Topic : Voltmeter and Ammeter

Voltmeter → Ideal / Practical

Voltmeter is use for measuring the voltage or open circuit voltage

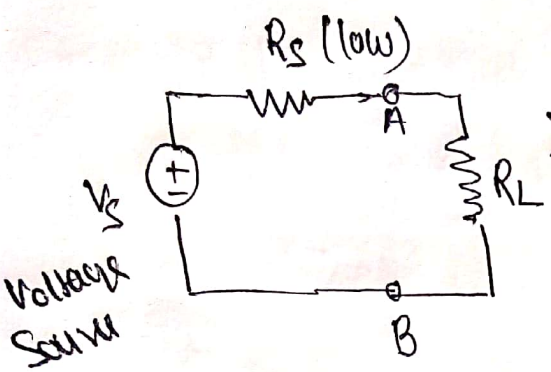


Fig.(a) Practical voltage Source

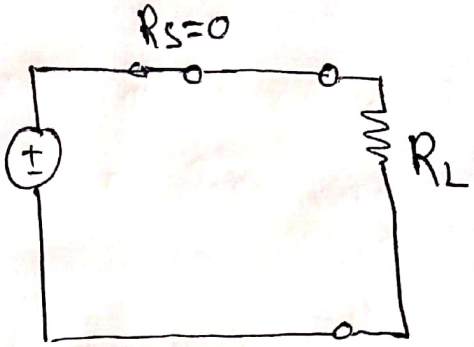


Fig.(b) Ideal Voltage Source

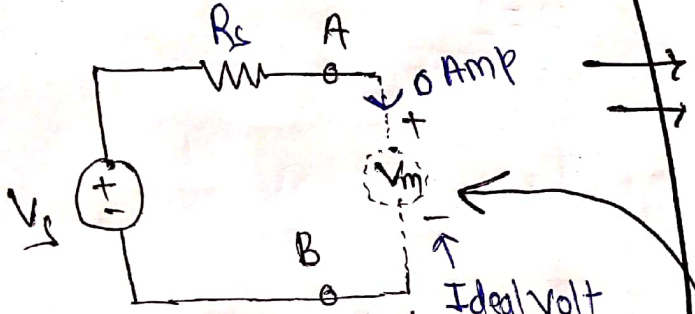


Fig.(c) Ideal Vm = voltmeter

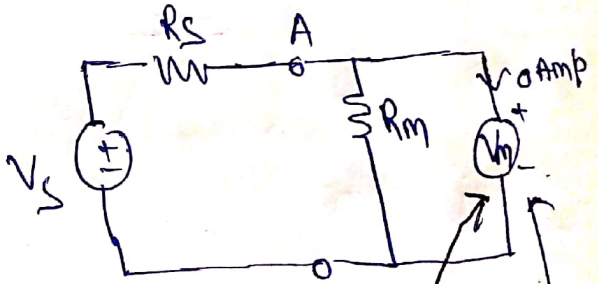


Fig.(d) Practical

Ideal Vm	Practical Vm
Internal Resistance Rm = ∞	Practical Internal Resistance Rm ≠ 0

Note ① Voltage always measure across the open terminal. Therefore, I have connected voltmeter across the A-B terminal so that it can measure the voltage.

① Ideal voltmeter alway have zero Ampcurrent

Apply KVL in Fig.(c)

$+V_S + 0 R_S + V_m$

$\boxed{V_S = V_m}$

V_m (Voltmeter) measure the voltage across A-B terminal

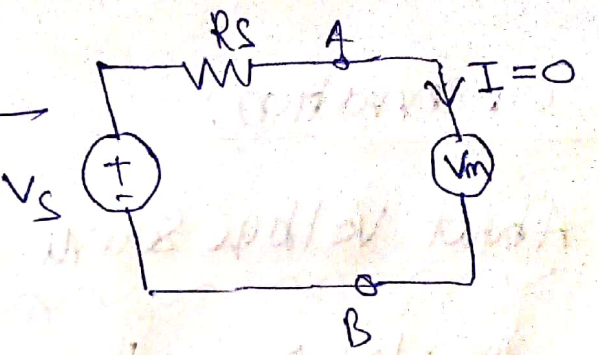


Fig.(c)

