A thin spherical insulating shell of radius R carries a uniformly distributed charge such that the potential at its surface is V_0. A hole with small area $\alpha 4\pi R^2 (\alpha << 1)$ is made on the shell without affecting the rest of the shell. Which one of the following statement is correct?

A. The ratio of the potential at the centre of the shell to that of the point at $\frac{1}{2}R$ from center towards the hole will be $\frac{1-\alpha}{1-2\alpha}$

B. The potential at the centre of shell is reduced by $2\alpha v_0$

C. The magnitude of electric field at the centre of the shell is reduced by $\frac{\alpha v_0}{2R}$

D. The magnitude of electric field at a point, located on a line passing through the hole and shell's center, on a distance 2R from the center of the spherical shell will be reduced by $\frac{\alpha v_0}{2R}$

Correct option is A)

Given V at surface

$$V_0 = \frac{KQ}{R}$$

V at C

$$V_C = \frac{KQ}{R} - \frac{K\alpha Q}{R} = V_0(1-\alpha)$$

V at B

$$V_B = \frac{KQ}{R} - \frac{K(\alpha Q)}{R/2} = V_0(1-2\alpha)$$

$$\therefore \frac{V_C}{V_B} = \frac{1-\alpha}{1-2\alpha}$$

E at A

$$E_A = \frac{KQ}{(2R)^2} - \frac{K\alpha Q}{R^2} = \frac{KQ}{4R^2} - \frac{\alpha V_0}{R}$$

So reduced by $\frac{\alpha V_0}{R}$

E at C

$$E_C = \frac{K(\alpha Q)}{R^2} = \frac{\alpha V_0}{R}$$

So increased by $\frac{\alpha V_0}{R}$.