مدل سازی شناختی

Cognitive Modeling

Presented by: Dr. Maleki, Semnan University, Spring 2024, http://maleki.semnan.ac.ir

مبحث هفتم:
مدل های جکین و هاکسلی

ای نامه ی اسرار الهی که تویی
وی آینه ی جمال شاهی که تویی
بیرون ز تو نیست آنچه در عالم هست
از خود بطلب هر آنچه خواهی که تویی

فهرست مطالب

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اساتید حین کار

"The Squid and its Giant Nerve Fiber" was filmed in the 1970s at Plymouth Marine Laboratory in England. This is the laboratory where Hodgkin and Huxley conducted experiments on the squid giant axon in the 1940s. Their experiments unraveled the mechanism of the action potential, and led to a Nobel Prize. Long out of print, the film is an historically important record of the voltage-clamp technique as developed by Hodgkin and Huxley, as well as an interesting glimpse at how the experiments were done. QuickTime video excerpts from the film are presented here.

Dissection and anatomy (J.Z. Young)

Removing the mantle nerves (H. Meves)

Cleaning and cannulating a giant fiber

Voltage clamping (P.F. Baker & A.L. Hodgkin)

Injection & perfusion (R.D. Keynes)

http://www.science.smith.edu/departments/neurosci/courses/bio330/squid.html

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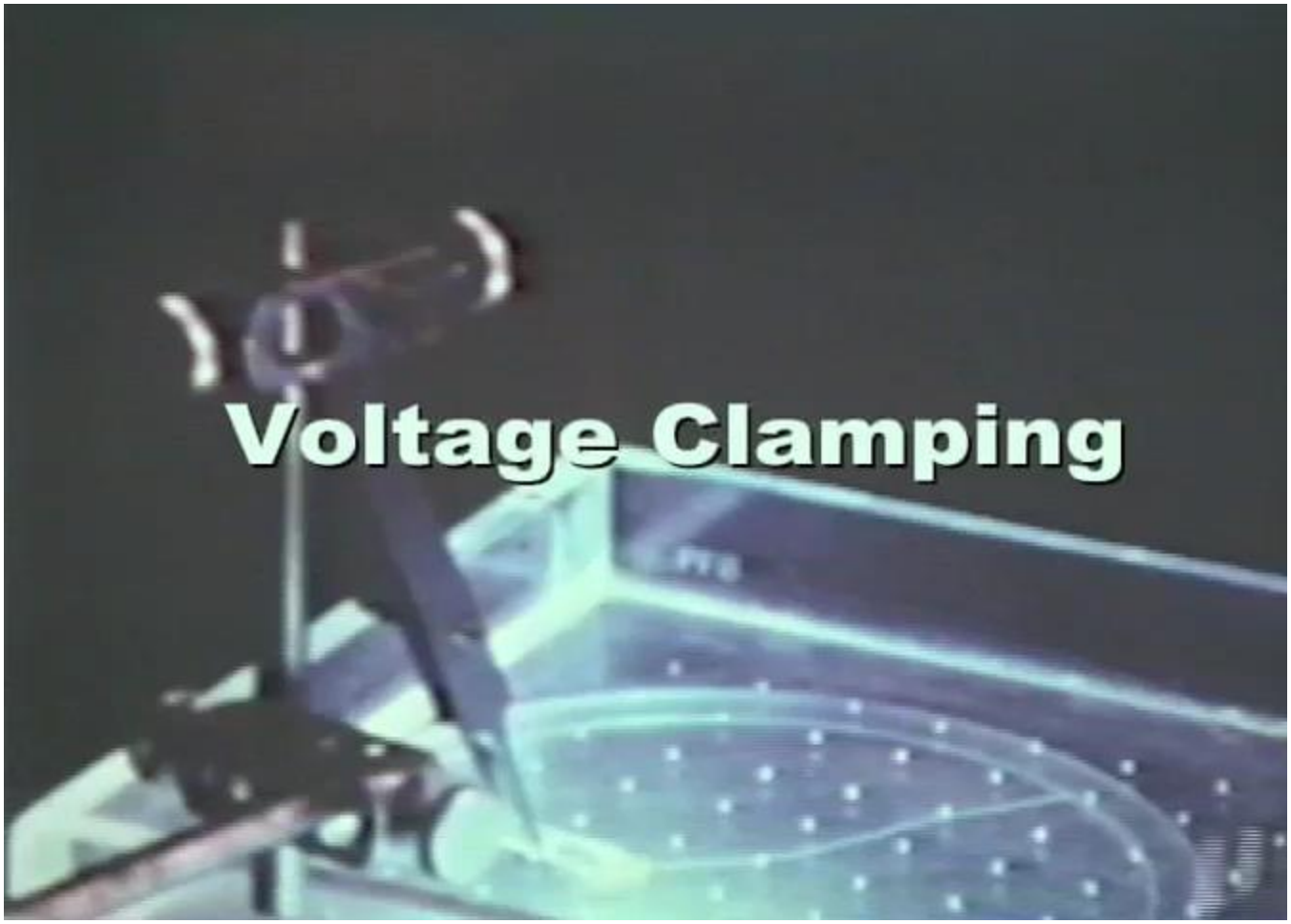
استاید حین کار



http://www.science.smith.edu/departments/neurosci/courses/bio330/squid.html

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http://www.science.smith.edu/departments/neurosci/courses/bio330/squid.html

فهرست مطالب

مدل هاجکین و هاکسلی

$$C\frac{dV(t)}{dt} = I_{injected}(t) - \left[\bar{g}_{Na}m^3 h\,(V(t) - E_{Na}) + \bar{g}_K n^4 (V(t) - E_K) + \bar{g}_L (V(t) - E_L)\right]$$

$$\dot{n} = \alpha_n(V)(1-n) - \beta_n(V)n \qquad \alpha_n(V) = \frac{0.1 - 0.01V}{e^{1-0.1V} - 1} \qquad \beta_n(V) = 0.125e^{-\frac{V}{80}}$$

$$\dot{m} = \alpha_m(V)(1-m) - \beta_m(V)m \qquad \alpha_m(V) = \frac{2.5 - 0.1V}{e^{2.5-0.1V} - 1} \qquad \beta_m(V) = 4e^{-\frac{V}{18}}$$

$$\dot{h} = \alpha_h(V)(1-h) - \beta_h(V)h \qquad \alpha_h(V) = 0.07e^{-\frac{V}{20}} \qquad \beta_h(V) = \frac{1}{e^{3-0.1V} + 1}$$

E_{Na}	$\bar{g}_{Na}$	E_K	$\bar{g}_K$	E_L	$\bar{g}_L$
$115\ mV$	$120\ mS/cm^2$	$-12\ mV$	$36\ mS/cm^2$	$10.6\ mV$	$0.3\ mS/cm^2$

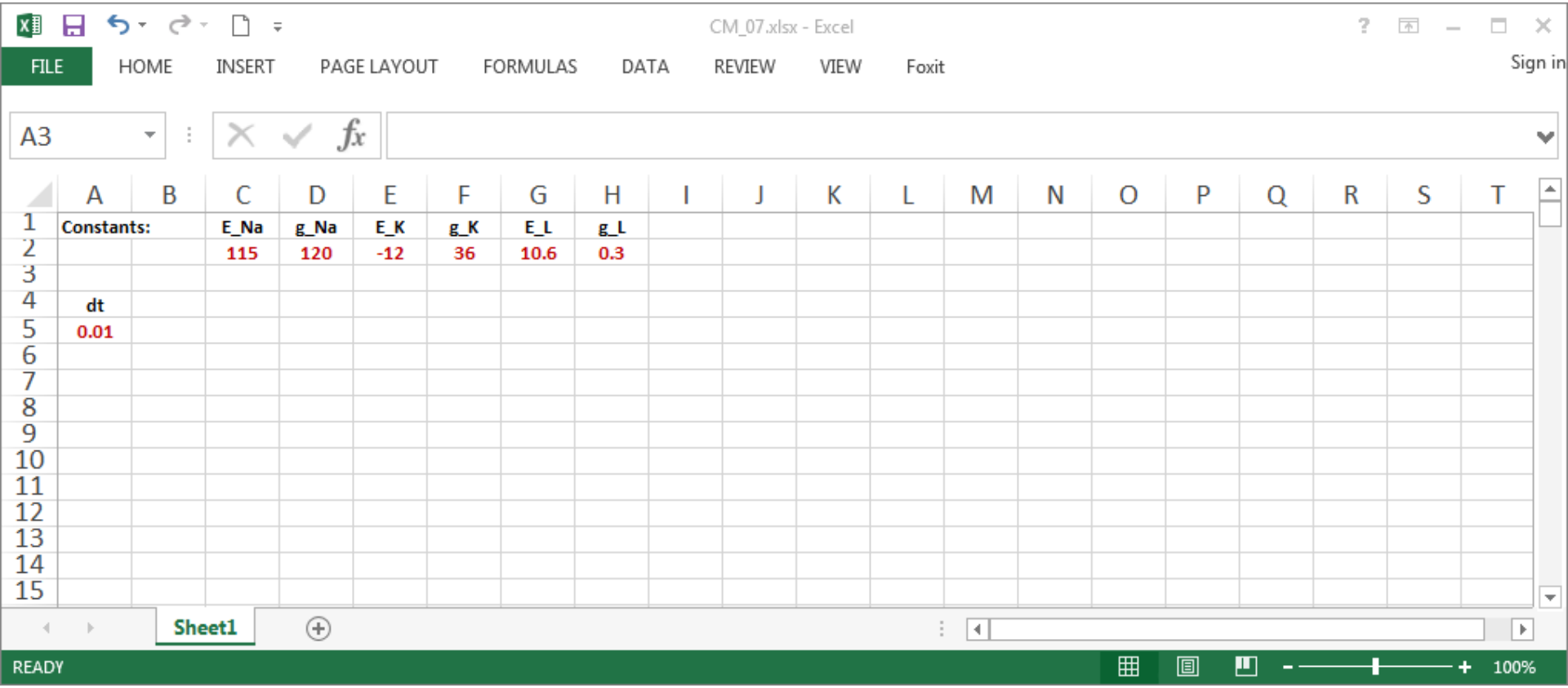
فهرست مطالب

پیاده‌سازی «مدل‌های جکین و هاکسلی» در اکسل:

از مبحث سوم درس به خاطر داریم که:

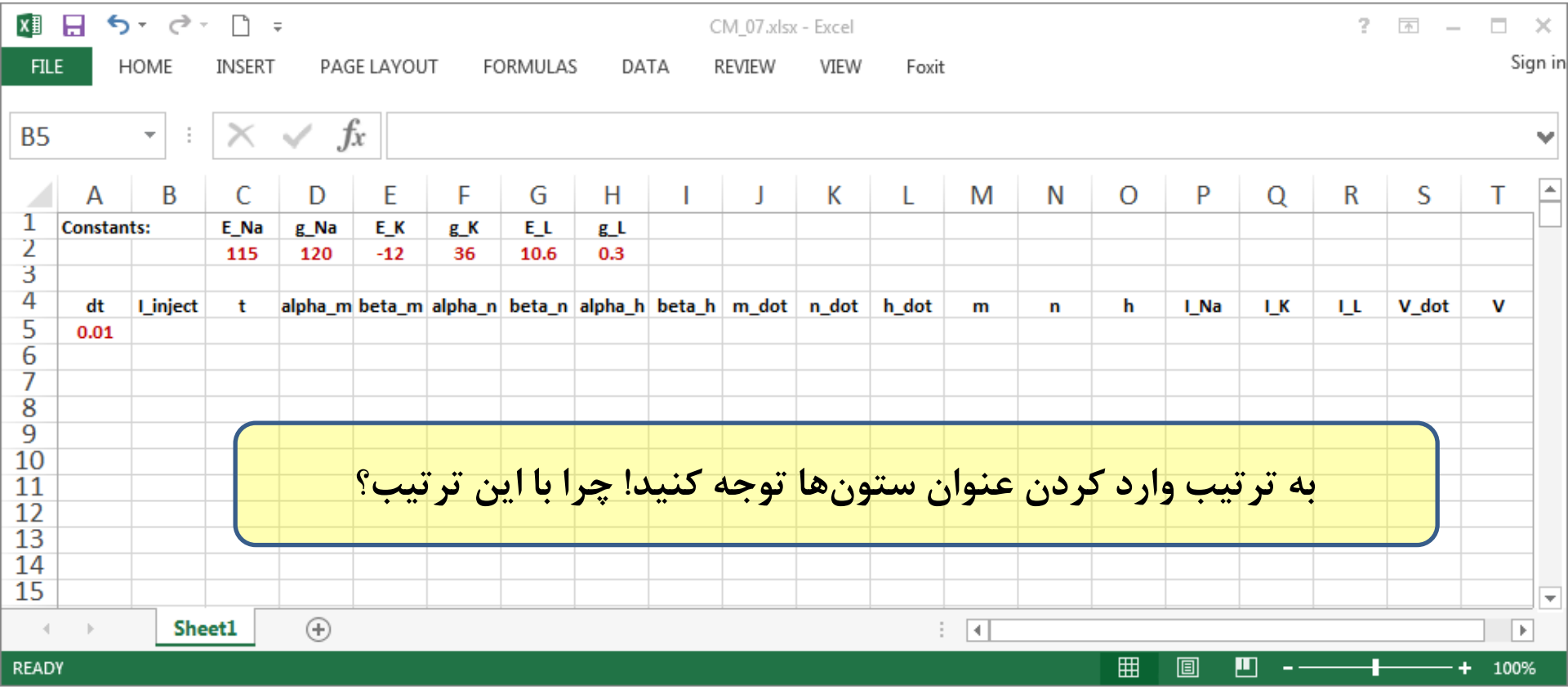
مقدار جدید = مقدار قبلی + نرخ تغییرات مقدار × گام زمانی

وارد کردن ثابت‌ها و گام شبیه‌سازی:



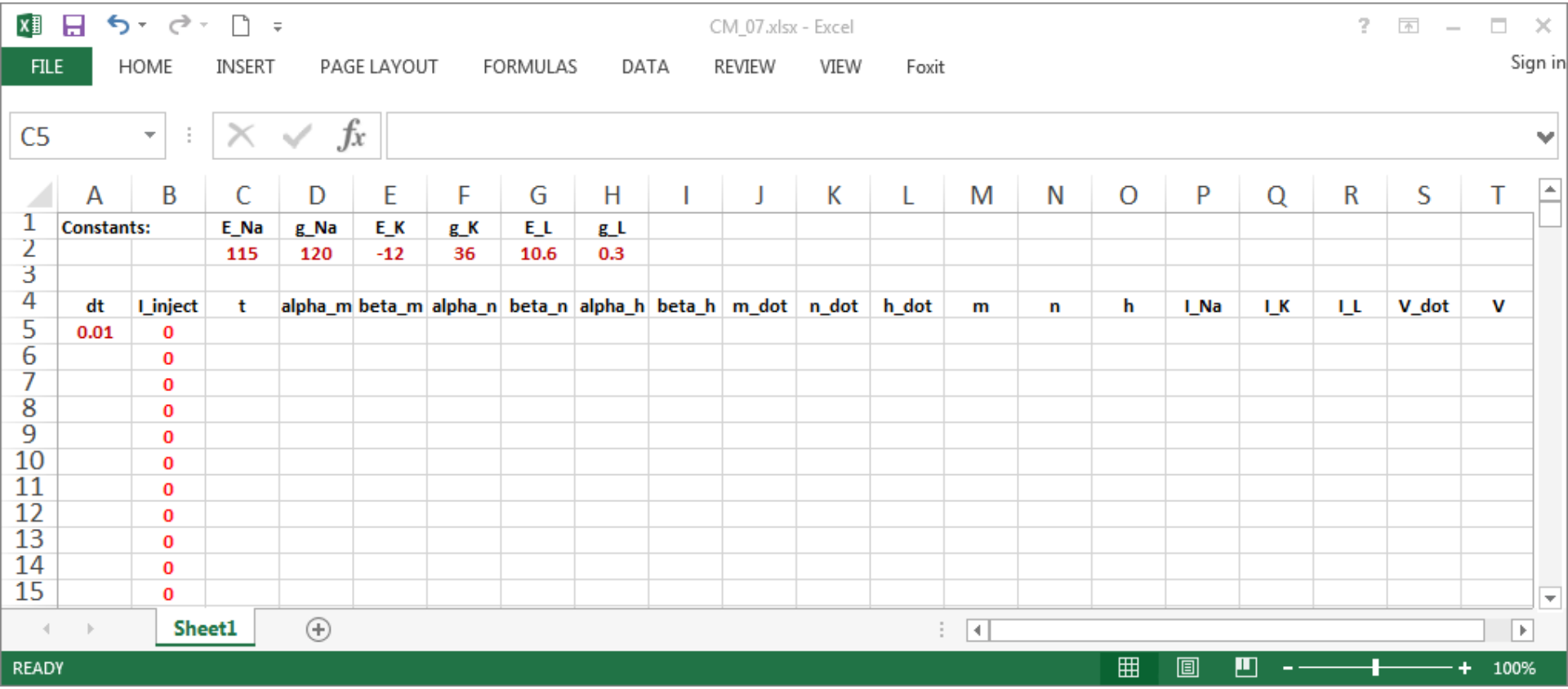
E_{Na}	$\bar{g}_{Na}$	E_K	$\bar{g}_K$	E_L	$\bar{g}_L$
$115\ mV$	$120\ mS/cm^2$	$-12\ mV$	$36\ mS/cm^2$	$10.6\ mV$	$0.3\ mS/cm^2$

