

h[67]:=

```
(*constants*)
ACC = 10000;
HWCap = 2.4*10^-3; (*nF*)
BIOCap = 0.24; (*nF*)
vShift = 1200;
vAlpha = 10;
(*calibration*) (*from calibtic.cpp*)
El[V_] := 1.02*V - 8.58;
gl[x_] := 5.52*10^-5*x^2 + 0.24*x + 0.89;
(*10^-5 instead of 10^-10 in M.O.Schwartz thesis*)
Vsyntc[x_] := -3.94*x^2 + 37*x + 1382;
Vt[V_] := 0.998*V - 3.55;
Ipl[x_] := 1/(0.025*x - 0.0004);
Igladapt[x_] := 4.93*10^-5*x^2 + 0.26*x - 0.66;
Iradapt[x_] := 1/(-4.4*10^-6*x^2 + 0.00032*x - 0.0005);
Ifire[x_] := -0.14*x^2 + 45*x + 54.75;
Irexp[x_] := 9.2386*x^2 + 66.3847*x - 94.2541;
Vexp[V_] := 0.3720*V + 100.2902(*93.15+0.64*V*);
```

h[82]:=

```
(*scaling*)
scaleV[V_] := vAlpha * V + vShift;
scaleConductance[x_] := x * ACC * HWCap / BIOCap;
scaleCurrent[x_] := x * vAlpha * ACC * HWCap / BIOCap;
scaleDeltaT[x_] := x * 10;
scaleTau[x_] := x / ACC * 1000;
```

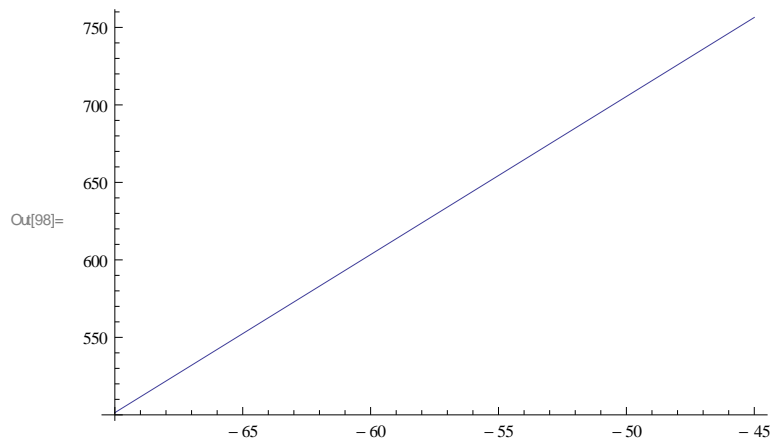
h[87]:=

```
(*transformations*)
transmempot[V_] := El[scaleV[V]];
transthresh[V_] := Vt[scaleV[V]];
transtcmem[x_] := gl[scaleConductance[x]];
transtcsyn[x_] := Vsyntc[scaleTau[x]];
transdeltat[x_] := Irexp[scaleDeltaT[x]];
transvexp[V_] := Vexp[scaleV[V]];
transtcref[x_] := Ipl[scaleTau[x]];
transtcadapt[x_] := Iradapt[scaleTau[x]];
transadapt[x_] := Igladapt[scaleConductance[x]];
transb[x_] := Ifire[scaleCurrent[x]];
(*plots*)
```

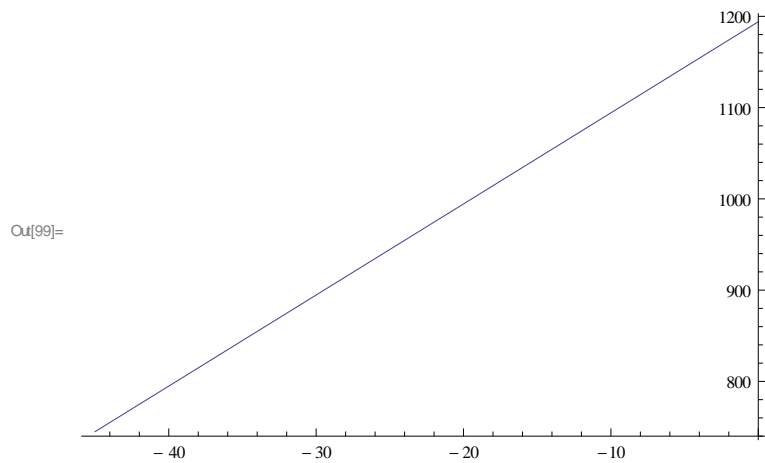
h[97]:=

```
(*LIF membrane dynamics*)
```

