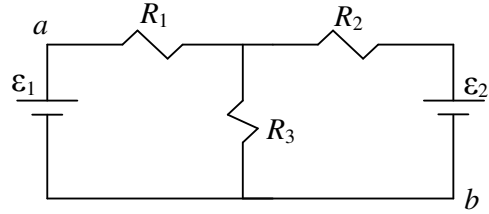**1.** In the given circuit
$R_1 = 10\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 30\ \Omega$, $\varepsilon_1 = 5V$ and $\varepsilon_2 = 10V$

Find:
(a) the current through the 10 $\Omega$ resistor,
(b) the potential difference between the points a and b



**2.** Derive the expression for the capacitance of a spherical capacitor of inner radius $R_{in}=15$ cm and outer radius $R_{out}=25$ cm. Then calculate it if the region between the inner and outer radius is filled with a dielectric of dielectric constant $\kappa = 2$.

**3.** Determine the magnitude and direction of the magnetic field at the mid point between the two long-straight wires of length 2L carrying currents $I_1=20$ A and $I_2=30$ A. Use the Biot-Sawart law in your calculation and assume L>>a.

Hint:

$$\int \frac{du}{(u^2 + R^2)^{3/2}} = \frac{u}{R^2(u^2 + R^2)^{1/2}} + C$$
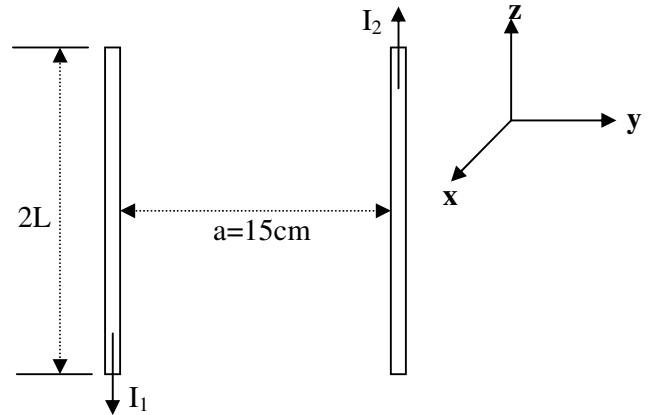


**4.** A conductor with a length of 50 m and diameter of 4 cm is connected to a potential difference of 100 volt. Find
(a) the current,
(b) the current density,
(c) magnitude of the electric field,
(d) the resistivity of the wire,
(e) the drift velocity of the charge carriers.

***Useful constants:*** $\mu_0 = 4\pi \times 10^{-7}$ N/A   $\varepsilon_0 = 8.85 \times 10^{-12}$ C$^2$/N.m$^2$