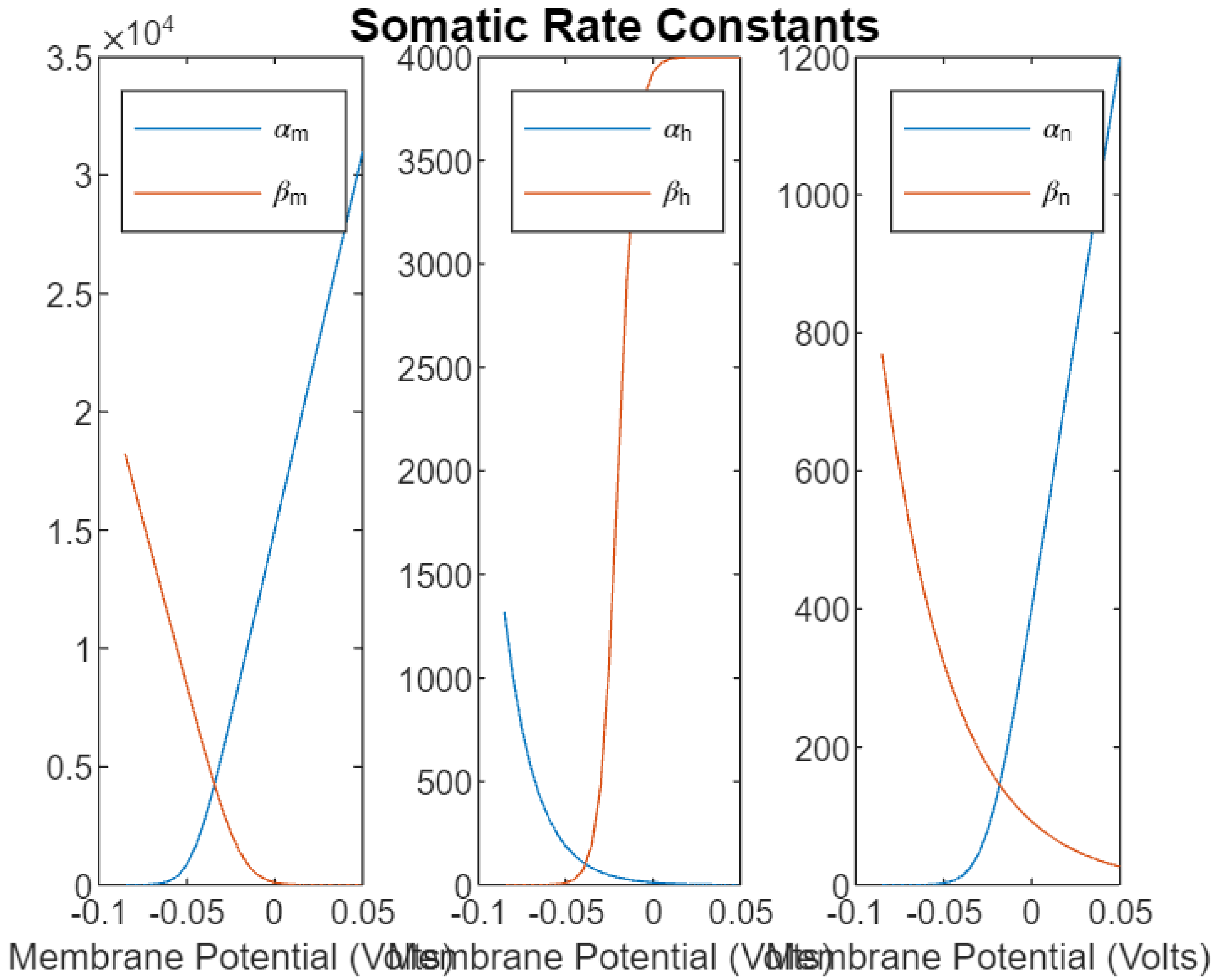
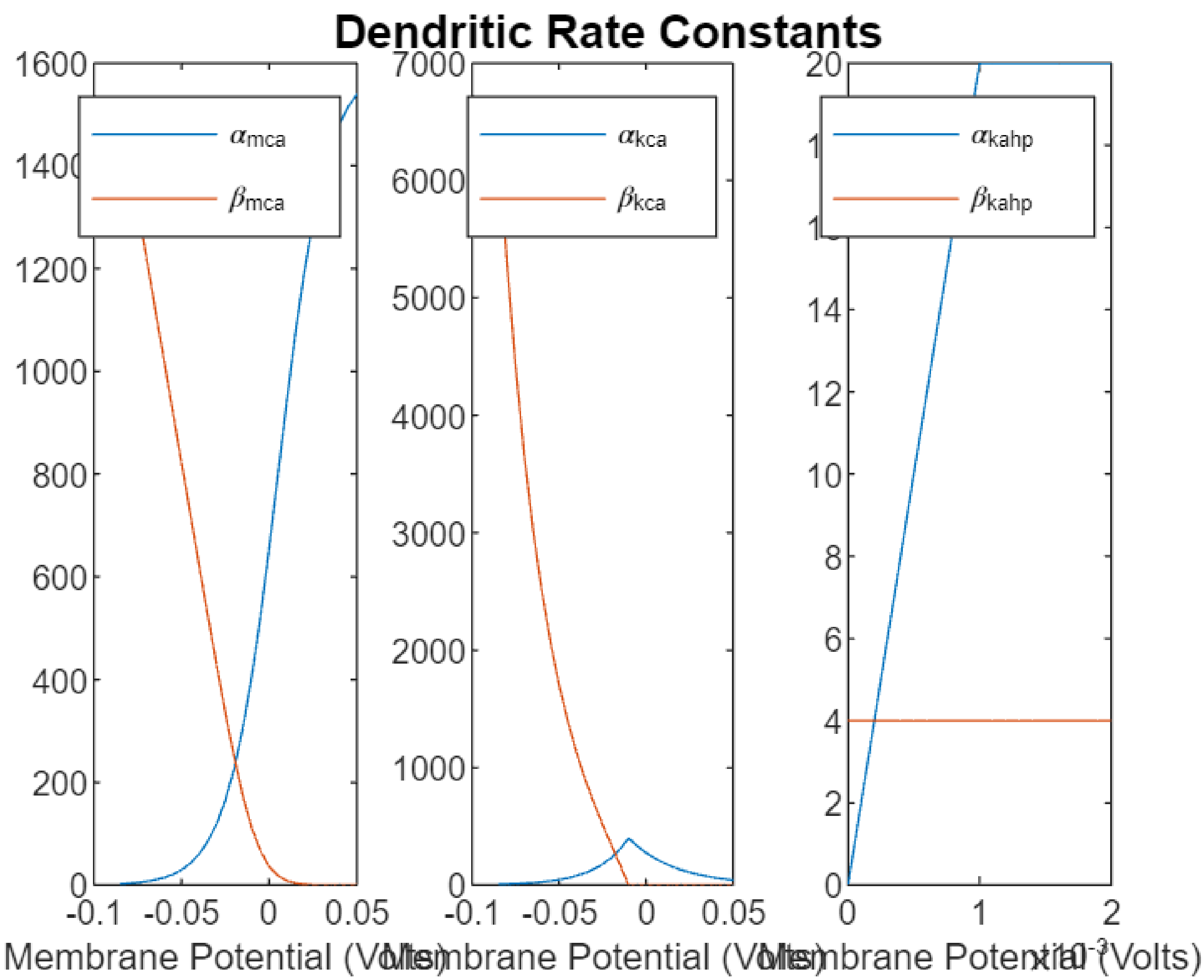
```
%All is done of Friday from 10PM to 2:30AM.
%% Question 2 - Set up Parameters (Anthony)
% Create vectors for membrane potential and calcium concentration.
