

HW Sol.

30.2

$$A = \pi R^2$$

$$\Phi = BA = \pi BR^2$$

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

$$= 2 \cdot \pi (0.8 \text{ T})(0.12 \text{ m})(0.75 \text{ m/s})$$

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

30.21

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

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

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

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

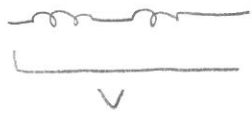
$$|\mathcal{E}| = \pi^2 r^2 f B = \pi^2 (2 \times 10^{-2})^2 40 \times (20 \times 10^{-3}) = 3.16 \times 10^{-3} \text{ V}$$

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

a)  $\mathcal{E} = -\pi r^2 \frac{1}{4} \dot{B} = -\pi (0.1 \text{ m})^2 \frac{1}{4} (3 \times 10^{-3} \frac{\text{T}}{\text{s}}) = -2.36 \times 10^{-5} \text{ V}$

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  $I_1 = I_2$

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

For  $N$  inductors in series

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

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$$\mathcal{E} = \mathcal{E}_1 = \mathcal{E}_2$$

$$I_1 + I_2 = I$$

$$L_1 \frac{dI_1}{dt} \quad L_2 \frac{dI_2}{dt}$$

$$\frac{dI_1}{dt} + \frac{dI_2}{dt} = \frac{dI}{dt}$$

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

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

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