Homework set #1 Due 2-5-2021, 8 am

1. Prove the mean value theorem

$$\frac{1}{4\pi}\int d\Omega\, \phi(r,\Omega) = \phi(0)$$

Hint: use expansion in spherical harmonics.

2. Consider a conducting sphere of radius R in a uniform applied electric field
   a) What is the potential of the applied electric field
   b) Find the potential of the induced charge distribution on the sphere
   c) Use this to find the charge distribution on the sphere

3. Consider a spherical shell with radius b and charge distribution $\sigma = \sigma_0(\cos\theta + \frac{1}{2}\sin\theta\cos\phi)$
   Find the electric potential for $r > b$ and $r < b$

4. In d dimensions the electric field is given by $E = q\, r^{1-d}\,\hat{r}$
   a) Formulate Gauss law for $d=1$ and $d=2$
   b) Find the potential for $d=1$ and $d=2$
   c) Given an interpretation of the electric field in 1d.