

國立臺北大學 107 學年度日間學士班暨進修學士班轉學生招生考試試題

系 別：電機工程學系日間學士班 2 年級

科 目：普通物理

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可 不可使用計算機

1. Briefly describe the following terms:
  - (a) Heisenberg's Uncertainty Principle (5%)
  - (b) Lorentz force law (5%)
2. Two insulating spheres have radii  $r_1$  and  $r_2$ , masses  $m_1$  and  $m_2$ , and uniformly distributed charges  $-q_1$  and  $q_2$ . They are released from rest when their centers are separated by a distance  $d$ . How fast is each moving when they collide? (10%)
3. Estimate the band gap of the semiconductor in the infrared LED of a typical television remote control at 1000 nm. [Hint:  $hc = 1240 \text{ eV} \cdot \text{nm}$ ] (10%)
4. A series RLC circuit has  $R = 425 \Omega$ ,  $L = 1.25 \text{ H}$ ,  $C = 3.50 \mu\text{F}$ . It is connected to an AC source with  $f = 60.0 \text{ Hz}$  and  $\Delta V_{\text{max}} = 150 \text{ V}$ .
  - (a) Determine the inductive reactance, the capacitive reactance, and the impedance of the circuit. (5%)
  - (b) Find the maximum current in the circuit. (5%)
5. A capacitor of capacitance  $C$  is discharging through a resistor of resistance  $R$ .
  - (a) After how many time constants is the charge on the capacitor one-fourth its initial value? (5%)
  - (b) After how many time constants is the stored energy on the capacitor one-fourth its initial value? (5%)
6. Please write down the Maxwell's four equations in integral form. (12%)
7. A rock of mass 50 g is thrown with a speed of 40 m/s. What is its de Broglie wavelength? (8%)
8. A  $N$ -turn solenoid has a radius of  $r$  and an overall length of  $\ell$ .
  - (a) What is the inductance ( $L$ ) of the solenoid? (5%)
  - (b) What is the self-induced emf ( $\mathcal{E}_L$ ) in the solenoid if the current it carries decreases at the rate of  $dI/dt$ ? (5%)
9. In SI units, the electric field in an electromagnetic wave is described by,  $E_y = 100 \sin(1.00 \times 10^7 x - \omega t)$ ; Find (a) the amplitude of the corresponding magnetic field oscillations, and (b) the wavelength  $\lambda$ . (10%)
10. The coil in an AC generator consists of 8 turns of wire, each of area  $A = 0.0900 \text{ m}^2$ , and the total resistance of the wire is  $12.0 \Omega$ . The coil rotates in a 0.500-T magnetic field at a constant frequency of 60.0 Hz. (a) Find the maximum induced emf in the coil, and (b) What is the maximum induced current in the coil when the output terminals are connected to a low-resistance conductor? (10%)

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