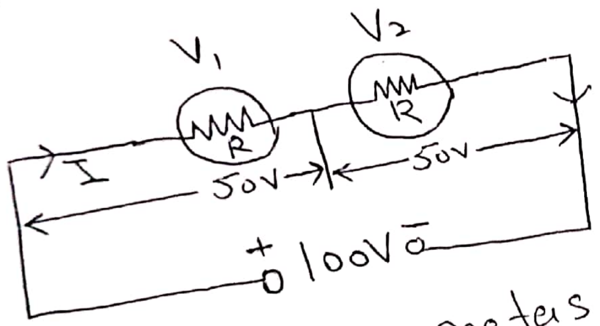
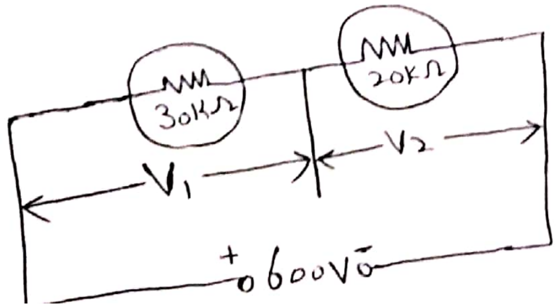
Q:- Two voltmeters, one with a full scale reading of 100V and another with a full scale reading of 200V are connected in series across a 100V supply. The internal resistance of both meters is same. What will be the readings of the voltmeters?

Sol:- Since the internal resistance of both the meters is the same; Therefore, when the two meters are connected in series across 100V supply, the voltage drop across each meter $\frac{100}{2} = 50V$ as shown in the figure below:-



→ Hence each meters will read 50V.

Q:- Two voltmeters have the same range 0–400V. The internal resistances are 30kΩ and 20kΩ respectively. If they are connected in series and 600V be applied across them, what will be their readings?



The figure shows the conditions of the problem.

Hence by voltage divider rule, the readings of the two voltmeters are.

$$V_1 = \frac{30K\Omega}{30K + 20K} \times 600 = \boxed{360V}$$

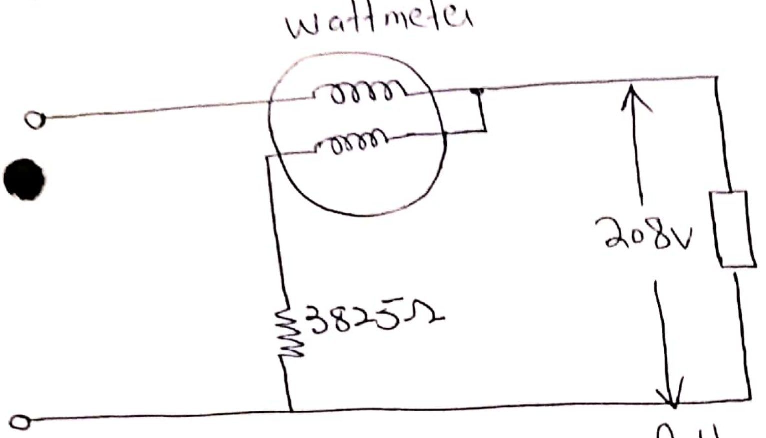
$$V_2 = \frac{20K}{30K + 20K} \times 600 = \boxed{240V}$$

Wattmeter Numericals :-

Q1:- A wattmeter with its voltage coil connected across the load side, reads 192W. The load voltage is 208V and the resistance of the potential coil is 3825Ω. Calculate.

i):- True load power

2):- % error due to wattmeter connection



Since the voltage coil of the wattmeter is connected on the load side (given), the power consumed by it is also included in the reading of wattmeter:-

wattmeter reading = 192W

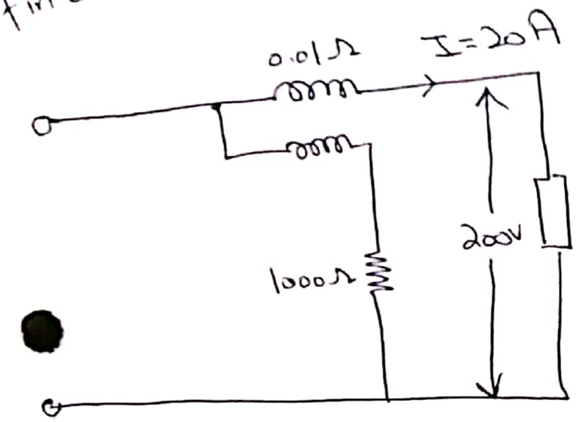
Power taken by the potential coil $= \frac{V^2}{R} = \frac{208^2}{3825} = 11.3W$

