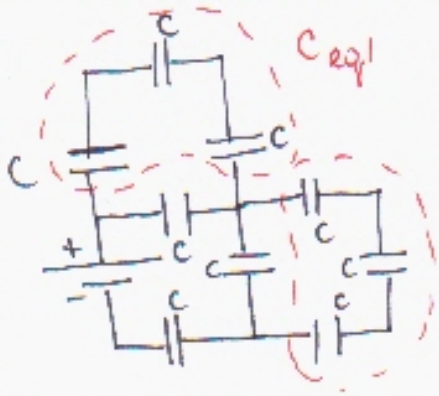
1) What is the effective capacitance?



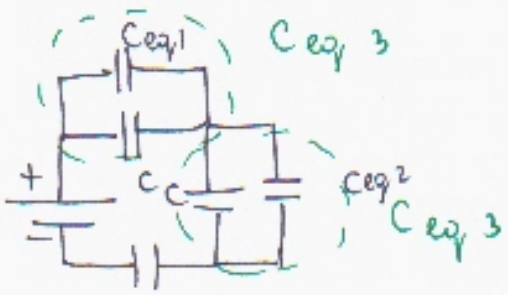
IN SERIES

$$\frac{1}{C_{eq1}} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C}$$

$$\frac{1}{C_{eq1}} = \frac{3}{C}$$

$$C_{eq1} = \frac{1}{3}C$$

$$C_{eq1} = C_{eq2} = \frac{1}{3}C$$



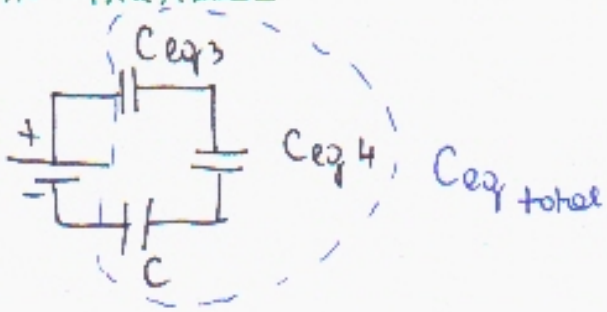
$$C_{eq3} = C_{eq1} + C$$

$$C_{eq3} = \frac{1}{3}C + C$$

$$= \frac{1}{3}C + \frac{3}{3}C = \frac{4}{3}C$$

$$C_{eq3} = C_{eq4} = \frac{4}{3}C$$

IN PARALLEL



$$\frac{1}{C_{eq\ total}} = \frac{1}{C_{eq3}} + \frac{1}{C_{eq4}} + \frac{1}{C}$$

$$\frac{1}{C_{eq\ total}} = \frac{1}{\frac{4}{3}C} + \frac{1}{\frac{4}{3}C} + \frac{1}{C}$$

$$= \frac{3}{4C} + \frac{3}{4C} + \frac{1}{C}$$

$$= \frac{3}{4C} + \frac{3}{4C} + \frac{4}{4C}$$

$$= \frac{10}{4C} = \frac{5}{2C}$$

$$C_{eq\ total} = \frac{2}{5}C$$

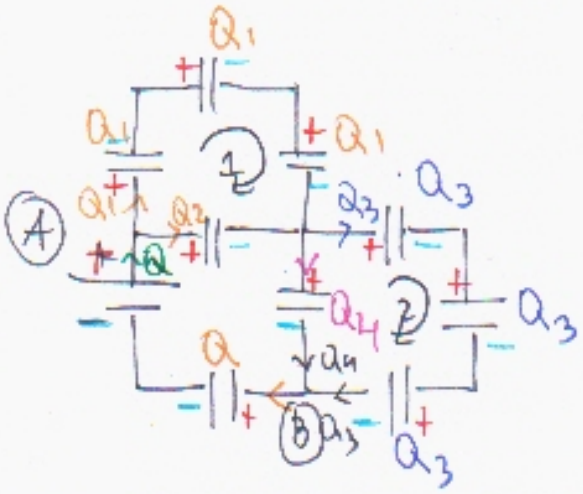
IN SERIES

2) What is the total charge moved through the battery?

$$Q = C\Delta V = C \cdot \mathcal{E}_{\text{battery}}$$

$$Q = C_{eq\ total} \cdot \mathcal{E}$$

3) What is the charge on each capacitor?



(A) $Q = Q_1 + Q_2$

Loop 1

$$-\frac{Q_1}{C} - \frac{Q_1}{C} - \frac{Q_1}{C} + \frac{Q_2}{C} = 0$$

$$3Q_1 = Q_2$$

$$Q = Q_1 + 3Q_1 = 4Q_1$$

$$Q_1 = \frac{Q}{4}$$

$$Q_2 = \frac{3}{4}Q$$

(B) $Q_3 + Q_4 = Q$

$$-\frac{Q_3}{C} - \frac{Q_3}{C} - \frac{Q_3}{C} + \frac{Q_4}{C} = 0$$

$$3Q_3 = Q_4$$

$$Q_3 + 3Q_3 = Q$$

$$Q_3 = \frac{Q}{4}$$

$$Q_4 = \frac{3}{4}Q$$

$$Q_1 = Q_3$$

$$Q_2 = Q_4$$