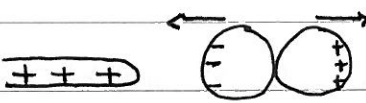


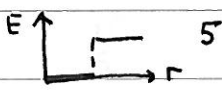
Midterm 7/5-09: LF

① $V(x) = 50 \text{ V} + (15 \frac{\text{V}}{\text{m}})x$
 $\Rightarrow \vec{E} = -\nabla V = -\hat{x} \frac{dV}{dx} = \underline{\underline{-(15 \frac{\text{V}}{\text{m}})\hat{x}}}$ (D)

② $\vec{E} = \pm \frac{\sigma}{2\epsilon_0} \hat{x} \Rightarrow$ lineart avtagende V i begge retninger
 $\Rightarrow$ (A)

③ Sammenhengende leder = ekvipotensial $\Rightarrow$ (B)

④  $\Rightarrow$ neg. ladd. til venstre $\Rightarrow$ (A)

⑤ $E(r) = -\partial V / \partial r \Rightarrow$  $\Rightarrow$ (D)

⑥ Før: ΔV_0 Etter: $\frac{2}{3} \Delta V_0 \Rightarrow C_1 = \frac{q}{\frac{2}{3} \Delta V_0} = \frac{3}{2} \frac{q}{\Delta V_0} = \frac{3}{2} C_0 \Rightarrow$ (C)

⑦ $\vec{D}$ og $\vec{E}$ stopper ikke ytterst på platen $\Rightarrow$ feltl. for $\vec{D} \Rightarrow$ (C)

⑧ metall = ekvipot. $\Rightarrow V_1 = V_2 = V_3 \Rightarrow$ (B)

⑨ $U = \sum_{i,j} U_{ij} = \frac{q^2}{4\pi\epsilon_0 a} \left\{ -4 + \frac{2}{\sqrt{2}} \right\} = \frac{q^2 \cdot 10^{-12} \cdot 9 \cdot 10^9}{5 \cdot 10^{-2}} \left\{ -4 + \sqrt{2} \right\} \text{ J}$
 $= (81 \cdot 9/5) \cdot 10^{-1} \cdot \left\{ -4 + \sqrt{2} \right\} \text{ J} \approx 160 \cdot (-2.6) / 10 \approx \underline{\underline{-38 \text{ J}}} \Rightarrow$ (D)

⑩ Gauss' lov $\Rightarrow -Q$ på indre flate av midtkule
 $\Rightarrow -Q$ på ytre " " $\Rightarrow$ (A)

⑪ $\vec{F} = I\vec{L} \times \vec{B}$; høyre leder: $I\vec{L} \hat{y} \times B\hat{z} \sim \hat{x}$
 venstre " " $I\vec{L} (-\hat{y}) \times B\hat{z} \sim -\hat{x}$ } $\Rightarrow$ krefter 1 $\Rightarrow$ (A)

⑫ uten avbrytning: $\vec{F}_e + \vec{F}_m = 0$

$$\vec{F}_e = q\vec{E} = qE_0\hat{y}, \quad \vec{F}_m = q\vec{v} \times \vec{B} = qvB_0\hat{x} \times \hat{z} = -qvB_0\hat{y}$$

$$\Rightarrow v = E_0/B_0 = 10^4/(50 \cdot 10^{-3}) \text{ m/s} = 2 \cdot 10^5 \text{ m/s} = \underline{200 \text{ km/s}} \Rightarrow \textcircled{D}$$

⑬ $R_{\text{tot}} = \left\{ \frac{1}{R} + \frac{1}{R + (1/R + 1/R)^{-1}} \right\}^{-1} = \left\{ \frac{3}{3R} + \frac{2}{3R} \right\}^{-1} = \frac{3R}{5}$

strøm totalt: $I_{\text{tot}} = V_0 / (3R/5) = 5V_0/3R$

øverst: $V_0/R \Rightarrow 2V_0/3R$ nederst $\Rightarrow I = V_0/3R \Rightarrow \textcircled{B}$

[evt mer direkte: nederst: $R + R/2 = 3R/2 \Rightarrow I = \frac{1}{2} \cdot \frac{V_0}{(3R/2)} = V_0/3R$]

⑭ $C = Q/V_0 \Rightarrow Q = V_0 C \Rightarrow \textcircled{A}$

⑮ $C_{\text{tot}} = \left\{ \frac{1}{C} + \frac{1}{C+3C} \right\}^{-1} = \frac{4C}{5}$

$$\Rightarrow Q = \frac{3}{4} \cdot V_0 \cdot \frac{4C}{5} = 3V_0 C/5 \Rightarrow \textcircled{C}$$

⑯ $\tau = RC = 10 \cdot 10^{-3} \text{ s} = 0.01 \text{ s} = 10 \text{ ms}$

$\Rightarrow t \sim \text{"noen } \tau \text{"}$ sannsynligvis et 30 ms mer presist $\Rightarrow \textcircled{B}$

