```
Constants
Equilibrium voltages, mV
    Sodium, Potassium, Leak
```

$$28$$

$$vNa := 35$$

$$vK := -67$$

$$vLeak := -20$$

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Fixed leak conductance
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$$gLeak := 0.020$$

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Sodium current
    maximum conductance, m and h components
    with max value and time constant as functions of voltage
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$$gbarNa := 7.000$$

$$minf := v \to \frac{1}{1 + \mathbf{e}^{(-3 - 1/8\ v)}}$$

$$taum := v \to 0.000 + \frac{1}{125} \frac{1}{1 + \mathbf{e}^{(0.500\ v + 20.000)}}$$

$$hinf := v \to \frac{1}{1 + \mathbf{e}^{(7.632 + 0.263\ v)}}$$

$$tauh := v \to 0.002 + \frac{3}{200} \frac{1}{1 + \mathbf{e}^{(0.263\ v + 6.395)}}$$

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Sustained Potassium current
    maximum conductance, NA and NB components
    with max value and time constant as functions of voltage
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$$gbarKA := 1.440$$

$$NAinf := v \to \frac{1}{1 + \mathbf{e}^{(0.898 - 0.060\ v)}}$$

$$tauNA := v \to 0.038 - 0.000\ v$$

$$gbarKB := 2.880$$

$$NBinf := v \to \frac{1}{1 + \mathbf{e}^{(0.589 - 0.068\ v)}}$$

$$tauNB := v \to 0.006 - 0.000\ v$$

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Transient Potassium current
    maximum conductance, a and b components
    with max value and time constant as functions of voltage
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$$gbarA := 12$$

$$ainf := v \to \frac{1}{1 + \mathbf{e}^{(-0.879 - 0.071\ v)}}$$

$$taua := v \to 0.002 - 0.000\ v$$

$$binf := v \to \frac{1}{1 + \mathbf{e}^{(0.152\ v + 10.758)}}$$

$$taub := v \to 0.026 + 0.000\ v$$

Initial conditions, start from equilibrium voltage (-52.5 mV)

$$v0 := -52.500$$

Sodium current

$$m0 := 0.028$$

$$h0 := 0.998$$

Sustained Potassium current

$$NA0 := 0.017$$

$$NB0 := 0.015$$

Transient Potassium current

$$a0 := 0.055$$

$$b0 := 0.057$$

Current equations

Sodium current

Sustained Potassium current

Transient Potassium current

Leak current

Total ionic current

$$INa := 7.000\ (\mathrm{v}(t) - 35)\ \mathrm{m}(t)^3\ \mathrm{h}(t)$$

$$IK := (\mathrm{v}(t) + 67)\ (1.440\ \mathrm{NA}(t)^2 + 2.880\ \mathrm{NB}(t))$$

$$IA := 12\ (\mathrm{v}(t) + 67)\ \mathrm{a}(t)^4\ \mathrm{b}(t)$$

$$ILeak := 0.020\ \mathrm{v}(t) + 0.400$$

$$ITotal := 7.000\ (\mathrm{v}(t) - 35)\ \mathrm{m}(t)^3\ \mathrm{h}(t) + (\mathrm{v}(t) + 67)\ (1.440\ \mathrm{NA}(t)^2 + 2.880\ \mathrm{NB}(t)) + 12\ (\mathrm{v}(t) + 67)\ \mathrm{a}(t)^4\ \mathrm{b}(t) + 0.020\ \mathrm{v}(t) + 0.400$$

