

# Electricity and magnetism

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Francis W. Sears, Addison-Wesley, 1946.

## Coulomb's law

1. The structure of the atom
2. Charging by contact
3. Conductors and insulators
4. Quantity of charge
5. Verification of Coulomb's law; Rutherford's nuclear atom
6. Systems of units

## The electric field

1. The electric field
2. Calculation of electric intensity
3. Field of a dipole
4. Field due to continuous distribution of charge
5. Lines of force
6. Gauss' law
7. Field and charge within a conductor
8. Application of Gauss' law
9. The Millikan oil drop experiment
10. Dielectric strength

## Potential

1. Electrostatic potential energy
2. Potential
3. Potential difference
4. Potential and charge distribution
5. Potential gradient
6. Potential of a charged spherical conductor
7. Poisson's and Laplace's equations
8. Electric intensity, potential, and charge distribution
9. Equipotential surfaces
10. Sharing of charge by conductors
11. The Van de Graaff generator

## Current, resistance, resistivity

1. Current
2. The direction of a current
3. The complete circuit
4. Electrical conductivity
5. Resistance and resistivity; Ohm's law
6. Standard resistors
7. Calculation of resistance
8. Measurement of current, potential difference, and resistance
9. Joule's law
10. Average and effective values of a current

## **D. C. circuits**

1. Electromotive force
2. The circuit equation
3. Alternate definition of electromotive force
4. Potential difference between points in a circuit
5. Terminal voltage of a seat of EMF
6. The potentiometer
7. Series and parallel connection of resistors
8. Networks containing seats of EMF
9. Kirchhoff's rules
10. The Wheatstone bridge
11. Power
12. Measurement of power and energy

## **Chemical and thermal EMFs**

1. Chemical energy and EMFs
2. Electrode potentials
3. Electrical cells
4. The hydrogen electrode
5. Calculation of EMFs
6. Hydrogen ion concentration
7. The Daniell cell
8. Reversibility
9. Polarization
10. The dry cell
11. The lead storage battery
12. Standard cells
13. Electrolysis
14. The electrolysis of water
15. Chemical free energy
16. Thermal EMFs
17. Thomson EMF
18. Peltier EMF
19. Seebeck EMF
20. Dependence of EMF on temperature

## **Properties of dielectrics**

1. Induced charges
2. Induced charges on spheres
3. Susceptibility, dielectric coefficient, and permittivity
4. Extension of Gauss' law; displacement
5. Boundary conditions
6. Polarization
7. Force between charges in a dielectric

## **Capacitance and capacitors**

1. Capacitance of an isolated conductor
2. Capacitors
3. The parallel plate capacitor
4. Other types of capacitor
5. Charge and discharge currents of a capacitor
6. Capacitors in series and parallel
7. Energy of a charged capacitor
8. Energy density in an electric field
9. Force between the plates of a capacitor
10. Displacement current

## The magnetic field

1. Magnetism
2. The magnetic field; induction
3. Force on a moving charge
4. Orbits of charged particles in magnetic fields
5. The cyclotron
6. Measurement of  $e/m$
7. The mass spectrograph
8. Force on a current-carrying conductor
9. Force and torque on a complete circuit

## Galvanometers, ammeters and voltmeters; the D. C. motor

1. The galvanometer
2. The pivoted coil galvanometer
3. Ammeters and voltmeters
4. The ballistic galvanometer
5. The dynamometer
6. The direct current motor
7. Magnetic field of a current element

## Magnetic field of a current and of a moving charge

1. Magnetic field of a current element
2. Field of a straight conductor
3. Surface and line integrals of magnetic induction
4. Force between parallel straight conductors; the ampère
5. Field of a circular turn
6. Field of a solenoid
7. Field of a moving point charge

## Induced electromotive force

1. Motional electromotive force
2. The Faraday law
3. Lenz's law
4. The betatron
5. Induced EMF in a rotating coil
6. The Faraday disk dynamo
7. The direct current generator
8. Search coil method of measuring magnetic flux
9. Galvanometer damping
10. Eddy currents

## Inductance

1. Mutual inductance
2. Self-inductance
3. Growth of current in an inductive circuit
4. Energy associated with an inductor
5. Inductors in series

## Magnetic properties of matter

1. Introduction
2. Origin of magnetic effects
3. Equivalent surface currents
4. Magnetic susceptibility, permeability, and magnetic intensity
5. Magnetization

## **Ferromagnetism**

1. Ferromagnetism
2. The Curie temperature
3. Hysteresis
4. The domain theory
5. Magnetic poles
6. The magnetic field of the Earth
7. General definition of magnetic intensity
8. Magnetization of a bar
9. Torque on a bar magnet
10. Magnetic moment; the magnetometer
11. The magnetic circuit
12. Derivation of magnetic circuit equation
13. Energy per unit volume in a magnetic field

## **Alternating currents**

1. The alternating current series circuit
2. Root-mean-square or effective values
3. Phase relations between voltage and current
4. Potential difference between points of an A.C. circuit
5. Rotating vector diagrams
6. Circuits in parallel
7. Resonance
8. Power in A.C. circuits
9. The transformer
10. The three-phase alternating current

## **Electrical oscillations and electromagnetic waves**

1. Electrical oscillations
2. Damped oscillations
3. Sustained oscillations
4. Radiation
5. Velocity of electromagnetic waves
6. The Poynting vector
7. Reflection and refraction; Fresnel's formulae

## **Electronics**

1. Elementary particles
2. Thermionic emission; the vacuum diode
3. Multi-electrode vacuum tubes
4. The cathode ray oscillograph
5. The photoelectric effect
6. The x-ray tube
7. Conduction in gases