Ques1.

A thick spherical shell, of inner and outer radii as $a$ and $b$ respectively, has the charge density $\rho = k/r^2$ in the region $a \leq r \leq b$. The potential at the center using infinity as the reference point is:

- $\frac{k}{\epsilon_0}\ln(b/a)$
- $\frac{k}{3\epsilon_0}\ln(4b/\sqrt{b^2+a^2})$
- $\frac{k}{\epsilon_0}\ln(4b/\sqrt{b^2+a^2})$
- $\frac{k}{\epsilon_0}\ln(b/\sqrt{b^2+a^2})$
- $\frac{k}{\epsilon_0}\ln(b/2a)$
- $\frac{k}{3\epsilon_0}$
- $\frac{k}{\epsilon_0}\ln(4b^2/a^2)$

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Ques2.

The value of the charge density $\rho(r,\theta,\phi)$ corresponding to an electric field $\vec{E}(\vec{r}) = \frac{1}{r}\hat{r} - \frac{2\sin\theta\cos\phi}{r}\hat{\phi}$ at a point $r = 1$, $\theta = \pi/4$, and $\phi = \pi/2$ is $n\epsilon_0$. The value of n is [3]. Provide the answer in integer form.

Divergence in Spherical polar coordinate system is given as

$$\nabla \cdot \mathbf{v} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 v_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(\sin\theta\, v_\theta) + \frac{1}{r\sin\theta}\frac{\partial v_\phi}{\partial\phi}$$

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Ques3.

A point charge $q$ is kept at the midpoint of the axis of a cylinder of radius $R$ and height $L$. The value of the electric flux through the cylindrical curved surface is given by

- $\frac{q}{\epsilon_0}\left[\frac{L}{\sqrt{L^2+4R^2}}\right]$
- $\frac{3q}{5\epsilon_0}\left[\frac{L}{\sqrt{L^2+R^2}}\right]$
- $\frac{q}{\epsilon_0}\left[\frac{L}{\sqrt{L^2+R^2}}\right]$
- $\frac{q}{2\epsilon_0}\left[\frac{L}{\sqrt{L^2+4R^2}}\right]$
- $\frac{2q}{\epsilon_0}\left[\frac{L}{\sqrt{L^2+R^2}}\right]$
- $\frac{q}{2\epsilon_0}\left[\frac{L}{\sqrt{L^2+R^2}}\right]$
- $\frac{2q}{\epsilon_0}\left[\frac{L}{\sqrt{L^2+4R^2}}\right]$

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Ques4.

The energy stored in a system of four identical point charges, $Q = 4\ \mathrm{nC}$, placed at the corners of a square of $1\ \mathrm{m}$ side is [780] $\mathrm{nJ}$. Round off the answer to the nearest integer.