#1

$\frac{3}{2}$ $\frac{2}{3}$ $\frac{5}{3}$ $I_{TOTAL} = \frac{3}{5}A$

$$R_{TOTAL} = r + \frac{Rr}{R+r}$$

$$I_{TOTAL} = \frac{V}{r + \frac{Rr}{R+r}}$$

$$I_R = \frac{V}{r + \frac{Rr}{R+r}} \cdot \frac{r}{R+r} = \frac{Vr}{r(R+r) + Rr} = \frac{Vr}{2rR + r^2} = \frac{V}{2R+r}$$

$$P = I_R^2 R = \frac{V^2 r^2 \, R}{(2rR + r^2)^2}$$

$$\frac{dP}{dR} = \frac{V^2 r^2}{(2rR+r^2)^2} + -2\frac{V^2 r^2 [2r]}{(2rR+r^2)^2}$$

$$\Rightarrow \quad 0 = \quad (2rR + r^2$$

$$P = \frac{V^2 \, R}{(2R+r)^2}$$

$$\frac{dP}{dR} = \frac{V^2}{(2R+r)^2} - 2\frac{V^2 R \cdot 2}{(2R+r)^3}$$

$$= \frac{V^2}{(2R+r)^3}\left[2R + r - 4R\right]$$

$$-2R + r = 0$$

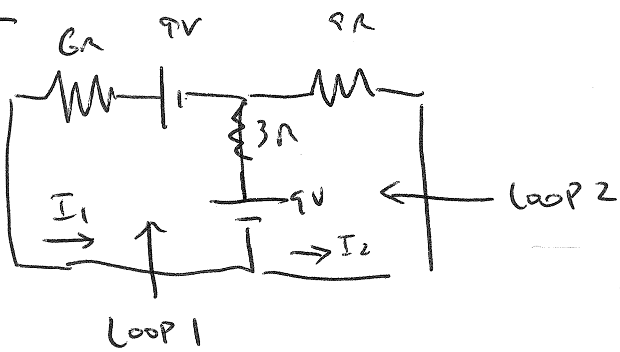
$$R = \frac{r}{2}$$

b) $R = \frac{r}{2}$

$$P = \frac{V^2}{(2R+r)^2} R = \frac{V^2 \frac{r}{2}}{(2r)^2}$$

$$\boxed{P_{MAX} = \frac{V^2}{8r}}$$

#2



Loop 1 : $+9 - 3(I_1 - I_2) + 9 - 6I_1 = 0$

Loop 2 : $-9I_2 + 3(I_1 - I_2) - 9 = 0$

#1 : $18 - 9I_1 + 3I_2 = 0$

$18 = 9I_1 - 3I_2$

$18 = 9I_1 - 3I_2$
$27 = 9I_1 - 36I_2$

#2 : $9 = 3I_1 - 12I_2$

#2×3 $27 = 9I_1 - 36I_2$

#1 − #2 × 3 $-9 = +33I_2$

$I_2 = -\frac{3}{11}$

$$9 = 3I_1 + \frac{36}{11}$$

$$\frac{99-36}{11} = 3I_1 \qquad \frac{63}{11 \times 3} = I_1$$

$$\boxed{I_1 = \frac{21}{11} A}$$

#3

a) $t=0$

$V = IR$

$5 = 100I$

$I = \frac{1}{20} A$ $\qquad \boxed{0.05A}$

b)

$$V_c = 5\cancel{4} \times e^{-t/RC}$$

$$\begin{array}{r} 2.73 \\ \times 5 \\ \hline 13.65 \end{array}$$

$$RC = 100 \times 10 \times 10^{-6} = 1ms$$

$$V_c = \frac{5}{e} = \frac{5}{2.783} \qquad V_R = 5 - \frac{5}{2.73}$$

$$= \frac{13.65-5}{2.73} = \frac{8.65}{2.73}$$

$$V_R = I_R R$$

$$\boxed{I_R = \frac{8.65}{273} A}$$

c) $\boxed{I = 0}$

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#4:

a) $$2\pi r L E = \frac{Q}{\varepsilon_0}$$

$$E = \frac{Q}{2\pi r L \varepsilon_0}$$

$$|\Delta V_{ab}| = \int_a^b \frac{Q}{2\pi r L \varepsilon_0}\, dr = \frac{Q}{2\pi L \varepsilon_0} \ln r \Big]_a^b$$

$$= \frac{Q}{2\pi L \varepsilon_0} \ln b/a$$

$$CV = Q$$

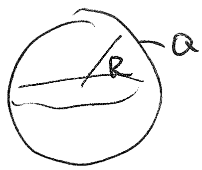
$$C = \frac{Q}{V} \Rightarrow C = \frac{2\pi L \varepsilon_0}{\ln b/a}$$

$$C/L = \frac{2\pi \varepsilon_0}{\ln b/a}$$

b) $$E/L = \frac{1}{2} C/L\, V^2 = \boxed{\frac{\pi \varepsilon_0}{\ln b/a} V^2}$$

PROBLEM 5

$$E(r) = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$



$$\Delta V = \int_R^\infty E(r)\,dr = \frac{1}{4\pi\varepsilon_0} - \frac{Q}{r}\Big]_R^\infty$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$$

$$\Delta V = \frac{Q}{C}$$

$$\boxed{C = 4\pi\varepsilon_0 R}$$