v = [-0.085:0.005:0.05];
ca = [0:0.1e-3:2e-3];
[alpha_m, beta_m, alpha_h, beta_h , alpha_n, beta_n] = PR_soma_gating(v);
[alpha_mca, beta_mca, alpha_kca, beta_kca, alpha_kahp, beta_kahp ] = PR_dend_gating(v, ca);

% Plot for somatic gating variables. (Anthony)
figure(1)
%Plot for gating variable m
subplot(1,3,1);
plot(v, alpha_m);
hold on
plot(v, beta_m);
legend("\alpha_m", "\beta_m");
xlabel("Membrane Potential (Volts)");
hold off

%Plot for gating variable h
subplot(1,3,2);
plot(v, alpha_h);
hold on
plot(v, beta_h);
legend("\alpha_h", "\beta_h")
xlabel("Membrane Potential (Volts)")
hold off

%Plot for gating variable n
subplot(1,3,3);
plot(v, alpha_n);
hold on
plot(v, beta_n);
legend("\alpha_n", "\beta_n")
xlabel("Membrane Potential (Volts)")
hold off

a = axes;
t1 = title('Somatic Rate Constants');
a.Visible = 'off';
```




```
t1.Visible = 'on';
```

```
% Plot for dendritic gating variables. (Anthony)
%Plot for gating variable mca

figure(2)
subplot(1,3,1);
plot(v, alpha_mca);
hold on
plot(v, beta_mca);
legend("\alpha_{mca}", "\beta_{mca}");
xlabel("Membrane Potential (Volts)");

%Plot for gating variable kca
subplot(1,3,2);
plot(v, alpha_kca);
hold on
plot(v, beta_kca);
```

```
legend("\alpha_{kca}", "\beta_{kca}");
xlabel("Membrane Potential (Volts)");

%Plot for gating variable kahp
subplot(1,3,3);
plot(ca, alpha_kahp);
hold on
plot(ca, beta_kahp);
legend("\alpha_{kahp}", "\beta_{kahp}");
xlabel("Membrane Potential (Volts)");
hold off

a = axes;
t1 = title('Dendritic Rate Constants');
a.Visible = 'off';
```




```
t1.Visible = 'on';
```

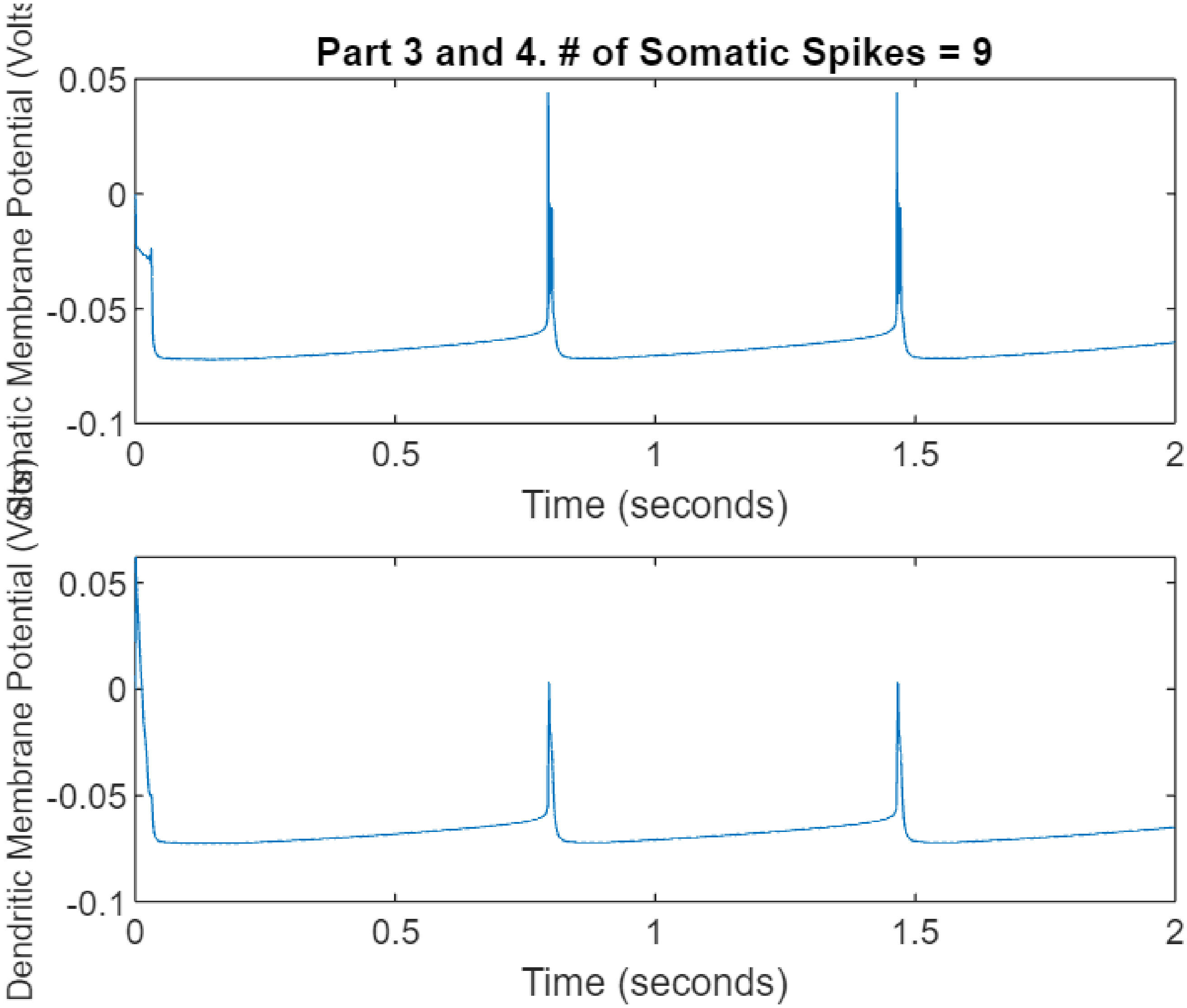
```
%%Problem 3: Model Implementation & Problem 4 - Detecting Somatic Spikes
```

```
%Define time in SI units (Eric)
clear
tspan = [0:2*10^-6:2]; % time span in sec

%Initial Values (Anthony)
Vm_soma0 = 0;
m0 = 0;
h0 = 0;
n0 = 0;
Vm_dend0 = 0;
mca0 = 0;
mkca0 = 0;
mkahp0 = 0;
ca_conc0 = 0;
y0 = [Vm_soma0;m0;h0;n0;Vm_dend0;mca0;mkca0;mkahp0;ca_conc0];

%ODE45 Implementation (All)
[t,y] = ode45(@(t,y) output(t,y),tspan,y0)
```

```
t = 1000001×1