وارد کردن برچسب ستون‌ها:



$$C\frac{dV(t)}{dt} = I_{injected}(t) - \left[\bar{g}_{Na}m^3 h\,(V(t) - E_{Na}) + \bar{g}_K n^4 (V(t) - E_K) + \bar{g}_L (V(t) - E_L)\right]$$

وارد کردن جریان ورودی:


CM_07.xlsx - Excel

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0																		
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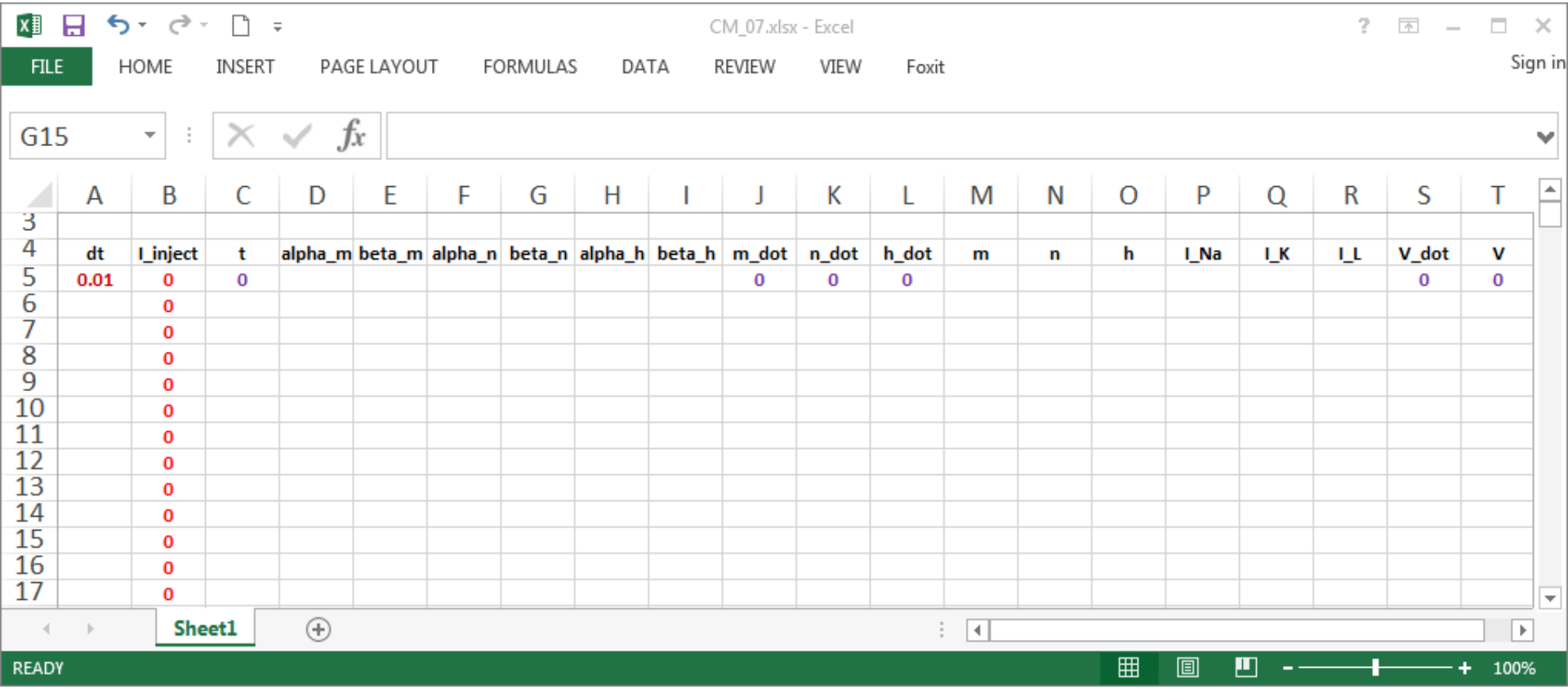
Sheet1

READY 100%

وارد کردن مقادیر اولیه:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0							0	0	0							0	0
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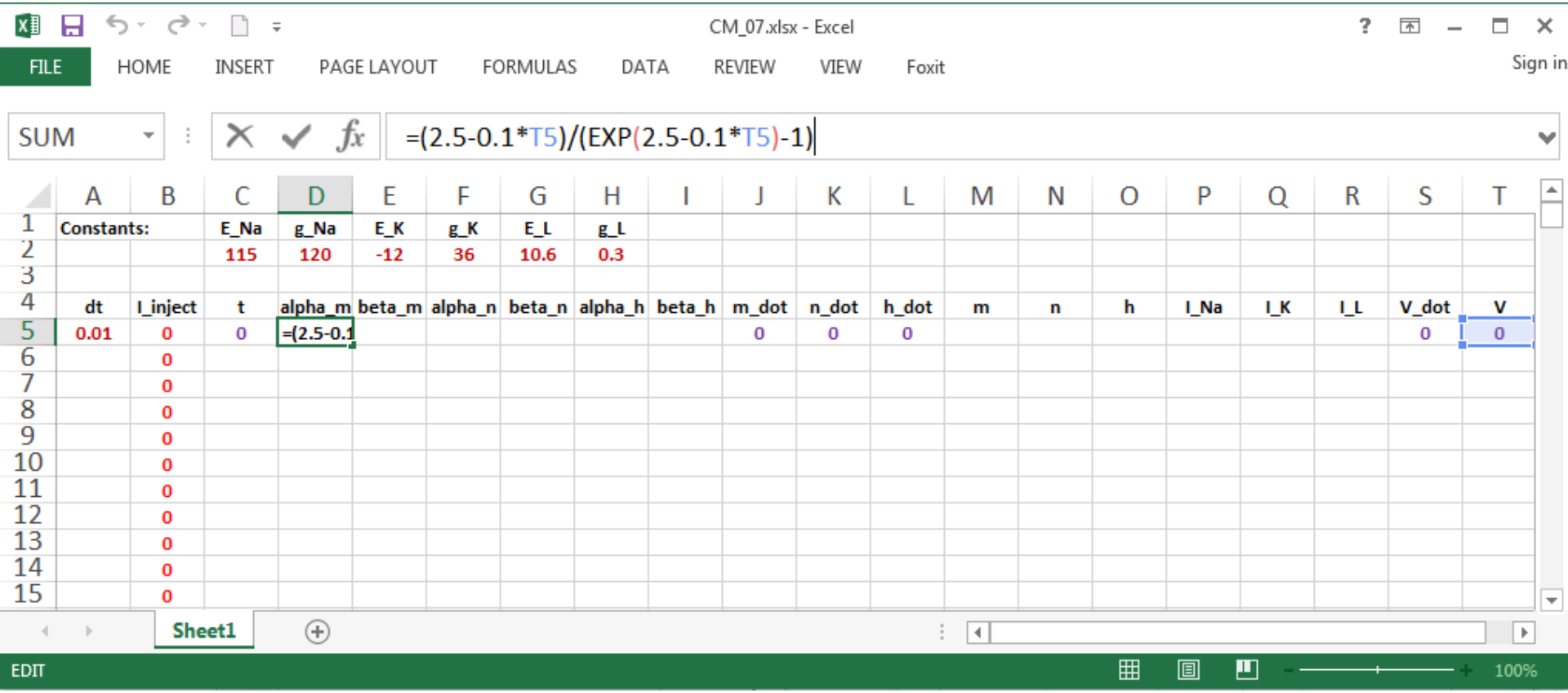
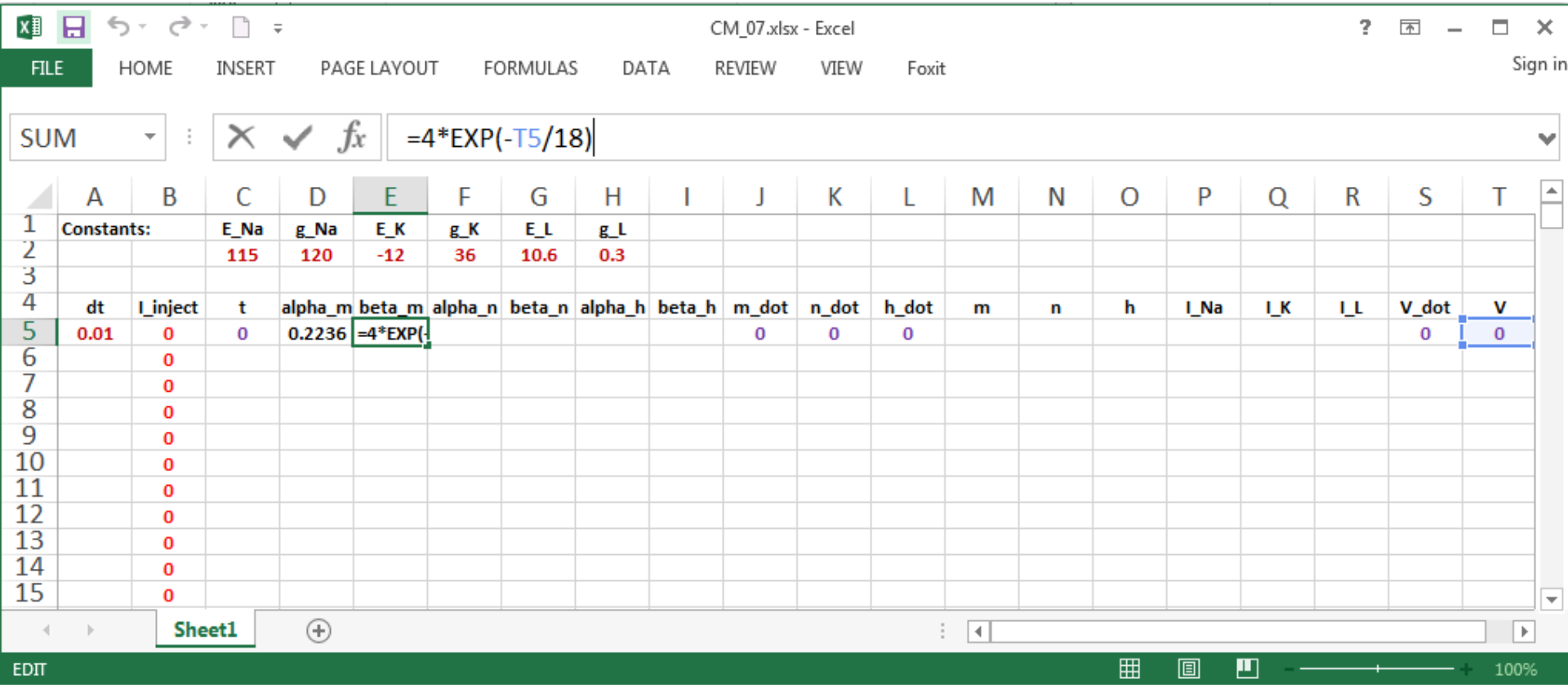


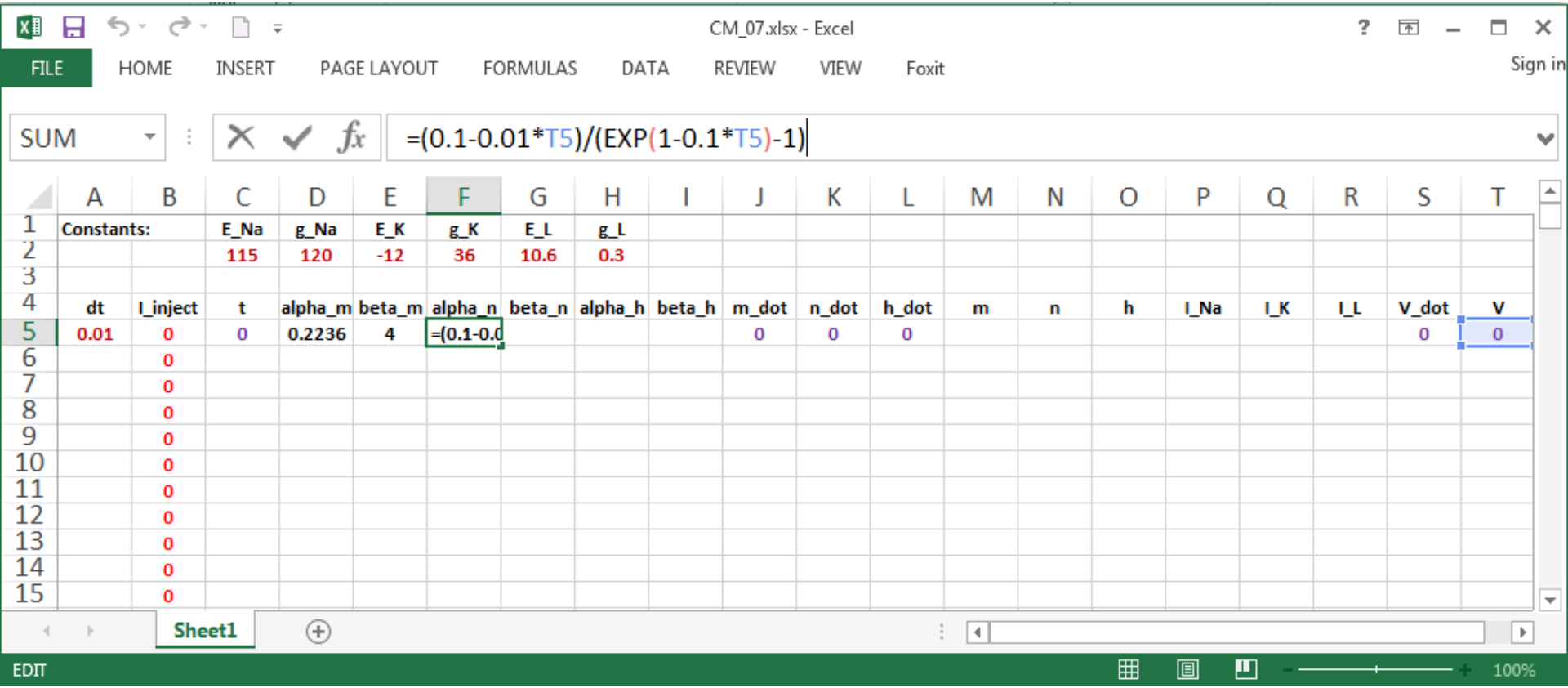
$$\alpha_m(V) = \frac{2.5 - 0.1V}{e^{2.5-0.1V} - 1}$$

