

SHEET
Capacitor and Inductors

1. Find the capacitance of a parallel-plate capacitor if the dimensions of each rectangular plate is 1 by 0.5 cm and the distance between plates is 0.1 mm. The dielectric is air. Also, find the capacitance if the dielectric is mica instead of air.
2. Find the distance between the plates of a 0.01-pF parallel-plate capacitor if the area of each plate is 0.07 m² and the dielectric is glass.
3. A capacitor has a disk-shaped dielectric of ceramic that has a 0.5-cm diameter and is 0.521 mm thick. The disk is coated on both sides with silver, this coating being the plates. Find the capacitance
4. Find the total capacitance C_T of the circuit shown in Fig. 1.

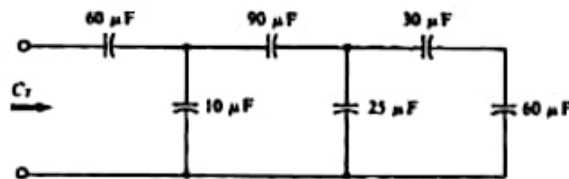


Fig. 1

5. A 4-pF capacitor, a 6-pF capacitor, and an 8-pF capacitor are in parallel across a 300-V source. Find (a) the total capacitance, (b) the magnitude of charge stored by each capacitor, and (c) the total (U) Because stored energy.
6. Find each capacitor voltage in the circuit shown in Fig. 2

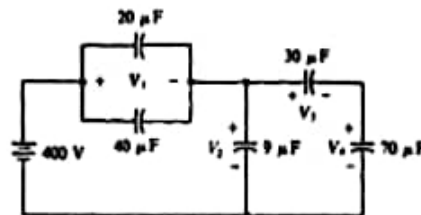


Fig 2

7. Find the inductance of a 100-turn coil that is linked by 3×10^{-4} Wb when a 20-mA current flows through it.
8. Find the approximate inductance of a single-layer coil that has 300 turns wound on a plastic cylinder 12 cm long and 0.5 cm in diameter.
9. Find the total inductance L_T of the circuit shown in Fig. 3.

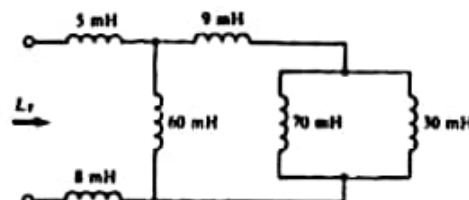


Fig 3

Sheet (4)
Capacitor and inductor

① rectangular 1 by 0.5 cm

$d = 0.1 \text{ mm}$, dielectric is air (1.0006) mica (7.5)

$C = ??$

$$C = \epsilon \frac{A}{d} \quad \begin{cases} \epsilon_{\text{air}} = \epsilon_0 \epsilon_r = 1.0006 \times 8.85 \times 10^{-12} = 8.855 \times 10^{-12} \\ \epsilon_{\text{mica}} = \epsilon_0 \epsilon_r = 7.5 \times 8.85 \times 10^{-12} = 4.4375 \times 10^{-11} \end{cases}$$

$$A = 1 \times 10^{-2} \times 0.5 \times 10^{-2} = 5 \times 10^{-5} \text{ m}^2$$

$$d = 0.1 \times 10^{-3} = 1 \times 10^{-4} \text{ m}$$

$$\therefore C_{\text{air}} = \frac{8.855 \times 10^{-12} \times 5 \times 10^{-5}}{1 \times 10^{-4}} = 4.43 \times 10^{-12} \text{ F}$$

$$C_{\text{mica}} = \frac{4.4375 \times 10^{-11} \times 5 \times 10^{-5}}{1 \times 10^{-4}} = 2.212 \times 10^{-13} \text{ F}$$

② $d = ??$ $C = 0.01 \text{ pF}$ $A = 0.07 \text{ m}^2$ dielectric is glass (7.5)

$$\epsilon = \epsilon_0 \epsilon_r = 8.85 \times 10^{-12} \times 7.5 = 6.6375 \times 10^{-11}$$

$$C = \epsilon \frac{A}{d} \rightarrow d = \frac{A \epsilon}{C} = \frac{0.07 \times 6.6375 \times 10^{-11}}{0.01 \times 10^{-12}} = 464.625 \text{ m}$$

