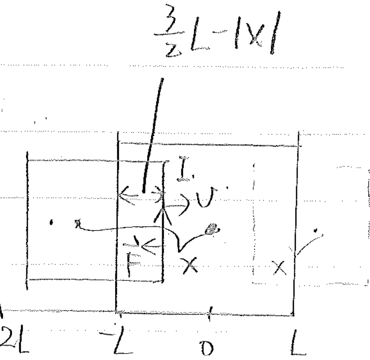
HW #12 Solution 29.26 & 29.49.



29.26 ① $-2L < x < -\frac{3}{2}L$ $\quad \vec{B} = 0. \quad F = 0$

② $-\frac{3}{2}L < x < -L$ $\quad \Phi_B = BL\left(\frac{3}{2}L - |x|\right) \quad \frac{d\Phi_B}{dt} > 0$

$\mathcal{E} = -\frac{d\Phi_B}{dt} = -BLV < 0 \quad \boxed{CCW}$

$I = \frac{|\mathcal{E}|}{R} = +\frac{BLV}{R}$

$F = I\vec{\ell} \times \vec{B} = \frac{+BLV}{R} LB = \frac{+B^2L^2v}{R}$ to the right

③ $-L < x < -\frac{L}{2}$ $\quad F = \frac{+B^2L^2v}{R}$ to the right.

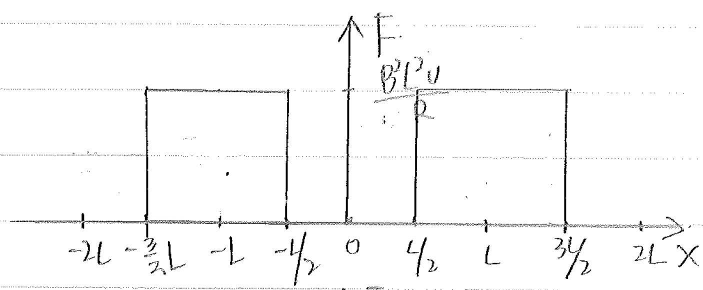
④ $-\frac{L}{2} < x < \frac{L}{2}$ Loop is totally inside the B-field $\frac{d\Phi_B}{dt} = 0$

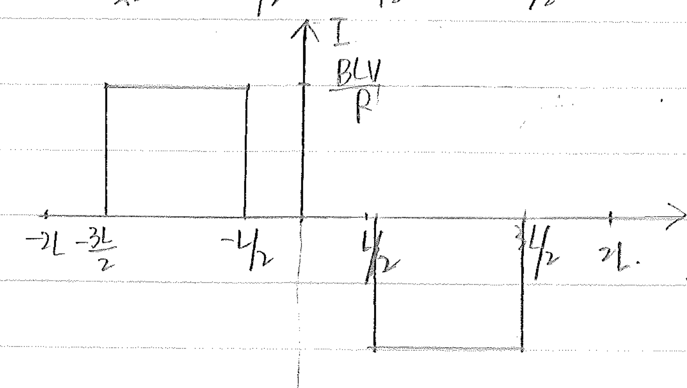
$F = 0$

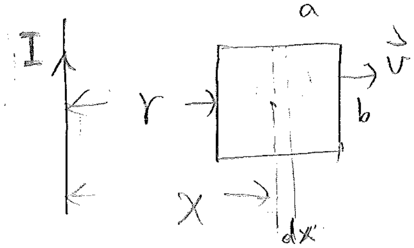
⑤ $\frac{L}{2} < x < L$ $\quad \Phi_B = BL\left(\frac{3}{2}L - x\right) \quad \frac{d\Phi_B}{dt} < 0$

$\mathcal{E} = -\frac{d\Phi_B}{dt} = BLv > 0 \quad \boxed{CW}$

$F = ILB = \frac{BLV}{R} LB = \frac{B^2L^2v}{R}$ to the right







29.49 (a)

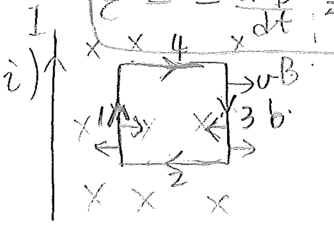
(i) $B = \frac{\mu_0 I}{2\pi x}$ $d\Phi_B = B(b \cdot dx) = \frac{\mu_0 I b}{2\pi x} dx$

$$\Phi_B = \int_r^{r+a} \frac{\mu_0 I b}{2\pi} \frac{1}{x} dx = \frac{\mu_0 I b}{2\pi} \ln \frac{r+a}{r}$$

$$\frac{d\Phi_B}{dt} = \frac{\mu_0 I b}{2\pi} \frac{r}{r+a} \cdot \left(-\frac{a}{r^2} v\right)$$

$$= \frac{-\mu_0 I a b v}{2\pi r(r+a)}$$

$$\boxed{\mathcal{E} = -\frac{d\Phi_B}{dt} = \frac{\mu_0 I a b v}{2\pi r(r+a)}}$$

(ii) 

$\mathcal{E} = BVL = \frac{\mu_0 I}{2\pi d} \cdot v b$

for 2, 4 $\mathcal{E}_2 = \mathcal{E}_4 = 0$

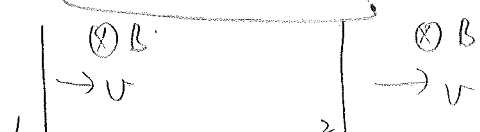
for 1, 3 $\mathcal{E}_1 = \frac{\mu_0 I}{2\pi r} b \cdot v$ $\mathcal{E}_3 = +\frac{\mu_0 I b v}{2\pi(r+a)}$

$$\boxed{\mathcal{E} = \mathcal{E}_1 - \mathcal{E}_3 = \frac{\mu_0 I a b v}{2\pi r(r+a)}} = \frac{\mu_0 I a b v}{2\pi r(r+a)}$$

(b) (i) $\Phi_B = \frac{\mu_0 I b}{2\pi} \ln\left(1 + \frac{a}{r}\right)$

$v \to$ right r increases Φ_B decrease, $\frac{d\Phi_B}{dt} < 0$

$\boxed{I : CW}$

(ii) 

$F_1 > F_2$ since $B_1 > B_2$ $\boxed{I \ CW}$

(c) $v = 0$ $\boxed{\mathcal{E} = 0}$

$a \to 0$ $\Phi_B \to 0$ $\frac{d\Phi_B}{dt} \to 0$ $\boxed{\mathcal{E} \to 0}$

$r \to \infty$ $\Phi_B \to 0$ $\frac{d\Phi_B}{dt} \to 0$ $\boxed{\mathcal{E} \to 0}$