k20 | k20 | 0000038 | 0.001 | | ☑ |
| k21 | k21 | 0000036 | $10^{8}$ | | ☑ |
| k22 | k22 | 0000035 | 8.200 | | ☑ |
| k23 | k23 | 0000039 | 22000.000 | | ☑ |
| k24 | k24 | 0000035 | 0.006 | | ☑ |
| k25 | k25 | 0000035 | 0.001 | | ☑ |
| k26 | k26 | 0000036 | $2 \cdot 10^{7}$ | | ☑ |
| k27 | k27 | 0000038 | 0.200 | | ☑ |
| k28 | k28 | 0000036 | $4 \cdot 10^{8}$ | | ☑ |
| k29 | k29 | 0000038 | 103.000 | | ☑ |
| k30 | k30 | 0000036 | $10^{8}$ | | ☑ |
| k31 | k31 | 0000035 | 63.500 | | ☑ |
| k32 | k32 | 0000036 | $1.5 \cdot 10^{7}$ | | ☑ |
| k33 | k33 | 0000038 | $3.6 \cdot 10^{-4}$ | | ☑ |
| k34 | k34 | 0000036 | 900000.000 | | ☑ |
| k35 | k35 | 0000038 | $1.1 \cdot 10^{-4}$ | | ☑ |
| k36 | k36 | 0000036 | $3.2 \cdot 10^{8}$ | | ☑ |
| k37 | k37 | 0000036 | $5 \cdot 10^{7}$ | | ☑ |

| Id | Name | SBO | Value | Unit | Constant |
|---|---|---|---|---|---|
| k38 | k38 | 0000036 | 1500.000 | | ☑ |
| k39 | k39 | 0000036 | 7100.000 | | ☑ |
| k40 | k40 | 0000036 | 490.000 | | ☑ |
| k41 | k41 | 0000036 | 7100.000 | | ☑ |
| k42 | k42 | 0000036 | 230.000 | | ☑ |
| IIa_plus_1-_2mIIa | IIa+1.2mIIa | | $10^{-9}$ | | ⊟ |
| k43 | k43 | 0000036 | 5700.000 | | ☑ |
| k44 | k44 | 0000036 | 3000000.000 | | ☑ |

# 6 Rule

This is an overview of one rule.

## 6.1 Rule IIa_plus_1_2mIIa

Rule IIa_plus_1_2mIIa is an assignment rule for parameter IIa_plus_1_2mIIa:

$$\text{IIa\_plus\_1\_2mIIa} = [\text{IIa}] + 1.2 \cdot [\text{mIIa}] \tag{1}$$

## 7 Reactions

This model contains 33 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 | R1 | R1 | $TF + VII \rightleftharpoons TF\_VII$ | |
| 2 | R2 | R2 | $TF + VIIa \rightleftharpoons TF\_VIIa$ | |
| 3 | R3 | R3 | $TF\_VIIa + VII \longrightarrow TF\_VIIa + VIIa$ | |
| 4 | R4 | R4 | $Xa + VII \longrightarrow Xa + VIIa$ | |
| 5 | R5 | R5 | $IIa + VII \longrightarrow IIa + VIIa$ | |
| 6 | R6 | R6 | $TF\_VIIa + X \rightleftharpoons TF\_VIIa\_X$ | |
| 7 | R7 | R7 | $TF\_VIIa + Xa \rightleftharpoons TF\_VIIa\_Xa$ | |
| 8 | R8 | R8 | $TF\_VIIa + IX \rightleftharpoons TF\_VIIa\_IX$ | |
| 9 | R9 | R9 | $Xa + II \longrightarrow Xa + IIa$ | |
| 10 | R10 | R10 | $IIa + VIII \longrightarrow IIa + VIIIa$ | |
| 11 | R11 | R11 | $IXa + VIIIa \rightleftharpoons IXa\_VIIIa$ | |
| 12 | R12 | R12 | $IXa\_VIIIa + X \rightleftharpoons IXa\_VIIIa\_X$ | |
| 13 | R13 | R13 | $VIIIa \rightleftharpoons VIIIa1\_L + VIIIa2$ | |
| 14 | R14 | R14 | $IXa\_VIIIa\_X \longrightarrow VIIIa1\_L + VIIIa2 + X + IXa$ | |
| 15 | R15 | R15 | $IXa\_VIIIa \longrightarrow VIIIa1\_L + VIIIa2 + IXa$ | |
| 16 | R16 | R16 | $IIa + V \longrightarrow IIa + Va$ | |
| 17 | R17 | R17 | $Xa + Va \rightleftharpoons Xa\_Va$ | |
| 18 | R18 | R18 | $Xa\_Va + II \rightleftharpoons Xa\_Va\_II$ | |
| 19 | R19 | R19 | $mIIa + Xa\_Va \longrightarrow IIa + Xa\_Va$ | |
| 20 | R20 | R20 | $Xa + TFPI \rightleftharpoons Xa\_TFPI$ | |
| 21 | R21 | R21 | $TF\_VIIa\_Xa + TFPI \rightleftharpoons TF\_VIIa\_Xa\_TFPI$ | |
| 22 | R22 | R22 | $TF\_VIIa + Xa\_TFPI \longrightarrow TF\_VIIa\_Xa\_TFPI$ | |
| 23 | R23 | R23 | $Xa + ATIII \longrightarrow Xa\_ATIII$ | |

