Physics 102

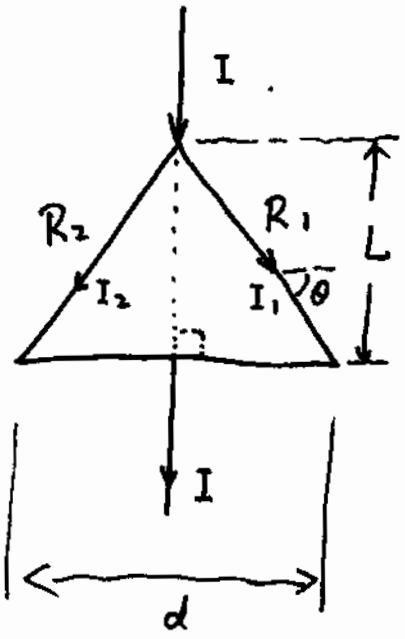
Sample Midterm #2 . Solutions .

1. $I_1 + I_2 = I$.

$I_1 R_1 = I_2 R_2$, $I_2 = \frac{R_1}{R_2} I_1$.

$I_1 = \frac{R_2 I}{R_1 + R_2}$, $I_2 = \frac{R_1 I}{R_1 + R_2}$

$= \frac{(9)(4)}{9+5} = 2.57$ A. $= \frac{(5)(4)}{9+5} = 1.43$ (A)



Magnetic force on I_1 :

$$F_1 = B I_1 \sqrt{L^2 + (\tfrac{d}{2})^2} \cdot \sin\theta$$

$$= B I_1 \sqrt{L^2 + (\tfrac{d}{2})^2} \cdot \frac{L}{\sqrt{L^2 + (\frac{d}{2})^2}}$$

$$= B I_1 L .$$

Force on I_2 : $F_2 = B I_2 L$

Both F_1 and F_2 are out of page .

Torque : $\tau = F_1 \frac{d}{4} - F_2 \frac{d}{4}$

$$= \frac{BL I_1 d}{4} - \frac{BL I_2 d}{4}$$

$$= \frac{BLd}{4}(I_1 - I_2) = \frac{(0.06)(0.16)(0.08)(2.57-1.43)}{4} = 2.19 \times 10^{-4} \text{ N.m}$$

OR: $= \frac{BLd\, I\, (R_2 - R_1)}{4\,(R_1 + R_2)}$

$$= \frac{(0.06)(0.16)(0.08)(9-5)}{4\,(9+5)} = 2.19 \times 10^{-4} \text{ N.m} .$$

2. $N = 50$, $\ell = 10.0\ cm = 0.100\ m$

$f = 30.0\ Hz$, $B = 0.750\ T$

$$\mathcal{E} = -N \cdot \frac{d\Phi}{dt}.$$

$$\Phi = B \cdot A \cdot \cos\theta$$

$$= B \cdot \ell^2 \cdot \cos(\omega t)$$

$$\frac{d\Phi}{dt} = -B \cdot \ell^2 \cdot \omega \cdot \sin(\omega t)$$

$$\therefore \mathcal{E} = NB\ell^2\omega \cdot \sin(\omega t).$$

$$\mathcal{E}_{peak} = NB\ell^2 \cdot \omega \cdot = NB\ell^2 \cdot 2\pi f$$

$$= (50)(0.75)(0.1)^2(2\pi)(30)$$

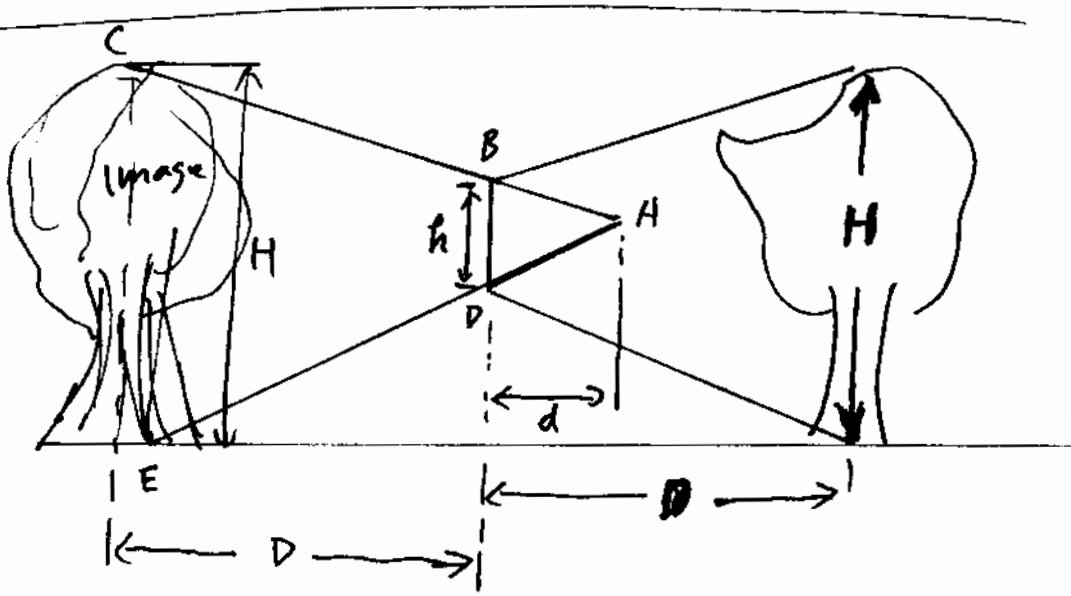
$$= 70.7\ V$$

3.

$D = 18\ m$.

$d = 3\ m$.

$h = 0.6\ m$.



$\triangle CAE \sim \triangle BAD$.

$$\frac{D+d}{d} = \frac{H}{h}$$

$$H = \frac{D+d}{d} h$$

$$= \frac{(18+3)\,0.6}{3.0} = 4.2\ m.$$

4. $f = -25.0$ cm

$d_o = 12.0$ cm

(a). $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$.

$$d_i = \frac{f \cdot d_o}{d_o - f} = \frac{(-25)(12)}{12 - (-25)} = \frac{-300}{37} = -8.11 \text{ cm}$$

(b). $$m = -\frac{d_i}{d_o} = -\frac{-8.11}{12} = 0.676$$

(c)