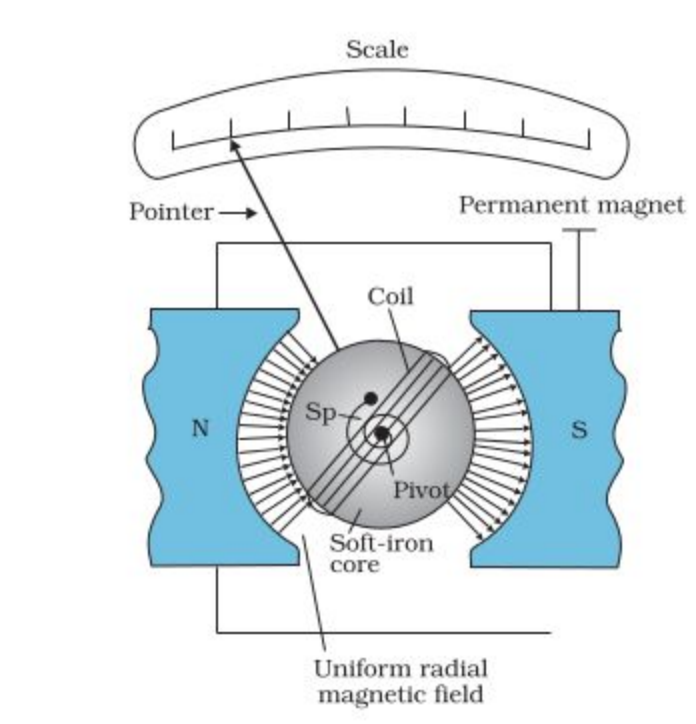
THE MOVING COIL GALVANOMETER

The galvanometer consists of a coil, with many turns, free to rotate about a fixed axis in a uniform **radial** magnetic field. There is a cylindrical soft iron core which not only makes the field radial but also **increases** the strength of the magnetic field.



When a current flows through the coil, a torque acts on it. This torque is given by **τ = NI AB**

Since the field is radial by design, we have taken

sin θ = 1

The magnetic torque NIAB tends to rotate the coil. A spring provides a **counter** torque **kφ** that balances the magnetic torque **NIAB**; resulting in a steady angular deflection φ. In equilibrium

$$k\varphi = NI\,AB$$

where k is the **torsional constant** of the spring;

The deflection φ is indicated on the scale by a pointer attached to the spring.

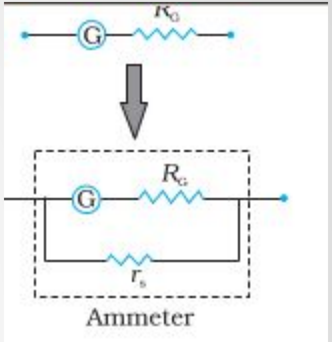
We have

$$\phi = \left(\frac{NAB}{k}\right) I$$

Conversion of Galvanometer to Ammeter

For measuring currents, the galvanometer has to be connected in series, and as it has a large resistance, this will change the value of the current in the circuit. To overcome these difficulties, one attaches a small resistance r_s, called shunt resistance, in parallel with the galvanometer coil; so that most of the current passes through the shunt.

The resistance of this arrangement is given by $R_G\, r_s/(R_G+r_s)$ which is nearly equal to r_s since $R_G >> r_s$



The current sensitivity of the galvanometer as the deflection per unit current

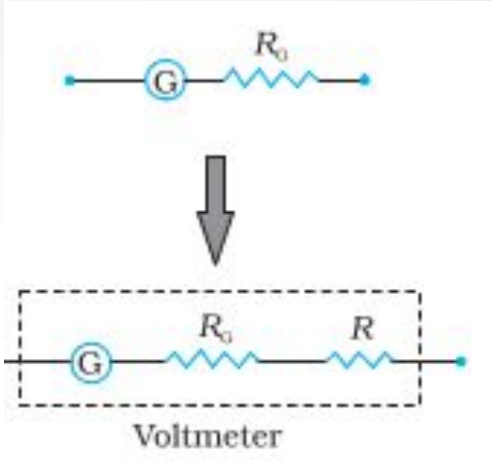
$$\frac{\phi}{I} = \frac{NAB}{k}$$

The scale of this ammeter is calibrated and then graduated to read off the current value with ease

Conversion of Galvanometer to Voltmeter

The galvanometer can also be used as a voltmeter to measure the voltage across a given section of the circuit. For this it must be connected in parallel with that section of the circuit. Further, it must draw a very small current, otherwise the voltage measurement will disturb the original set up by an amount which is very large

Resistance of the voltmeter is now, $R_G + R$ which is nearly equal to R (large)



The scale of the voltmeter is calibrated to read off the voltage value with ease.

We define the voltage sensitivity as the deflection per unit voltage.

$$\frac{\phi}{V} = \left(\frac{NAB}{k}\right)\frac{I}{V} = \left(\frac{NAB}{k}\right)\frac{1}{R}$$