| № | Id | Name | Reaction Equation | SBO |
|---|---|---|---|---|
| 24 | R24 | R24 | mIIa + ATIII ⟶ mIIa_ATIII | |
| 25 | R25 | R25 | IXa + ATIII ⟶ IXa_ATIII | |
| 26 | R26 | R26 | IIa + ATIII ⟶ IIa_ATIII | |
| 27 | R27 | R27 | TF_VIIa + ATIII ⟶ TF_VIIa_ATIII | |
| 28 | R6b | R6b | TF_VIIa_X ⟶ TF_VIIa_Xa | |
| 29 | R8b | R8b | TF_VIIa_IX ⟶ TF_VIIa + IXa | |
| 30 | R12b | R12b | IXa_VIIIa_X ⟶ IXa_VIIIa + Xa | |
| 31 | R18b | R18b | Xa_Va_II ⟶ Xa_Va + mIIa | |
| 32 | R28 | R28 | IXa + X ⟶ IXa + Xa | |
| 33 | R29 | R29 | mIIa + V ⟶ mIIa + Va | |

## 7.1 Reaction R1

This is a reversible reaction of two reactants forming one product.

**Name** R1

### Reaction equation

$$\mathrm{TF} + \mathrm{VII} \rightleftharpoons \mathrm{TF\_VII} \tag{2}$$

### Reactants

Table 6: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF | TF | 0000010 |
| VII | VII | 0000010 |

### Product

Table 7: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VII | TF_VII | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_1 = \mathrm{vol}\left(\mathrm{compartment\_1}\right) \cdot \left(\mathrm{k2} \cdot [\mathrm{TF}] \cdot [\mathrm{VII}] - \mathrm{k1} \cdot [\mathrm{TF\_VII}]\right) \tag{3}$$

## 7.2 Reaction R2

This is a reversible reaction of two reactants forming one product.

**Name** R2

### Reaction equation

$$\mathrm{TF} + \mathrm{VIIa} \rightleftharpoons \mathrm{TF\_VIIa} \tag{4}$$

### Reactants

Table 8: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF | TF | 0000010 |
| VIIa | VIIa | 0000010 |

### Product

Table 9: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_2 = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k4} \cdot [\mathrm{TF}] \cdot [\mathrm{VIIa}] - \mathrm{k3} \cdot [\mathrm{TF\_VIIa}]) \tag{5}$$

## 7.3 Reaction R3

This is an irreversible reaction of two reactants forming two products.

**Name** R3

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{VII} \longrightarrow \mathrm{TF\_VIIa} + \mathrm{VIIa} \tag{6}$$

### Reactants

Table 10: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000461 |
| VII | VII | 0000010 |

### Products

Table 11: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000461 |
| VIIa | VIIa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_3 = \mathrm{vol}\left(\mathrm{compartment\_1}\right) \cdot \mathrm{k5} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{VII}] \tag{7}$$

## 7.4 Reaction R4

This is an irreversible reaction of two reactants forming two products.

**Name** R4

### Reaction equation

$$\mathrm{Xa} + \mathrm{VII} \longrightarrow \mathrm{Xa} + \mathrm{VIIa} \tag{8}$$

### Reactants

Table 12: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000461 |
| VII | VII | 0000010 |

### Products

Table 13: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000461 |
| VIIa | VIIa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_4 = \mathrm{vol}(\mathrm{compartment\_1}) \cdot \mathrm{k6} \cdot [\mathrm{Xa}] \cdot [\mathrm{VII}] \tag{9}$$

## 7.5 Reaction R5

This is an irreversible reaction of two reactants forming two products.

**Name** R5

### Reaction equation

$$\mathrm{IIa} + \mathrm{VII} \longrightarrow \mathrm{IIa} + \mathrm{VIIa} \tag{10}$$

### Reactants

Table 14: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| VII | VII | 0000010 |

### Products

Table 15: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| VIIa | VIIa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_5 = \mathrm{vol}(\mathrm{compartment\_1}) \cdot \mathrm{k7} \cdot [\mathrm{IIa}] \cdot [\mathrm{VII}] \tag{11}$$

## 7.6 Reaction R6

This is a reversible reaction of two reactants forming one product.

