HW Sol.

30.2

$$A = \pi R(t)^2$$

$$\Phi = BA = \pi B R(t)^2$$

$$\mathcal{E} = -\frac{d\Phi}{dt} = 2\pi B R \dot{R}$$

$$= 2 \cdot \pi (.8\,T)(.12\,m)(.75\,m/s)$$

$$= 4.52 \times 10^{-1}\,V$$

30.21

$$\Phi = \Phi_0 + \frac{1}{2}\pi r^2 \cos(2\pi f t + \phi) B$$

$$f = 40\ s^{-1}$$

$$\omega = 2\pi \times 40 = 2.51 \times 10^2\ rad/s$$

$$\mathcal{E} = -\frac{d\Phi}{dt} = \frac{1}{2}\pi r^2 2\pi f B \sin(2\pi f t + \phi)$$

$$|\mathcal{E}| = \pi^2 r^2 f B = \pi^2 (2\times10^{-2})^2 40 \times (20\times10^{-3}) = 3.16 \times 10^{-3}\,V$$

30.24 $\Phi = \int \vec{B} \cdot \hat{n}\, dA = \pi r^2 \frac{1}{4} \cdot B$

a) $\mathcal{E} = -\pi r^2 \frac{1}{4} \dot{B} = -\pi (.1m)^2 \frac{1}{4} (3\times10^{-3}\,\frac{T}{s}) = -2.36 \times 10^{-5}\,V$

b) clockwise - by Lenz's law

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$$\mathcal{E} = \mathcal{E}_1 + \mathcal{E}_2 = L_1 \frac{dI_1}{dt} + L_2 \frac{dI_2}{dt} = (L_1 + L_2) \frac{dI}{dt}$$

since $I_1 = I_2$

$$\frac{\mathcal{E}}{\frac{dI}{dt}} = L_{eff} = L_1 + L_2$$

For N inductors in series

$$L = \sum_{i=1}^{N} L_i \qquad \mathcal{E} = \left(\sum L_i\right) \frac{dI}{dt} \Rightarrow L = \frac{\mathcal{E}}{\frac{dI}{dt}} = \sum L_i$$

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$$\mathcal{E} = \mathcal{E}_1 = \mathcal{E}_2 \qquad I_1 + I_2 = I$$

$$\| \qquad \|$$

$$L_1 \frac{dI_1}{dt} \quad L_2 \frac{dI_2}{dt} \qquad \frac{dI_1}{dt} + \frac{dI_2}{dt} = \frac{dI}{dt}$$

$$\frac{dI}{dt} \cdot \frac{1}{\mathcal{E}} = \frac{1}{L} = \frac{dI_1}{dt} \frac{1}{\mathcal{E}} + \frac{dI_2}{dt} \frac{1}{\mathcal{E}} = \frac{1}{L_1} + \frac{1}{L_2}$$

$$\frac{1}{L} = \frac{1}{L_2} + \frac{1}{L_1}$$

$$\frac{dI}{dt} \frac{1}{\mathcal{E}} = \sum \frac{dI_0}{dt} \frac{1}{\mathcal{E}} = \sum \frac{1}{L_i} = \frac{1}{L}$$