Problem 2.58) They are all correct. Alice writes Maxwell's equations as follows:

$$\varepsilon_o \boldsymbol{\nabla} \cdot \boldsymbol{E} = \rho_{\text{free}} - \boldsymbol{\nabla} \cdot \boldsymbol{P}$$

$$\boldsymbol{\nabla} \times \boldsymbol{B} = \mu_o \left(\boldsymbol{J}_{\text{free}} + \partial \boldsymbol{P}/\partial t + \mu_o^{-1} \boldsymbol{\nabla} \times \boldsymbol{M}\right) + \mu_o \varepsilon_o \, \partial \boldsymbol{E}/\partial t$$

$$\boldsymbol{\nabla} \times \boldsymbol{E} = - \, \partial \boldsymbol{B}/\partial t$$

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

In her approach, polarization produces electric charges and currents, while magnetization produces electric currents only. Alice then bundles all charge densities together, and all current densities together, and proceeds to use her equations to compute the resulting $\boldsymbol{E}$ and $\boldsymbol{B}$ fields.

In contrast, Brian writes Maxwell's equations as follows:

$$\boldsymbol{\nabla} \cdot \boldsymbol{D} = \rho_{\text{free}}$$

$$\boldsymbol{\nabla} \times \boldsymbol{H} = \boldsymbol{J}_{\text{free}} + \partial \boldsymbol{D}/\partial t$$

$$\boldsymbol{\nabla} \times \boldsymbol{D} = -\varepsilon_o \left(\partial \boldsymbol{M}/\partial t - \varepsilon_o^{-1} \boldsymbol{\nabla} \times \boldsymbol{P}\right) - \mu_o \varepsilon_o \partial \boldsymbol{H}/\partial t$$

$$\mu_o \boldsymbol{\nabla} \cdot \boldsymbol{H} = -\boldsymbol{\nabla} \cdot \boldsymbol{M}$$

In this approach, magnetization produces magnetic charges and currents, while polarization produces magnetic currents only. Brian then bundles the two magnetic current-densities together, while treating electric and magnetic charge-densities separately. He proceeds to use his equations to compute the resulting $\boldsymbol{D}$ and $\boldsymbol{H}$ fields.

Carol writes Maxwell's equations as follows:

$$\varepsilon_o \boldsymbol{\nabla} \cdot \boldsymbol{E} = \rho_{\text{free}} - \boldsymbol{\nabla} \cdot \boldsymbol{P}$$

$$\boldsymbol{\nabla} \times \boldsymbol{H} = \left(\boldsymbol{J}_{\text{free}} + \partial \boldsymbol{P}/\partial t\right) + \varepsilon_o \, \partial \boldsymbol{E}/\partial t$$

$$\boldsymbol{\nabla} \times \boldsymbol{E} = - \, \partial \boldsymbol{M}/\partial t - \mu_o \partial \boldsymbol{H}/\partial t$$

$$\mu_o \boldsymbol{\nabla} \cdot \boldsymbol{H} = -\boldsymbol{\nabla} \cdot \boldsymbol{M}$$

In her approach, polarization produces electric charges and currents, while magnetization produces magnetic charges and currents. Carol treats the two types of charge-density separately, and also the two types of current-density separately. She then proceeds to use her version of Maxwell's equations to compute the resulting $\boldsymbol{E}$ and $\boldsymbol{H}$ fields.

David writes Maxwell's equations as follows:

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

$$\boldsymbol{\nabla} \times \boldsymbol{B} = \mu_o \left(\boldsymbol{J}_{\text{free}} + \mu_o^{-1} \boldsymbol{\nabla} \times \boldsymbol{M}\right) + \mu_o \, \partial \boldsymbol{D}/\partial t,$$

$$\boldsymbol{\nabla} \times \boldsymbol{D} = -\varepsilon_o \left(-\varepsilon_o^{-1} \boldsymbol{\nabla} \times \boldsymbol{P}\right) - \varepsilon_o \partial \boldsymbol{B}/\partial t,$$

$$\boldsymbol{\nabla} \cdot \boldsymbol{B} = 0.$$

In David's approach, polarization produces magnetic currents, while magnetization produces electric currents. David then treats the two types of current-density separately, and proceeds to use his version of Maxwell's equations to compute the resulting $\boldsymbol{D}$ and $\boldsymbol{B}$ fields.