**Name** R6

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{X} \rightleftharpoons \mathrm{TF\_VIIa\_X} \tag{12}$$

### Reactants

Table 16: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000010 |
| X | X | 0000010 |

### Product

Table 17: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_X | TF_VIIa_X | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_6 = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k9} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{X}] - \mathrm{k8} \cdot [\mathrm{TF\_VIIa\_X}]) \tag{13}$$

## 7.7 Reaction R7

This is a reversible reaction of two reactants forming one product.

**Name** R7

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{Xa} \rightleftharpoons \mathrm{TF\_VIIa\_Xa} \tag{14}$$

### Reactants

Table 18: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000010 |
| Xa | Xa | 0000010 |

### Product

Table 19: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_Xa | TF_VIIa_Xa | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_7 = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k12} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{Xa}] - \mathrm{k11} \cdot [\mathrm{TF\_VIIa\_Xa}]) \tag{15}$$

## 7.8 Reaction R8

This is a reversible reaction of two reactants forming one product.

**Name** R8

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{IX} \rightleftharpoons \mathrm{TF\_VIIa\_IX} \tag{16}$$

### Reactants

Table 20: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000010 |
| IX | IX | 0000010 |

### Product

Table 21: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_IX | TF_VIIa_IX | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_8 = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k14} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{IX}] - \mathrm{k13} \cdot [\mathrm{TF\_VIIa\_IX}]) \tag{17}$$

## 7.9 Reaction R9

This is an irreversible reaction of two reactants forming two products.

**Name** R9

### Reaction equation

$$\mathrm{Xa} + \mathrm{II} \longrightarrow \mathrm{Xa} + \mathrm{IIa} \tag{18}$$

### Reactants

Table 22: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000461 |
| II | II | 0000010 |

### Products

Table 23: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000461 |
| IIa | IIa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_9 = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k16} \cdot [\mathrm{Xa}] \cdot [\mathrm{II}] \tag{19}$$

## 7.10 Reaction R10

This is an irreversible reaction of two reactants forming two products.

**Name** R10

### Reaction equation

$$\mathrm{IIa} + \mathrm{VIII} \longrightarrow \mathrm{IIa} + \mathrm{VIIIa} \tag{20}$$

### Reactants

Table 24: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| VIII | VIII | 0000010 |

### Products

Table 25: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| VIIIa | VIIIa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_{10} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k17} \cdot [\mathrm{IIa}] \cdot [\mathrm{VIII}] \tag{21}$$

## 7.11 Reaction R11

This is a reversible reaction of two reactants forming one product.

**Name** R11

### Reaction equation

$$\mathrm{IXa} + \mathrm{VIIIa} \rightleftharpoons \mathrm{IXa\_VIIIa} \tag{22}$$

### Reactants

Table 26: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa | IXa | 0000010 |
| VIIIa | VIIIa | 0000010 |

### Product

Table 27: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa | IXa_VIIIa | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{11} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k19} \cdot [\mathrm{IXa}] \cdot [\mathrm{VIIIa}] - \mathrm{k18} \cdot [\mathrm{IXa\_VIIIa}]) \tag{23}$$

## 7.12 Reaction R12

This is a reversible reaction of two reactants forming one product.

**Name** R12

### Reaction equation

$$\mathrm{IXa\_VIIIa} + \mathrm{X} \rightleftharpoons \mathrm{IXa\_VIIIa\_X} \tag{24}$$

### Reactants

Table 28: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa | IXa_VIIIa | 0000010 |
| X | X | 0000010 |

### Product

Table 29: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa_X | IXa_VIIIa_X | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{12} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k21} \cdot [\mathrm{IXa\_VIIIa}] \cdot [\mathrm{X}] - \mathrm{k20} \cdot [\mathrm{IXa\_VIIIa\_X}]) \tag{25}$$

## 7.13 Reaction R13

This is a reversible reaction of one reactant forming two products.

**Name** R13

### Reaction equation

$$\mathrm{VIIIa} \rightleftharpoons \mathrm{VIIIa1\_L} + \mathrm{VIIIa2} \tag{26}$$

### Reactant

Table 30: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| VIIIa | VIIIa | 0000010 |

### Products

Table 31: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| VIIIa1_L | VIIIa1_L | 0000011 |
| VIIIa2 | VIIIa2 | 0000011 |

### Kinetic Law

**SBO:0000083** mass action rate law for first order forward, second order reverse, reversible reactions, two products, continuous scheme

**Derived unit** contains undeclared units

$$v_{13} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k24} \cdot [\mathrm{VIIIa}] - \mathrm{k23} \cdot [\mathrm{VIIIa1\_L}] \cdot [\mathrm{VIIIa2}]) \tag{27}$$

## 7.14 Reaction R14

This is an irreversible reaction of one reactant forming four products.

