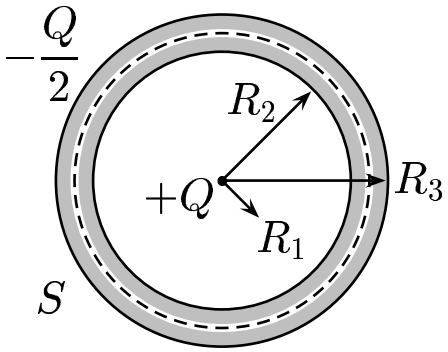
Consider an electrostatic situation. A point charge $Q$ is located at the center of a thick spherical conducting shell. The net charge on the shell is $-\frac{1}{2}Q$. Let $S$ (dashed circular line) be a concentric spherical surface (Gaussian surface) with a radius $r$.




What is the charge on the outer surface of the thick spherical conducting shell?

A) $Q_{outer\ surface} = -\frac{1}{2}Q$ B) $Q_{outer\ surface} = +\frac{1}{2}Q$

C) $Q_{outer\ surface} = -Q$ D) $Q_{outer\ surface} = +Q$

E) $Q_{outer\ surface} = -\frac{3}{2}Q$

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For an electrostatic case, there must not be charge(s) inside of a conductor (otherwise $E_{inside} \neq 0$). So the charges can only reside on the inner surface and outer surface of the conducting shell. Since $\Phi_S = 0$, the enclosed charge $Q_{inner\ surface} + Q = 0$, thus $Q_{inner\ surface} = -Q$.

Since $Q^{net}_{shell} = Q_{inner\ surface} + Q_{outer\ surface}$, we have

$$\begin{aligned} Q_{outer\ surface} &= Q^{net}_{shell} - Q_{inner\ surface} \\ &= -\frac{1}{2}Q + Q \\ &= \frac{1}{2}Q\,. \end{aligned}$$

Answer **B**.