Mer presist: $Q(t) = V_0 C (1 - e^{-t/RC}) = 0.95 V_0 C$

$$\Rightarrow 0.05 = e^{-t/RC} \Rightarrow \frac{t}{RC} = \ln 20 \Rightarrow t = 10 \text{ ms} \cdot \ln 20 = \underline{30 \text{ ms}}$$

⑰ $I(t) = \frac{V_0}{R} e^{-t/RC} \Rightarrow I(0+) = V_0/R = \frac{3}{10} \text{ A} = \underline{0.30 \text{ A}} \Rightarrow \textcircled{B}$

⑱ $d\vec{p} = \hat{z} \cdot dq \cdot 2|z(x)| = \hat{z} \cdot \sigma \cdot dy \cdot R d\theta \cdot 2\sqrt{R^2 - x^2}$

$x = R \cos \theta \Rightarrow \sqrt{R^2 - x^2} = R \sin \theta$

$$\Rightarrow \vec{p} = \hat{z} \sigma R^2 \cdot \int dy \cdot 2 \int_0^\pi \sin \theta d\theta = \hat{z} \cdot 2L\sigma R^2 \int_0^\pi -\cos \theta = \hat{z} \cdot 4L\sigma R^2$$

$$\Rightarrow \vec{p}/L = 4\sigma R^2 \hat{z}$$

$\Rightarrow \textcircled{B}$

Evt $\pm Q = \pm \sigma \cdot \pi R \cdot L$; $\langle \Delta \vec{z} \rangle \stackrel{(\approx)}{=} \hat{z} \cdot R \Rightarrow \vec{p}/L \stackrel{(\approx)}{=} \pi R^2 \sigma \Rightarrow B \dots$

(19) For rett leder: $R = \frac{l}{\sigma A}$ ($\Rightarrow G = \sigma A/l$)

$\Rightarrow$ For sylinderskall med radius r , tykkelse dr , lengde L :

$$dR = dr / (\sigma \cdot 2\pi r \cdot L) = \frac{1}{2\pi\sigma L} \frac{dr}{r}$$

$$\Rightarrow R = \int dR = \frac{1}{2\pi\sigma L} \int_a^b \frac{dr}{r} = \frac{1}{2\pi\sigma L} \ln b/a$$

(venkstrøing!)

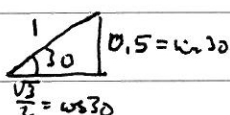
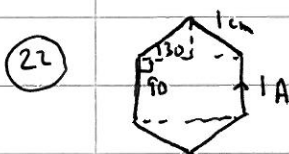
$$\Rightarrow G = 2\pi\sigma L / \ln(b/a) \Rightarrow \textcircled{D}$$

(20) sirkelbevegelse, med radius bestemt ved at

$$mv^2/r = qvB \Rightarrow r = mv/qB$$

Her er $v = \sqrt{v_0^2 + v_z^2} = \sqrt{2} v_0 \Rightarrow r = \sqrt{2} mv_0/qB \Rightarrow \textcircled{B}$

(21) $B = \mu_0 n I = 4\pi \cdot 10^{-7} \cdot 0.3142 \cdot 2 \text{ T} = 16 \cdot 10^{-3} \text{ T} = 16 \text{ mT} \Rightarrow \textcircled{B}$



$$\Rightarrow \text{areal: } A = 1 \cdot \sqrt{3} + \frac{1}{2} \cdot \sqrt{3} = \frac{3}{2} \sqrt{3} \text{ cm}^2 \approx 2.6 \text{ cm}^2$$

$$\Rightarrow |\vec{m}| = IA = 2.6 \text{ A cm}^2 \Rightarrow \textcircled{C}$$

(23) $Z_C = 1/\omega C = \frac{1}{10^6 \cdot 200 \cdot 10^{-9}} = \frac{1000}{200} = 5 \Omega \Rightarrow \textcircled{D}$

(24) $Z_L = \omega L = 10^6 \cdot 200 \cdot 10^{-12} \Omega = 2 \cdot 10^{-4} \Omega = 0.2 \text{ m}\Omega \Rightarrow \textcircled{A}$

(25) $I(t) = \frac{V_0}{R} (1 - e^{-t/\tau})$ der $\tau = L/R = \frac{10^{-6}}{10^{-3}} \text{ s} = 10^{-3} \text{ s} = 1 \text{ ms}$

$$\Rightarrow \frac{V_0}{R} (1 - e^{-t/\tau}) = 0.8 \frac{V_0}{R} \Rightarrow e^{-t/\tau} = 0.2 \Rightarrow e^{t/\tau} = 5$$

$$\Rightarrow t = \tau \cdot 4.5 \approx 1.6 \tau = 1.6 \text{ ms} \Rightarrow \textcircled{B}$$