**Name** R14

### Reaction equation

$$\mathrm{IXa\_VIIIa\_X} \longrightarrow \mathrm{VIIIa1\_L} + \mathrm{VIIIa2} + \mathrm{X} + \mathrm{IXa} \tag{28}$$

### Reactant

Table 32: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa_X | IXa_VIIIa_X | 0000010 |

### Products

Table 33: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| VIIIa1_L | VIIIa1_L | 0000011 |
| VIIIa2 | VIIIa2 | 0000011 |
| X | X | 0000011 |
| IXa | IXa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{14} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k25} \cdot [\mathrm{IXa\_VIIIa\_X}] \tag{29}$$

## 7.15 Reaction R15

This is an irreversible reaction of one reactant forming three products.

**Name** R15

### Reaction equation

$$\mathrm{IXa\_VIIIa} \longrightarrow \mathrm{VIIIa1\_L} + \mathrm{VIIIa2} + \mathrm{IXa} \tag{30}$$

### Reactant

Table 34: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa | IXa_VIIIa | 0000010 |

### Products

Table 35: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| VIIIa1_L | VIIIa1_L | 0000011 |
| VIIIa2 | VIIIa2 | 0000011 |
| IXa | IXa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{15} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k25} \cdot [\mathrm{IXa\_VIIIa}] \tag{31}$$

## 7.16 Reaction R16

This is an irreversible reaction of two reactants forming two products.

**Name** R16

### Reaction equation

$$\mathrm{IIa} + \mathrm{V} \longrightarrow \mathrm{IIa} + \mathrm{Va} \tag{32}$$

### Reactants

Table 36: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| V | V | 0000010 |

### Products

Table 37: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000461 |
| Va | Va | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_{16} = \mathrm{vol}\left(\mathrm{compartment\_1}\right) \cdot \mathrm{k26} \cdot [\mathrm{IIa}] \cdot [\mathrm{V}] \tag{33}$$

## 7.17 Reaction R17

This is a reversible reaction of two reactants forming one product.

**Name** R17

### Reaction equation

$$\mathrm{Xa} + \mathrm{Va} \rightleftharpoons \mathrm{Xa\_Va} \tag{34}$$

### Reactants

Table 38: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000010 |
| Va | Va | 0000010 |

### Product

Table 39: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa_Va | Xa_Va | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{17} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k28} \cdot [\mathrm{Xa}] \cdot [\mathrm{Va}] - \mathrm{k27} \cdot [\mathrm{Xa\_Va}]) \tag{35}$$

## 7.18 Reaction R18

This is a reversible reaction of two reactants forming one product.

**Name** R18

### Reaction equation

$$\mathrm{Xa\_Va} + \mathrm{II} \rightleftharpoons \mathrm{Xa\_Va\_II} \tag{36}$$

### Reactants

Table 40: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa_Va | Xa_Va | 0000010 |
| II | II | 0000010 |

### Product

Table 41: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa_Va_II | Xa_Va_II | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{18} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k30} \cdot [\mathrm{Xa\_Va}] \cdot [\mathrm{II}] - \mathrm{k29} \cdot [\mathrm{Xa\_Va\_II}]) \tag{37}$$

## 7.19 Reaction R19

This is an irreversible reaction of two reactants forming two products.

**Name** R19

### Reaction equation

$$\mathrm{mIIa} + \mathrm{Xa\_Va} \longrightarrow \mathrm{IIa} + \mathrm{Xa\_Va} \tag{38}$$

### Reactants

Table 42: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| mIIa | mIIa | 0000010 |
| Xa_Va | Xa_Va | 0000461 |

### Products

Table 43: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000011 |
| Xa_Va | Xa_Va | 0000461 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_{19} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k32} \cdot [\mathrm{mIIa}] \cdot [\mathrm{Xa\_Va}] \tag{39}$$

## 7.20 Reaction R20

This is a reversible reaction of two reactants forming one product.

**Name** R20

### Reaction equation

$$\mathrm{Xa} + \mathrm{TFPI} \rightleftharpoons \mathrm{Xa\_TFPI} \tag{40}$$

### Reactants

Table 44: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000010 |
| TFPI | TFPI | 0000010 |

### Product

Table 45: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa_TFPI | Xa_TFPI | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{20} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot (\mathrm{k34} \cdot [\mathrm{Xa}] \cdot [\mathrm{TFPI}] - \mathrm{k33} \cdot [\mathrm{Xa\_TFPI}]) \tag{41}$$

## 7.21 Reaction R21

This is a reversible reaction of two reactants forming one product.