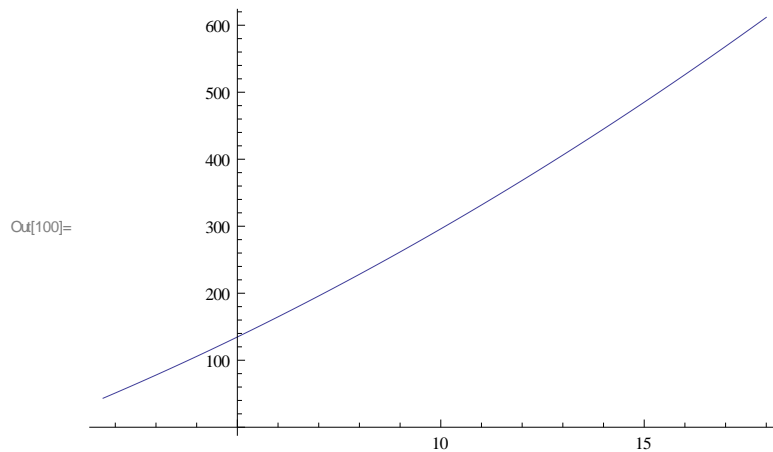
```
In[98]:= Plot [transmpot[V], {V, -70, -45}] (*also valid for E_syn, V_reset*)
```



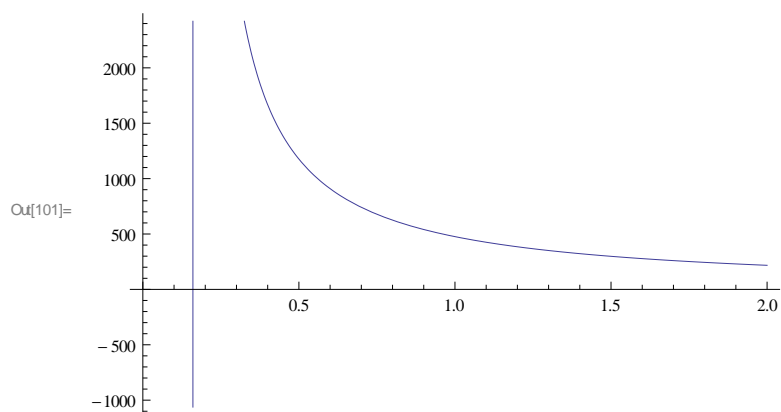
```
In[99]:= Plot [transthresh[V], {V, -45, 0}]
```



```
In[100]:= Plot [transtmem[x], {x, 1.7, 18}]
```

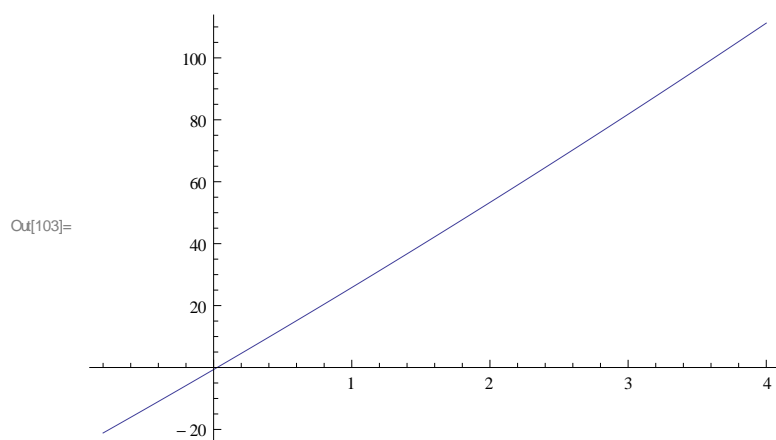


```
In[101]:= Plot [transtcref[x], {x, 0, 2}] (*diverges... but ok for biological ref > 0.4ms *)
```

