Sensors, Measurements & Instrumentation

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October 14, 2022

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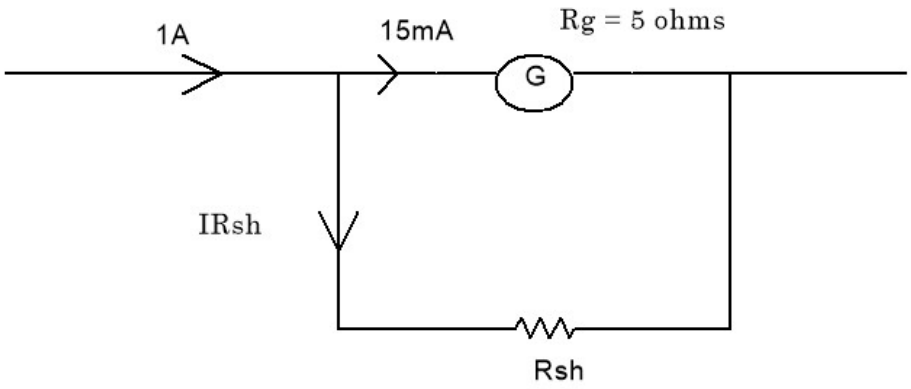
Question 1

Resistance of galvanometer, $R_G = 5\,\Omega$
Current through galvanometer, $I_G = 15 \times 10^{-3}\,\text{A}$
Current through shunt resistor, $I_{R_{sh}}$
Voltage across galvanometer, V_G
Voltage across shunt resistor, V_{sh}
Voltage across multiplier resistor, V_M

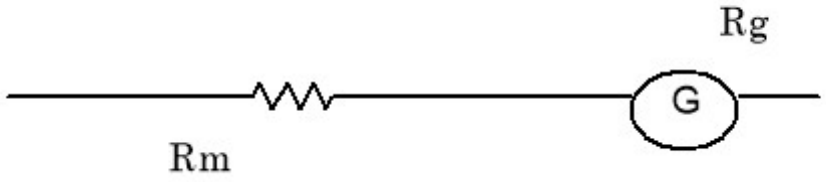
Resistance of shunt, R_{sh}
Resistance of multiplier, R_M



$$I) \qquad I_{R_{sh}} = 1 - (15 \times 10^{-3})$$
$$I_{R_{sh}} = 0.985\,\mathrm{A}$$

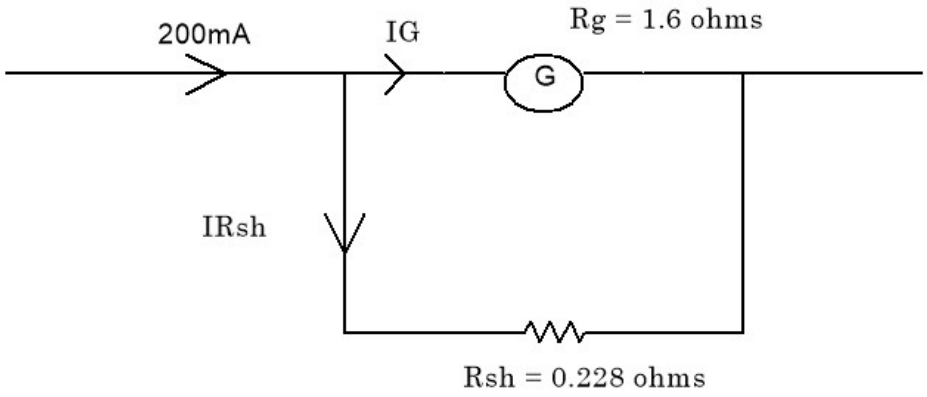
$$
\begin{aligned}
V_G &= V_{sh} \\
I_G R_G &= I_{R_{sh}} R_{sh} \\
R_{sh} &= \frac{I_G R_G}{I_{R_{sh}}} \\
&= \frac{15 \times 10^{-3} \times 5}{0.985} \\
&= \underline{\underline{0.076\,\Omega}}
\end{aligned}
$$

