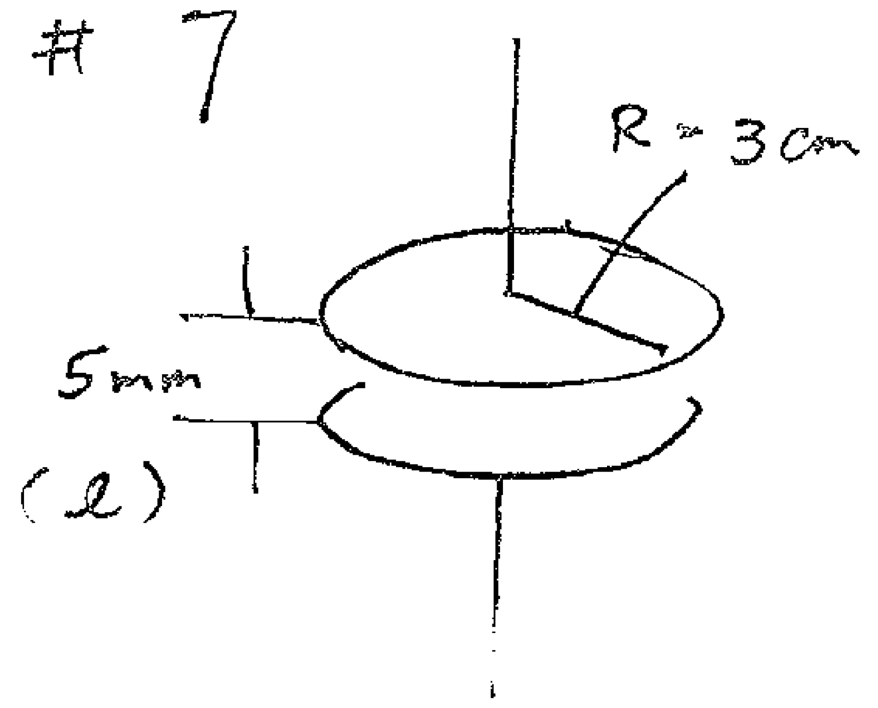
ch 32 # 7, 16, 17, 18, 21

7



$\mathcal{E}_m = 150\,V$

$\nu = 60\,Hz$

$V = 150 \sin(2\pi\nu t)$

Since $V = \int E \cdot ds = E \cdot l$ (E is const.)

$E = \frac{V}{\ }$

(a)

$$\oint B \cdot ds = \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

$$B \cdot 2\pi r = \mu_0 \varepsilon_0 \frac{d(E \cdot A)}{dt}$$

$$= \mu_0 \varepsilon_0 \pi r^2 \frac{d(E)}{dt} \qquad (A = \pi r^2 = \text{const})$$

$$= \mu_0 \varepsilon_0 \pi r^2 \frac{d(\frac{V}{l})}{dt}$$

$$= \frac{\mu_0 \varepsilon_0 \pi r^2}{l} \frac{dV}{dt}$$

$$\therefore B = \frac{\mu_0 \varepsilon_0 \pi r^2}{2\pi r l} \cdot \frac{dV}{dt}$$

$\varepsilon_0 = 8.85 \times 10^{-12}$

$\mu_0 = 4\pi \times 10^{-7}$

$r = 0.03\,m$

$$= \frac{\mu_0 \varepsilon_0}{2l} r \cdot 2\pi\nu \cdot 150 \cancel{\cos(2\pi\nu t)}$$ 1 for max B.

