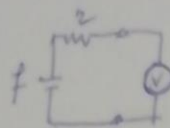
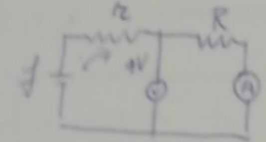
Correzione prova del 3/11/20:

①



10 V

$f = 10\,V$ perché $I = 0$ (Voltmetro ideale: $R_{in} = \infty$)



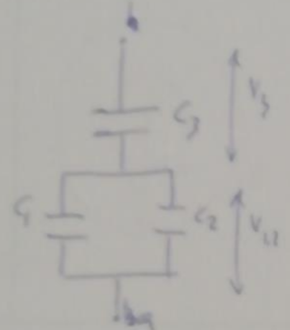
$$I = \frac{f}{r+R} = 200\,mA$$

$$f - rI = 9\,V$$

$$10V - 200\,mA\,r = 9$$

$$1\,V = 200\,mA\,r \Rightarrow r = \frac{1\,V}{0,2}\,\Omega = 5\,\Omega$$

②



$$V_b - V_a = 53\,V$$

$$C_{eq} = \frac{C_3(C_1+C_2)}{C_1+C_2+C_3} = \frac{2,4\,(2.9+1.8)}{2.9+1.8+2.4} = \frac{11.28}{7.1} = 1.59\,\mu F$$

$$Q_{eq} = 53 \times C_{eq} = 84,27\,\mu C$$

$$Q_{eq} = Q_3$$

$$V_3 = \frac{Q_3}{C_3} = \frac{84.27\,\mu C}{2.4\,\mu F} = 35.11\,V \Rightarrow V_{1,2} = 53 - 35.11 = 17.89\,V$$

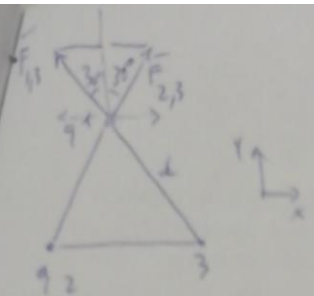
$$Q_1 = V_{1,2}\,C_1 = 17,89 \times 2,9\,\mu F = 51.88\,\mu C$$

$$Q_2 = V_{1,2}\,C_2 = 17.89 \times 1.8\,\mu F = 32,20\,\mu C$$

$$E_3 = \frac{1}{2}\frac{Q_3^2}{C_3} = \frac{1}{2}\frac{(84,27)^2 \times 10^{-12}}{2,4 \times 10^{-6}} = 1,48 \times 10^{3} \times 10^{-6} = 1.48 \times 10^{-3}\,J$$

$$E_2 = \frac{1}{2}\frac{Q_2^2}{C_2} = \frac{1}{2}\frac{(32,2)^2 \times 10^{-12}}{1,8 \times 10^{-6}} = 0,288 \times 10^{-3}\,J$$

$$E_1 = \frac{1}{2}\frac{Q_1^2}{C_1} = \frac{1}{2}\frac{(51.88)^2 \times 10^{-12}}{2,9 \times 10^{-6}} = 0,464 \times 10^{-3}$$



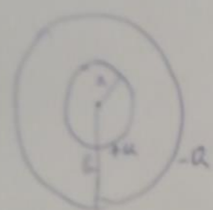
La forza risultante su ogni particella è data da:

$$\bar{F}_{1,3} + \bar{F}_{2,3}$$

Per simmetria le componenti lungo $\hat{x}$ si cancellano, mentre quelle lungo y si sommano.

$$\left|F_{tot}\right| = \frac{2}{4\pi\varepsilon_0}\frac{q^2}{d^2}\cos 30° = \frac{q^2}{4\pi\varepsilon_0 d^2}\sqrt{3}\ .$$

④



$a<r<b \quad \vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{r}$, $\bar{E} = 0$ altrove.

$$V(b) - V(a) = -\int_a^b \bar{E}\,d\bar{r} = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r}\right]_a^b = \frac{Q}{4\pi\varepsilon_0}\frac{a-b}{ab}$$

$$\frac{Q}{V(a)-V(b)} = 4\pi\varepsilon_0\frac{ab}{b-a} = C$$