DPP – 8

SOLUTION

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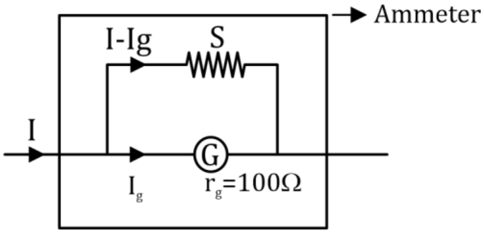
1. $Ig = 10\text{ mA}$ (maximum current in galvanometer)

$I = 100\text{ mA}$



$I_g r_g = (I - I_g)s$

$10 \times 100 = 90 \times S$

$S = \frac{100}{9}\Omega$

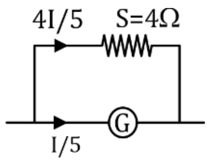
2. Let main current is I.

$I_g = \frac{I \times 10}{100} = \frac{I}{10}$ $\Rightarrow$ $r_g = 99\Omega$

$(I - I_g)S = I_g r_g$

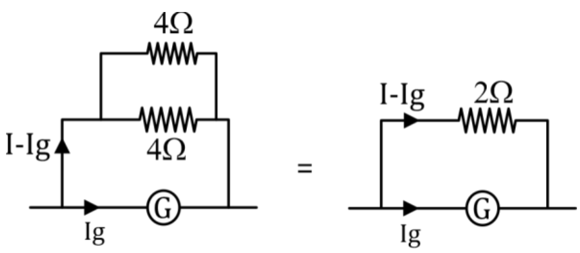
$\frac{9I}{10} \times S = \frac{I}{10} \times 99$ $\Rightarrow$ $S = \frac{99}{9} = 11\Omega$

3. $\frac{I}{5} \times G = \frac{4}{5} I \times 4$



$\Rightarrow G = 16\Omega$

When additional shunt of 4Ω used



$Ig \times 16 = (I - Ig)^2$

$16Ig = 2I - 2Ig$

$I_g = \frac{I}{9}$

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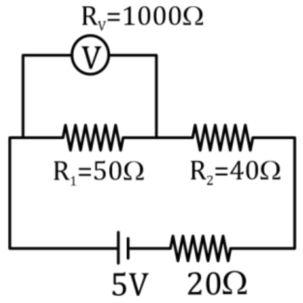
4. $\Rightarrow$ First If voltmeter is not connected



then $I_{Ckt} = \frac{5}{110} = \frac{1}{22}$ Amp

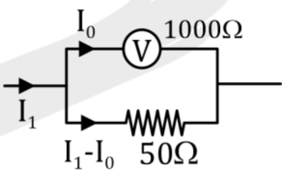
$V_{R_1} = IR = \frac{1}{22} \times 50 = \frac{25}{11}$ volt $= 2.27$ V

when voltmeter is connected

$(R_{eq.})_{Ckt} = 40 + 20 + \frac{50 \times 1000}{1050} = 60 + \frac{5000}{105}$

$(R_{eq.})_{Ckt} = \frac{6300 + 5000}{105} = \frac{11300}{105}$

$I_1 = \frac{5 \times 105}{11300} = \frac{105}{2260} = \frac{21}{452}$



$I_0 \times 1000 = (I_1 - I_0)50$

$I_0 \times 20 = I_1 - I_0$

$21I_0 = I_1$

$I_0 = \frac{I_1}{21} = \frac{21}{21 \times 452} = \frac{1}{452}$

Reading of Voltmeter $= I_0 R_V$

$= \frac{1}{452} \times 1000$

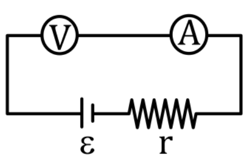
$V = 2.21$Volt

% error in reading $= \frac{2.27 - 2.21}{2.27} \times 100 \quad \Rightarrow \quad 2.6\ \%$

5. resistance of voltmeter is very high Current in Circuit is very

law & Potential across the voltmeter approx the εmf of battery

because resistance of ammeter is very Law.



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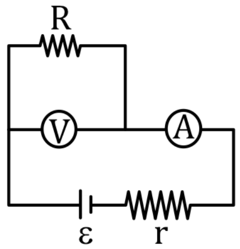


when a resistance connected parallel to (V) overall resistance of circuit decrease & current in circuit increase.

So potential across ammeter increase & across voltmeter decrease.

6. A voltmeter of range 10V.

7. $I_g = 2 \times 10^{-4}$ Amp

$r_g = 50\Omega$

$I = 12$ Amp at full deflection

$(I - Ig)S = I_g r_g$

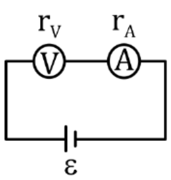
$I - Ig \simeq I$

$12 \times S = 2 \times 10^{-4} \times 50$

$S = \frac{10^{-2}}{12} = 0.83 \times 10^{-3}\Omega$

8. Initial reading are

$V = \frac{\varepsilon r_v}{r_v + r_A}$ ______ (i)



current in ammeter Initially

$$I = \frac{\varepsilon}{r_V + r_A}$$

finally after connection of resistance

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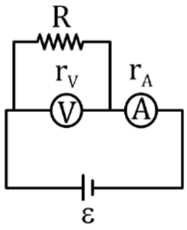
$I^1 = \frac{\varepsilon}{r_A + \frac{r_V R}{r_V + R}}$



final reading of voltmeter

$v_f = \frac{v}{k} = \varepsilon - \frac{\varepsilon r_A}{r_A + \frac{r_V R}{r_V + R}}$ ______(ii)

$I_f = kI = \frac{\varepsilon}{r_A + \frac{r_V R}{r_V + R}}$ ______ (iii)

$I_f = KI$

$$\frac{\varepsilon}{r_A + \frac{r_V R}{r_V + R}} = \frac{k\varepsilon}{r_V + r_A}$$

from equation (ii) $\frac{v}{k} = \varepsilon - \frac{k\varepsilon r_A}{r_V + r_A}$

$$\Rightarrow \frac{\varepsilon r_V}{k(r_v + r_A)} = \varepsilon - \frac{k\varepsilon r_A}{r_A + r_V}$$

$$\frac{r_V}{k(r_v + r_A)} = \frac{r_A + r_V - kr_A}{(r_V + r_A)}$$

$$r_V - \frac{r_V}{k} = kr_A - r_A$$

$$r_V\left(\frac{k - I}{k}\right) = r_A(k - 1)$$

$r_V = kr_A$ put the value in

equation I $\Rightarrow V = \frac{\varepsilon r_V}{r_V + r_{V/K}} \Rightarrow V = \frac{k\varepsilon}{(k+1)}$

$$V_f = \frac{V}{k} = \frac{\varepsilon}{k + I}$$

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9. For range 1 volt, galvanometer and R_1 is series.

$$I_g = \frac{V}{G+R_1} \Rightarrow 10^{-3} = \frac{1}{50+R_1}$$

$$\Rightarrow R_1 = 950\Omega$$

For 10 volt, galvanometer & R_1, R_2 are series

$$I = \frac{10}{G + R_1 + R_2}$$

$$10^{-3} = \frac{10}{50+950+R_2} \Rightarrow R_2 = 9k\Omega$$

For range 100 V, Galvanometer, R_1, R_2 & R_3 are in series

$$I = \frac{100}{G + R_1 + R_2 + R_3} \Rightarrow R_3 = 90k\Omega$$