i):- True load power $= 192 - 11.3 =$ **180.7W**

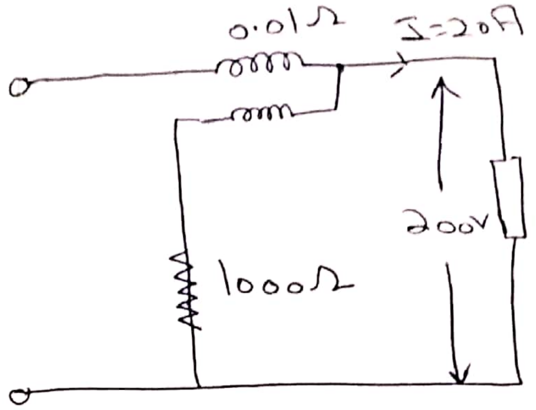
2):- % error due to wattmeter connection $= \frac{192 - 180.7}{180.7}$

= 6.25%

Q2:- The resistances of the two coils of a wattmeter are 0.01 Ω and 1000 Ω respectively. The load is taking a current of 20A at 200V and 0.8 pf lagging. Show the two ways in which the voltage coil can be connected and find the error in the reading of the meter in each case.



i)



2):-

Load power = $VI\cos\phi$ = $(200)(20)(0.8) = 3200W$

i):- By considering the connection shown in fig ①:-

Power loss in current coil = $I^2R_c = 20^2(0.01) = 4W$

wattmeter reading = $3200 + 4 = 3204W$

% error = $\frac{3204-3200}{3200} \times 100$ = **0.125%**

2):- By considering the connection shown in fig 2)

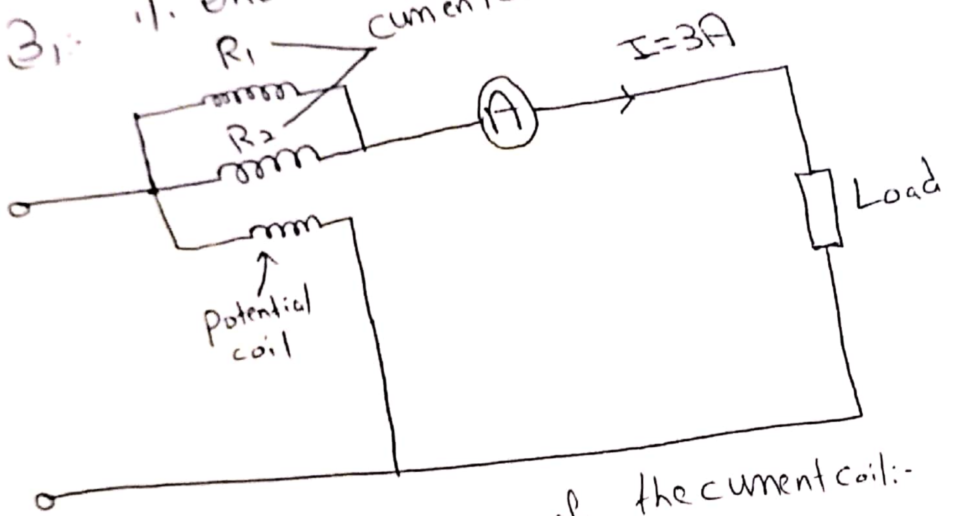
power loss in voltage coil = $\frac{V^2}{R_p} = \frac{200^2}{1000} = 40W$

wattmeter reading = $3200 + 40 = 3240W$

% error = $\frac{3240-3200}{3200} \times 100$ = **1.25%**

Q3. A wattmeter has 2 current coils connected in parallel, each having a resistance of 0.7 Ω. The wattmeter is connected in a circuit to measure power with its potential coil on the supply side. The reading on the wattmeter is 150W and the reading on the ammeter connected in series with the current coil is 3A. Calculate:

1) Power loss in the wattmeter
2) True load power
3) % error due to wattmeter connection



Sol:

Effective resistance of the current coil:

$$R_c = \frac{R_1 R_2}{R_1 + R_2} = \frac{0.7 \times 0.7}{0.7 + 0.7} = 0.35\,\Omega$$