         0
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
      ⋮

y = 1000001×9
         0         0         0         0         0         0         0         0 ⋯
   -0.0000    0.0296    0.0000    0.0008   -0.0000    0.0013    0.0006    0.0000
   -0.0000    0.0582    0.0000    0.0016   -0.0000    0.0026    0.0011    0.0000
   -0.0000    0.0861    0.0001    0.0024   -0.0000    0.0039    0.0017    0.0000
   -0.0000    0.1131    0.0001    0.0032   -0.0000    0.0052    0.0022    0.0000
   -0.0000    0.1392    0.0001    0.0040   -0.0000    0.0065    0.0028    0.0000
   -0.0000    0.1647    0.0001    0.0048   -0.0000    0.0079    0.0033    0.0000
   -0.0000    0.1893    0.0002    0.0056   -0.0000    0.0092    0.0039    0.0000
   -0.0000    0.2132    0.0002    0.0064   -0.0000    0.0105    0.0044    0.0000
   -0.0001    0.2364    0.0002    0.0072   -0.0001    0.0117    0.0050    0.0000
      ⋮
```

```
%Extract Vm of Dendrite and Soma (Anthony)
Vm_soma = y(:,1);
Vm_dend = y(:,5);

%Count Spikes (Anthony)
blocker = 0; %use to block recording spikes before v is less than -30e-3
trigger_v = -10e-3; %above which we count a spike
unblock_v = -30e-3; %below which we allow new spikes to be counted
for n = 1:(length(t)-1)
```

```
    if Vm_soma(n) > trigger_v
        if blocker == 0 %if blocker was set to 0 due to v less than -30e-3
            spikes(n) = 1; %add a 1 to spikes vector
            blocker = 1; %turn on blocker
        end
    end

    if Vm_soma(n) < unblock_v
        blocker = 0;
    end
end

%Plot Results (Anthony)
hold off
subplot(2,1,1)
plot(t,Vm_soma);
ylabel("Somatic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
title(sprintf("Part 3 and 4. # of Somatic Spikes = %d", sum(spikes)));
subplot(2,1,2)
plot(t,Vm_dend);
ylabel("Dendritic Membrane Potential (Volts)", "FontSize", 8);
xlabel("Time (seconds)");
```


Part 3 and 4. # of Somatic Spikes = 9
Somatic Membrane Potential (Volts)
0.05
0
-0.05
-0.1
0
0.5
1
1.5
2
Time (seconds)
Dendritic Membrane Potential (Volts)
0.05
0
-0.05
-0.1
0
0.5
1
1.5
2
Time (seconds)