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Subject:

Date: 20/1/04

1)

$$Q = CV$$

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

$$= \frac{20 \times 40 \times 10^{-6}}{10 \times 10^{-6}}$$

$$= 800V$$

2i)

$$Q = CV$$

$$0.16 \times 10^{-3} \times V = 64 \times 10^{-6} \times 30$$

$$V = 120V$$

2ii)

$$E = \frac{1}{2} QV$$

$$= \frac{1}{2} \times 0.16 \times 10^{-3} \times 120 \times 30$$

$$= 0.0288J$$

3)

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

$$\frac{1}{C_{eq}} = \frac{4}{C}$$

$$C_{eq} = \frac{C}{4}$$

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

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

$$C_{eq} = C + C + C + C$$

$$= 4C$$

$$\frac{1}{C_{eq}} = \frac{1}{2C} + \frac{1}{2C}$$

$$= \frac{2}{2C}$$

$$C_{eq} = C$$

$$C_{eq} = 2C + \frac{C}{2}$$

$$= 2\frac{1}{2}C$$

$$\frac{1}{C_{eq}} = \frac{1}{C} + \frac{1}{C} + \frac{1}{2C}$$

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

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

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4ia) P.d across each capacitor = V

4ib) Q across each capacitor = CV

4ic) Total energy = $2 \times \frac{1}{2} CV^2$
 $= CV^2$

4iia) P.d across each capacitor = V

4iib) Q on each capacitor = CV

4iic) Total energy = $3 \times \frac{1}{2} CV^2$
 $= \frac{3}{2} CV^2$

4iia) P.d across each capacitor = $\frac{V}{2}$

4iib) Q on each capacitor = $\frac{CV}{2}$

4iic) Total energy = $2 \times \frac{1}{2} C \left(\frac{V}{2}\right)^2$
 $= \frac{CV^2}{4}$

4iia) P.d across each capacitor = $\frac{V}{3}$

4iib) Q on each capacitor = $\frac{CV}{3}$

4iic) Total energy = $3 \times \frac{1}{2} C \left(\frac{V}{3}\right)^2$
 $= 3 \times \frac{1}{2} C \frac{V^2}{9}$
 $= \frac{CV^2}{6}$

4va)

P.d across each capacitor = $\frac{V}{3}$ P.d across each series capacitor = $\frac{2}{3}V$

4vb)

$$Q_1 = CV_1$$

$$= \frac{2}{3}CV$$

$$Q_2 = CV_2$$

$$= \frac{1}{3}CV$$

4vc)

$$E_T = E_1 + E_2$$

$$= \frac{1}{2}CV_1^2 + \frac{1}{2}CV_2^2$$

$$= \frac{2}{9}CV^2 + \frac{1}{9}CV^2$$

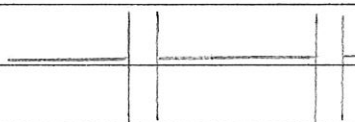
$$= \frac{1}{3}CV^2$$

5)

$$C = 3 \times 2C + C$$

$$= 7C$$

8a)



$$V_1C + V_1C = Q$$

$$V_1 \frac{C}{2} + V_1 \frac{C}{2} =$$

$$V_1 \frac{C}{2} + V_2 \frac{C}{2} =$$

$$C \frac{V}{2} = Q$$

$$V_1 \frac{C}{2} + V_2 \frac{C}{2} =$$

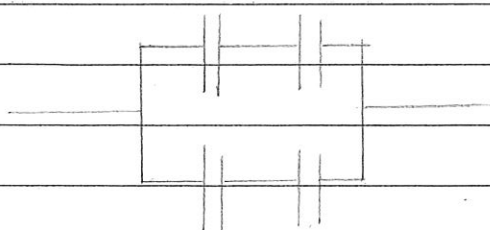
$$C \frac{V}{2} = Q$$

$$C \frac{V}{2} = Q$$

$$V_1 \frac{C}{2} + V_2 \frac{C}{2} =$$

$$C \frac{V}{2} = Q$$

8b)



9a)

$$I = \frac{Q}{t} \quad Q = It$$

$$Q = \frac{I}{f} = I \left(\frac{1}{f} \right)$$

$$= \frac{I}{f} = \frac{I}{f}$$

9b)

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

$$= \frac{I}{f} \left(\frac{1}{f} \right)$$

$$= \frac{7.3 \times 10^{-6}}{50 \times 6.0}$$

$$= 2.5 \times 10^{-8}$$

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7c)

$$C = \frac{\epsilon A}{d}$$

$$\frac{I}{fV} = \frac{\epsilon A}{d}$$

$$\epsilon = \frac{Id}{fVA}$$

9d)

$$\epsilon_r = \frac{\epsilon_{\text{glass}}}{\epsilon_{\text{air}}}$$

Conduct experiment with air as dielectric, measuring

 I_{air} Conduct experiment with glass as dielectric, measuring I_{glass}

$$\epsilon \propto I$$

$$= kI$$

$$\epsilon_r = \frac{I_{\text{glass}}}{I_{\text{air}}}$$

10)

$$Q = CV$$

$$= 2 \times 10^{-6} \times 200$$

$$= 4 \times 10^{-4} \text{ C}$$

$$Q = C_1 V + C_2 V$$

$$= C_1 V + \frac{1}{2} C_2 V$$

$$= \frac{3}{2} C_2 V + \frac{3}{2} C_1 V$$

$$C_1 = \frac{2}{3} C$$

$$= \frac{2}{3} \times 4 \times 10^{-4}$$

$$= 2.67 \times 10^{-4} \text{ C}$$

$$C_2 = \frac{1}{3} C$$

$$= \frac{1}{3} \times 4 \times 10^{-4}$$

$$= 1.33 \times 10^{-4} \text{ C}$$

11a)

$$V = \frac{Q}{C_{\text{eq}}}$$

$$= \frac{1}{\frac{1}{1 \times 10^{-6}} + \frac{1}{2 \times 10^{-6}}}$$

$$V_1 = \frac{2}{3} \times 1200$$

$$C_1 V_1 = C_2 V_2$$

$$C_1 V_1 = 2C(V_2)$$

$$V_1 = 2 \times 2V_2$$

$$V_1 + V_2 = V$$

$$4V_2 = V$$

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$$V_2 = \frac{1}{3}V$$

$$= 400V$$

$$V_1 = 800V$$

$$Q = \cancel{C_1} V C_{eq}$$

$$= 1200 \times \frac{1}{\frac{1}{1 \times 10^{-6}} + \frac{1}{2 \times 10^{-6}}}$$

$$= 8 \times 10^{-4} C$$

1/b)

$$Q + Q = Q_1' + Q_2'$$

$$2Q = C_1 V + C_2 V$$

$$= (3 \times 10^{-6}) V$$

$$V = \frac{2 \times 8 \times 10^{-4}}{3 \times 10^{-6}}$$

$$= 5.33 \times 10^2 V$$

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$$V_{\text{eff}} = V$$

$$V_{\text{eff}} =$$

$$V_{\text{eff}} =$$

$$V_{\text{eff}} = V - \frac{1}{2} V$$

$$\frac{1}{2} V = 1000 \times \frac{1}{2} = 500$$

$$V_{\text{eff}} = 500$$

$$V_{\text{eff}} + V_{\text{eff}} = V + V$$

$$V_{\text{eff}} + V_{\text{eff}} = 2V$$

$$V_{\text{eff}} = 2V$$

$$V_{\text{eff}} = 2V$$

$$V_{\text{eff}} = 2V$$