**Name** R21

### Reaction equation

$$\mathrm{TF\_VIIa\_Xa} + \mathrm{TFPI} \rightleftharpoons \mathrm{TF\_VIIa\_Xa\_TFPI} \tag{42}$$

### Reactants

Table 46: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_Xa | TF_VIIa_Xa | 0000010 |
| TFPI | TFPI | 0000010 |

### Product

Table 47: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_Xa_TFPI | TF_VIIa_Xa_TFPI | 0000011 |

### Kinetic Law

**SBO:0000101** mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{21} = \mathrm{vol}(\mathrm{compartment\_1}) \cdot (\mathrm{k36} \cdot [\mathrm{TF\_VIIa\_Xa}] \cdot [\mathrm{TFPI}] - \mathrm{k35} \cdot [\mathrm{TF\_VIIa\_Xa\_TFPI}]) \tag{43}$$

## 7.22 Reaction R22

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

**Name** R22

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{Xa\_TFPI} \longrightarrow \mathrm{TF\_VIIa\_Xa\_TFPI} \tag{44}$$

### Reactants

Table 48: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000010 |
| Xa_TFPI | Xa_TFPI | 0000010 |

### Product

Table 49: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_Xa_TFPI | TF_VIIa_Xa_TFPI | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{22} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k37} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{Xa\_TFPI}] \tag{45}$$

## 7.23 Reaction R23

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

**Name** R23

### Reaction equation

$$\mathrm{Xa} + \mathrm{ATIII} \longrightarrow \mathrm{Xa\_ATIII} \tag{46}$$

### Reactants

Table 50: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa | Xa | 0000010 |
| ATIII | ATIII | 0000010 |

### Product

Table 51: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa_ATIII | Xa_ATIII | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{23} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k38} \cdot [\mathrm{Xa}] \cdot [\mathrm{ATIII}] \tag{47}$$

## 7.24 Reaction R24

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

**Name** R24

### Reaction equation

$$\mathrm{mIIa} + \mathrm{ATIII} \longrightarrow \mathrm{mIIa\_ATIII} \tag{48}$$

### Reactants

Table 52: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| mIIa | mIIa | 0000010 |
| ATIII | ATIII | 0000010 |

### Product

Table 53: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| mIIa_ATIII | mIIa_ATIII | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{24} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k39} \cdot [\mathrm{mIIa}] \cdot [\mathrm{ATIII}] \tag{49}$$

## 7.25 Reaction R25

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

**Name** R25

### Reaction equation

$$\mathrm{IXa} + \mathrm{ATIII} \longrightarrow \mathrm{IXa\_ATIII} \tag{50}$$

### Reactants

Table 54: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa | IXa | 0000010 |
| ATIII | ATIII | 0000010 |

### Product

Table 55: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IXa_ATIII | IXa_ATIII | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{25} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k40} \cdot [\mathrm{IXa}] \cdot [\mathrm{ATIII}] \tag{51}$$

## 7.26 Reaction R26

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

**Name** R26

### Reaction equation

$$\mathrm{IIa} + \mathrm{ATIII} \longrightarrow \mathrm{IIa\_ATIII} \tag{52}$$

### Reactants

Table 56: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IIa | IIa | 0000010 |
| ATIII | ATIII | 0000010 |

### Product

Table 57: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IIa_ATIII | IIa_ATIII | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{26} = \mathrm{vol}\left(\mathrm{compartment\_1}\right) \cdot \mathrm{k41} \cdot [\mathrm{IIa}] \cdot [\mathrm{ATIII}] \tag{53}$$

## 7.27 Reaction R27

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

**Name** R27

### Reaction equation

$$\mathrm{TF\_VIIa} + \mathrm{ATIII} \longrightarrow \mathrm{TF\_VIIa\_ATIII} \tag{54}$$

### Reactants

Table 58: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000010 |
| ATIII | ATIII | 0000010 |

### Product

Table 59: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_ATIII | TF_VIIa_ATIII | 0000011 |

### Kinetic Law

**SBO:0000054** mass action rate law for second order irreversible reactions, two reactants, continuous scheme

**Derived unit** contains undeclared units

$$v_{27} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k42} \cdot [\mathrm{TF\_VIIa}] \cdot [\mathrm{ATIII}] \tag{55}$$

## 7.28 Reaction R6b

This is an irreversible reaction of one reactant forming one product.

**Name** R6b

### Reaction equation

$$\mathrm{TF\_VIIa\_X} \longrightarrow \mathrm{TF\_VIIa\_Xa} \tag{56}$$

### Reactant

Table 60: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_X | TF_VIIa_X | 0000010 |

### Product

Table 61: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_Xa | TF_VIIa_Xa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{28} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k10} \cdot [\mathrm{TF\_VIIa\_X}] \tag{57}$$

## 7.29 Reaction R8b

This is an irreversible reaction of one reactant forming two products.

