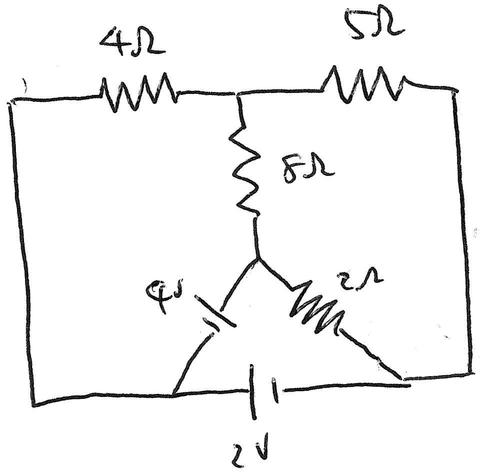
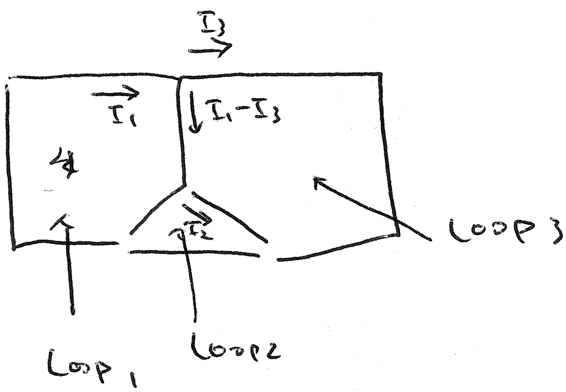
1 REVISED





Loop 1 : $-4I_1 - 8(I_1 - I_3) - 4 = 0$

Loop 2 : $-5I_3 - 2(I_3 - I_2) + 8(I_1 - I_3) = 0$

Loop 3 : $-2I_2 + 2 + 4 = 0$

~~I2 =~~ $I_2 = 3\ A$

$-12I_1 + 8I_3 = 4$ (Loop 1)

$-5I_3 - 2(I_3 - 3) + 8(I_1 - I_3) = 0$

$6 + 8I_1 - 15I_3 = 0$ (Loop 3)

$-12I_1 + 8I_3 = 4$

$(-15I_3 + 8I_1 = -6) \times \frac{3}{2}$

$-12I_1 + 8I_3 = 4$

$-22.5I_3 + 12I_1 = -9$

$-14.5I_3 = -5$

$I_3 = \frac{10}{29}\ A$

$$-12 I_1 + 8\left(-\frac{10}{29}\right) = 4$$

$$-12 I_1 + -\frac{80}{29} = 4$$

$$-12 I_1 = \frac{80 + 4 \times 29}{29}$$

$$-12 I_1 = \frac{196}{29}$$

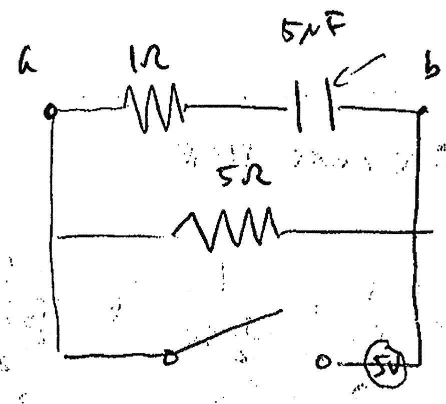
$$I_1 = -\frac{\overset{49}{\cancel{196}}}{\underset{3}{\cancel{12}} \cdot 29}$$

$$\boxed{I_1 = -\frac{49}{87}\,A}$$

#2

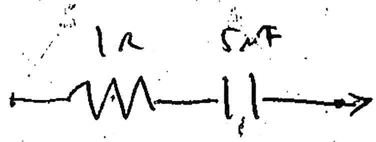
a) CAPACITOR ACTS LIKE A CLOSED CIRCUIT AT T = 0
(W/ $R = 0$)

AND WINDS UP BEIN LIKE A OPEN CIRCUIT AT THE END



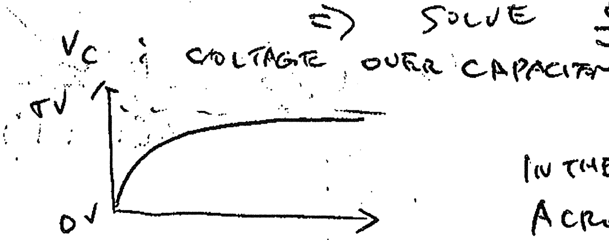
~~THRU 5Ω RESISTOR CURRENT IS ALWAYS 0~~

WHEN YOU APPLY 5V ACROSS a TO b CAPACITOR CHARGES



$$5V = -I(t) \cdot RE - \frac{Q}{C}$$

⇒ SOLVE OR



IN THE BEGINNING VOLTAGE ACROSS RESISTOR IS

5A (5V)