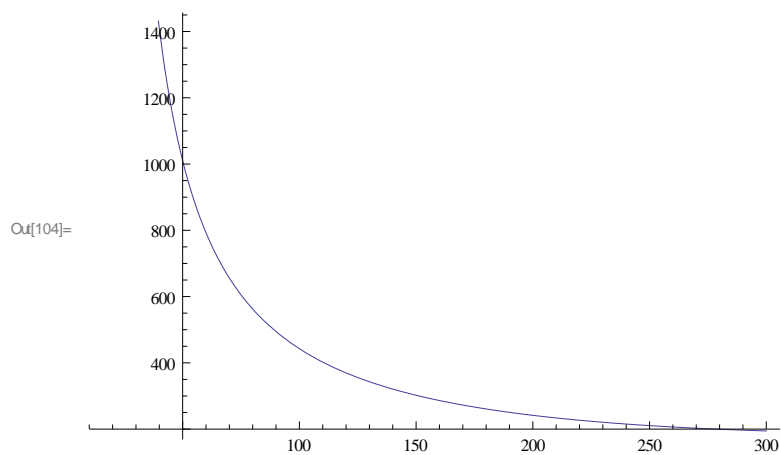


```
In[102]:= (*Adaptation term*)
```

```
In[103]:= Plot [transadapt[x], {x, -0.8, 4}]
```

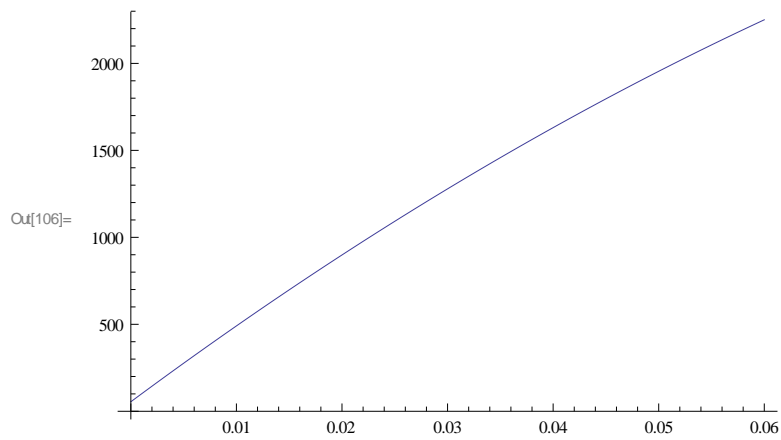


```
In[104]:= Plot [transtcadapt[x], {x, 16, 300}]
```



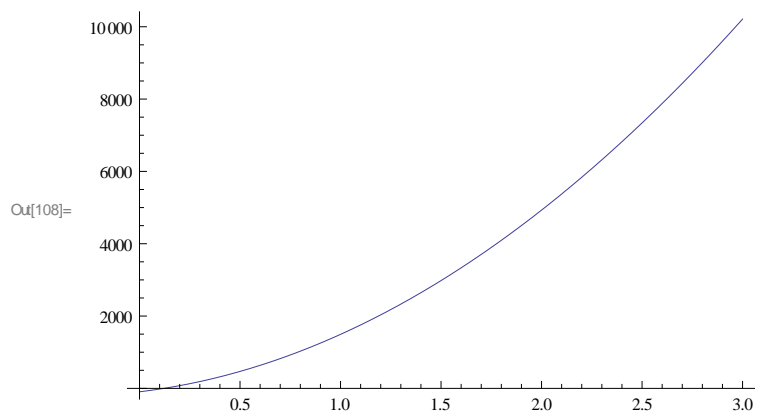
```
In[105]:=
```

```
In[106]:= Plot [transb[x], {x, 0, 0.06}]
```