Apply KVL

$V_S - R_S I - I R_m$

$\boxed{I = \frac{V_S}{R_S + R_m}}$

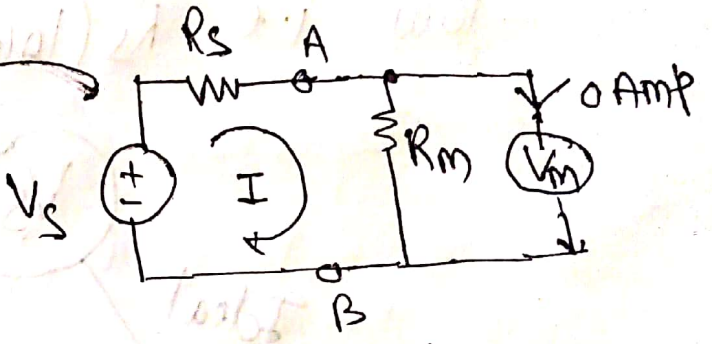


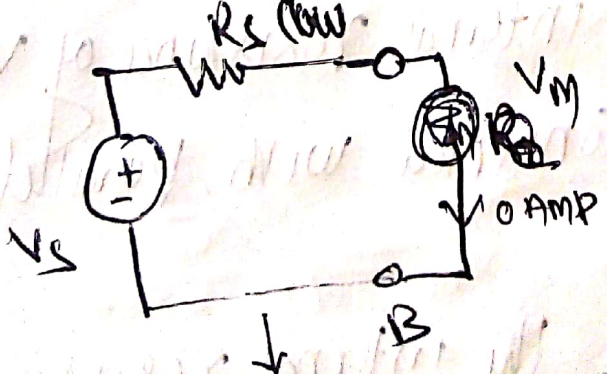
Fig.(d)

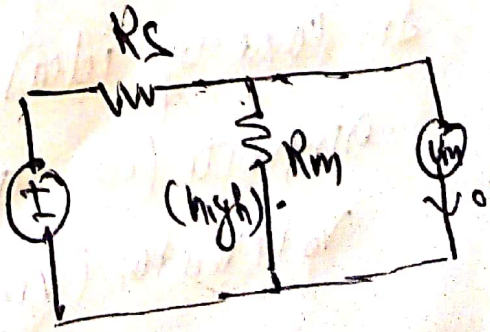
therefore,

$V_m = I \times R_m$

$\boxed{V_m = \frac{V_S R_m}{R_S + R_m}}$

Note



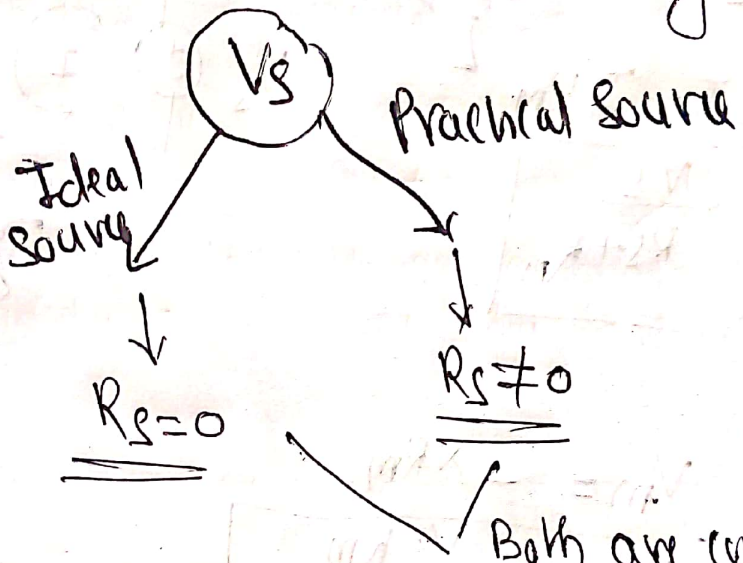


Observation:

About Voltage Source (Vs):

In ideal case, the internal resistance of V_s is zero i.e $R_s = 0$

In practical case, the internal resistance of V_s is low i.e R_s (low) i.e. Something value



About Voltmeter: (Vm):

In case of ideal, the internal resistance of V_M is infinity (∞) and connected with parallel to voltmeter (Vm)

In case of practical, the internal resistance of Vm is Rm (having some value) and connected with parallel to voltmeter (Vm).

