2. A multimeter having a sensitivity of 2000 Ω/V is used for a measurement of voltage across a ckt having an o/p resistance of 10 kΩ.

The open ckt voltage of a ckt is 6V

ⓐ Find the reading of m.m when it is set to its 10V range/scale.

ⓑ Find the % error if the o/p R of the ckt is 1000Ω & open ckt voltage is 6V at its 10V scale.

ⓒ Find % error

ⓓ Comment on your result.

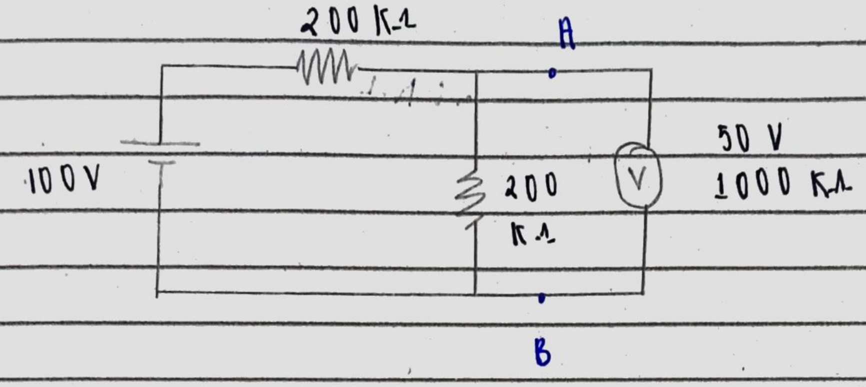
3. A 50V range voltmeter is connected across the terminal A & B of a ckt below.

ⓐ Find reading of voltmeter under open ckt & loaded condn

ⓑ Find accuracy & loading error (% error)

Date
Page

voltmeter has a resistance (R) of 1000 KΩ



19th Dec

(2) Soln

Given,

sensitivity (S) = 2000 Ω / V

open ckt voltage = 6 V

O/P resistance of ckt = 10 KΩ

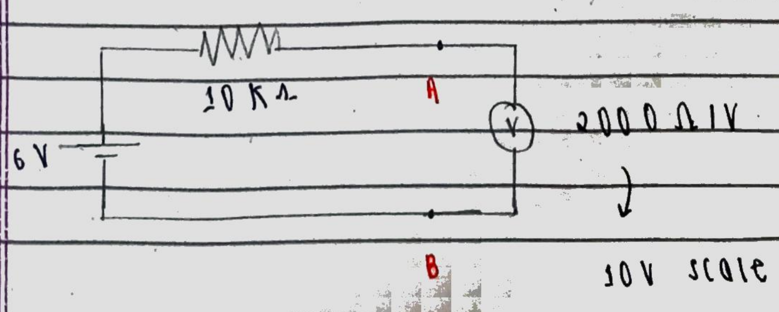
· range of voltmeter = 10 V

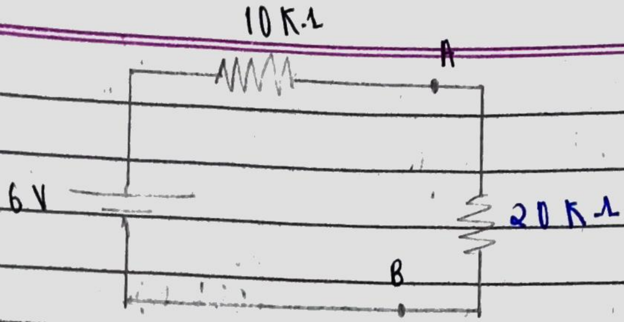
↓

Total internal resistance (Ri)

=> 2000 * 10

= 20 KΩ





Now,

Voltage across AB (VAB)

$$= \frac{20}{10+20} * 6$$

$$= 4V$$

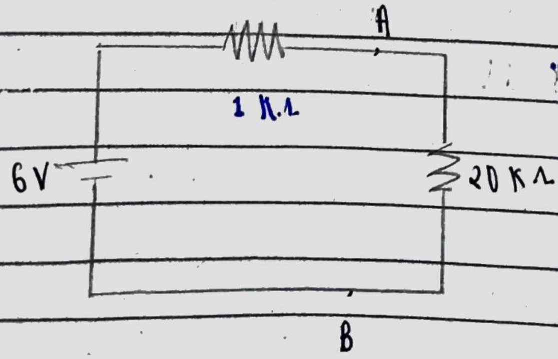
Then,

% loading error

$$= \left| \frac{6-4}{6} \right| * 100$$

$$= 33.33\ \%$$

2nd case



Now,

voltage across AB (V_{AB})

