Ex 2.4

a) Displayed Voltage $U_D = 1V$

b) Displayed Current $I_D = 1A$

c) In general

$$x(t) = A \sin(2\pi f t + \varphi) + K$$

For the current:

$A = 3$ Ampere $\varphi = 0$ $i(t) = 3 \sin\left(\frac{2\pi}{T} t\right) + 1$

$f = \frac{1}{T}$ $K = 1$ Ampere

For the voltage:

$A = 2V$ $\varphi = + \frac{1}{8} \cdot 2\pi$

$f = \frac{1}{T}$ $u(t) = 2 \sin\left(\frac{2\pi}{T} t + \frac{2\pi}{8}\right) + 1$

$K = 1V$

d) $X_{RMS} = \sqrt{\frac{1}{T}\int_0^T x(t)^2\,dt}$ $\qquad \frac{2\pi}{T}t + \frac{2\pi}{8} = a(t)$

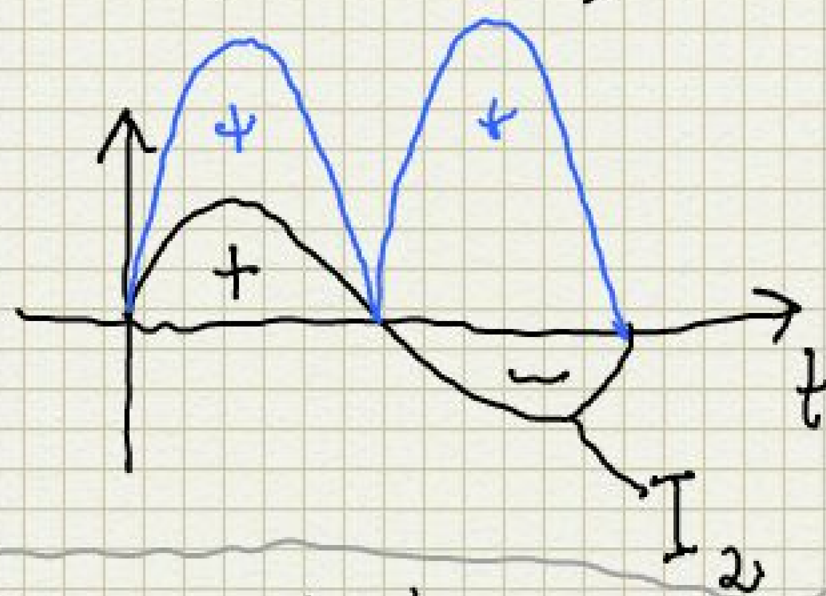
$$u^2(t) = \left[2\sin\left(\frac{2\pi}{T}t + \frac{2\pi}{8}\right) + 1\right]^2$$

$$= 4\sin^2\left(\frac{2\pi}{T}t + \frac{2\pi}{8}\right) + 4\sin\left(\frac{2\pi}{T}t + \frac{2\pi}{8}\right) + 1$$

$$\hookrightarrow u_{RMS} = \sqrt{\frac{1}{T}\Big[\underbrace{\int_0^T 4\sin^2 a(t)\,dt}_{I_1} + \underbrace{\int_0^T 4\sin a(t)\,dt}_{I_2} + \underbrace{\int_0^T 1\,dt}_{I_3}\Big]}$$

I_3: $\int_0^T 1\,dt = t\Big|_0^T = T$

I_2: $\int_0^T 4\sin a(t)\,dt = 0$



I_1: $\int_0^T 4\sin^2 a(t)\,dt$

$= \int_0^T \frac{4}{2}\,dt - \int_0^T 2\cos\left(\frac{4\pi}{T}t + \frac{4\pi}{8}\right)dt$

