Problem 2.57)

a) 1) $\boldsymbol{\nabla} \cdot \boldsymbol{D} = \rho_{\text{free}}$,

2) $\boldsymbol{\nabla} \times \boldsymbol{H} = \boldsymbol{J}_{\text{free}} + \frac{\partial \boldsymbol{D}}{\partial t}$, $\frac{\partial \boldsymbol{D}}{\partial t} \to 0$

3) $\boldsymbol{\nabla} \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$, $\frac{\partial \boldsymbol{B}}{\partial t} \to 0$

4) $\boldsymbol{\nabla} \cdot \boldsymbol{B} = 0$

b) The first and third equations thus form the set of equations for electrostatics, namely,

$$\varepsilon_{\text{o}} \boldsymbol{\nabla} \cdot \boldsymbol{E}(\boldsymbol{r}) = \rho_{\text{free}}(\boldsymbol{r}) - \boldsymbol{\nabla} \cdot \boldsymbol{P}(\boldsymbol{r}),$$

$$\boldsymbol{\nabla} \times \boldsymbol{E}(\boldsymbol{r}) = 0.$$

Similarly, the second and fourth equations form the set of equations for magnetostatics, that is,

$$\boldsymbol{\nabla} \times \boldsymbol{H}(\boldsymbol{r}) = \boldsymbol{J}_{\text{free}}(\boldsymbol{r}),$$

$$\mu_{\text{o}} \boldsymbol{\nabla} \cdot \boldsymbol{H}(\boldsymbol{r}) = -\boldsymbol{\nabla} \cdot \boldsymbol{M}(\boldsymbol{r}).$$

c) The sources of the electrostatic field $\boldsymbol{E}(\boldsymbol{r})$ are the free and bound electric charge densities $\rho_{\text{free}}(\boldsymbol{r})$ and $-\boldsymbol{\nabla} \cdot \boldsymbol{P}(\boldsymbol{r})$, respectively.

d) The sources of the magnetostatic field $\boldsymbol{H}$ are the free electric current-density $\boldsymbol{J}_{\text{free}}$ and the bound magnetic charge density $-\boldsymbol{\nabla} \cdot \boldsymbol{M}$.