1. Consider a spherical surface with radius R. (Not a conductor or insulator but an imaginary spherical shell.) A charge q is located a distance z from the center of the spherical surface, $z > R$. The average potential over the surface of the sphere is
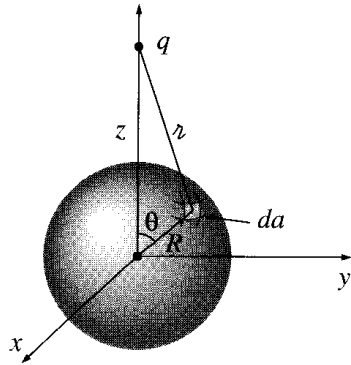
A)

$$V_{ave} = \frac{1}{4\pi\epsilon_0}\frac{q}{z}$$

B) zero

C)

$$V_{ave} = \frac{1}{4\pi\epsilon_0}\frac{q}{R}$$

D)

$$V_{ave} = -\frac{1}{4\pi\epsilon_0}\frac{q}{z}$$

2. At some point $\mathbf{r}$ in empty space the potential is $V(\mathbf{r})$. A spherical shell, radius R, is centered at $\mathbf{r}$. The average value of V over the surface of the sphere is

$$V_{avg-sur} = \frac{1}{4\pi R^2} \oint_{sphere} V(\mathbf{r'})da'$$

It is always true, never true, or sometimes true that: $V_{avg-sur} = V(\mathbf{r})$.

A) Always true

B) Never true

C) Sometimes

3. At some point $\mathbf{r}$ in empty space the potential is $V(\mathbf{r})$. A spherical shell, radius R, is centered at $\mathbf{r}$. The average value of V over the volume of the sphere is

$$V_{avg-vol} = \frac{3}{4\pi R^3} \oint_{sphere} V(\mathbf{r}')d\tau'$$

It is always true, never true, or sometimes true that: $V_{avg-vol} = V(\mathbf{r})$.

A) Always true

B) Never true

C) Sometimes

4. The solution to Laplace's equation $(\nabla^2 V = 0)$, in some volume $\mathcal{V}$, is uniquely determined if V is specified on the boundary surface $\mathcal{S}$.

   A) Sometimes

   B) Always

   C) Never