

Preliminary Study Guide

1. Coulomb law and applications (Chapter 23), especially Section 23.3 (Examples 23.2-23.4)

- 1) three charged beads on a insulating rod and equilibrium (Problem 23.13)
- 2) equilibrium of the electric charge in electric and gravitational field (Problem 23.33)

2. Gauss law and its applications (Chapter 24; Problems 24.11, 24.17)

- 1) Derivation of the electric field from an infinite uniformly charged thin rod (Example 24.4)
- 2) Derivation of the electric field from an insulating uniformly charged spherical shell
- 3) Derivation of the electric field from an insulating uniformly charged solid sphere (Example 24.3)
- 4) Electric field of an infinite plane (Example 24.5)

3. Electric field (Chapter 23) and electric potential (Chapter 25; Example 25.3) of uniform charge distributions (Sections 23.5, 25.5)

- 1) infinite uniformly charged thin rod (at some distance away from the rod, example 23.7, Problem 25.45)
- 2) uniformly charged ring (Example 23.8, Example 25.5, Problem 25.47)
- 3) uniformly charged semicircular rod (the electric field at the center of the circle, Problems 23.45, 25.44)
- 4) electrostatic shielding (Section 24.4, Example 24.7): explanation based on electric field and electric potential of a charged conducting spherical shell
- 5) electric field and electric potential inside, on surface and outside conducting solid sphere (Section 25.6)

4. Capacitors and dielectrics (Chapter 26)

- 1) Definition of capacitance and capacitance of a spherical conductor (Sections 26.1, 26.2)
- 2) Capacitance of a parallel-plate capacitor (Section 26.2)
- 3) Capacitors in combination: derivation of equivalent capacitance for capacitors connected in parallel (Section 26.3)
- 4) Capacitors in combination: derivation of equivalent capacitance for capacitors connected in series (Section 26.3)
- 5) Capacitors in combination (Example 26.3, Problems 26.22, 26.25)
- 6) Energy stored in a charged capacitors: derivation (Section 26.4)

5. Electrical current and Ohm's law (Chapter 27):

- 1) Resistance of conducting wire and its relation to the length and the cross-sectional area (Section 27.2, Example 27.2)
- 2) Resistance in combination: resistance in series and in parallel (Section 28.2)
- 3) Equivalent resistance for resistance in combinations (Examples 28.4, 28.5, Problems 28.7, 28.9, 28.17, 28.21)

6. DC circuits (Chapter 28)

- 1) Kirchhoff's rules and their applications: single loop circuits and multi loop circuits (Sections 28.3, Examples 28.6, 28.7, Problems 28.31, 28.33a)
- 2) RC circuit -- charging a capacitor (Section 28.4, Example 28.9)

7. Magnetic field (Chapter 29-30-31-32)

- 1) Charged particle in magnetic field (Section 29.3, Problem 29.16)
- 2) Ampere's law and applications (magnetic field inside and outside long wire (Example 30.5, Problem 30.38), magnetic field inside long solenoid (Section 30.4))
- 3) Bio-Savart law and applications (derivation magnetic field at the center of a circular loop, Example 30.3)
- 4) Magnetic field of some combinations of wires (Example 30.2, Problems 30.7, 30.10, 30.13)
- 5) Magnetic flux and Faraday's law (Example 31.3, Problem 31.13, Problem 31.26)
- 6) Magnetic energy: derivation (Section 32.3)
- 7) Inductance of a long solenoid: derivation (Example 32.1)
- 8) RL circuits: qualitative understanding (as discussed during the corresponding group work, Section 32.2)

8. AC circuits (Chapter 33):

- 1) resistor circuits (derivation of the current as function of time), Section 33.2
- 2) capacitor circuits (derivation of the current as function of time), Section 33.4
- 3) inductor circuits(derivation of current and charge as function of time), Section 33.3
- 4) freely oscillating LC circuit (derivation of $Q(t)$ and $I(t)$), Section 32.5

9. Maxwell equations (Chapter 34):

- 1) Qualitative discussion of Maxwell equation: physical meaning (Section 34.2, **Eq. 34.4-34.7 must be remembered by heart!**)
- 2) Qualitative discussion on EM waves (Section 34.3)
- 3) Wave equation and harmonic traveling wave solutions (Section 34.3)
- 4) Definition and physical meaning of Poynting vector (Section 34.4, 34.5, Example 34.5)