Vm (voltmeter)

Ideal Voltmeter (Vm)

↓

Internal resistance

$R_m = 0$

↓

Connected with Parallel to Vm

Practical voltmeter (Vm)

↓

Internal resistance

R_m = high

↓

Connected with parallel to Vm

Ammeter: It is used for measure the current across short circuit

Ideal

Practical

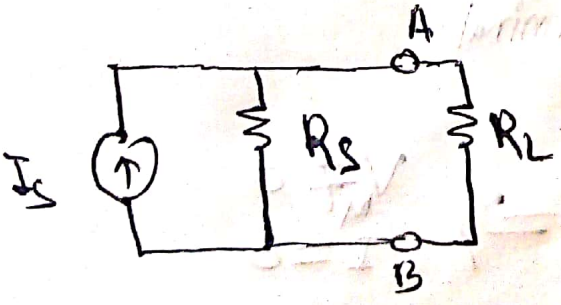


Fig. (a) Practical current source

R_s = high

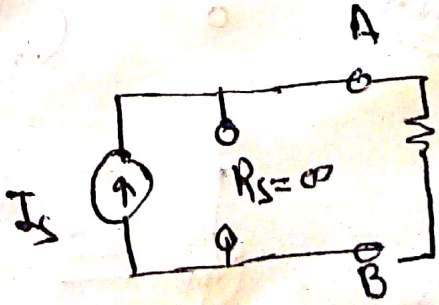
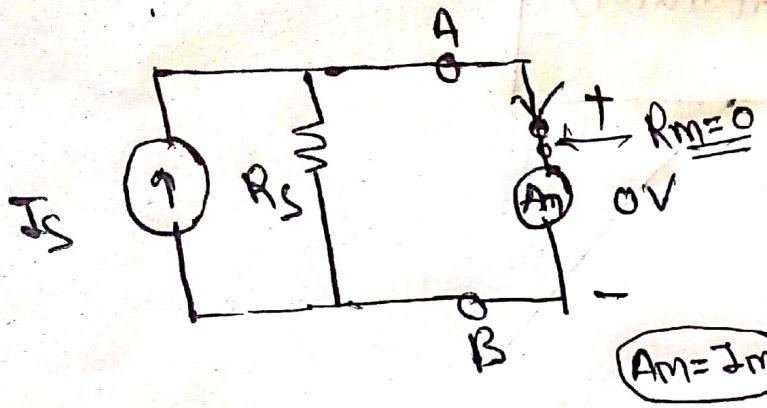


Fig. (b) Ideal current source

R_s = very thygh = ∞



Am = Im

Fig.(c) Ideal Ammeter

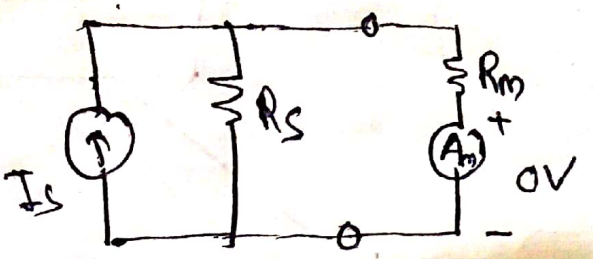
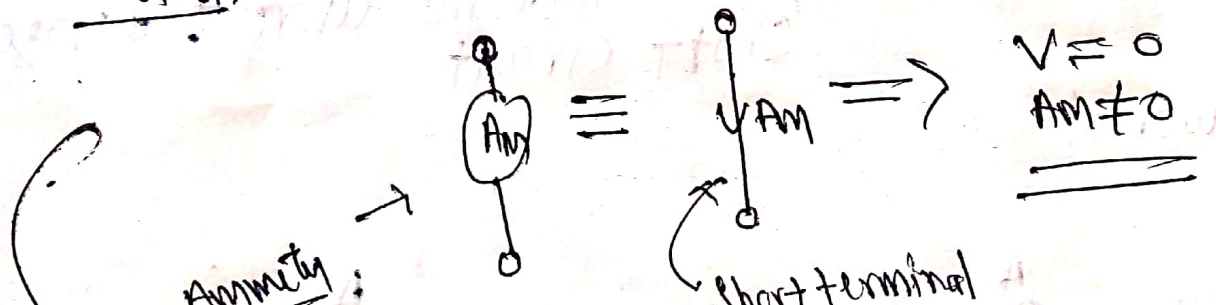
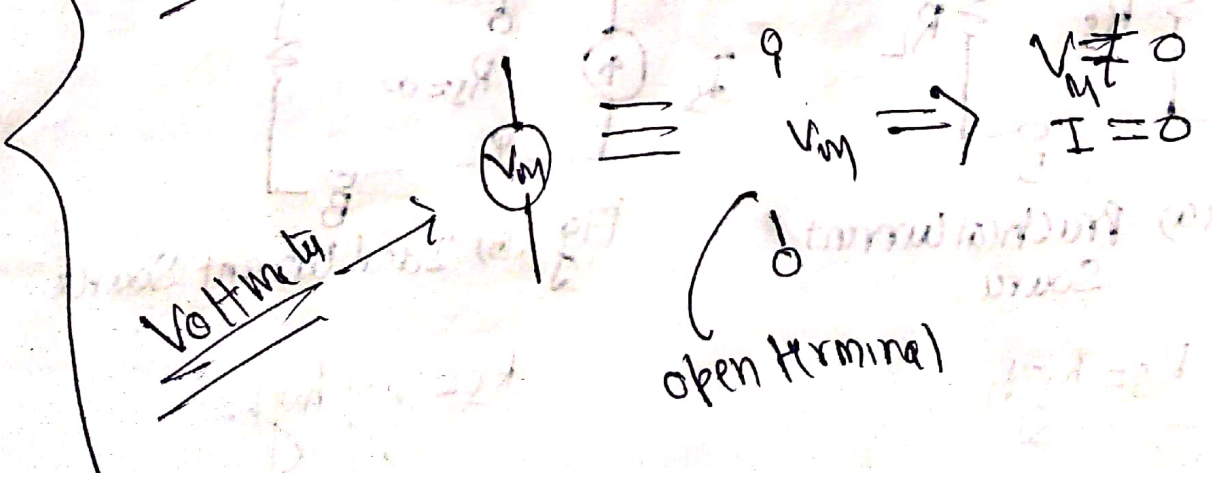


