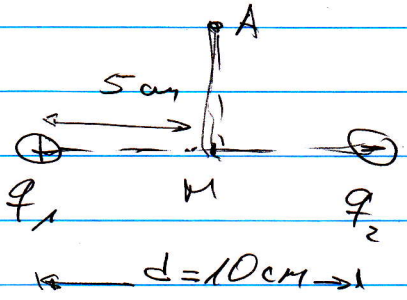
Ejercicio 1

$q_1 = 5\,\mu C \qquad q_2 = -2q_1 = -10\,\mu C$



a) $W_{\infty \to A} = q(V_A - V_\infty) = q V_A \qquad q = -e = -1.6 \times 10^{-19}\,C$

$$V_A = \frac{Kq_1}{r_1} + \frac{Kq_2}{r_2} = 9\times 10^9 \left(\frac{5\times 10^{-6}}{5\times 10^{-2}} - \frac{10\times 10^{-6}}{5\times 10^{-2}} \right) = -9\times 10^5 \text{ Volts}$$

$$W_{\infty \to A} = -1.6\times 10^{-19} \times (-9\times 10^5) = \boxed{1.44\times 10^{-13} \text{ Joules}}$$

b) $V_M = V_M(q_1) + V_M(q_2) + V_M(q_3) = 0 \Rightarrow V_M(q_3) = -V_M(q_1) - V_M(q_2) =$

$= 9\times 10^5 \text{ Volts} \Rightarrow \frac{Kq_3}{r_{AM}} = 9\times 10^5 \text{ volt} \Rightarrow q_3 = \frac{9\times 10^5 \times 5\times 10^{-2}}{9\times 10^9}$

$$q_3 = 5\times 10^{-6} C = \boxed{5\,\mu C}$$

c) $V_A = \frac{Kq_2}{r_{1A}} + \frac{Kq_2}{r_{2A}} = \frac{2Kq_2}{\sqrt{r_{1M}^2 + r_{MA}^2}} = \frac{-2\times 9\times 10^9 \times 10\times 10^{-6}}{\sqrt{2\times (5\times 10^{-2})^2}} = -2.55\times 10^6$ V

$$V_M = \frac{2Kq_2}{r_{1M}} = \frac{2\times 9\times 10^9 \times (-10\times 10^{-6})}{5\times 10^{-2}} = -3.6\times 10^6 \text{ V}$$

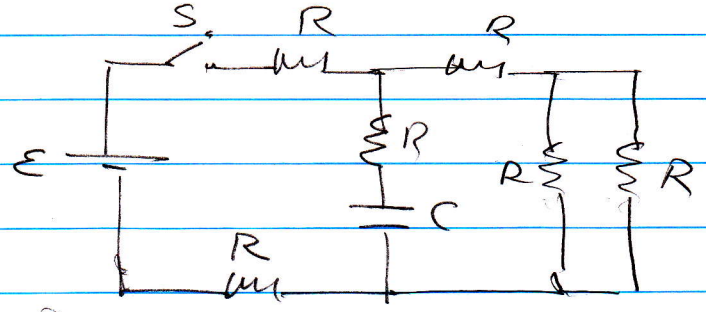
$EC_M + qV_M = EC_A + qV_A \Rightarrow EC_M = q(V_A - V_M) = 1.6\times 10^{-19} \times 1.05\times 10^6 =$

($EC_A = 0$)

$EC_M = 1.68\times 10^{-13}$ Joules $= \frac{1}{2} m_p v_M^2 \Rightarrow v_M = \sqrt{\frac{2\times 1.68\times 10^{-13}}{1.67\times 10^{-27}}}$