وارد کردن فرمول‌ها:



$$\beta_m(V) = 4e^{-\frac{V}{18}}$$

وارد کردن فرمول‌ها:



$$\alpha_n(V) = \frac{0.1 - 0.01V}{e^{1-0.1V} - 1}$$

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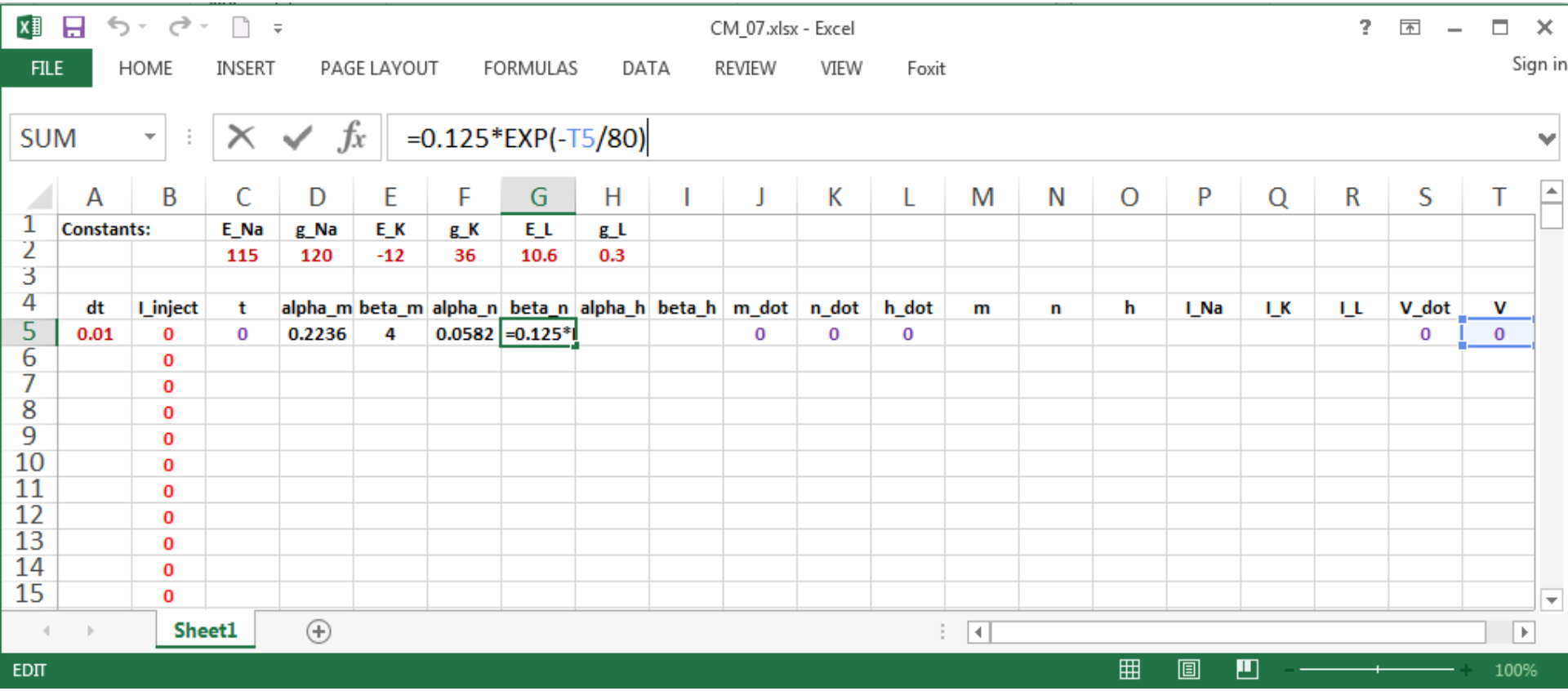
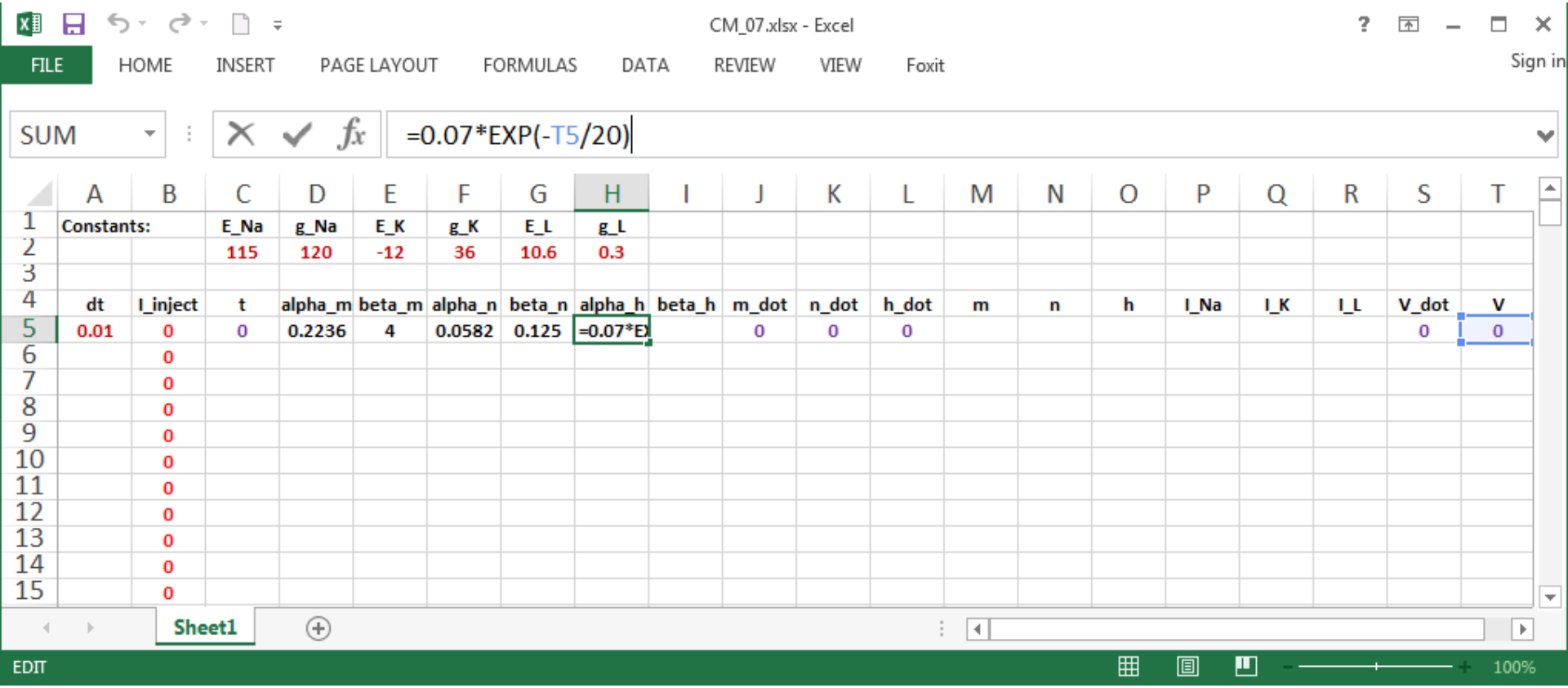


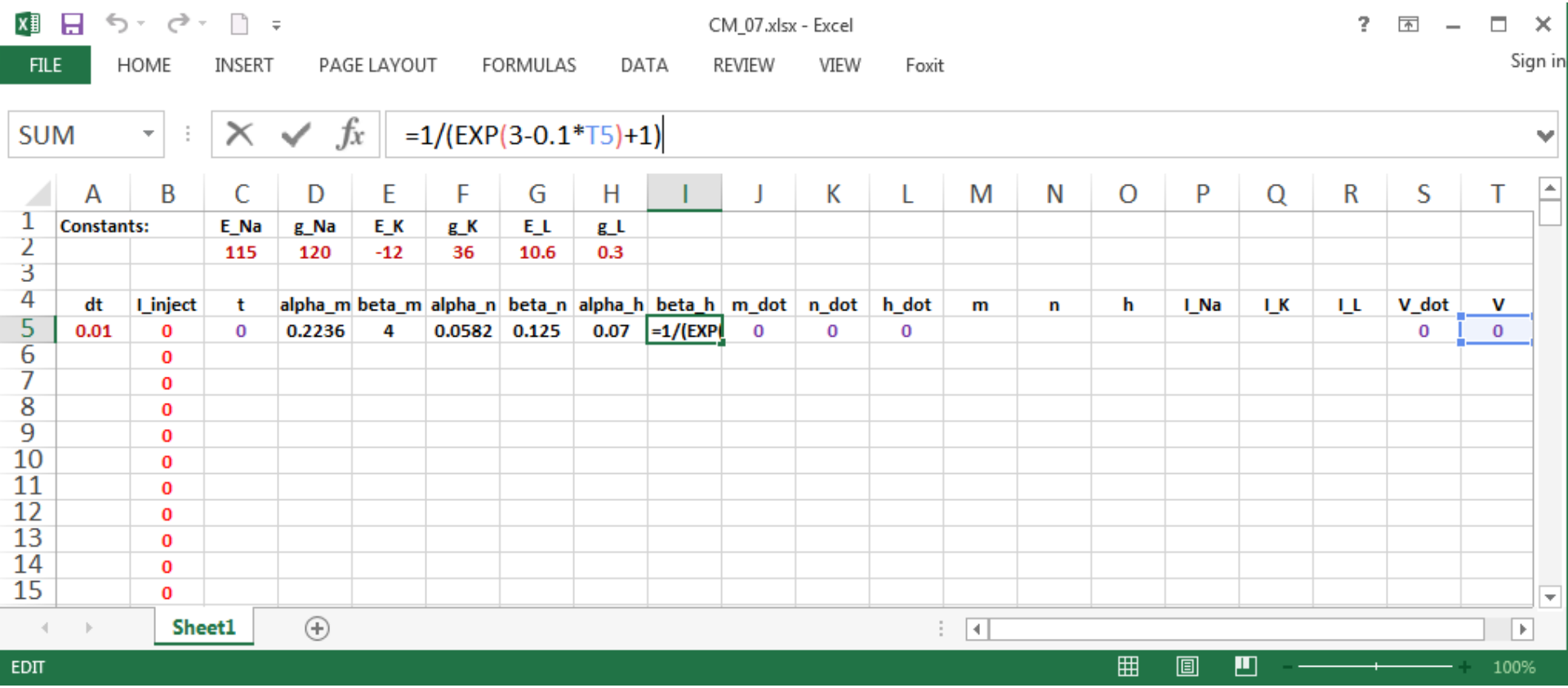
$$\beta_n(V) = 0.125e^{-\frac{V}{80}}$$

وارد کردن فرمول‌ها:



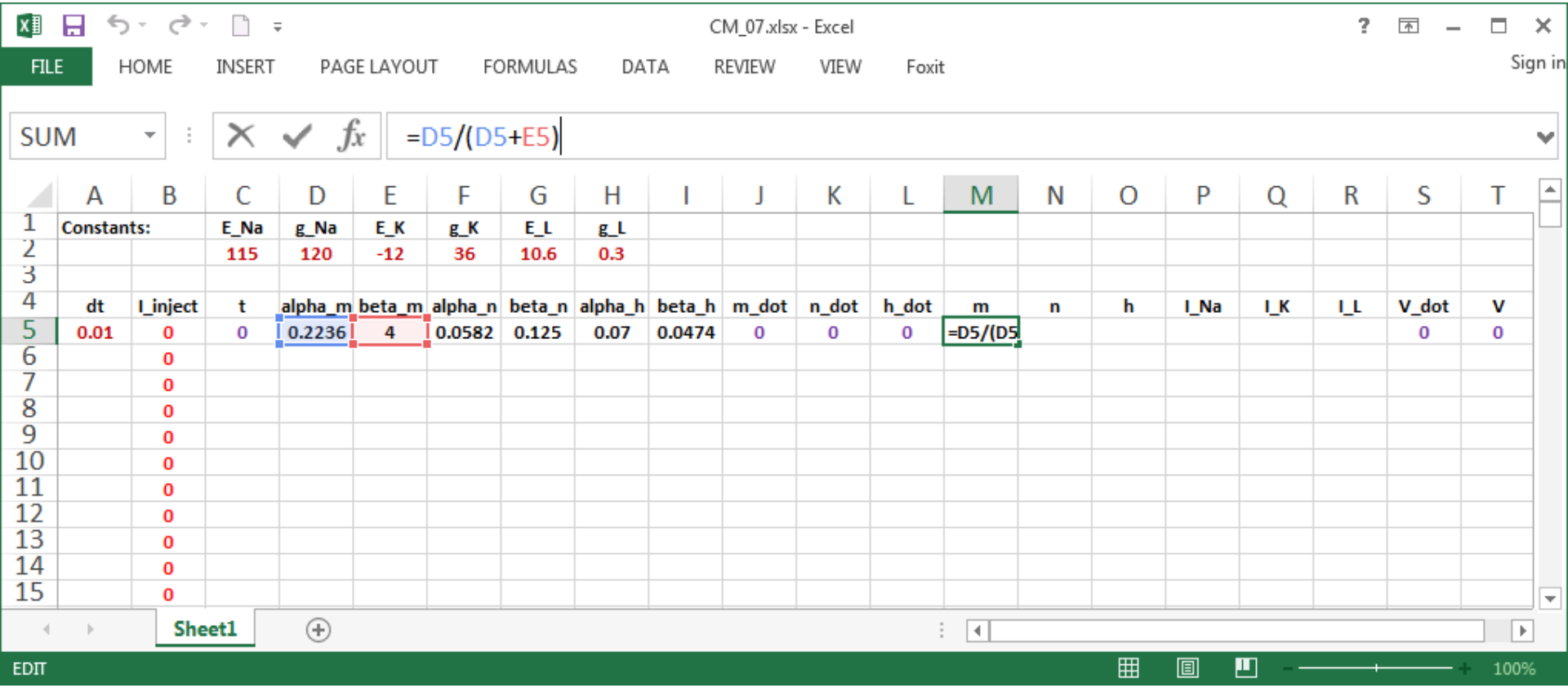
$$\alpha_h(V) = 0.07e^{-\frac{V}{20}}$$

وارد کردن فرمول‌ها:



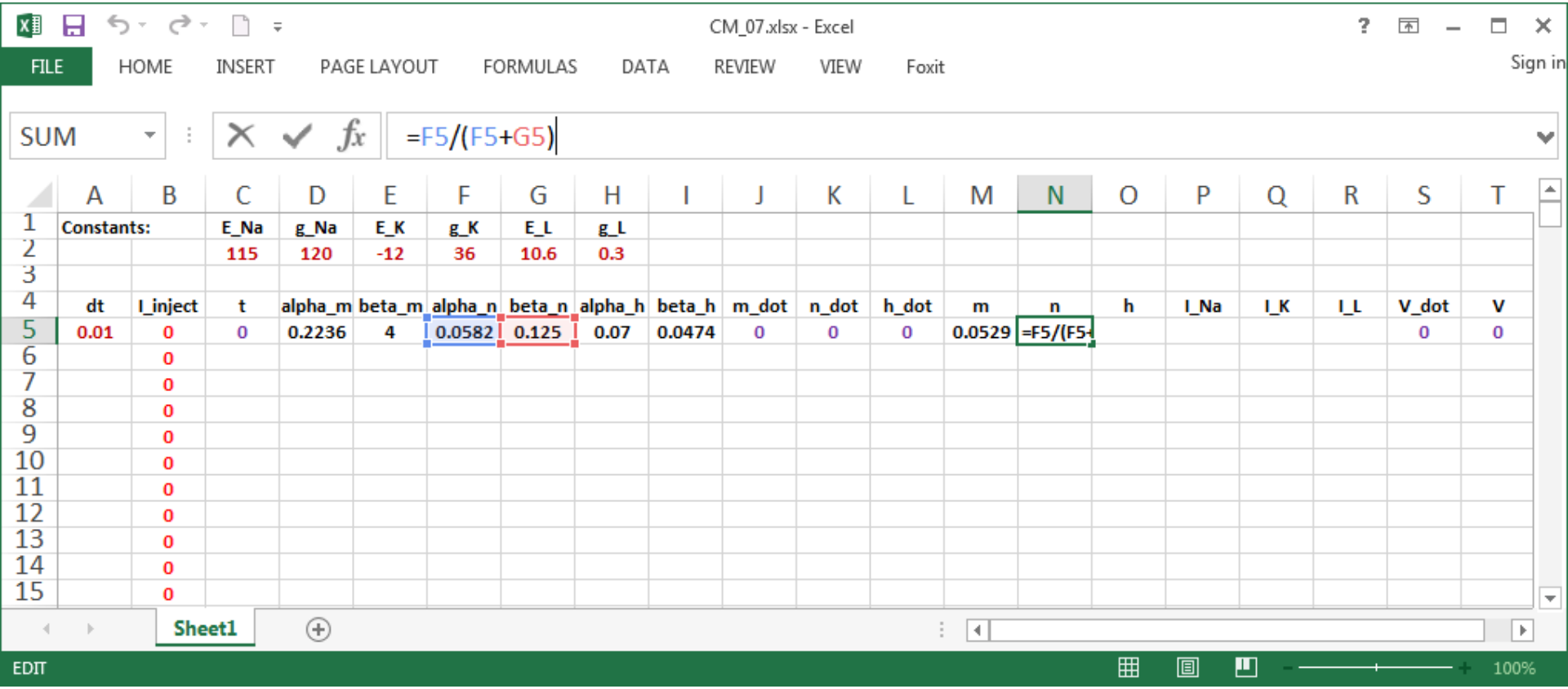
$$\beta_h(V) = \frac{1}{e^{3-0.1V} + 1}$$

