Problem 18)

a) $\boldsymbol{M}(\boldsymbol{r},t) = m_o\,\delta(x)\,\delta(y)\,\delta(z)\,[\cos(\omega_o t)\hat{\boldsymbol{x}} + \sin(\omega_o t)\hat{\boldsymbol{y}}]$.

b) $$\boldsymbol{J}_b^{(e)}(\boldsymbol{r},t) = \mu_o^{-1}\boldsymbol{\nabla}\times\boldsymbol{M}(\boldsymbol{r},t) = \mu_o^{-1}[-(\partial M_y/\partial z)\hat{\boldsymbol{x}} + (\partial M_x/\partial z)\hat{\boldsymbol{y}} + (\partial M_y/\partial x - \partial M_x/\partial y)\hat{\boldsymbol{z}}]$$
$$= \mu_o^{-1} m_o\{\delta(x)\,\delta(y)\,\delta'(z)[-\sin(\omega_o t)\hat{\boldsymbol{x}} + \cos(\omega_o t)\hat{\boldsymbol{y}}]$$
$$+[\delta'(x)\,\delta(y)\sin(\omega_o t) - \delta(x)\,\delta'(y)\cos(\omega_o t)]\,\delta(z)\hat{\boldsymbol{z}}\}.$$

c) For the magnetic point-dipole $m_o\cos(\omega_o t)\hat{\boldsymbol{z}}$ aligned with the z-axis, the vector potential is given in a spherical coordinate system. In the present problem we have two oscillating dipoles, one aligned with the x-axis, having magnitude $m_o\cos(\omega_o t)$, the other aligned with the y-axis and having magnitude $m_o\sin(\omega_o t)$. Retaining the same spherical coordinate system in which θ is measured from the z-axis, we recognize that, for the first dipole, $(\sin\theta)\hat{\boldsymbol{\phi}} = \hat{\boldsymbol{z}}\times\hat{\boldsymbol{r}}$ in the expression of the vector potential of a z-oriented dipole must be replaced with $\hat{\boldsymbol{x}}\times\hat{\boldsymbol{r}}$, while for the second dipole it must be replaced with $\hat{\boldsymbol{y}}\times\hat{\boldsymbol{r}}$. Also, for the second dipole, the origin of time t must be shifted by one quarter of one period such that $\cos(\omega_o t)$ is turned into $\sin(\omega_o t)$, in which case $\sin(\omega_o t)$ appearing in the expression of the vector potential must undergo a corresponding shift to become $-\cos(\omega_o t)$. Adding the vector potentials of the two dipoles we find

$$\boldsymbol{A}(\boldsymbol{r},t) = (m_o/4\pi r^2)\{\cos[\omega_o(t-r/c)] - (\omega_o r/c)\sin[\omega_o(t-r/c)]\}(\hat{\boldsymbol{x}}\times\hat{\boldsymbol{r}})$$
$$+(m_o/4\pi r^2)\{\sin[\omega_o(t-r/c)] + (\omega_o r/c)\cos[\omega_o(t-r/c)]\}(\hat{\boldsymbol{y}}\times\hat{\boldsymbol{r}})$$
$$= (m_o\hat{\boldsymbol{r}}/4\pi r^2)\times\{[(\omega_o r/c)\hat{\boldsymbol{x}} - \hat{\boldsymbol{y}}]\sin[\omega_o(t-r/c)] - [\hat{\boldsymbol{x}} + (\omega_o r/c)\hat{\boldsymbol{y}}]\cos[\omega_o(t-r/c)]\}.$$