Equilibrium current as function of voltage

Sodium current

Sustained Potassium current

Transient Potassium current

Leak current

$$\frac{7.000\ (\mathrm{v}(t) - 35)\ \mathrm{h}(t)}{\left(1 + \mathbf{e}^{\left(-3 - \frac{t}{8}\right)}\right)^3}$$

$$\frac{7.000\ (v(t)-35)}{\left(1+e^{\left(-3-\frac{t}{8}\right)}\right)^3\ (1+e^{(7.632+0.263\ t)})}$$

$$INainf := \frac{7.000\ (t-35)}{\left(1+e^{\left(-3-\frac{t}{8}\right)}\right)^3\ (1+e^{(7.632+0.263\ t)})}$$

$$(v(t)+67)\left(\frac{1.440}{(1+e^{(0.898-0.060\ t)})^2}+2.880\ NB(t)\right)$$

$$(v(t)+67)\left(\frac{1.440}{(1+e^{(0.898-0.060\ t)})^2}+\frac{2.880}{1+e^{(0.589-0.068\ t)}}\right)$$

$$IKinf := (t+67)\left(\frac{1.440}{(1+e^{(0.898-0.060\ t)})^2}+\frac{2.880}{1+e^{(0.589-0.068\ t)}}\right)$$

$$\frac{12\ (v(t)+67)\ b(t)}{(1+e^{(-0.879-0.071\ t)})^4}$$

$$\frac{12\ (v(t)+67)}{(1+e^{(-0.879-0.071\ t)})^4\ (1+e^{(0.152\ t+10.758)})}$$

$$IAinf := \frac{12\ (t+67)}{(1+e^{(-0.879-0.071\ t)})^4\ (1+e^{(0.152\ t+10.758)})}$$

$$ILeakinf := 0.020\ t+0.400$$

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    Total Equilibrium current
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$$ITotalinf := \frac{7.000\ (t-35)}{\left(1+e^{\left(-3-\frac{t}{8}\right)}\right)^3\ (1+e^{(7.632+0.263\ t)})} + (t+67)\left(\frac{1.440}{(1+e^{(0.898-0.060\ t)})^2}+\frac{2.880}{1+e^{(0.589-0.068\ t)}}\right) + \frac{12\ (t+67)}{(1+e^{(-0.879-0.071\ t)})^4\ (1+e^{(0.152\ t+10.758)})} + 0.020\ t+0.400$$

