To Determine Resistance Of a Galvanometer By Half-Deflection Method & to Find Its Figure Of Merit

Aim

To determine resistance of a galvanometer by half-deflection method and to find its figure of merit.

Apparatus

A Weston type galvanometer, a voltmeter, a battery or battery eliminator, two (10,000 Ω and 200 Ω) resistance boxes, two one-way keys, a rheostat, a screw gauge, a metre scale, an ammeter of given range, connecting wires and a piece of sand paper.

Theory

(*i*) The resistance of the given galvanometer as found by half deflection method

$$G = \frac{R.S}{R-S} \qquad \ldots(1)$$

where R is the resistance connected in series with the galvanometer and S is the shunt resistance.

(*ii*) The figure of merit, $k = \dfrac{E}{(R+G)\theta}$ ...(2)

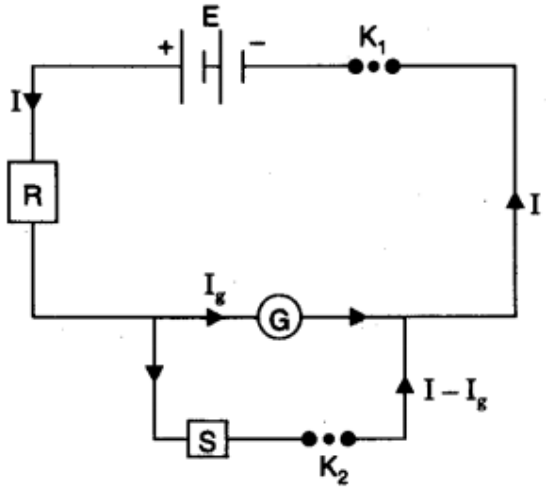
where E is the e.m.f. of the cell and θ is the deflection produced with resistance R.

(*iii*) The maximum current that can pass through the galvanometer,

$$I_g = nk \qquad \ldots(3)$$

where n is the total number of divisions on the galvanometer scale on either side of zero.

Circuit diagram



Resistance of galvanometer.

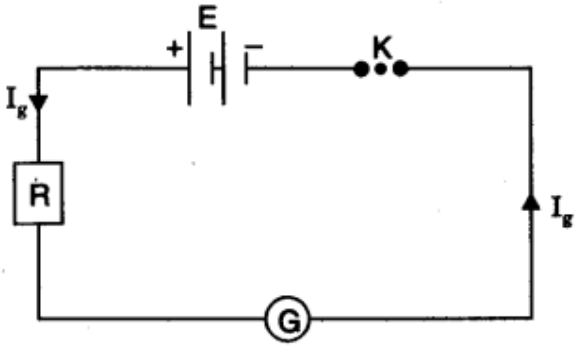


Figure of merit.

Procedure

(a) Resistance of galvanometer by half deflection method

1. Make the connections accordingly as shown in circuit diagram.
2. See that all plugs of the resistance boxes are tight.
3. Take out the high resistance (say 2000 Ω) from the resistance box R and insert the key K_1 only.
4. Adjust the value of R so that deflection is maximum, even in number and within the scale.
5. Note the deflection. Let it be θ.
6. Insert the key also and without changing the value of R, adjust the value of S, such that deflection in the galvanometer reduces to exactly half the value obtained in step 5 i.e., θ/2.
7. Note the value of resistance S.
8. Repeat steps 4 to 7 three times taking out different values of R and adjusting S every time.
   (b) Figure of merit
9. Take one cell of the battery (battery eliminator) and find its E.M.F. by a voltmeter by connecting +ve of the voltmeter with +ve of the cell and -ve of voltmeter with -ve of the cell. Let it be E.
10. Make connections as in circuit diagram.
11. Adjust the value of R to obtain a certain deflection 0 (say 30 divisions) when the circuit is closed.
12. Note the values of resistance R and deflection θ.
13. Now change the value of R and note the galvanometer deflection again.
14. Repeat the steps 9 to 13 with both cells of the battery with different voltages like 2, 4, 6, 8, volts from battery eliminator.
15. Find the figure of merit k using the formula.

Observations and Calculations

1. **Table for resistance of the galvanometer by half deflection method**

Serial No. of Obs (1)	*Resistance R (ohm)* (2)	*Deflection in the Galvanometer θ* (3)	*Shunt resistance S (ohm)* (4)	*Half deflection* $\frac{\theta}{2}$ (5)	*Galvanometer resistance* $G = \frac{RS}{R-S}$ *(ohm)* (6)
1.					
2.					
3.					
4.					

2. **Table for figure of merit**

Serial No. of Obs (1)	*Number of cells (Battery eliminator)* (2)	*e.m.f. of the cells E(V) or reading of battery eliminator* (3)	*Resistance from R.B. R (ohm)* (4)	*Deflection θ (div.)* (5)	*Figure of merit* $k = \frac{E}{(R+G)\theta}$ (6)
1. 2. 3. 4.					

Number of divisions in the galvanometer scale, n = ...

1. Calculation for G

(*i*) Calculate G, using formula, $G = \frac{RS}{R-S}$ and write it in column 6 of Table 1.

(*ii*) Take mean of values of G recorded in column 6 of Table 1.

2. Calculation for k

(*i*) Calculate k, using formula, $k = \frac{E}{(R+G)\theta}$ and write it in column 6 of Table 2.

(*ii*) Take mean of values of k recorded in column 6 of Table 2.

Result

1. Resistance of given galvanometer = …….. Ω
2. Figure of merit of given galvanometer = A/dn.

Precautions

1. All the connections should be neat, clean and tight.
2. All the plugs in resistance boxes should be tight.
3. The e.m.f. of cell or battery should be constant.
4. Initially a high resistance from the resistance box (R) should be introduced in the circuit (otherwise for small resistance an excessive current will flow through the galvanometer or ammeter can be damaged).

Sources of error

1. The screws of the instruments may be loose.
2. The plugs of resistance boxes may not be clean.
3. The e.m.f. of battery may not be constant.
4. The galvanometer divisions may not be of equal size.