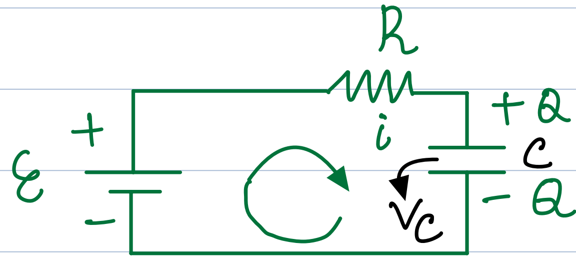


$$\boxed{V = Ri}$$

$$\boxed{Q = f(t)}$$

$$Q = CV_c$$

$$V_c = \frac{Q}{C}$$

$$+\varepsilon - V_R - V_C = 0$$

$$\boxed{+\varepsilon - Ri - \frac{Q}{C} = 0}$$

$$\Rightarrow \varepsilon - R\frac{dQ}{dt} - \frac{Q}{C} = 0$$

$$\Rightarrow \varepsilon - \frac{Q}{C} = R\frac{dQ}{dt}$$

$$\Rightarrow \frac{\varepsilon C - Q}{R} = \frac{dQ}{dt}$$

$$\Rightarrow \frac{dt}{RC} = \frac{dQ}{\varepsilon C - Q}$$

$$\Rightarrow \int_0^t \frac{dt}{RC} = \int_{Q=0}^{Q} \frac{dQ}{\mathcal{E}C - Q}$$

$$\Rightarrow \frac{t}{RC} = \Big[-\ln(\mathcal{E}C - Q)\Big]_{Q=0}^{Q}$$

$$\Rightarrow \frac{t}{RC} = -\ln(\mathcal{E}C - Q) - (-\ln(\mathcal{E}C))$$

$$\Rightarrow \frac{t}{RC} = -(\ln(\mathcal{E}C - Q) - \ln(\mathcal{E}C))$$

$$\Rightarrow \frac{t}{RC} = \ln\left(\frac{\mathcal{E}C - Q}{\mathcal{E}C}\right)$$

$$\mathcal{E}C - Q = u$$

$$\Rightarrow -dQ = du$$

$$\int \frac{-du}{u} = -\ln u$$

$$= \ln(\mathcal{E}C - Q)$$

$$\Rightarrow e^{-t/RC} = \frac{\mathcal{E}C - Q}{\mathcal{E}C}$$

$$\left[\ln A - \ln B = \ln\left(\frac{A}{B}\right)\right]$$

$$\Rightarrow \mathcal{E}C e^{-t/RC} = \mathcal{E}C - Q$$

$$\Rightarrow Q = \mathcal{E}C - \mathcal{E}C e^{-t/RC}$$

$$\therefore Q = \mathcal{E}C(1 - e^{-t/RC})$$

$$t = 0; \quad Q = \mathcal{E}C(1 - e^{0}) = \mathcal{E}C(1-1) = 0$$

$$t = \infty; \quad Q = \mathcal{E}C(1 - e^{-\infty}) = \mathcal{E}C(1-0) = \mathcal{E}C$$

$t = RC \quad \boxed{T_c}$,

$$Q = \mathcal{E}C\left(1 - e^{-RC/RC}\right)$$
$$= \mathcal{E}C\left(1 - e^{-1}\right)$$
$$= \mathcal{E}C\left(1 - \frac{1}{e}\right)$$
$$= 0{\cdot}632\,C$$

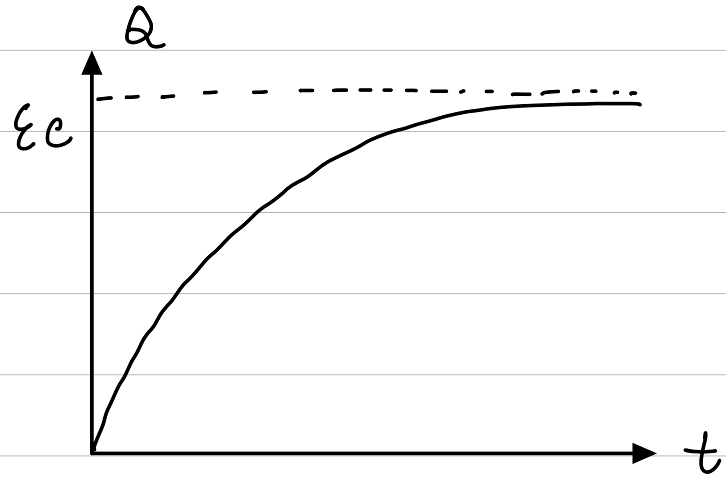
$V = Ri$

$R = \frac{V}{I}$

$Q = CV$

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

$$RC = \frac{V}{I} \cdot \frac{Q}{V}$$
$$= \frac{Q}{I}$$
$$= \frac{Q}{\left(\frac{Q}{T}\right)}$$
$$= Q \times \frac{T}{Q}$$
$$= T$$



