These are some of the equations introduced at the beginning of the course that it is necessary to know. Please note that it is nowhere near *sufficient* to know just these formulae. They are only meant to set a common level for those of mathematics and physics backgrounds.
Do not try to take this sheet into the exam.

BASIC ELECTROPHYSIOLOGY

- BASIC ELECTRICAL EQUATIONS

$$Q = CV \quad \text{Q is charge [Coulombs], C is Capacitance [Farads], V is Voltage [Volts]} \tag{1}$$

$$\frac{dQ}{dt} = I \quad \text{I is current [Amps], t is time [seconds]} \tag{2}$$

$$V = IR \quad \text{Ohms law: R is resistance [Ohms].} \tag{3}$$

$$0 = \sum_i I_k \quad \text{charge is conserved so the sum of currents at a junction vanishes} \tag{4}$$

Note that some of these relations are in scalar form. In equation (1) there is an equal, but opposite amount of charge on both sides of the capacitor. Also in equation (3) positive ions will flow down the potential gradient. So if $V(x_2) > V(x_1)$ and $x_2 > x_1$ then the flow of current is to the left.

- ELECTROPHYSIOLOGY

$$V_m = V = V_{in} - V_{out} \quad \text{voltage of neuron measured relative to the outside} \tag{5}$$

$$C\frac{dV}{dt} = g_L(E_L - V) + I_{syn} + I_{inj} \quad \text{voltage equation for a passive neuron} \tag{6}$$

CABLE THEORY

- BASIC THEORY

$$R_A = r_a L/A \quad \text{total axial resistance for length } L \text{ and cross-sectional area } A \tag{7}$$

$$\tau_L \frac{\partial V}{\partial t} = E_L - V + \lambda^2 \frac{\partial V^2}{\partial x^2} \quad \text{cable equation} \tag{8}$$

$$I_A = -\frac{\lambda}{R_\lambda}\frac{\partial V}{\partial x} \quad \text{axial current in terms of electrotonic length } \lambda \text{ and resistance } R_\lambda \tag{9}$$