**Name** R8b

### Reaction equation

$$\mathrm{TF\_VIIa\_IX} \longrightarrow \mathrm{TF\_VIIa} + \mathrm{IXa} \tag{58}$$

### Reactant

Table 62: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa_IX | TF_VIIa_IX | 0000010 |

### Products

Table 63: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| TF_VIIa | TF_VIIa | 0000011 |
| IXa | IXa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{29} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k15} \cdot [\mathrm{TF\_VIIa\_IX}] \tag{59}$$

## 7.30 Reaction R12b

This is an irreversible reaction of one reactant forming two products.

**Name** R12b

### Reaction equation

$$\mathrm{IXa\_VIIIa\_X} \longrightarrow \mathrm{IXa\_VIIIa} + \mathrm{Xa} \tag{60}$$

### Reactant

Table 64: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa_X | IXa_VIIIa_X | 0000010 |

### Products

Table 65: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IXa_VIIIa | IXa_VIIIa | 0000011 |
| Xa | Xa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{30} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k22} \cdot [\mathrm{IXa\_VIIIa\_X}] \tag{61}$$

## 7.31 Reaction R18b

This is an irreversible reaction of one reactant forming two products.

**Name** R18b

### Reaction equation

$$\mathrm{Xa\_Va\_II} \longrightarrow \mathrm{Xa\_Va} + \mathrm{mIIa} \tag{62}$$

### Reactant

Table 66: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| Xa_Va_II | Xa_Va_II | 0000010 |

### Products

Table 67: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| Xa_Va | Xa_Va | 0000011 |
| mIIa | mIIa | 0000011 |

### Kinetic Law

**SBO:0000049** mass action rate law for first order irreversible reactions, continuous scheme

**Derived unit** contains undeclared units

$$v_{31} = \mathrm{vol}\left(\mathrm{compartment\_1}\right) \cdot \mathrm{k31} \cdot [\mathrm{Xa\_Va\_II}] \tag{63}$$

## 7.32 Reaction R28

This is an irreversible reaction of two reactants forming two products.

**Name** R28

### Reaction equation

$$\mathrm{IXa} + \mathrm{X} \longrightarrow \mathrm{IXa} + \mathrm{Xa} \tag{64}$$

### Reactants

Table 68: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| IXa | IXa | 0000461 |
| X | X | 0000010 |

### Products

Table 69: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| IXa | IXa | 0000461 |
| Xa | Xa | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_{32} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k43} \cdot [\mathrm{IXa}] \cdot [\mathrm{X}] \tag{65}$$

## 7.33 Reaction R29

This is an irreversible reaction of two reactants forming two products.

**Name** R29

### Reaction equation

$$\mathrm{mIIa} + \mathrm{V} \longrightarrow \mathrm{mIIa} + \mathrm{Va} \tag{66}$$

### Reactants

Table 70: Properties of each reactant.

| Id | Name | SBO |
|---|---|---|
| mIIa | mIIa | 0000461 |
| V | V | 0000010 |

### Products

Table 71: Properties of each product.

| Id | Name | SBO |
|---|---|---|
| mIIa | mIIa | 0000461 |
| Va | Va | 0000011 |

### Kinetic Law

**SBO:0000045** mass action rate law for second order irreversible reactions

**Derived unit** contains undeclared units

$$v_{33} = \mathrm{vol}\,(\mathrm{compartment\_1}) \cdot \mathrm{k44} \cdot [\mathrm{mIIa}] \cdot [\mathrm{V}] \tag{67}$$

# 8 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.

## 8.1 Species `TF`

**Name** TF

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in `R1`, `R2`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF} = -\,v_1 - v_2 \tag{68}$$

## 8.2 Species `TF_VII`

**Name** TF_VII

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a product in `R1`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VII} = v_1 \tag{69}$$

## 8.3 Species `VII`

**Name** VII

**Initial concentration** $10^{-8}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in `R1`, `R3`, `R4`, `R5`).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VII} = -\,v_1 - v_3 - v_4 - v_5 \tag{70}$$

## 8.4 Species TF_VIIa

**Name** TF_VIIa

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in nine reactions (as a reactant in R3, R6, R7, R8, R22, R27 and as a product in R2, R3, R8b).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa} = v_2 + v_3 + v_{29} - v_3 - v_6 - v_7 - v_8 - v_{22} - v_{27} \tag{71}$$

## 8.5 Species VIIa

**Name** VIIa

**Initial concentration** $10^{-10}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in R2 and as a product in R3, R4, R5).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VIIa} = v_3 + v_4 + v_5 - v_2 \tag{72}$$

## 8.6 Species Xa

**Name** Xa

**Initial concentration** $9.4\cdot 10^{-11}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in ten reactions (as a reactant in R4, R7, R9, R17, R20, R23 and as a product in R4, R9, R12b, R28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa} = v_4 + v_9 + v_{30} + v_{32} - v_4 - v_7 - v_9 - v_{17} - v_{20} - v_{23} \tag{73}$$

