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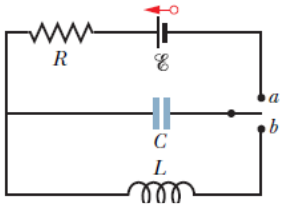
Solid State Physics

Siegen, 18/12/2019

Physics 1 for Nano: written Exercises 6

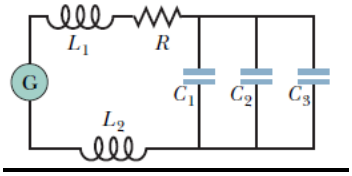
WS 2019 (sheet 5)

Exercise 31



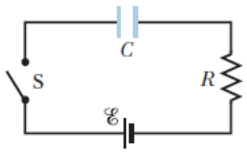
In circut shown left R=14.0 Ω, C = 6.20 mF, and L = 54.0 mH, and the ideal battery has emf = 34.0 V. The switch is kept at *a* for a long time and then thrown to position *b*. What are the (a) frequency and (b) current amplitude of the resulting oscillations?

Exercise 32



In Fig. left, a generator with an adjustable frequency of oscillation is connected to resistance R=100Ω, inductances are L_1 =1.70 mH and L_2=2.30mH, and capacitances C_1= 4.00 µF, C_2= 2.50 µF, and C_3= 3.50µF. (a) What is the resonant frequency of the circuit? (Hint: Review the derivations for resistors in parallel and capacitors in parallel) What happens to the resonant frequency if (b) R is increased by ΔR=1Ω, (c) L_1 is increased by ΔL_1=0.05 mH, and (d) C_3 is removed from the circuit?

Exercise 33.



The circuit shown left consists of switch S, a 12.0 V ideal battery, a 20.0 resistor, and an air-filled M2 capacitor. The capacitor has parallel circular plates of radius 5.00 cm, separated by 3.00 mm. At time t=0, switch S is closed to begin charging the capacitor. The electric field between the plates is uniform. At t=250 µs, what is the magnitude of the magnetic field within the capacitor, at radial distance 3.00 cm?

Exercise 34

Some neodymium–glass lasers can provide 100 TW of power in 1.0 ns pulses at a wavelength of 0.26 mm. How much energy is contained in a single pulse? What is the amplitude of the electric and magnetic field?

Exercise 35

A plane electromagnetic wave, with wavelength 3.0 m, travels in vacuum in the positive direction of an x axis. The electric field, of amplitude 300 V/m, oscillates parallel to the y axis. What are the (a) frequency, (b) angular frequency, and (c) angular wave number of the wave? (d) What is the amplitude of the magnetic field

component? (e) Parallel to which axis does the magnetic field oscillate? (f) What is the time averaged rate of energy flow in watts per square meter associated with this wave? The wave uniformly illuminates a surface of area 2.0 m2. If the surface totally absorbs the wave, what are (g) the rate at which momentum is transferred to the surface and (h) the radiation pressure on the surface?

Exercise 36

Sunlight just outside Earth's atmosphere has an intensity of 1.40 kW/m². Calculate (a) E_m and (b) B_m for sunlight there, assuming it to be a plane wave. In middle Europe the solar intensity in summer is 0.7kWm² and in winter about 0.25kW/m² due to mean angle of illumination of 65° and 15°, respectively. Estimate the mean absorption of sunlight by the atmosphere.

Note:
Exercises have to give back at lecture 14.01.20. It will be discussed in exercise hours at 15.01.20
Next Lectures January 7 and 8 8:30am