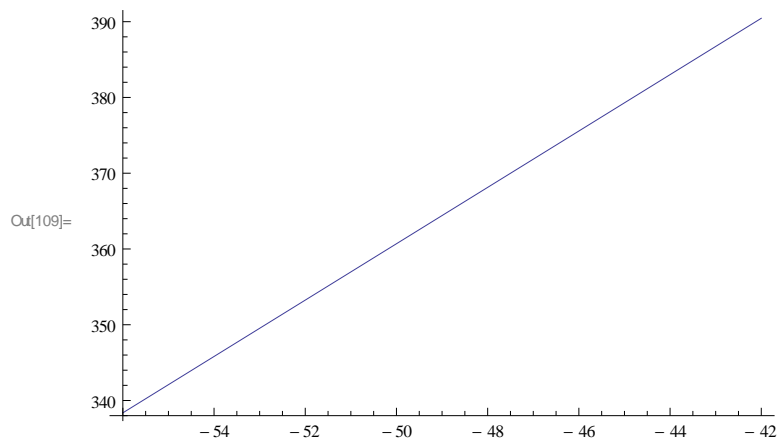


```
In[107]:= (*Exponential term*)
```

```
In[108]:= Plot [transdeltat[x], {x, 0, 3}]
```

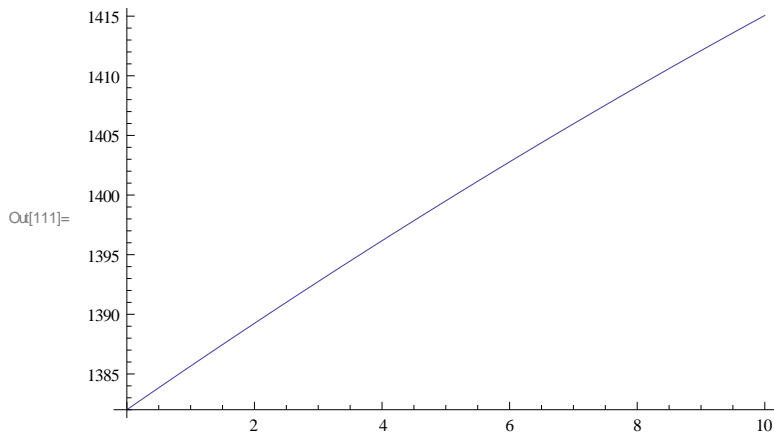


```
In[109]:= Plot [transvexp[V], {V, -56, -42}]
```



```
In[110]:= (*synaptic input*)
```

```
In[111]:= Plot [transtcsyn[x], {x, 0, 10}]
```



```
In[112]:= mvoltdac [x_] := x * 1023 / 1800;  
currdac [x_] := x * 1023 / 2500;
```

```
In[114]:= (*test data for calibtic.cpp *)
```

```
In[115]:= currdac [transtceref [1.0035]]
```

```
Out[115]= 194.049
```

```
In[116]:= currdac [transadapt [2.3872]]
```

```
Out[116]= 26.2775
```

```
In[117]:= currdac [transtcmem [18]]
```

```
(* needs a conductance as input in contrast to calibtic which gets a time*)
```

```
Out[117]= 250.323
```

```
In[118]:= mvoltdac [transmempot [5.2301]]
```

```
Out[118]= 721.083
```

```
In[119]:= mvoltdac [transmempot [-80.2931]]
```

```
Out[119]= 225.305
```

```
In[120]:= currdac [transdeltat [1.54]]
```

```
Out[120]= 1276.33
```

```
In[121]:= currdac [transb [0.1001]]
```

```
Out[121]= 1291.62
```

```
In[122]:= mvoltdac [transtcsyn [10.0001]]
```

```
Out[122]= 804.226
```

```
In[123]:= mvoltdac [transthresh [0.0103]]
```

```
Out[123]= 678.677
```

```
In[124]:= currdac [transtcadapt [100.0500]]
```

```
Out[124]= 180.969
```

```
In[125]:= mvoltdac [transmempot [-60.23109]]
```

```
Out[125]= 341.604
```

```
In[126]:= mvvoltdac [transvexp [- 50.2010] ]
```

```
Out[126]= 204.567
```