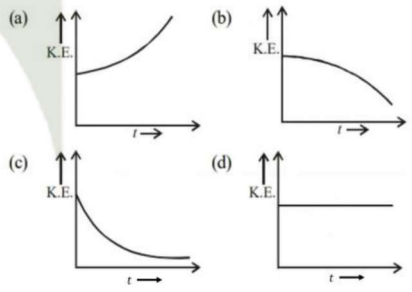
Magnetic Field: Magnetic Effect of Current (Part-1)

- ✓ *Force on a moving charge due to magnetic field:* $\boldsymbol{F = Bqv\sin\theta}$
- ✓ *Lorentz Force:* $\boldsymbol{F = qE + Bqv\sin\theta}$, Vector Representation of lorentz force: $\vec{F} = q[\vec{E} + (\vec{v} \times \vec{B})]$
  If $\vec{E} = 0$, Lorentz force $\boldsymbol{F = Bqv\sin\theta}$, Then In vector form: $\vec{F} = q[(\vec{v} \times \vec{B})]$
- ✓ *Magnetic Force on a Current Carrying Conductor:* $\boldsymbol{F = BIl\sin\theta}$ & $\boldsymbol{I = v_d enA}$
- ✓ *Torque on rectangular coil in uniform field*:
  $\boldsymbol{\tau = BINA\cos\theta}$ **'or'** $\boldsymbol{\tau = BINA\sin\alpha}$ Where θ is angle bet'n plane of coil and $\vec{B}$ and α is angle bet'n area vector and $\vec{B}$
- ✓ *Current Sensitivity* $\frac{\emptyset}{I} = \frac{BNA}{K}$ *Voltage sensitivity* $\frac{\emptyset}{V} = \frac{BNA}{RK}$, R is resistance of coil
- ✓ *Hall Voltage:* $V_H = \frac{BI}{net}$, $\therefore V_H \propto \frac{1}{n}$ Hall coefficient $H_c = \frac{1}{ne}$

Day-1

1. A particle of mass m and charge q enters a magnetic field B perpendicularly with a velocity v. The radius of the circular path described by it will be,
   a. $\frac{Bq}{mv}$ b. $\frac{mq}{Bv}$ c. mB/qv d. mv/Bq
2. An electron having a charge e moves with velocity v in X- direction. An electric field acts on it in Y- direction? The force on the electron acts in,
   a. Positive direction of $Y-axis$ c. Negative direction of $Y-axis$
   b. Positive direction of $Z-axis$ d. Negative direction of $Z-axis$
3. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the
   a. Velocity remains unchanged
   b. Speed of the particle remains unchanged
   c. Direction of the particle remains unchanged
   d. Acceleration remains unchanged
4. A charge q is moving with a velocity v parallel to a magnetic field B. Force on the charge due to magnetic field is,
   a. Bqv b. Bq/v c. $Zero$ d. $Bqvsin\theta$
5. A charged particle enters in a magnetic field in a direction perpendicular to the magnetic field. Which of the following graphs show the correct variation of kinetic energy of the particle with time?



6. Fundamental nature of magnetism is the interaction of moving charge.
   a) What is Lorentz force. Write the vector representation of Lorentz force?
   b) Derive the expression for force on a moving charge due to magnetic field.
   c) Can a charged particle move through a magnetic field without experiencing any force?
   d) Can a constant magnetic field set an electron at rest into motion? Explain.
   e) An electron experiences a magnetic force of magnitude $4.60 \times 10^{-15}N$ when moving at an angle of 60^0 with respect to a magnetic field of magnitude $3.50 \times 10^{-3}T$. Find the speed of the electron. $(Ans: 9.47 \times 10^6 m/s)$
   f) An electron of KE $10eV$ is moving in a circular orbit of radius $11cm$, in a plane at right angles to a uniform magnetic field. Determine the value of flux density. $(Ans: 9.7 \times 10^{-5}T)$

Day-2

7. When a current carrying conductor placed in magnetic field, the conductor experiences magnetic force, derive an expression for force experienced by conductor placed in magnetic field.
   a) A straight conductor of length 5 cm carries current of 1.5A. The conductor experiences a magnetic force of 4.5×10^{-3}N when it is placed in a magnetic field of 0.9 T. What angle the conductor makes with magnetic field? $(Ans: 3.8^0)$
   b) A copper wire has 10^{29} free electrons per cubic meter, a cross sectional area of $2mm^2$ and carries a current of $5A$. Calculate the force acting on each electron if the wire is now placed in a magnetic field of flux density $0.15T$ which is perpendicular to the wire. $(Ans: 3.75 \times 10^{-24}N)$