وارد کردن فرمول‌ها:



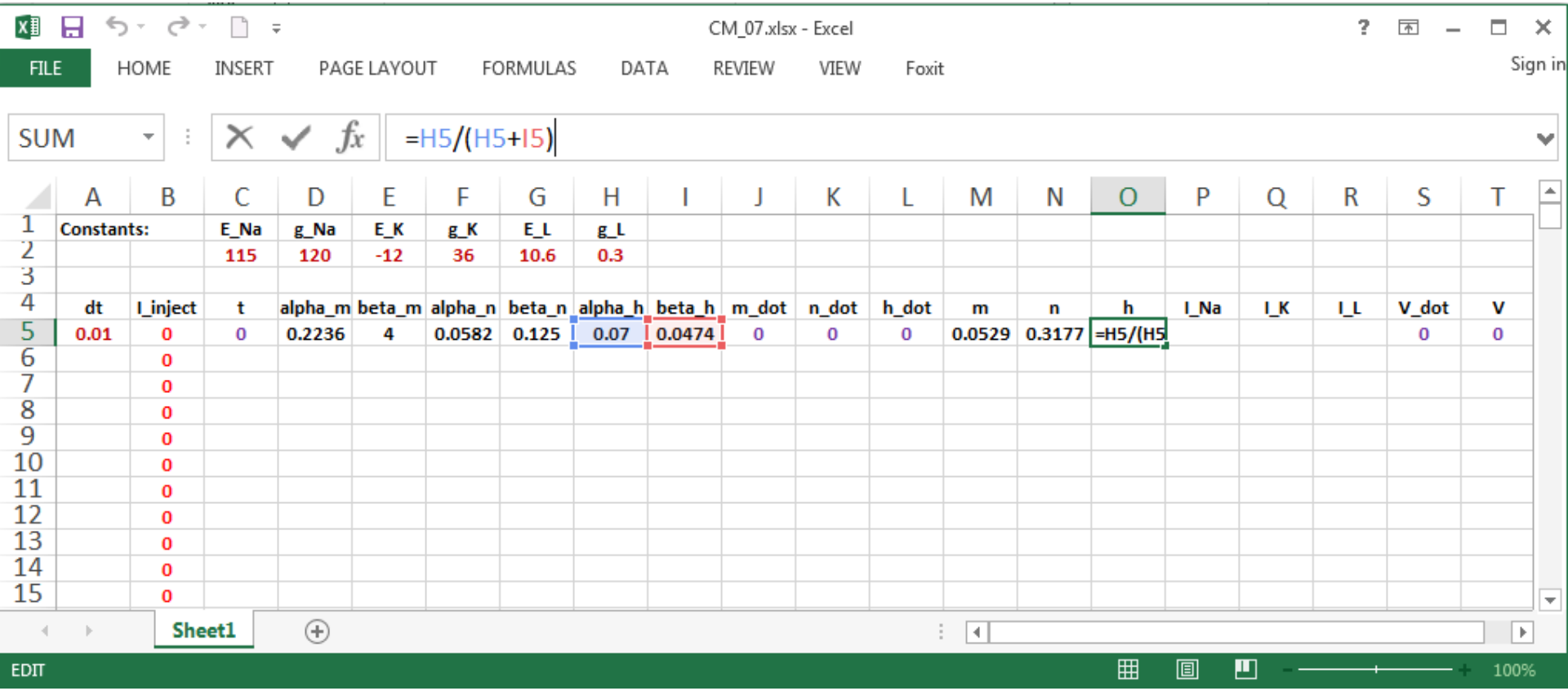
$$\dot{m} = \alpha_m(V)(1-m) - \beta_m(V)m$$

وارد کردن فرمول‌ها:



$$\dot{n} = \alpha_n(V)(1-n) - \beta_n(V)n$$

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	=H5/(H5				0	0
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$$\dot{h} = \alpha_h(V)(1-h) - \beta_h(V)h$$

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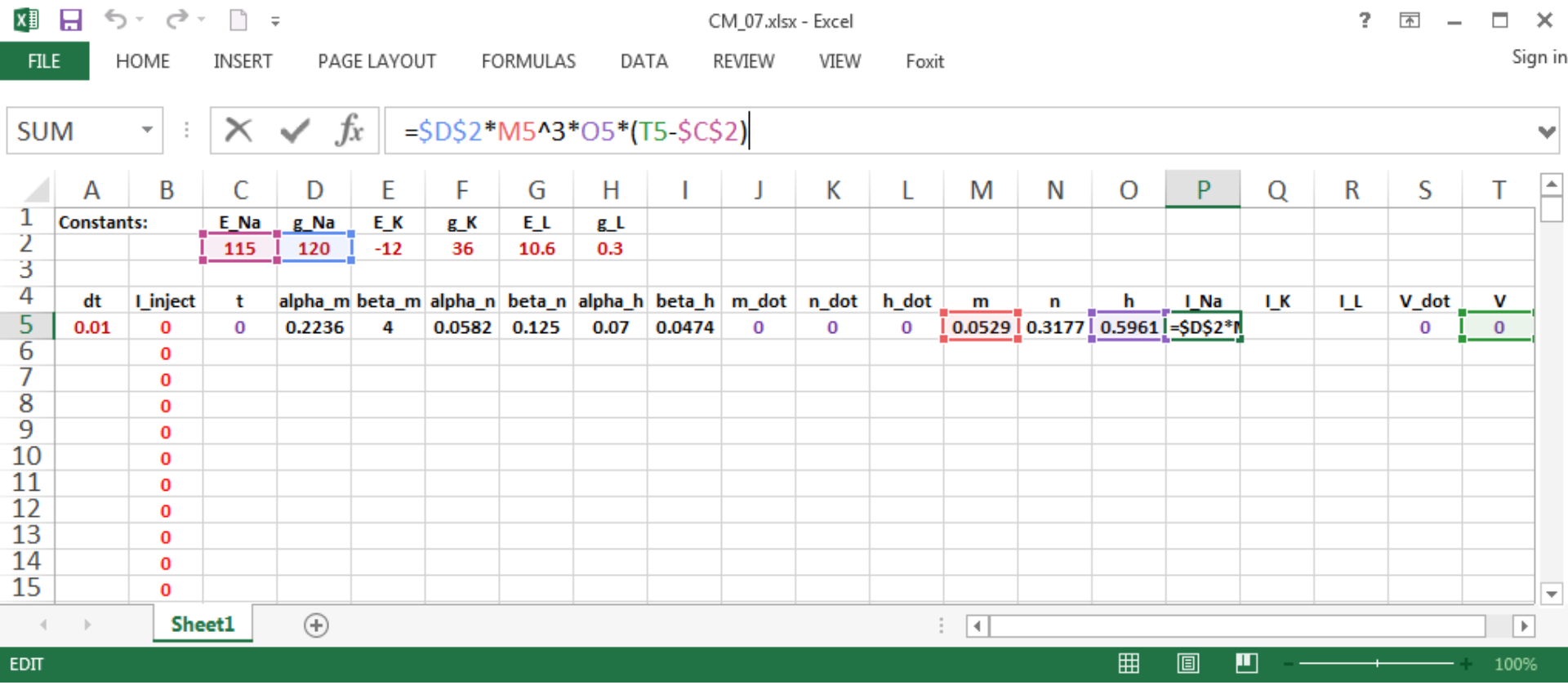

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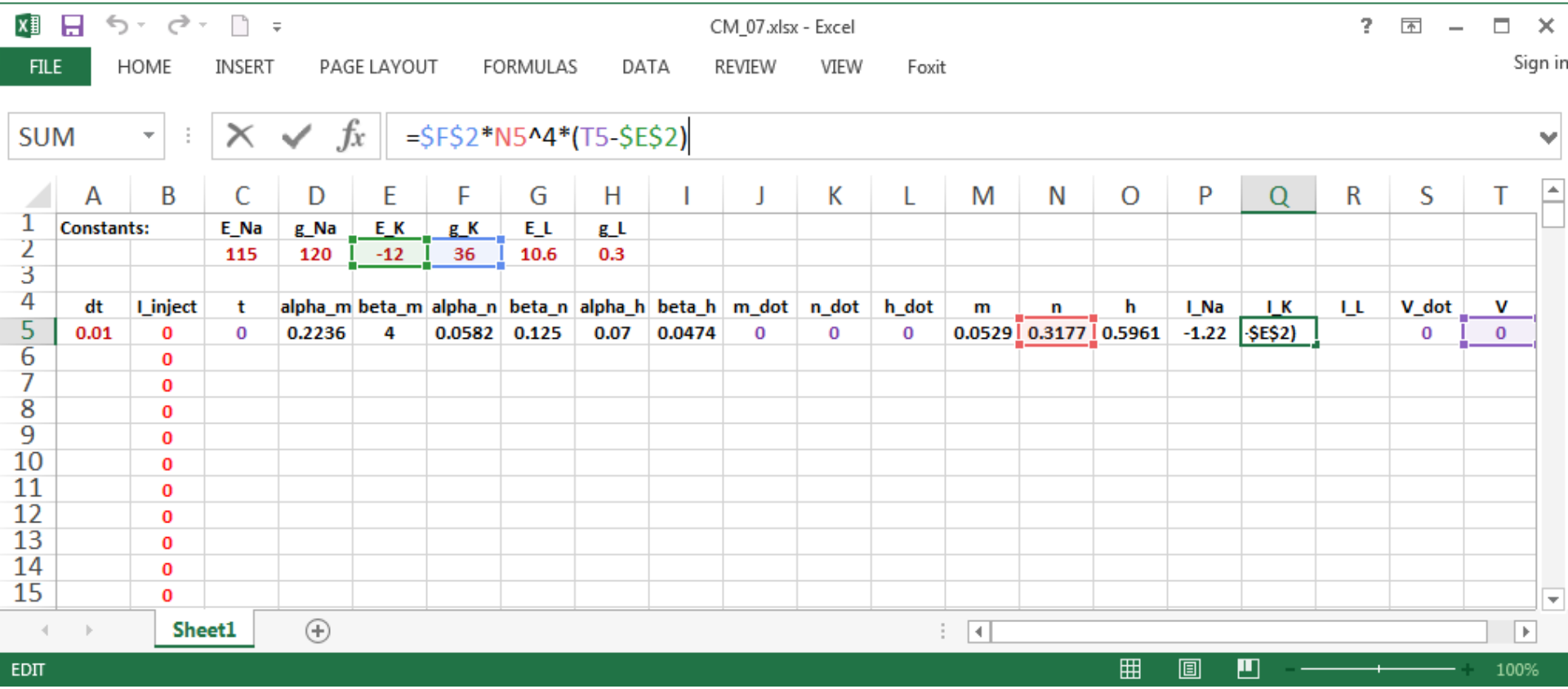

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	-E2)		0	0
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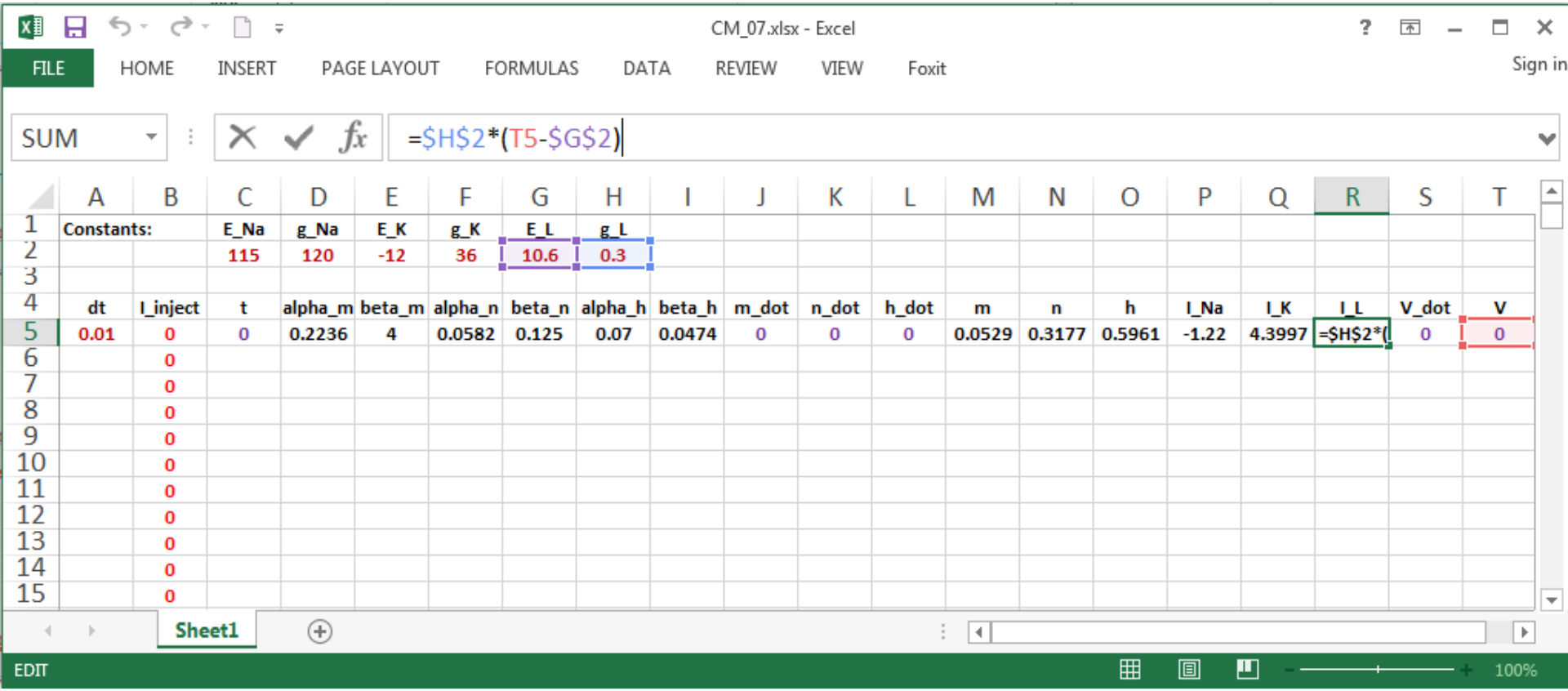

$$C\frac{dV(t)}{dt} = I_{injected}(t) - \left[\bar{g}_{Na}m^3 h\,(V(t)-E_{Na}) + \bar{g}_K n^4 (V(t)-E_K) + \bar{g}_L (V(t)-E_L)\right]$$