1) Power loss in the wattmeter $= I^2 R_c = 3^2 (0.35) = \boxed{3.15W}$

2) True load power $= 150 - 3.15 = \boxed{146.85W}$

3) % age error $= \frac{150 - 146.85}{146.85} \times 100 = \boxed{2.14\%}$

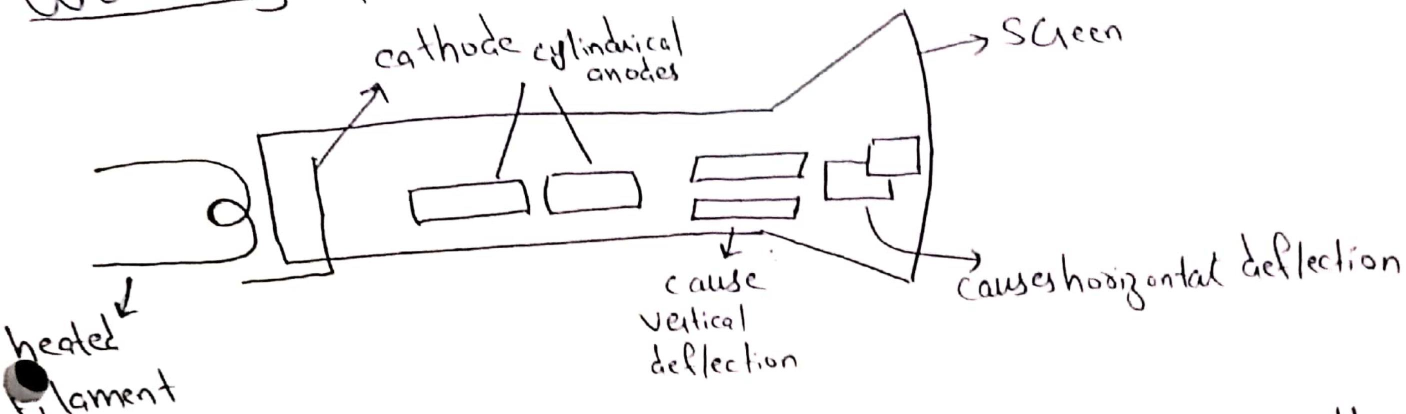
Oscilloscope:-

"An oscilloscope is a laboratory instrument commonly used to display and analyze the waveform of electronic signals as a function of time"

A probe is used to connect the oscilloscope to the circuit. Oscilloscope shows the potential difference between the two terminals of the probe.

- The terminals ending with a hook is usually connected to the node in the ckt whose voltage is of interest.

Working principle of oscilloscope:-



Working:-

1:- When we apply a potential to the filament, it heats up thus emitting electrons.

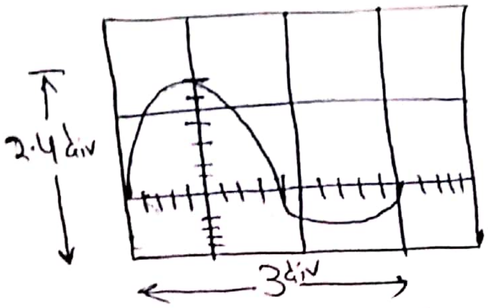
2:- These electrons hits the cathode and hence cathode ejects more electrons thus forming an electron beam.

3:- Next these electrons are attracted by the cylindrical anodes. Next there are set of plates which gives vertical deflection to the beam and there are other set of plates which gives horizontal deflection to the beam.

4:- Next there are other set of plates which gives horizontal deflection to the beam.

c): The last part is the screen which is phosphorous coated. The property of phosphor is that when electron beam strikes it, it illuminates.

Numerical 1:-



&, Time / Div = 10msec

Suppose volt / Div nobe is set at 100mV / find:-

a): V_{p-p} b): V_p c): V_{rms}

d): Time period e): frequency

a): V_{p-p} = no. of vertical divisions × Volt / Div

$= 2.4 \times 100 \times 10^{-3} = \boxed{240\,mV}$

b): $V_p = \frac{V_{p-p}}{2} = \frac{240m}{2} = \boxed{120\,mV}$

c): $V_{rms} = \frac{V_p}{\sqrt{2}} = \frac{120 \times 10^{-3}}{\sqrt{2}} = 60\,mV$

d): T = No. of horizontal div × Time / Div

$= 3 \times 10 \times 10^{-3} = \boxed{30\,mS}$

e): $f = \frac{1}{T} = \frac{1}{30 \times 10^{-3}} = \boxed{0.033\,KHz}$