Total voltage through multiplier and galvanometer, V



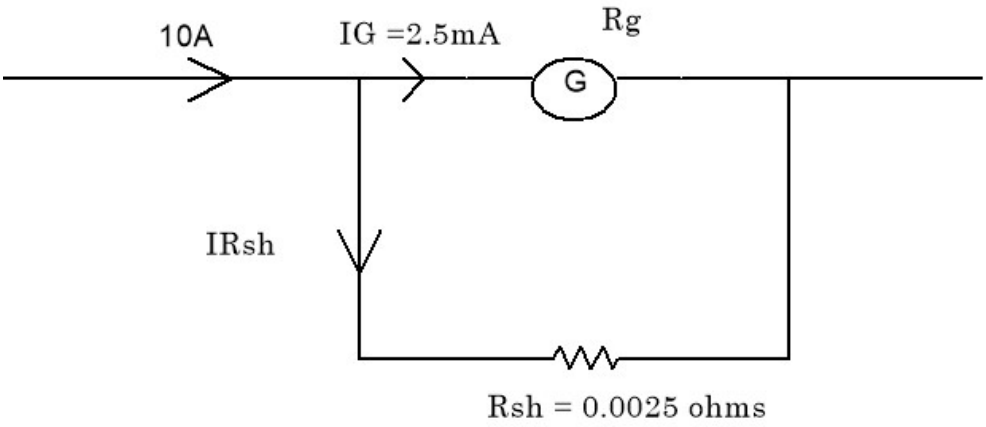
$$
\begin{aligned}
II) \qquad V &= V_M + V_G \\
V &= I_G R_M + I_G R_G \\
R_M &= \frac{V - I_G R_G}{I_G} \\
R_M &= \frac{15 - (15 \times 10^{-3}) \times (5)}{(15 \times 10^{-3})} \\
R_M &= \underline{\underline{995\,\Omega}}
\end{aligned}
$$

Question 2



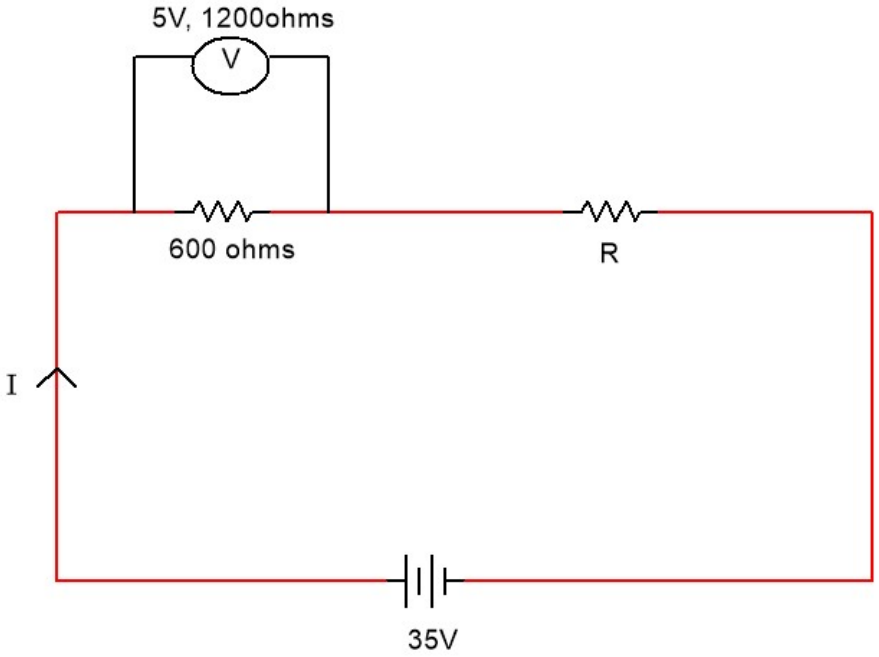
$$
\begin{aligned}
V_G &= V_{R_{sh}} \qquad I_{R_{sh}} = 0.2 - I_G \\
I_G R_G &= I_{R_{sh}} R_{sh} \\
I_G R_G &= 0.2 R_{sh} - I_G R_{sh} \\
I_G R_G + I_G R_{sh} &= 0.2 R_{sh} \\
I_G &= \frac{0.2 R_{sh}}{R_G + R_{sh}} \\
&= \frac{0.2 \times 0.228}{1.6 + 0.228} \\
&= 0.0249 \\
&= \underline{\underline{24.9\,\text{mA}}}
\end{aligned}
$$

Question 3



$$
\begin{aligned}
I_{R_{sh}} &= 10 - (2.5 \times 10^{-3}) \\
I_G R_G &= I_{R_{sh}} R_{sh} \\
R_G &= \frac{9.9975 \times 0.0025}{2.5 \times 10^{-3}} \\
&= \underline{\underline{9.9975\,\Omega}}
\end{aligned}
$$

Question 4



Resistance across parallel connection

$$\begin{aligned} R_{\parallel} &= \frac{1200 \times 600}{1200 + 600} \\ &= 400\Omega \end{aligned}$$

$$
\begin{aligned}
V &= IR_{\|} \\
I &= \frac{V}{R_{\|}} \\
&= \frac{5}{400} \\
&= \frac{1}{80}\ A
\end{aligned}
$$

$$Voltage\ across\ R : 35 - 5 = 30\,\mathrm{V}$$

$$
\begin{aligned}
R = \frac{V}{I} &= \frac{30}{1/80} \\
&= \underline{\underline{2400\Omega}}
\end{aligned}
$$