$$i = \frac{dQ}{dt}$$

$$= \frac{\varepsilon C}{RC} e^{-t/RC}$$

$$= \frac{\varepsilon}{R} e^{-t/RC}$$

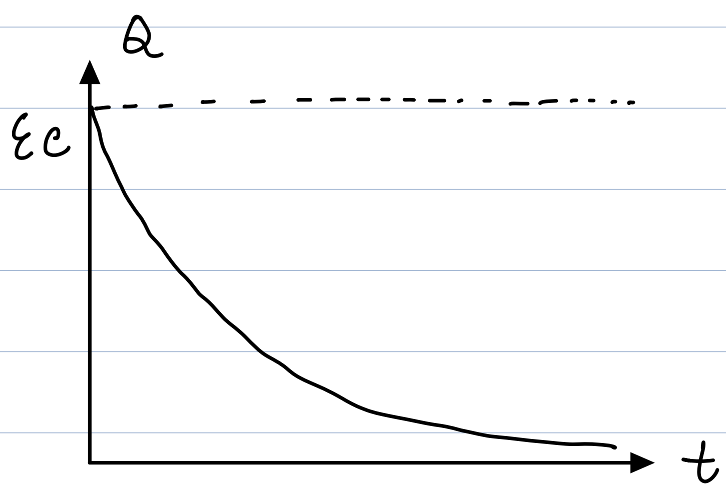
$$= i_0 e^{-t/RC}$$

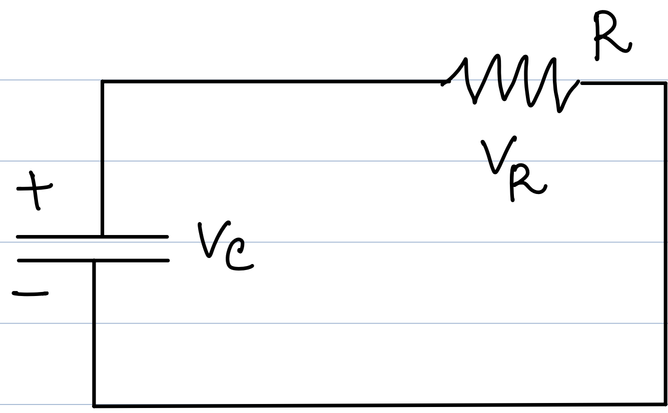
$t = 0, \quad i = i_0 e^{0} = i_0$

$t = \infty, \quad i = i_0 e^{-\infty} = \frac{i_0}{e^{\infty}} = 0$

$t = RC, \quad i = i_0 e^{-\frac{RC}{RC}}$

$$= \frac{i_0}{e} = 0.37\, i_0$$





$Q = CV_C$

$V_C = \frac{Q}{C}$

$V_C - V_R = 0$

$\Rightarrow \frac{Q}{C} - iR = 0$

$\Rightarrow \frac{Q}{C} - \left(-\frac{dQ}{dt}\right) R = 0$

$\Rightarrow \frac{Q}{C} + \frac{dQ}{dt} R = 0$

$\Rightarrow \frac{dQ}{dt} = \frac{-Q}{RC}$

$\Rightarrow \frac{dQ}{Q} = \frac{-dt}{RC}$

$\Rightarrow \int_{\varepsilon C}^{Q} \frac{dQ}{Q} = -\int_{t=0}^{t} \frac{dt}{RC}$

