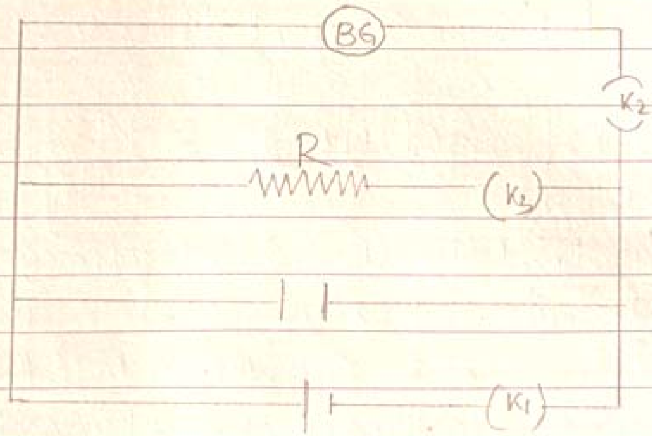
Use Of Ballistic Galvanometer:

Measurement Of high resistance (Of the order of Kilo or mega ohm) by leakage, using a Ballistic galvanometer:



① Key K_1 is closed; K_2 & K_3 are opened; the Capacitor is charged to a P.d, equal to the e.m.f Of the battery. Let Q_0 be the charge stored in the Capacitor.

② K_1 is opened; K_3 is opened & closing the Key K_2 only; the charge Q_0 in the Capacitor is discharged through the ballistic galvanometer & the first throw Of B.G is noted.
Let θ_0 be the 1st observed throw.
The correct throw considering the correction due to damping; $\theta_c = \theta_0 [1 + \lambda/2]$
where λ is the logarithmic decrement Of the B.G.

$$\therefore \quad Q_0 = \frac{T}{2\pi} \frac{C}{nAB} \theta_0 \left(1 + \lambda/2\right) \quad \text{—} \; ①$$

③. Key K_2 is opened ; K_3 is opened closing the key K_1 only, the Capacitor is charged again to the P.d, same as the e.m.f of the source i.e a charge Q_0 is again stored in the capacitor.

④. Key K_1 is opened; K_2 opened & key K_3 is closed only & the moment K_3 is closed, a stopwatch is started & the charge in the capacitor is discharged through resistance for certain time interval t sec.

⑤. K_3 is opened & K_2 is closed only, the remaining charge in the capacitor is discharged through the B.G & the deflection is noted.

Let t = time for which capacitor discharged through the resistance R (measured).
Q = charge stored in the capacitor after t sec.

$$\therefore \boxed{Q = Q_0 e^{-t/RC}} \quad \text{—②}$$

Let θ' = deflection in B.G when charge Q is passed through it.

$$Q = \frac{T}{2\pi}\frac{C}{nAB}\theta'\left[1+\lambda/2\right] \quad \text{—③}$$

Equating ② and ③: $Q_0 e^{-t/RC} = \frac{T}{2\pi}\frac{C}{nAB}\theta'\left[1+\frac{\lambda}{2}\right]$ ④

Dividing ① by ④:-

$$\frac{Q_0}{Q_0 e^{-t/RC}} = \frac{\theta_0}{\theta'} \quad \text{or} \quad \frac{t}{RC} = \log_e\left[\frac{\theta_0}{\theta'}\right]$$

$$\therefore \boxed{R = \frac{t}{C\left[\log_e \theta_0 - \log_e \theta'\right]}}$$