$$= \frac{20}{1+20} * 6$$

$$= 5.71V$$

Then,

$$\% \text{ loading error} = \left| \frac{6-5.71}{6} \right| * 100$$

$$= 4.76 \%$$

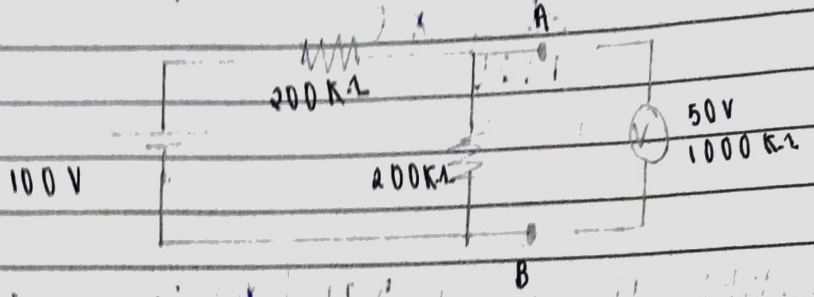
So,

when voltmeter having i/p resistance comparable to that of ckt are used for measurement purpose, it seriously modifies the value of test voltage.

When o/p impedance of source is quite ↓ (low) as compared w. i/p impedance of ~~volta~~ voltmeter the error involved in measurement is quite small.

(8) soln

a) open ckt

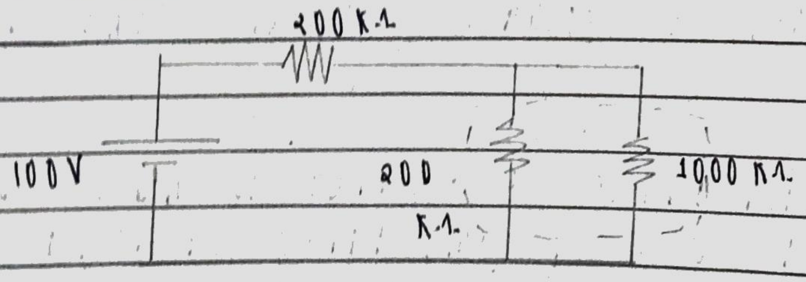


For this,

$$V_{AB} = \frac{200}{200+200} * 100$$

$$= 50\,V$$

loaded condn



$$R \Rightarrow (200 \parallel 1000)$$

$$= \frac{500}{3}$$

voltage across AB,

$$V_{AB} = \frac{R}{R+200} * 100$$

$$= 45.45 V$$

load joda aaune error

% loading error (Er)

$$= \left| \frac{50 - 45.45}{50} \right| * 100$$

$$= 9.1\%$$

actual as open ckt ma load nei jodeko hunda.

∴ Accuracy

$$= 100\% - Er (\%)$$

$$= 100\% - 9.1\%$$

$$= 90.9\%$$

ioe

1. A bridge is balanced at 1000 Hz & has the following const.

Arm (AB) has 0.2 μF pure capacitance

Arm (BC) has 500 Ω pure resistance

& Arm (AD) has $R = 300\,\Omega$ in parallel w. $C = 0.1\,\mu F$.

Find:

value of R & C or L const. of arm CD

i) consider as series ckt

ii) consider as parallel ckt.

ioe

2. A 1000 Hz bridge has following const.

Arm (AB) has $R = 1000\,\Omega$ in $\parallel$ w. $C = 0.5\,\mu F$

capacitor

Arm (BC) has $R = 1000\,\Omega$ in series w. $C = 0.5\,\mu F$

& Arm (CD) has $R = 200\,\Omega$ in series w. $L = 30\,mH$

Find :