$$\Rightarrow \ln Q \Big|_{\varepsilon C}^{Q} = \frac{-t}{RC}\Big|_{0}^{t}$$

$$\Rightarrow \ln Q - \ln(\varepsilon C) = \frac{-t}{RC}$$

$$\Rightarrow \ln \frac{Q}{\varepsilon C} = \frac{-t}{RC}$$

$N = N_0 e^{-\lambda t}$

$$\Rightarrow \frac{Q}{\varepsilon C} = e^{-t/RC}$$

$$\therefore Q = \varepsilon C e^{-t/RC}$$

$Q \rightarrow$ how much change there is in the capacitor

$(\varepsilon C - Q) \rightarrow$ how much charge was discharge

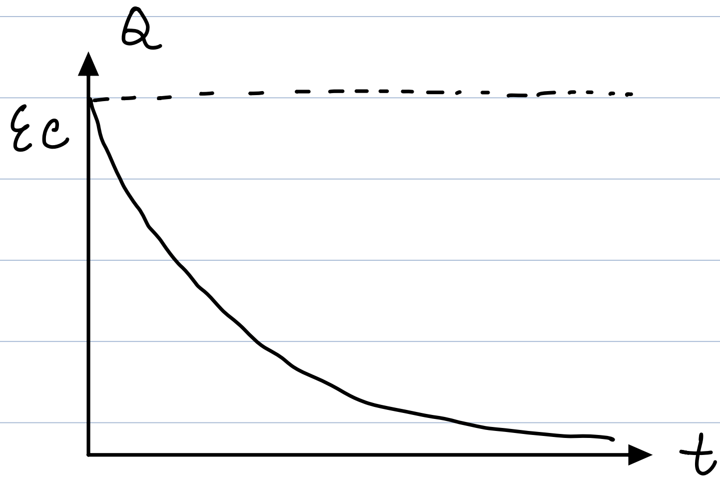
$t = 0, \ Q = \varepsilon C$

$t = \infty, \ Q = 0$

$t = RC, \ Q = \varepsilon C e^{-1}$

$= \varepsilon \frac{C}{e}$

$= 0.37\ \mathcal{E}C$

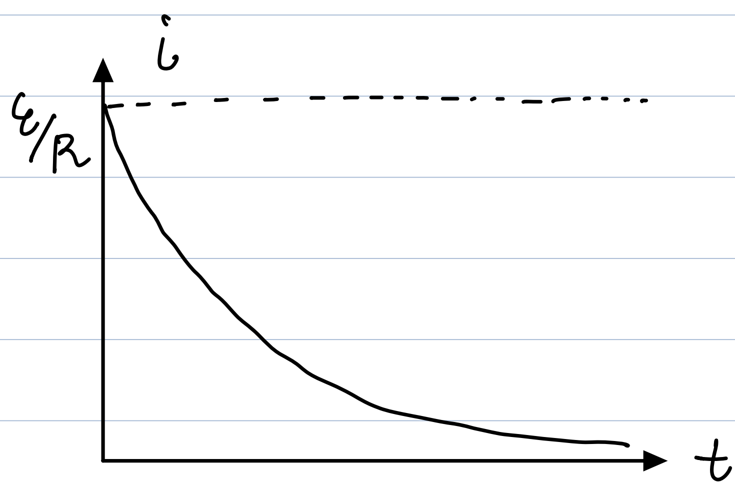


$$i = -\frac{dQ}{dt} = -\frac{d}{dt}\left(\mathcal{E}C\, e^{-t/RC}\right)$$

$$= -\mathcal{E}C \times \left(-\frac{1}{RC} e^{-t/RC}\right)$$

$$= \frac{\mathcal{E}}{R} e^{-t/RC}$$

$$= i_0\, e^{-t/RC}$$



$t = 0, \quad i = \frac{\mathcal{E}}{R} = i_0$

$t = \infty, \; i = 0$

$t = RC, \; i = \frac{\mathcal{E}}{R} \cdot \frac{1}{e}$

Chapter-27

57, 58, 59, 61, 64, 66

57| $\quad Q = \mathcal{E}C(1 - e^{-t/RC})$

$\Rightarrow CV_C = \mathcal{E}C(1 - e^{-t/RC})$

$\Rightarrow V_C = \mathcal{E}C(1 - e^{-t/RC})$

$V_R = Ri$

$= R\frac{\mathcal{E}}{R}e^{-t/RC}$

$V_R = V_C$

$\Rightarrow \mathcal{E}e^{-t/RC} =$

$\mathcal{E}(1 - e^{-t/RC})$

$\Rightarrow t =$

58|

a) $\tau = RC$

b) $Q = \mathcal{E}C$

c) $Q = \mathcal{E}C(1 - e^{-t/RC})$

$t =$

59|

$Q = \mathcal{E}C(1 - e^{-t/RC})$

$\Rightarrow \mathcal{E}C \times 0.99 = \mathcal{E}C \times (1 - e^{-t/RC})$

$t = \underset{\sim}{4.6}\,RC$

61|

a) $Q = \mathcal{E}C(1 - e^{-t/RC})$

$\Rightarrow CV_0 = \mathcal{E}C(1 - e^{-t/RC})$

$\Rightarrow V_0 = \mathcal{E}(1 - e^{-t/RC})$

$\Rightarrow 5 = 12\left(1 - e^{\frac{-1.3 \times 10^{-6}}{\tau}}\right)$

$\tau =$

b) $\tau = RC$

$\Rightarrow \dfrac{\tau}{R} = C$