$\boxed{\#18.69}$

solution to diff. eq. : $\underline{\frac{\Delta Q}{\Delta t} R + Q/C = \mathcal{E}}$ (*)

$\frac{\Delta Q}{\Delta t} \to \frac{dQ}{dt}$

$R \frac{dQ}{dt} + Q/C = \mathcal{E}$ (**)

Solution to homogeneous eq. $R \frac{dQ}{dt} + Q/C = 0$

is $Q(t) = A e^{-t/RC}$ where A - const. (see 18.9)

(which can be found from initial condition)

For non-homogeneous eq. (**) assume that A is <u>function</u>, i.e. $A = A(t)$

Try $Q(t) = A(t) e^{-t/RC}$ (*) as solution

Let's find $\frac{dQ}{dt}$:

$$\frac{dQ(t)}{dt} = \frac{d}{dt}\left(A(t) \cdot e^{-t/RC}\right) = \frac{dA(t)}{dt} \cdot e^{-t/RC} + A(t) \frac{d}{dt}\left(e^{-t/RC}\right)$$

$$\frac{dQ(t)}{dt} = A'(t) e^{-t/RC} - \frac{A(t)}{RC} e^{-\frac{t}{RC}}$$

plug in this into (**); replace $Q(t)$ accordingly (*)

$\Rightarrow \quad R A'(t) = \mathcal{E} e^{t/RC}$

integrate: $A(t) = \mathcal{E} C e^{t/RC} + B$, B - const

$\Rightarrow \quad Q(t) = B e^{-t/RC} + \mathcal{E} C$

$$I(t) = \frac{dQ(t)}{dt} = -\frac{B}{RC} e^{-t/RC}$$

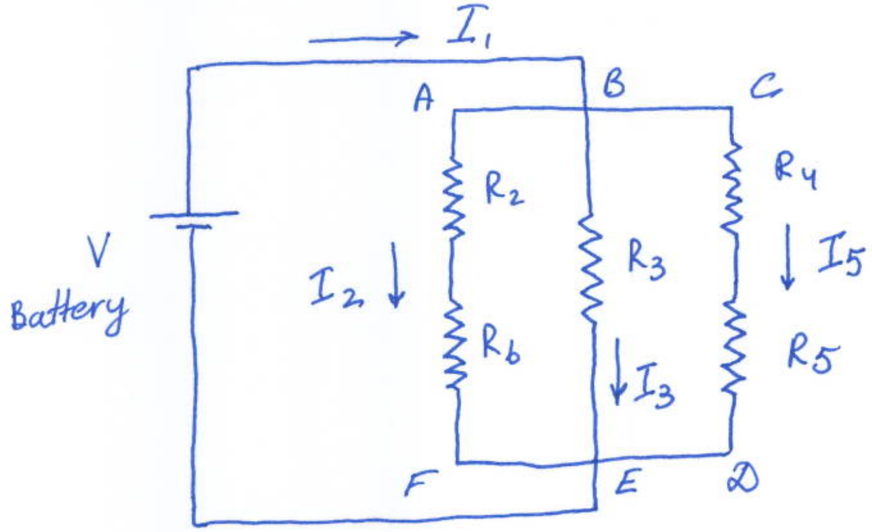
Initial condition $I(0) = \frac{\mathcal{E}}{R}$ (read p 739)

$\Rightarrow$ gives $\underline{B = -\mathcal{E} C}$

therefore $\boxed{I(t) = \frac{\mathcal{E}}{R} e^{-t/RC}}$

$\boxed{\#18.93}$

Can transform to more convinient look



$R_2 = 5\,\Omega$; $R_3 = 30\,\Omega$; $R_4 = 2\,\Omega$; $R_b = 10\,\Omega$;

$I_3 = 1A$; $I_2 = 2A$; $I_4 = 5A$;

what are V, R, I_2, I_5 -? (where $R \equiv R_5$)

1) Note

$$I_4 = I_5$$
$$I_b = I_2$$

2) Consider closed branch B-C-D-E:

Apply Loop Rule:

$$-I_3 R_3 + I_5 R_4 + I_5 R_5 = 0$$ (direct. is counter-clock wise)

$$\Rightarrow 30 = I_5 (2 + R)$$

$$\Rightarrow \boxed{R = 4}$$

3) Consider node B:

Apply Node Rule

$$I_1 = I_2 + I_3 + I_5$$

$$\Rightarrow \boxed{I_1 = 8A}$$

4) Voltage V : $(AF \parallel BE \parallel CD)$

$\Rightarrow$ $V = I_3 R_3$

$$\boxed{V = 30 \text{ V}}$$