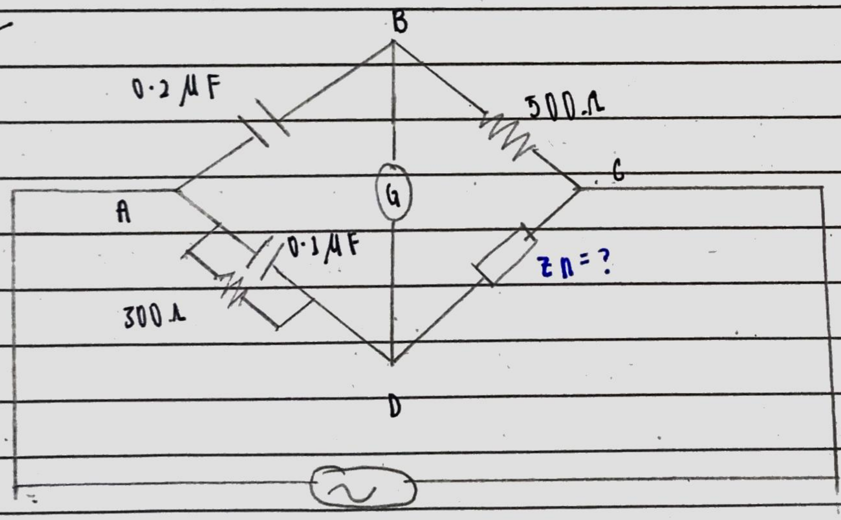
the const: of arm DA to make the bridge balanced.

Express the result as pure resistor (R) in || w. pure capacitor (C) or inductor (L)

Also,

express result as pure resistor (R) in series w. a pure capactior (C) or inductor (L).

① soln



Note:

Zn nikalda R ⊕ jX or ∡ +ve vayo vane inductor ho

R ⊖ jX or ∡ -ve vayo vane capacitor ho

$\overset{0}{R} - jX_C$

In arm AB,

$$Z_{AB} = -jX_C$$

$$= \frac{-j}{\omega C} \rightarrow \frac{-j}{2\pi f C}$$

$$= \frac{-j}{2\pi \times 1000 \times 0.2 \times 10^{-6}}$$

$$= -j\,795.77\,\Omega$$

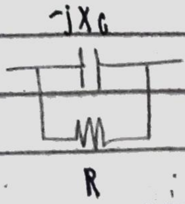
In arm BC,

$$Z_{BC} = 500\,\Omega$$

In arm AD,

Note:

For $\parallel$ capacitor & R



$$\frac{1}{Z_{eq}} = \frac{1}{R} + \frac{1}{-jX_C}$$

$$= \frac{1}{R} + \frac{1}{\frac{-j}{\omega C}} \qquad [\because X_C = 1/\omega C]$$

$$\therefore \frac{1}{Zeq} = \frac{1}{R} + \frac{WC}{-j}$$ yo mathi lagyo vane plus hunxa

$$\boxed{\frac{1}{Zeq} = \frac{1}{R} + jWC}$$

or, In arm AD,

$$\frac{1}{Zeq} = \frac{1}{R} + jWC$$

$$\text{or, } \frac{1}{Zeq} = \frac{1}{300} + j * 2\pi \times 1000 \times 0.1 \times 10^{-6}$$

$$= 289.70 - j\,54.608$$

When,

bridge is balanced then,

$$Z_{AB} * Z_{DC} = Z_{BC} * Z_{AD}$$

$$\Rightarrow Z_{DC} = \frac{Z_{BC} * Z_{AD}}{Z_{AB}}$$

$$\Rightarrow Z_{DC} = \frac{300\ (289.71 - 54.608j)}{-j\,795.77}$$

$$\therefore Z_{DC} = \underbrace{34.313}_{R} + j\,\underbrace{182.03}_{X_L}$$

As imag part has +ve value so there is inductor in ckt.

(i) When R & L are in series

$$Z_{DC} = R + jX_L$$

so,

$R = 34.313\ \Omega$

$X_L = 182.03$

$X_L = \omega L$

or, $L = \dfrac{182.03}{2\pi \times 1000}$

$= 0.0289\ H$

(ii) When R & L are in parallel

$$\frac{1}{Z_{DC}} = \frac{1}{R} + \frac{1}{jX_L}$$

$$\Rightarrow \frac{1}{34.313 + 182.03j} = \frac{1}{R} + \frac{1}{jX_L}$$

$$\Rightarrow 0.001 - 0.005305j = \frac{1}{R} + \frac{1}{jX_L}$$

Equating real & imag. part

$$\frac{1}{R} = 0.001$$

$\therefore R = 1000\ \Omega$

similarly,

$$-j\,0.005305 = \frac{1}{jX_L}$$

or, $$\frac{1}{X_L} = 0.005305$$

or, $$l = \frac{1}{0.005305 \times 2\pi \times 1000}$$

$\therefore L = 0.030H$

voltmeter- ammeter method for measuring resistance

6

diy