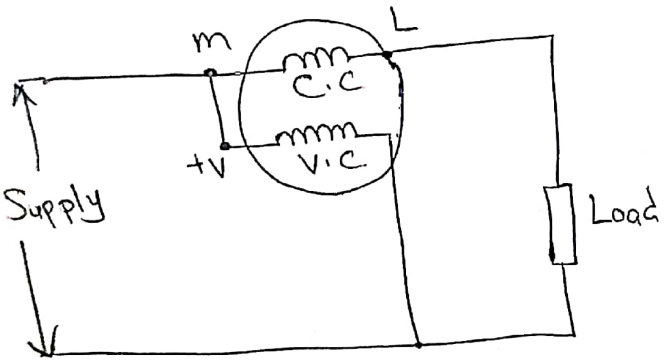
Wattmeter:-

"A wattmeter is an instrument for measuring electrical power in a circuit"

The below fig shows typical connections of a wattmeter used for measuring power suppled to a load. The instrument has two coils.

1) a current coil, which is connected in series with the load like an ammeter. and,

2) a voltage coil, which is connected in parallel with the load, like a voltmeter.



Problem:-

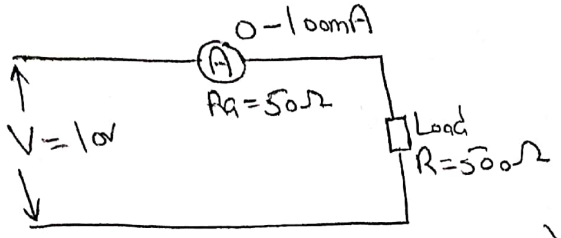
An ammeter has a fsd of 100mA and a resistance of 50Ω. The ammeter is used to measure the current in a load of resistance 500Ω when the supply voltage is 10V Calculate:-

a):- expected ammeter reading.

b):- The actual current in the ckt.

c):- The power dissipated in the ammeter

d):- The power dissipated in the load.



a):- expected ammeter reading = $\frac{V}{R+R_a}$

as we are neglecting R_a

$= \frac{10}{500}$ = 20mA

b):- Actual ammeter reading :-

$= \frac{V}{R+R_a} = \frac{10}{500+50}$ = 18.18mA

c):- power dissipated in ammeter:-

$P_a = I^2 R_a = (18.18 \times 10^{-3})^2 (50)$

$P_a = 16.53mW$

d):- power dissipated in load:-

$P_L = I^2 R = (18.18 \times 10^{-3})^2 (500)$ = 165.3mW

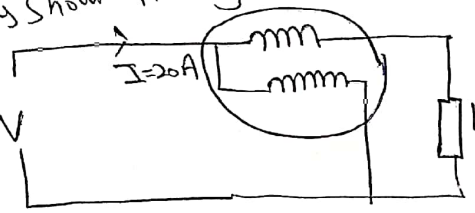
problem:-

a):- A current of 20A flows through a load having a resistance of 2Ω. Determine the power dissipated in the load:-

Soln:- power dissipated in the load, $P = I^2 R$

$= (20)^2 (2)$ = 800W

b):- A wattmeter whose current coil resistance is 0.01Ω is connected as shown in fig below. Determine the wattmeter reading.



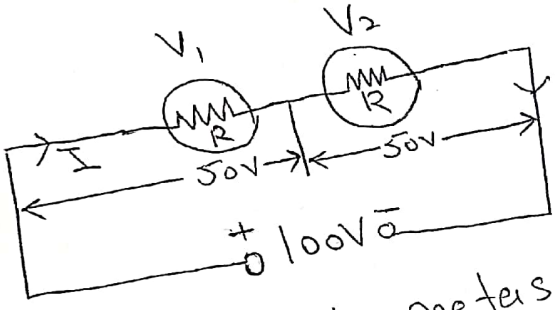
$P = I^2 (R_s + R_L)$

$P = (20)^2 (0.01+2)$

P = 804W

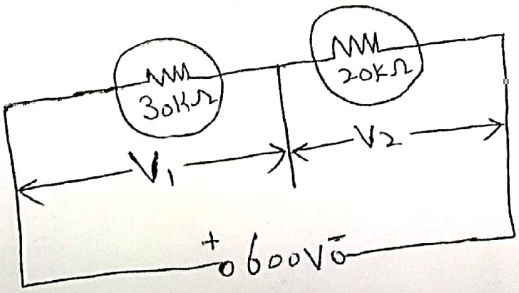
Q:- Two voltmeters, one with a Full scale reading of 100V and another with a fullscale reading of 200V are connected in series across a 100V supply. The internal resistance of both meters is same. What will be the readings of the voltmeters?

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?



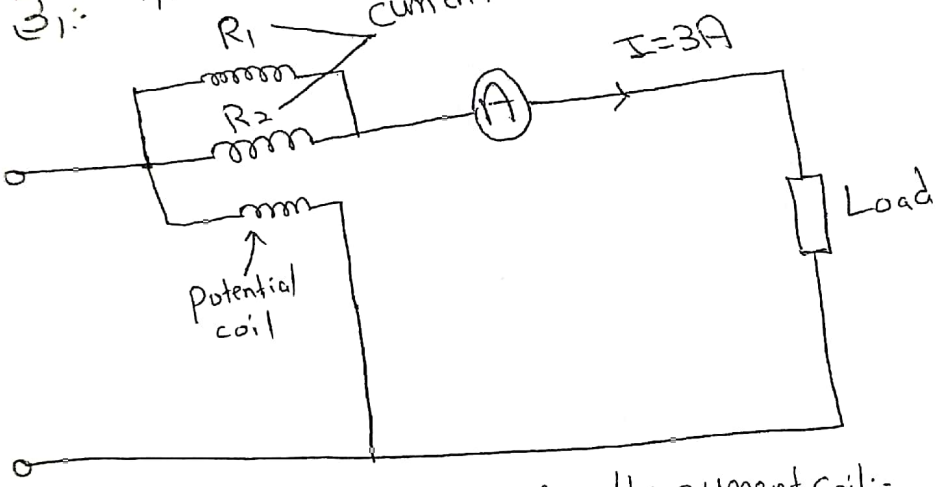
The figure shows the conditions of the problem.

Q3:- A wattmeter has 2 current coils connected in parallel, each having a resistance of 0.7Ω. 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:-

i):- Power loss in the wattmeter

ii):- True load power

iii):- % error due to wattmeter connection



Sol:- Effective resistance of the current coil:-

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

i):- Power loss in the wattmeter = $I^2 R_c = 3^2(0.35) = \boxed{3.15w}$

ii):- True load power = $150 - 3.15 = \boxed{146.85w}$

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

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

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

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