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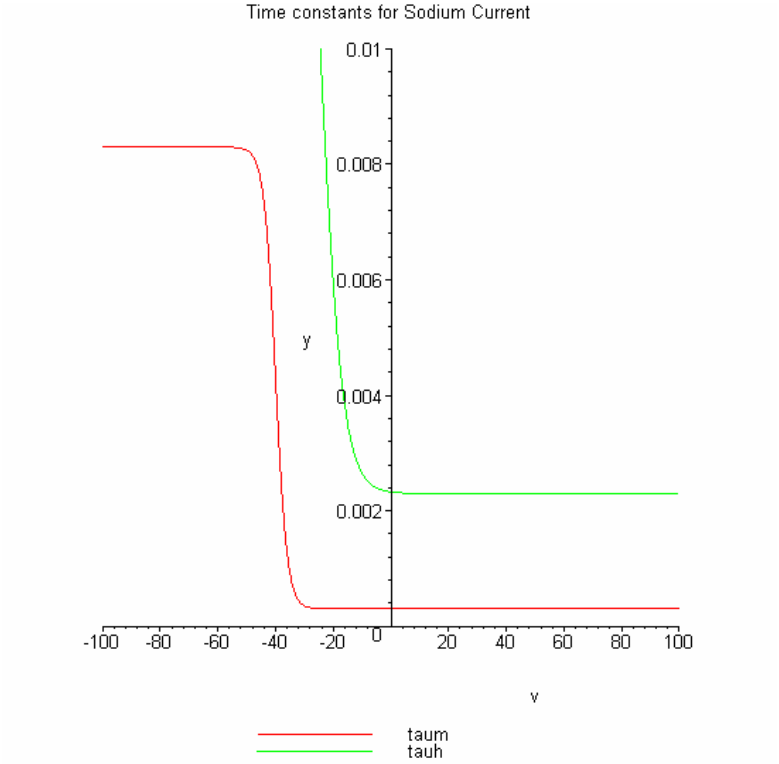
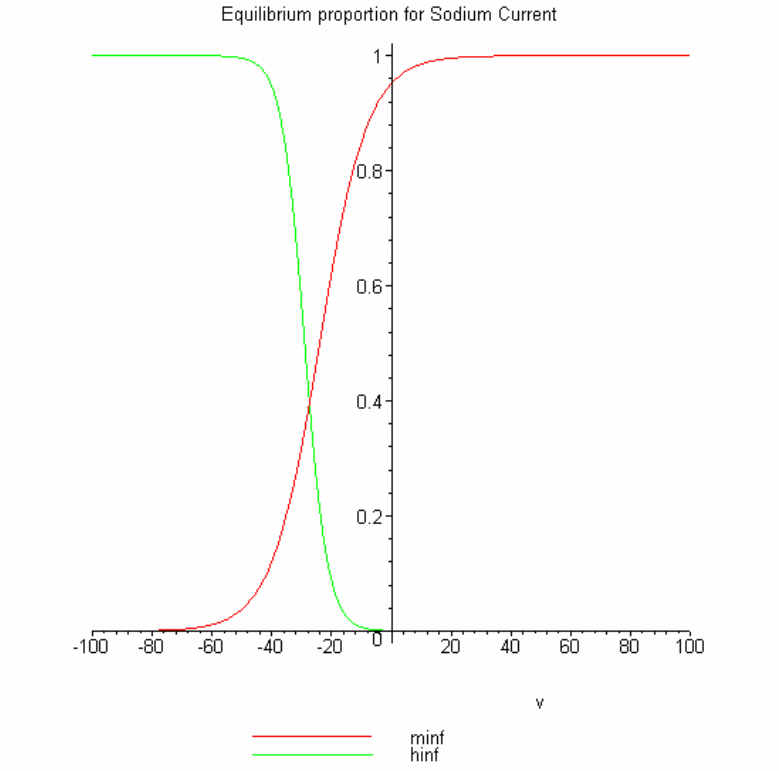
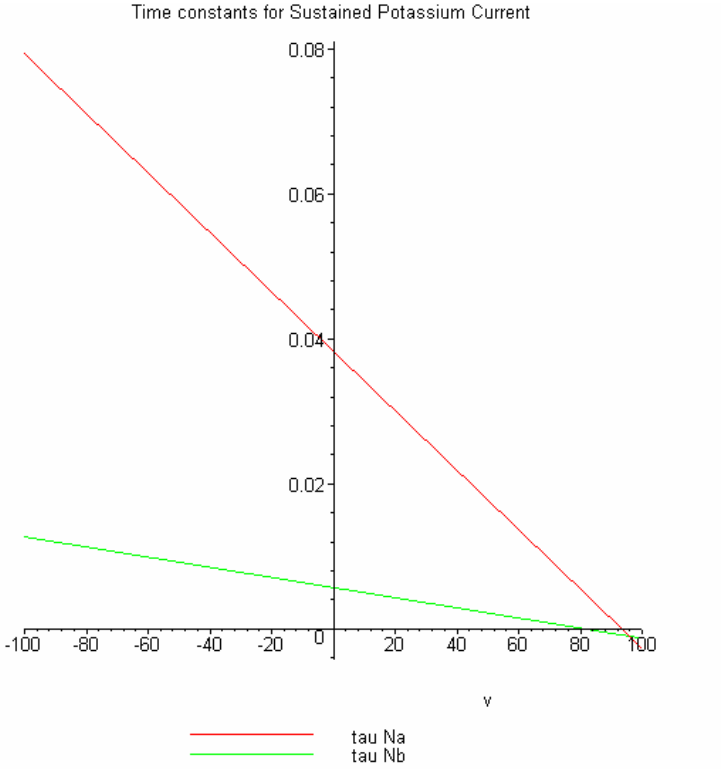
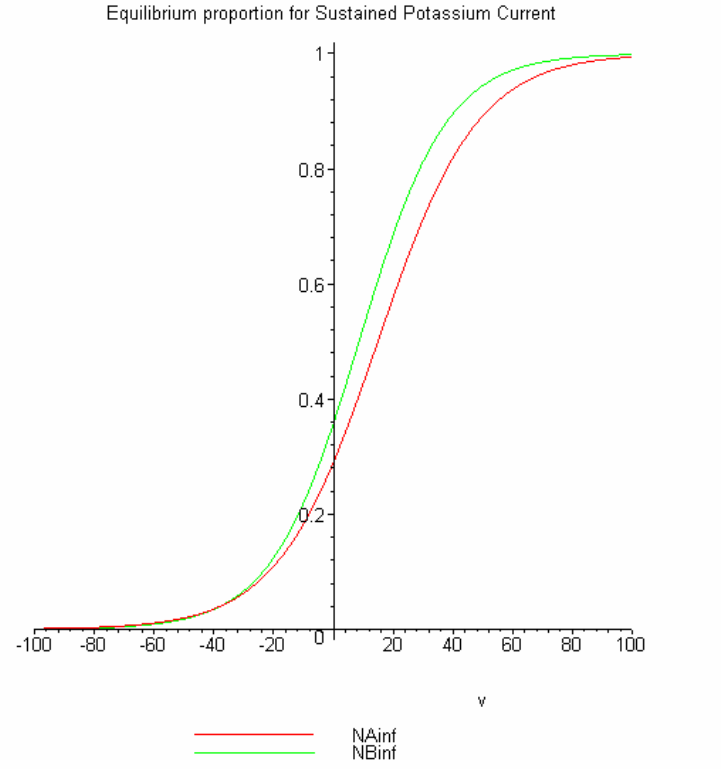
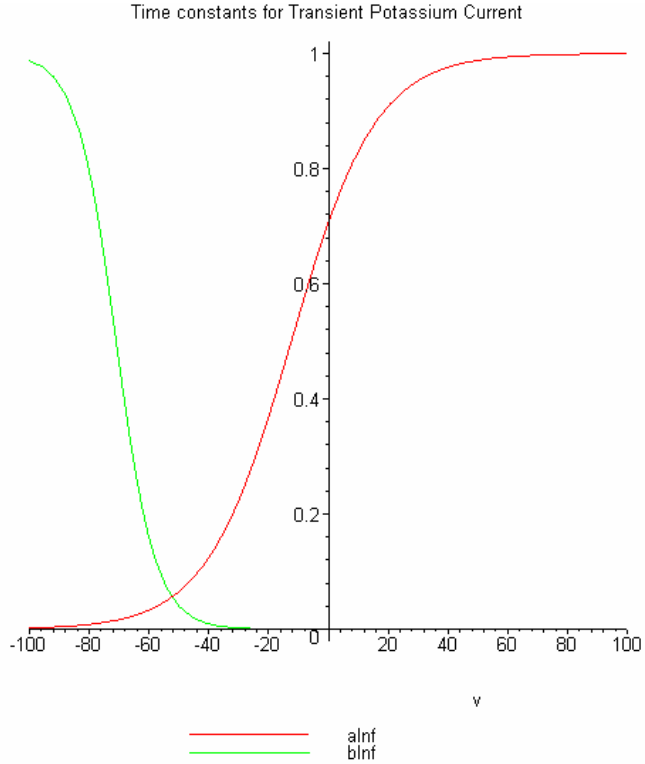
Plotting Time constants and equilibrium values
    Sodium current
    Sustained Potassium current
    Transient Potassium current
    Total Equilibrium current
```

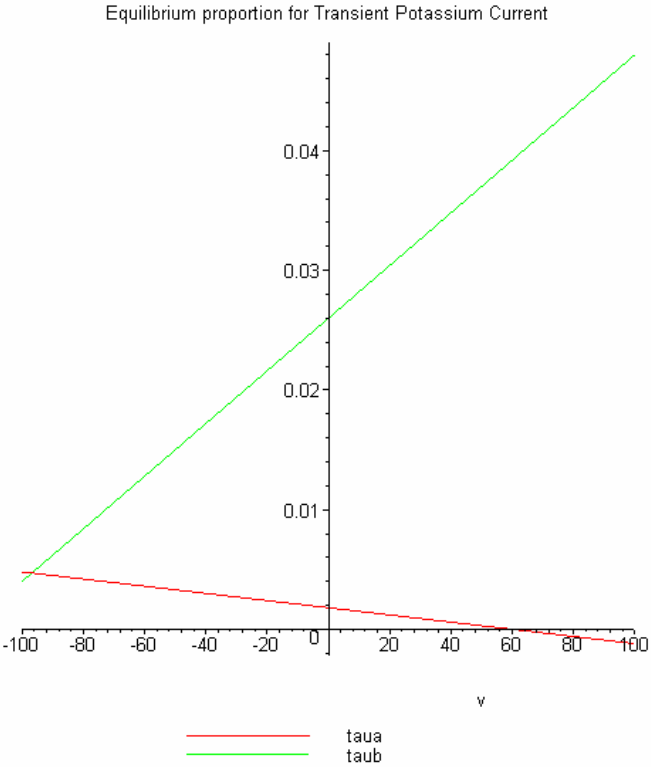

