7.1a

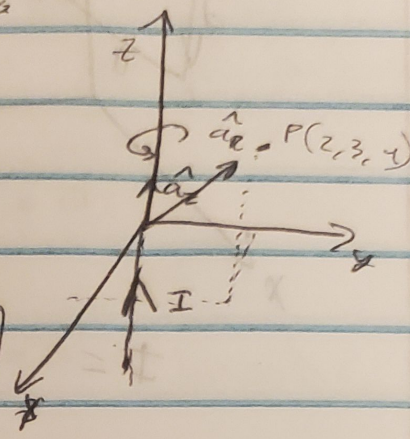
$$\vec{H} = \oint \frac{I\,d\vec{l} \times \hat{a}_R}{4\pi R^2} \qquad P \to 2\hat{a}_x + 3\hat{a}_y + 4\hat{a}_z$$

$$\vec{H} = \int_{-\infty}^{\infty} \frac{8\,mA\,\hat{a}_z \times (2\hat{a}_x + 3\hat{a}_y + (4-z)\hat{a}_z)\,0.008\,dz}{4\pi(z^2 - 8z + 29)^{3/2}}$$

$$= \frac{0.008}{4\pi} \int_{-\infty}^{\infty} \frac{2\hat{a}_y - 3\hat{a}_x}{(z^2 - 8z + 29)^{3/2}}\,dz$$

$$= \frac{0.008}{4\pi}\left(2\hat{a}_y - 3\hat{a}_x\right)$$

$$= \boxed{-294\,\hat{a}_x + 196\,\hat{a}_y\ \mu A/m}$$



7.15 $\sigma = 1.5e^{-150\rho}\ kS/m \qquad \vec{E} = 30\hat{a}_z\ V/m$

$$\nabla \times \vec{H} = \vec{J} = \sigma\vec{E} = \boxed{45e^{-150\rho}\hat{a}_z\ kA/m^2} \qquad 0 < \rho < \rho_0,\ z = 0,\ 0 < \phi < 2\pi$$

$$I = \int_0^{2\pi}\int_0^{\rho_0} 45e^{-150\rho}\,d\rho\,d\phi$$

$$= 90\pi \int_0^{\rho_0} e^{-150\rho}\,d\rho$$

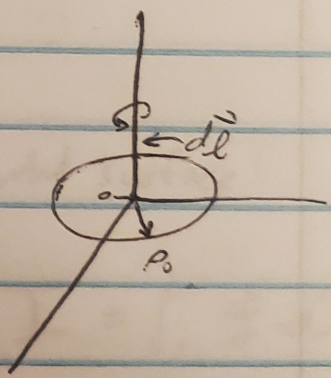
$$= \boxed{90\pi\left(\frac{1 - e^{-150\rho_0}}{150}\right) A}$$

$$\oint \vec{H} \cdot d\vec{l} = I$$

$$I = 2\pi\rho H_\phi \to \vec{H} = \frac{I}{2\pi\rho}\hat{a}_\phi$$

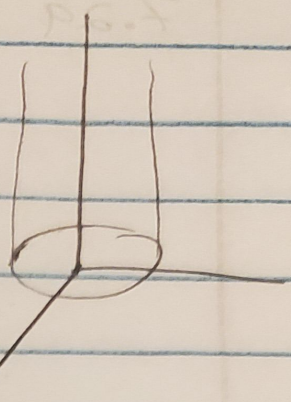
$$= \frac{90\pi\left(1 - e^{-150\rho}\right)}{150}$$

$$= \boxed{\frac{45\left(1 - e^{-150\rho}\right)}{150\rho}\hat{a}_\phi\ A/m}$$



7.20 $\rho = 0.005m$ $z = 20m$ $\phi = 2\pi$

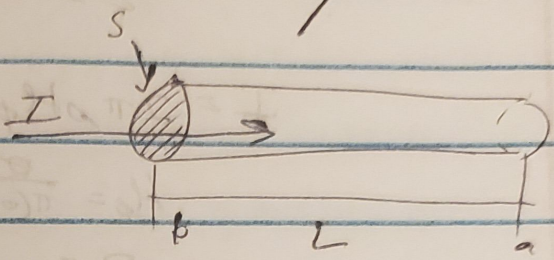
$V = 0.1V$ $\vec{H} = 100000\rho^2 \hat{a}_\phi$



$\sigma = \frac{IL}{\oint V} = \frac{\vec{J}}{\vec{E}}$ $\vec{J} = \nabla \times \vec{H}$

$\vec{E} = \frac{V}{d} = 0.005 \hat{a}_z$

~~$I = \oint \vec{H} \cdot d\vec{l}$~~



$\vec{J} = \nabla \times 100000\rho^2 \hat{a}_\phi$

$= 300000\rho \hat{a}_z$

$\sigma = \boxed{60\rho \ MS/m}$

$I = \int \vec{J} \cdot d\vec{S} = \int_0^{2\pi} \int_0^{0.005} 300000\rho \hat{a}_z \cdot \rho d\rho d\phi \hat{a}_z$

$= 600000\pi \int_0^{0.005} \rho^2 d\rho$

$= 78 mA$

$R = V/I = \boxed{1.3\Omega}$

7.23 $\vec{H} = 20\rho^2 \hat{a}_\phi \ A/m$ $\vec{J} = \nabla \times \vec{H} = \boxed{60\rho \hat{a}_z \ A/m^2}$

$I = \int \vec{J} \cdot d\vec{S} = \int_0^{2\pi} \int_0^1 60\rho \hat{a}_z \cdot \rho d\rho d\phi \hat{a}_z$

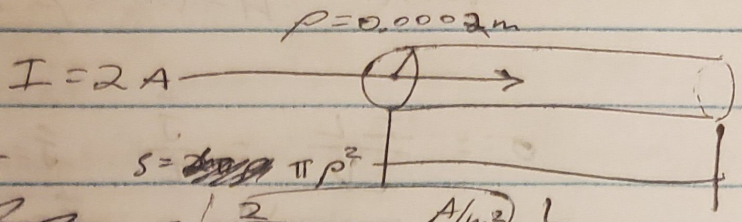
$= 120\pi \int_0^1 \rho^2 d\rho = \boxed{40\pi \ A}$

$\rho = 1$ $\phi = 2\pi$ $z = 0$

$I = \oint \vec{H} \cdot d\vec{l} = \int_0^{2\pi} 20\rho^2 \hat{a}_\phi \cdot \rho d\phi \hat{a}_\phi$

$= \boxed{40\pi}$

7.29



$J = I/S \qquad S = \pi\rho^2$

$= \frac{2}{\pi(0.0002)^2} = \frac{2}{\pi(0.0002)^2}\ A/m^2\ L$

$I = 2\pi\rho H_\phi = JS \rightarrow H_\phi = \frac{JS}{2\pi\rho}$

$H_\phi = \frac{2}{\pi(0.0002)^2} \cdot \frac{1}{2\pi 0.0002} = \frac{1}{\pi^2(0.0002)^3}\ A/m$

$B = \mu_0 H = \frac{\mu_0}{\pi^2(0.0002)^3}\ T$

$\nabla \times \vec{H} = \vec{J} = 15.7\ MA/m^2\ \hat{a}_z$

$\vec{H} = \frac{I}{2\pi\rho} a_\phi =$

$= \frac{1}{\pi\rho} a_\phi\ A/m \rightarrow 0$

$\nabla \times \vec{H} = \vec{J} = \frac{1}{\pi\rho} \hat{a}_z\ A/m \rightarrow 0$