3. If the electric potential is zero at infinity then at the surface of a uniformly charged sphere it is $V = q/4\pi\varepsilon_0 R$, where q is the charge on the sphere and R is the sphere radius. Thus $q = 4\pi\varepsilon_0 RV$ and the number of electrons is

$$n = \frac{|q|}{e} = \frac{4\pi\varepsilon_0 R|V|}{e} = \frac{\left(1.0\times10^{-6}\ \text{m}\right)\left(400\ \text{V}\right)}{\left(8.99\times10^{9}\ \text{N}\cdot\text{m}^2/\text{C}^2\right)\left(1.60\times10^{-19}\ \text{C}\right)} = 2.8\times10^{5}\ .$$

6. (a) $V_B - V_A = \Delta U/q = -W/(-e) = -(3.94\times10^{-19}\ \text{J})/(-1.60\times10^{-19}\ \text{C}) = 2.46\ \text{V}$.

(b) $V_C - V_A = V_B - V_A = 2.46$ V.

(c) $V_C - V_B = 0$ (since C and B are on the same equipotential line).

7. We connect A to the origin with a line along the y axis, along which there is no change of potential (Eq. 24-18: $\int \vec{E}\cdot d\vec{s} = 0$). Then, we connect the origin to B with a line along the x axis, along which the change in potential is

$$\Delta V = -\int_0^{x=4} \vec{E}\cdot d\vec{s} = -4.00\int_0^4 x\,dx = -4.00\left(\frac{4^2}{2}\right)$$

which yields $V_B - V_A = -32.0$ V.

9. (a) The work done by the electric field is

$$W = \int_i^f q_0\vec{E}\cdot d\vec{s} = \frac{q_0\sigma}{2\varepsilon_0}\int_0^d dz = \frac{q_0\sigma d}{2\varepsilon_0} = \frac{(1.60\times10^{-19}\,\text{C})(5.80\times10^{-12}\ \text{C/m}^2)(0.0356\ \text{m})}{2(8.85\times10^{-12}\ \text{C}^2/\text{N}\cdot\text{m}^2)}$$
$$= 1.87\times10^{-21}\,\text{J}.$$

(b) Since $V - V_0 = -W/q_0 = -\sigma z/2\varepsilon_0$, with V_0 set to be zero on the sheet, the electric potential at P is

$$V = -\frac{\sigma z}{2\varepsilon_0} = -\frac{(5.80\times10^{-12}\ \text{C/m}^2)(0.0356\ \text{m})}{2(8.85\times10^{-12}\ \text{C}^2/\text{N}\cdot\text{m}^2)} = -1.17\times10^{-2}\ \text{V}.$$