

Membrane Function

5. (12 pts) It's not widely known but Alice during her adventures through the Looking Glass kept a scientific journal. One of the creatures she encountered, which unfortunately neither sang nor danced, was a giant squid. Astutely, Alice noted the squid, consistent with their position at the apex of the aquatic food chain in the Looking Glass World (LGW), were rapidly moving, voracious predators. Not surprisingly, therefore, she also noted their complex muscular and nervous systems, and found their cells (and extracellular fluids) exhibited the ionic concentrations (in mM) listed in the Table below; also listed in the Table are log values for the ratios of these ions. The monovalent ions trans Looking Glass, however, differ from those on this side, and the common ones in squid are represented in the Table below as "M⁺", "N⁺", and "O⁻".

<u>Ion:</u>	<u>M⁺</u>	<u>N⁺</u>	<u>O⁻</u>	<u>Logs of Concentration Ratios</u>
Inside cells	180	6	34	$[M^+]_{in}/[M^+]_{out} = - 0.93$ $[M^+]_{out}/ [M^+]_{in} = 0.93$
Outside cells	21	244	300	$[N^+]_{in}/ [N^+]_{out} = 1.60$ $[N^+]_{out}/ [N^+]_{in} = - 1.60$ $[O^-]_{in}/ [O^-]_{out} = - 0.95$ $[O^-]_{out}/ [O^-]_{in} = 0.95$

Patch-clamping measurements by LGW scientists indicate the resting membrane potentials of nerve and muscle cells in these extraterrestrial creatures is +88 mV, with cytoplasm positive relative to the external environment. LGW has a uniform aquatic temperature of 298 °K (a sultry 25 °C). Consider these data and answer **all** the following questions, **showing all relevant calculations**.

a. (4 pts) Which ion is closest to equilibrium in these creatures?

B. (4 pts) To which ion is the LGW squid cell membrane most permeable? Why?

C. (4 pts) How is the resting potential likely generated in these cells? Briefly explain the basis for your answer.