

Moving Charges and Magnetism — Assignment 1

Class 12 Physics · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
 (2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
 (3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

Lorentz Force and Motion in a Magnetic Field

MCQ Questions (choose the correct option)

- The magnetic force on a charge q moving with velocity v in a magnetic field B is
 - $q(v \times B)$
 - $q(v \cdot B)$
 - $q(E + v \times B)$
 - $q(v/B)$
- The magnetic force on a moving charge is
 - perpendicular to both v and B
 - parallel to v
 - parallel to B
 - in the direction of $v + B$
- The work done by the magnetic force on a moving charged particle is
 - zero
 - positive
 - negative
 - always maximum
- A charged particle moving parallel to B experiences a magnetic force of
 - zero
 - qvB
 - $qvB/2$
 - maximum

1 Mark Questions

- Write the expression for the Lorentz force.
- What is the work done by the magnetic force on a moving charged particle?
- Under what condition is the magnetic force on a moving charge zero?

2 Mark Questions

- Define the Lorentz force and explain why the magnetic force does no work on a moving charge.
- A proton moves at $3 \times 10^6 \text{ m/s}$ perpendicular to a magnetic field of 0.5 T . Find the force on it ($q = 1.6 \times 10^{-19} \text{ C}$).
 (Ans: $2.4 \times 10^{-13} \text{ N}$)

3 Mark Questions

- Show that a charged particle moving perpendicular to a uniform magnetic field undergoes circular motion, and derive the radius $r = mv/qB$.
- A charged particle of charge q and mass m enters a uniform magnetic field B at right angles. Derive its time period and show that it is independent of the speed.

Biot-Savart Law

MCQ Questions (choose the correct option)

- The Biot-Savart law gives the
 - magnetic field due to a current element
 - electric field due to a charge
 - force on a current element
 - magnetic flux through a loop
- The magnetic field due to a long straight conductor at distance r is
 - $\mu_0 I / 2\pi r$
 - $\mu_0 I / 4\pi r$
 - $\mu_0 I / 2r$
 - $2\pi\mu_0 I / r$
- The magnetic field at the centre of a circular coil of N turns and radius R is
 - $\mu_0 NI / 2R$
 - $\mu_0 NI / R$
 - $\mu_0 I / 2\pi R$
 - $2\mu_0 NI / R$
- The direction of the magnetic field due to a current element is given by the
 - right-hand rule
 - left-hand rule
 - Faraday rule
 - Fleming rule only

1 Mark Questions

- State the Biot-Savart law.
- Write the expression for the magnetic field due to a long straight current-carrying conductor.
- Write the expression for the magnetic field at the centre of a circular current loop.

2 Mark Questions

- State the Biot-Savart law and write its vector form.
- A long straight wire carries a current of 10 A. Find the magnetic field at a distance of 0.2 m from it. (Ans: 1×10^{-5} T)

3 Mark Questions

- State the Biot-Savart law and use it to derive the expression for the magnetic field on the axis of a circular current loop.
- Derive, using the Biot-Savart law, the expression for the magnetic field due to a long straight current-carrying conductor at a perpendicular distance r .

Ampere's Circuital Law

MCQ Questions (choose the correct option)

- Ampere's circuital law states that
 - $\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I$

- (B) $\mathbf{B} \cdot d\mathbf{l} = 0$
 - (C) $\mathbf{E} \cdot d\mathbf{l} = -d\Phi/dt$
 - (D) $\mathbf{B} \cdot d\mathbf{A} = \mu_0 I$
2. Ampere's circuital law is analogous to
- (A) Gauss's law in electrostatics
 - (B) Faraday's law
 - (C) Lenz's law
 - (D) Coulomb's law
3. The Amperian loop used in Ampere's law is
- (A) a closed loop of arbitrary shape
 - (B) always a circle
 - (C) always a square
 - (D) an open curve
4. Ampere's circuital law is conveniently used to find the field of
- (A) a long straight conductor or a solenoid
 - (B) a single point charge
 - (C) a dipole
 - (D) a capacitor

1 Mark Questions

1. State Ampere's circuital law.
2. Write Ampere's circuital law mathematically.
3. Name the electrostatic law analogous to Ampere's circuital law.

2 Mark Questions

1. State Ampere's circuital law and use it to find the magnetic field due to a long straight current-carrying conductor.
2. Use Ampere's circuital law to find the magnetic field inside a long solenoid.

3 Mark Questions

1. State Ampere's circuital law and apply it to derive the magnetic field on the axis of a long solenoid.
2. State Ampere's circuital law and use it to derive the magnetic field due to a long straight current-carrying conductor and a toroid.

