MT2 #1

(a) $C_1 = C_3 = C_0$

$C_{23} = C_2 + C_3 = 2C_0$

$C_{eq} = \left(\frac{1}{C_0} + \frac{1}{3C_0}\right)^{-1}$

$= \left(\frac{4}{3C_0}\right)^{-1} = \frac{3}{4}C_0$

$Q_1 = \frac{3}{4}C_0V$

$Q_2 = \frac{1}{2}C_0V$

$Q_3 = \frac{1}{4}C_0V$

$Q_{eq} = VC_{eq} = \frac{3}{4}VC_0$

$V = V_1 + V_{23}$

$V_1 = \frac{Q_1}{C_1} = \left(\frac{3}{4}C_0V\right)\left(\frac{1}{C_0}\right)$

$V_1 = \frac{3}{4}V$

$V_2 = V_3 = V - V_1 = \frac{1}{4}V$

$Q_2 = V_2C_2 = \frac{1}{4}V \cdot 2C_0 = \frac{1}{2}VC_0$

$Q_3 = V_3C_3 = \frac{1}{4}VC_0$

(b) $U = \frac{1}{2}CV^2$

$\Rightarrow U_2 = \frac{1}{2}C_2V_2^2$

$= \frac{1}{2}(2C_0)\left(\frac{1}{4}V\right)^2$

$= \left(\frac{1}{2}\right)(2C_0)\left(\frac{1}{16}V^2\right)$

$U_2 = \frac{1}{16}C_0V^2$

(c) $C_2 = \frac{\varepsilon_0 A}{d} = 2C_0$

$C_2' = \frac{\varepsilon_0 A}{(2d)} = \frac{1}{2}C_2 = C_0$

$C_{23} = C_1 + C_2 = 2C_0$

$C_{eq} = \left(\frac{1}{C_1} + \frac{1}{C_{23}}\right)^{-1} = \left(\frac{1}{C_0} + \frac{1}{2C_0}\right)^{-1}$

$= \left(\frac{3}{2C_0}\right)^{-1} = \frac{2}{3}C_0$

$Q_T = Q_1 = \frac{2}{3}C_0V$

$Q_1 = \frac{2}{3}C_0V$

$Q_2 = Q_3 = \frac{1}{3}C_0V$

$V = V_1 + V_{23}$

$V_1 = \frac{Q_1}{C_1} = \frac{2}{3}C_0V\left(\frac{1}{C_0}\right) = \frac{2}{3}V$

$V_2 = V_3 = V - V_1 = \frac{1}{3}V$

$Q_2 = V_2C_2 = \frac{1}{3}VC_0$

$Q_3 = V_3C_3 = \frac{1}{3}VC_0$

(d) $U_2' = \frac{1}{2}C_2V_2^2$

$= \frac{1}{2}C_0\left(\frac{1}{3}V\right)^2$

$U_2' = \frac{1}{18}C_0V^2$

(e) $\Delta Q = Q_T' - Q_T$

$= \left(\frac{2}{3}C_0V\right) - \left(\frac{3}{4}C_0V\right)$

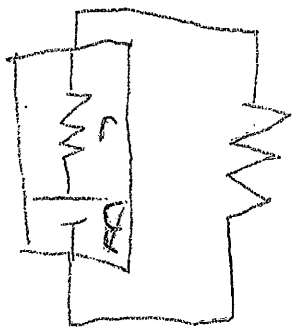
$= \left(\frac{2}{3} - \frac{3}{4}\right)C_0V$

$\Delta Q = -\frac{1}{12}C_0V$

(f) $W = \Delta QV = -\frac{1}{12}C_0V^2$

E2Q2 Answers

$$\frac{\mathcal{E}}{r+R_1} = I_1, \quad \frac{\mathcal{E}}{r+R_2} = I_2$$



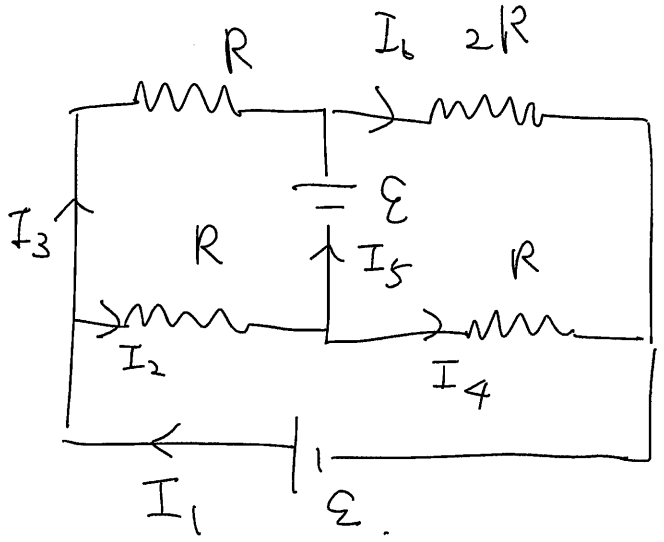
$$I_1(r+R_1) = \mathcal{E} = I_2(r+R_2)$$

$$(I_1 - I_2)r = I_2R_2 - I_1R_1$$

$$r = \frac{I_2R_2 - I_1R_1}{I_1 - I_2} = 500\,\Omega$$

$$\mathcal{E} = I_1(r+R_1) = 525\,V$$

Exam 2.
Prob 3.