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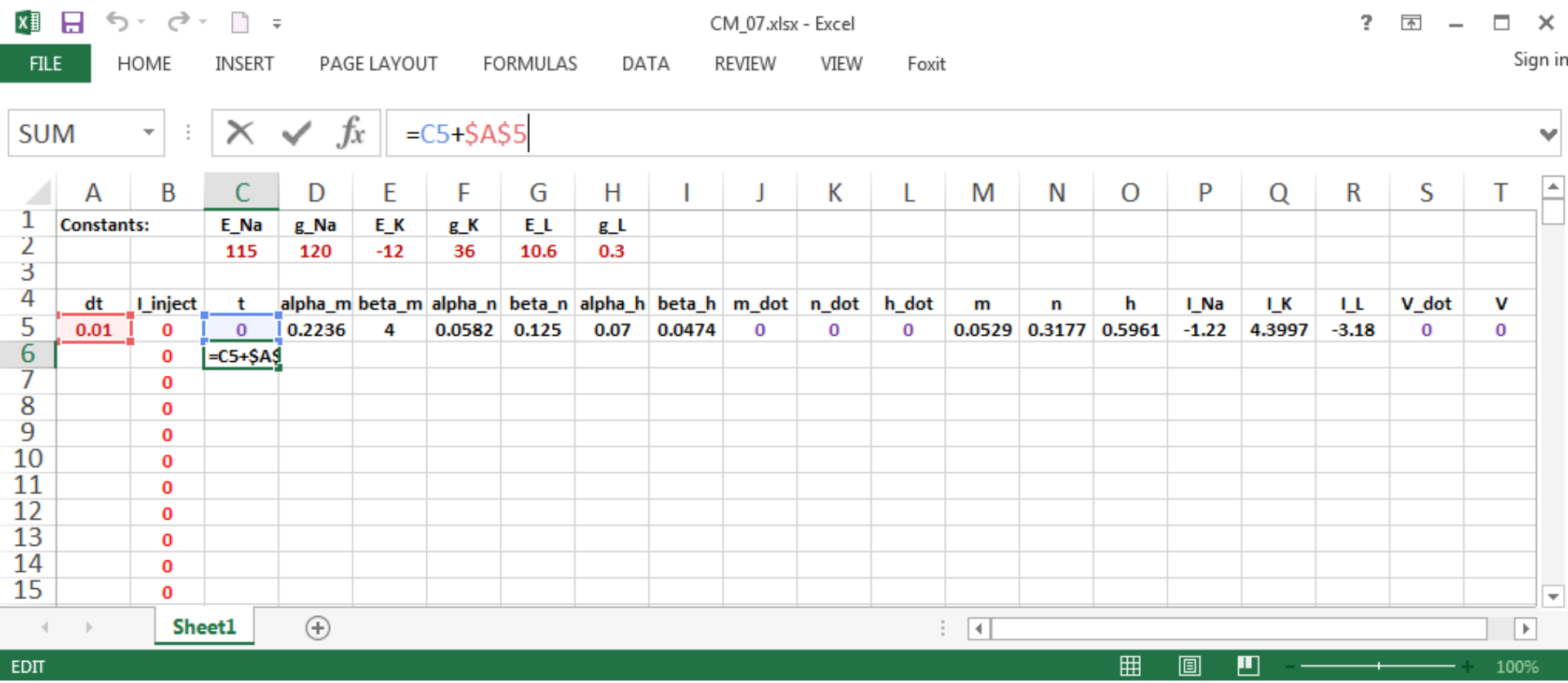

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
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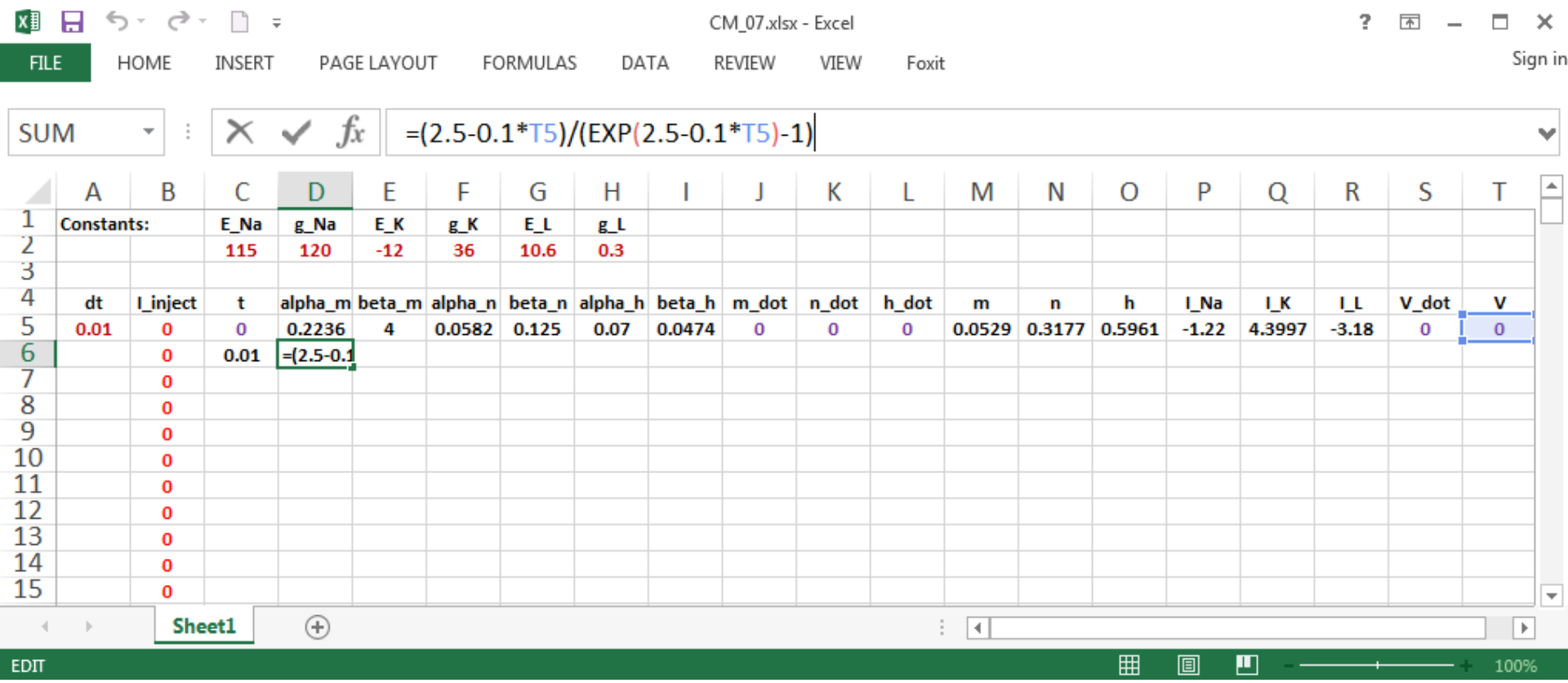

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
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3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
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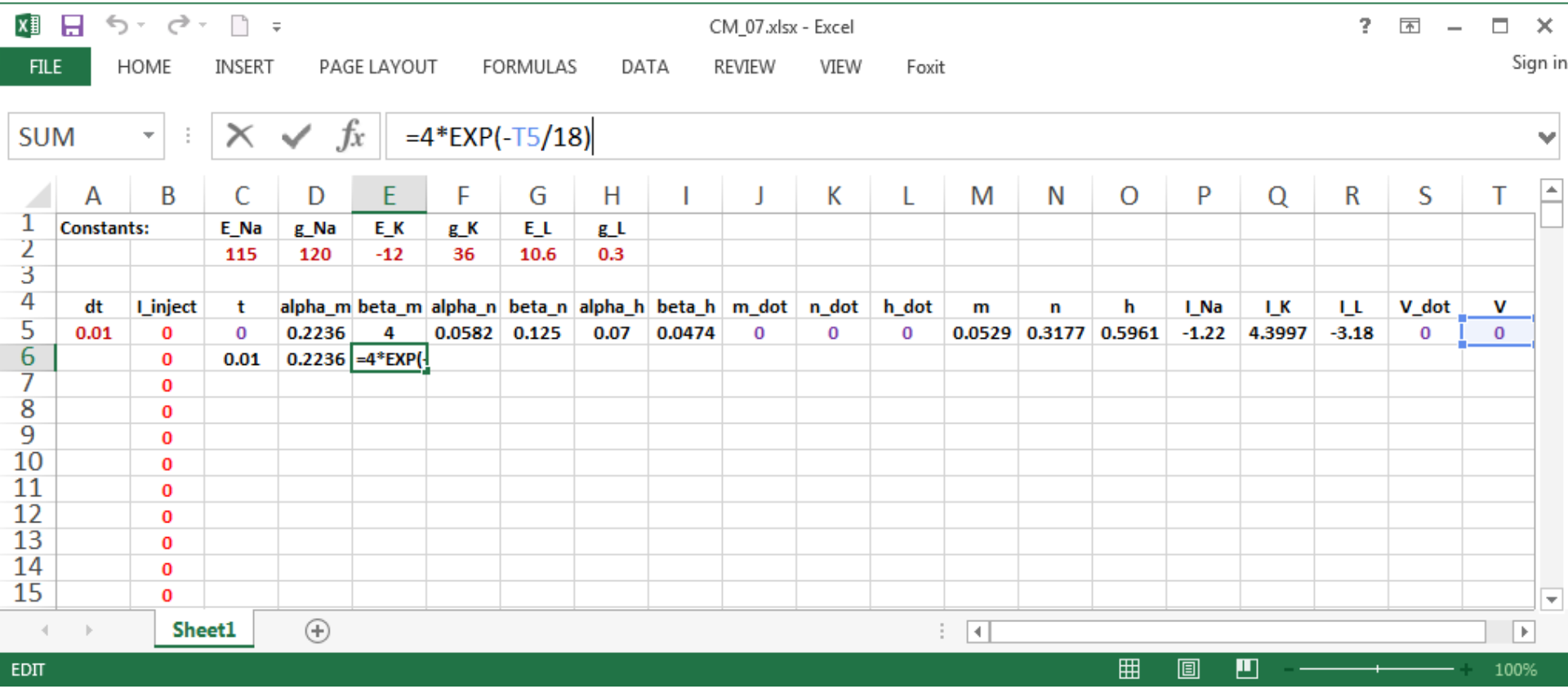

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
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4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
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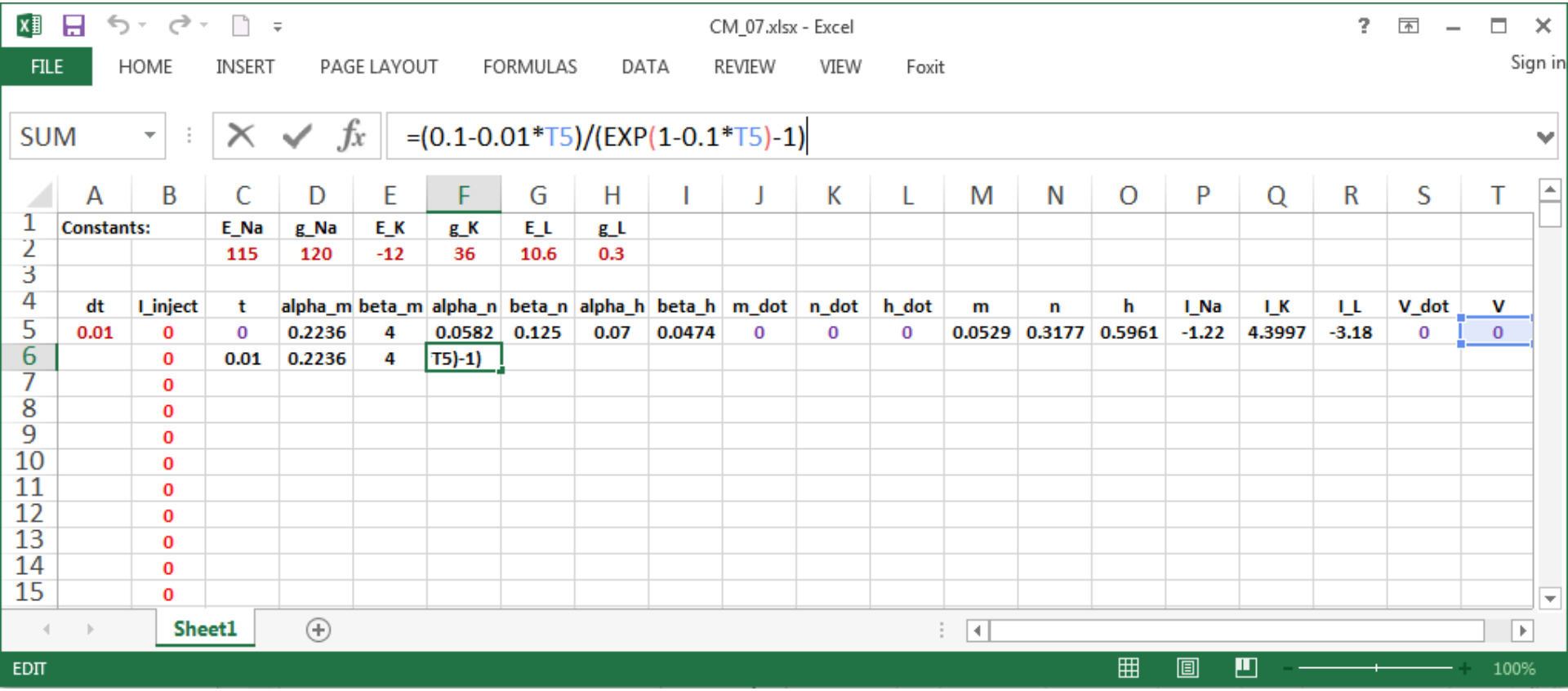

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	T5)-1)														
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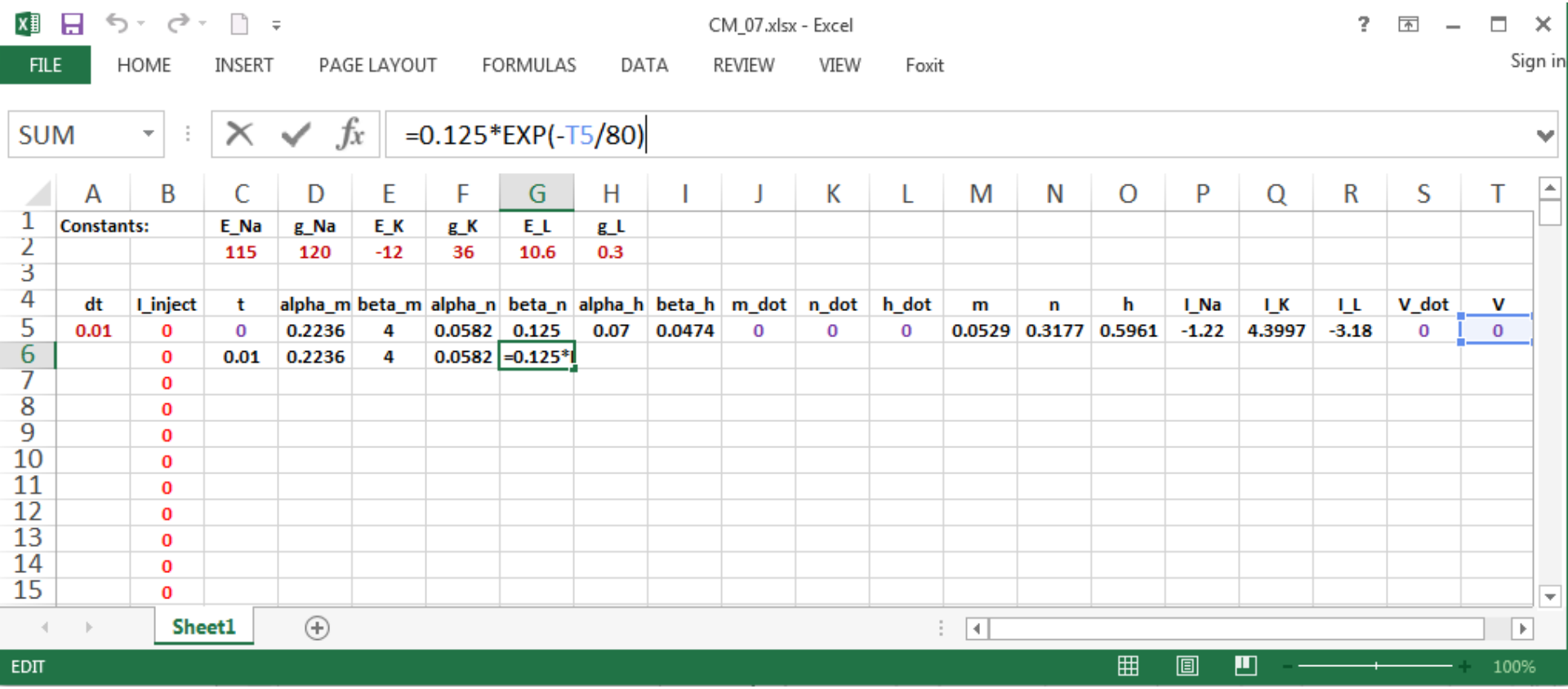

