Unit 1 Exercise Questions

(1) Which mechanism is responsible for creating the gradient of Na^+ ions, and K^+ ions over membranes? What are the resulting approximate intracellular and extracellular concentrations of the two ions?

	$[X^+]_{intra}$	$[X^+]_{extra}$
Na^+		
K^+		

(2) Calculate the equilibrium potentials for K^+ ions (E_K), for Na^+ ions (E_{Na}) and for Cl^- (E_{Cl}) using the ion concentrations given in lecture.

Assume a temperature of 36 °C =36 +273 K = 309 K

J = C*V (Energy = electrical charge*voltage)

Ions	Intracellular Concentration (mM)	Extracellular Concentration (mM)
K^+	140	~3
Na^+	~10	145
Cl^-	~5	125
Ca^{2+}	10^{-7} M	1.6

Nernst equation

$$E_K = \frac{RT}{zF} \ln \frac{[K^+]_o}{[K^+]_i}$$

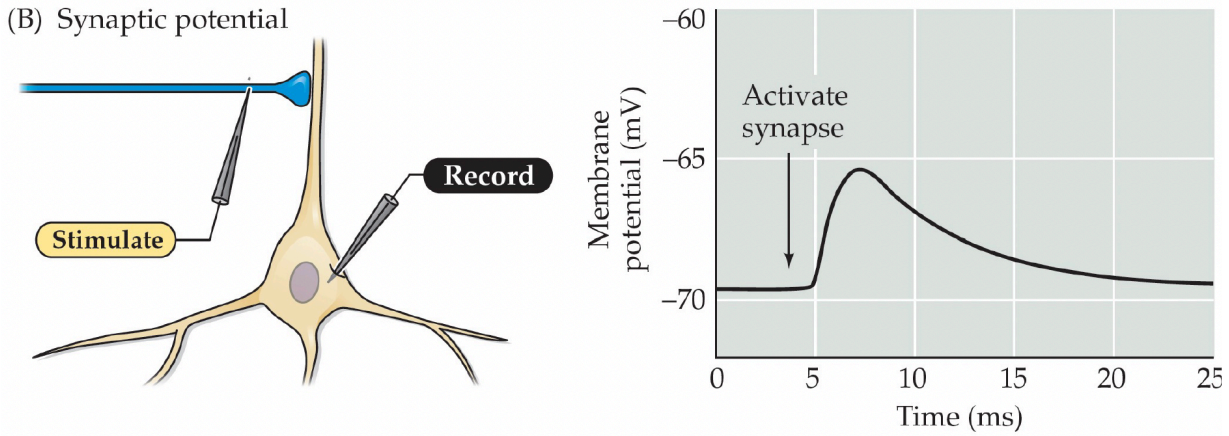
Gas constant: R = 8.314 J K^{-1} mol^{-1}

Faraday's constant F = 9.648 * 10^4 C mol^{-1}

Elementary charge e = 1.602 * 10^{-19} C

(3) What is the "resting membrane potential" of a neuron? What is its typical value? Which ion is responsible for creating resting membrane potential? Which ion channel is responsible for creating the resting membrane potential?

Neurons have a negative "resting" membrane potential



- a microelectrode is inserted into a neuron
- note the *negative* resting membrane potential, ~ -70 mV before stimulation
- resting Vm, usually -60 to - 80 mV
- stimulation of an excitatory synapse causes a small EPSP, graded V_m change

V_m = membrane potential unit: [V], usually [mV]

(4) Explain the electrical equivalent circuit of a simple neuron. Which structures of the cell membrane are equivalent to Cm and Rm ?