Force Between Two Parallel Currents

MCQ Questions (choose the correct option)

1. Two parallel currents flowing in the same direction
 - (A) attract each other
 - (B) repel each other
 - (C) exert no force
 - (D) rotate each other
2. The force per unit length between two long parallel wires carrying currents I_1 and I_2 separated by d is
 - (A) $\mu_0 I_1 I_2 / 2\pi d$
 - (B) $\mu_0 I_1 I_2 / 4\pi d$
 - (C) $\mu_0 I_1 I_2 / d$

- (D) $2\pi\mu_0 I_1 I_2 / d$
3. The ampere is defined in terms of
- (A) the force between two parallel current-carrying conductors
 - (B) the charge on an electron
 - (C) the magnetic field of a coil
 - (D) the resistance of a wire
4. Two parallel currents flowing in opposite directions
- (A) repel each other
 - (B) attract each other
 - (C) exert no force
 - (D) merge into one

1 Mark Questions

1. Write the expression for the force per unit length between two parallel current-carrying conductors.
2. When do two parallel current-carrying wires attract each other?
3. State the definition of an ampere.

2 Mark Questions

1. Derive the expression for the force per unit length between two long parallel current-carrying conductors.
2. Two straight parallel wires 0.1 m apart carry currents of 5 A and 10 A in the same direction. Find the force per unit length. (Ans: 1×10^{-4} N/m, attractive)

3 Mark Questions

1. Derive the expression for the force between two long parallel current-carrying conductors and use it to define the ampere.
2. Two parallel wires carrying equal currents of 8 A in opposite directions are 0.2 m apart. Find the force per unit length and state whether it is attractive or repulsive.

Moving Coil Galvanometer

MCQ Questions (choose the correct option)

1. The current sensitivity of a moving coil galvanometer is
 - (A) NBA/k
 - (B) k/NAB
 - (C) NAB
 - (D) $k/NAB \cdot I$
2. A galvanometer can be converted into an ammeter by connecting
 - (A) a low resistance (shunt) in parallel with it
 - (B) a high resistance in series with it
 - (C) a capacitor in series
 - (D) an inductor in parallel
3. A galvanometer can be converted into a voltmeter by connecting
 - (A) a high resistance in series with it
 - (B) a low resistance in parallel with it
 - (C) a capacitor in parallel
 - (D) nothing at all

4. The deflection of a moving coil galvanometer is proportional to the
- (A) current through the coil
 - (B) voltage squared
 - (C) resistance of the coil only
 - (D) magnetic flux squared

1 Mark Questions

1. On what principle does a moving coil galvanometer work?
2. Define the current sensitivity of a moving coil galvanometer.
3. How is a galvanometer converted into an ammeter?

2 Mark Questions

1. Explain the principle and construction of a moving coil galvanometer.
2. Define the current sensitivity and the voltage sensitivity of a moving coil galvanometer.

3 Mark Questions

1. Explain the working of a moving coil galvanometer and derive the expression for its current sensitivity.
2. Describe how a galvanometer is converted into (i) an ammeter and (ii) a voltmeter, and give the formulae for the shunt and the series resistance.

Cyclotron

MCQ Questions (choose the correct option)

1. A cyclotron is used to
 - (A) accelerate charged particles to high energies
 - (B) measure current
 - (C) store charge
 - (D) rectify alternating current
2. The cyclotron frequency of a charged particle moving in a magnetic field B is
 - (A) $qB/2\pi m$
 - (B) $2\pi m/qB$
 - (C) qB/m
 - (D) mB/q
3. The cyclotron frequency is independent of the
 - (A) speed (energy) of the particle
 - (B) charge of the particle
 - (C) mass of the particle
 - (D) magnetic field
4. In a cyclotron the charged particles are accelerated
 - (A) twice per revolution
 - (B) once per revolution
 - (C) four times per revolution
 - (D) continuously inside the dees

1 Mark Questions

1. What is the principle of a cyclotron?

2. Write the expression for the cyclotron frequency.
3. Why does a cyclotron fail to accelerate electrons or particles to very high speeds?

2 Mark Questions

1. State the principle of a cyclotron and write the expression for the cyclotron frequency.
2. Calculate the cyclotron frequency of a proton in a magnetic field of 1 T ($q = 1.6 \times 10^{-19}$ C, $m = 1.67 \times 10^{-27}$ kg). (Ans: $\approx 1.5 \times 10^7$ Hz)

3 Mark Questions

1. Explain the construction and working of a cyclotron and derive the expression for the cyclotron frequency.
2. Describe the working of a cyclotron, state its limitations, and explain why electrons cannot be accelerated by it.