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	=0.125*I													
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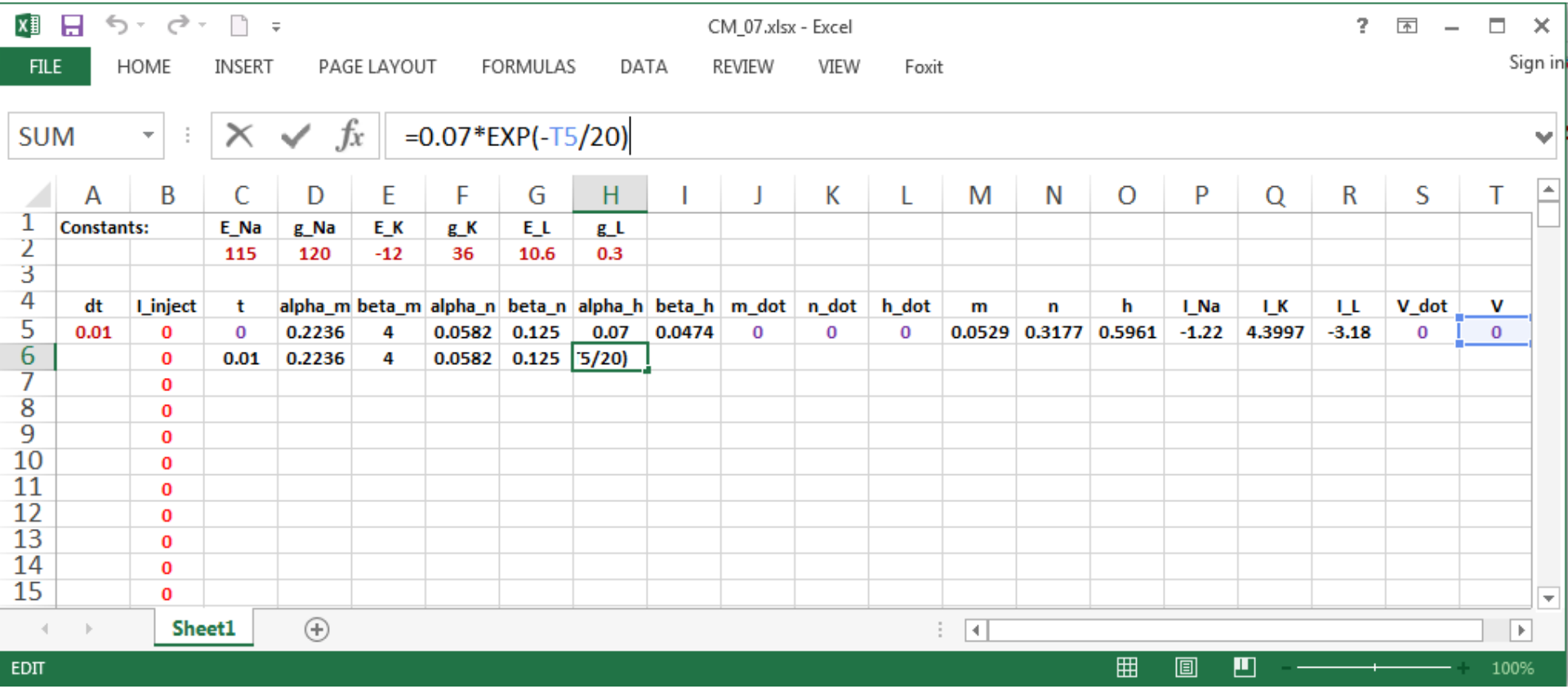
وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	5/20)												
7		0																		
8		0																		
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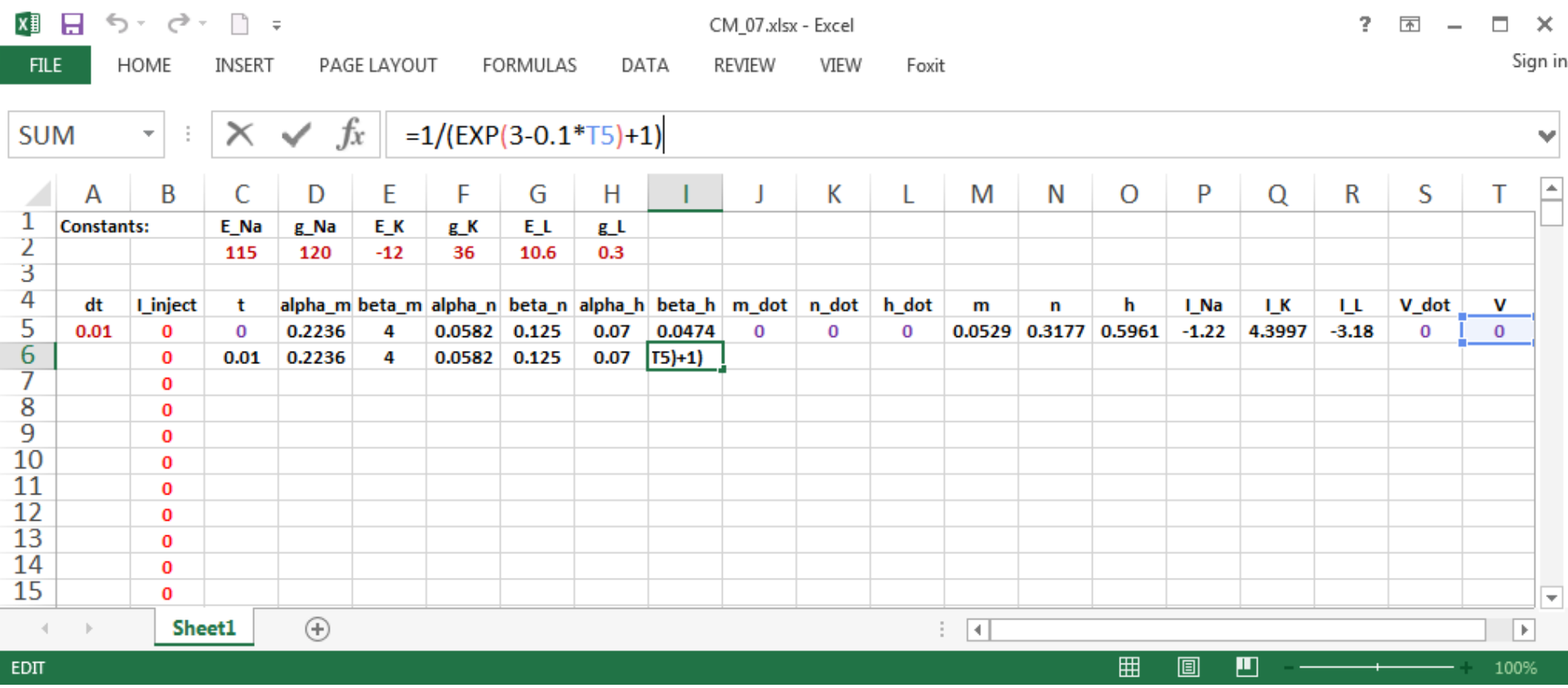
14		0																		
15		0																		

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	T5)+1)											
7		0																		
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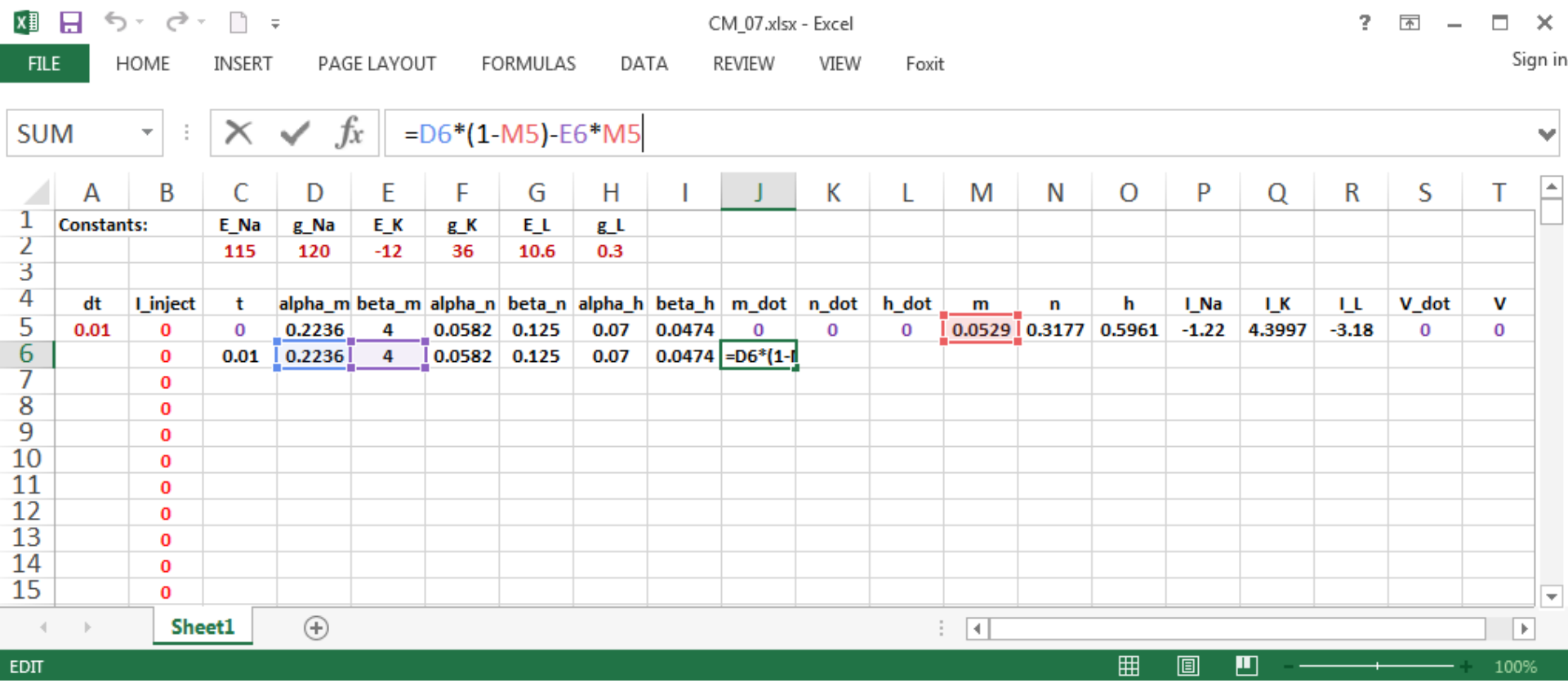
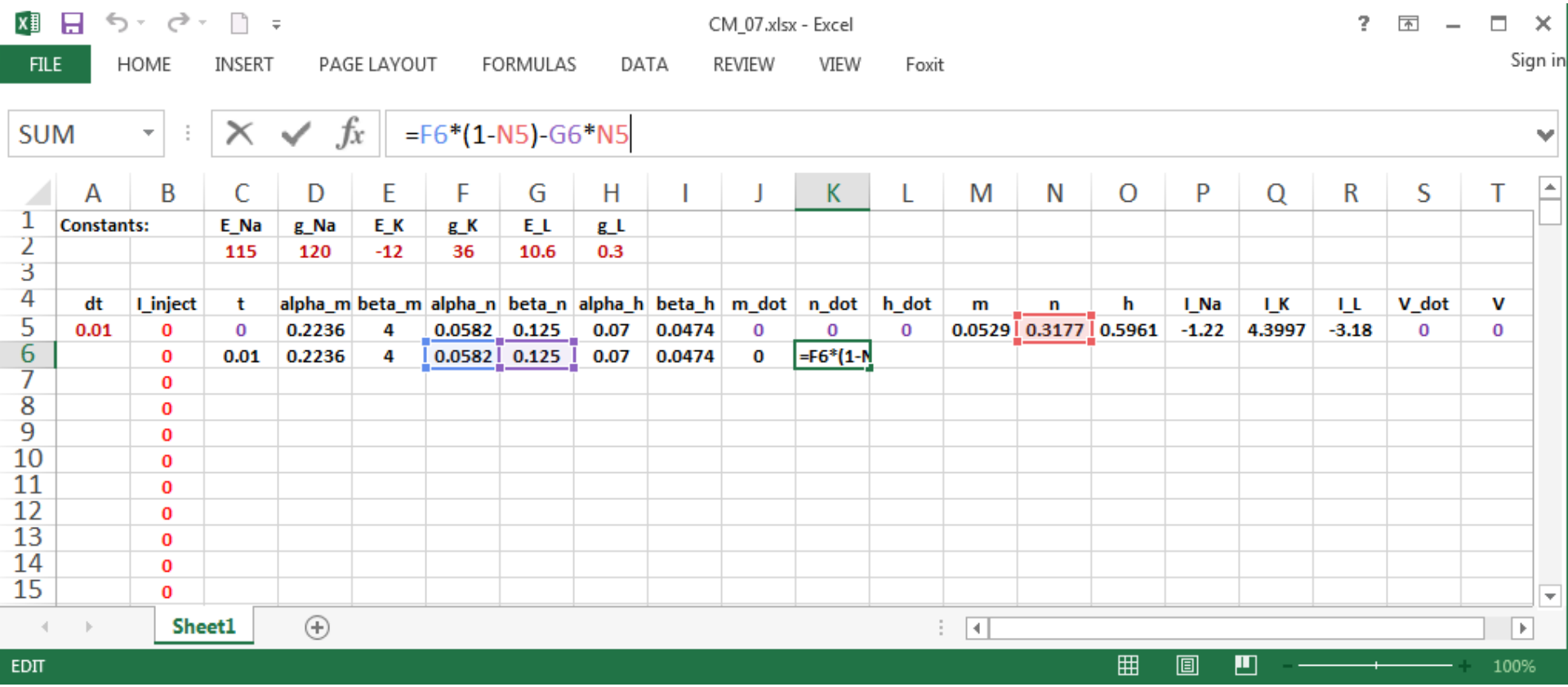
وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	=D6*(1-I										
7		0																		
8		0																		
9		0																		
10		0																		
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

$$\dot{m} = \alpha_m(V)(1-m) - \beta_m(V)m$$

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	=F6*(1-N									
7		0																		
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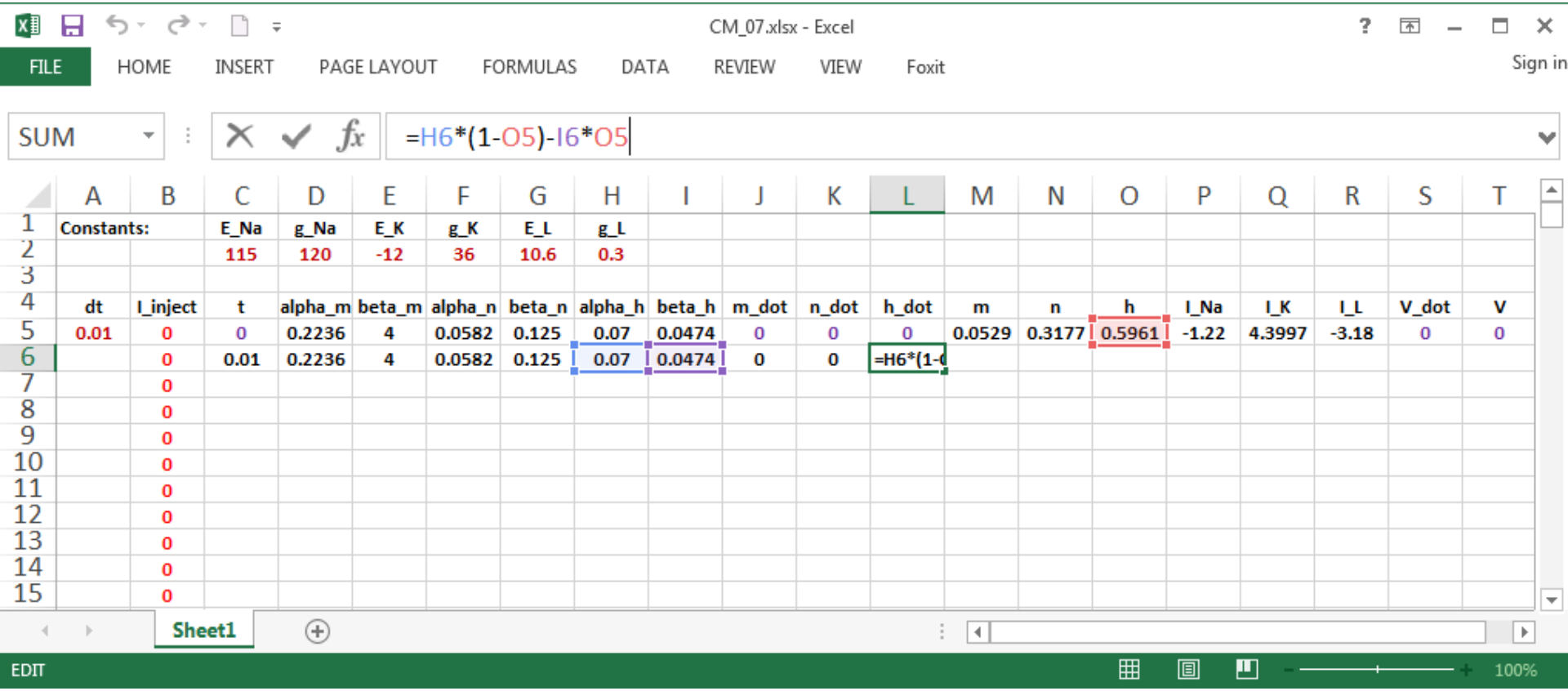
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

