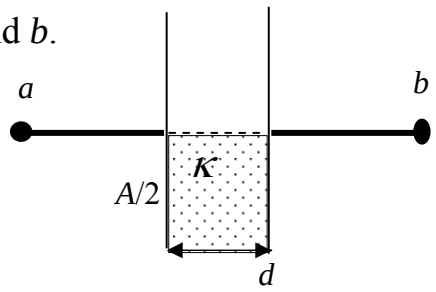
University of Bahrain	**PHYCS 102**	**Fall - 01-02**
Department of Physics	**Second Exam**	**Time:45 min**.

Name:…… ID#……Section:…….

Q1 (10 points) A parallel plate capacitor of plate separation d=1mm and capacitance C_o=18 pF is charged by a battery to charge Q_o= 45 pc. The battery is then disconnected, and the capacitor is half- filled with dielectric of κ=5, as shown in the figure.

a) Find the equivalent capacitance (C).
b) Find the potential difference (V) between points a and b.
c) Find the electric field (E) inside the dielectric.



Solution:

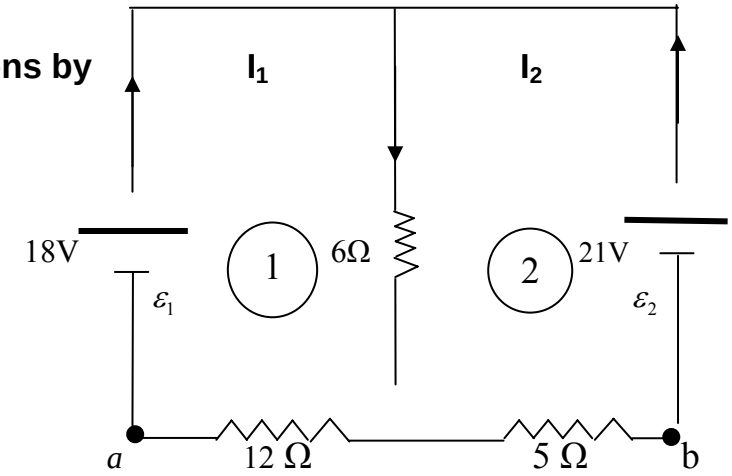
a) $C_o = \frac{\varepsilon_o A}{d}, C = C_1 + C_2 = \frac{\varepsilon_o (A/2) k}{d} + \frac{\varepsilon_o (A/2)}{d}$

$$C = \frac{\varepsilon_o A}{d} \cdot \frac{k+1}{2} = C_o \frac{k+1}{2} = 54 \rho F$$

b) $Q_o = Q = CV, V = 45\,pC / 54\,pF = 0.833V$

c) $E = V/d = 833.3$V/m

Q2 (10 points) In the shown circuit:
(a) **Write the loop and juction equations by I_3** applying krichhoff's rules.
(b) If I_1 = 0.445 A, find I_2 and I_3.
(c) What is the power output of ε_2?
(d) Find the potential between a and b.



Solution:

a) $I_1 - I_2 + I_3 = 0$
$12I_1 + 6I_2 = 18$
$6I_2 + 5I_3 = 21$

b) $I_2 = 2.11$A $\quad I_3 = 1.668$A

c) $P_{out} = \varepsilon_2 \, . \, I_3 = 35.03$ W

d) $V_{ab} = -12\, I_1 + 5\, I_3 = 3$V

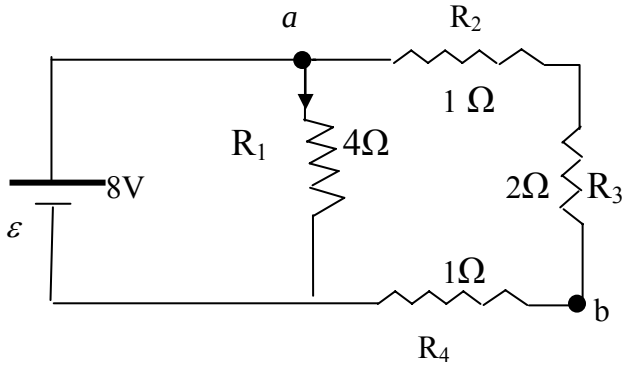
Q3 (10 points) In the shown circuit, Find:

(a) The equivalent resistance.

(b) The current I_1.

(c) The potential difference between *a* and *b*.

(d) The power dissipated in R_3.



Solution:

a) $R_{eq} = \{R_1 \,//[R_2 = R_3 = R_4\,]\}$

$= \{4//4\} = 2\Omega$

b) $I_1 = 8/R_1 = 2$A

c) $$I_2 = \frac{8}{(R_2 + R_3 + R_4)} = 2A,\ V_{ab} = I_2(R_2 + R_3) = 6V$$

d) $P = I_2^2 \, . \, R_3 = 8W$

Useful constants

$K=9\text{x}10^9$ N.m^2/C^2	$\varepsilon_o = 8.854\text{x}10^{-12} C^2 / N.m^2$,	$m_e=9.1\text{x}10^{-31}$kg
$M_p=1.67\text{x}10^{-27}$kg	$e = 1.602\text{x}10^{-19}$C	g=10m/s^2