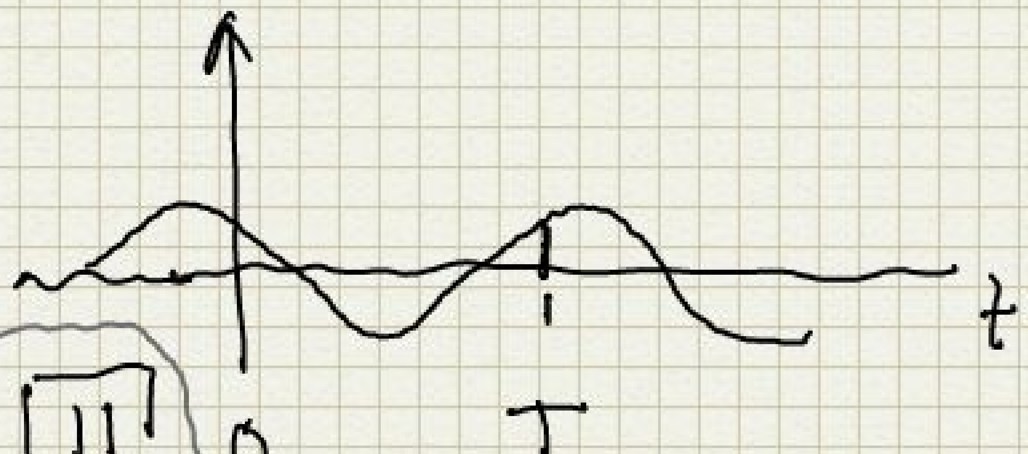
$= 2T - 0$

Power reduction formula

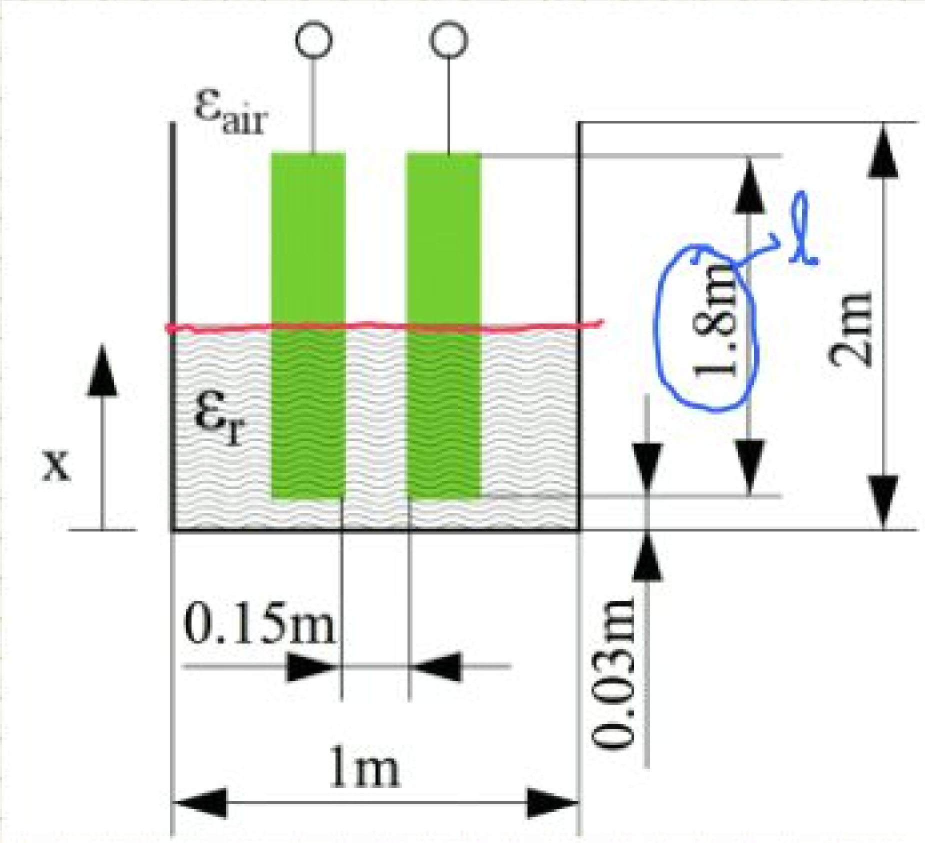
$$\sin^2\theta = \frac{1-\cos(2\theta)}{2}$$

$$u_{RMS} = \sqrt{\frac{1}{T}\left[2T + T\right]}$$

$$= \sqrt{3}$$



$I_{RMS} = \sqrt{\frac{11}{2}}$



Ex 3.1

a)