Fig.(d) Practical Ammeter

Ideal (I_m)	Practical (I_m)
① Internal Resistance $R_m = 0$	① Internal Resistance $R_m \neq 0$ (Some thing value)
② Voltage across ammeter is zero due to Short	② voltage across the ammeter is zero due to short circuit

① Note: Ammeter measure short short current.





~~Superhanded system~~

Apply current division

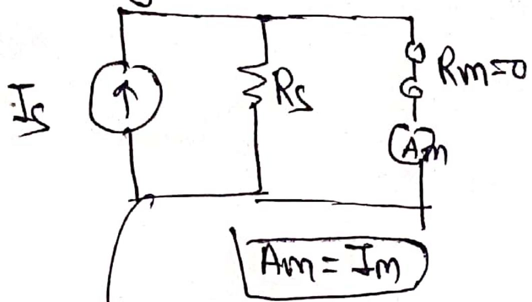
$$A_m \text{ or } I_m = \frac{I_s \times R_s}{R_s + R_m}$$

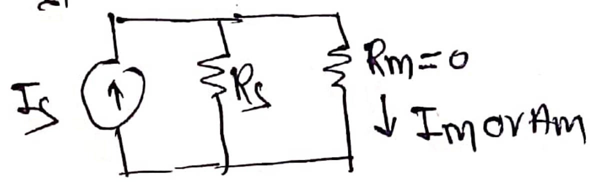
R_m is 0

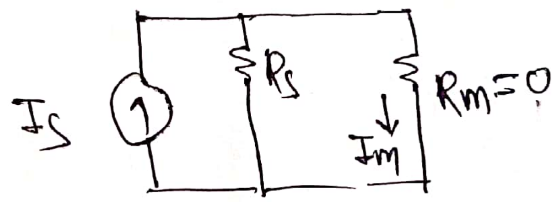
$$I_m = A_m = \frac{I_s \times R_s}{R_s}$$

$$\boxed{I_m = I_s}$$

Fig.(c) For Ideal Ammeter



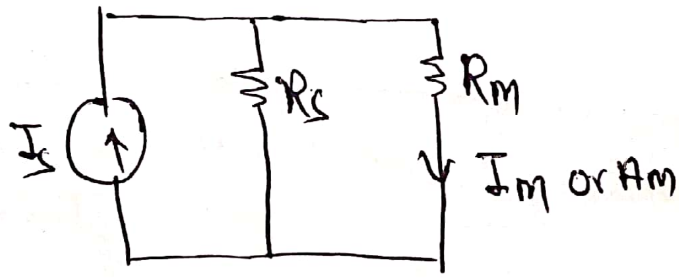




Apply current division

$$\boxed{I_m = \frac{I_s \times R_s}{R_s + R_m}}$$

Fig.(d) For Practical Ammeter



Observation:

I_s current source	I_m or A_m Ammeter current
I_s → Ideal: $R_s \neq 0$; Practical: $R_s = \infty$. Both are connected in parallel with I_s.	I_m → Ideal: internal Resistance (R_m), $R_m = \infty$ → connected in series with Ammeter (A_m). Practical: internal Resistance (R_m), $R_m \neq 0$ → connected in series with Ammeter