

EXPERIMENT NO. 7

Object :- To convert a Weston type galvanometer into an ammeter (ranges 5, 10, 15 amp) and a voltmeter (ranges 5, 10, 15 volt).

Apparatus Used :- Post office box, galvanometer, ~~tactanche~~ ~~cell~~, high resistance box and battery eliminator.

Formula Used :-

1. Conversion into ammeter

$$S = \frac{I_g \cdot G}{A - I_g}$$

where

S = Resistance (in Ω) of required shunt

I_g = current (in Ampere) which produce full scale deflection in galvanometer

G = Resistance (in Ω) of galvanometer coil

A = ammeter current (in ampere / range).

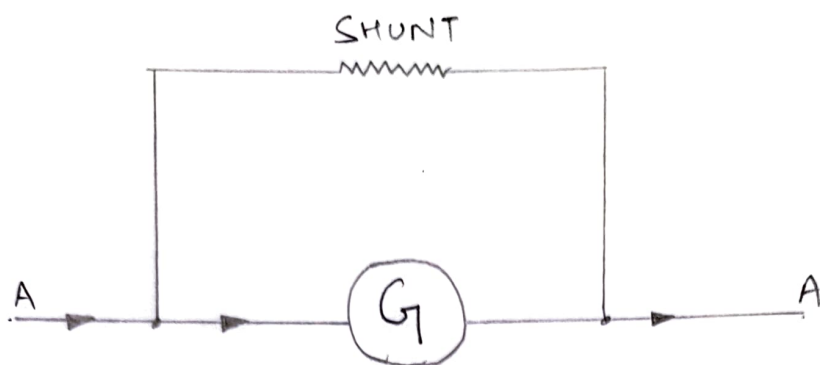


Fig. 1 (a)

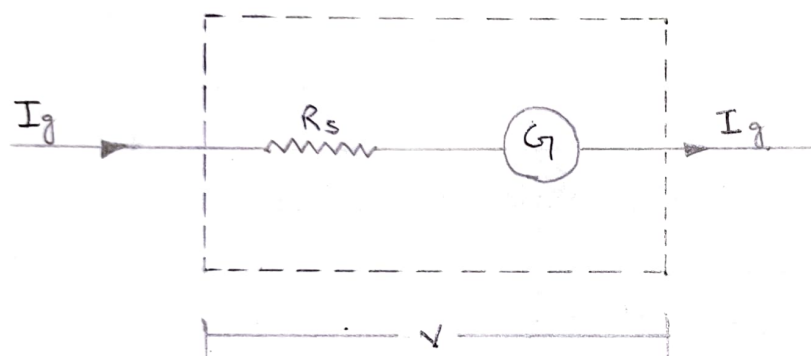
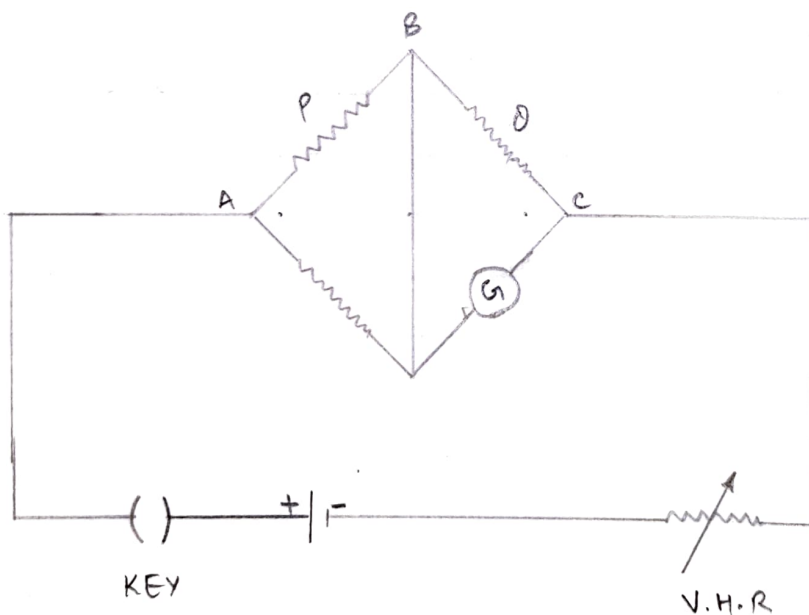
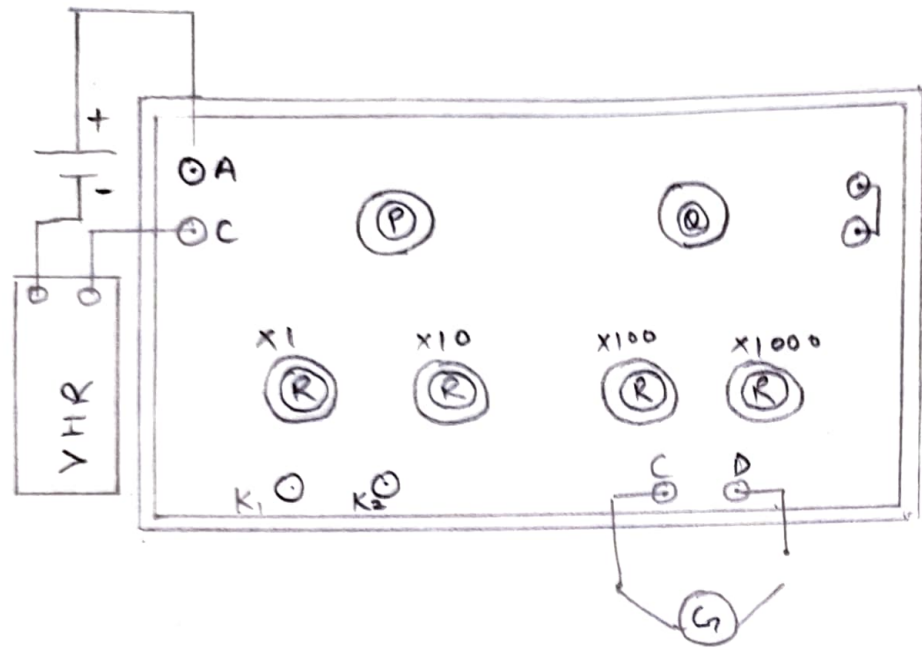