## 8.7 Species IIa

**Name** IIa

**Initial concentration** $10^{-9}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in nine reactions (as a reactant in R5, R10, R16, R26 and as a product in R5, R9, R10, R16, R19).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IIa} = v_5 + v_9 + v_{10} + v_{16} + v_{19} - v_5 - v_{10} - v_{16} - v_{26} \tag{74}$$

## 8.8 Species TF_VIIa_X

**Name** TF_VIIa_X

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R6b and as a product in R6).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa\_X} = v_6 - v_{28} \tag{75}$$

## 8.9 Species X

**Name** X

**Initial concentration** $1.6\cdot 10^{-7}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in R6, R12, R28 and as a product in R14).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{X} = v_{14} - v_6 - v_{12} - v_{32} \tag{76}$$

## 8.10 Species TF_VIIa_Xa

**Name** TF_VIIa_Xa

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in R21 and as a product in R7, R6b).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa\_Xa} = v_7 + v_{28} - v_{21} \tag{77}$$

## 8.11 Species IX

**Name** IX

**Initial concentration** $9\cdot 10^{-8}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in R8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IX} = -v_8 \tag{78}$$

## 8.12 Species TF_VIIa_IX

**Name** TF_VIIa_IX

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R8b and as a product in R8).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa\_IX} = v_8 - v_{29} \tag{79}$$

## 8.13 Species IXa

**Name** IXa

**Initial concentration** $2.1 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in seven reactions (as a reactant in R11, R25, R28 and as a product in R14, R15, R8b, R28).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IXa} = v_{14} + v_{15} + v_{29} + v_{32} - v_{11} - v_{25} - v_{32} \tag{80}$$

## 8.14 Species II

**Name** II

**Initial concentration** $1.4 \cdot 10^{-6}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R9, R18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{II} = -v_{9} - v_{18} \tag{81}$$

## 8.15 Species VIII

**Name** VIII

**Initial concentration** $7 \cdot 10^{-10}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a reactant in R10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VIII} = -v_{10} \tag{82}$$

## 8.16 Species VIIIa

**Name** VIIIa

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in R11, R13 and as a product in R10).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VIIIa} = v_{10} - v_{11} - v_{13} \tag{83}$$

## 8.17 Species IXa_VIIIa

**Name** IXa_VIIIa

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in four reactions (as a reactant in R12, R15 and as a product in R11, R12b).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IXa\_VIIIa} = v_{11} + v_{30} - v_{12} - v_{15} \tag{84}$$

## 8.18 Species IXa_VIIIa_X

**Name** IXa_VIIIa_X

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in R14, R12b and as a product in R12).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IXa\_VIIIa\_X} = v_{12} - v_{14} - v_{30} \tag{85}$$

## 8.19 Species VIIIa1_L

**Name** VIIIa1_L

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in R13, R14, R15).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VIIIa1\_L} = v_{13} + v_{14} + v_{15} \tag{86}$$

## 8.20 Species VIIIa2

**Name** VIIIa2

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a product in R13, R14, R15).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{VIIIa2} = v_{13} + v_{14} + v_{15} \tag{87}$$

## 8.21 Species V

**Name** V

**Initial concentration** $2\cdot 10^{-8}\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R16, R29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{V} = -v_{16} - v_{33} \tag{88}$$

## 8.22 Species Va

**Name** Va

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in three reactions (as a reactant in R17 and as a product in R16, R29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Va} = v_{16} + v_{33} - v_{17} \tag{89}$$

## 8.23 Species Xa_Va

**Name** Xa_Va

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in R18, R19 and as a product in R17, R19, R18b).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa\_Va} = v_{17} + v_{19} + v_{31} - v_{18} - v_{19} \tag{90}$$

## 8.24 Species Xa_Va_II

**Name** Xa_Va_II

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R18b and as a product in R18).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa\_Va\_II} = v_{18} - v_{31} \tag{91}$$

## 8.25 Species mIIa

**Name** mIIa

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in R19, R24, R29 and as a product in R18b, R29).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIIa} = v_{31} + v_{33} - v_{19} - v_{24} - v_{33} \tag{92}$$

## 8.26 Species TFPI

**Name** TFPI

**Initial concentration** $2.5 \cdot 10^{-9}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R20, R21).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TFPI} = -\ v_{20} - v_{21} \tag{93}$$

## 8.27 Species Xa_TFPI

**Name** Xa_TFPI

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a reactant in R22 and as a product in R20).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa\_TFPI} = v_{20} - v_{22} \tag{94}$$

