Department of Mechanical, Materials and Manufacturing Engineering

The University of Nottingham

Electromechanical Devices MMME2051EMD

Exercise Sheet 2 – Inductance and Capacitance

2.1 A 6 V battery supplies a 2.2 nF capacitor and a 4.7 nF capacitor connected in series. Calculate the equivalent capacitance of the circuit, the total charge stored and the voltage across the 2.2 nF capacitor.

1.5nF, 9×10^{-9} C; 4.09 V

2.2 A 12 V battery supplies a 2.2 nF capacitor and a 4.7 nF capacitor connected in parallel. Calculate the equivalent capacitance of the circuit, the total charge stored and the charge on the 2.2 nF capacitor.

6.9nF, 8.28×10^{-8} C; 2.64×10^{-8} C

2.3 A 6V power supply (shown as a battery) supplies a 470 μF capacitor in series with 100 μF and 220 μF capacitors connected in parallel as shown in Fig 2.3. Calculate the capacitance of the circuit.

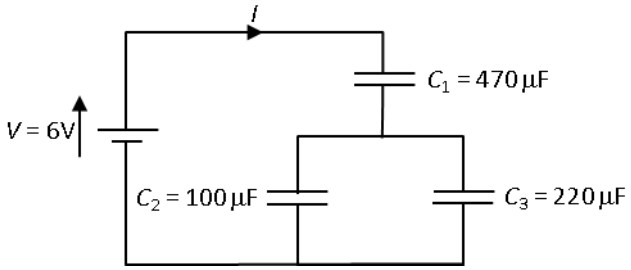

Fig 2.2

The supply voltage now drops to zero at a steady rate over ten seconds. What current *I* flows in the circuit and in which direction?

190 μF; –0.11 mA i.e., current flows backwards into the power supply.

2.4 A circuit consists of three inductors as shown in Fig 2.3. Calculate the overall inductance of the circuit. Assume there is no mutual inductance between the various inductors in the circuit.

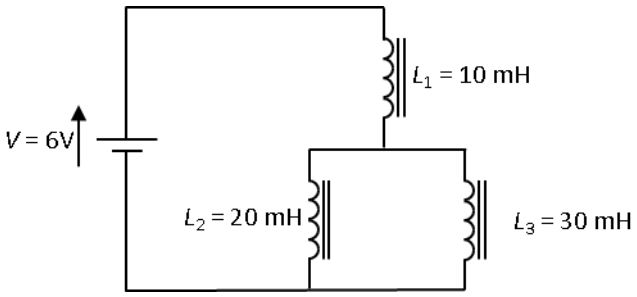

Fig 2.3

22 mH

2.5 A 100 nF capacitor is connected across a 10 V, 1 kHz power supply. Find the current, expressed both in Cartesian and polar form. Does the current lead or lag the voltage?

j6.3 mA or 6.3 mA ∠90° (leading)

2.6 A 10 mH inductor is connected across a 10 V, 1.5 kHz power supply. Find the current, expressed both in Cartesian and polar form. Does the current lead or lag the voltage?

–j106 mA or 106 mA ∠–90° (lagging)

2.7 A 6V battery supplies a 220 μF capacitor and a 470 μF capacitor connected in parallel. Calculate the equivalent capacitance of the circuit and the total charge stored.

690 μF; 0.00414 C.

2.8 A steady current of 0.2 A flows through an inductor with a value of 5 mH. The current starts to **decrease** at a rate of 10mAs^{-1}. Calculate the voltage induced in the coil.

–50μV.