$$\dot{n} = \alpha_n(V)(1-n) - \beta_n(V)n$$

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	=H6*(1-O								
7		0																		
8		0																		
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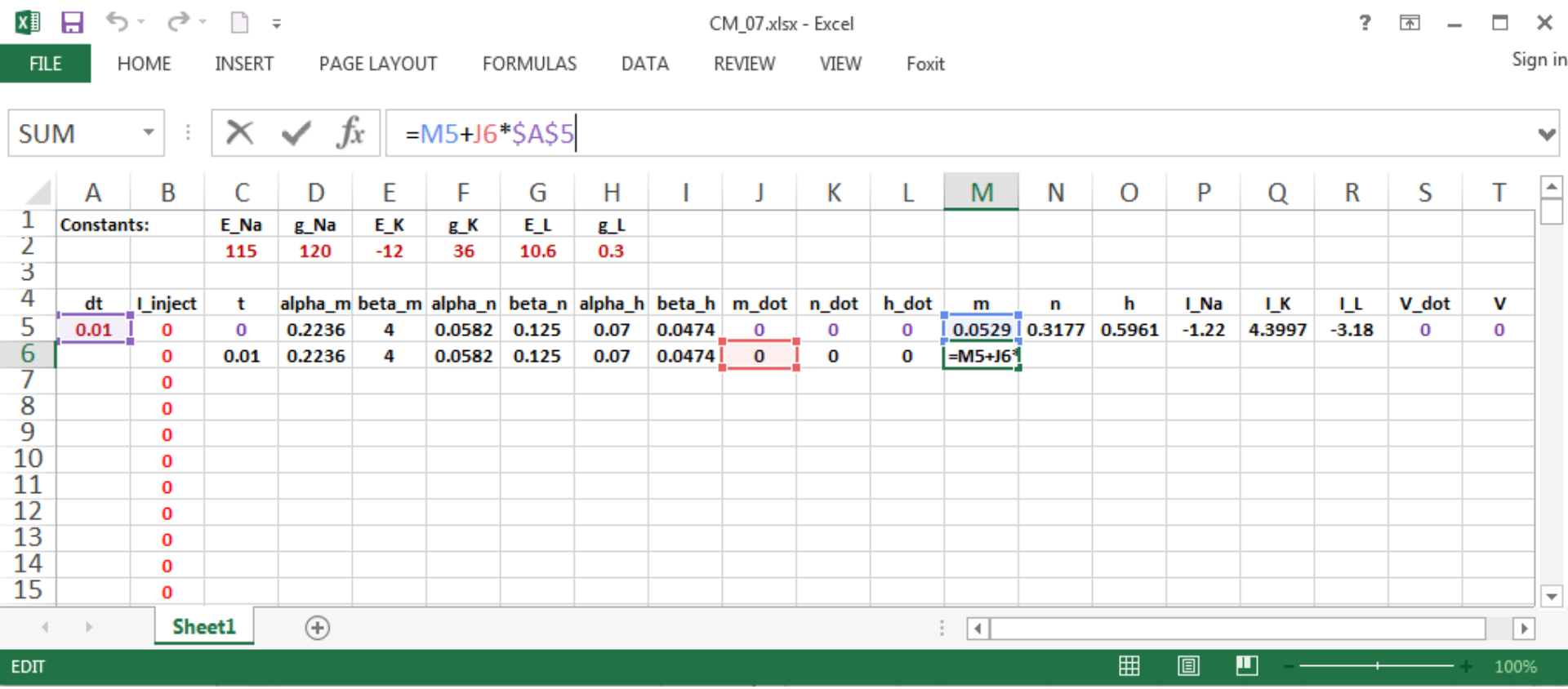
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

$$\dot{h} = \alpha_h(V)(1-h) - \beta_h(V)h$$

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	=M5+J6							
7		0																		
8		0																		
9		0																		
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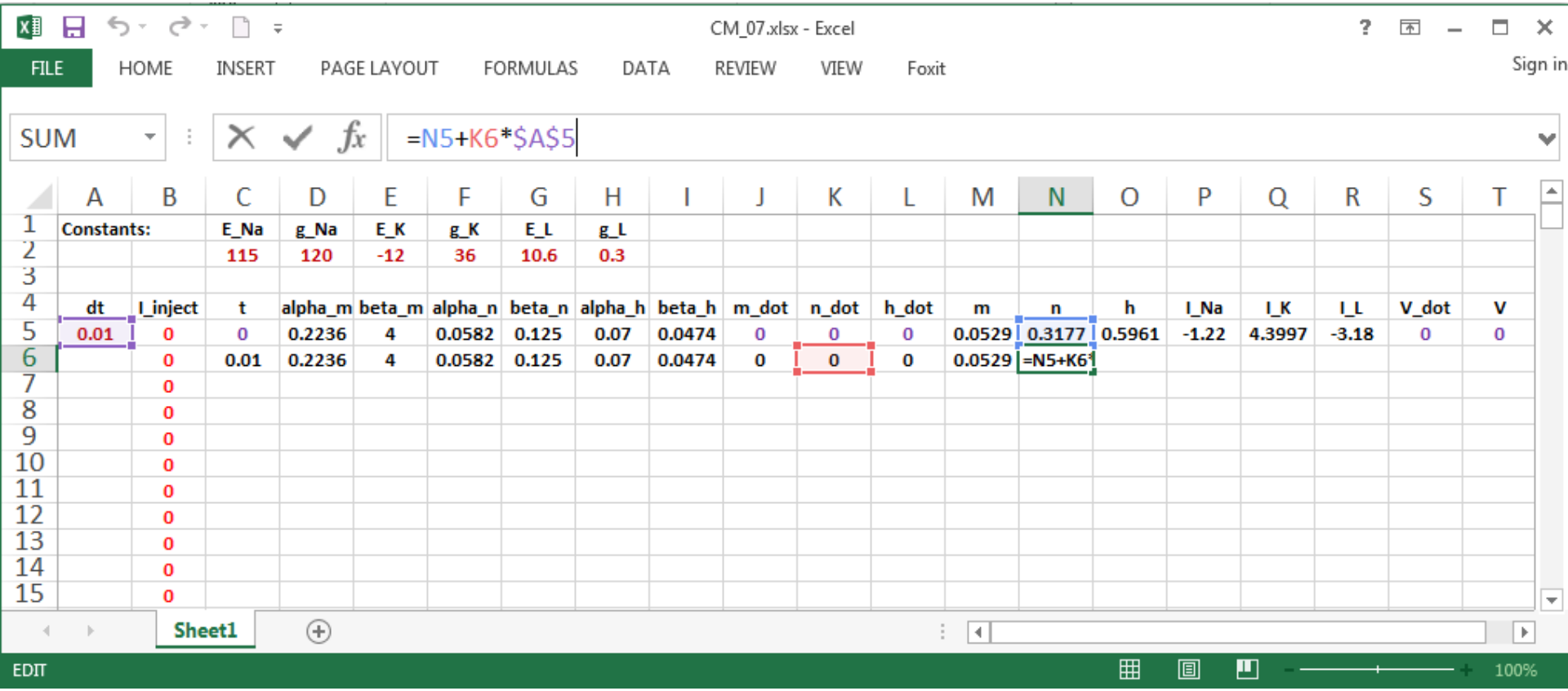
14		0																		
15		0																		

وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	=N5+K6						
7		0																		
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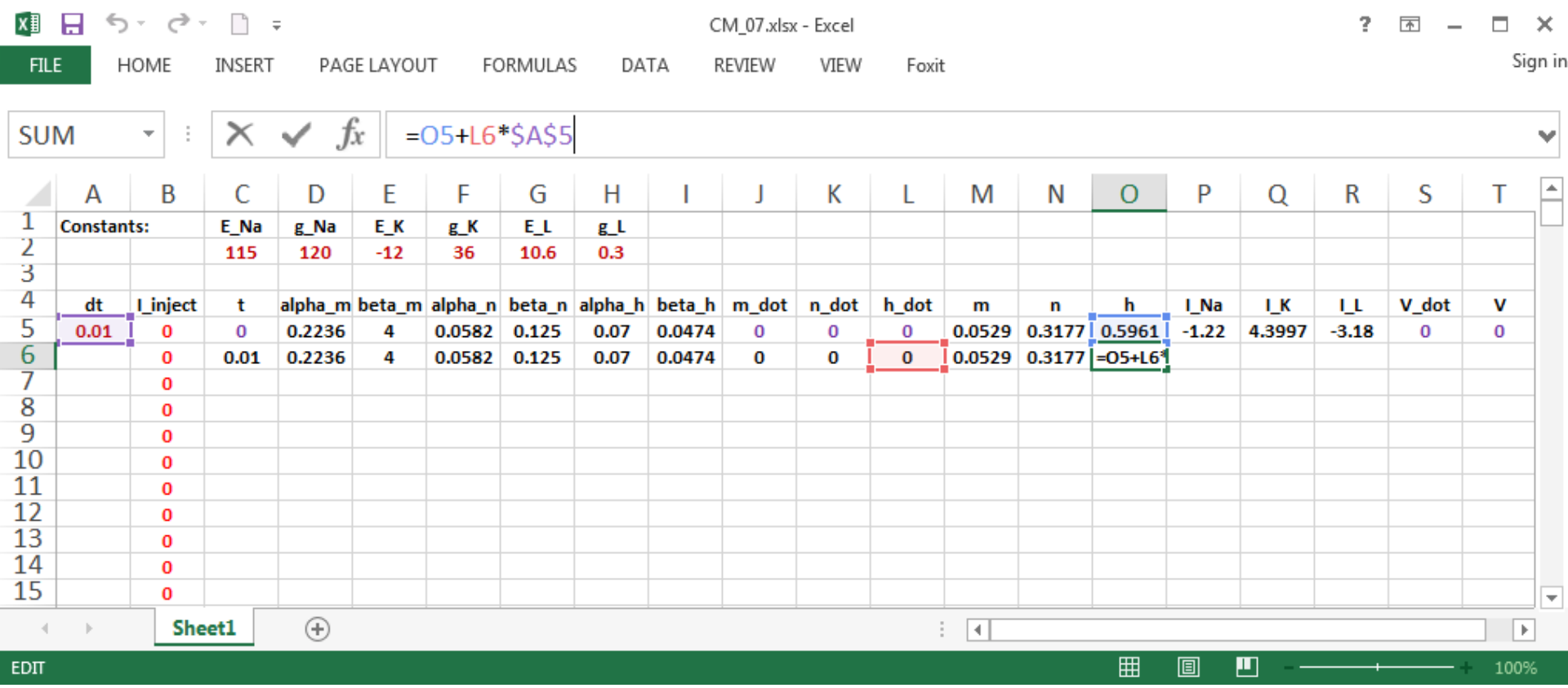
وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	=O5+L6					
7		0																		
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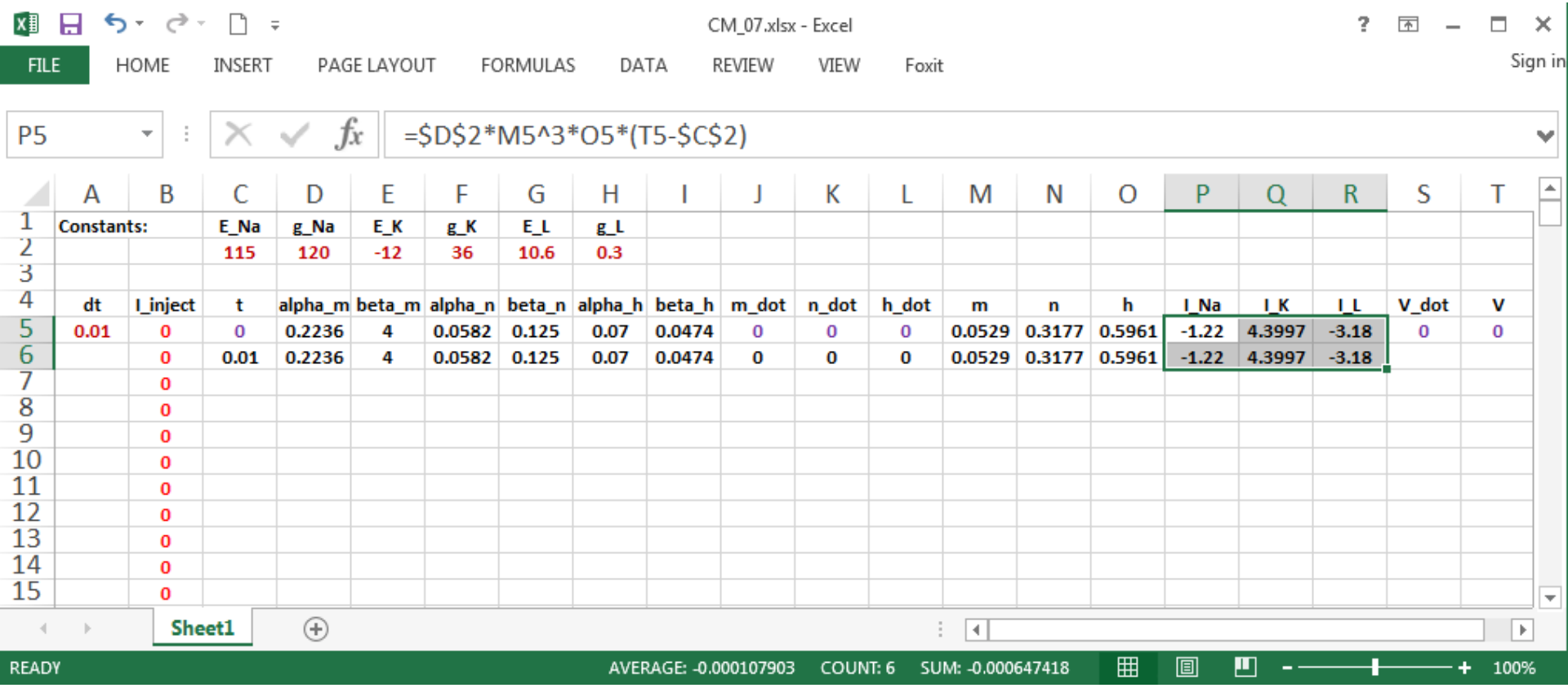
13		0																		
14		0																		
15		0																		

کپی کردن روابط از سطر قبل برای ....:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18		
7		0																		
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10		0																		
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

وارد کردن فرمول‌ها:

CM_07.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Foxit Sign in

SUM | =B6-(P6+Q6+R6)

