

Problem 1

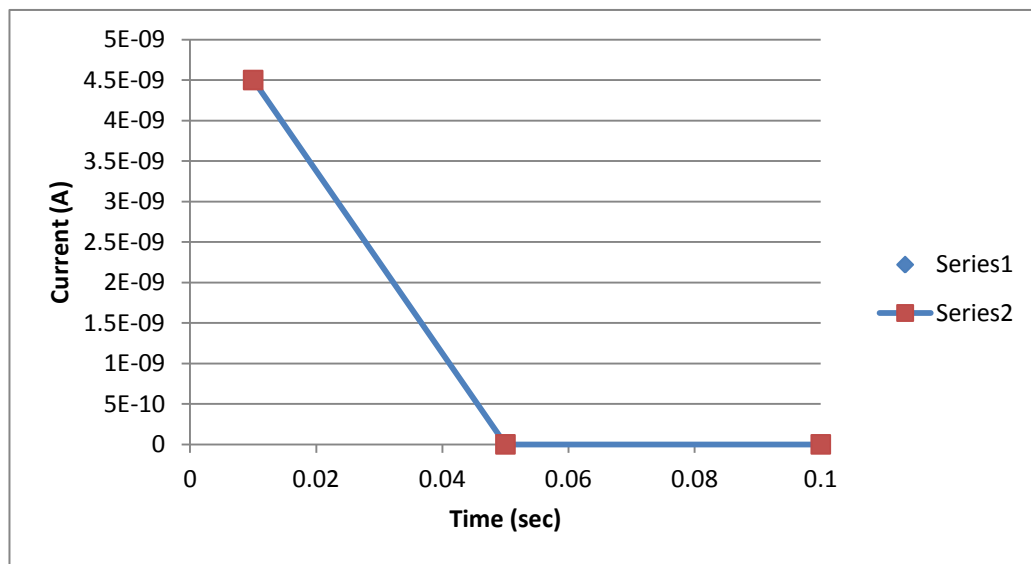
Charging up the electric double layer at an electrode - a capacitor

$$i_{ch} = \frac{E_{appl}}{R_s} \exp\left(\frac{-t}{R_s C_{dl}}\right)$$

$E_{appl} = 1 \text{ V}$
 $R_s = 25 \text{ ohm (V/A)}$
 $A = 1 \text{ cm}^2$
 $C_{dl} = 25 \times 10^{-6} \text{ F/cm}^2 \times 1 \text{ cm}^2$

Time (sec)	Current (A)
	1.35 E-05
0.01	4.50E-09
0.05	7.22E-37
0.1	0
1	0
2	0
3	0
4	0
5	0

Full charged up interface in less than 50 msec!!
The 0.005 s time point is left off plot



Examining the diffusion controlled current decay after a potential step.

$$i_f = \frac{nFAD^{1/2}C}{\pi^{1/2}t^{1/2}}$$

n = 1
 A = 1 cm²
 D = 7 x 10⁻⁶ cm²/s
 C = 1 mM = 1.0 x 10⁻⁶ mol/cm³

Time (s)	Current (A)	it ^{1/2}
0.005	2.03E-03	1.43E-04
0.01	1.44E-03	1.44E-04
0.05	6.44E-04	1.44E-04
0.1	4.55E-04	1.44E-04
1	1.44E-04	1.44E-04
2	1.01E-04	1.43E-04
3	8.31E-05	1.44E-04
4	7.02E-05	1.41E-04
5	6.44E-05	1.44E-04

Notice that current is flowing well after 0.1 s when the double layer has fully charged. Current at short times is a combination of charging and faradaic current.