Time constants for Sodium Current
0.01
0.008
0.006
y
0.004
0.002
-100
-80
-60
-40
-20
0
20
40
60
80
100
v
taum
tauh

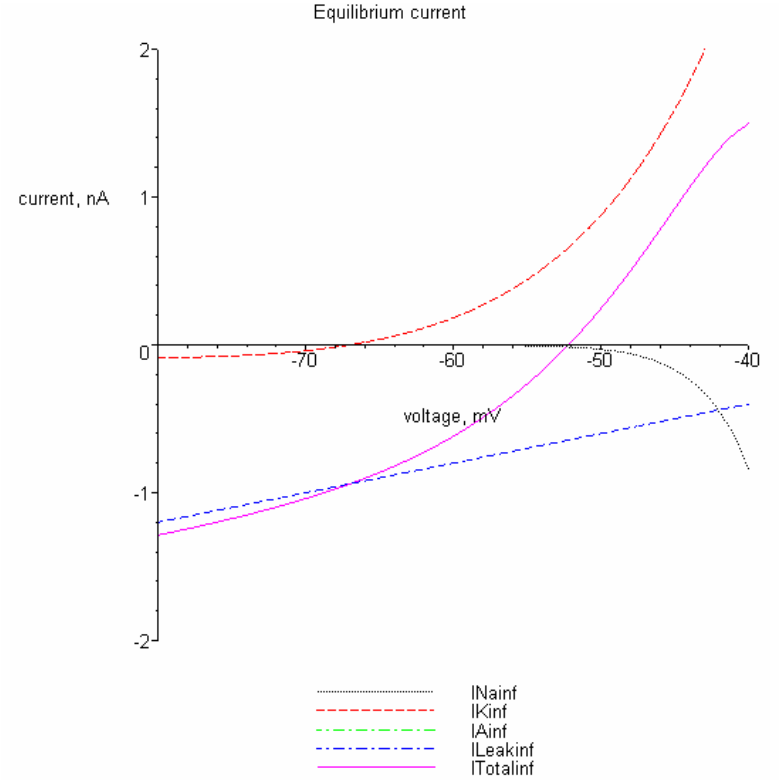

Equilibrium proportion for Sodium Current
1
0.8
0.6
0.4
0.2
-100
-80
-60
-40
-20
0
20
40
60
80
100
v
minf
hinf


Time constants for Sustained Potassium Current
0.08
0.06
0.04
0.02
-100
-80
-60
-40
-20
0
20
40
60
80
100
v
tau Na
tau Nb


Equilibrium proportion for Sustained Potassium Current
1
0.8
0.6
0.4
0.2
-100
-80
-60
-40
-20
0
20
40
60
80
100
v
NAinf
NBinf


Time constants for Transient Potassium Current
1
0.8
0.6
0.4
0.2
0
-100
-80
-60
-40
-20
20
40
60
80
100
v
alnf
blnf


Equilibrium proportion for Transient Potassium Current
0.04
0.03
0.02
0.01
0
-100
-80
-60
-40
-20
20
40
60
80
100
v
taua
taub


Equilibrium current
current, nA
2
1
0
-1
-2
-70
-60
-50
-40
voltage, mV
INainf
IKinf
IAinf
ILeakinf
ITotalinf