$$= \underline{\underline{1.886673577 \times 10^{-12}\,T}}$$

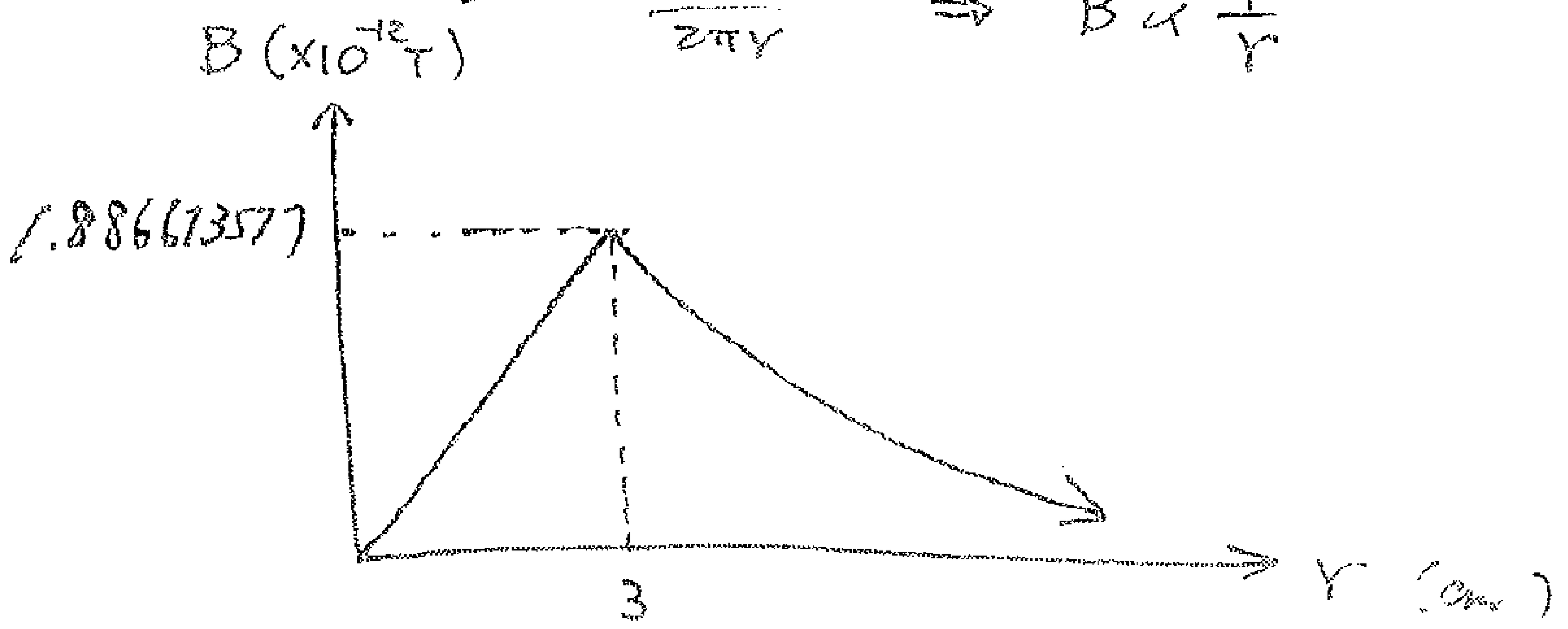
(b) $0 < r < 0.03$

In (a) $B = \frac{\mu_0 \varepsilon_0}{2l} 2\pi\nu \cdot 150 \cdot r \Rightarrow B \propto r$

$r > 0.03\,m$

$B \cdot 2\pi r = \mu_0 i$

$B = \frac{\mu_0 i}{2\pi r} \Rightarrow B \propto \frac{1}{r}$



16

$$E = 4\times10^{5} - 6\times10^{4}\,t$$

$t = 0$, $E \uparrow$

$A = 4\times10^{-2}\ m^2$

(a) $$i_d = \varepsilon_0 \frac{d\Phi_E}{dt}$$

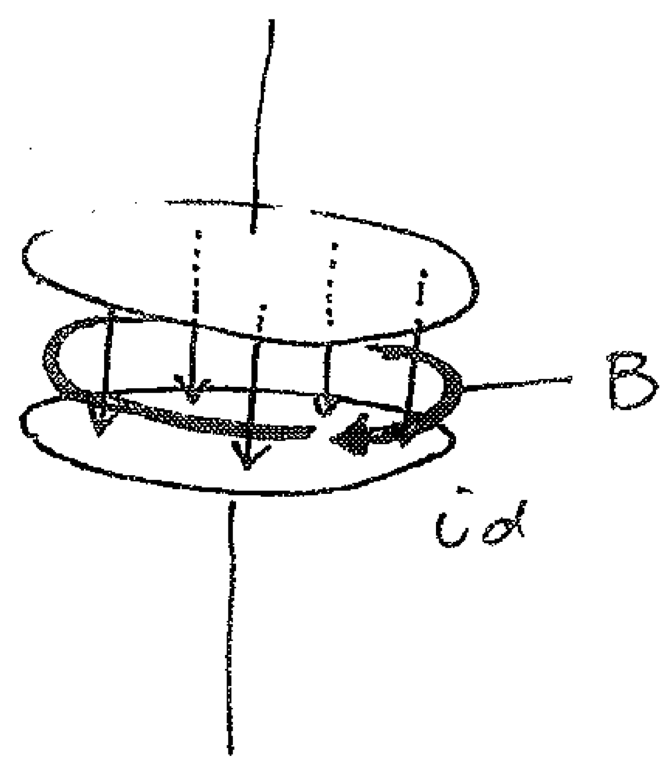
$$= \varepsilon_0 \frac{A\,dE}{dt} \qquad (A = \text{const.})$$

$$= \varepsilon_0 A\,(-6\times10^{4})$$

$$= 8.85\times10^{-12} \cdot 4\times10^{-12} \cdot (-6\times10^{4})$$

$$= \underline{-2.124\times10^{-8}\ \text{amp}}$$ (− shows the downward direction)

(b)



Since id is down, B is clockwise seen from above (use the right hand rule)

17

$$\oint B\cdot dS = \mu_0 i$$ J: current density (A/m^2)

(a) $$B\cdot 2\pi r = \mu_0 i$$

$$B = \frac{\mu_0 i}{2\pi r} = \frac{\mu_0 J\cdot A}{2\pi r}$$

$$= \frac{4\pi\times10^{-7}\cdot(20)(\pi\cdot(0.05)^2)}{2\pi\ (0.05)} = \underline{6.283185307\times10^{-7}\ T}$$