$$I_1 = I_2 + I_3 = I_4 + I_6 \quad (1)$$

$$I_2 = I_4 + I_5 \quad (2)$$

$$I_6 = I_3 + I_5 \quad (3)$$

$$\mathcal{E} - I_2 R - I_4 R = 0 \quad (4)$$

$$\mathcal{E} + I_3 R - I_2 R = 0 \quad (5)$$

$$\mathcal{E} - I_6 2R + I_4 R = 0 \quad (6)$$

$$\mathcal{E} - I_3 R - I_6 2R = 0 \quad (7)$$

⑥ - ⑦

$$I_4 R + I_3 R = 0$$

$$I_4 = -I_3 . \quad (10)$$

$$I_6 2R = \mathcal{E} - I_3 R .$$

$$I_6 = \frac{\mathcal{E} - I_3 R}{2R} = \frac{\mathcal{E}}{2R} - \frac{I_3}{2} \quad (12)$$

③

$$\frac{\mathcal{E}}{2R} - \frac{I_3}{2} = I_3 + I_5$$

$$I_5 = \frac{\mathcal{E}}{2R} - \frac{3}{2} I_3 . \quad (11)$$

⑤

$$I_2 = \frac{\mathcal{E}}{R} + I_3 \quad (9)$$

① $I_1 = \frac{\mathcal{E}}{R} + 2I_3 = -I_3 + \frac{\mathcal{E}}{2R} - \frac{I_3}{2}$ ⑧

$= -\frac{3}{2} I_3 + \frac{\mathcal{E}}{2R}$

$\frac{7}{2} I_3 = -\frac{\mathcal{E}}{2R}$

$\boxed{I_3 = -\frac{1}{7}\frac{\mathcal{E}}{R}}$

⑧ $I_1 = \frac{\mathcal{E}}{R} - \frac{2}{7}\frac{\mathcal{E}}{R}$.

$= \boxed{\frac{5}{7}\frac{\mathcal{E}}{R}}$

⑨ $I_2 = \frac{\mathcal{E}}{R} - \frac{1}{7}\frac{\mathcal{E}}{R}$

$= \boxed{\frac{6}{7}\frac{\mathcal{E}}{R}}$

⑩ $\boxed{I_4 = \frac{\mathcal{E}}{7R}}$

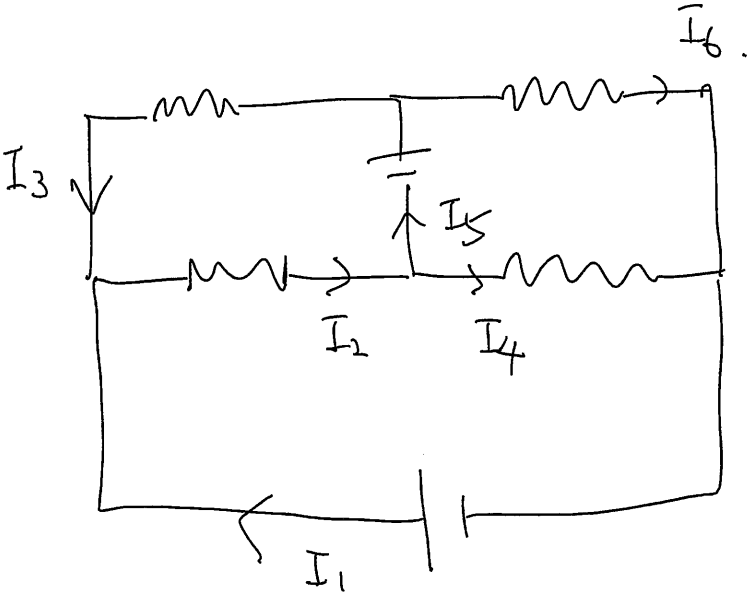
⑪ $I_5 = \frac{\mathcal{E}}{2R} + \frac{3}{2}\frac{1}{7}\frac{\mathcal{E}}{R}$

$= \frac{10}{14}\frac{\mathcal{E}}{R} = \boxed{\frac{5}{7}\frac{\mathcal{E}}{R}}$

① $I_6 = \frac{\mathcal{E}}{2R} + \frac{1}{2}\frac{1}{7}\frac{\mathcal{E}}{R}$

$= \frac{8}{14}\frac{\mathcal{E}}{R}$

$= \boxed{\frac{4}{7}\frac{\mathcal{E}}{R}}$



$P_5 = I_5 \mathcal{E}$

$= \frac{5}{7}\frac{\mathcal{E}^2}{R}$

$P_1 = I_1 \mathcal{E} = \frac{5}{7}\frac{\mathcal{E}^2}{R} = P_5$ the same.

$$P = P_3 + P_2 + P_4 + P_6$$

$$= I_3^2 R + I_2^2 R + I_4^2 R + I_6^2 2R$$

$$= \frac{1}{49}\frac{\mathcal{E}^2}{R} + \frac{36}{49}\frac{\mathcal{E}^2}{R} + \frac{1}{49}\frac{\mathcal{E}^2}{R} + \frac{32}{49}\frac{\mathcal{E}^2}{R}$$

$$= \frac{70}{49}\frac{\mathcal{E}^2}{R}$$

$$= \boxed{\frac{10}{7}\frac{\mathcal{E}^2}{R}} = P_1 + P_5$$