Quiz 1.2: Passive membrane response

Possible membrane responses

0 points possible (ungraded)
Note that in the following check box questions, there might be more than one correct answer. You must select all the options that apply.

1. Which ones are possible solutions of the following differential equation for $t > 0$?

$$\tau \frac{d}{dt} u = -(u - u_{rest}) + RI(t)$$

where $I(t) = 0$ for $t < 0$, and $u_{rest} < 0, \tau = RC$. Note that even though for $t < 0, I(t) = 0$, the voltage may be clamped artificially for $t < 0$.

- [x] $u(t) = u_{rest} + \frac{R}{\tau} \int_0^\infty e^{-s/\tau} I(t-s)\, ds$
- [x] $u(t) = [9.5 - u_{rest}]\, e^{-t/\tau} + \frac{1}{C} \int_0^t e^{-s/\tau} I(t-s)\, ds + u_{rest}$
- [x] $u(t) = u_{rest} + \frac{R}{\tau} \int_0^t e^{-(t-r)/\tau} I(r)\, dr$

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Answers are displayed within the problem

Input current

0 points possible (ungraded)
2. Which of the followings can be correct if $u(t) = [50 - 12e^{-t/17ms}]\, mV$ is a solution of the differential equation above?

- [ ] A step current is switched on at time t=17 ms
- [x] A step current is switched on at time t=0 ms
- [ ] The resting potential is 12 mV
- [x] The resting potential is 38 mV
- [ ] The step current leads to a voltage step of 50 mV
- [x] The step current leads to a voltage step of 12 mV
- [x] A dirac-delta pulse current occurs at time t=0 ms
- [x] The resting potential is 50 mV

"The given equation can result from 2 different cases. 1. when resting potential is 38mV and a step current is applied which leads to 50mV final potential. 2. when resting potential is 50mV and a negative Dirac Delta pulse is applied. so at t=0, it reduces the potential which eventually and exponentially reaches back to 50mV. In both the cases, the equation will be the same assuming that the equation is given for t>=0 only. the two cases can be differentiated by the knowledge of the potential for t<0. if the potential was 38mV for t<0, then it is case 1 and if the potential was 50mV then it would be case 2". This answer makes sense to me. Also share your thoughts on

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