(b) $$i_d = J\cdot A = 20\cdot\pi\,(0.05)^2 = \varepsilon_0 \frac{d\Phi_E}{dt} = \varepsilon_0 \frac{dEA}{dt}$$

$$\therefore \frac{dE}{dt} = \frac{20\cdot\pi\,(0.05)^2}{\varepsilon_0\, \underset{\pi(0.05)^2}{A_R}} = \frac{20}{\varepsilon_0} = \frac{20}{8.85\times10^{-12}} = \underline{2.259887006\times10^{12}\ \frac{V}{m\cdot s}}$$

18

(a) $$i = i_d = i\cdot\frac{\pi\left(\frac{R}{3}\right)^2}{\pi R^2} = i\cdot\frac{1}{9} = \underline{0.i\ \text{Amp}}$$

(b) $$B = \frac{\mu_0 i_d}{2\pi r} = \frac{\mu_0\, i\, \frac{\pi r^2}{\pi R^2}}{2\pi r} \quad \frac{\mu_0 i}{2\pi R^2}\cdot r \rightarrow B \propto r$$

(c) $$B = \frac{\mu_0 i}{2\pi r}$$ (outside) $\longrightarrow$ $B \propto \frac{1}{r}$

Both requires $\frac{12}{3}$ of B_{max} or $\frac{1}{4}B_{max}$ ∴ (b) $\frac{1}{4}$ of R ∴ $r = \frac{1.2\,cm}{4} = \underline{0.3\,cm}$

(c) 4 of R $r = 4\cdot1.2\,cm = \underline{4.8\,cm}$

#21

$$\oint B\cdot dS = \mu_0 i + \underbrace{\mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}}_{i_d}$$

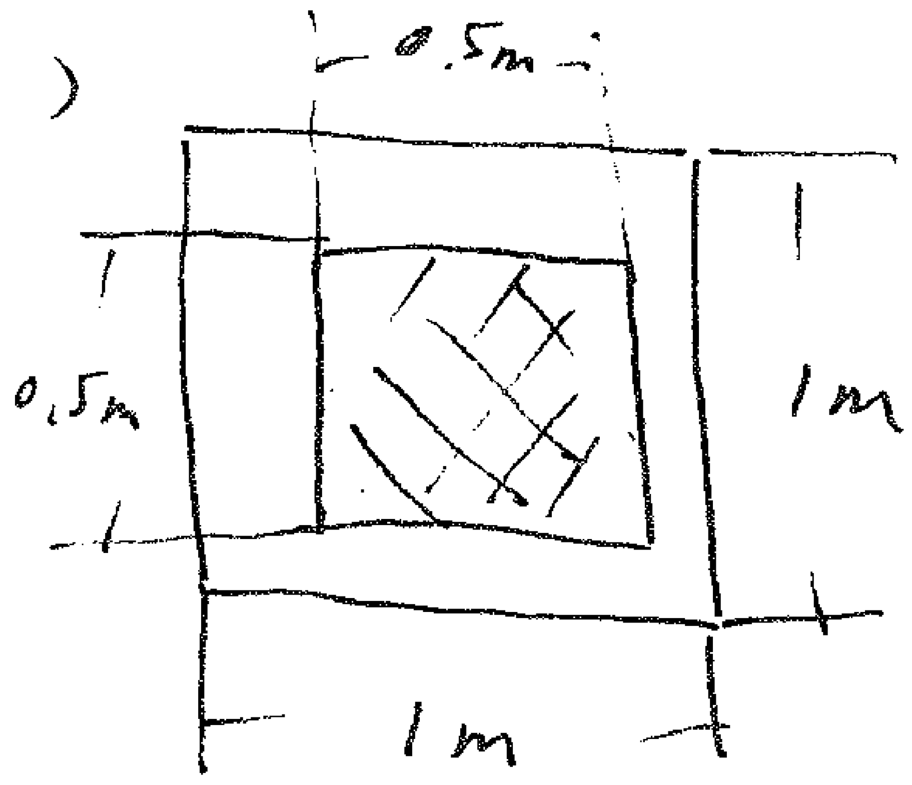
(a) $2A$ $\quad (i = i_d)$

for outside $\quad$ for inside

(b) $$\varepsilon_0 \frac{d\Phi_E}{dt} = 2A$$

$$\frac{d\Phi_E}{dt} = \frac{2A}{\varepsilon_0} = \frac{2A}{8.85\times10^{-12}} = \underline{\underline{2259887006\times10^{11}\ \frac{V}{m\cdot s}}}$$

(c)



Total Area $-$ $1m \times 1m = 1m^2$

shaded Area $-$ $0.5m \times 0.5m = 0.25m^2$

$$i_{shaded} = i_d \cdot \frac{\text{shaded Area}}{\text{Total Area}} = 2 \cdot \frac{0.25m^2}{1m^2}$$

$$= \underline{\underline{0.5A}}$$

(d) $$\oint B\cdot dS = \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$

$$= \mu_0\, i_{d\,(shaded)}$$

$$= 4\pi\times10^{-7} \cdot 0.5A$$

$$= \underline{\underline{0.6283185307\ \mu T\cdot m}}$$