③ disk of ceramic (7500) diameter = 0.5 cm and 0.521 mm thick

$C = ??$

$$C = \epsilon \frac{A}{d} \quad \begin{cases} \epsilon = \epsilon_0 \epsilon_r = 8.85 \times 10^{-12} \times 7500 = 6.6375 \times 10^{-8} \\ A = \pi r^2 = \pi \left(\frac{0.5 \times 10^{-2}}{2} \right)^2 = 1.96 \times 10^{-5} \end{cases}$$

$$C = 6.6375 \times 10^{-8} \times \frac{1.96 \times 10^{-5}}{0.521 \times 10^{-3}} = 2.5 \times 10^{-9} \text{ F}$$

④ Find total capacitance

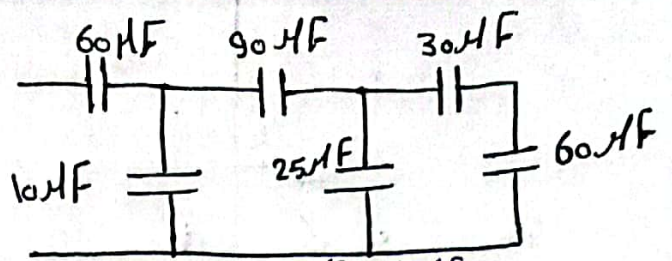
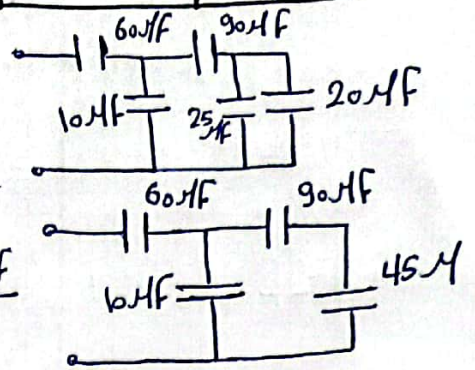
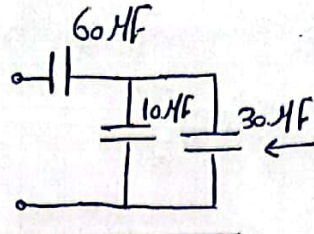
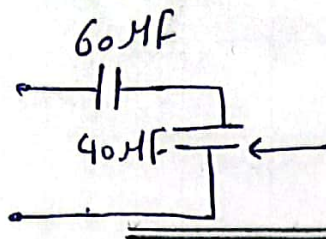
$$(60, 30) \text{ Series} = \frac{30 \times 60}{30 + 60} = 20 \mu F$$

$$(20 || 25) \text{ parallel} = 45 \mu F$$

$$(45, 90) \text{ Series} = 30 \mu F$$

$$(30 || 10) \text{ parallel} = 40 \mu F$$

$$C_T = 40 \times 60 = 24 \mu F$$

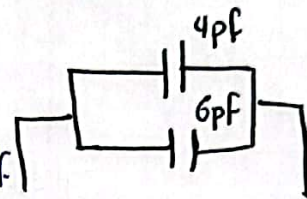


⑤

$$C_T = 4p + 6p = 10pF$$

$$Q = C \times V = 10 \times 300 \times 10^{-12} = 3 \times 10^{-9} C$$

$$W_c = \frac{1}{2} C V^2 = \frac{1}{2} \times 10^{-11} \times (300)^2 = 4.5 \times 10^{-7} J$$



$$U = 300V$$

⑥ <<report>>

⑦ Find $L = ??$ $N = 100 \text{ turn}$, $\phi = 3 \times 10^{-4} \text{ wb}$, $I = 20 \text{ mA}$

$$L = \frac{N\phi}{I} = \frac{100 \times 3 \times 10^{-4}}{20 \times 10^{-3}} =$$

⑧ $\mu_r = 1$, $N = 300 \text{ turn}$, $\ell = 12 \times 10^{-2} \text{ m}$, $r = \frac{0.5}{2} \times 10^{-2} \text{ m}$

$$L = \mu N^2 \frac{A}{\ell}$$

$$\mu = \mu_0 \mu_r = 1 \times 4\pi \times 10^{-7} = 4\pi \times 10^{-7}$$

$$A = \left(\frac{0.5}{2} \times 10^{-2}\right)^2 \pi = 1.96 \times 10^{-5} \text{ m}^2$$

$$L = \frac{4\pi \times 10^{-7} \times 1.96 \times 10^{-5} \times (300)^2}{12 \times 10^{-2}} = 1.85 \times 10^{-5} \text{ H}$$

⑨ Find total impedance

$$70 \text{ H } 30 = 21 \text{ m H}$$

$$9 + 21 = 30 \text{ m H}$$

$$30 // 60 = 5 \text{ m H}$$

$$L_T = 5 + 5 + 8 = 18 \text{ m H}$$

