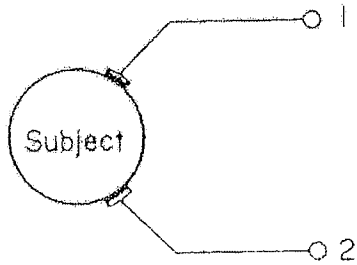


From Geddes and Baker,
Principles of Applied
Biomedical Instrumentation,
3rd edition

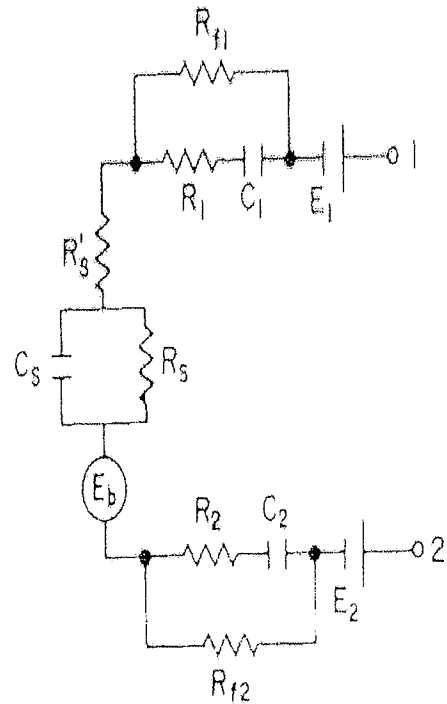
1. An equivalent circuit consisting of a resistor (R) and capacitance (C) provides a reasonably accurate means of representing the cell membrane for modeling stimulation of excitable tissue. In the equivalent circuit shown, we can assume that stimulation occurs when the capacitor voltage reaches a critical value V_{crit} .

(a) (40 points) Assume a rectangular current stimulus of amplitude I and width d . **Derive** an expression for the strength-duration relationship between the current I and duration d required to achieve the onset of stimulation.

(b) (10 points) Sketch a plot of I vs. d and label key values on the plot.



From Geddes and Baker,
Principles of Applied
Biomedical Instrumentation,
3rd edition



2. Shown above is the equivalent circuit for two electrodes in contact with a subject, with C_s , R_s , and R'_s being associated with the subject and E_b represents a bioelectric signal.

- (a) (10 points) Describe the physical origin of E_1 and E_2 .
- (b) (20 points) Sketch the magnitude of the impedance between electrode 1 and 2 vs. frequency (up to 1 MHz) and label key values on your plot.
- (c) (20 points) Assume electrode 1 on the left arm and electrode 2 on the right arm. Very approximately, calculate an estimate for the resistance R_s . (Your reasoning is more important than the actual answer.)