## 8.28 Species TF_VIIa_Xa_TFPI

**Name** TF_VIIa_Xa_TFPI

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in two reactions (as a product in R21, R22).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa\_Xa\_TFPI} = v_{21} + v_{22} \tag{95}$$

## 8.29 Species ATIII

**Name** ATIII

**Initial concentration** $3.4 \cdot 10^{-6}\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in five reactions (as a reactant in R23, R24, R25, R26, R27).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{ATIII} = -\ v_{23} - v_{24} - v_{25} - v_{26} - v_{27} \tag{96}$$

## 8.30 Species Xa_ATIII

**Name** Xa_ATIII

**Initial concentration** $0\ \mathrm{mol} \cdot \mathrm{l}^{-1}$

This species takes part in one reaction (as a product in R23).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{Xa\_ATIII} = v_{23} \tag{97}$$

## 8.31 Species mIIa_ATIII

**Name** mIIa_ATIII

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in R24).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{mIIa\_ATIII} = v_{24} \tag{98}$$

## 8.32 Species IXa_ATIII

**Name** IXa_ATIII

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in R25).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IXa\_ATIII} = v_{25} \tag{99}$$

## 8.33 Species IIa_ATIII

**Name** IIa_ATIII

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in R26).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{IIa\_ATIII} = v_{26} \tag{100}$$

## 8.34 Species TF_VIIa_ATIII

**Name** TF_VIIa_ATIII

**Initial concentration** $0\ \mathrm{mol}\cdot\mathrm{l}^{-1}$

This species takes part in one reaction (as a product in R27).

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{TF\_VIIa\_ATIII} = v_{27} \tag{101}$$

# A Glossary of Systems Biology Ontology Terms

**SBO:0000010 reactant:** Substance consumed by a chemical reaction. Reactants react with each other to form the products of a chemical reaction. In a chemical equation the Reactants are the elements or compounds on the left hand side of the reaction equation. A reactant can be consumed and produced by the same reaction, its global quantity remaining unchanged

**SBO:0000011 product:** Substance that is produced in a reaction. In a chemical equation the Products are the elements or compounds on the right hand side of the reaction equation. A product can be produced and consumed by the same reaction, its global quantity remaining unchanged

**SBO:0000035 forward unimolecular rate constant, continuous case:** Numerical parameter that quantifies the forward velocity of a chemical reaction involving only one reactant. This parameter encompasses all the contributions to the velocity except the quantity of the reactant. It is to be used in a reaction modelled using a continuous framework

**SBO:0000036 forward bimolecular rate constant, continuous case:** Numerical parameter that quantifies the forward velocity of a chemical reaction involving two reactants. This parameter encompasses all the contributions to the velocity except the quantity of the reactants. It is to be used in a reaction modelled using a continuous framework

**SBO:0000038 reverse unimolecular rate constant, continuous case:** Numerical parameter that quantifies the reverse velocity of a chemical reaction involving only one product. This parameter encompasses all the contributions to the velocity except the quantity of the product. It is to be used in a reaction modelled using a continuous framework

**SBO:0000039 reverse bimolecular rate constant, continuous case:** Numerical parameter that quantifies the reverse velocity of a chemical reaction involving only one product. This parameter encompasses all the contributions to the velocity except the quantity of the product. It is to be used in a reaction modelled using a continuous framework

**SBO:0000045 mass action rate law for second order irreversible reactions:** Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does not include any reverse process that creates the reactants from the products. The change of a product quantity is proportional to two reactant quantity

**SBO:0000049 mass action rate law for first order irreversible reactions, continuous scheme:** Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does not include any reverse process that creates the reactants from the products. The change of a product quantity is proportional to the quantity of one reactant. It is to be used in a reaction modelled using a continuous framework.

**SBO:0000054 mass action rate law for second order irreversible reactions, two reactants, continuous scheme:** Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does not include any reverse process that creates the reactants from the products. The change of a product quantity is proportional to the product of two reactant quantities. It is to be used in a reaction modelled using a continuous framework.

**SBO:0000083 mass action rate law for first order forward, second order reverse, reversible reactions, two products, continuous scheme:** Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does include a reverse process that creates the reactants from the products. The rate of the forward process is proportional to the quantity of one reactant. The rate of the reverse process is proportional to the product of two product quantities. It is to be used in a reaction modelled using a continuous framework.

**SBO:0000101 mass action rate law for second order forward, first order reverse, reversible reactions, two reactants, continuous scheme:** Reaction scheme where the products are created from the reactants and the change of a product quantity is proportional to the product of reactant activities. The reaction scheme does include a reverse process that creates the reactants from the products. The rate of the forward process is proportional to the product of two reactant quantities. The rate of the reverse process is proportional to the quantity of one product. It is to be used in a reaction modelled using a continuous framework.

**SBO:0000461 essential activator:** A substance that is absolutely required for occurrence and stimulation of a reaction

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