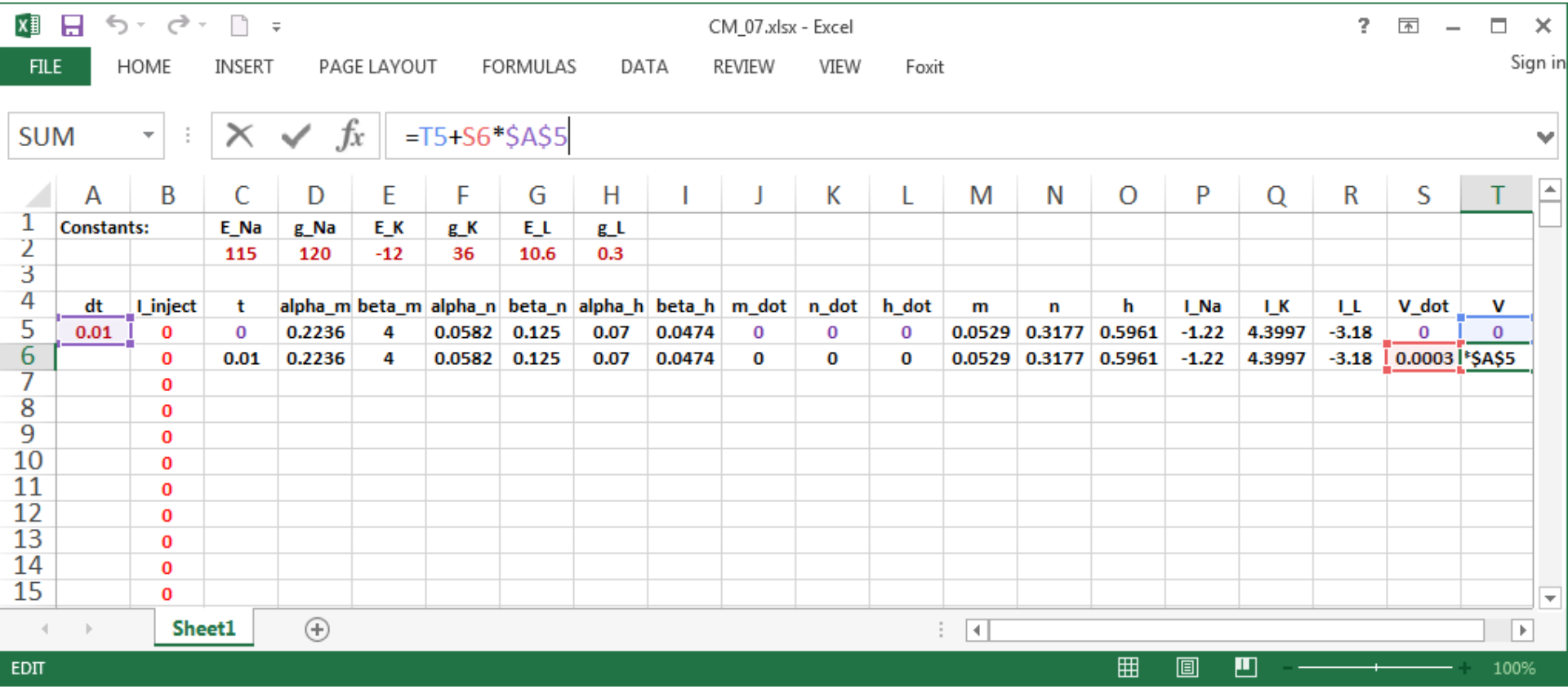
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	=B6-(P6+	
7		0																		
8		0																		
9		0																		
10		0																		
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

Sheet1

EDIT 100%

$$C\frac{dV(t)}{dt} = I_{injected}(t) - \left[\bar{g}_{Na}m^3 h\,(V(t) - E_{Na}) + \bar{g}_K n^4 (V(t) - E_K) + \bar{g}_L (V(t) - E_L)\right]$$

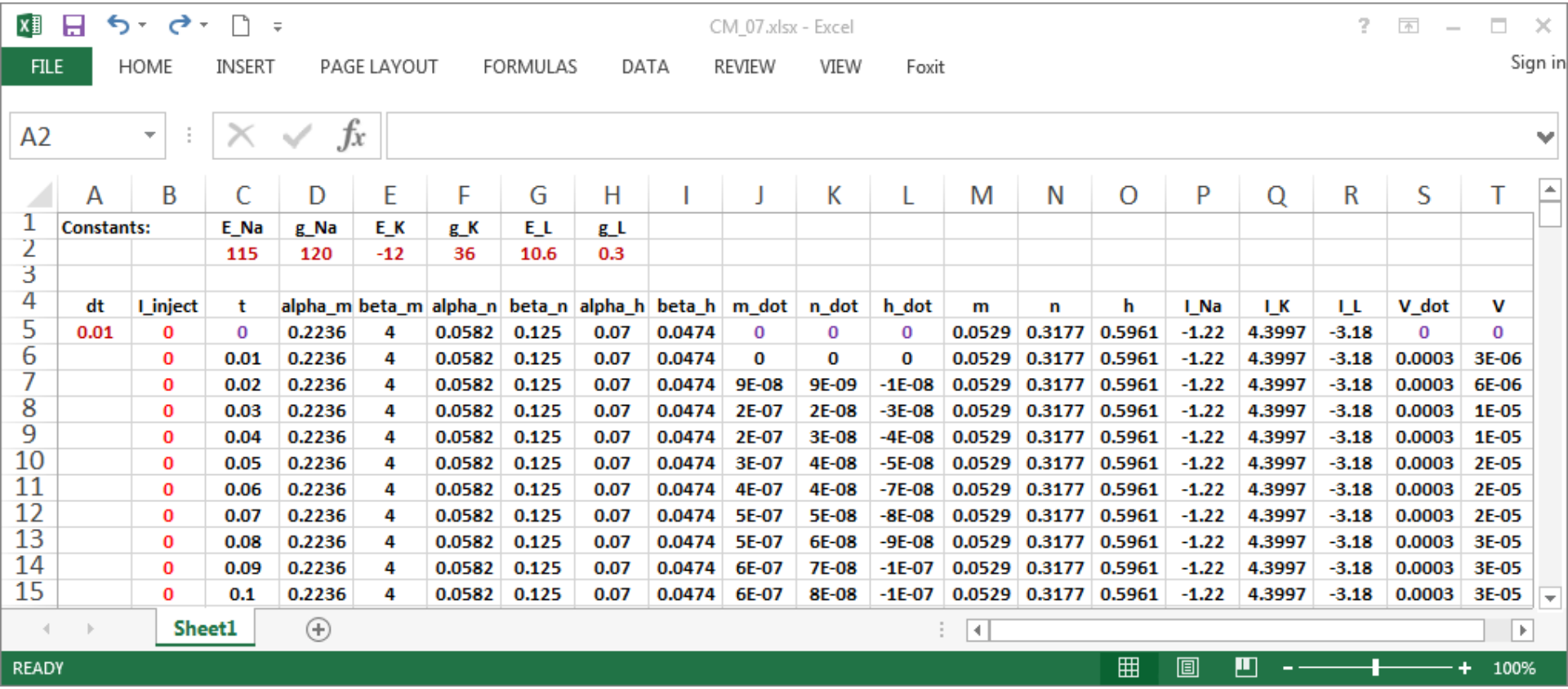
وارد کردن فرمول‌ها:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	*A5
7		0																		
8		0																		
9		0																		
10		0																		
11		0																		
12		0																		
13		0																		
14		0																		
15		0																		

$$C\frac{dV(t)}{dt} = I_{injected}(t) - \left[\bar{g}_{Na}m^3 h\,(V(t) - E_{Na}) + \bar{g}_K n^4 (V(t) - E_K) + \bar{g}_L (V(t) - E_L)\right]$$

وارد کردن فرمول‌ها:


CM_07.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Foxit Sign in

A2

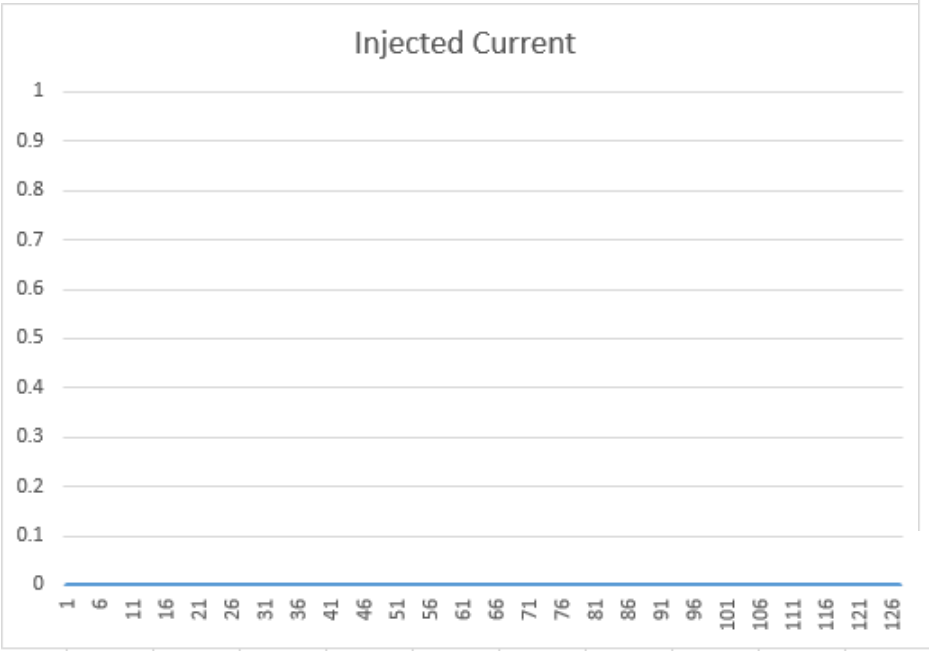
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Constants:		E_Na	g_Na	E_K	g_K	E_L	g_L												
2			115	120	-12	36	10.6	0.3												
3																				
4	dt	I_inject	t	alpha_m	beta_m	alpha_n	beta_n	alpha_h	beta_h	m_dot	n_dot	h_dot	m	n	h	I_Na	I_K	I_L	V_dot	V
5	0.01	0	0	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0	0
6		0	0.01	0.2236	4	0.0582	0.125	0.07	0.0474	0	0	0	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	3E-06
7		0	0.02	0.2236	4	0.0582	0.125	0.07	0.0474	9E-08	9E-09	-1E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	6E-06
8		0	0.03	0.2236	4	0.0582	0.125	0.07	0.0474	2E-07	2E-08	-3E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	1E-05
9		0	0.04	0.2236	4	0.0582	0.125	0.07	0.0474	2E-07	3E-08	-4E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	1E-05
10		0	0.05	0.2236	4	0.0582	0.125	0.07	0.0474	3E-07	4E-08	-5E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	2E-05
11		0	0.06	0.2236	4	0.0582	0.125	0.07	0.0474	4E-07	4E-08	-7E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	2E-05
12		0	0.07	0.2236	4	0.0582	0.125	0.07	0.0474	5E-07	5E-08	-8E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	2E-05
13		0	0.08	0.2236	4	0.0582	0.125	0.07	0.0474	5E-07	6E-08	-9E-08	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	3E-05
14		0	0.09	0.2236	4	0.0582	0.125	0.07	0.0474	6E-07	7E-08	-1E-07	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	3E-05
15		0	0.1	0.2236	4	0.0582	0.125	0.07	0.0474	6E-07	8E-08	-1E-07	0.0529	0.3177	0.5961	-1.22	4.3997	-3.18	0.0003	3E-05

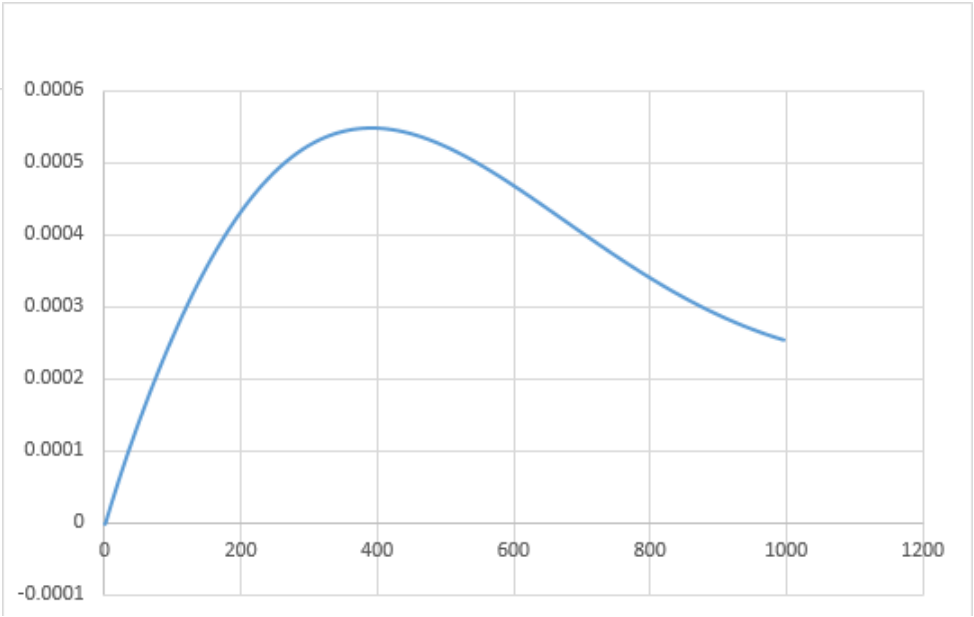
Sheet1

READY 100%

ترسیم و نمایش نتایج:

ترسیم و نمایش نتایج:





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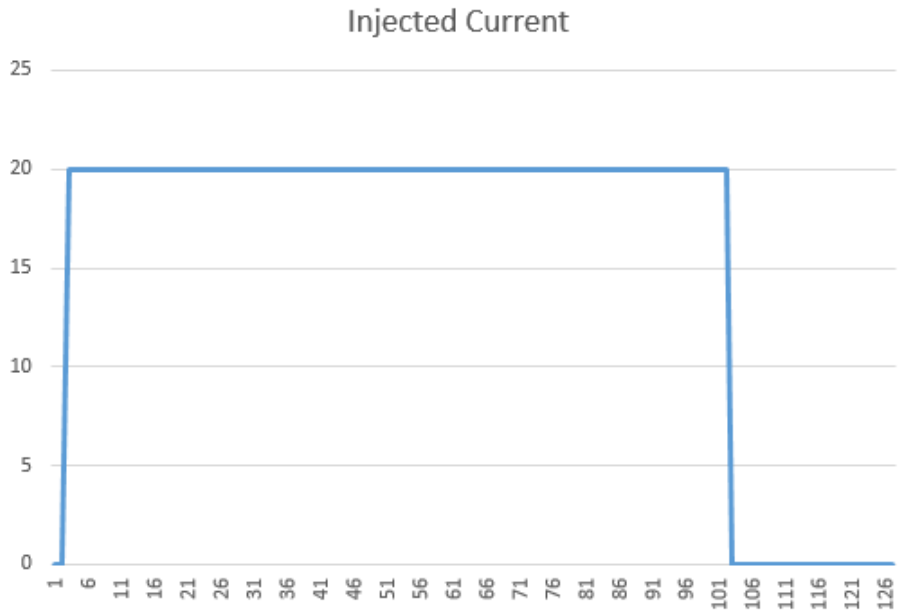

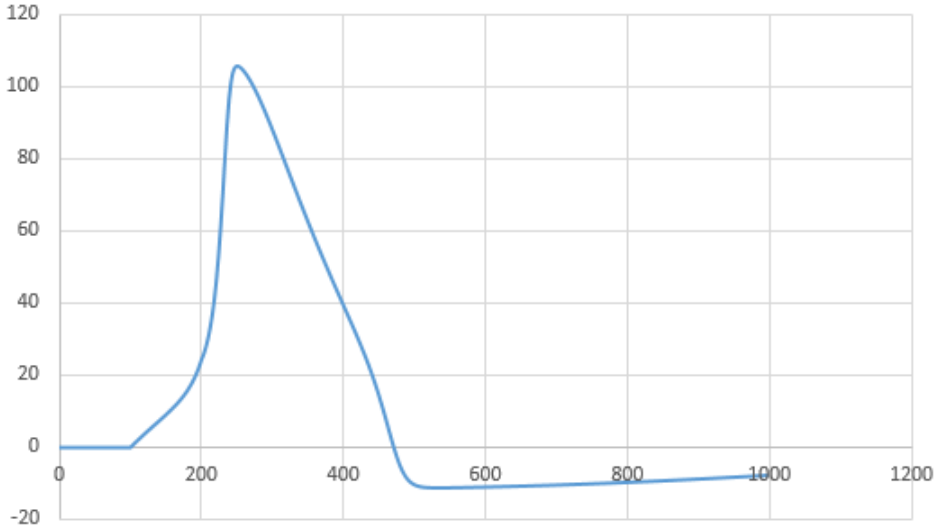

فهرست مطالب

فهرست مطالب


به کسانی که به شما حسودی می کنند احترام بگذارید،
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