

51. (a) We imagine a Gaussian surface A which is just outside the inner surface of the spherical shell. Then \vec{E} is zero everywhere on surface A . Thus

$$\oint_A \vec{E} \cdot d\vec{A} = \frac{(Q' + Q)}{\epsilon_0} = 0 ,$$

where Q' is the charge on the inner surface of the shell. This gives $Q' = -Q$.

- (b) Since \vec{E} remains zero on surface A the result is unchanged.

- (c) Now,

$$\oint_A \vec{E} \cdot d\vec{A} = \frac{(Q' + q + Q)}{\epsilon_0} = 0 ,$$

so $Q' = -(Q + q)$.

- (d) Yes, since \vec{E} remains zero on surface A regardless of where you place the sphere inside the shell.