Fig. 1 (b)





2. Conversion into Voltmeter

$$R_s = \left[\frac{V}{I_g} \right] - G$$

where

V = Voltmeter range (in volt)

 I_g = Galvanometer current G = Galvanometer coil resistance.

Observation Table

1. Determination of the galvanometer resistance

S.No	Ratio P:0 (ohm)	R (ohm)	Deflection of the needle	Inference
1.	10:10	1 1000 R_1 (R_1+1)	Say, decrease Increase 27 dec. 28 Inc.	Connection alright $(R_1+1) > G > R_1$
2.	100:10	R_2 (R_2+1)	276 dec. 277 Inc.	$(R_2+1) > G > R_2$
3.	1000:10	$(R-1)$ R $(R+1)$	2754 dec. 2755 No change 2756 Inc.	$G = \left(\frac{10}{1000} \right) R \text{ (ohm)}$

Galvanometer resistance (G) = 27.55 Ω

Teacher's Signature : _____

2. Measurement of current per unit length

S.No	High resistance in Resistance box X (ohm)	No. of division of galvanometer deflection 'h'	P.D. across the battery eliminator 'E'	Current in the circuit $i = \frac{E}{X+h}$	Current per unit division of deflection $\frac{i}{h}$
1	5100	23	2	0.39	16.958
2	6400	20	2	0.311	15.558
3	9000	17	2	0.221	13.032
4	12000	13	2	0.166	12.791
5	19000	10	2	0.105	10.511

Mean $i/h = 13.77 \times 10^6$ amp/division

3. Total no. of division on the galvanometer scale

N = 25

Teacher's Signature : _____

Calculation

A) For conversion into ammeter

$$I_g = \frac{i}{n} \times N = 13.77 \times 10^6 \times 25 = 0.34425 \text{ mA}$$

where $\frac{i}{n}$ is current per unit division and N is total division.

i) Ammeter range $A = 5 \text{ amp}$

$$S = \frac{I_g}{A - I_g} G = \frac{0.34425 \times 10^{-3}}{5 - 0.34425 \times 10^{-3}} \times 27.55$$

$$\S \quad \boxed{S = 1.8969 \text{ m}\Omega}$$

ii) Ammeter range $A = 10 \text{ amp}$

$$S = \frac{I_g}{A - I_g} G = \frac{0.34425 \times 10^{-3}}{10 - 0.34425 \times 10^{-3}} \times 27.55$$

$$S = 0.9484 \text{ m}\Omega$$

iii) Ammeter range $A = 15 \text{ amp}$

$$S = \frac{I_g}{A - I_g} G = \frac{0.34425 \times 10^{-3}}{15 - 0.34425 \times 10^{-3}} \times 27.55$$

$$S = 0.6322 \text{ m}\Omega$$

B) For Conversion into voltmeter

i) Voltmeter range $V = 5 \text{ volt}$

$$R_s = \frac{V}{I_g} - G = \frac{5}{0.34425 \times 10^{-3}} - 27.55$$

$$R_s = 14496.70 \Omega$$

(ii) Voltmeter range $V = 10 \text{ volt}$

$$R_s = \frac{V}{I_g} - G = \frac{10}{0.34425 \times 10^{-3}} - 27.55$$

$$R_s = 29021.11 \Omega$$

iii) Voltmeter Range $V=15$ volt

$$R_s = \frac{V}{I_g} - G = \frac{15}{0.34425 \times 10^{-3}} - 27.55$$

$$\boxed{R_s = 43545.43 \, \Omega}$$

Results

The value of the shunt S required for converting the given galvanometer into ammeter and the series resistance for converting galvanometer into voltmeter of given range are tabulated below.

S.No	Ammeter Range (ampere)	Required shunt Resistance (Ω)	voltmeter Range (volt)	Required Series Resistance R_s (Ω)
1	5.0	1.8969×10^{-3}	5.0	14496.70
2	10.0	0.9484×10^{-3}	10.0	29021.11
3	15.0	0.6322×10^{-3}	15.0	43545.43

Precautions and Sources of Error

1. The connection must be neat and clean and tight.
2. while using P.O Box, the cell Key K_1 , should be pressed first and then the bridge Key K_2
3. while releasing the key reverse order should be followed
3. The usual place of galvanometer in the B-D arm of the Post office Box should be connected by a thick copper wire and the galvanometer

Should be placed in the unknown arm D-c

4. A high resistance of 10,000 or so should be used in series with the Leclanche cell before connecting to P.O Box.

5. In the part of determining I_g , a lead accumulator must be used as a source of constant e.m.f.