IN THE END

0A

So total current at $t=0$

is $1A + 5A = \boxed{6A}$

b) Total current at $t \to \infty$ is

$\boxed{1A}$

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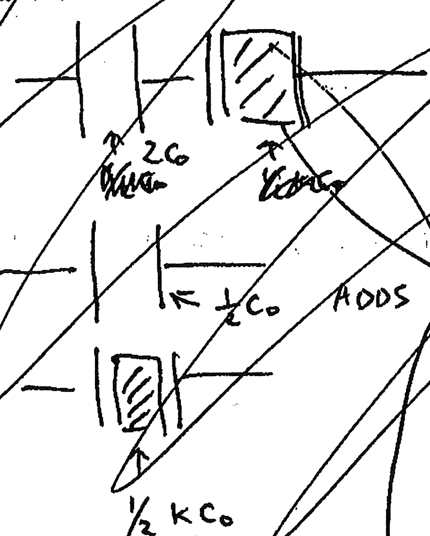
PROBLEM 3

a) Equivalent C_T



$$\frac{1}{C_T} = \frac{1}{\frac{1}{2}C_0} + \frac{1}{\frac{kC_0}{2}}$$

$$= \frac{2}{C_0} + \frac{2}{kC_0}$$

$$= \frac{2(k_0+1)}{kC_0}$$

b)

$$\frac{1}{2}C_0 + \frac{1}{2}kC_0 = \frac{1}{2}C_0[1+k_0]$$

$k_0 > 1$

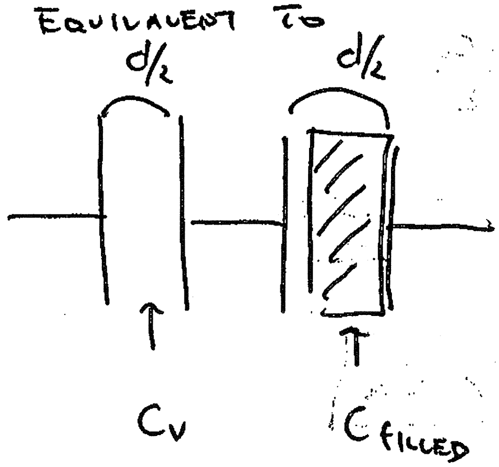
a) $C_T = \dfrac{kC_0}{2(k+1)}$

PROBLEM 3

a)

$$C_0 = \frac{\varepsilon_0 A}{d} \quad \text{(UNFILLED CAPACITOR)}$$

EQUIVALENT TO



$$\frac{1}{C_T} = \frac{1}{C_v} + \frac{1}{C_f}$$

$$C_v = 2C_0$$

$$C_f = \frac{2\varepsilon_0 A K}{d} \quad (K=2)$$

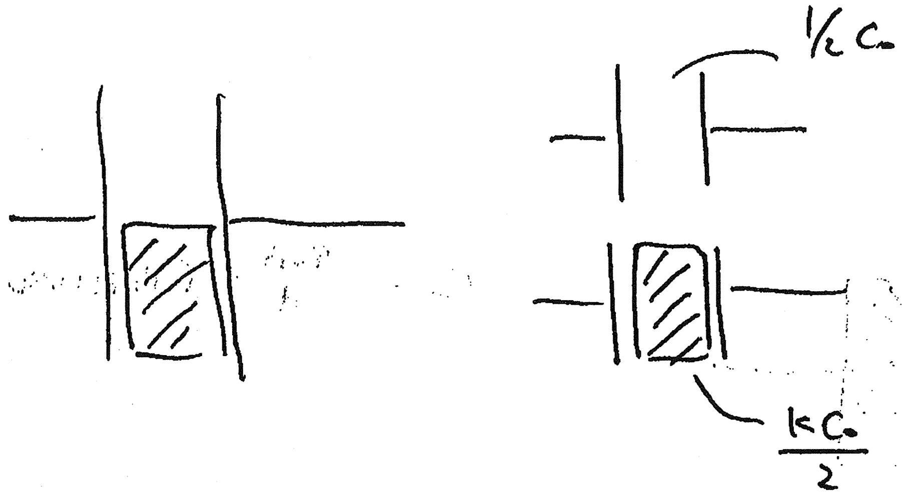
$$= \frac{4\varepsilon_0 A}{d} = 4C_0$$

$$\frac{1}{C_T} = \frac{1}{2C_0} + \frac{1}{4C_0}$$

$$= \frac{2+1}{4C_0}$$

$$C_T = \frac{4}{3}C_0 \approx 1.33\,C_0$$

b)



$$C_T = \frac{1}{2}C_0 + \frac{kC_0}{2}$$

$$= \frac{3}{2}C_0 \qquad = 1.5\,C_0$$

$$\boxed{C_b > C_a}$$

PROBLEM 4

a) 5V STORED

$$\text{CAPACITANCE} = \frac{\varepsilon_0 A}{d} = \frac{8.85\times10^{-12} \cdot 1m^2}{0.1m.}$$

$$= 8.85\times10^{-11}\ F$$

$$\sim 0.1nF.$$

$$E = \frac{1}{2}CV^2 = \frac{1}{2}(8.85\times10^{-11}F)\ 5V^2$$

$$= 110\times10^{-11}$$

$$= \boxed{1.1\times10^{-9}\ J}$$

b) $E = V/d = \frac{5V}{0.1m} = \boxed{50V/m}$

c) $\frac{E}{V} = \frac{1.1\times10^{-9}J}{0.1m^3} = \boxed{1.1\times10^{-8}\ J/m^3}$

OR $\frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\ 8.85\times10^{-12}\ 2500$

$$= 1.1\times10^{-8}\ J/m^3$$