CAPACITANCE/ TUTORIAL ANSWERS

ANSWERS FOR TUTORIAL 1

1.

$$C = \frac{Q}{V} \quad \Rightarrow \quad C = \frac{0.005}{50}$$
$$= 1\times10^{-4}$$

The capacitance is $1x10^{-4}F$ (100μF)

2.

$$C = \frac{Q}{V} \quad \Rightarrow \quad 25\times10^{-6} = \frac{Q}{20}$$
$$\Rightarrow \quad Q = 5\times10^{-4}$$

The capacitor is storing 0.0005C

3.

$$C = \frac{Q}{V} \quad \Rightarrow \quad 50\times10^{-6} = \frac{2.5\times10^{-3}}{V}$$
$$\Rightarrow \quad V = 50$$

The p.d. across the capacitor is 50V

ANSWERS FOR TUTORIAL 2

1.

$$E = \tfrac{1}{2}QV \quad \Rightarrow \quad E = \tfrac{1}{2} \times 0.001 \times 20$$
$$= 0.01$$

The work done during charging is 0.01J

2.

$$E = \tfrac{1}{2}CV^2 \quad \Rightarrow \quad 0.016 = \tfrac{1}{2}C \times 40^2$$
$$\Rightarrow \quad C = 2 \times 10^{-5}$$

The capacitance is 2×10^{-5}F (20μF)

3.

$$E = \frac{\frac{1}{2}Q^2}{C} \quad \Rightarrow \quad 1.35 = \frac{\frac{1}{2}Q^2}{30 \times 10^{-6}}$$
$$\Rightarrow \quad Q = \sqrt{8.1 \times 10^{-5}}$$
$$= 0.009$$

The stored charge is 0.009C

4.

$$E = \tfrac{1}{2}CV^2 \quad \Rightarrow \quad 0.0125 = \tfrac{1}{2} \times 10 \times 10^{-6} \times V^2$$
$$\Rightarrow \quad V = 50$$

The p.d. across the capacitor is 50V

ANSWERS FOR TUTORIAL 3

1.

$$V = RI \quad \Rightarrow \quad 20 = R \times 5 \times 10^{-3}$$
$$\Rightarrow \quad R = 4000$$

The reactance of the capacitor is 4000Ω

2. Apply V=RI to the whole circuit to get:-

$$5 = R \times 2 \times 10^{-3}$$

$$\Rightarrow \quad R = 2500$$

Since the resistance of the whole circuit is 2500Ω, the reactance of the capacitor must be 1000Ω.

3. Since the circuit is behaving as a voltage divider, the p.d. across the capacitor is $\frac{1500}{(2000+1500)} \times 14V$
$= 6$

This is the r.m.s. voltage across the capacitor so the peak voltage must by 6x√2 = 8V

ANSWERS FOR TUTORIAL 4

1. Note the voltage and current at some frequency. Use them to calculate the resistance of the component. Repeat the measurements for different supply frequencies. If the resistance remains constant, then the component is a resistor.

2.

$$V = RI \quad \Rightarrow \quad 24 = 480 \times I$$
$$\Rightarrow \quad I = 0.05$$

Since the resistance is independent of the frequency, the current remains at 0.005A when the frequency doubles to 200Hz.

3. The initial current depends only on the p.d. and the resistance.

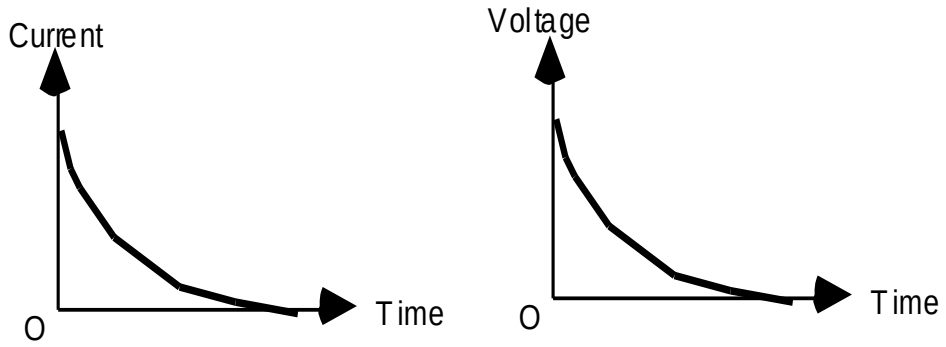
$$C = \frac{Q}{V} \quad \Rightarrow \quad 2 \times 10^{-6} = \frac{20 \times 10^{-3}}{V}$$
$$\Rightarrow \quad V = 10000$$

Since the p.d. is 10000V,

$$V = RI \quad \Rightarrow 10000 = 10000 \times I$$
$$\Rightarrow \quad I = 1$$

The initial current is 1A

4.



5. Each is 2.5 times brighter since neither the resistance nor the capacitive reactance depend on the supply voltage.

6. The bulbs increase in brightness from (1) to (3) since the capacitive reactance becomes less with increasing capacitance.

7. Bulb (1) remains at constant brightness while bulb (2) increases in brightness as the capacitive reactance decreases with the increase in supply frequency.

8.

$$E = \tfrac{1}{2}CV^2 \Rightarrow \quad 1.125\times10^{-4} = \tfrac{1}{2}\times25\times10^{-6}\times V^2$$
$$\Rightarrow \quad v = 3$$

The p.d. across the capacitor is 3V.

V=RI applied to the resistor gives V = 2000 x 2.5x10^{-3} = 5 volts.

Since the supply voltage equals the sum of the individual p.d.'s round the circuit, its value is 8V.