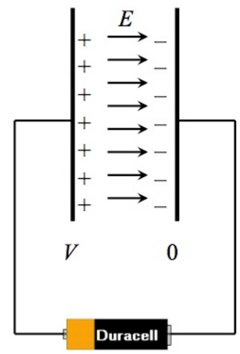
Name ______________________________

Physics 132 | **Prof. Redish**
Spring 2017 | **13.March.17**

Quiz #6
(10 points)

1. (4 points) Consider a capacitor that is made of two parallel conducting places separated by a distance small compared to the dimensions of the plates. The plates are connect to a battery as shown and charged to a voltage V. The distance between the plates is then increased by about 50%. During this, the battery remains connected to the plates. Assuming you can still treat the plates as large, what happens to the following quantities as a result of the change in the distance? Answer with I (increases), D (decreases), or S (remains the same).



1.1 Magnitude of the potential difference between the plates

1.2 Magnitude of the electric field between the plates.

1.3 The magnitude of charge on each plate.

1.4 The capacitance of the capacitor.

1.1 _____
1.2 _____
1.3 _____
1.4 _____

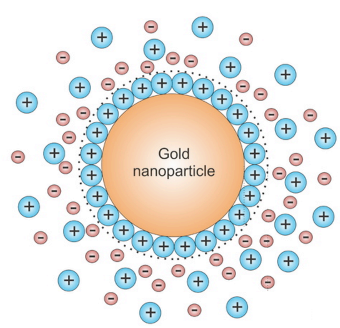
2. (3 points) When a membrane allows one kind of ion to pass through and not another, a concentration difference can lead to an electric potential difference developing across the membrane. For example, if the concentration of NaCl on one side of a membrane is c_1 = 10 mM and c_2 =2 mM on the other, letting only Na^+ ions through (and not Cl^-) will build up a potential difference across the membrane. This is controlled by the equation that says that the electric potential energy, $q\Delta V$, balances the concentration difference effects via the Boltzmann factor thus:

$$c_1 / c_2 = e^{-q\Delta V / k_B T}$$

For a given set of concentrations (c_1 and c_2 fixed) would you expect increasing the temperature to increase (I), decrease (D), or leave the Nernst potential, ΔV, unaffected (U)?

3. (3 points) A positively charged gold nanoparticle with charge Q is placed in an ionic fluid at room temperature. The average electric potential outside the nanoparticle is given by

$$V(r) = \frac{1}{\kappa}\left(\frac{k_C Q}{r}\right) e^{-r/\lambda_D}$$



where λ_D is the Debye length and r is the distance from the center of the particle. If you are at a distance r from the center and the temperature increases, would you expect the potential you measure to increase (I), decrease (D), or remain unaffected (U)?