Fluid flow through a tube with a static magnetic field. A liquid of conductivity σ flows with a constant velocity $\mathbf{v} = v\mathbf{a}_x$ through a tube of width d, in which a uniform time-invariant magnetic field of flux density $\mathbf{B} = B\mathbf{a}_y$ is applied, as depicted in Fig. Q6.10. The induced electric field intensity vector, $\mathbf{E}_{\text{ind}}$, and the field intensity vector due to excess charge, $\mathbf{E}_q$, in the liquid are given by

(A) $\mathbf{E}_{\text{ind}} = vBd\mathbf{a}_z$ and $\mathbf{E}_q = 0$.
(B) $\mathbf{E}_{\text{ind}} = E_q = vBd\mathbf{a}_z$.
(C) $\mathbf{E}_{\text{ind}} = \mathbf{E}_q = vB\mathbf{a}_z$.
(D) $\mathbf{E}_{\text{ind}} = vB\mathbf{a}_z$ and $\mathbf{E}_q = 0$.
(E) $\mathbf{E}_{\text{ind}} = vB\mathbf{a}_z$ and $\mathbf{E}_q = -vB\mathbf{a}_z$.
(F) $\mathbf{E}_{\text{ind}} = \mathbf{E}_q = 0$.

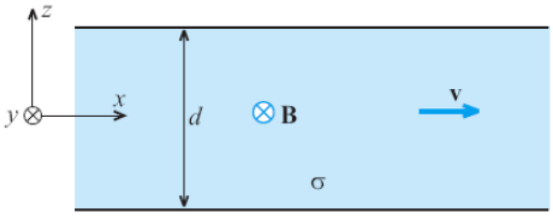

Figure Q6.10 Conducting fluid flow through a tube with a time-constant magnetic field; for Question 6.22.

Solution: (E)
Answer: (E)