b) $C = \frac{\varepsilon_0 \varepsilon_r A}{d}$

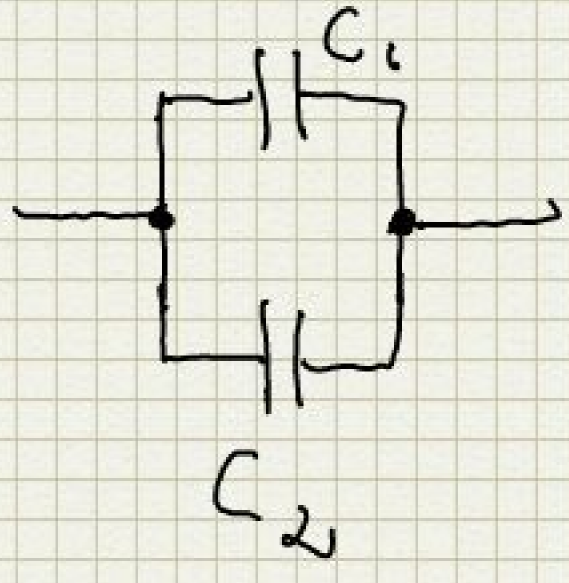
$A_1 = w_p(1.83 - x)$

$A_2 = w_p(x - 0.03)$

$C_1 = \frac{\varepsilon_0 \varepsilon_{air} A_1}{d}$

$C_2 = \frac{\varepsilon_0 \varepsilon_r A_2}{d}$

$C_{tot} = C_1 + C_2$



Case I: $x \leq 0{,}03m$

$C_{tot} = C_1$

$= \frac{\varepsilon_0 \varepsilon_{air} w_p l}{d}$

w_p → width of a capacitor plate

Case 2: $x > 1{,}83m$

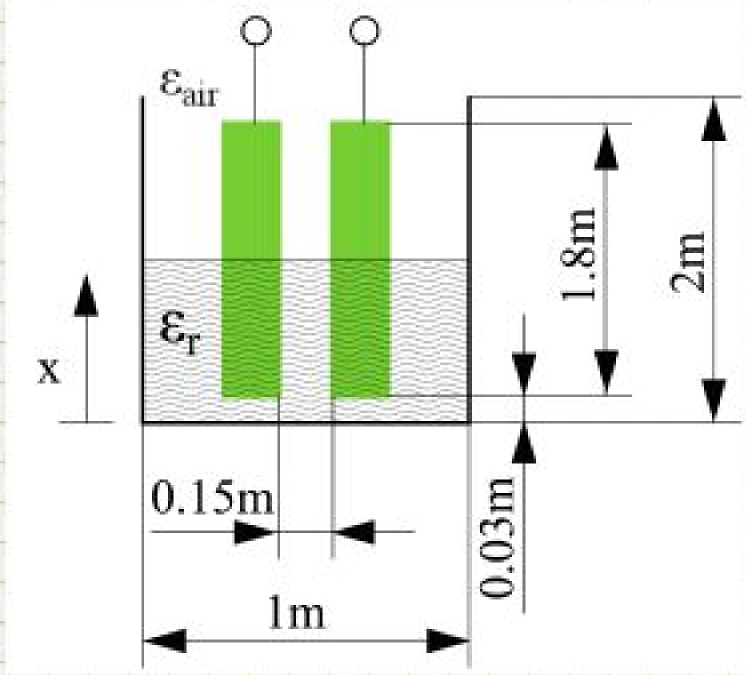
$C_{tot} = C_2 = \frac{\varepsilon_0 \varepsilon_r w_p l}{d}$

Case 3: $0{,}03m < x \leq 1.83m$

$C_{tot} = C_1 + C_2$

$= \frac{\varepsilon_0 \varepsilon_{air} w_p (1.83m - x)}{d} + \frac{\varepsilon_0 \varepsilon_r w_p (x - 0.03)}{d}$

$$C(x) = \begin{cases} \dfrac{\varepsilon_0 \varepsilon_{air} w_p l}{d} & \text{for } x \leq 0.03\text{m} \\ \dfrac{\varepsilon_0 \varepsilon_r w_p l}{d} & \text{for } x > 1.83\text{m} \\ \dfrac{\varepsilon_0 w_p}{d}\left[(\varepsilon_r - \varepsilon_{air})x + 1.83\varepsilon_{air} - \ldots \right. \\ \left. \ldots 0.03\varepsilon_r\right] & \text{else} \end{cases}$$



c)