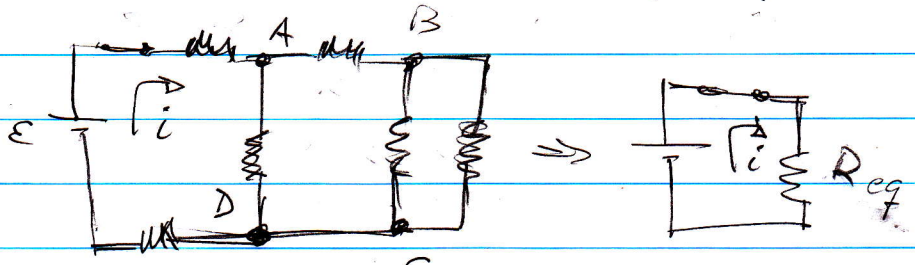
$v_M = 1.42\times 10^7$ m/s

Ejercicio 2



a) En $t=0 \Rightarrow q_C = 0 \Rightarrow$

$V_C = 0 \Rightarrow$

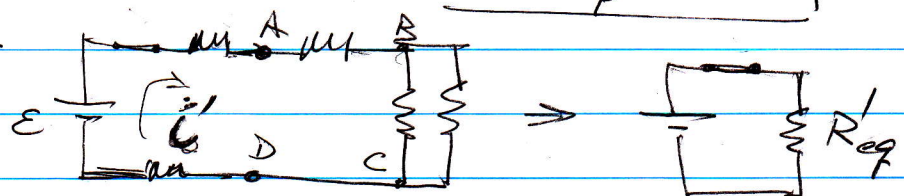


$$\frac{1}{R_{BC}} = \frac{1}{R} + \frac{1}{R} \Rightarrow R_{BC} = \frac{R}{2} \qquad R_{AC} = R + R_{BC} = R + \frac{R}{2} = \frac{3}{2}R$$

$$\frac{1}{R_{AD}} = \frac{1}{R} + \frac{1}{R_{AC}} = \frac{1}{R} + \frac{2}{3R} = \frac{5}{3R} \Rightarrow R_{AD} = \frac{3R}{5}$$

$$R_{eq} = 2R + R_{AD} = 2R + \frac{3R}{5} = \frac{13}{5}R \qquad \boxed{i = \frac{\mathcal{E}}{R_{eq}} = \frac{5}{13}\frac{\mathcal{E}}{R}}$$

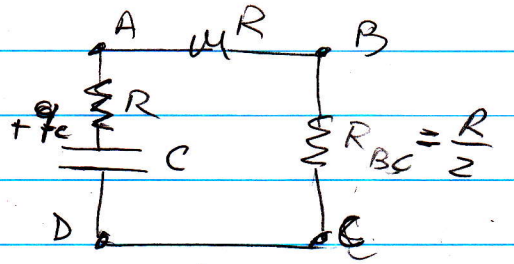
b) $t \to \infty \Rightarrow i_c = 0 \Rightarrow$



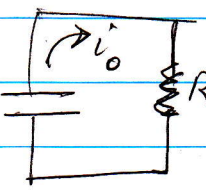
$$R'_{eq} = 2R + R + R_{BC} = 3R + \frac{R}{2} = \frac{7}{2}R \Rightarrow i' = \frac{\mathcal{E}}{R'_{eq}} = \frac{2}{7}\frac{\mathcal{E}}{R}$$

$$\boxed{P = \mathcal{E}i' = \frac{2}{7}\frac{\mathcal{E}^2}{R}}$$

c)



$\Rightarrow$



$$V_{AD}(0) = i' \cdot R_{AD} = i'\left(R + R_{BC}\right) = i'\left(R + \frac{R}{2}\right) = \frac{3}{2}i'R$$

Ejercicio 2 (continuación)

$$V_{AB}(0) = \frac{3}{2}\,\frac{2}{7}\,\frac{\mathcal{E}}{R}\,R = \frac{3}{7}\mathcal{E} \qquad i_0' = \frac{V_{AB}(0)}{R_0} = \frac{3}{7}\,\frac{\mathcal{E}}{5R}\,\frac{2}{} = \frac{6}{35}\,\frac{\mathcal{E}}{R}$$

$$P(0) = i_0'^{\,2} R_0 = \left(\frac{6}{35}\,\frac{\mathcal{E}}{R}\right)^2 \frac{5}{2} R = \boxed{\frac{18}{245}\,\frac{\mathcal{E}^2}{R} = P(0)}$$

Ejercicio 3

a) $R = \rho \frac{e}{A}$ $\quad A = 2\pi a h \Rightarrow R = \frac{\rho e}{2\pi a h} = \boxed{0.2\ \Omega}$

b) $i = \frac{V}{R} = \frac{5\ \text{Volt}}{0.2\ \Omega} = 25\ \text{Amp}$ $\quad J = \frac{i}{A} = \frac{i}{2\pi a h} = \boxed{7958\ \frac{\text{Amp}}{m^2}}$

c) $dR = \rho \frac{dr}{A} = \rho \frac{dr}{2\pi r h} \Rightarrow R = \frac{\rho}{2\pi h} \int_a^{a+e} \frac{dr}{r} = \frac{\rho}{2\pi h} \ln \frac{a}{a}$

$e = \frac{a}{2} \Rightarrow R = \frac{\rho}{2\pi h} \ln \frac{3}{2} = \boxed{826\ \Omega}$